Tab E, No. 4(c)
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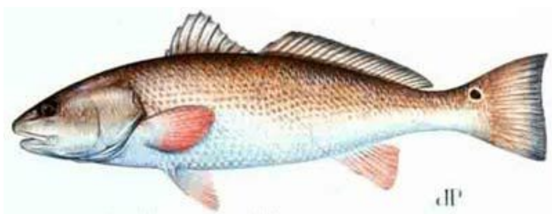
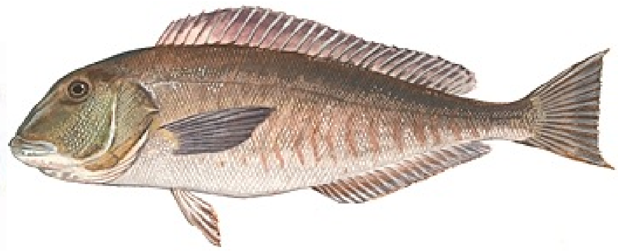
Status Determination Criteria and Optimum Yield for Reef Fish and Red Drum

Public Hearing Draft
Amendment 48 to the Fishery Management Plan for Reef Fish Resources of the Gulf of Mexico and Amendment 5 to the Fishery Management Plan for the Red Drum Fishery of the Gulf of Mexico

Including Environmental Assessment and Fishery Impact Statement

January 2021

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ENVIRONMENTAL ASSESSMENT COVER SHEET

Status Determination Criteria and Optimum Yield for Reef Fish and Red Drum: Amendment 48 to the Fishery Management Plan for Reef Fish Resources of the Gulf of Mexico and Amendment 5 to the Fishery Management Plan for the Red Drum Fishery of the Gulf of Mexico including Environmental Assessment

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ABBREVIATIONS USED IN THIS DOCUMENT

ABC	acceptable biological catch
ACL	annual catch limit
ACT	annual catch target
AM	accountability measures
B	biomass
BiOp	biological opinion
B_{MSY}	stock biomass level capable of producing an equilibrium yield of MSY
Council	Gulf of Mexico Fishery Management Council
CS	consumer surplus
DLM	Data Limited Method
DLMTool	Data Limited Methods Tool
DPS	distinct population segment
DWG	deep-water grouper
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EIS	environmental impact statement
EJ	environmental justice
ELMRP	Estuarine Living Marine Resources Program
ESA	Endangered Species Act
F	instantaneous rate of fishing mortality
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
$F_{x\%\ SPR}$	fishing mortality corresponding to an x percent spawning potential ratio
FMP	Fishery Management Plan
GDP	Gross Domestic Product
GT-IFQ	grouper-tilefish individual fishing quota
Gulf	Gulf of Mexico
IFQ	Individual Fishing Quota
M	natural mortality rate
Magnuson-Stevens Act	Magnuson-Stevens Fishery Conservation and Management Act
MFMT	maximum fishing mortality threshold
MMPA	Marine Mammal Protection Act
MSST	minimum stock size threshold
MSY	maximum sustainable yield
NARW	North Atlantic right whale
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
PAH	polycyclic aromatic hydrocarbons
PS	producer surplus
PW	product weight
RDSAP	Red Drum Stock Assessment Panel
Red Drum FMP	Secretarial FMP for the Red Drum Fishery of the Gulf of Mexico
Reef Fish FMP	Fishery Management Plan for the Reef Fish Resources in the Gulf of Mexico
RFA	Regulatory Flexibility Act of 1980
RFFA	reasonably foreseeable future actions
RIR	Regulatory Impact Review
RS-IFQ	red snapper individual fishing quota
SDC	status determination criteria
Secretary	Secretary of Commerce
SEDAR	Southeast Data, Assessment and Review
SEFSC	Southeast Fisheries Science Center
SEIS	supplemental environmental impact statement
SFA	Sustainable Fisheries Act
SOI	Segments of Interest
South Atlantic Council	South Atlantic Fishery Management Council
SRD	Science Research Director
SRHS	Southeast Regional Headboat Survey
SSB	spawning stock biomass
SSBR	spawning stock biomass per recruit
SSC	Scientific and Statistical Committee
SSRG	Social Science Research Group
SPR	spawning potential ratio
SWG	shallow-water grouper
TAC	total allowable catch
TF	tilefish
TL	total length

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FISHERY IMPACT STATEMENT

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

The National Standard 1 (NS1) guidelines require that each fishery management plan (FMP) describe objective and measurable criteria to determine overfishing and overfished status for each stock or stock complex, including a minimum stock size threshold (MSST) and maximum fishing mortality threshold (MFMT) or an overfishing limit (OFL), collectively known as status determination criteria (SDC). MSST is a biomass level set at or below the biomass level capable for producing MSY or the MSY proxy (B_{MSY} [or proxy]) for a stock or stock complex. The OFL is a yield that corresponds to fishing at MFMT. These thresholds represent the point at which a stock is determined to be overfished (i.e., below MSST) or experiencing overfishing (i.e., above MFMT or OFL). The FMP must also specify an estimate of maximum sustainable yield (MSY) or proxy, and the fishing mortality rate associated with catching the MSY (F_{MSY}) to determine overfished and overfishing status, as well as optimum yield (OY), which should be based on MSY as reduced by relevant economic, social, or ecological factors.

Under the Magnuson-Stevens Act, the Gulf of Mexico Fishery Management Council's (Council) Scientific and Statistical Committee (SSC) is tasked with recommending an MSY to the Council for implementation for each managed stock or stock complex in the FMP. However, the actual MSY can rarely be estimated with certainty due to the difficulty in accurately estimating the relationship between the size of the spawning stock and the subsequent annual recruitment. Thus, proxies that are easier to measure are typically used. Generally, MSY proxies used for reef fish species in the Gulf of Mexico (Gulf) are based on some percentage of spawning potential ratio (SPR) and are expressed as the yield when fishing at F_{PROXY}.

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

This Amendment 48 to the FMP for Reef Fish Resources of the Gulf of Mexico (Reef Fish FMP) and Amendment 5 to the Secretarial FMP for the Red Drum Fishery in the Gulf of Mexico (Red Drum FMP) establishes or modifies MSY proxies, MFMT, MSST, and OY consistent with current NS1 guidelines. These biological reference points are needed for determining status of the stocks or stock complexes. This amendment consists of 4 actions, with Action 4 consisting of 2 sub-actions. The preferred alternatives for each action are summarized in Table 1.

Table 1. Summary of amendment actions and preferred alternatives.

Action 1	**MSY proxies**
Preferred Alternative 2	For stocks or complexes that do not have an MSY proxy, the MSY proxy is the yield when fishing at 30% SPR ($F_{30\% SPR}$).
Preferred Alternative 3	For goliath grouper, the MSY proxy is the yield when fishing at 40% SPR ($F_{40\% SPR}$).
Preferred Alternative 4	For red drum, the MSY proxy is the yield that provides for an escapement rate of juvenile fish to the spawning stock biomass (SSB) equivalent to 30% of those that would have escaped had there been no inshore fishery.
Preferred Alternative 5	For future assessments of reef fish stocks and red drum, the MSY proxy equals the yield produced by F_{MSY} or F_{Proxy} recommended by the Council's SSC and subject to approval by the Council through a plan amendment.
Action 2	**MFMT**
Preferred Alternative 2	For stocks where an MSY proxy has not been defined, set the MFMT equal to the fishing mortality at the MSY proxy for each stock or stock complex as determined in Action 1.
Action 3	**MSST**
Preferred Alternative 3	MSST = $0.75 * B_{MSY}$ (or proxy). This alternative applies to stocks and stock complexes in Action 1, except for those included in Preferred Alternative 5.
Preferred Alternative 5	For stocks assessed across the South Atlantic and Gulf Councils' jurisdictions (goliath grouper, mutton snapper, yellowtail snapper, and black grouper), MSST for these species would use existing definitions of MSST defined by the South Atlantic Council.
Action 4.1	**OY for Action 1 Reef Fish Stocks and Hogfish**
Preferred Alternative 2, Preferred Option 2b	For reef fish stocks from Action 1 and for hogfish, where OY is undefined, OY, implicitly accounting for relevant economic, social, or ecological factors, would be 90% of MSY or MSYproxy.
Preferred Alternative 3, Preferred Option 3b	For shallow-water grouper, OY, implicitly accounting for relevant economic, social, or ecological factors, would be 90% of MSY or MSYproxy.
Preferred Alternative 4, Preferred Option 4d	For goliath grouper, OY, implicitly accounting for relevant economic, social, or ecological factors, would be (ACL/OFL) * MSY or MSYproxy; or zero if the ACL equals zero. (ACL = annual catch limit)
Action 4.2	**OY for Red Drum**
Preferred Alternative 1	No Action. Maintain the OY for red drum: All red drum recreationally and commercially harvested from state waters landed consistent with state laws and regulations under a goal of allowing 30% escapement of the juvenile population. All harvest of red drum from federal waters is prohibited.

Action 1: MSY Proxies

This action would establish an MSY proxy for stocks and stock complexes without an MSY or an MSY proxy. **Alternative 1** would leave the MSY proxy undefined in the Reef Fish and Red Drum FMPs, and in non-compliance with the Magnuson-Stevens Act. The SSC would continue to provide recommendations to the Council regarding the most appropriate MSY proxy. A range of options are provided as MSY proxies for reef fish (**Preferred Alternative 2**), goliath grouper (**Preferred Alternative 3**), and red drum (**Preferred Alternative 4**).

Preferred Alternative 2 would define MSY proxies for the five stock complexes and four individual stocks in the Reef Fish FMP (See Table 2.1.1). **Option a** would define the MSY proxy as $F_{20\%\ SPR}$. This is the least conservative MSY proxy considered by the SSC. It may be a sustainable level, but has the greatest risk of driving the stock below the true B_{MSY} among the options. **Preferred Option 2b** would define the MSY proxy as $F_{30\%\ SPR}$, which is the proxy usually selected by the SSC for assessed reef fish stocks and was recommended as the preferred MSY proxy by the SSC for the stocks considered in this action. It is likely a sustainable level with a lower risk of driving the stock below the true B_{MSY} than **Option 2a** ($F_{20\%\ SPR}$). **Option 2c** would define the MSY proxy as the yield at $F_{40\%\ SPR}$ and is the most biologically conservative among the options. This is likely a sustainable level, with a lower risk of driving the stock below the true B_{MSY}, but it may result in foregone yield.

Preferred Alternative 3 would define an MSY proxy for goliath grouper, which has been closed to harvest since 1990 and does not have a completed stock assessment. Similar to the options provided for reef fish, but reflecting a more conservative range, **Option 3a** is the least conservative and would allow more harvest, in the event it was open, than the other options, while **Option 3c** would be the most biologically conservative. The South Atlantic Council has established an MSY proxy of $F_{SPR\ 40\%}$ for goliath grouper, which is equivalent to **Preferred Option 3b** in this document and intermediary between **Options 3a** and **3c**.

Preferred Alternative 4 considers two options to set an MSY proxy for red drum. There is no allowable harvest in federal waters, although harvest in state waters has continued. **Preferred Option 4a** sets the MSY proxy for red drum at the yield that provides for a 30% escapement rate. This is the management objective currently used by the states and could function as an alternative proxy to the yield at $F_{X\%\ SPR}$. **Option 4b** would set the MSY proxy for red drum equal to the yield when fishing at $F_{30\%\ SPR}$ and would be more biologically conservative than **Preferred Option 4a**. However, because the five Gulf states have adopted different methods to estimate escapement, escapement estimates from the different states may not be comparable for use under **Preferred Option 4a**, while under **Option 4b** the fishing mortality rate is difficult to estimate as harvest is prohibited in federal waters, and stock assessments conducted on the inshore harvest may not be comparable.

Preferred Alternative 5 would adopt a streamlined procedure to modify the MSY proxy defined in the Reef Fish or Red Drum FMP in the future, by allowing the Council to adopt the new MSY proxy that is recommended by the SSC by noting the change in a plan amendment rather than by requiring a full action with alternatives.

Action 2: MFMT

Preferred Alternative 2 would set MFMT equal to the fishing mortality rate based on the MSY proxies adopted in Action 1 and would only apply to the stocks and complexes addressed 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.

Action 3: MSST

Under **Alternative 1**, MSST is undefined and would need to be established on a case-by-case basis. This approach is inconsistent with the MSA and NS1 guidelines, which require that FMPs establish criteria to determine when a stock or stock complex is overfished.

Alternative 2 sets MSST at (1-M)*B_{MSY} (or proxy) for reef fish stocks and stock complexes and red drum, where M is the natural mortality rate. This method has often been the *de facto* MSST used to determine overfished status for stocks where MSST is undefined. Setting a wider buffer can allow a greater opportunity for management action to end a decline in a stock that is approaching an overfished condition without the constraints imposed by a rebuilding plan. However, if stock size drops 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. **Alternative 2** requires an estimate of M for each stock or stock complex. For reef fish stocks considered in this action that have been assessed, estimates of M range from 0.073 (yellowedge grouper) to 0.30 (maximum estimate for lane snapper). For these stocks, resulting MSST values using this formula range from 70% to 93% of the B_{MSY} (or proxy). For the stock complexes, the MSST for the shallow-water and deep-water grouper stock complexes would use the M for black grouper (0.136) and yellowedge grouper (0.073). For the tilefish complex, only tilefish (golden) has an estimate of M (0.13) from the Gulf, and this estimate could be used as a proxy for this complex upon SSC recommendation and Council approval.

Preferred Alternative 3 sets MSST at 0.75*B_{MSY} (or proxy) for all reef fish stocks and stock complexes, unless **Preferred Alternative 5** is selected, and for red drum. 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 lowest MSST level allowed by the NS1 guidelines. Therefore, this alternative is more conservative than **Alternative 4**, which sets MSST at 50% of B_{MSY}. Relative to **Alternative 2**, the effect of this alternative depends on the M of the individual species. For species where M is greater than 0.25, **Preferred Alternative 3** is more conservative than **Alternative 2** (e.g., lane snapper). Where M is equal to 0.25, **Preferred Alternative 3** is equal to **Alternative 2**. Where M is less than 0.25, **Preferred Alternative 3** is less conservative than **Alternative 2**.

Alternative 4 sets MSST equal to 0.50*B_{MSY} (or proxy) for reef fish stocks and stock complexes, and red drum. This would set MSST at the 50% level for all stocks and stock complexes. This is the widest buffer allowed under the NS1 guidelines and is the least conservative alternative.

Preferred Alternative 5 would use existing definitions of MSST defined by the South Atlantic Council for four stocks assessed as single stocks that span both the South Atlantic and Gulf Council's areas of jurisdiction: goliath grouper, black grouper, mutton snapper, and yellowtail snapper. If **Preferred Alternative 3** and **Preferred Alternative 5** are both selected, **Preferred Alternative 5** would supersede **Preferred Alternative** 3 for these four stocks.

Action 4.1: OY for Action 1 Reef Fish Stocks and Hogfish

Alternative 1 would leave OY undefined for the stocks and stock complexes identified in Action 1 as needing an MSY, as well as hogfish. Leaving stocks or stock complexes with OY undefined is inconsistent with the NS1 guidelines. **Preferred Alternatives 2-4** are aligned similarly to those in Action 1 with the exception that hogfish is included in **Preferred Alternative 2** and shallow-water grouper are covered in a separate alternative (**Preferred Alternative 3**) because black grouper has a stock OFL defined for the combined Gulf and South Atlantic jurisdictions. For this reason, the shallow-water grouper OFL is undefined. **Preferred Alternative 2** would specify a long-term OY for the reef fish stocks and complexes shown in Table 2.4.2 with the exception of shallow-water grouper (**Preferred Alternative 3**). **Preferred Alternative 4** would apply to goliath grouper.

There are four options for **Preferred Alternatives 2** and **4** and three options for **Preferred Alternative 3**. These options follow the SEFSC advice that OY be a percentage of MSY. **Options a-c**, which apply to **Preferred Alternatives 2-4**, are fixed percentages where OY would be between 85% and 95% of the MSY (or MSY proxy). **Option d**, which applies to **Preferred Alternatives 2** and **4**, is a percentage based on the relationship between the stock or stock complex ACL and OFL.

Options a would define OY as 85% of the MSY (or MSY proxy) and is the most conservative of the options considered, as the OY value would be the furthest below MSY. This option would provide the greatest protection for the stock or stock complex, but may have negative social and economic effects if this OY level contributes to management practices that lower reef fish catch levels. Fishing at 95% of the MSY (or MSY proxy) would be the least biologically conservative option (**Option c**), as OY would be closest to MSY. **Option c** would provide the least protection to the stock or stock complex, but if this OY level contributes to management practices that allow higher catch levels, this could provide positive social and economic effects. **Option b** (90% of the MSY [or MSY proxy]) is intermediate to **Option a** and **Option c**.

Option d uses the ratio between the ACL and OFL to determine the amount MSY should be reduced to achieve OY. Using the relationship between the OFL and ACL accounts for scientific and management uncertainty and would apply that knowledge to guide where OY should be set relative to MSY for each species and species complex. Under this option, the level of management precaution is reflected in the difference between MSY and OY. The greater the difference between the ACL and OFL, the more precaution is needed in managing a species harvest. Disadvantages of using OFLs and ACLs are that these are values are annual, allowing them to vary from year to year, and are conditioned on the changing fleet allocations inherent to stock assessments. This short-term variability is inconsistent with the definition of OY, which is a long-term average amount of desired yield. For the stocks in **Preferred Alternative 2**, the **Option d** values range from 55.5% (mid-water snapper complex) to 93.9% (mutton snapper). For **Preferred Option d** in **Preferred Alternative 4**, the goliath grouper OY would be zero because the ACL for goliath grouper is also zero.

Action 4.2: OY for Red Drum

Preferred Alternative 1 is an OY definition established through Amendment 2 to the Red Drum FMP and implemented in 1988. This OY definition was based on a SEFSC stock assessment that concluded under certain escapement rates of juveniles, the stock could rebuild. It was recommended that the ABC for federal waters be maintained at zero and that the states increase escapement rates of juveniles to 30% to rebuild the stock. This escapement rate would allow the stock to recover to a 20% SSB ratio relative to the unfished stock. To achieve this OY, the Gulf states have independently and cooperatively implemented red drum regulations to try to achieve a 30% or greater escapement rate to the spawning stocks for each year class. Harvest of red drum is still prohibited from federal waters.

Alternative 2 provides three options that reduce OY from MSY (or MSY proxy) by fixed percentages between 85% and 95%. **Option 2a** would define OY as 85% of the MSY (or MSY proxy) and is the most biologically conservative of the options, as the OY value would be the furthest below MSY, but may have negative socio-economic effects if this OY level contributes to management practices that lower red drum catch levels. Fishing at 95% of the MSY (or MSY proxy) would be the least conservative option (**Option 2c**), as OY would be closest to MSY, but if this OY level contributes to management practices that allow higher catch levels, this could provide positive social and economic effects. **Option 2b** (90% of the MSY [or MSY proxy]) is intermediate to **Option 2a** and **Option 2c**.

<u>Biological Effects</u>

The definitions for the SDC, MSY proxy, MFMT, and MSST (Actions 1-3), establish reference points for determination of overfished and overfishing status. The expected biological effects of establishing SDC (Actions 1-3) and OY (Action 4) for reef fish and red drum would be indirect as no changes from the catch limits or management measures for subject stocks through this action are expected in the short term. In general, future management changes that reduce harvest would be expected to result in positive biological effects whereas increase in harvest would have negative biological effects. The actions in this document are expected to have positive long term, indirect effects as the establishment of SDC and OY for previously undefined stocks would support sustainable management practices including the long-term conservation of fish stocks and associated habitat.

Action 1 – The effects of **Preferred Option 2b** would be modest in the short term as this is not expected to modify harvest levels for any managed stock at this time. In the future, additional species may have completed stock assessments and the effects would be positive relative to **Alternative** 1 and intermediary between the $F_{20\%\ SPR}$ and $F_{40\%\ SPR}$ options. No effects would be expected from the MSY proxy selected for goliath grouper (**Preferred Option 3b**) or red drum (**Preferred Option 4a**) as harvest in federal waters would remain closed for both species.

Action 2 – **Preferred Alternative 2** would modify the MFMT definition such that it matches the MSY proxies selected in Action 1, resulting in similar effects for the respective species. Some indirect effects could occur from **Preferred Alternative 2**. Positive effects would be expected when stock assessments are completed for additional stocks and the MFMT prevents the establishment of unsustainable fishing levels.

Action 3 – Biological effects from **Preferred Alternative 3** would be indirect and occur subsequent to a determination of overfished status based on the selected buffer. The effects would be intermediary between the alternatives that propose wider and narrower buffers between the biomass at MSY and the MSST. In the short term, wider buffers may allow increased harvest and negative biological effects. In the longer term, wider buffers may allow the stock to persist at biomass levels below the level necessary to support MSY. In contrast narrower buffers would be expected to maintain the stock at a larger size with a lower risk of stock depletion but may require more frequent management intervention. Narrow buffers may also be more likely to result in an overfished determination but rebuilding timelines may be shorter and with an increased likelihood of successful rebuilding and achieving the associated biological benefits.

Action 4.1 – For **Preferred Alternative 2** (all Action 4.1 species excluding shallow-water grouper and goliath grouper) and **Preferred Alternative 3** (shallow-water grouper) would affect different species and so are not directly comparable; however, each Option within the respective alternatives, when compared to each other would have similar effects. The more conservative the OY, the more fishing effort would be limited and have the highest associated biomass level. Thus, it would have the lowest risk of allowing the stock size becoming depleted and would be the more beneficial to the biological environment. Conversely, the less conservative the OY, more fishing effort is likely to occur and the lower the stock biomass, so the greater the likelihood a stock could be depleted. Options 2b and 3b are intermediate to the other options evaluated in this amendment and thus any effects would also likely be intermediate as well.

For **Preferred Alternative 4** (goliath grouper), the harvest of goliath grouper is prohibited, so at this time, regardless of the OY Option, the harvest would be the same at zero and maintain current protections on the stock.

Action 4.2 – **Preferred Alternative 1** would maintain the OY definition put in place through Amendment 2 to the Red Drum FMP. Harvest levels would continue to be prohibited in federal waters and managed in state waters to achieve a 30% escapement rate. There would be no change to the current effects on the biological environment.

Economic Effects

Action 1 – **Preferred Alternative 2 - Preferred Option 2b** would set the MSY proxy for stocks and stock complexes without an MSY proxy as the yield at $F_{30\%SPR}$. Because **Preferred Alternative 2 - Preferred Option 2b** would not directly affect the harvest of the stocks and stock complexes considered in this action, only indirect economic effects would be expected to result from this preferred alternative. Furthermore, impacts would only if a stock or stock complex is assessed and the proxy is used to determine catch levels. **Preferred Alternative 2 -**

Preferred Option 2b would be expected to result in potential negative economic effects due to possible decreases in fishing opportunities in the short run. However, these potential losses would be offset by the anticipated decreases in the risk of stock depletion, which would be expected to result in positive economic effects in the long run. The relative magnitude of these potential indirect effects would determine the net economic effects that would result from **Preferred Alternative 2 - Preferred Option 2b**.

Preferred Alternative 3-Preferred Option 3b would set the MSY proxy for goliath grouper as the yield at $F_{40\%SPR}$. Should goliath grouper harvest be allowed in the future, net indirect economic effects expected to result from **Preferred Alternative 3-Preferred Option 3b** are determined by the relative magnitude of adverse economic effects that may result from forgone fishing opportunities in the short run and by longer term economic benefits that would result from reductions in the risk of stock depletion. Similarly, once red drum harvests are permitted in federal waters, the net indirect economic effects that would be expected to result from **Preferred Alternative 4-Preferred Option 4a** would be determined by the relative size of the short run negative effects associated with forgone fishing opportunities and the long-term positive effects due to reductions in the risk of stock depletion.

With Council agreement, **Preferred Alternative 5** would allow the establishment of a proxy recommended by the Scientific and Statistical Committee (SSC) and based on a stock assessment. **Preferred Alternative 5** would be expected to result in indirect economic effects associated with the trade-off between short run fishing opportunities and long-term risks of stock depletion. In addition, **Preferred Alternative 5** would be expected to result in indirect economic benefits due to a timelier adjustment to the MSY proxy, when warranted. The MSY proxy selected by the SSC and by the timeliness of its implementation would determine the net economic effects expected to result from **Preferred Alternative 5**.

Action 2 – For stocks and complexes without an MSY proxy, **Preferred Alternative 2** would set the MFMT equal to the fishing mortality at the MSY proxy for each stock or stock complex as determined in Action 1. **Preferred Alternative 2** would not be expected to affect the harvest of these stocks or stock complexes and would therefore not be expected to result in direct economic effects. However, for a given stock (or complex), if **Preferred Alternative 2** results in a more conservative MFMT compared to the no action alternative, **Preferred Alternative 2** would be expected to require less restrictive measures to end overfishing (if overfishing occurs) thereby resulting in smaller adverse economic effects. Conversely, if a less conservative MFMT is established, **Preferred Alternative 2** would be expected to necessitate more severe corrective measures should overfishing occur, thereby resulting in larger adverse economic effects. Because it would ensure consistency between the MFMT and the MSY proxy for each stock or stock complex, **Preferred Alternative 2** would also be expected to result in indirect economic benefits.

Action 3 – **Preferred Alternative 3** would set MSST based on the $0.75{*}B_{MSY}$ (or proxy) formula to all stocks considered in Action 1. For a given stock or stock complex, the establishment of an MSST is an administrative action and would therefore not be expected to result in direct economic effects. **Preferred Alternative 3** would be expected to result in indirect economic benefits due to additional harvesting opportunities that could be made available by the increased management flexibility. The magnitude of these potential economic benefits would be determined by the expected additional harvests afforded to recreational anglers and commercial fishermen. However, should a stock or complex be declared overfished, **Preferred Alternative 3** would be expected to require more stringent rebuilding measures compared to the no action alternative, thereby resulting in adverse economic effects during the rebuilding period.

Preferred Alternative 5 would use the South Atlantic Council's existing definition for MSST for mutton snapper, yellowtail snapper, and black grouper. Therefore, indirect economic effects that would be expected to result from Preferred Alternative 5 would be determined by the balance between economic benefits due to potential additional harvesting opportunities and adverse economic effects stemming from rebuilding measures should one of these species be declared overfished. **Preferred Alternative 5** would set an MSST for goliath grouper equal to $0.88 * B_{MSY}$. The establishment of an MSST for goliath grouper is a purely administrative action and would not be expected to result in economic effects at this time because harvesting goliath grouper is currently prohibited.

Action 4.1 – For hogfish and each stock and stock complex in Action 1, **Preferred Alternative 2 – Preferred Option 2b** would set OY at 90% of MSY or MSY proxy. For shallow-water grouper, **Preferred Alternative 3 - Preferred Option 3b** would define OY at 90% of MSY or MSY proxy. Neither **Preferred Alternative 2** nor **Preferred Alternative 3** would be expected to result in direct economic effects because the definition of OY for these stocks and stock complexes would not be expected to affect fishing practices or harvest levels for these stocks and complexes. However, should the ACL for each stock or complex be linked to its OY in the future, **Preferred Alternative 2** and **Preferred Alternative 3** may be expected to result in indirect economic effects. The size and direction of these potential indirect economic effects would be determined by the relationship between the stock or complex ACL and its OY.

Once harvesting goliath grouper is allowed, **Preferred Alternative 4**, **Preferred Option 4d** would set OY by multiplying MSY or MSY proxy by a ratio between the ACL and OFL. **Preferred Alternative 4** is a purely administrative measure without expected economic effects because the harvest of goliath grouper is currently prohibited. Should the harvest of goliath grouper be permitted in the future, indirect economic effects determined by the nature of the link between OY and ACL levels would be expected to result from **Preferred Alternative 4**.

Action 4.2 – **Preferred Alternative 1** would maintain the current OY definition for red drum. Therefore, even if red drum harvest in federal waters is allowed, **Preferred Alternative 1** would not be expected to result in economic effects.

Social Effects

The expected social effects of establishing SDC and OY for reef fish and red drum would be indirect as no changes are made to the catch limits or management measures for subject stocks through this action. In general, any indirect effects could be positive or negative for the shorter term, related to the direction of any changes to the total allowable harvest. For the long term, indirect effects would be expected to be positive, as changes to the SDC and OY would contribute to determining the sustainable level of harvest and allow for more consistent fishing activity.

Action 1 – The effects of **Preferred Option 2b** would be intermediary ($F_{30\%\ SPR}$) between a more conservative and less conservative option. No additional effects would be expected from the MSY proxy selected for goliath grouper (**Preferred Option 3b**) or red drum (**Preferred Option 4a**) as harvest in federal waters would remain closed for both species.

Action 2 – **Preferred Alternative 2** would modify the MFMT definition such that it matches the MSY proxies selected in Action 1, resulting in similar effects for the respective species. Some indirect effects could occur from **Preferred Alternative 2** if changes to the MFMT results in a change that affects fishing activity for those stocks for which the MSY proxy is changed in Action 1.

Action 3 – The social effects from **Preferred Alternative 3** would be indirect and occur subsequent to a determination of overfished status based on the selected buffer. The effects would be intermediary between the alternatives that propose wider and narrower buffers. 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 a subsequent rebuilding plan could curtail existing fishing effort, but may allow for more consistent fishing activity over the long term. Adopting the same MSST as the South Atlantic Council (**Preferred Alternative 5**) would be expected to provide some minimal positive effects by making the MSST consistent across jurisdictions that share management of each single stock.

Action 4.1 – Any effects from **Preferred Alternatives 2** and **3** would be indirect, long-term, and relate 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. The effects from **Preferred Options 2b** or **3b** would be intermediary between an option that would result in the greatest negative effects, by defining OY as reduced the most from MSY or its proxy, and an option that would set OY the closest to the MSY proxy, which would allow the most fish to be caught. No effects would be expected from **Preferred Alternative 4**, **Preferred Option 4d**, as harvest would remain closed.

Action 4.2 – Additional effects would not be expected for retaining the OY for red drum (**Preferred Alternative 1**), as there is no allowable harvest of red drum from federal waters. Modifying OY would not be expected to result in changes to the availability of harvest opportunities in state waters.

The actions of this amendment would affect only the SDC and OY of stocks managed by the Council in the Gulf through its Reef Fish FMP and Red Drum FMP. Thus, the actions are not expected to impact fishery participants in areas adjacent to the Gulf, including fisheries managed under the Caribbean and South Atlantic Councils' jurisdictions. For those actions affecting stocks under the jurisdiction of both Councils, a jurisdictional apportionment is in place that authorizes management for an agreed upon portion of the stock's quota to each respective Council. Further, for the stocks affected by this action that are managed by both Councils, the preferred alternatives selected would define the SDC and OY to be consistent with the South Atlantic Council.

The actions in this amendment would not directly affect fishing behavior nor result in additional incentives to participate in reef fish or red drum fishing under adverse weather or ocean conditions as a result of the proposed changes in SDC and OY. Therefore, safety-at-sea issues are not expected to result from this action.

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.

Status Determination Criteria and Biological Reference Points

The National Standard 1 (NS1) guidelines require that each fishery management plan (FMP) describe objective and measurable criteria to determine overfishing and overfished status for each stock or stock complex, including 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 (i.e., below MSST) or experiencing overfishing (i.e., above MFMT or OFL). The FMP must also specify a maximum sustainable yield (MSY) or proxy, and an OY for each stock or stock complex.

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, long-term average catch that can be taken from a stock or stock complex under prevailing ecological and environmental conditions, fishery technology characteristics, and the distribution of catch among fleets. OY is a long-term average catch level based on MSY as reduced by any relevant economic, social, or ecological factors. Therefore, OY cannot exceed - MSY. A proxy for MSY may be used when data are insufficient to estimate MSY directly. The most common proxy is a yield that will allow the stock to maintain a specified level of egg production or spawning potential ratio (SPR). Other proxies are described in Appendix B.

Stock Biomass Reference Points

A biomass reference point measures how many fish are left in the water rather than how many fish are caught. This 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 long-term average size of a stock that results from harvesting at the MSY level is called the biomass at MSY (B_{MSY}). If the stock level falls below B_{MSY}, it cannot sustain harvest at the MSY level without further depletion. However, biomass may 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 MSST cannot be set 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 it may be less difficult 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 the stock or stock complex 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, 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. In contrast, fishing mortality (F) and MFMT refer to rates of removal of fish by fishing.[1]

The F_{MSY} is the fishing mortality rate that, if applied over the long-term, would result in harvesting the 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}, and is often set equal to F_{MSY}. However, under some conditions it may be necessary

[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.

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.

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 typically used to represent 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 factors and accounts for 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.

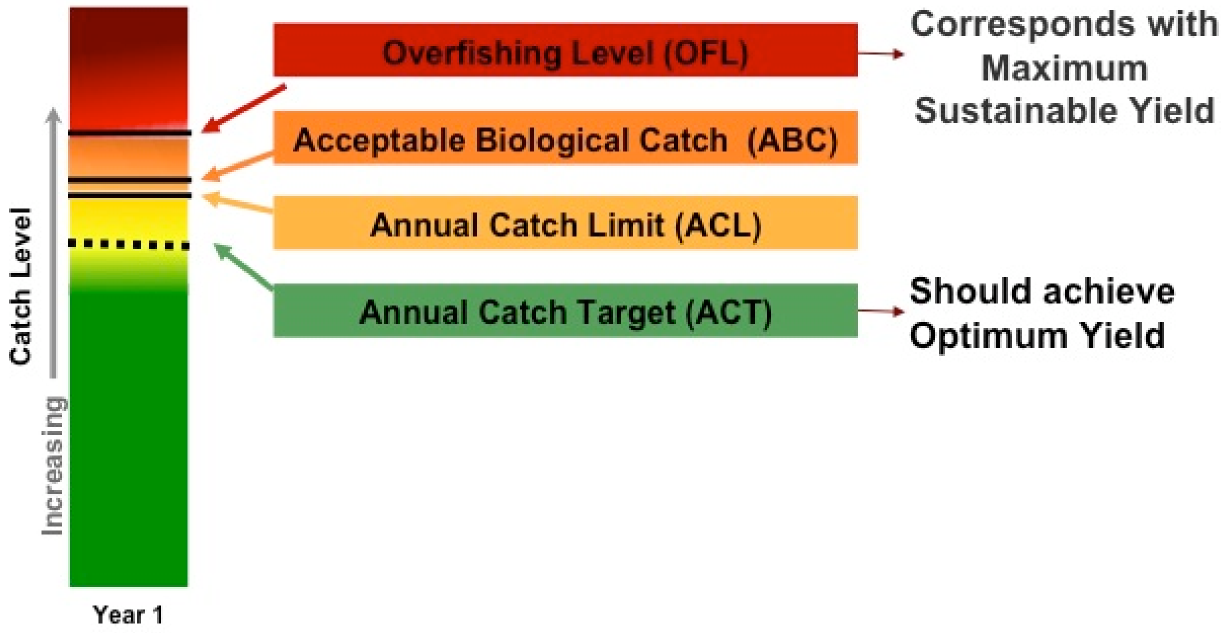
Spawning Potential Ratio (SPR)

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.

Long-term vs. Annual Reference Points

Once calculated, the MSY and OY reference points do not change unless some new information about the productivity of the stock is identified, or the Council modifies the MSST or MFMT. On the other hand, the 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 (Figure 1.1.1); whereas, OY, B_{MSY}, and MSST are all based on MSY.

Figure 1.1.1. Description of annual reference points used to set harvest limits.



The OFL is the catch level that results from fishing at the MFMT rate. If the 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 could be higher than the long-term MSY, but will gradually be reduced as the stock is fished down to its B_{MSY} level.

The Council currently has MFMT and OFL defined for all stocks or complexes. However, MSY proxies, MSST, and OY are defined for some, but not all, reef fish stocks and not for red drum. 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 other management changes were needed.

The actions in this amendment are intended to establish reference points for stocks where they do not currently exist, and in some cases to consider modifying existing reference points. To comply with the Magnuson-Stevens Act and NS1 guidelines, and to provide measurable reference points for determining overfished and overfishing status, MSY proxies, MFMT, MSST, and OY must be established for all stocks. Several reef fish stocks have these values defined, which are shown in Table 1.1.1. For other reef fish stocks and stock complexes, they remain undefined and are addressed in Actions 1-4.

Table 1.1.1. Stocks with status determination criteria assigned.

Stock	MSY	MFMT	MSST*	OY	Source
Gag	Yield at F_{MAX}**	F_{MAX}**	0.50*B_{MAX}**	Yield at 75% of F_{MAX}**	Amendment 30B (GMFMC 2008a)
Red grouper	Yield at $F_{30\%\ SPR}$	$F_{30\%\ SPR}$	0.50* $B_{30\%\ SPR}$	Yield at 75% of F_{MSY}	Secretarial Amendment 1 (GMFMC 2004a)
Red snapper	Yield at $F_{26\%\ SPR}$	$F_{26\%\ SPR}$	0.50*B_{MSY}	Yield at 75% of $F_{26\%\ SPR}$	Amendment 22 (GMFMC 2004b) Amendment 27 (GMFMC 2007)
Vermilion snapper	Yield at $F_{30\%\ SPR}$	$F_{30\%\ SPR}$	0.50*$B_{30\%\ SPR}$	Yield at 75% of $F_{30\%\ SPR}$	Amendment 23 (GMFMC 2004c) Amendment 47 (GMFMC 2017a)
Gray triggerfish	Yield at $F_{30\%\ SPR}$	$F_{30\%\ SPR}$	0.50*$B_{30\%\ SPR}$	Yield at 75% of $F_{30\%\ SPR}$	Amendment 30A (GMFMC 2008b)
Greater amberjack	Yield at $F_{30\%\ SPR}$	$F_{30\%\ SPR}$	0.50*$B_{30\%\ SPR}$	Yield at $F_{40\%\ SPR}$	Secretarial Amendment 2 (GMFMC 2002)
Hogfish	Yield at $F_{30\%\ SPR}$	$F_{30\%\ SPR}$	0.50*$B_{30\%\ SPR}$	Undefined	Amendment 43 (GMFMC 2016)
Gray Snapper* **	Yield at $F_{26\%\ SPR}$	$F_{26\%\ SPR}$	0.50*$B_{26\%\ SPR}$	Yield at 90% of $F_{26\%\ SPR}$	Amendment 51 (GMFMC 2019)

* 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.
*** Status determination criteria noted for gray snapper were selected in Reef Fish Amendment 51 (GMFMC 2019) that was approved by the Council and transmitted to NMFS in November 2019.

The South Atlantic Fishery Management Council (South Atlantic Council) has established MSY proxies, MSST, and OY for four stocks that occur in both Councils' jurisdictions (Table 1.1.2). All of the status determination criteria defined for these single stocks apply to the stock throughout its range, with the exception of the OY definitions that only apply to the South Atlantic Council's jurisdictional apportionment of black grouper, mutton snapper, and yellowtail snapper.

Table 1.1.2. Stocks assessed across both Councils' jurisdictions with Status Determination Criteria assigned by the South Atlantic Council.

Stock	MSY	MFMT	MSST	OY	Source
Black Grouper	Yield at $F_{30\% \ SPR}$	$F_{30\% \ SPR}$	$0.75*SSB_{30\% \ SPR}$	ACL = OY = ABC (South Atlantic only)	Amendment 11 (SAFMC 1998) Amendment 21 (SAFMC 2014) Amendment 25 (SAFMC 2011)
Mutton Snapper	Yield at $F_{30\% \ SPR}$	$F_{30\% \ SPR}$	$0.75*SSB_{30\% \ SPR}$	ACL = OY = ABC (South Atlantic only)	Amendment 11 (SAFMC 1998) Amendment 41 (SAFMC 2017)
Yellowtail Snapper	Yield at $F_{30\% \ SPR}$	$F_{30\% \ SPR}$	$0.75*SSB_{30\% \ SPR}$	ACL = OY = ABC (South Atlantic only)	Amendment 11 (SAFMC 1998) Amendment 15 (SAFMC 2013) Amendment 21 (SAMFMC 2014)
Goliath Grouper	Yield at $F_{40\% \ SPR}$	$F_{40\% \ SPR}$	[(1-M) or 0.5 whichever is greater]*B_{MSY} M=0.12	$F_{50\% \ SPR}$ (South Atlantic only)	Amendment 11 (SAFMC 1998)

Traditionally, management measures have been implemented using MSY proxies in species-specific stock assessments. However, red drum and many of the stocks in the 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 NS1 guidelines allow an MSY proxy to be assigned to a stock complex under certain conditions. A 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 SDC; or when it is not feasible for fishermen to distinguish individual stocks among their catch. Farmer and Malinowski (2010) conducted an analysis to develop a scientific basis for defining multiple stocks for management purposes and a variety of life history parameters, landings data, and depth and area fished information were utilized from a large number of fishery independent and fishery-dependent data sources for the analysis. The Generic ACL/Accountability Measures (AM) Amendment defined five stock complexes listed in Table 1.1.3 (GMFMC 2011) based on Farmer and Malinowski (2010). The Council established an ACL, AM, and OFL for each stock complex except the other shallow-water grouper complex. The OFL was not defined for other shallow-water grouper, as black grouper is managed within this complex and does not have an accepted OFL, therefore the OFL for the entire complex is undefined (GMFMC 2011).

Table 1.1.3. Stock complexes as defined in the Generic ACL/AM Amendment.

Stock Complex	Species
Tilefishes	Tilefish (Golden) Blueline Tilefish Goldface Tilefish
Other Shallow-water Grouper	Black Grouper Scamp Yellowmouth Grouper Yellowfin Grouper
Deep-water Grouper	Yellowedge Grouper Warsaw Grouper Snowy Grouper Speckled Hind
Jacks	Lesser Amberjack Almaco Jack Banded Rudderfish
Mid-water Snappers	Silk Snapper Wenchman Blackfin Snapper Queen Snapper

1.2 Purpose and Need

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

The need is to have biological reference points that can be used for determining status of the stocks or stock complexes.

1.3 History of Management

This history of management covers events pertinent to the development of SDC and OY for reef fish and red drum in the Gulf. A complete history of management for the Reef Fish FMP and the Secretarial FMP for the Red Drum Fishery of the Gulf of Mexico (Red Drum FMP) is available on the Council's website.[2]

1.3.1 Reef Fish Amendments

The Reef Fish FMP (with 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 million pounds (mp) for all snappers and groupers combined, and 500,000 lbs for all sea basses combined. The OY was

[2] http://gulfcouncil.org/fishery-management/implemented-plans/reef-fish/

defined as 45 mp for all snappers and groupers combined, and 500,000 lbs for all sea basses combined.

Amendment 1 (with associated environmental assessment (EA), regulatory impact review (RIR), and regulatory flexibility analysis (RFA), 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 associated EA and RIR), implemented in July 1991, revised the target for stock rebuilding from 20% SSBR to 20% 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. It also 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 associated EA and RIR), implemented in January 1996, included revisions to dealer and vessel permit requirements 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 based on 30% SPR [63 FR 24522].

Amendment 22 (with associated supplemental EIS (SEIS), RIR, and initial RFA), 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 fishery.

Amendment 23 (with 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% of MSY, except that, during rebuilding, allowable harvest for each year based on the rebuilding strategy.

Amendment 27 (with associated SEIS, RIR, and RFA) was 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 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 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 $(1\text{-}M)*SSB_{MSY}$, and set OY as the yield associated with 75% of F_{MSY} when the stock is at equilibrium.

Amendment 30B (with associated EIS, RIR, and initial RFA, implemented August 2008, contained measures 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 $(1\text{-}M)*SSB_{MAX}$ (where $M = 0.15$). The OY was set at the yield at 75% of F_{MAX}.

Amendment 43 (with 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 associated EA), was approved on December 21, 2017. There was no implementation date, because there was no rulemaking associated with this amendment. 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.

Amendment 51 (with its associated EA, RIR, and RFA) becomes effective on December 17, 2020. This amendment establishes an MSY proxy, MSST, and OY for gray snapper. This amendment also modifies the MFMT and the ACL for gray snapper. The MSY proxy was the yield associated with $F_{26\%\ SPR}$. The MSST was defined to be 50% of the B_{MSY} proxy.

Secretarial Amendments

Section 304(c)(1) and Section 304 (e)(5) of the Magnuson-Steven Act provides 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 RFA, implemented in July 2004, established MSY, FMSY, MFMT, SSB_{MSY}, MSST, and OY for the U.S. Gulf red grouper stock.

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).

1.3.2 Red Drum History Amendments

The Red Drum FMP (with its associated EA and RIR) was implemented December 19, 1986. It prohibited directed commercial harvest of red drum from federal waters 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 less than 30% of what it would be if there were no exploitation. Inshore equilibrium yield was estimated to be 10.2 mp, but the overall range of MSY estimates was between 6.1 mp and 63.2 mp.

Amendment 2, implemented in 1988, prohibited retention and possession of red drum from federal waters. Overfishing was defined as a fishing mortality that prohibits attaining the spawning stock goal or threshold which is currently set at a 20% 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% escapement of the juvenile population.

1.3.3 Generic Amendments

Generic Sustainable Fisheries Act Amendment (with associated EA, RIR, and initial RFA), 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.

The **Generic ACL/Accountability Measures (AM) Amendment** (with associated EIS, RIR, and RFA) addressed a requirement in the Magnuson-Stevens Reauthorization Act of 2006 to establish ACLs and AMs for federally managed species. The amendment also established five stock complexes with ACLs and AMs for each complex.

1.3.4 South Atlantic Amendments

Comprehensive Sustainable Fisheries Act Amendment 11, implemented in 1999 established and MSY Proxy for goliath and Nassau grouper = 40% static SPR; all other species = 30% static SPR; OY: hermaphroditic groupers = 45% static SPR; goliath and Nassau grouper = 50% static SPR; all other species = 40% static SPR. Defined MFMT for goliath grouper as $F_{40\% \ SPR}$ and established MSST = [(1-M) or 0.5 whichever is greater]*B_{MSY}.

Regulatory Amendment 21 redefined the overfished threshold for red snapper, blueline tilefish, gag, black grouper, yellowtail snapper, vermilion snapper, red porgy, and greater amberjack. The current definition of the MSST for these species, which is used to determine if a species is overfished, is function of the natural mortality rate (M). MSST equals SSB_{MSY}*(1-M or 0.5, whichever is greater), where SSB_{MSY} is the biomass when the stock is at the MSY level and considered to be rebuilt.

Regulatory Amendment 13 modified the existing specification of OY and the ACL for yellowtail snapper in the South Atlantic.

Amendment 25 Comprehensive Annual Catch Limit Amendment was implemented in 2012. This amendment established ABC control rules, ABCs, ACLs, and AMs for species not undergoing overfishing; removed some species from South Atlantic Fishery Management Unit and designated others as ecosystem component species; specified allocations between the commercial and recreational sectors for species not undergoing overfishing; and limited the total mortality for federally managed species in the South Atlantic to the ACLs.

CHAPTER 2. MANAGEMENT ALTERNATIVES

2.1 Action 1 – Maximum Sustainable Yield (MSY) Proxies

Alternative 1: No Action. The MSY proxy for stocks or complexes that do not have an MSY proxy will remain undefined.

Preferred Alternative 2: For stocks or complexes that do not have an MSY proxy, the MSY proxy is:

> **Option 2a:** the yield when fishing at 20% spawning potential ratio ($F_{20\%\ SPR}$).
> **Preferred Option 2b:** the yield when fishing at 30% spawning potential ratio ($F_{30\%\ SPR}$).
> **Option 2c:** the yield when fishing at 40% spawning potential ratio ($F_{40\%\ SPR}$).

Preferred Alternative 3: For goliath grouper, the MSY proxy is:

> **Option 3a:** the yield when fishing at 30% spawning potential ratio ($F_{30\%\ SPR}$).
> **Preferred Option 3b:** the yield when fishing at 40% spawning potential ratio ($F_{40\%\ SPR}$).
> **Option 3c:** the yield when fishing at 50% spawning potential ratio ($F_{50\%\ SPR}$).

Preferred Alternative 4: For red drum, the MSY proxy is:

> **Preferred Option 4a:** the yield that provides for an escapement rate of juvenile fish to the spawning stock biomass (SSB) equivalent to 30% of those that would have escaped had there been no inshore fishery.
> **Option 4b:** the yield when fishing at 30% spawning potential ratio ($F_{30\%\ SPR}$).

Preferred Alternative 5: For future assessments of reef fish stocks and red drum, the MSY proxy equals the yield produced by F_{MSY} or F_{Proxy} recommended by the Gulf of Mexico Fishery Management Council's (Council) Scientific and Statistical Committee (SSC) and subject to approval by the Council through a plan amendment.

*Note: **Alternatives 2-5** can be selected concurrently.

<u>Discussion</u>:

Stocks need an estimate of MSY and the fishing mortality rate associated with catching the MSY (F_{MSY}) to determine overfished and overfishing status. Under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), the SSC is tasked with recommending an MSY to the Council for implementation for each managed stock or stock complex in the fishery management plan (FMP). However, the actual MSY can rarely be estimated with certainty due to the difficulty in accurately estimating the relationship between the size of the spawning stock and the subsequent annual recruitment. Thus, proxies that are easier to measure are typically used. Generally, MSY proxies used for reef fish species in the

Gulf of Mexico (Gulf) are based on some percentage of spawning potential ratio (SPR) and are expressed as the yield when fishing at F_{PROXY}.

This action includes alternatives to establish MSY proxies for stocks and stock complexes that an MSY or an MSY proxy has not been previously defined. This action would include species managed in five stock complexes that were defined in the Generic Annual Catch Limits/Accountability Measures (ACL/AM) Amendment (GMFMC 2011), as well as MSY proxies for cubera snapper, lane snapper, mutton snapper, yellowtail snapper, goliath grouper, and red drum; all of which are managed as individual stocks. The methodology used to establish the stock complexes in the Generic ACL/AM Amendment was described in Farmer and Malinowski (2010), and is summarized in Appendix A.

Alternative 1 would leave the MSY proxy for the stocks listed in Table 2.1.1 undefined in the FMP for the Reef Fish Resources in the Gulf of Mexico (Reef Fish FMP) and the Secretarial FMP for the Red Drum Fishery of the Gulf of Mexico (Red Drum FMP), and in non-compliance with the Magnuson-Stevens Act. The SSC would continue to provide recommendations to the Council regarding the most appropriate MSY proxy.

Table 2.1.1. Stocks and stock complexes affected by the alternatives in this action.

Alternative	Complex	Stock
2	Shallow-water grouper	Scamp, black, yellowmouth, yellowfin
2	Deep-water grouper	Yellowedge, warsaw, snowy groupers, speckled hind
2	Tilefishes	Golden, blueline, goldface tilefish
2	Jacks	Lesser amberjack, almaco jack, banded rudderfish
2	Mid-water snapper	Wenchman, silk, blackfin, queen snapper
2		Cubera snapper
2		Lane snapper
2		Mutton snapper
2		Yellowtail snapper
3		Goliath grouper
4		Red drum
5		All reef fish stocks, complexes, and red drum

Alternatives 2-4 contain a broad range of options from $F_{20\%\ SPR} – F_{40\%\ SPR}$ for **Preferred Alternative 2** (reef fish), $F_{30\%\ SPR} – F_{50\%\ SPR}$ for **Preferred Alternative 3** (goliath grouper), and both escapement rate and SPR Options for red drum (**Preferred Alternative 4**).

Preferred Alternative 2 would define MSY proxies for the five stock complexes and four individual stocks listed in Table 2.1.1. This alternative contains three options. **Option a** would define the MSY proxy as $F_{20\%\ SPR}$. This is the least conservative MSY proxy considered by the

SSC. It may be a sustainable level, but has more risk of driving the stock below the true B_{MSY} than **Preferred Option 2b** or **Option 2c**.

Preferred Option 2b would define the MSY proxy as **$F_{30\%\ SPR}$**. This is the proxy usually selected by the SSC for assessed reef fish stocks and was recommended as the preferred MSY proxy by the SSC for stocks considered in **Preferred Alternative 2**. It is likely a sustainable level with a lower risk of driving the stock below the true B_{MSY} than **Option 2a** ($F_{20\%\ SPR}$). All reef fish stocks except for red snapper, gag, and gray snapper have an MSY proxy of $F_{30\%\ SPR}$ (Table 1.1.1). In addition, for mutton snapper and yellowtail snapper, the stock assessments and subsequent management advice were based on an MSY proxy of $F_{30\%\ SPR}$.

Option 2c would define the MSY proxy as the yield at $F_{40\%\ SPR}$ and is the most biologically conservative Option in **Preferred Alternative 2**. This is the proxy recommended by Harford et al. (2019) for gonochoristic (non-sex changing) species. This is likely a sustainable level, with a lower risk of driving the stock below the true B_{MSY} than $F_{20\%\ SPR}$ **(Option 2a)** or $F_{30\%\ SPR}$ (**Preferred Option 2b**). However, if **Option 2c is** unnecessarily restrictive, it may result in foregone yield.

Preferred Alternative 3 would define an MSY proxy for goliath grouper. This species occurs as a single stock in the Gulf and U.S. South Atlantic. It is vulnerable to overfishing because of its long life-span and slow growth rate. This species has been closed to harvest since 1990 in the Gulf and South Atlantic, but no stock assessment has been completed for this species. **Preferred Alternative 3** contains three options (**Option 3a**, **Preferred Option 3b**, **Option 3c**) that would establish the MSY proxy as $F_{30\%\ SPR}$, $F_{40\%\ SPR}$, or $F_{50\%\ SPR}$, respectively. Similar to the options in **Preferred Alternative 2**, **Option 3a** is the least conservative and would allow more harvest than either **Preferred Option 3b**, or the most conservative **Option 3c**. In comparison to **Preferred Alternative 2** that addresses other reef fish stocks and complexes, the options for goliath grouper are biologically more conservative. The 1999 Sustainable Fisheries Act (SFA) Amendment had proposed an MSY proxy of 50% SPR for goliath grouper. That proposal was rejected by the National Marine Fisheries Service (NMFS) on the basis that SPR by itself was not an acceptable proxy for biomass. However, the yield from fishing at $F_{50\%\ SPR}$ is an acceptable proxy, and it accomplishes the intent of the SFA Amendment (GFMFC 1999).

The South Atlantic Fishery Management Council (South Atlantic Council) has established an MSY proxy of $F_{SPR\ 40\%}$ for goliath grouper, which is equivalent to **Preferred Option 3b** in this document.

Preferred Alternative 4 considers two options to set an MSY proxy for red drum. Directed commercial harvest of red drum from the exclusive economic zone (EEZ) has been prohibited since 1987, and all harvest from the EEZ has been prohibited since 1988. Harvest in state waters has continued. In Red Drum Amendment 2 (1988), the Gulf of Mexico Fishery Management Council (Council) requested that all Gulf states implement rules within their jurisdictions that would provide for an escapement rate of juvenile fish to the SSB equivalent to 30% of those that would have escaped had there been no inshore fishery. **Preferred Option 4a** sets the MSY proxy for red drum at the yield that provides for a 30% escapement rate. This is the management objective adopted by the states in response to the Council's request, and could function as an alternative proxy to the yield at $F_{X\%\ SPR}$. One drawback to this option is that, while it is generally assumed that a 30% escapement is approximately equivalent to 20% SPR, the precise relationship between escapement and SPR is not known. Another drawback is that, while escapement may be a measurable objective, there is no standard way of measuring it and in practice, the five Gulf states have adopted different methods to estimate escapement. Consequently, escapement estimates from the different states may not be comparable. If **Preferred Option 4a** is adopted, NMFS and the states should work to develop standard and compatible methods for estimating escapement. **Option 4b** would set the MSY proxy for red drum equal to the yield when fishing at $F_{30\%\ SPR}$. As discussed above, the current policy of a 30% escapement is considered approximately equivalent to 20% SPR. However, **Option 4b** would presumably be more biologically conservative than **Preferred Option 4a**. One drawback to **Option 4b** is that the fishing mortality rate is difficult to estimate for this stock as harvest is prohibited in the EEZ, and stock assessments conducted on the inshore components of the stock by each Gulf state may not be comparable.

Preferred Alternative 5 would adopt a streamlined procedure to modify the MSY proxy defined in the Reef Fish or Red Drum FMP in the future. Currently, in order to adopt a new recommended proxy by the SSC, the Council must create an action in a plan amendment that contains a range of alternatives for proxies along with an analysis of those alternatives. **Preferred Alternative 5** would allow the Council to adopt the new MSY proxy that is recommended by the SSC by noting the change in a plan amendment rather than by requiring a full action with alternatives. This alternative could be applied to the setting of an MSY proxy for a stock being assessed for the first time, as well as to changes for stocks previously assigned a proxy. **Preferred Alternative 5** would not require the Council to adopt an MSY proxy based on an SSC recommendation. The Council could return a recommendation to the SSC with questions, which could affect the SSC's recommendation, choose to retain the current definition, or establish a different MSY proxy than recommended by the SSC. In addition, the SSC might recommend alternative MSY proxies. In this situation, a plan amendment action with alternatives may be required. For further explanation of other MSY proxies see Appendix B.

2.2 Action 2 – Maximum Fishing Mortality Threshold

Alternative 1: No Action. Maintain current definitions of the maximum fishing mortality threshold (MFMT). These are: $F_{50\%\ SPR}$ for goliath grouper; and $F_{30\%\ SPR}$ for all other reef fish stocks considered in Action 1 and red drum.

Preferred Alternative 2: For stocks where an MSY proxy has not been defined, set the MFMT equal to the fishing mortality at the MSY proxy for each stock or stock complex as determined in Action 1.

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

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

1. The National Standard 1 (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 2011), in years where there is a stock assessment, overfishing is occurring if the stock assessment's estimate of the current fishing mortality rate is above MFMT.
2. The overfishing limit (OFL) is a yield that corresponds to fishing at MFMT. Under the provisions of the Generic ACL/AM Amendment (GMFMC 2011), 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 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 red drum, and for all reef fish stocks except red snapper. For gag, the fishing mortality rate proxy for MSY (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 to the Reef Fish FMP (GMFMC 2008a). Following additional analyses conducted for the 2005 benchmark assessment of red snapper (SEDAR 7 2005), Amendment 27 to the Reef Fish FMP (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 Action 1 reef fish stocks and stock complexes plus red drum have an MFMT of $F_{30\%\ SPR}$ as a result of the Generic SFA Amendment (GMFMC 1999), or subsequent amendments.

Preferred Alternative 2 would set MFMT equal to the fishing mortality rate based on the MSY proxies adopted in Action 1. This would only apply to the stocks and complexes addressed in Action 1 (Alternatives 2 - 4, see Table 2.1.1.). 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.

If an F_{Proxy} based MSY proxy is adopted where the fishing mortality rate (F) cannot be determined, the MFMT would be a placeholder until a stock assessment can be conducted and fishing mortality 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.

2.3 Action 3 – Minimum Stock Size Threshold

Alternative 1: No Action. Do not define minimum stock size threshold (MSST) for stocks and stock complexes in action 1.

Alternative 2: MSST = (1-M)*B_{MSY} (or proxy) where M is the natural mortality rate. This alternative applies to stocks and stock complexes in Action 1.

Preferred Alternative 3: MSST = 0.75*B_{MSY} (or proxy). This alternative applies to stocks and stock complexes in Action 1.

Alternative 4: MSST = 0.50*B_{MSY} (or proxy). This alternative applies to stocks and stock complexes in Action 1.

Preferred Alternative 5: For stocks assessed across the South Atlantic and Gulf Councils' jurisdictions (goliath grouper, mutton snapper, yellowtail snapper, and black grouper), MSST for these species would use existing definitions of MSST defined by the South Atlantic Council.**

*Note: **Alternative 5** can be selected with **Alternative 2, 3,** or **4**.

** Note: If **Alternative 5** is selected as preferred, **Alternative 3** would not apply to the stocks considered in **Alternative 5**.

<u>Discussion</u>:

MSST is a biomass level set at or below the biomass level capable for producing MSY or the MSY proxy (B_{MSY} [or proxy]) for a stock or stock complex. It is used to determine when a stock or stock complex is overfished. Amendment 44 to the Reef Fish FMP (GMFMC 2017b) 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). When implemented by the Secretary of Commerce,[3] Amendment 51 to the Reef Fish FMP (GMFMC 2019) would set MSST equal to 0.50*B_{MSY} (or proxy) for gray snapper. The remaining reef fish stocks and stock complexes have not had MSST defined, nor has it been defined for red drum in the Red Drum FMP. This action proposes to define MSST for the remaining reef fish stocks and stock complexes, 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 (MFMT), the stock or stock complex biomass is unlikely to drop below the overfished level (MSST). However, the stock or stock complex 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).

[3] Final rule published November 17, 2020 and will become effective December 17, 2020.

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 in Action 3 sets MSST equal to some multiple of the stock or stock complex biomass corresponding to MSY or the MSY proxy (B_{MSY} [or proxy]). B_{MSY} (or proxy) may not be known for data-poor stocks. If B_{MSY} (or proxy) is unknown, then MSST is also unknown. For these stocks and stock complexes, 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 approach is inconsistent with the MSA and NS1 guidelines, which require that FMPs establish criteria to determine when a stock or stock complex is overfished.

Alternative 2 sets MSST at $(1\text{-}M)*B_{MSY}$ (or proxy) for reef fish stocks and stock complexes and red drum. In the past, this method 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 $(1\text{-}M)*B_{MSY}$ (or proxy), stocks with a low natural mortality rate (M) could have an MSST that is only slightly below SSB at B_{MSY} (or proxy). 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 B_{MSY} may temporarily drop the SSB below MSST, although analysis from the Southeast Fisheries Science Center (SEFSC) suggests that this is unlikely except at very low M values (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 action to end a decline in a stock that is approaching an overfished condition without the constraints imposed by a rebuilding plan. However, if stock size drops 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 for MSST is used for some stocks managed by four of the Regional Management Councils (South Atlantic, Caribbean, Pacific, Western Pacific), plus the Highly Migratory Species Division of NMFS. In addition, this is the MSST value used by the South Atlantic Council for goliath grouper, a species that is recognized as a single stock under shared management by the South Atlantic and the Gulf Councils.

Alternative 2 requires an estimate of M for each stock or stock complex considered in Action 1. For reef fish stocks considered in Action 3 that have been assessed, estimates of M range from 0.073 (yellowedge grouper) to 0.30 (maximum estimate for lane snapper; Table 2.2.2). For these stocks, resulting MSST values using this formula range from 70% to 93% of the B_{MSY} (or proxy). For the stock complexes, the MSST for the shallow-water and deep-water grouper stock complexes would use the M for black grouper (0.136) and yellowedge grouper (0.073). For the tilefish complex, only tilefish (golden) has an estimate of M (0.13) from the Gulf, and this estimate could be used as a proxy for this complex upon SSC recommendation and Gulf Council approval. For the jack and mid-water snapper complexes, and for cubera snapper, there are no estimates of M from the Gulf. The SEFSC and the SSC would need to determine if proxies for M could be developed by other means (e.g., estimates of M from the literature or from species sharing similar life history characteristics). A proxy for M would also need to be developed for lane snapper as literature-based estimates of M in the Gulf range from 0.11 to 0.30.

Under **Alternative 2**, if any species are added to the management unit, or if the estimate of M is changed in a peer-review report or Southeast Data, Assessment and Review (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.

Preferred Alternative 3 sets MSST at $0.75*B_{MSY}$ (or proxy) for all reef fish stocks and stock complexes considered in Action 1, unless **Preferred Alternative 5** is selected, and for red drum. 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 lowest MSST level allowed by the NS1 guidelines. Therefore, this alternative is more conservative than **Alternative 4**, which sets MSST at 50% of B_{MSY}. Relative to **Alternative 2**, the effect of this alternative depends on the M of the individual species (Table 2.3.1). For species where M is greater than 0.25, **Preferred Alternative 3** is more conservative than **Alternative 2** (e.g., lane snapper). Where M is equal to 0.25, **Preferred Alternative 3** is equal to **Alternative 2**. Where M is less than 0.25, **Preferred Alternative 3** is less conservative than **Alternative 2**.

Alternative 4 sets MSST equal to $0.50*B_{MSY}$ (or proxy) for reef fish stocks and stock complexes, and red drum. This would set MSST at the 50% level for all stocks and stock complexes in Action 1. This level of MSST would match the MSST level established for seven other reef fish stocks in Amendment 44 to the Reef Fish FMP. This is the widest buffer allowed under the NS1 guidelines and is the least conservative alternative. This buffer is used for several Gulf stocks and at least some stocks managed by three other Regional Fishery Management Councils (New England, Mid-Atlantic, and North Pacific).

Table 2.3.1. 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)
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)
Black grouper	*Mycteroperca bonaci*	0.136	SEDAR 19 (2010)
Tilefishes			
Tilefish	*Lopholatilus chamaeleonticeps*	0.13	SEDAR 22 (2011a)

Notes: * 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.

Preferred Alternative 5 would use existing definitions of MSST defined by the South Atlantic Council for four stocks assessed as single stocks that span both the South Atlantic and Gulf Council's areas of jurisdiction: goliath grouper, black grouper, mutton snapper, and yellowtail snapper. If **Preferred Alternative 3** and **Preferred Alternative 5** are both selected, **Preferred Alternative 5** would supersede **Preferred Alternative** 3 for goliath grouper, black grouper, mutton snapper, and yellowtail snapper. Neither the Gulf nor South Atlantic Council's SSCs were able to endorse the goliath grouper assessment (SEDAR 48), so the condition of the stock is unknown. The stock acceptable biological catch (ABC) for black grouper, mutton snapper, and yellowtail snapper is apportioned between the Gulf and South Atlantic Councils for management (Table 2.3.2). For these stocks, the South Atlantic Council has already set MSST values and **Preferred Alternative 5** would establish an MSST in the Gulf that is compatible with the South Atlantic Council's existing definitions of MSST. **Preferred Alternative 5** would preclude a situation where two different overfished definitions would apply to a single stock.

Table 2.3.2. South Atlantic Council MSST definitions for four snapper-grouper stocks sharing jurisdiction with the Gulf Council and South Atlantic. Three stocks have South Atlantic:Gulf allocations based on percentages of the total allowable harvest.

Species	MSST	Allocation S Atlantic:Gulf
Mutton snapper	$0.75*SSB_{30\%SPR}$	82:18
Yellowtail snapper	$0.75*SSB_{30\%SPR}$	75:25
Black grouper	$0.75*SSB_{30\%SPR}$	47:53
Goliath grouper	$(1-M)*B_{MSY}$	---

Note: M = 0.12 for goliath grouper.

2.4 Action 4 – Optimum Yield

2.4.1 Action 4.1 – Optimum Yield for Action 1 Reef Fish Stocks and Hogfish

Alternative 1: No Action. Do not define optimum yield (OY) for stocks and stock complexes in Action 1. Do not define an OY for hogfish.

Preferred Alternative 2: For reef fish stocks from Action 1 and for hogfish, where OY is undefined, OY, implicitly accounting for relevant economic, social, or ecological factors, would be:

> **Option 2a:** 85% of MSY or MSYproxy.
> **Preferred Option 2b:** 90% of MSY or MSYproxy.
> **Option 2c:** 95% of MSY or MSYproxy.
> **Option 2d:** (ACL/OFL) * MSY or MSYproxy; or zero if the ACL equals zero.

Preferred Alternative 3: For shallow-water grouper, OY, implicitly accounting for relevant economic, social, or ecological factors, would be:

> **Option 3a:** 85% of MSY or MSYproxy.
> **Preferred Option 3b:** 90% of MSY or MSYproxy.
> **Option 3c:** 95% of MSY or MSYproxy.

Preferred Alternative 4: For goliath grouper, OY, implicitly accounting for relevant economic, social, or ecological factors, would be:

> **Option 4a:** 85% of MSY or MSYproxy.
> **Option 4b:** 90% of MSY or MSYproxy.
> **Option 4c:** 95% of MSY or MSYproxy.
> **Preferred Option 4d:** (ACL/OFL) * MSY or MSYproxy; or zero if the ACL equals zero.

Discussion:

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

For Action 4, hogfish is included along with the reef fish stocks identified in Action 1, Preferred Alternative 2. MSY, MFMT, and MSST for hogfish were defined in Amendment 43 to the Reef Fish FMP, but OY was not defined. Therefore, OY for hogfish remains undefined and is included here. Goliath grouper is addressed in a separate alternative here as a biologically more conservative OY may be appropriate given the concerns expressed in Action 1, Preferred

Alternative 3. The red drum OY is addressed in a separate sub-action (Action 4.2), because it currently has a defined OY that the Council may or may not wish to revise.

OYs for other reef fish species have been defined as the yield from fishing at a percentage of $F_{MSY\ or\ proxy}$ (Table 2.4.1). The rationale for defining OY in these terms was derived from the technical guidance on the use of precautionary approaches provided by Restrepo et al. (1998). This guidance recommended that the target fishing mortality rate (F_{OY}) be set equal to the average yield available on a continuing basis from fishing at 0.75*F_{MSY} (75% of F_{MSY}). Studies using Mace's deterministic model (Mace 1994) indicated that, when a stock is at equilibrium, fishing at 0.75*F_{MSY} would produce biomass levels between 125% and 131% of B_{MSY} and yields of 94% of MSY or greater (Restrepo et al. 1998).

Table 2.4.1. Current reef fish 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)
Gray Snapper	Yield at 90% of $F_{MSY\ proxy}$	Amendment 51 (GMFMC 2019)

SEFSC staff and the SSC have recommended against specifying OY as the yield at a certain F and have suggested instead it be a percentage of MSY.[4] They provided three reasons to support this rationale. One is that after an assessment is completed and approved by the SSC, SEFSC staff would need to provide two sets of yield projections; one set to iteratively search for the value of F that achieves the intended $F_{MSY\ proxy}$, and another set to find the value of F that achieves the intended $F_{OY\ proxy}$. This adds complexity to the projections. A second reason is that it is possible that the calculated long-term yield at the $F_{OY\ proxy}$ is greater than the calculated long-term yield at the $F_{MSY\ proxy}$. This can occur if the assumptions made about the mix of fisheries and bycatch with recent levels of recruitment do not necessarily agree with the life history assumptions made in selecting an SPR-based MSY proxy. If this happens, it is possible that maintaining a biomass necessary to harvest MSY could lead to growth overfishing or some other factor that reduces the long-term yield to below the long-term yield derived under a higher biomass level that occurs when fishing at the lower $F_{OY\ proxy}$. The final reason given by SEFSC

[4] E-mail from Clay Porch, SEFSC to the Reef Fish Amendment 48, Red Drum Amendment 5 interdisciplinary plan team, dated February 21, 2020.

staff is defining OY as a percent of MSY is more intuitive and easier to understand by the public than using a percentage of the $F_{MSY\ proxy}$ to define OY.

Alternative 1 (No Action) would leave OY undefined for the stocks and stock complexes identified in Action 1 as needing an MSY, as well as hogfish. Leaving stocks or stock complexes with OY undefined is inconsistent with the NS1 guidelines.

Preferred Alternatives 2-4 are aligned similarly to those in Action 1 with the exception that hogfish is included in **Preferred Alternative 2** for the reasons stated above and shallow-water grouper are covered in a separate alternative (**Preferred Alternative 3**) because black grouper, a part of this complex, has a stock OFL defined for the combined Gulf and South Atlantic jurisdictions. For this reason, the shallow-water grouper OFL is undefined. **Preferred Alternative 2** would specify a long-term OY for the reef fish stocks and complexes shown in Table 2.4.2 with the exception of shallow-water grouper (**Preferred Alternative 3**). **Preferred Alternative 4** would apply to goliath grouper.

Table 2.4.2. Stocks or stocks complexes that do not have an accepted definition of OY and are included in **Preferred Alternatives 2** and **3**.

Complex	Alternative	Stock
Deep-water grouper	**Preferred Alternative 2**	Yellowedge grouper
		Warsaw grouper
		Snowy grouper
		Speckled hind
Tilefish	**Preferred Alternative 2**	Golden tilefish
		Blueline tilefish
		Goldface tilefish
Jacks	**Preferred Alternative 2**	Lesser amberjack
		Almaco jack
		Banded rudderfish
Mid-water snapper	**Preferred Alternative 2**	Silk snapper
		Wenchman
		Blackfin snapper
		Queen snapper
---	**Preferred Alternative 2**	Cubera snapper
---	**Preferred Alternative 2**	Lane snapper
---	**Preferred Alternative 2**	Goliath grouper**
---	**Preferred Alternative 2**	Mutton snapper*
---	**Preferred Alternative 2**	Yellowtail snapper*
---	**Preferred Alternative 2**	Hogfish
Shallow-water grouper	**Preferred Alternative 3**	Black grouper*
		Scamp
		Yellowmouth grouper
		Yellowfin grouper

Notes: * Stocks jointly managed with the South Atlantic Council and they also have a South Atlantic Council defined OY = ABC = ACL in the South Atlantic region.
** Goliath grouper is jointly managed with the SAFMC and has a SAFMC defined OY = 50% static SPR in the South Atlantic region.

There are four options for **Preferred Alternatives 2** and **4** and three options for **Preferred Alternative 3**. These options follow the SEFSC advice that OY be a percentage of MSY. **Options a-c**, which apply to **Preferred Alternatives 2-4**, are fixed percentages where OY would be between 85% and 95% of the MSY (or MSY proxy). **Option d**, which applies to **Preferred Alternatives 2** and **4**, is a percentage based on the relationship between the stock or stock complex ACL and OFL. The reason **Option d** is not used for shallow-water grouper (**Preferred Alternative 3**) is an OFL was not defined in the Generic ACL/AM Amendment (GMFMC 2011) because of incompatible OFLs within the shallow-water complex. The black grouper stock OFL was defined for the combined Gulf and South Atlantic jurisdictions and OFLs for the other groupers in this complex would have been for the Gulf only if they had been defined. During the development of the Generic ACL/AM Amendment, the SSC was not able to reconcile this difference and so declined to define the shallow-water grouper (SWG) complex OFL. This is why the OFL is listed as undefined in Table 2.4.3.

Options a would define OY as 85% of the MSY (or MSY proxy) and is the most conservative of the options considered, as the OY value would be the furthest below MSY. This option would provide the greatest protection for the stock or stock complex, but may have negative social and economic effects if this OY level contributes to management practices that lower reef fish catch levels. Fishing at 95% of the MSY (or MSY proxy) would be the least conservative option (**Options c**), as OY would be closest to MSY. **Options c** would provide the least protection to the stock or stock complex, but if this OY level contributes to management practices that allow higher catch levels, this could provide positive social and economic effects. **Options b** (90% of the MSY [or MSY proxy]) is intermediate to **Options a** and **Options c**. The Council has selected **Option b** as preferred for **Preferred Alternatives 2** and **3**.

Option d uses the ratio between the ACL and OFL to determine the amount MSY should be reduced to achieve OY. The OFL refers to the annual amount of catch (numbers of fish or weight) that corresponds to the estimate of MFMT applied to a stock or stock complex's abundance. The ABC is a level of a stock or stock complex's annual catch, which is based on a Council's ABC Control Rule that accounts for the scientific uncertainty in the estimate of OFL, any other scientific uncertainty, and the Council's risk policy. Thus, the ABC, which is the basis for setting ACLs, is less than the OFL. The ACL is a limit on the total annual catch of a stock or stock complex, which cannot exceed the ABC. The ACL serves as the basis for invoking AMs, and in a Council's ACL Control Rule, would account for management uncertainty. As a result, using the relationship between the OFL and ACL accounts for scientific and management uncertainty and would apply that knowledge to guide where OY should be set relative to MSY for each species and species complex. Under this option, the level of management precaution is reflected in the difference between MSY and OY. The greater the difference between the ACL and OFL, the more precaution is needed in managing a species harvest. Disadvantages of using OFLs and ACLs are that these are values are annual, allowing them to vary from year to year, and are conditioned on the changing fleet allocations inherent to stock assessments. This short-term variability is inconsistent with the definition of OY, which is a long-term average amount of desired yield. For the stocks in **Preferred Alternative 2**, the **Option d** values range from 55.5% (mid-water snapper complex) to 93.9% (mutton snapper; Table 2.4.3). For **Preferred Option d** in **Preferred Alternative 4**, the goliath grouper OY would be zero because the ACL for goliath grouper is also zero.

The black grouper (**Preferred Alternative 3**), mutton snapper (**Preferred Alternative 2**), and yellowtail snapper (**Preferred Alternative 2**) stocks are allocated between the Gulf and South Atlantic Council. The South Atlantic Council has previously defined OY for these stocks as OY = ABC = ACL (SAFMC 2011). However, this approach is not consistent with revised NS1 guidelines (81 FR 71858) and thus, the Gulf Council is unable to adopt a concurrent definition for these stocks. When mutton snapper and yellowtail snapper are assessed, a stock OFL and ABC are provided by the two Councils' SSC and then the ABC is allocated between the Gulf and South Atlantic Councils for setting ACLs. The current allocations are 18% Gulf and 82% South Atlantic for mutton snapper and 25% Gulf and 75% South Atlantic for yellowtail snapper. To apply **Option d** to these species, the Gulf portion of the OFL, based on the jurisdictional allocations, would be used for the OFL in the **Option d** equation. These values are provided in Table 2.4.3. Because the shallow-water grouper is not defined, this exercise was not applied to black grouper, which is a part of this complex. The current allocation of the ABC between the Gulf and South Atlantic 53% and 47%, respectively (GMFMC 2011).

Table 2.4.3. Overfishing limits (OFL), stock annual catch limits (ACL), and the percent the ACL is of the OFL.

Species	OFL	ACL	Percent ACL/OFL
Shallow-water grouper	Not defined	710,000	
Deep-water grouper	1,220,000	1,105,000	90.6
Tilefishes	747,000	608,000	81.4
Jacks complex	372,000	312,000	83.9
Mid-water snapper	209,000	116,000	55.5
Cubera snapper	7,000	5,065	72.4
Lane snapper	358,000	301,000	84.1
Hogfish 2020 2021+	163,700 172,500	141,300 150,400	86.3 87.1
Yellowtail snapper*	1,127,500	901,125	87.3
Mutton snapper**	153.014	143,694	93.9
Goliath grouper	0	0	---

***** The allocation of the yellowtail snapper ABC is 75% to the South Atlantic and 25% to the Gulf. What is provided for the OFL for this table is 25% of the stock OFL of 4.51 million pounds.
** The allocation of the mutton snapper ABC is 82% to the South Atlantic and 18% to the Gulf. What is provided for the OFL for this table is 18% of the stock OFL of 850,077 lbs.

Goliath grouper (**Preferred Alternative 4**) is also jointly managed with the South Atlantic Council. Even though the OY for the South Atlantic region is equivalent to zero, as would be the value derived from **Options a-c** and **Preferred Option d** in **Preferred Alternative 4** given no harvest is allowed**,** the method for calculating OY would be different between jurisdictions.

2.4.2 Action 4.2 – Optimum Yield for Red Drum

Preferred Alternative 1: No Action. Maintain the optimum yield (OY) for red drum:

- All red drum recreationally and commercially harvested from state waters landed consistent with state laws and regulations under a goal of allowing 30% escapement of the juvenile population.

- All red drum commercially or recreationally harvested from the Primary Area of the exclusive economic zone (EEZ) under the total allowable catch (TAC) level and allocations specified under the provisions of the FMP, and a zero-retention level from the Secondary Areas of the EEZ. (Note: TAC for the EEZ has been set at zero since 1988.)

Alternative 2: For red drum, OY, implicitly accounting for relevant economic, social, or ecological factors, would be:

Option 2a: 85% of MSY or MSY_{Proxy}.

Option 2b: 90% of MSY or MSY_{Proxy}.

Option 2c: 95% of MSY or MSY_{Proxy}.

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

Preferred Alternative 1 (No Action) is an OY definition established through Amendment 2 to the Red Drum FMP and implemented in 1988. This OY definition was based on a SEFSC stock assessment (Goodyear 1987), that concluded under certain escapement rates of juveniles, the stock could rebuild. The 1987 Red Drum Stock Assessment Panel (RDSAP 1987) recommended the ABC for the EEZ be maintained at zero, and that the states increase escapement rates of juveniles to 30% to rebuild the stock. This escapement rate would allow the stock to recover to a 20% SSB ratio relative to the unfished stock.[5] To achieve this OY, the Gulf states have independently and cooperatively implemented red drum regulations to try to achieve a 30% or greater escapement rate to the spawning stocks for each year class. Harvest of red drum is still prohibited in the EEZ. This alternative is equivalent to the red drum MSY in **Alternative 4**, **Option 4a** in Action 1.

For **Alternative 2**, there are three options that reduce OY from MSY (or MSY proxy) by fixed percentages between 85% and 95% (see the discussion in Sub-Action 4.1 regarding using a percentage of MSY as opposed to the yield at a percentage of F_{MSY}). **Option 2a** would define OY as 85% of the MSY (or MSY proxy) and is the most conservative of the options considered, as the OY value would be the furthest below MSY. This option would provide the greatest protection for the stock, but may have negative social and economic effects if this OY level contributes to management practices that lower red drum catch levels. Fishing at 90% of the

[5] Note that Goodyear (1987) separated the stock into a primary area, the EEZ waters off Louisiana, Mississippi, and Alabama, and a secondary area, the EEZ waters off Florida and Texas.

MSY (or MSY proxy) would be the least conservative option (**Option 2c**), as OY would be closest to MSY. **Option 2c** would provide the least protection to the stock, but if this OY level contributes to management practices that allow higher catch levels, this could provide positive social and economic effects. **Option 2b** (90% of the MSY [or MSY proxy]) is intermediate to **Option 2a** and **Option 2c**.

Unlike Alternatives 2 and 4 in Action 2, no Option d ([ACL/OFL] * MSY or MSY Proxy; or zero if the OFL equals zero) was added to **Alternative 2** of Action 4.2. This is because there is no OFL for red drum. In the Generic ACL/AM Amendment (GMFMC 2011), it was determined that because the harvest of red drum in the EEZ is currently set to zero through earlier actions to the Red Drum FMP, red drum has an ACL, which is effectively set at zero for the EEZ. Thus, the conclusion in the Generic ACL/AM Amendment was that no further action was needed for this stock. Hence, no effort was made to establish a red drum OFL.

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.[6] Presently, the reef fish fishery management unit contains 31 species (see Section 3.3).

Management of commercial and recreational 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 Amendment 2 to the Red Drum FMP (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.[7]

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).[8] Additionally, Sections 3.4 and 3.5 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 September 27, 2019, a total of 845 vessels have the permit. Of these, 99% provide a mailing address in a Gulf state (Table 3.1.1.1). These vessels must have a vessel monitoring system onboard.

[6] https://gulfcouncil.org/fishery-management/implemented-plans/reef-fish/
[7] https://gulfcouncil.org/fishery-management/implemented-plans/red-drum/
[8] https://gulfcouncil.org/wp-content/uploads/FISHERY%20MANAGEMENT/REEF%20FISH/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 as of September 27, 2019.

State	Commercial Reef Fish Permits	
	Number	Percent
AL	38	4.5%
FL	667	80.1%
LA	43	5.1%
MS	7	0.8%
TX	74	8.8%
Subtotal	**839**	**99.3%**
Other	6	0.7%
Total	**845**	**100.0%**

Source: NMFS SERO Permit database last updated 9/27/2019. Accessed 2/12/2020

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 85º30ʹW. longitude must also have a valid eastern Gulf longline endorsement. As of December 31, 2019, 62 of the permit holders have the longline endorsement, and all but two 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 programs and commercial reef fish management, see Amendments 26 (GMFMC 2006), 29 (GMFMC 2008c), and 36A (GMFMC 2017c). 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 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.[9]

[9] 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 (2012-2018).

	Groupers and Tilefishes	Red snapper	Gray triggerfish	Greater amberjack
2012	8,799,961	4,036,398	72,778	308,334
2013	8,065,531	5,448,544	63,086	457,879
2014	9,459,077	5,567,822	40,908	482,277
2015	8,343,924	7,184,210	48,013	460,786
2016	8,334,050	6,723,823	59,787	437,390
2017	6,332,123	6,978,662	63,264	453,849
2018	5,055,079	6,977,131	65,372	326,087

Source: Grouper and tilefish landings come from SERO Commercial Quotas Catch Allowance Summary (https://portal.southeast.fisheries.noaa.gov/reports/cs/CommercialQuotasCatchAllowanceTable.pdf). Gray triggerfish and greater amberjack landings from Commercial ACL file provided by SEFSC on November 15, 2019.

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 on privately owned or rented vessels must obey the regulations for the waters in which they are fishing.

Table 3.1.1.3. Recreational minimum size limits, bag limits, and seasons for reef fish species.

Stock	Min size	Daily bag limit	Season
Red snapper	16 inches TL	2 per person	Federal for-hire season opens June 1; private recreational season determined by individual Gulf states
Gray (mangrove) snapper	12 inches TL	10 snapper aggregate bag limit**	January 1-December 31*
Mutton snapper	18 inches TL	5 per person within 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	15 inches FL	1 per person within 20 reef fish aggregate bag limit	March 1-May 31; August 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 within 5 fish combined bag limit	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 Dec 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.
^ 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 December 31, 2019, there were 1,310 vessels with a valid or renewable for-hire reef fish permit: 1,277 vessels with the permit and another 33 with a historical captain endorsement (Table 3.1.1.4). Approximately 63% of the permits have mailing recipients in Florida. Texas recipients hold the second highest number of permits with 15%. Collectively, approximately 99% 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 and historical captain endorsements by state.

State	Permits	Historical Captain	Percent
AL	140	4	10.99%
FL	799	17	62.29%
LA	111	6	8.93%
MS	29	2	2.37%
TX	189	4	14.73%
Subtotal	**1,268**	**33**	**99.31%**
Other	9		0.69%
Total	**1,277**	**33**	**100.00%**

Source: NMFS SERO, accessed April 16, 2020.[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 (2012-2018).

Year	For-hire	Private	Total
2012	4,935,088	8,122,638	13,057,726
2013	5,170,856	15,440,201	20,611,057
2014	3,510,353	9,534,450	13,044,803
2015	5,717,134	7,330,600	13,047,734
2016	5,536,520	10,805,980	16,342,500
2017	5,554,999	10,500,299	16,055,298
2018	6,112,300	9,508,723	15,621,023

Source: NMFS SEFSC Recreational ACL file (MRIP-CHTS), December 4, 2019.

10 http://sero.nmfs.noaa.gov/operations_management_information_services/constituency_services_branch/freedom_of_information_act/common_foia/RCG.htm Accessed December 4, 2019.

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 with 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 primary 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. A recent exception has occurred in Florida since 2019. In response to a red tide event that occurred from November 2019 through February 2019, Florida has restricted red drum to catch and release only since (August 30, 2018). Currently, all west coast Florida state waters from Hernando/Pasco county line through Gordon pass in Collier County are catch-and-release only for red drum through May 31, 2021. 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 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 2012 through 2018.

	AL	FL	LA	MS	TX	Total
2012	1,116,708	1,698,998	8,553,784	833,870	1,666,142	13,869,502
2013	1,120,653	1,569,572	13,705,281	1,254,038	1,620,888	19,270,432
2014	572,574	1,611,823	7,874,750	741,551	1,437,445	12,238,143
2015	1,346,799	2,001,397	1,256,512	892,975	1,249,660	6,747,343
2016	993,915	1,541,279	4,776,611	971,676	1,409,539	9,693,020
2017	853,128	1,100,191	6,640,250	661,216	1,501,551	10,756,336
2018	911,323	899,573	8,057,503	963,712	1,550,309	12,382,420

Source: NMFS SEFSC Recreational ACL file (MRIP-CHTS), December 4, 2019.

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 2005), 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 surface 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.

General 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

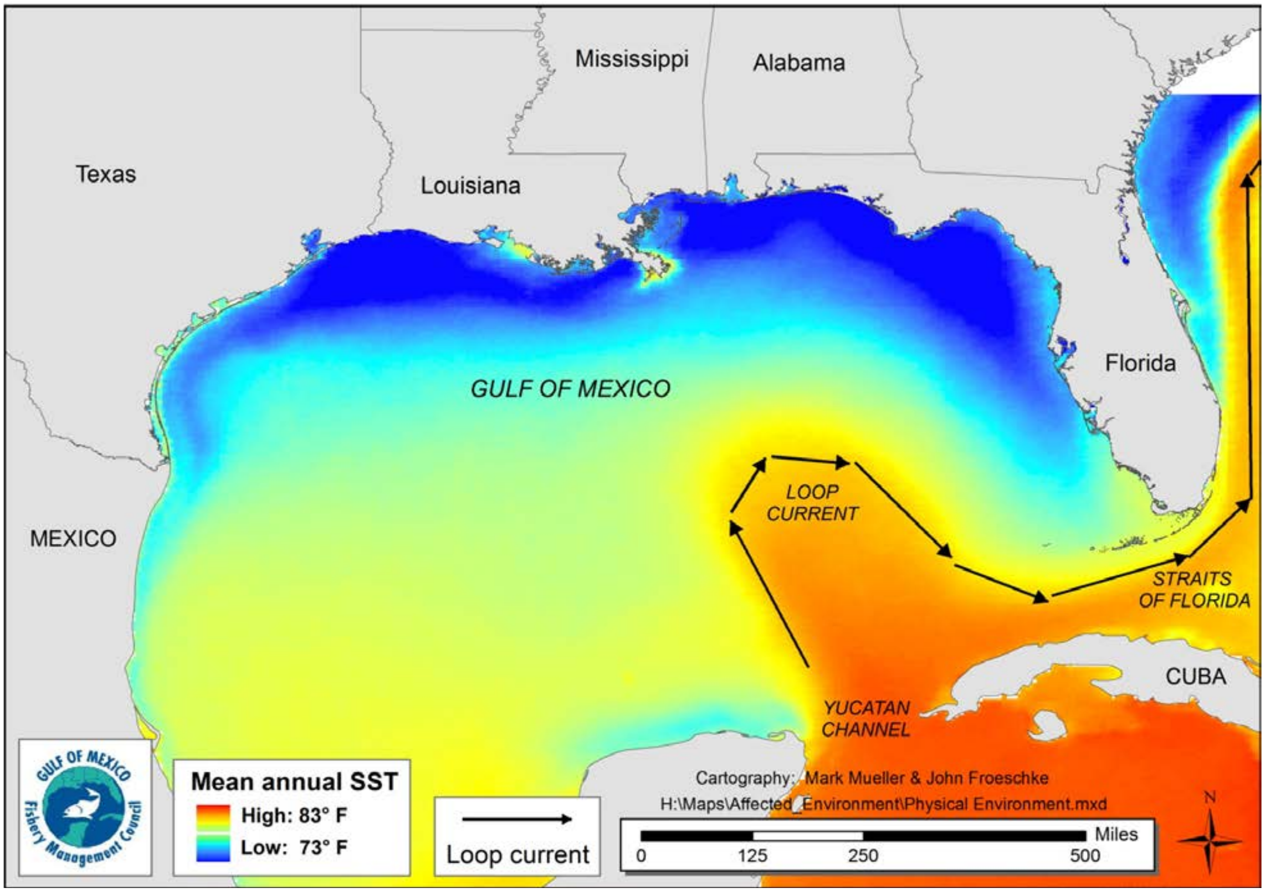


Figure 3.2.1. Physical environment of the Gulf, including major feature names and mean annual sea surface temperature as derived from the Advanced Very High-Resolution Radiometer Pathfinder Version 5 sea surface temperature data set (http://accession.nodc.noaa.gov/0072888)

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 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. 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.[13]

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. 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 2019, the extent of the hypoxic area was estimated to be 6,952 square miles and ranks as the eighth largest event over the past 33 years the area has been mapped.[14] The hypoxic conditions in the northern Gulf directly affect 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., gray 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).

Greenhouse Gases

The Intergovernmental Panel on Climate Change[15] has indicated 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 3.2.1 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

[13] http://www.boem.gov/Environmental-Stewardship/Archaeology/Shipwrecks.aspx.
[14] http://gulfhypoxia.net
[15] https://www.ipcc.ch/srocc/

from the Gulf (2.04% and 1.67%, respectively).

Table 3.2.1. Total Gulf greenhouse gas emissions estimates (tons per year [tpy]) from oil platform and non-oil platform sources, commercial fishing, and percent greenhouse gas emissions from commercial fishing vessels of the total emissions*. Data are for 2011 only.

Emission source	CO_2	Greenhouse CH_4	Gas N_2O	Total CO_{2e}**
Oil platform	5,940,330	225,667	98	11,611,272
Non-platform	14,017,962	1,999	2,646	14,856,307
Total	**19,958,292**	**227,665**	**2,743**	**26,467,578**
Commercial fishing	531,190	3	25	538,842
Recreational fishing	435,327	3	21	441,559
Percent commercial fishing	2.66%	>0.01%	0.91%	2.04%
Percent recreational fishing	2.18%	>0.01%	0.77%	1.67%

*Compiled from Tables 6-11, 6-12, and 6-13 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

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 2015) 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 is 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, 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 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[16] 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[17] and Southeast Data, Assessment and Review (SEDAR)[18] websites. Of the 12 stocks for which stock assessments have been conducted, the fourth quarter report of the 2020 Status of U.S. Fisheries classifies only one as overfished (greater amberjack), and three stocks as undergoing overfishing (greater amberjack, lane snapper, and the Gulf of Mexico Jacks Complex [lesser amberjack, almaco jack, banded rudderfish]).

The status of both assessed and unassessed stocks, as of the writing of this amendment is provided in Table 3.3.1. Reef fish Amendment 44 (GMFMC 2017b), 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 and remains in a rebuilding program.

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 or management advice.

Stock assessments have been conducted for seven reef fish stocks using the Data Limited Methods Tool (DLMTool; SEDAR 49 2016). This data limited approach allows the setting of overfishing limit (OFL) and acceptable biological catch (ABC) based on limited data and life

[16] https://www.fisheries.noaa.gov/national/population-assessments/fishery-stock-status-updates
[17] www.gulfcouncil.org
[18] http://sedarweb.org/

history information, but does not provide assessment-based status determinations. However, 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 overfished 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. Scamp is undergoing a research track 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*	N	N	SEDAR 43 2015
Family Carangidae – Jacks				
greater amberjack	*Seriola dumerili*	N	Y	SEDAR 33 Update 2016a
lesser amberjack	*Seriola fasciata*	Y	Unknown	SEDAR 49 2016
almaco jack	*Seriola rivoliana*	Y	Unknown	SEDAR 49 2016
banded rudderfish	*Seriola zonata*	Y	Unknown	
Family Labridae – Wrasses				
hogfish	*Lachnolaimus maximus*	N	N	SEDAR 37 2014
Family Malacanthidae – Tilefishes				
tilefish (golden)	*Lopholatilus chamaeleonticeps*	N	N	SEDAR 22 2011a
blueline tilefish	*Caulolatilus microps*	N	Unknown	
goldface tilefish	*Caulolatilus chrysops*	N	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	N	
lane snapper	*Lutjanus synagris*	Y	Unknown	SEDAR 49 2016
silk snapper	*Lutjanus vivanus*	N	Unknown	
yellowtail snapper	*Ocyurus chrysurus*	N	N	SEDAR 27A 2012
vermilion snapper	*Rhomboplites aurorubens*	N	N	SEDAR 45 2016
wenchman	*Pristipomoides aquilonaris*	N	Unknown	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. Species status based on the NOAA Quarter 4 2020 FSSI report.

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) from 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 primarily takes place in nearshore waters including 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 occurring at this time

Red drum were included with several reef fish stocks using the Data Limited Methods Tool (DLMTool; SEDAR 49 2016). This method allows the setting of OFLs and ABCs based on limited data and life history information, but does not provide assessment-based status determinations. However, the Council's SSC determined that red drum could not be further evaluated using the DLMTool because red drum did not have a reference period of federal landings.

Table 3.3.2. Red drum stock status as of September 30, 2019.

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.[19]

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, 2007, 2014a, 2015b), grouper (GMFMC 2008a, 2009, 2010,

[19] https://www.fisheries.noaa.gov/national/population-assessments/fishery-stock-status-updates.

2011b, 2012a), vermilion snapper (GMFMC 2004c, 2017c), greater amberjack (GMFMC 2008b, 2012b, 2017b), gray triggerfish (GMFMC 2012b), and hogfish (GMFMC 2016). 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

NMFS manages marine protected species in the Southeast region under the Endangered Species Act (ESA) and the Marine Mammal Protection Act (MMPA). A very brief summary of these two laws and more information is available on NMFS Office of Protected Resources website[20]. There are 21 ESA-listed species of marine mammals, sea turtles, fish, and corals that may occur in the EEZ of the Gulf. There are 91 stocks of marine mammals managed within the Southeast region plus the addition of the stocks such as North Atlantic right whales (NARW), and humpback, sei, fin, minke, and blue whales that regularly or sometimes occur in Southeast region managed waters for a portion of the year (Hayes et al. 2017). All marine mammals in U.S. waters are protected under the MMPA.

Of the four marine mammals that may be present in the Gulf (sperm, sei, fin, and Gulf Bryde's), the sperm, sei, and Gulf of Mexico Bryde's whale are listed as endangered under the ESA. Bryde's whales are the only resident baleen whales in the Gulf. Manatees, listed as threatened under the ESA, also occur in the Gulf and are the only marine mammal species in this area managed by the U.S. Fish and Wildlife Service.

The gear used by the Gulf reef fish fishery is classified in the MMPA 2019 List of Fisheries as a Category III fishery (84 FR 22051). 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 the reef fish fishery. Bottlenose dolphins prey upon bait, catch, and/or released discards of fish from the reef fish fishery. They are also a common predator around reef fish vessels, feeding on the discards. Marine Mammal Stock Assessment Reports and additional information are available on the NMFS Office of Protected Species website.[21]

Sea turtles, fish, and corals that are listed as threatened or endangered under the ESA occur in the Gulf. These include the following: six species of sea turtles (Kemp's ridley, loggerhead (Northwest Atlantic Ocean distinct population segment (DPS), green (North Atlantic and South Atlantic DPSs), leatherback, and hawksbill); five species of fish (Gulf sturgeon, smalltooth sawfish, Nassau grouper, oceanic whitetip shark and giant manta ray); and six species of coral (elkhorn, staghorn, lobed star, mountainous star, boulder star, and rough cactus). Critical habitat

[20] http://www.nmfs.noaa.gov/pr/laws/
[21] http://www.nmfs.noaa.gov/pr/sspecies/

designated under the ESA for smalltooth sawfish, Gulf sturgeon, and the Northwest Atlantic Ocean DPS of loggerhead sea turtles occur in the Gulf, though only loggerhead critical habitat occurs in federal waters.

The most recent biological opinion (BiOp) for the FMP was completed on September 30, 2011. The BiOp determined the operation of the Gulf reef fish fishery managed under the Reef Fish FMP is not likely to adversely affect ESA-listed marine mammals or coral, and was not likely to jeopardize the continued existence of sea turtles (loggerhead, Kemp's ridley, green, hawksbill, and leatherback) or smalltooth sawfish. Since issuing the opinion, in memoranda dated September 16, 2014, and October 7, 2014, NMFS concluded that the activities associated with the Reef Fish FMP are not likely to adversely affect critical habitat for the Northwest Atlantic Ocean loggerhead sea turtle DPS and four species of corals (lobed star, mountainous star, boulder star, and rough cactus). On September 29, 2016, NMFS requested reinitiation of Section 7 consultation on the operation of reef fish fishing managed by the Reef Fish FMP because new species (i.e., Nassau grouper [81 FR 42268] and green sea turtle North Atlantic and South Atlantic DPSs [81 FR 20057]) were listed under the ESA that may be affected by the proposed action. NMFS documented a determination that the operation of the fishery during the reinitiation period is not likely to adversely affect these species.

On January 22, 2018, NMFS published a final rule (83 FR 2916) listing the giant manta ray as threatened under the ESA. On January 30, 2018, NMFS published a final rule (83 FR 4153) listing the oceanic whitetip shark as threatened under the ESA. In a memorandum dated March 6, 2018, NMFS revised the request for reinitiation of consultation on the Reef Fish FMP to address the listings of the giant manta and oceanic whitetip. In that memorandum, NMFS also determined that fishing under the Reef Fish FMP during the extended re-initiation period will not jeopardize the continued existence of the giant manta ray, oceanic whitetip shark, Nassau grouper, or the North Atlantic and South Atlantic DPSs of green sea turtles.

NMFS published a final rule on April 15, 2019, listing the Gulf Bryde's whale as endangered. In a memorandum dated June 20, 2019, NMFS revised the reinitiation request to include the Gulf Bryde's whale and determined that fishing under the Reef Fish FMP to continue during the re-initiation period will not jeopardize the continued existence of any of the newly listed species discussed above.

Climate Change

Climate change projections predict increases in sea-surface temperature and sea level; decreases in sea-ice cover; and changes in salinity, wave climate, and ocean circulation.[22] These changes are likely to affect plankton biomass and fish larvae abundance that could adversely affect fish, marine mammals, seabirds, and ocean biodiversity. Kennedy et al. (2002) and Osgood (2008) have suggested global climate change could affect temperature changes in coastal and marine ecosystems that can influence organism metabolism and alter ecological processes such as productivity and species interactions, change precipitation patterns and cause a rise in sea level. This could change the water balance of coastal ecosystems; altering patterns of wind and water circulation in the ocean environment; and influence the productivity of critical coastal

[22] http://www.ipcc.ch/

ecosystems such as wetlands, estuaries, and coral reefs. The National Oceanic and Atmospheric Association (NOAA) Climate Change Web Portal[23] predicts the average sea surface temperature in the Gulf will increase by 1-3ºC for 2010-2070 compared to the average over the years 1950-2010. For reef fishes, Burton (2008) speculated climate change could cause shifts in spawning seasons, changes in migration patterns, and changes to basic life history parameters such as growth rates. The smooth puffer and common snook are examples of species for which 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. For other fish 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. However, some stocks have shown increases in abundance in the northern Gulf (Fodrie et al. 2010). This may be a result of increasing water temperatures in coastal environments.

Deepwater Horizon MC252 Oil Spill

The presence of polycyclic aromatic hydrocarbons (PAH), which are highly toxic chemicals that tend to persist in the environment for long periods of time, in marine environments can have detrimental impacts on marine finfish, especially during the more vulnerable larval stage of development (Whitehead et al. 2012). When exposed to realistic, yet toxic levels of PAHs (1–15 μg/L), greater amberjack larvae develop cardiac abnormalities and physiological defects (Incardona et al. 2014). The future reproductive success of long-lived species, including red drum and many reef fish species, may be negatively affected by episodic events resulting in high-mortality years or low recruitment. These episodic events could leave gaps in the age structure of the population, thereby affecting future reproductive output (Mendelssohn et al. 2012). Other studies have described the vulnerabilities of various marine finfish species, with morphological and/or life history characteristics similar to species found in the Gulf, to oil spills and dispersants (Hose et al. 1996; Carls et al. 1999; Heintz et al. 1999; Short 2003).

Increases in histopathological lesions were found in red snapper in the area affected by the oil, but Murawski et al. (2014) found that the incidence of lesions had declined between 2011 and 2012. The occurrence of such lesions in marine fish is not uncommon (Sindermann 1979; Haensly et al. 1982; Solangi and Overstreet 1982; Khan and Kiceniuk 1984, 1988; Kiceniuk and Khan 1987; Khan 1990). Red snapper diet was also affected after the spill. A decrease in zooplankton consumed, especially by adults (greater than 400 mm total length) over natural and artificial substrates may have contributed to an increase in the consumption of fish and invertebrate prey – more so at artificial reefs than natural reefs (Tarnecki and Patterson 2015).

[23] https://www.esrl.noaa.gov/psd/ipcc/

In addition to the crude oil, over a million gallons of the dispersant, Corexit 9500A®, was applied to the ocean surface and an additional hundreds of thousands of gallons of dispersant was pumped to the mile-deep wellhead (National Commission 2010). No large-scale applications of dispersants in deep water had been conducted until the *Deepwater Horizon* MC252 oil spill. Thus, no data exist on the environmental fate of dispersants in deep water. The effect of oil, dispersants, and the combination of oil and dispersants on fishes of the Gulf remains an area of concern.

Red Tide

Red tide is a common name for harmful algal blooms caused by species of dinoflagellates and other organisms that cause the water to appear to be red. Red tide blooms occur in the Gulf almost every year, generally in late summer or early fall. They are most common off the central and southwestern coasts of Florida between Clearwater and Sanibel Island but may occur anywhere in the Gulf. More than 50 species capable of causing red tides occur in the Gulf, but one of the best-known species is *Karenia brevis*. This organism produces toxins capable of killing fish, birds and other marine animals.[24]

The effects of red tide on fish stocks have been well established. In 2005, a severe red tide event occurred in the Gulf along with an associated large decline in multiple abundance indices for red grouper, gag, red drum, and other species thought to be susceptible to mortality from red tide events. It is unknown whether mortality occurs via absorption of toxins across gill membranes (Abbott et al. 1975; Baden 1988), ingestion of toxic biota (Landsberg 2002), or from some indirect effect of red tide such as hypoxia (Walter et al. 2013). In 2018, a severe red tide event occurred off the southwest coast of Florida from Monroe County to Sarasota County that persisted for more than 10 months; the impacts on fish stocks will likely be considered in future stock assessments.

3.4 Description of the Economic Environment

A description of the reef fish and red drum stocks affected by the actions considered in this amendment is provided in Section 3.3 Additional details on the economic environment of the recreational and commercial sectors of the Gulf reef fish fishery, specifically with respect to the stocks considered in this Amendment, are provided in Reef Fish Amendment 49 (GMFMC 2018a), the Framework Action to Modify Red Snapper and Hogfish Catch Limits (GMFMC 2018b), Framework Action to Modify Mutton Snapper and Gag Management Measures (GMFMC 2017a), and Reef Fish Amendment 36A (GMFMC 2017).

This amendment does not contain management measures that would directly or indirectly affect Gulf reef fish dealers and thus additional details on the economic environment of that component of the commercial sector are not provided here. Sections 3.4.1 and 3.4.2 contain additional information on the economic environment of the commercial sector and the for-hire and private recreational components of the recreational sector in the Gulf reef fish and red drum fisheries.

[24] http://myfwc.com/research/redtide/general/about/

3.4.1 Commercial Sector

Permits

Any fishing vessel that harvests and sells any of the reef fish species managed under the reef fish FMP from the Gulf Exclusive Economic Zone (EEZ) must have a valid Gulf commercial reef fish permit. According to Table 3.4.1.1, the number of permits that were valid or renewable in a given year has continually decreased in the years after the red snapper IFQ program was implemented in 2007. This decline has continued since the grouper-tilefish IFQ program was implemented in 2010, but at a slower rate. As of February 27, 2020, there were 834 valid or renewable commercial reef fish permits, 763 of which were valid.

Table 3.4.1.1. Number of valid or renewable commercial reef fish permits, 2008-2018.

Year	Number of Permits
2008	1,099
2009	998
2010	969
2011	952
2012	917
2013	895
2014	882
2015	868
2016	852
2017	850
2018	845

Source: NMFS SERO SF Access Permits Database.

Although red drum is federally managed, the fishery has been closed in federal waters since Amendment 2 to the Red Drum FMP became effective in June 1988. As a result of this closure, there are currently no federal permits to commercially harvest red drum in federal waters.

Economic Performance

The information in Tables 3.4.1.2 and 3.4.1.3 describes the activity of vessels that were active in the commercial sector of the reef fish fishery in each year from 2014 to 2018. The tables contain summarized data based on the SEFSC Social Science Research Group (SSRG) Socioeconomic Panel data set.[25] Inflation adjusted revenues and prices are reported in 2018 dollars. All nominal dollar values were converted to 2018 dollars using the annual GDP implicit price deflator provided by the U.S. Bureau of Economic Analysis. The estimates of total landings, total revenue, and average revenue per vessel in each year include the harvest of all species included in the SEFSC coastal logbook data for the vessels that harvested reef fish in that year.

[25] This data set is compiled by the SEFSC SSRG from coastal logbook data, supplemented by average prices calculated from the Accumulated Landings System (ALS). Because these landings are self-reported, they may diverge slightly from dealer-reported landings presented elsewhere.

Table 3.4.1.2. Summary of vessel counts, trips, and logbook landings (pounds gutted weight (lbs gw)) for vessels landing at least one pound of reef fish, 2014-2018.

Year	Number of vessels that landed reef fish (> 0 lbs gw)	Number of trips that landed reef fish	Reef fish landings (lbs gw)	Other species' landings jointly harvested with reef fish (lbs gw)	Number of Gulf trips that only landed other species	Other species' landings on Gulf trips without reef fish (lbs gw)	All species landings on South Atlantic trips (lbs gw)
2014	576	6,986	15,459,573	895,474	1,010	848,153	401,112
2015	547	7,008	15,394,253	738,836	785	800,750	587,285
2016	538	7,122	15,083,589	699,728	827	955,544	540,643
2017	563	6,785	13,737,792	608,335	798	770,676	533,278
2018	544	5,877	12,280,078	433,185	633	549,059	326,080
Average	554	6,756	15,459,573	675,112	811	784,836	477,680

Source: SEFSC/SSRG Socioeconomic Panel (accessed Jan. 10, 2020).

Table 3.4.1.3. Summary of vessel counts and revenue (2018 dollars) for vessels landing at least one pound of reef fish, 2014-2018.

Year	Number of vessels that landed reef fish (> 0 lbs gw)	Dockside revenue from reef fish	Dockside revenue from 'other species' jointly landed with reef fish	Dockside revenue from 'other species' landed on Gulf trips without reef fish	Dockside revenue from 'all species' landed on South Atlantic trips.	Total dockside revenue	Average total dockside revenue per vessel
2014	576	$63,611,912	$1,524,599	$1,979,609	$1,384,546	$68,500,666	$118,925
2015	547	$65,115,901	$1,316,933	$1,528,046	$1,998,431	$69,959,311	$127,896
2016	538	$64,014,325	$1,222,673	$1,991,812	$1,655,825	$68,884,635	$128,038
2017	563	$58,009,080	$1,079,956	$1,596,470	$1,742,732	$62,428,238	$110,885
2018	544	$53,900,260	$764,634	$1,306,361	$1,162,903	$57,134,158	$105,026
Average	554	$60,930,296	$1,181,759	$1,680,460	$1,588,887	$65,381,402	$118,154

Source: SEFSC/SSRG Socioeconomic Panel (accessed Jan. 10, 2020).

Vessel participation in the commercial sector of the Gulf reef fish fishery is very fluid. While many vessels were active in every year between 2014 and 2018, some vessels were only active in certain years. The information in Tables 3.4.1.1 and 3.4.1.2 only represents the activity of vessels that harvested reef fish in each specific year. Thus, for example, if a vessel harvested reef fish in 2014 but not in 2015, that vessel's fishing activities in 2015 are not represented in these tables. Further, this data does not account for landings and revenues generated from fishing activity that is not covered by the coastal logbooks. If vessels are shifting between fisheries based on their relative profitability, as economic theory would suggest, then this information likely understates the economic performance of vessels that only participate in the reef fish fishery in certain years.

Vessel participation in the commercial sector of the reef fish fishery does not demonstrate a distinct trend during the 2014-2018 time period. However, landings of reef fish and associated revenues generally remained stable from 2014-2016, but decreased noticeably in 2017 and 2018. Although ex-vessel prices for most of the major species increased in 2017 and 2018, landings decreased for species in all of the GT-IFQ program's share categories, with red grouper and gag experiencing the largest declines. Since commercial quotas were stable or increased during this time, the percentage of the commercial quotas in the GT-IFQ program decreased from about 79% on average from 2014-2016 to only 45% on average in 2017-2018. Further, landings and revenues from other species landed on Gulf reef fish trips, other trips where reef fish were not harvested, and South Atlantic trips also declined in 2017 and 2018. As a result, average gross revenue per vessel from fisheries covered by the coastal logbooks decreased by about 18% from 2016 to 2018.

The actions in this amendment are not expected to affect the major species within the Reef Fish FMP. Rather, the actions in this amendment focus on species that have not been assessed and/or for which some status determination criteria (SDCs) have not been established. These species will be referred to as species with no SDCs. Hogfish is included only because optimum yield (OY) has not been established for that species. Also, some of the species without SDCs are jointly assessed across the Gulf and South Atlantic (black grouper, yellowtail snapper, mutton snapper, and goliath grouper), and thus additional considerations must be taken into account in those cases. Tables 3.4.1.4 and 3.4.1.5 provide vessel participation, landings, and revenue data for vessels that harvest species for which no SDCs have not been established. Tables 3.4.1.6 and 3.4.1.7 provide vessel participation, landings, and revenue data for vessels that harvest species for which no SDCs have been established in the Gulf and are also jointly assessed across the Gulf and South Atlantic. Tables 3.4.1.8 and 3.4.1.9 provide vessel participation, landings, and revenue data for vessels that harvest hogfish.

Table 3.4.1.4. Summary of vessel counts, trips, and logbook landings (pounds gutted weight) for vessels landing at least one pound of reef fish with no SDCs, 2014-2018.

Year	Number of vessels (> 0 lbs gw)	Number of trips	Landings of reef fish with no SDCs (lbs gw)	Other species' landings jointly harvested (lbs gw)	Number of Gulf trips that only landed other species	Other species' landings on Gulf trips (lbs gw)	All species landings on South Atlantic trips (lbs gw)
2014	496	4,534	2,841,566	10,592,686	2,918	3,337,490	365,644
2015	476	4,394	2,388,320	10,222,159	2,912	3,792,654	587,158
2016	476	4,717	2,280,144	10,802,758	4,129	3,238,425	507,082
2017	488	4,354	2,159,608	9,061,288	4,007	3,378,317	533,206
2018	469	3,864	2,031,008	7,720,588	3,386	2,862,705	318,584
Average	481	4,373	2,340,129	9,679,896	3,470	3,321,918	462,335

Source: SEFSC/SSRG Socioeconomic Panel (accessed Jan. 10, 2020).

Table 3.4.1.5. Summary of vessel counts and revenue (2018 dollars) for vessels landing at least one pound of reef fish with no SDCs, 2014-2018.

Year	Number of vessels (> 0 lbs gw)	Dockside revenue from reef fish with no SDCs	Dockside revenue from 'other species' jointly landed	Dockside revenue from 'other species' landed on Gulf trips	Dockside revenue from 'all species' landed on South Atlantic trips.	Total dockside revenue	Average total dockside revenue per vessel
2014	496	$10,906,512	$42,143,490	$12,481,187	$1,262,599	$66,793,789	$134,665
2015	476	$9,576,611	$41,927,374	$14,464,673	$1,997,910	$67,966,567	$142,787
2016	476	$9,286,809	$44,379,389	$12,068,427	$1,596,585	$67,331,210	$141,452
2017	488	$8,518,847	$37,043,437	$13,248,784	$1,742,467	$60,553,534	$124,085
2018	469	$8,364,809	$33,257,179	$11,971,703	$1,144,011	$54,737,702	$116,712
Average	481	$9,330,717	$39,750,174	$12,846,955	$1,548,714	$63,476,560	$131,940

Source: SEFSC/SSRG Socioeconomic Panel (accessed Jan. 10, 2020).

Table 3.4.1.6. Summary of vessel counts, trips, and logbook landings (pounds gutted weight) for vessels landing at least one pound of jointly assessed reef fish with no SDCs, 2014-2018.

Year	Number of vessels (> 0 lbs gw)	Number of trips	Landings (lbs gw)	Other species' landings jointly harvested (lbs gw)	Number of Gulf trips that only landed other species	Other species' landings on Gulf trips (lbs gw)	All species landings on South Atlantic trips (lbs gw)
2014	252	1,385	829,344	2,715,976	2,722	7,070,067	361,965
2015	229	1,169	539,052	2,718,298	2,595	5,921,842	474,459
2016	266	1,356	505,256	3,237,422	4,472	6,644,632	426,691
2017	251	1,229	540,677	2,390,917	4,044	4,528,198	526,662
2018	249	1,211	568,249	2,163,247	3,363	4,097,692	318,584
Average	249	1,270	596,516	2,645,172	3,439	5,652,486	421,672

Source: SEFSC/SSRG Socioeconomic Panel (accessed Jan. 10, 2020).

Table 3.4.1.7. Summary of vessel counts and revenue (2018 dollars) for vessels landing at least one pound of jointly assessed reef fish with no SDCs, 2014-2018.

Year	Number of vessels (> 0 lbs gw)	Dockside revenue	Dockside revenue from 'other species' jointly landed	Dockside revenue from 'other species' landed on Gulf trips	Dockside revenue from 'all species' landed on South Atlantic trips.	Total dockside revenue	Average total dockside revenue per vessel
2014	252	$2,941,959	$10,850,778	$27,603,207	$1,251,524	$42,647,469	$169,236
2015	229	$1,962,041	$11,191,918	$23,952,925	$1,655,141	$38,762,025	$169,266
2016	266	$1,853,984	$13,406,859	$26,733,552	$1,403,961	$43,398,356	$163,152
2017	251	$1,843,735	$9,971,571	$18,424,738	$1,731,821	$31,971,865	$127,378
2018	249	$2,086,445	$9,650,964	$17,151,875	$1,144,011	$30,033,295	$120,616
Average	249	$2,137,633	$11,014,418	$22,773,259	$1,437,291	$37,362,602	$149,930

Source: SEFSC/SSRG Socioeconomic Panel (accessed Jan. 10, 2020).

Table 3.4.1.8. Summary of vessel counts, trips, and logbook landings (pounds gutted weight) for vessels landing at least one pound of hogfish, 2014-2018.

Year	Number of vessels that landed hogfish (> 0 lbs gw)	Number of trips that landed hogfish	Hogfish landings (lbs gw)	Other species' landings jointly harvested with reef fish (lbs gw)	Number of Gulf trips that only landed other species	Other species' landings on Gulf trips without hogfish (lbs gw)	All species landings on South Atlantic trips (lbs gw)
2014	76	360	33,563	191,386	753	454,968	23,292
2015	61	360	25,132	144,779	569	495,887	56,391
2016	61	356	27,462	130,508	3,108	508,133	122,055
2017	51	229	15,337	98,802	2,955	333,178	90,869
2018	42	179	12,105	111,425	2,395	331,911	87,004
Average	58	297	22,720	135,380	1,956	424,816	75,922

Source: SEFSC/SSRG Socioeconomic Panel (accessed Jan. 10, 2020).

Table 3.4.1.9. Summary of vessel counts and revenue (2018 dollars) for vessels landing at least one pound of hogfish, 2014-2018.

Year	Number of vessels that landed hogfish (> 0 lbs gw)	Dockside revenue from hogfish	Dockside revenue from 'other species' jointly landed with hogfish	Dockside revenue from 'other species' landed on Gulf trips without hogfish	Dockside revenue from 'all species' landed on South Atlantic trips.	Total dockside revenue	Average total dockside revenue per vessel
2014	76	$148,410	$712,894	$1,566,066	$115,522	$2,542,892	$33,459
2015	61	$114,583	$550,619	$2,078,233	$204,149	$2,947,583	$48,321
2016	61	$127,349	$523,368	$1,953,364	$373,210	$2,977,291	$48,808
2017	51	$69,853	$381,098	$1,271,924	$293,739	$2,016,615	$39,541
2018	42	$56,101	$436,252	$1,113,801	$339,100	$1,945,254	$46,316
Average	58	$103,259	$520,846	$1,596,678	$265,144	$2,485,927	$43,289

Source: SEFSC/SSRG Socioeconomic Panel (accessed Jan. 10, 2020).

The most important finding from these tables is they generally reflect the same trends seen for reef fish in the aggregate, even though those trends were primarily driven by declines in the GT-IFQ program species' landings. Specifically, though stable from 2014 through 2016, total landings and revenues for vessels harvesting species with no SDCs declined in 2017 and 2018. However, landings of and revenues from reef fish species with no SDCs declined continuously from 2014 through 2018. The trends for the jointly assessed species and hogfish differ slightly, but still indicate a mostly downward trend in landings and revenues, as well as participation in the case of hogfish.

Estimates of economic return measures have not been available historically for the commercial sector of the Gulf reef fish fishery. Recent reports (Overstreet, Perruso, and Liese 2017, Overstreet and Liese 2018a, and Overstreet and Liese 2018b) provided the first such estimates. These estimates are specific to economic performance in 2014, 2015 and 2016, respectively. Overstreet and Liese (2018b) also provides average estimates of economic returns across 2014-2016, which are the most useful for current purposes, and thus findings from that report are summarized below. Estimates in these reports are based on a combination of Southeast Coastal logbook data, a supplemental economic add-on survey to the logbooks, and an annual economic survey at the vessel level. The economic surveys collect data on gross revenue, variable costs, fixed costs, as well as some auxiliary economic variables (e.g., market value of the vessel). The report provides estimates of critical economic variables for the commercial sector of the Gulf reef fish fishery as a whole, but also provides estimates by "subsets" within this sector. These subsets are referred to as Segments of Interest (SOI). Subsets are generally defined at the individual species (e.g., red snapper), species group (e.g., Jacks), and/or gear-level (e.g., longline). In addition, estimates are provided at the trip level and the annual vessel level for each SOI. For current purposes, the most important results are those for the commercial sector as a whole, as there is no SOI specific to species without SDCs.

From an economic returns perspective, the two most critical results at the trip level are the estimates of trip net cash flow and trip net revenue. Trip net cash flow is trip revenue minus the costs for fuel, bait, ice, groceries, miscellaneous, hired crew, and purchases of annual allocation from other allocation holders. Thus, this estimate represents the amount of cash generated by a typical reef fish trip over and above the cash cost of taking the trip (i.e., variable costs of the trip) and is a proxy for producer surplus at the trip level. Trip net revenue is trip revenue minus the costs for fuel, bait, ice, groceries, miscellaneous, hired crew, and the opportunity cost of owner's time as captain. By including opportunity cost of the owner's time and excluding purchases of annual allocation, trip net revenue is a measure of the commercial fishing trip's economic profit.

Table 3.4.1.10 illustrates the economic "margins" generated on reef fish trips, i.e., trip net cash flow and trip net revenue as a percentage of trip revenue. According to this table, 27%, 16% and 20% of the revenues generated on reef fish trips were used to pay for crew costs, fuel/supplies costs, and purchases of annual allocation, while the remaining 38% was net cash flow back to the owner(s). The margin associated with trip net revenue was higher at 51%. Thus, trip cash flow and trip net revenue were both positive on average from 2014-2016, generally indicating that reef fish trips were profitable during this time.

Table 3.4.1.10. Economic characteristics of reef fish trips 2014-2016 (2018$).

	2014	2015	2016	Average
Number of Observations	1,237	1,787	1,948	
Response Rate (%)	78%	85%	94%	
SOI Trip				
Owner-Operated	73%	66%	68%	69%
Fuel Used per Day at Sea (gallons/day)	46	45	40	44
Total Revenue	100%	100%	100%	100%
Costs (% of Revenue)				
Fuel	6.8%	4.9%	4.3%	5.3%
Bait	3.1%	3.4%	3.6%	3.4%
Ice	1.4%	1.5%	1.7%	1.5%
Groceries	2.4%	2.4%	3.1%	2.6%
Miscellaneous	2.5%	2.4%	3%	2.6%
Hired Crew	28.2%	25.9%	27.1%	27.1%
IFQ Purchase	14.7%	26.5%	18.4%	19.9%
OC Owner-Captain Time	6.5%	6.3%	7.5%	6.8%
Trip Net Cash Flow	41%	33%	39%	38%
Trip Net Revenue	49%	53%	50%	51%
Labor - Hired & Owner	35%	32%	35%	34%
Fuel & Supplies	16%	15%	16%	16%
Input Prices				
Fuel Price (per gallon)	$3.68	$2.68	$2.13	$2.81
Hire Crew Wage (per crew-day)	$344	$291	$262	$299
Productivity Measures				
Landings/Fuel Use (lbs/gallon)	13.3	12.6	11.4	12
Landings/Labor Use (lbs/crew-day)	221	203	169	198

Table 3.4.1.11 provides estimates of the important economic variables at the annual level for all vessels that had reef fish landings from 2014-2016. Similar to the trip level, the three most important estimates of economic returns are net cash flow, net revenue from operations,[26] and economic return on asset value. Of these measures, net revenue from operations most closely represents economic profits to the owner(s). Net cash flow is total annual revenue minus the costs for fuel, other supplies, hired crew, vessel repair and maintenance, insurance, overhead, loan payments, and purchases of annual allocation. Net revenue from operations is total annual revenue minus the costs for fuel, other supplies, hired crew, vessel repair and maintenance, insurance, overhead, and the opportunity cost of an owner's time as captain as well as the vessel's depreciation. Economic return on asset value is calculated by dividing the net revenue from operations by the vessel value.

[26] Net revenue from operations accrues to the vessel owner and, when applicable, the IFQ shareholder, who may not be the same entity.

Table 3.4.1.11. Economic characteristics of reef fish vessels from 2014-2016 (2018$).

	2014	2015	2016	Average
Number of Observations	84	105	121	
Response Rate (%)	62%	75%	82%	
SOI Vessel				
Owner-Operated	78%	70%	78%	75%
For-Hire Active	9%	17%	16%	14%
Vessel Value	$125,504	$104,531	$89,287	$106,440
Total Revenue	100%	100%	100%	100%
Costs (% of Revenue)				
Fuel	8.4%	6.1%	6.7%	7.1%
Other Supplies	9.7%	9.4%	10.8%	10%
Hired Crew	26.9%	25.3%	24.5%	25.6%
Vessel Repair & Maintenance	7.8%	6.9%	8.5%	7.7%
Insurance	1.1%	0.8%	1%	1%
Overhead	5.6%	5.5%	5.1%	5.4%
Loan Payment	1%	1.4%	1.3%	1.2%
IFQ Purchase	11.2%	24.2%	13.9%	16.4%
OC Owner-Captain Time	5.6%	5.5%	6.7%	5.9%
Net Cash Flow	29%	21%	28%	26%
Net Revenue for Operations	31%	38%	33%	34%
Depreciation	3.7%	3%	3.2%	3.3%
Fixed Costs	14%	13%	15%	14%
Labor - Hired & Owner	32%	31%	31%	31%
Fuel & Supplies	18%	15%	18%	17%
Economic Return (on asset value)	42.5%	61.7%	51.5%	51.9%

Net cash flow and net revenue from operations at the annual vessel level were both positive from 2014-2016, generally indicating that commercial reef fish vessels in the commercial sector were profitable, though some vessels earned much greater profits than others. More specifically, net cash flow and net revenue from operations averaged 26% and 34%, respectively, while the economic return on asset value was approximately 22% during this time.

Overstreet and Liese (2018b) only provide estimates of economic returns from 2014-2016, and thus it cannot be used to assess how economic returns and related measures have changed since the implementation of the IFQ programs. However, Liese (pers. communication, Nov. 22, 2017) has conducted an analysis that compares economic returns and related measures in 2006 and 2014, and thus examines how they have changed since the implementation of the GT and RS-IFQ programs. Because of the years chosen, the changes in economic performance indicated by these results can only, at best, be attributed to the combination of the two IFQ programs as opposed to one or the other. Also, his results apply to all trips that landed Gulf reef fish species as opposed to landings of species managed under one or both of the IFQ programs. Further, as these results are preliminary, only a generally qualitative overview can be provided.

First, effort in the commercial sector of the fishery has decreased significantly according to multiple measures. Specifically, the number of vessels, trips, and days at sea decreased by 31%, 38%, and 28%, respectively, between 2006 and 2014. At the same time, landings of Gulf reef fish were relatively unchanged, decreasing by about 4% during that time. Thus, output per unit of input (one measure of productivity) has increased significantly since the IFQ programs were implemented. Further, even though landings have remained about the same, the average ex-vessel price of Gulf reef fish landings increased by 20% during this time, resulting in a 16% increase in total annual revenues from these landings.

Because productivity increased, costs decreased. Specifically, crew costs decreased by 6%, other variable costs (supplies, fuel, etc.) decreased by 33%, and fixed costs decreased by 19%. The decrease in crew costs was driven by a decrease in crew days of 26%, as crew compensation per day actually increased by 24% (i.e., the amount of labor used decreased somewhat significantly, but "wages" increased somewhat significantly as well). Similarly, even though fuel prices increased by 25%, a 49% decrease in fuel usage was the primary driver of the decline in other variable costs. In addition, the opportunity costs associated with the owner's labor time and capital invested in the vessel decreased by 16% and 31%, respectively.

Because costs decreased, significantly lower percentages of the total revenues had to be used to cover these costs, in turn resulting in much higher economic returns and margins. Net cash flow to the owner(s) increased by more than 300% while net revenue from operations increased by more than 400%. Trip net revenue as a percentage of total trip revenue increased by 94% while, at the vessel level, net revenue from operations as a percentage of total revenues increased by 180%. While such increases may appear to be exorbitant, it must be kept in mind that, in 2006, net cash flows were only slightly above the break-even point and net revenues from operations were negative (i.e., commercial reef fish levels were earning economic losses on average).

Commercial harvest of red drum from the EEZ has been prohibited since June 29, 1988. Thus, commercial landings of red drum are not reported to the SEFSC's coastal logbook program. As such, economic information regarding the commercial harvest of red drum is limited.

At present, commercial harvest of red drum in the Gulf is only allowed in state waters off of Mississippi, though some of that harvest is landed in Alabama. Commercial landings of red drum in Alabama cannot be disclosed as those data are considered confidential due to the small number of dealers (i.e., less than 3) that purchase those landings in each year. Thus, the summary information in Table 3.4.1.12 only represents commercial landings of red drum by vessels landing in Mississippi as reported through dealer reports to the state (J. Chau, pers. comm., Jan. 7, 2020).

Table 3.4.1.12. Summary of vessel counts, trips, average prices, and revenue for commercial vessels landing at least one pound of red drum in each year, 2014-2018. Landings are whole weight, dollar values are in 2018 dollars.

Year	**Number of vessels that landed red drum**	**Number of trips that landed red drum**	**Red Drum landings**	**Dockside revenue from red drum**	**Average price per pound**	**Dockside Revenue from other species[27]**	**Total Revenue**
2014	54	789	27,753	$59,335	$2.14	$7,588,191	$7,647,527
2015	41	875	36,788	$78,246	$2.13	$6,666,329	$6,744,575
2016	37	525	38,670	$85,724	$2.22	$6,790,498	$6,876,222
2017	73	1,040	61,492	$157,504	$2.56	$3,101,295	$3,258,800
2018	96	1,133	60,511	$149,803	$2.48	$2,901,077	$3,050,880
Average	60	872	45,043	$106,122	$2.30	$5,409,478	$5,515,601

Source: NMFS SEFSC, personal communication, Jan., 7, 2020.

According to the information in Table 3.4.1.12, the commercial sector of the red drum fishery is relatively small with respect to the number of participating vessels, number of trips, landings, and revenue compared to the commercial sector of many other fisheries in the Gulf (e.g., reef fish, coastal migratory pelagics, shrimp, etc.). However, the commercial sector expanded somewhat significantly in 2017 and 2018 relative to 2014 through 2016. More specifically, the average number of vessels and number of trips commercially harvesting red drum in 2017/2018 increased by more than 100% (i.e., more than doubled) from their average levels from 2014 through 2016. As a result, average landings and revenues for red drum also increased significantly, with landings increasing by about 80% and revenue increasing by 107%. Most of the increase in red drum revenues was due to the increase in landings, though the average price per pound for red drum also increased by about 17% from 2014-2016 compared to 2017/2018. These trends in turn led to an increase in average annual red drum revenue per vessel from about $1,700 in 2014-2016 to slightly more than $1,800 per vessel in 2017/2018.

Conversely, the average revenue from other species harvested by vessels that commercially harvest red drum decreased significantly from almost $7.6 million to less than $3 million (about 62%) from 2014 to 2018. As this decline was significantly greater than the increase in red drum revenue, total commercial fishing revenue from this fleet also decreased significantly from around $7.65 million to $3.05 million (about 60%) from 2014 to 2018. As the number of vessels increased in 2017/2018, the average total commercial fishing revenue per vessel decreased even more significantly from about $142,000 to just over $32,000, or by about 77%. The decrease in revenue from other species combined with the increase in revenue from red drum also caused these vessels to be slightly more dependent on revenue from red drum, which had only represented .8% of their total commercial fishing revenue in 2014 to 5% in 2018. Based on the limited information available, it is not possible to discern why revenues from other species

[27] Includes revenue from other species caught on trips harvesting red drum as well as all other trips taken by vessels commercially harvesting red drum in that year.

decreased. However, that decrease and the increase in the price of red drum may have led to the increase in participation, landings, and revenues in the commercial sector of the red drum fishery.

Imports

Imports of seafood products compete in the domestic seafood market and have in fact dominated many segments of the seafood market. Imports aid in determining the price for domestic seafood products and tend to set the price in the market segments in which they dominate. Seafood imports have downstream effects on the local fish market. At the harvest level for reef fish and red drum, imports affect the returns to fishermen through the ex-vessel prices they receive for their landings. As substitutes to domestic production of reef fish, imports tend to cushion the adverse economic effects on consumers resulting from a reduction in domestic landings. The following describes the imports of fish products which directly compete with domestic harvest of reef fish and red drum.[28] All monetary estimates are in 2018 dollars.

Total imports of snapper increased significantly (36%) from 2014 through 2016, increasing from about 33 mp product weight (pw) to 45 mp pw during this time. However, snapper imports declined slightly thereafter to about 43 mp pw in 2018. Revenue from snapper imports followed a similar pattern, increasing from almost $103 million in 2014 to $134 million in 2016, but then falling to about $132 million in 2018. Although the average price per pound fluctuated somewhat between 2014 and 2018, moving inversely to volume, it generally vacillated around $3/lb. Imports of fresh snapper increased steadily from 23.6 mp pw in 2014 to 31.2 mp pw in 2017, before declining slightly to 31.2 mp pw in 2018. Total revenue from fresh snapper imports increased from $77 million (2018 dollars) in 2014 to an all-time high of $96.8 million in 2018. The average price decreased from $3.26/lb to $2.95/lb between 2014 and 2017 as volume increased, but rose to $3.15/lb in 2018 when volume declined. Imports of fresh snappers primarily originated in Mexico, Panama, and Nicaragua, and entered the U.S. through the port of Miami. Imports of frozen snapper were substantially less than imports of fresh snapper from 2014 through 2018. Frozen snapper imports ranged from 9.3 mp pw worth $26 million (2018 dollars) in 2014 to 14.4 mp pw worth $39.5 million in 2018. The average price fluctuated around $2.80 during this time. Imports of frozen snapper primarily originated in Brazil. The majority of frozen snapper imports entered the U.S. through the ports of Miami and New York.

Total imports of grouper increased significantly (64%) from 10.4 mp pw in 2014 to 17.1 mp pw in 2018. Total revenue from grouper imports also increased significantly (43%) from $41.6 million to $59.3 million during this time period. Revenue from grouper imports did not increase as significantly as the volume due to a 15% decrease in the average price per pound of grouper imports. Imports of frozen grouper were minimal from 2014 through 2016, decreasing from 1.75 mp pw in 2014 to only .81 mp pw in 2016. However, frozen grouper imports increased significantly in 2018, up to 4.6 mp pw. As a result, frozen grouper composed 27% of total grouper imports in 2018 compared to only 17% in 2014. Further, the average price per pound of frozen imports decreased significantly, from $2.62/lb to only $1.25/lb between 2015 and 2018.

[28] As there are no imports of red drum into the U.S., it is assumed that snapper and grouper imports are the closest import substitutes for red drum as well as snapper and grouper. Imports of other reef fish are not explicitly identified in the NMFS trade data.

Similarly, total revenue from frozen grouper decreased from $3.7 million (2018 dollars) to $1.5 million from 2014 to 2016, but then increased to $5.7 million in 2018. The decline in the average price of frozen grouper in combination with frozen product making up a higher proportion of total imports explains why revenue from grouper imports, frozen and in total, did not increase as significantly as volume did from 2014 through 2018. The volume and revenue from fresh grouper imports also increased from 2014 through 2018, increasing from 8.6 mp pw and $37.8 million in 2014 to 12.5 mp pw and $53.6 million in 2018, respectively. Average price was relatively stable at around $4.30/lb. Thus, the price premium attached to fresh grouper relative to frozen grouper is much greater than the premium attached to fresh snapper compared to frozen snapper. The bulk of fresh and frozen grouper imports originated in Mexico and entered the U.S. through Miami and Tampa.

Economic Impacts

The commercial harvest and subsequent sales and consumption of fish generates business activity as fishermen expend funds to harvest the fish and consumers spend money on goods and services, such as red drum purchased at a local fish market and served during restaurant visits. These expenditures spur additional business activity in the region(s) where the harvest and purchases are made, such as jobs in local fish markets, grocers, restaurants, and fishing supply establishments. In the absence of the availability of a given species for purchase, consumers would spend their money on substitute goods and services. As a result, the analysis presented below represents a distributional analysis only; that is, it only shows how economic impacts may be distributed through regional markets and should not be interpreted to represent the impacts if these species are not available for harvest or purchase.

In addition to these types of impacts, economic impact models can be used to determine the sources of the impacts. Each impact can be broken down into direct, indirect, and induced economic impacts. "Direct" economic impacts are the results of the money initially spent in the study area (e.g., country, region, state, or community) by the fishery or industry being studied. This includes money spent to pay for labor, supplies, raw materials, and operating expenses. The direct economic impacts from the initial spending create additional activity in the local economy, i.e., "indirect" economic impacts. Indirect economic impacts are the results of business-to-business transactions indirectly caused by the direct impacts. For example, businesses initially benefiting from the direct impacts will subsequently increase spending at other local businesses. The indirect economic impact is a measure of this increase in business-to-business activity, excluding the initial round of spending which is included in the estimate of direct impacts. "Induced" economic impacts are the results of increased personal income caused by the direct and indirect economic impacts. For example, businesses experiencing increased revenue from the direct and indirect impacts will subsequently increase spending on labor by hiring more employees, increasing work hours, raising salaries/wage rates, etc. In turn, households will increase spending at local businesses. The induced impact is a measure of this increase in household-to-business activity.

Estimates of the U.S. average annual business activity associated with the commercial harvest of reef fish species without SDCs in the Gulf were derived using the model developed for and applied in NMFS (2018) and are provided in Table 3.4.1.13. Specifically, these impact estimates reflect the expected impacts from average annual gross revenues generated by landings of Gulf reef fish from 2014 through 2018. Similar information is presented for the commercial harvest of red drum in the Gulf (Mississippi only) in Table 3.4.1.14. This business activity is characterized as jobs (full- and part-time), income impacts (wages, salaries, and self-employed income), value-added impacts (the difference between the value of goods and the cost of materials or supplies), and output impacts (gross business sales). Income impacts should not be added to output (sales) impacts because this would result in double counting.

Table 3.4.1.13. Average annual economic impacts of species with no SDCs in the commercial sector of the Gulf reef fish fishery. All monetary estimates are in thousands of 2018 dollars and employment is measured in full-time equivalent jobs.

Industry sector	Direct	Indirect	Induced	Total
Harvesters				
Employment impacts	48	7	10	65
Income impacts	$1,154	$214	$518	$1,887
Total value-added impacts	$1,230	$771	$887	$2,888
Output Impacts	$2,138	$1,739	$1,721	$5,598
Primary dealers/processors				
Employment impacts	10	4	7	21
Income impacts	$377	$347	$328	$1,052
Total value-added impacts	$401	$443	$618	$1,462
Output impacts	$1,212	$913	$1,208	$3,333
Secondary wholesalers/distributors				
Employment impacts	5	1	4	10
Income impacts	$224	$67	$236	$527
Total value-added impacts	$239	$112	$403	$754
Output impacts	$601	$219	$784	$1,604
Grocers				
Employment impacts	20	2	4	26
Income impacts	$461	$153	$232	$846
Total value-added impacts	$492	$247	$392	$1,131
Output impacts	$789	$401	$770	$1,960
Restaurants				
Employment impacts	123	8	20	151
Income impacts	$1,851	$561	$1,060	$3,473
Total value-added impacts	$1,973	$1,004	$1,787	$4,763
Output impacts	$3,608	$1,570	$3,525	$8,704
Harvesters and seafood industry				
Employment impacts	205	23	46	274
Income impacts	$4,068	$1,343	$2,374	$7,785
Total value-added impacts	$4,336	$2,577	$4,086	$10,999
Output impacts	$8,347	$4,843	$8,008	$21,199

Table 3.4.1.14. Average annual economic impacts of the commercial sector in the Gulf red drum fishery (Mississippi only). All monetary estimates are in thousands of 2018 dollars and employment is measured in full-time equivalent jobs.

Industry sector	Direct	Indirect	Induced	Total
Harvesters				
Employment impacts	4	1	1	5
Income impacts	$86	$16	$39	$141
Total value-added impacts	$92	$58	$66	$216
Output Impacts	$160	$130	$129	$419
Primary dealers/processors				
Employment impacts	1	0	1	2
Income impacts	$28	$26	$25	$79
Total value-added impacts	$30	$33	$46	$110
Output impacts	$91	$68	$90	$250
Secondary wholesalers/distributors				
Employment impacts	0	0	0	1
Income impacts	$17	$5	$18	$39
Total value-added impacts	$18	$8	$30	$56
Output impacts	$45	$16	$59	$120
Grocers				
Employment impacts	1	0	0	2
Income impacts	$35	$11	$17	$63
Total value-added impacts	$37	$19	$29	$85
Output impacts	$59	$30	$58	$147
Restaurants				
Employment impacts	9	1	2	11
Income impacts	$139	$42	$79	$260
Total value-added impacts	$148	$75	$134	$357
Output impacts	$270	$118	$264	$652
Harvesters and seafood industry				
Employment impacts	15	2	3	21
Income impacts	$305	$101	$178	$583
Total value-added impacts	$325	$193	$306	$824
Output impacts	$625	$363	$600	$1,588

The results provided should be interpreted with caution and demonstrate the limitations of these types of assessments. These results are based on average relationships developed through the analysis of many fishing operations that harvest many different species. Separate models for individual species are not available.

Between 2014 and 2018, landings of Gulf reef fish species without SDCs resulted in approximately $2.14 million (2018$) in gross revenue on average. In turn, this revenue generated employment, income, value-added, and output impacts of 274 jobs, $7.8 million, $11 million, and $21.2 million per year, respectively, on average. For red drum, average annual gross revenue during these years was about $106,000. In turn, this revenue generated employment, income, value-added, and output impacts of 21 jobs, $.58 million, $.82 million, and $1.59 million per year, respectively, on average.[29]

3.4.2 Recreational Sector

The proposed actions in this amendment apply to for-hire vessels (i.e., charter vessels and headboats) and the private recreational components of the recreational sector for reef fish and red drum. Therefore, descriptions of the economic environment for the for-hire and private angler components of the recreational sector are provided.

Angler Effort

Recreational effort derived from the MRIP database can be characterized in terms of the number of trips as follows:

- Target trips - The number of individual angler trips, regardless of duration, where the intercepted angler indicated that the species, or a species in the species group, was targeted as either the first or the second primary target for the trip. The species did not have to be caught.
- Catch trips - The number of individual angler trips, regardless of duration and target intent, where the individual species or a species in the species group was caught. The fish did not have to be kept.
- Total recreational trips - The total estimated number of recreational trips in the Gulf, regardless of target intent or catch success.

Other measures of effort are available as well, such as directed trips (the number of individual angler trips that either targeted or caught a particular species). Estimates of average annual recreational effort, 2016-2018,[30] for reef fish species, particularly those without SDCs, and red drum are provided in Tables 3.4.2.1-3.4.2.4. Tables 3.4.2.1 and Table 3.4.2.2 present estimates of target trips and catch trips across all modes by state. Tables 3.4.2.3 and 3.4.2.4 present estimates of target trips and catch trips across all states by mode. As might be expected, Florida dominates the other Gulf states in terms of the average annual number of target or catch trips for all of the individual or groups of reef fish species, while Florida as well as Louisiana are dominant with respect to target and catch trips for red drum. The private angling mode is the dominant mode across all species and groups of species as well as across all states. Estimates for additional years, and other measures of directed effort, are available at https://www.st.nmfs.noaa.gov/recreational-fisheries/data-and-documentation/queries/index

[29] The economic impact model does not contain multipliers specific to the commercial sector of the red drum fishery. Therefore, as with how imports were handled, it was assumed the multipliers for red drum are similar to the multipliers for reef fish and thus the latter multipliers were used to generate the red drum impact estimates.
[30] Comparable catch effort estimates in 2014 are not available for LA and LA did not collect target species data until 2016. Thus, average effort in the Gulf was estimated for 2016-2018 rather than 2014-2018.

Table 3.4.2.1. Average annual recreational target effort in the Gulf by state across all modes, 2016-2018.

	State					
Species	**Alabama**	**Florida**	**Louisiana**	**Mississippi**	**Texas**	**Total**
All Reef Fish	247,962	1,707,265	229,046	33,975	N/A	2,591,680
Goliath Grouper	0	3,889	0	0	N/A	4,046
Hogfish	0	58,507	0	0	N/A	57,455
Goliath Grouper, Black Grouper, Mutton Snapper, and Yellowtail Snapper	0	94,141	0	16	N/A	78,794
All Other Reef Fish without SDCs[31]	10,398	41,535	17,379	179	N/A	84,068
Red Drum	408,426	2,755,352	2,561,804	371,356	196,089	6,781,523

Sources: MRIP Survey Data available at https://www.fisheries.noaa.gov/recreational-fishing-data/recreational-fishing-data-downloads. Effort estimates for Texas are from the Texas Parks and Wildlife Department's Marine Sport-Harvest Monitoring Program and assumed equivalent to MRIP-FES estimates. Target effort estimates for most reef fish species in Texas are unavailable. Louisiana recreational effort estimates came from the Louisiana Department of Wildlife and Fisheries Recreational Creel Survey and were adjusted to MRIP-FES equivalents using the ratios in NMFS (2020). Headboat target effort is unavailable.

Table 3.4.2.2. Average annual recreational catch effort in the Gulf by state across all modes, 2016-2018.

	State					
Species	**Alabama**	**Florida**	**Louisiana**	**Mississippi**	**Texas**	**Total**
All Reef Fish	247,962	1,707,265	303,735	33,975	32,747	5,343,065
Goliath Grouper	0	3,889	0	0	0	17,059
Hogfish	0	58,507	0	0	0	94,444
Goliath Grouper, Black Grouper, Mutton Snapper, and Yellowtail Snapper	0	94,141	496	16	17	460,876
All Other Reef Fish without SDCs	10,398	41,535	56,287	179	1,613	497,651
Red Drum	408,426	2,755,352	2,909,725	371,356	314,107	5,184,508

Sources: MRIP Survey Data available at https://www.fisheries.noaa.gov/recreational-fishing-data/recreational-fishing-data-downloads. Effort estimates for Texas are from the Texas Parks and Wildlife Department's Marine Sport-Harvest Monitoring Program and assumed equivalent to MRIP-FES estimates. Louisiana recreational effort estimates came from the Louisiana Department of Wildlife and Fisheries Recreational Creel Survey and were adjusted to MRIP-FES equivalents using the ratios in NMFS (2020). Headboat estimates are unavailable.

[31] Other reef fish without SDCs include yellowmouth grouper, yellowfin grouper, yellowedge grouper, warsaw grouper, snowy grouper, speckled hind, golden tilefish, goldface tilefish, blueline tilefish, almaco jack, lesser amberjack, banded rudderfish, silk snapper, wenchman, blackfin snapper, queen snapper, cubera snapper, and lane snapper.

Table 3.4.2.3. Average annual recreational target effort in the Gulf by mode across all states, 2016-2018.

	Mode			
Species*	**Shore**	**Charter**	**Private**	**Total**
All Reef Fish	468,336	210,543	1,912,791	2,591,670
Goliath Grouper	585	475	2,986	4,046
Hogfish	0	11,124	46,332	57,455
Goliath Grouper, Black Grouper, Mutton Snapper, and Yellowtail Snapper	7,913	9,732	61,149	78,794
All Other Reef Fish without SDCs	0	16,882	67,185	84,067
Red Drum	1,001,484	177,289	5,602,750	6,781,523

Sources: MRIP Survey Data available at https://www.fisheries.noaa.gov/recreational-fishing-data/recreational-fishing-data-downloads. Effort estimates for Texas are from the Texas Parks and Wildlife Department's Marine Sport-Harvest Monitoring Program and assumed equivalent to MRIP-FES estimates. Target effort estimates for most reef fish species in Texas are unavailable. Louisiana recreational effort estimates came from the Louisiana Department of Wildlife and Fisheries Recreational Creel Survey and were adjusted to MRIP-FES equivalents using the ratios in NMFS (2020). Headboat target effort estimates are unavailable.

Table 3.4.2.4. Average annual recreational catch effort in the Gulf by mode across all states, 2016-2018.

	Mode			
Species*	**Shore**	**Charter**	**Private**	**Total**
All Reef Fish	1,392,660	568,099	3,382,307	5,343,066
Goliath Grouper	7,290	2,218	7,551	17,059
Hogfish	10,682	21,692	62,070	94,444
Goliath Grouper, Black Grouper, Mutton Snapper, and Yellowtail Snapper	153,981	93,649	213,245	460,875
All Other Reef Fish without SDCs	117	177,944	319,589	497,650
Red Drum	332,452	312,249	4,539,807	5,184,508

Sources: MRIP Survey Data available at https://www.fisheries.noaa.gov/recreational-fishing-data/recreational-fishing-data-downloads. Effort estimates for Texas are from the Texas Parks and Wildlife Department's Marine Sport-Harvest Monitoring Program and assumed equivalent to MRIP-FES estimates. Louisiana recreational effort estimates came from the Louisiana Department of Wildlife and Fisheries Recreational Creel Survey and were adjusted to MRIP-FES equivalents using the ratios in NMFS (2020). Headboat estimates are unavailable.

Similar analysis of recreational effort is not possible for the headboat mode because headboat data are not collected at the angler level. Estimates of effort by the headboat mode are provided in terms of angler days, or the number of standardized 12-hour fishing days that account for the different half-, three-quarter-, and full-day fishing trips by headboats. The stationary "fishing for demersal (bottom-dwelling) species" nature of headboat fishing, as opposed to trolling, suggests that most, if not all, headboat trips and, hence, angler days, are demersal or reef fish trips by intent.

Headboat angler days were fairly stable across the Gulf states from 2014 through 2018 (Table 3.4.2.5). There was, however, a noticeable peak in reported angler days in Florida in 2016 and modest fluctuations elsewhere. On average (2014 through 2018), Florida accounted for the majority of headboat angler days reported, followed by Texas and Alabama; whereas, Mississippi and Louisiana combined accounted for only a small percentage.

Table 3.4.2.5. Gulf headboat angler days and percent distribution by state (2014-2018).

	Angler Days				Percent Distribution			
	FL	**AL**	**MS-LA****	**TX**	**FL**	**AL**	**MS-LA**	**TX**
2014	174,599	16,766	3,257	51,231	71.0%	6.8%	1.3%	20.8%
2015	176,375	18,008	3,587	55,135	69.7%	7.1%	1.4%	21.8%
2016	183,147	16,831	2,955	54,083	71.3%	6.5%	1.1%	21.0%
2017	178,816	17,841	3,189	51,575	71.1%	7.1%	1.3%	20.5%
2018	171,996	19,851	3,235	52,160	69.6%	8.0%	1.3%	21.1%
Average	176,987	17,859	3,245	52,837	70.5%	7.1%	1.3%	21.1%

Source: NMFS SRHS.
**Headboat data from Mississippi and Louisiana are combined for confidentiality purposes.

Permits

There are no specific federal permitting requirements for recreational anglers to fish for or harvest reef fish. Instead, private anglers are required to possess either a state recreational fishing permit that authorizes saltwater fishing in general, or be registered in the federal National Saltwater Angler Registry system, subject to appropriate exemptions. As a result, it is not possible to identify with available data how many individual anglers would be expected to be affected by the actions in this amendment.

The for-hire component of the recreational sector is comprised of charter vessels and headboats (party boats). Although charter vessels tend to be smaller, on average, than headboats, the key distinction between the two types of operations is how the fee is determined. On a charter boat trip, the fee charged is for the entire vessel, regardless of how many passengers are carried, whereas the fee charged for a headboat trip is paid per individual angler.

A federal charter/headboat (for-hire) vessel permit is required for fishing in federal waters for Gulf reef fish. Gulf reef fish for-hire permits are limited access permits. From a historical perspective, the number of permits that were valid or renewable in a given year has continually decreased over the past several years, as illustrated in Table 3.4.2.6. However, the rate of attrition with for-hire reef fish permits has been relatively slow and far less compared to commercial reef fish permits.

Table 3.4.2.6. Number of valid or renewable for-hire reef fish permits, 2008-2018.

Year	Number of Permits
2008	1,458
2009	1,417
2010	1,385
2011	1,353
2012	1,336
2013	1,323
2014	1,310
2015	1,294
2016	1,282
2017	1,280
2018	1,279

Source: NMFS SERO SF Access Permits Database.

As of February 27, 2020, there were 1,270 valid or renewable for-hire reef fish permits, 1,179 of which were valid. A renewable permit is an expired limited access permit that cannot be actively fished, but is renewable for up to one year after expiration.

Although the for-hire permit application collects information on the primary method of operation, the permit itself does not identify the permitted vessel as either a headboat or a charter vessel and vessels may operate in both capacities. However, if a vessel meets the selection criteria used by the SRHS and is selected to report by the Science Research Director (SRD) of the SEFSC, it is determined to operate primarily as a headboat and is required to submit harvest and effort information to the SRHS.

The number of federally permitted Gulf headboats in the SRHS ranged from 68 in 2014 and 2015 to 72 in 2018 (K. Fitzpatrick, NMFS SEFSC, pers. comm.). Souza and Liese (2019) estimate that approximately 10% of all permitted Southeast (Gulf and South Atlantic) for-hire vessels determined to be headboats were not actively fishing in 2017.[32] Further, of those that were active, 14% were not active in offshore waters. Thus, approximately 23% of the permitted Southeast headboats were likely not active in the EEZ. With respect to permitted Gulf charter vessels, they estimate that 24% were not active in 2017, while 13% of those that were active were not active in offshore waters. Thus, approximately 34% of the permitted Gulf charter vessels were likely not active in the EEZ in 2017.

Information on Gulf charter vessel and headboat operating characteristics is included in Savolainen et al. (2012) and is incorporated herein by reference. The average charter vessel operation took 46 full-day (9 hours) and 55 half-day (5 hours) trips per year, carried 4.8 and 4.6 passengers per trip type, respectively, targeted reef fish species on 64% of all trips, respectively,

[32] Sample sizes were too small to generate reliable estimates for Gulf and South Atlantic headboats separately.

and took 68% of all trips in the EEZ. The average headboat operation took 83 full-day (10 hours) and 37 half-day (6 hours) trips per year, carried 13.1 and 14.6 passengers per trip type, respectively, targeted reef fish species on 84% of all trips, respectively, and took 81% of all trips in the EEZ.

Economic Value

Participation, effort, and harvest are indicators of the value of saltwater recreational fishing. However, a more specific indicator of value is the satisfaction that anglers experience over and above their costs of fishing. The economic value of this satisfaction is referred to as consumer surplus (CS). The value or benefit derived from the recreational experience is dependent on several quality determinants, which include fish size, catch success rate, and the number of fish kept. These variables help determine the value of a fishing trip and influence total demand for recreational fishing trips. For example, the estimated value of the CS for catching and keeping a second red snapper[33] on an angler trip is approximately $84 (2018 dollars), and decreases thereafter (approximately $56 for a third red snapper, $41 for a fourth red snapper, and $33 for a fifth red snapper) (Carter and Liese 2012). In comparison, the estimated value of the CS for catching and keeping a grouper is approximately $108 for the second fish, $72 for the third fish, $53 for the fourth fish, and $42 for the fifth fish (Carter and Liese 2012).

Estimates of average annual gross revenue for charter vessels in 2009 are provided in Savolainen, et al. (2012). In 2018 dollars, the average annual gross revenue for a Gulf headboat is $267,067 while the average annual gross revenue for a Gulf charter vessel is $88,111. More recent estimates of average annual gross revenue for Gulf headboats are provided in Willard and Abbott (2017) and D. Carter (pers. comm., March 15, 2018). Abbott and Willard (2017) suggest that Savolainen, et al.'s estimate of average annual gross revenue for headboats may be an underestimate as data in the former suggest that average gross revenue in 2009 for the vessels in their sample was about $472,000 (2018$). Further, their data suggests average annual gross revenue per vessel had increased to about $570,000 (2018$) by 2014. However, Abbott and Willard's estimates are based on a sample of 17 headboats that chose to participate in the Headboat Collaborative Program in 2014 while Savolainen, et al.'s are based on a random sample of 20 headboats. The headboats that participated in the Collaborative may be economic highliners, in which case Abbott and Willard's estimates would overestimate average annual gross revenue for Gulf headboats. Carter (2018) recently estimated that average annual gross revenue for Gulf headboats were approximately $420,190 (2018$) in 2017. This estimate is likely the best current estimate of annual gross revenue for Gulf headboats as it is based on a relatively large sample of 63 boats, or more than 90% of the active fleet, and is more recent.

However, gross revenues overstate the annual economic value and profits generated by for-hire vessels. Economic value for for-hire vessels can be measured by annual PS. In general, PS is the amount of money a vessel owner earns in excess of variable (trip) costs. Economic profit is the amount of money a vessel owner earns in excess of variable and fixed costs, inclusive of all implicit costs, such as the value of a vessel owner's time as captain and as entrepreneur, and the cost of using physical capital (i.e., depreciation of the vessel and gear). In 2018 dollars, Savolainen, et al. (2012) estimated the annual producer surplus for Gulf headboats and charter

[33] The study only considered trips with at least one fish caught and kept in its experimental design; thus, an estimate for the first caught and kept fish is not available.

vessels was approximately $186,860 and $57,964 respectively. Their best estimates of economic profit were $77,960 and $26,053 (2018 dollars), respectively.[34] Estimates of producer surplus and economic profit for headboats is not available from Willard and Abbott (2017) or D. Carter (2018) as they did not collect comprehensive cost data at the vessel level.[35]

With regard to for-hire trips, economic value can be measured by producer surplus (PS) per angler trip, which represents the amount of money that a vessel owner earns in excess of the cost of providing the trip. Estimates of revenue, costs, and trip net revenue trips taken by headboats and charter vessels in 2017 are available from Souza and Liese (2019). They also provide estimates of trip net cash flow per angler trip, which are an approximation of PS per angler trip. According to Table 3.4.2.7, after accounting for transactions fees, supply costs, and labor costs, net revenue per trip was 42% of revenue for Gulf charter vessels and 54% of revenue for Southeast headboats, or $766 and $1,780 (2018 dollars), respectively. Given the respective average number of anglers per trip for each fleet, PS per trip is estimated to be $139 for charter vessels and $63 for headboats.

Table 3.4.2.7. Trip economics in percent of revenue terms for offshore trips by Gulf charter vessels and southeast headboats in 2017.

	Gulf Charter Vessels	Southeast Headboats
Revenue	100%	100%
Transaction Fees (% of revenue)	3%	3%
Supply Costs (% of revenue)	27%	29%
Labor Costs (% of revenue)	27%	28%
Net Revenue per trip including Labor costs (% of revenue)	42%	54%
Net Revenue per Trip	$766	$1,780
Average # of Anglers per Trip	5.5	28.2
Trip Net Cash Flow per Angler Trip	$139	$63

Economic Impacts

The desire for recreational fishing generates economic activity as consumers spend their income on various goods and services needed for recreational fishing. This spurs economic activity in the region where recreational fishing occurs. In the absence of the opportunity to fish, the income would likely be spent on other goods and services and these expenditures would similarly generate economic activity in the region where the expenditure occurs. As such, the analysis below represents a distributional analysis only.

Estimates of the economic impacts (business activity) associated with recreational angling for Gulf reef fish on charter vessels were calculated using average trip-level impact coefficients derived from the 2016 Fisheries Economics of the U.S. report (NMFS 2018) and underlying data

[34] Although Savolainen, et al. (2012) account for all explicit variable and fixed costs, they do not account for implicit costs, and thus they over-estimate actual economic profits for these vessels.
[35] Abbott and Willard (2017) do report revenue net of fuel costs, but this ignores important costs such as processing fees, commissions, ice, bait, tackle, and labor.

provided by the NOAA Office of Science and Technology. Economic impact estimates were adjusted to 2018 dollars using the annual, not seasonally adjusted GDP implicit price deflator provided by the U.S. Bureau of Economic Analysis.

Recreational fishing generates economic impacts (business activity). Business activity for the recreational sector is characterized in the form of jobs (full- and part-time), income impacts (wages, salaries, and self-employed income), value-added impacts (the difference between the value of goods and the cost of materials or supplies), and output impacts (gross business sales). Estimates of the average target effort for reef fish with no SDCs by state and mode (2016-2018) and associated business activity are provided in Table 3.4.2.8, while the economic impacts for red drum by state and mode are presented in Table 3.4.2.9. With the exception of red drum, economic impacts for Texas cannot be provided due to the lack of target effort data for most reef fish species.

The estimates provided in Table 3.4.2.8 and Table 3.4.2.9 use state level multipliers and thus only apply at the state-level. For example, estimates of business activity in Florida represent business activity in Florida only and not to other states (for e.g., a good purchased in Florida may have been manufactured in a neighboring state) or the nation as a whole. The same holds true for each of the other states.

Table 3.4.2.8. Average annual economic impacts from Gulf reef fish with no SDCs recreational target trips to U.S., using state multipliers.

	FL	AL	MS	LA	TX
	Charter Mode				
Target Trips	10,381	4,543	0	1,958	N/A
Value Added Impacts	$3,521	$1,835	$0	$900	N/A
Sales Impacts	$5,913	$3,336	$0	$1,691	N/A
Income Impacts	$2,058	$1,046	$0	$531	N/A
Employment	56	37	0	20	N/A
	Private/Rental Mode				
Target Trips	42,755	8,711	298	15,421	N/A
Value Added Impacts	$1,494	$382	$6	$2,231	N/A
Sales Impacts	$2,316	$591	$10	$3,819	N/A
Income Impacts	$784	$149	$3	$1,205	N/A
Employment	22	6	0	31	N/A
	Shore				
Target Trips	0	0	0	0	N/A
Value Added Impacts	$0	$0	$0	$0	N/A
Sales Impacts	$0	$0	$0	$0	N/A
Income Impacts	$0	$0	$0	$0	N/A
Employment	0	0	0	0	N/A
	All Modes				
Target Trips	53,137	13,254	298	17,379	N/A
Value Added Impacts	$5,016	$2,216	$6	$3,131	N/A
Sales Impacts	$8,230	$3,927	$10	$5,510	N/A
Income Impacts	$2,842	$1,195	$3	$1,736	N/A
Employment	78	43	0	51	N/A

Sources: MRIP Survey Data available at https://www.fisheries.noaa.gov/recreational-fishing-data/recreational-fishing-data-downloads. Effort estimates for Texas are from the Texas Parks and Wildlife Department's Marine Sport-Harvest Monitoring Program and assumed equivalent to MRIP-FES estimates. Target effort estimates for most reef fish species in Texas are unavailable. Louisiana recreational effort estimates came from the Louisiana Department of Wildlife and Fisheries Recreational Creel Survey and were adjusted to MRIP-FES equivalents using the ratios in NMFS (2020). All monetary estimates are in thousands of 2018 dollars and jobs are full-time equivalents.

Table 3.4.2.9. Average annual economic impacts from Gulf red drum recreational target trips to U.S., using state multipliers. All monetary estimates are in thousands of 2018 dollars and jobs are full-time equivalents.

	FL	AL	MS	LA	TX
	Charter Mode				
Target Trips	56,709	10,095	6,942	103,543	45,263
Value Added Impacts	$19,236	$4,077	$3,016	$47,617	$17,762
Sales Impacts	$32,302	$7,414	$5,695	$89,445	$29,495
Income Impacts	$11,241	$2,325	$1,735	$28,068	$9,953
Employment	307	83	69	1,072	259
	Private/Rental Mode				
Target Trips	2,468,059	265,185	210,295	2,458,261	155,688
Value Added Impacts	$86,263	$11,623	$4,451	$355,594	$25,837
Sales Impacts	$133,702	$17,984	$7,388	$608,744	$42,577
Income Impacts	$45,266	$4,524	$2,341	$192,121	$13,213
Employment	1,261	171	77	4,919	307
	Shore				
Target Trips	580,393	197,976	223,115	0	0
Value Added Impacts	$20,613	$13,547	$2,773	$0	0
Sales Impacts	$32,214	$23,331	$4,284	$0	0
Income Impacts	$10,858	$6,971	$1,508	$0	0
Employment	305	245	55	0	0
	All Modes				
Target Trips	3,105,161	473,256	440,352	2,561,804	200,951
Value Added Impacts	$126,112	$29,246	$10,239	$403,211	$43,599
Sales Impacts	$198,218	$48,729	$17,367	$698,188	$72,071
Income Impacts	$67,365	$13,820	$5,584	$220,189	$23,166
Employment	1,872	500	200	5,991	566

Sources: MRIP Survey Data available at https://www.fisheries.noaa.gov/recreational-fishing-data/recreational-fishing-data-downloads. Effort estimates for Texas are from the Texas Parks and Wildlife Department's Marine Sport-Harvest Monitoring Program and assumed equivalent to MRIP-FES estimates. Target effort estimates for most reef fish species in Texas are unavailable. Louisiana recreational effort estimates came from the Louisiana Department of Wildlife and Fisheries Recreational Creel Survey and were adjusted to MRIP-FES equivalents using the ratios in NMFS (2020).

Addition of the state-level estimates to produce a regional (or national) total may underestimate the actual amount of total business activity because state-level impact multipliers do not account for interstate and interregional trading. National-level multipliers must be used to account for interstate and interregional trading. Estimates of the average target effort for reef fish with no

SDCs across all modes and the associated economic impacts are presented in Table 3.4.2.10, while the while the economic impacts for red drum across modes are presented in Table 3.4.2.11.

Table 3.4.2.10. Average annual economic impacts from Gulf reef fish with no SDCs recreational target trips to U.S., using national multipliers. All monetary estimates are in thousands of 2018 dollars and jobs are full-time equivalents.

Mode	Total # of Target Trips	Value Added Impacts	Sales Impacts	Income Impacts	Employment Impacts
Charter	16,882	$8,898	$15,624	$5,204	126
Private/Rental	67,185	$7,220	$12,718	$3,991	76
Shore	0	$0	$0	$0	0

Sources: MRIP Survey Data available at https://www.fisheries.noaa.gov/recreational-fishing-data/recreational-fishing-data-downloads. Effort estimates for Texas are from the Texas Parks and Wildlife Department's Marine Sport-Harvest Monitoring Program and assumed equivalent to MRIP-FES estimates. Target effort estimates for most reef fish species in Texas are unavailable. Louisiana recreational effort estimates came from the Louisiana Department of Wildlife and Fisheries Recreational Creel Survey and were adjusted to MRIP-FES equivalents using the ratios in NMFS (2020).

Table 3.4.2.11. Average annual economic impacts from Gulf red drum recreational target trips to U.S., using national multipliers. All monetary estimates are in thousands of 2018 dollars and jobs are full-time equivalents.

Mode	Total # of Target Trips	Value Added Impacts	Sales Impacts	Income Impacts	Employment Impacts
Charter	222,552	$135,132	$237,283	$79,035	1,906
Private/Rental	5,557,487	$824,447	$1,452,336	$455,696	8,741
Shore	1,001,484	$60,111	$103,536	$34,375	715

Sources: MRIP Survey Data available at https://www.fisheries.noaa.gov/recreational-fishing-data/recreational-fishing-data-downloads. Effort estimates for Texas are from the Texas Parks and Wildlife Department's Marine Sport-Harvest Monitoring Program and assumed equivalent to MRIP-FES estimates. Target effort estimates for most reef fish species in Texas are unavailable. Louisiana recreational effort estimates came from the Louisiana Department of Wildlife and Fisheries Recreational Creel Survey and were adjusted to MRIP-FES equivalents using the ratios in NMFS (2020).

Between 2016 and 2018, and using national-level multipliers, target effort for reef fish with no SDCs generated employment, income, value-added, and output (sales) impacts of 202 jobs, $9.2 million, $16.1 million, and $28.3 million per year, respectively, on average. Between 2016 and 2018, and using national-level multipliers, target effort for red drum generated employment, income, value-added, and output (sales) impacts of 11,362 jobs, $569.1 million, $1.02 billion, and $1.79 billion per year, respectively, on average. Income impacts should not be added to output (sales) impacts because this would result in double counting. The results provided should be interpreted with caution and demonstrate the limitations of these types of assessments. These results are based on average relationships developed through the analysis of many fishing operations that harvest many different species.

Estimates of the economic impacts resulting from headboat target effort for reef fish are not available. Headboats are not covered in MRIP so, in addition to the absence of estimates of target effort, estimates of the appropriate business activity coefficients for headboat effort have not been generated.

3.5 Description of the Social Environment

This amendment affects both commercial and recreational management of reef fish and red drum in the Gulf. Harvest of red drum is not allowed in Federal waters; however, some states allow harvest and some states allow red drum to be landed although disallowing harvest in their waters.

Descriptions of the top recreational and commercial fishing communities based on engagement and reliance are included. Community level data are presented to meet the requirements of National Standard 8 of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), which requires the consideration of the importance of fishery resources to human communities when changes to fishing regulations are considered. Additional details on the social environment of the recreational and commercial sectors of the Gulf reef fish fishery, or components thereof, are provided in Reef Fish Amendment 51 (GMFMC 2019), Reef Fish Amendment 47 (GMFMC 2017a), and Reef Fish Amendment 44 (GMFMC 2017b).

3.5.2 Commercial Fishing Communities

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

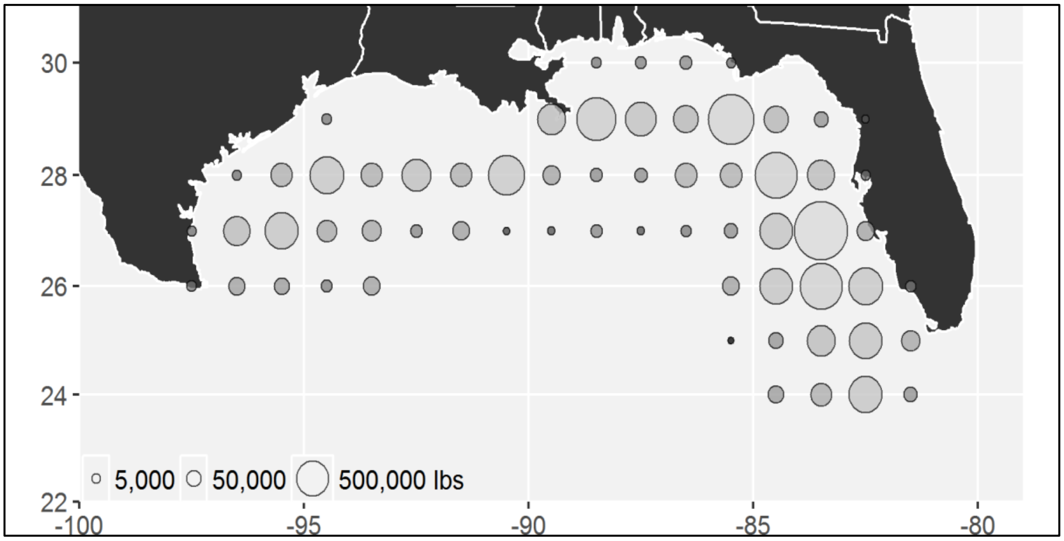


Figure 3.5.1.1. Distribution of reef fish landings by area fished for Gulf reef fish.
Source: Overstreet et al. 2017.

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. Commercial fishing engagement is represented by the number of commercial vessels designated as "commercial" by homeport and owners address plus landings and value of all commercially harvested species for a community. Another measure examines fishing reliance, which includes the same variables as fishing engagement divided by population. Communities are presented in rank order by fishing engagement and all 20 included communities demonstrate high levels of commercial engagement, although this is not specific to fishing for reef fish. Factor scores of both engagement and reliance were plotted together in Figure 3.5.1.2 to provide some indication of the importance of commercial fishing to a particular community.

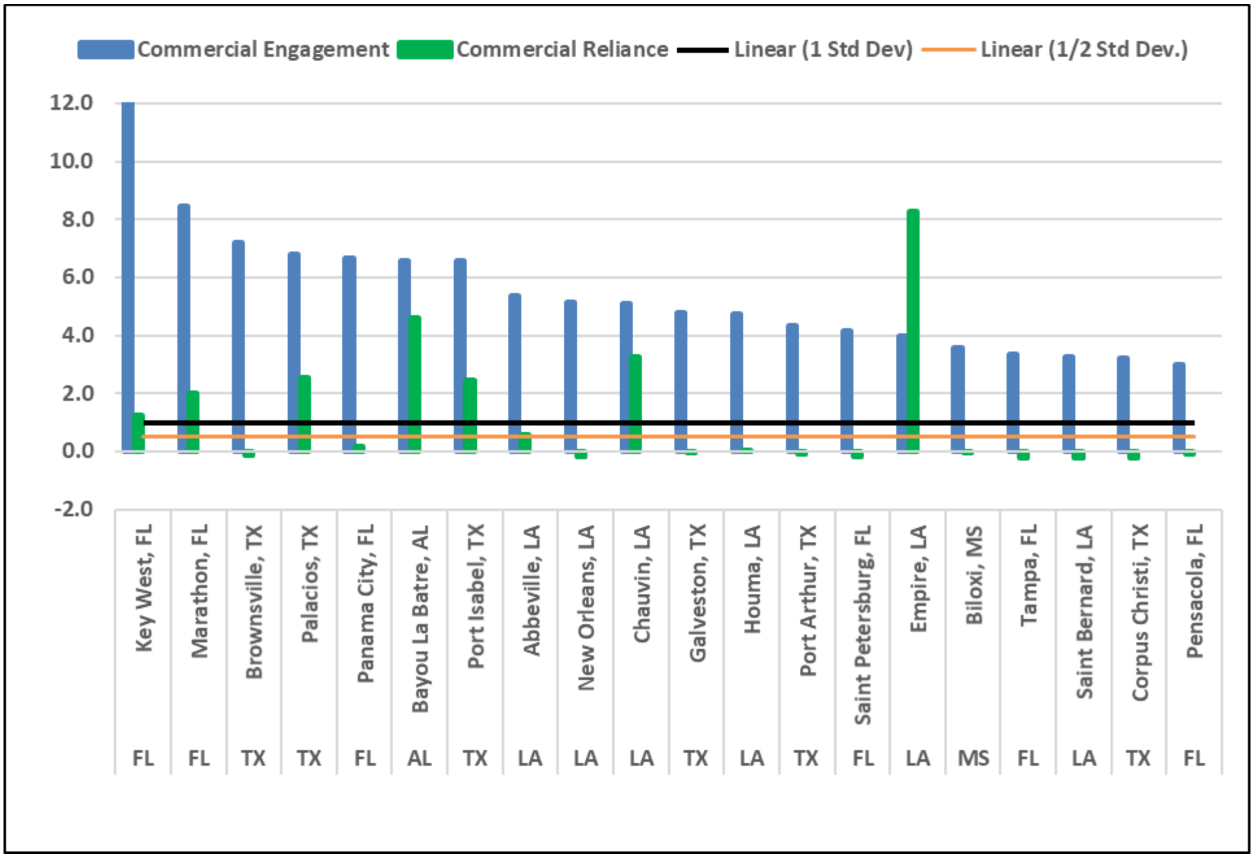


Figure 3.5.1.2. Top 20 Gulf commercial fishing communities by overall commercial fishing engagement and reliance.
Source: SERO, Community Social Vulnerability Indicators Database 2019.

Figure 3.5.1.2 identifies the top 20 Gulf communities that are engaged and reliant upon commercial fishing in general, not specific to reef fish. 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 are located in Louisiana. The ranking of many of the top 20 commercial fishing communities are likely attributable to their involvement in the shrimp fishery. However, several communities, especially those that are highly reliant on commercial fishing in general are also homeports for the larger concentrations of commercial reef fish permit holders.

The distribution of commercial reef fish permits by county is provided in Figure 3.5.1.3. The top counties are in Florida with Pinellas County having more commercial permits than any other county in the Gulf with over 170 permits. Bay and Monroe Counties have the next largest number of permits with 94 and 85 permits, respectively in 2018. Galveston County in Texas is ranked fifth with 45 commercial reef fish permits, followed by Mobile County in Alabama with 24 permits.

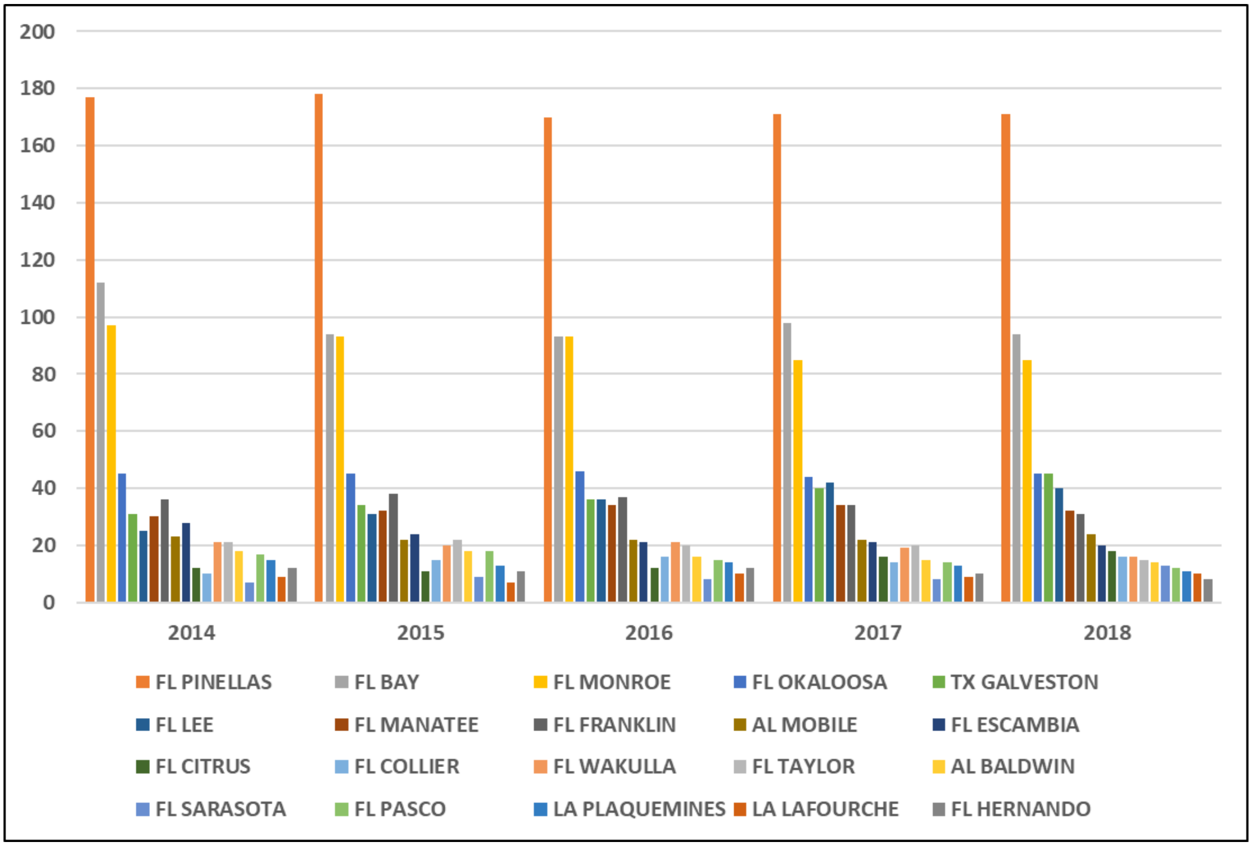


Figure 3.5.1.3. Top 20 Gulf counties with commercial reef fish permits for 2014-2018, ranked by year 2018.
Source: NMFS Southeast Regional Office permit office, SERO Access database December 27, 2019. Includes valid and renewable permits.

The distribution of commercial reef fish permits by community is provided in Figure 3.5.1.4 and are rank ordered in the legend by year 2018. The two top communities are in Florida with Panama City and Key West having far more than any other communities with each having over 70 permits. Galveston, Texas is ranked third with just over 40 commercial reef fish permits and has surpassed the Florida communities of Destin, Madeira Beach and Tarpon Springs over the past five years.

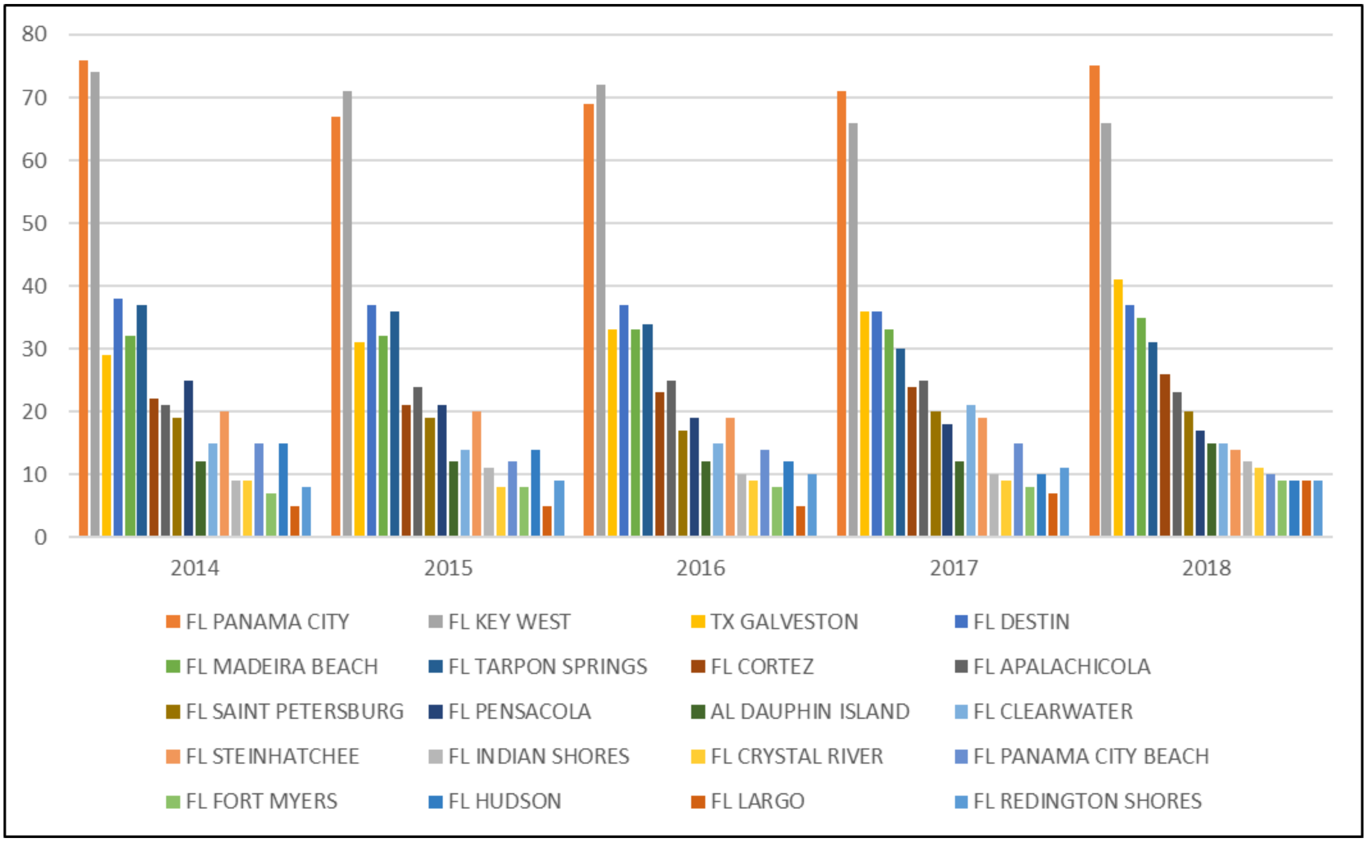


Figure 3.5.1.4. Top 20 Gulf communities with commercial reef fish permits for 2014-2018, ranked by year 2018.
Source: NMFS Southeast Regional Office permit office, SERO Access database December 27, 2019. Includes valid and renewable permits.

In terms of reef fish landings, Figure 3.5.1.5 provides a ranking of communities by their regional quotient of species included in this amendment. Regional quotient is the amount of landings in the community divided by the total landed in the region. The Florida communities of Key West, Marathon, Madeira Beach, and Panama City are currently the top communities in terms of regional quotient, although in past years Galveston, Texas was ranked third in terms of regional quotient while ranking fifth in 2017.

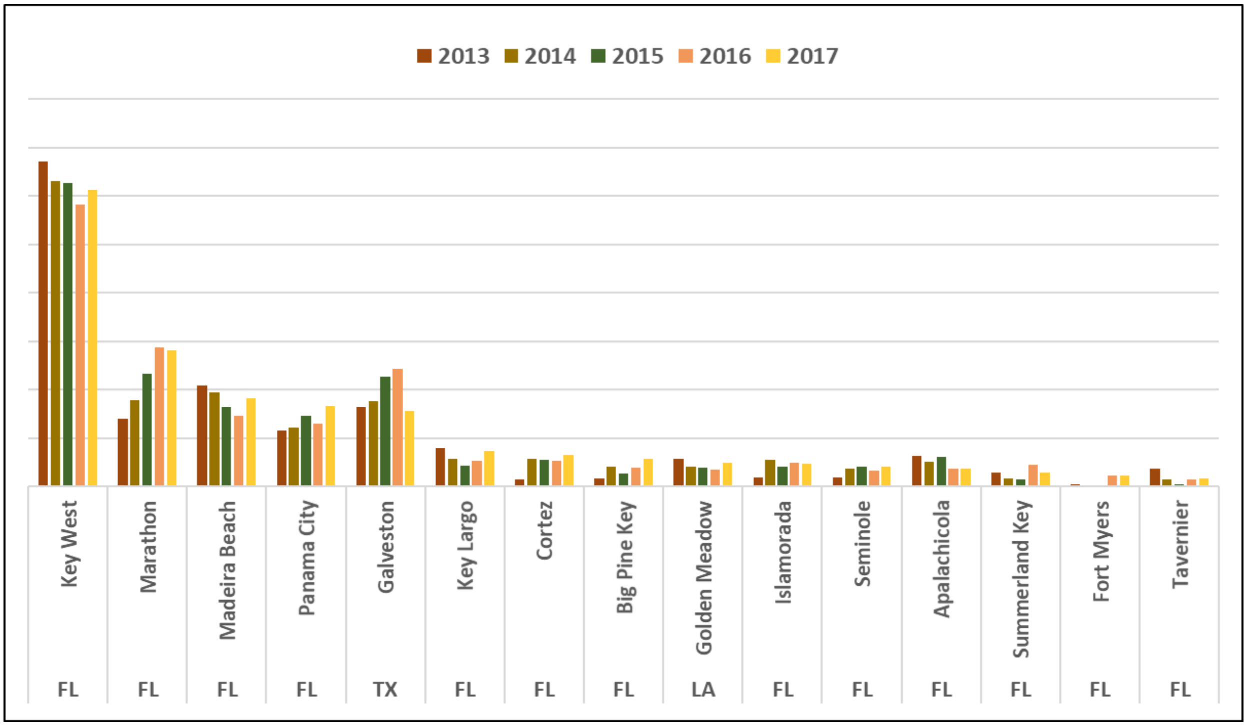


Figure 3.5.1.5. Top 15 Gulf communities ranked by regional quotient of reef fish species included in this amendment 2013-2017, ranked by year 2017.
Source: SERO, Community Accumulated Landings Database 2019

The top communities in terms of regional quotient for red drum are ranked in order by their regional quotient in 2017 in Figure 3.5.1.6. Bayou La Batre, Alabama is currently the top ranked community but the communities in Mississippi were ranked much higher in the previous years. Pascagoula, Mississippi was the top ranked community in 2013 and 2014 with a regional quotient higher than any community, but has since seen substantially lower landings. Red drum harvest is not allowed in Federal waters; however, some states do allow harvest and landings are allowed in some states where harvest is prohibited. In both Figures 3.5.1.5 and 3.5.1.6 the y axis has been removed to protect confidentiality.

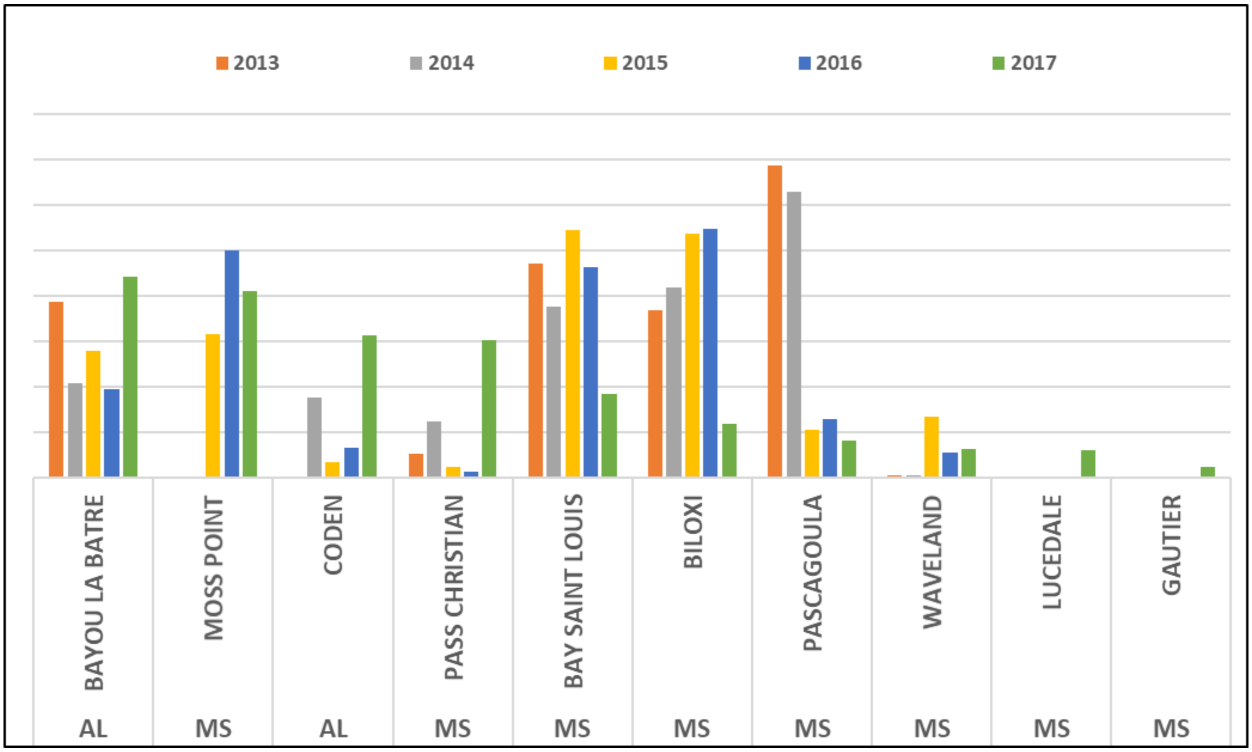


Figure 3.5.1.6. Top 10 Gulf communities ranked by regional quotient of red drum 2013-2017, ranked by year 2017.
Source: SERO, Community Accumulated Landings Database 2019

3.5.3 Recreational Fishing Communities

Reef fish landings for the recreational sector are not available at the community level, making it difficult to identify communities as dependent on recreational fishing for reef fish. Because limited data are available concerning how recreational fishing communities are engaged and reliant on specific species or species groups, indices were created using secondary data from permit and infrastructure information for the southeast recreational fishing sector at the community level (Jepson and Colburn 2013). Recreational fishing engagement is represented by the number of charter/headboat permits for reef fish and vessels designated as "charter/headboat" by homeport and owners' address. Fishing reliance includes the same variables as fishing engagement, divided by population. Factor scores of both engagement and reliance were plotted into Figure 3.5.2.1.

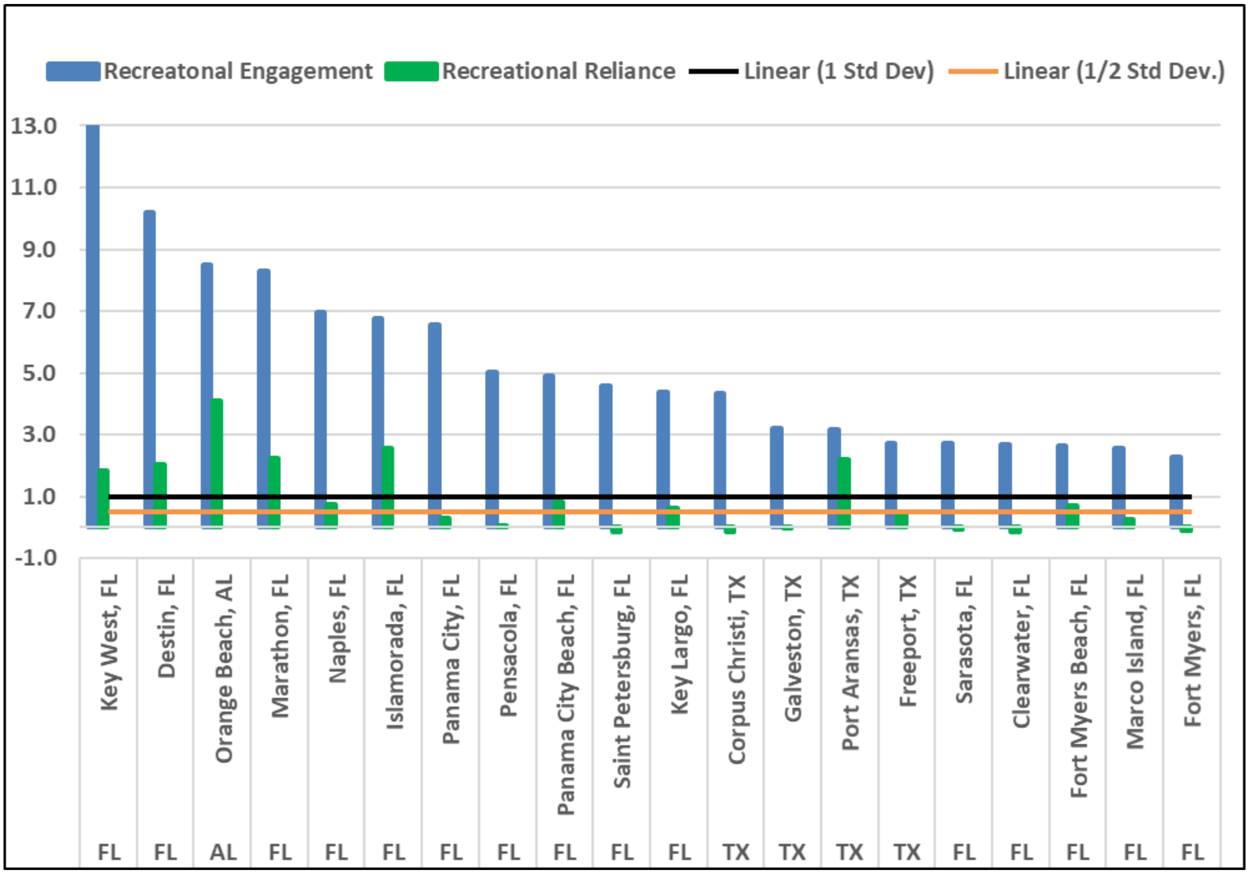


Figure 3.5.2.1. Top 20 recreational fishing communities' overall recreational fishing engagement and reliance.
Source: SERO, Community Social Vulnerability Indicators Database 2019.

The top Gulf communities that are engaged and reliant upon recreational fishing in general are identified in Figure 3.5.2.1. Two thresholds, one and one-half standard deviation above the mean were plotted to help determine a threshold for significance. Communities are presented in ranked order by fishing engagement and all 20 included communities demonstrate high levels of recreational engagement, although this is not specific to fishing for reef fish. Because the analysis used discrete geo-political boundaries, Panama City and Panama City Beach, Florida had separate values for the associated variables. Calculated independently, each still ranked high enough to appear in the top 20 list suggesting a greater importance for recreational fishing in that area. The communities of Key West, Destin, Marathon, and Islamorada in Florida, all demonstrate high reliance on recreational fishing in addition to high engagement. Outside of Florida, the communities of Orange Beach, Alabama and Port Aransas, Texas are the only communities among the top 20 that demonstrate both a high reliance and high engagement upon recreational fishing. It is important to note that Port Aransas, Texas was significantly affected by Hurricane Harvey in 2017 and has been recovering since then, yet continues to demonstrate both reliance and engagement upon recreational fishing.

Reef Fish For-hire Permits by County and Community

In order to present information about the for-hire component of the recreational sector that is engaged in the recreational reef fish fishery, federal for-hire permit for the top 20 counties with reef fish charter/headboat permits are included in Figure 3.5.2.2 rank ordered by the number of permits in 2018.

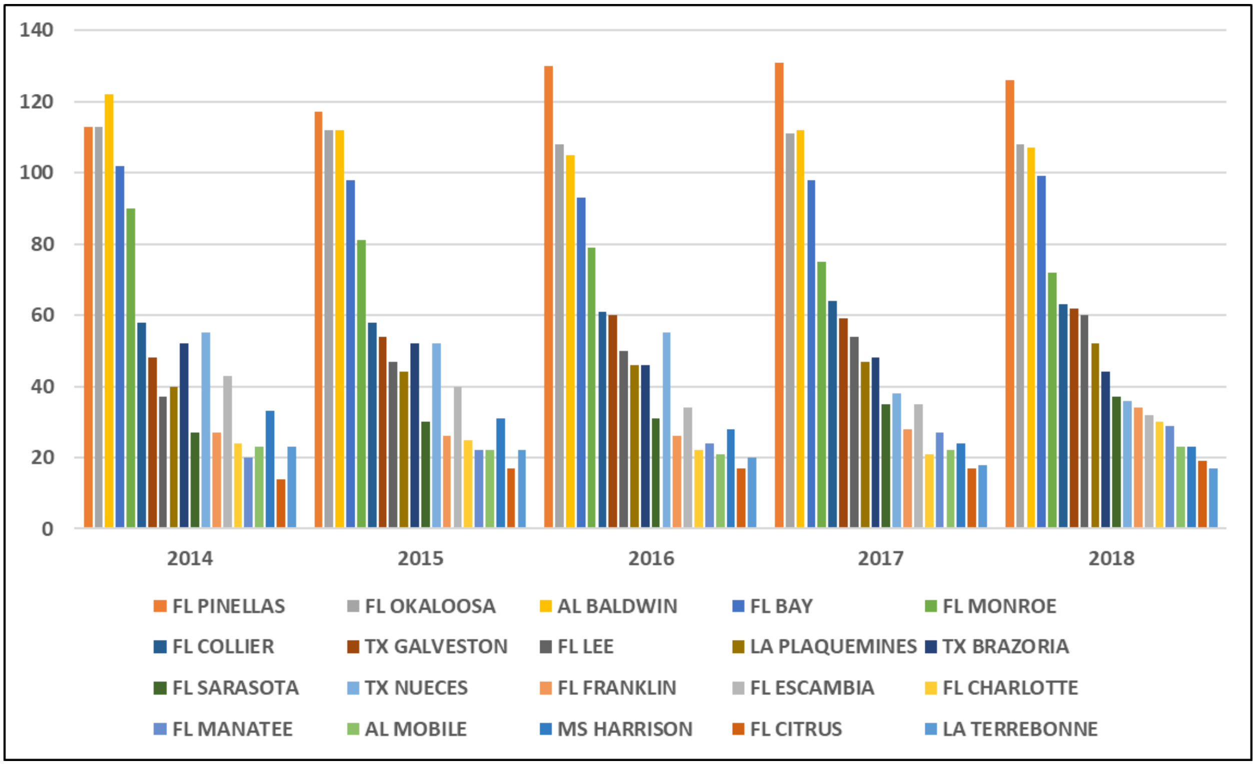


Figure 3.5.2.2. Number of federal for-hire permits for Gulf reef fish by top 20 counties 2014-2018, ranked in order by year 2018.
Source: NMFS Southeast Regional Office permit office, SERO Access database December 27, 2019. Includes valid and renewable permits.

Currently, the most federal charter/headboat permits for reef fish are held by operators in the Florida counties of Pinellas and Okaloosa, although Baldwin County, Alabama currently ranks third, but ranked first in 2014. Texas has two counties in the top ten with Galveston ranked seventh and Brazoria tenth in 2018. Louisiana has only one county (parish) in the top ten with Plaquemines ranked ninth. Data included in Table 3.5.2.2 are based on the number of permits throughout the year, rather than from a specific date, and include permits that were valid or renewable sometime during the year. However, if the permit was sold, then only the location of the most current permit holder has been counted.

The number of for-hire reef fish permits by community are provided in Figure 3.5.2.3 with the top 20 communities ranked by the number of permits in 2018. Destin, Florida and Orange Beach, Alabama far exceed other communities in terms of the number of permits in their communities. Galveston, Texas ranks third, with the next three communities (Panama City and

Key West in Florida, and Venice, Louisiana) being close in the number of permits. The number of permits within each community have remained fairly stable over time with some fluctuation.

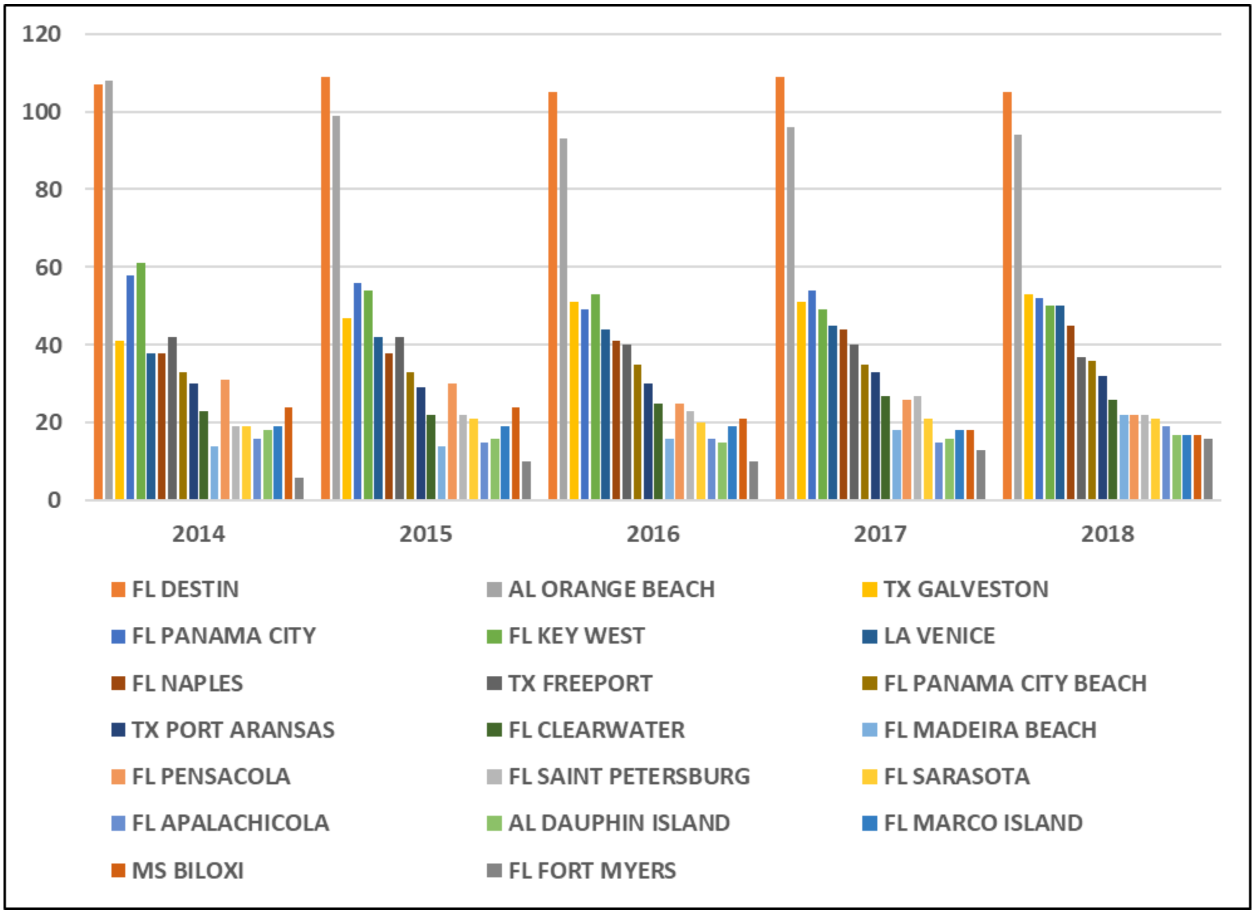


Figure 3.5.2.3. Number of federal for-hire permits for Gulf reef fish by top 20 communities 2014-2018, ranked in order by year 2018.
Source: NMFS Southeast Regional Office permit office, SERO Access database December 27, 2019. Includes valid and renewable permits.

3.5.4 Environmental Justice Considerations

Executive Order 12898 requires federal agencies to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations. This executive order is generally referred to as environmental justice (EJ).

To evaluate EJ considerations for the proposed actions, analysis was completed utilizing a suite of indices created to examine the social vulnerability of coastal communities and is shown in Figures 3.5.3.1 and 3.5.3.2. The three indices are poverty, population composition, and personal disruptions. The variables included in each of these indices have been identified through the literature as being important components that contribute to a community's social vulnerability.

Indicators such as increased poverty rates for different groups; more single female-headed households; more households with children under the age of 5; and disruptions like higher separation rates, higher crime rates, and unemployment all are signs of populations having vulnerabilities. The data used to create these indices are from the American Community Survey estimates at the U.S. Census Bureau. The thresholds of 1 and 0.5 standard deviation are the same for these standardized indices. For those communities that exceed both thresholds for all indices, it would be expected that they are exhibiting vulnerabilities to sudden changes or social disruption that might accrue from regulatory change.

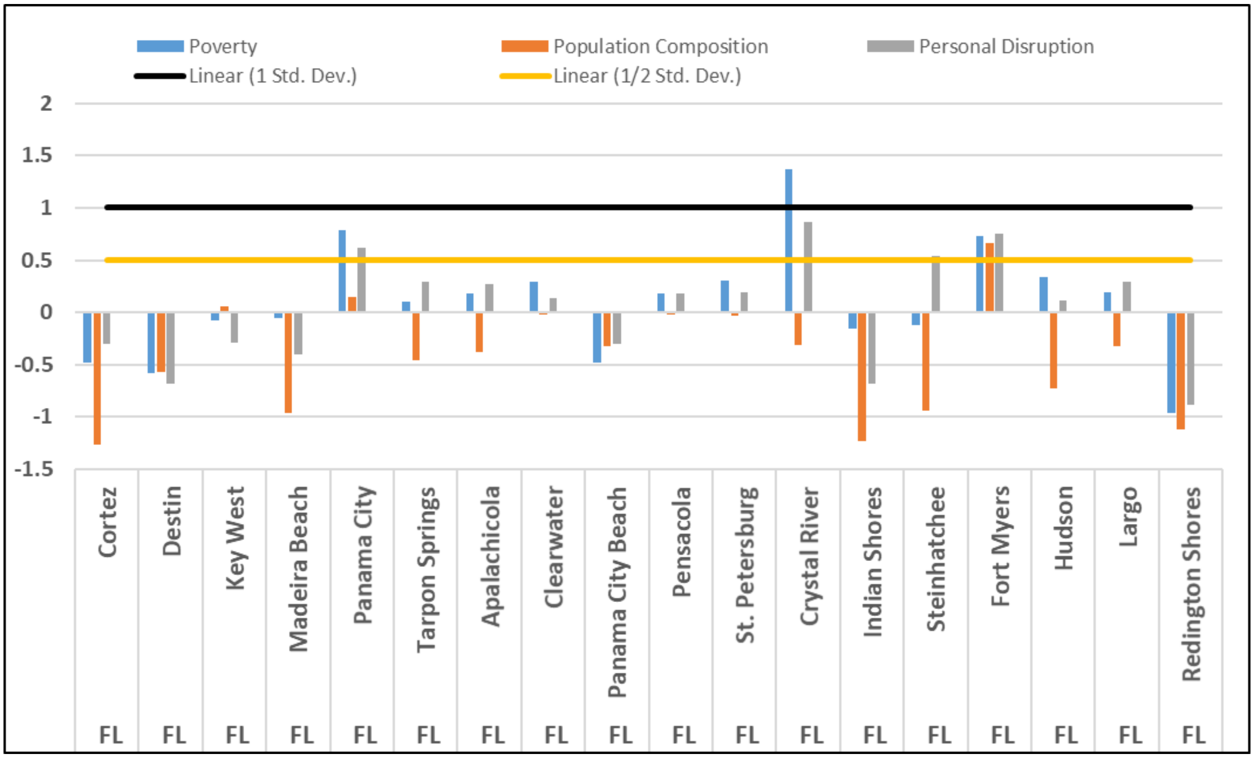


Figure 3.5.3.1. Community social vulnerability indices for Florida fishing communities identified in the description of the social environment as engaged and/or reliant on fishing.
Source: SERO, Community Social Vulnerability Indicators Database 2019 (2016 ACS data).

Similar to the reliance index discussed previously, the vulnerability indices also use normalized factor scores. Comparison of vulnerability scores is relative, but the score is related to the percent of communities with similar attributes. The social vulnerability indices provide a way to gauge change over time within these communities but also provides a comparison of one community with another.

With regard to social vulnerabilities (Figure 3.5.3.1), the following Florida communities exceed the threshold of 0.5 standard deviation for at least one of the social vulnerability indices: Panama City, Crystal River, Steinhatchee, and Fort Myers. Fort Myers exceeds the threshold of ½ standard deviation on all three social vulnerability indices, while Crystal River exceeds the 1 standard deviation threshold for poverty. This suggests that these communities are expressing social vulnerabilities and may be susceptible to further effects from any regulatory change depending upon the direction and extent of that change.

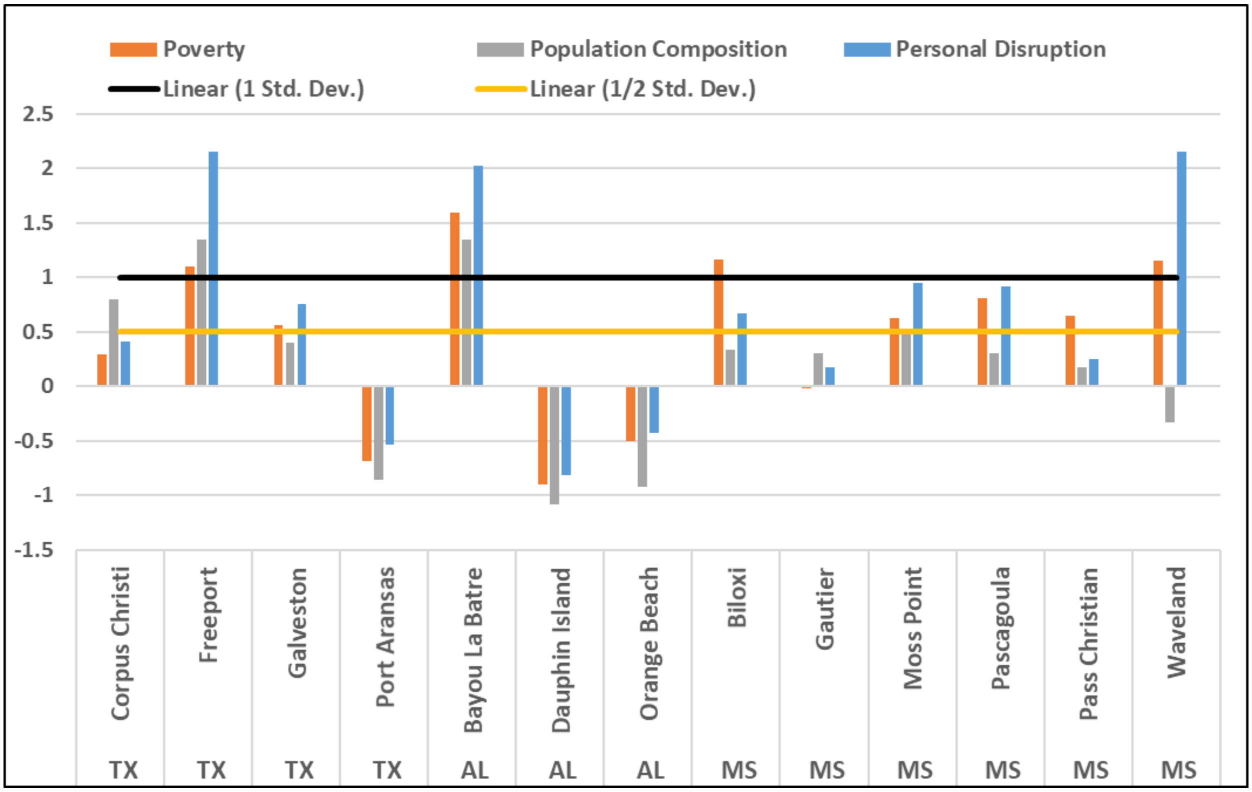


Figure 3.5.3.2 Community Social Vulnerability Indices for other Gulf fishing communities identified in this amendment.
Source: SERO, Community Social Vulnerability Indicators Database 2019 (2016 ACS data).

With regard to social vulnerabilities in other Gulf states several communities exceed the threshold of 0.5 standard deviation for at least one or more of the social vulnerability indices (Figure 3.5.3.2). The communities of Freeport, Texas and Bayou LaBatre, Alabama exceed both thresholds for all three indices, which suggests these communities may exhibit considerable social vulnerabilities. Waveland, Mississippi exceeds the 1 standard deviation for poverty and personal disruption, which also suggests substantial vulnerabilities. Other communities that exceed the 0.5 standard deviation for several indices would also express some vulnerabilities, but not to the degree of the previously mentioned communities.

People in these communities may be affected by fishing regulations in two ways: participation and employment. Although some Gulf communities have been identified as exhibiting some measure of social vulnerability, and may have the greatest potential for EJ concerns, no data are available on the race and income status for those involved in the local fishing industry (employment), or for their dependence on fishing specifically (participation). However, the implementation of the proposed actions of this amendment, the effects of which are expected to be minimal and indirect, would not discriminate against any group based on their race, ethnicity, or income status because the proposed actions would be applied to all participants in the fishery. Further, there is no known subsistence fishing for reef fish or red drum. Thus, the actions of this amendment are not expected to result in adverse or disproportionate environmental or public health impacts to EJ populations. Although no EJ issues have been identified, the absence of potential EJ concerns cannot be assumed.

3.6 Description of the Administrative Environment

3.6.1 Federal Fishery Management

Federal fishery management is conducted under the authority of the Magnuson-Stevens Act (16 U.S.C. 1801 *et seq*.). It was originally enacted in 1976 as the Fishery Conservation and Management Act. 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.[36]
Reef fish and red drum 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/

[36] www.gsmfc.org

CHAPTER 4. ENVIRONMENTAL CONSEQUENCES

4.1 Action 1: Maximum Sustainable Yield (MSY) Proxies

Alternative 1: No Action. The MSY proxy for stocks or complexes that do not have an MSY proxy will remain undefined.

Preferred Alternative 2: For stocks or complexes that do not have an MSY proxy, the MSY proxy is:

Option 2a: the yield when fishing at 20% spawning potential ratio ($F_{20\%\ SPR}$).
Preferred Option 2b: the yield when fishing at 30% spawning potential ratio ($F_{30\%\ SPR}$).
Option 2c: the yield when fishing at 40% spawning potential ratio ($F_{40\%\ SPR}$).

Preferred Alternative 3: For goliath grouper, the MSY proxy is:

Option 3a: the yield when fishing at 30% spawning potential ratio ($F_{30\%\ SPR}$).
Preferred Option 3b: the yield when fishing at 40% spawning potential ratio ($F_{40\%\ SPR}$).
Option 3c: the yield when fishing at 50% spawning potential ratio ($F_{50\%\ SPR}$).

Preferred Alternative 4: For red drum, the MSY proxy is:

Preferred Option 4a: the yield that provides for an escapement rate of juvenile fish to the spawning stock biomass (SSB) equivalent to 30% of those that would have escaped had there been no inshore fishery.
Option 4b: the yield when fishing at 30% spawning potential ratio ($F_{30\%\ SPR}$).

Preferred Alternative 5: For future assessments of reef fish stocks and red drum, the MSY proxy equals the yield produced by F_{MSY} or F_{Proxy} recommended by the Gulf of Mexico (Gulf) Fishery Management Council's (Council) Scientific and Statistical Committee (SSC) and subject to approval by the Council through a plan amendment.

*Note: **Alternatives 2-5** can be selected concurrently.

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, when there is a stock assessment, the MSY proxy is used to establish the catch levels for the overfishing limit (OFL), acceptable biological catch (ABC), and annual catch limit (ACL). MSY 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 of red drum does occur 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 a 60,000 lb annual quota that is split into three, four-month periods. It is illegal for a vessel carrying a purse seine in Mississippi waters to possess any red drum. Allowable gear for commercial red drum harvest in Mississippi includes hook-and-line, legal nets, and trot lines. Legal nets include haul seines, trammel nets, gill nets and cast nets but there are restrictions on fishing area and net materials. In 2019, a majority of the landings reported on trip tickets indicated the hook-and-line fishing was the predominant gear used.[37]

Commercial harvesting for reef fish using 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).

The abundance 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

[37] https://dmr.ms.gov/wp-content/uploads/2019/08/2019-2020-MS-SW-Fishing-Rules-and-Regulations.pdf

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).

Alternative 1 (No Action) would leave the MSY proxy undefined for several reef fish stocks, stock complexes, and red drum resulting in no change to the Fishery Management Plan for the Reef Fish Resources of the Gulf of Mexico (Reef Fish FMP) or FMP for the Red Drum Fishery of the Gulf of Mexico (Red Drum FMP). Therefore, under **Alternative 1** there would be no change to the fishing effort or effects on the physical environment.

Preferred Alternative 2 would define MSY proxies for the five stock complexes and four individual stocks listed in Table 2.1.1. **Preferred Alternative 2** contains **Option 2a**, **Preferred Option 2b**, and **Option 2c** that would define an MSY proxy as the yield at the fishing mortality rate (F) corresponding to a spawning potential ratio (SPR) of 20%, 30%, or 40%, respectively. Generally, lower SPRs correspond to higher MSYs which may allow for higher levels of fishing effort, producing potentially greater adverse effects to the physical environment. Thus, if these stocks are assessed, $F_{20\%SPR}$ could result in the greatest adverse effects, with fewer adverse effects expected for $F_{30\%SPR}$, and the least for $F_{40\%SPR}$.

Preferred Alternative 3 would define the MSY proxy for goliath grouper as $F_{30\%\ SPR}$ (**Option 3a**), $F_{40\%\ SPR}$ (**Preferred Option 3b**), or $F_{50\%\ SPR}$ (**Option 3c**). Harvest of goliath grouper has been prohibited in the Gulf since 1990. However, if goliath grouper is assessed and harvest is permitted, expected effects would be similar to **Preferred Alternative 2** where lower SPRs correspond to higher MSYs which may allow result in higher fishing effort.

Preferred Alternative 4 would establish an MSY proxy for red drum and contains two Options. Harvest of red drum has been prohibited in the Gulf EEZ since 1988, but an extensive fishery for red drum has continued in state waters. Without landings data or fishery independent sampling of the EEZ portion of the red drum population, it has not been possible to conduct a Gulf-wide stock assessment. **Preferred Option 4a** would set the MSY proxy as the yield corresponding to an escapement rate of juvenile fish to the spawning stock biomass equivalent to 30% of those that would have escaped had there been no inshore fishery. This proxy is largely consistent with the state management objectives of achieving a 30% escapement (Florida has a target escapement of 40%). The impacts to the bottom habitat from interaction with the fishing gear from **Preferred Option 4a** should be similar to **Alternative 1** as it would not be expected to change the nature or magnitude of the red drum fishery. **Option 4b** would set the MSY proxy for red drum at the yield at $F_{30\%\ SPR}$ that is thought to more restrictive than **Preferred Option 4a** in terms of allowable harvest and thus would be expected to have fewer negative effects than **Option 4b** on the physical environment. **Option 4b** would have no immediate effect on the physical environment because, without a stock assessment, fishing mortality rates cannot be determined, and there is currently insufficient information from the Gulf EEZ portion of the stock to conduct a traditional assessment that would provide fishing mortality rate information. Therefore, there would be no basis for setting an ABC that would allow harvest in federal waters. This proxy is not currently measurable but it would serve as a placeholder until an assessment can be conducted.

Preferred Alternative 5 allows for a streamlined procedure to modify the MSY proxy defined in the Reef Fish FMP or Red Drum FMP in the future. This objective of this alternative is to allow for more efficient management and most greatly effects the administrative process. Therefore, **Preferred Alternative 5** should have no measurable effects to the physical environment.

Preferred Alternatives 2 - 4 address different species and species complexes, therefore it is difficult to compare them. However, the general pattern where MSY proxies based on lower SPR values are expected to allow larger harvests and additional interactions with the physical environment. **Preferred Alternative 5** is also not directly comparable to **Preferred Alternatives 2 – 4** but would apply in the same manner across each of these alternatives.

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 primarily 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 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 magnified 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 2014, GMFMC 2015b), grouper (GMFMC 2008a, 2009, 2011b, 2012a), vermilion snapper (GMFMC 2004c, 2017c), greater amberjack (GMFMC 2008b, 2012b), gray triggerfish (GMFMC 2012b), and hogfish (GMFMC 2016). 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, the most recent biological opinion (NMFS 2011) for the Reef Fish FMP and reinitiation memos concluded that the operation of fishery is not likely to jeopardize the continued existence of sea turtles, and other species listed under the Endangered Species Act (ESA) (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 2019 proposed List of Fisheries (83 FR 53422) 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).

Reef Fish

Action 1 sets the MSY proxy for several reef fish species and stocks that are not currently defined in the Reef Fish FMP. **Alternative 1** (No Action) would not assign an MSY proxy for these reef fish species and stocks.

Preferred Alternative 2 would define MSY proxies for the five stock complexes and four individual stocks listed in Table 2.1.1. **Preferred Alternative 2** contains **Option 2a**, **Preferred Option 2b**, and **Option 2c** that would define an MSY proxy as the yield at the fishing mortality rate (F) corresponding to a spawning ratio (SPR) of 20%, 30%, or 40%, respectively. Lower SPRs correspond to higher MSYs and may allow for higher levels of fishing effort, producing potentially greater adverse effects of the biological/ecological environment. Thus, if the stocks are assessed, $F_{20\%\ SPR}$ could have the greatest adverse impacts, with successively fewer adverse impacts for $F_{30\%\ SPR}$, and $F_{40\%\ SPR}$.

For **Preferred Alternative 2**, establishing an MSY proxy of $F_{30\%SPR}$ (**Preferred Option 2b**) would be consistent with many other reef fish species (except red snapper and gray snapper) which currently have defined MSY proxies of $F_{26\%SPR}$.

Goliath Grouper

Harvest of goliath grouper has been prohibited in the Gulf since 1990. Under **Alternative 1** (No Action), the MSY proxy for goliath grouper would continue to be undefined. Because harvest is currently prohibited, this would have no effect on the biological/ecological environment. **Option 3a** and **Preferred Option 3b** have lower SPRs than **Option 3c** which, if assessed, could create fewer negative effects on the biological/ecological environment than **Option 3a** or **Preferred Option 3b**. **Option 3c** would set the MSY proxy for goliath grouper at the yield at $F_{50\%\ SPR}$. In terms of allowable fishing effort, **Option 3a** is the most permissive, **Option 3c** the most restrictive, and **Preferred Option 3b** is intermediate relative to the other options in **Alternative 3**.

Red Drum

Harvest of red drum has been prohibited in the Gulf EEZ since 1988, but it allowed in state waters. Without landings data or fishery independent sampling of the EEZ portion of the red drum population, it has not been possible to conduct a Gulf-wide stock assessment. Under **Alternative 1** (No Action), the MSY proxy for red drum would continue to be undefined. Because harvest in the EEZ is currently prohibited, this would have no effect on the biological/ecological environment.

Preferred Option 4a would set the MSY proxy as the yield corresponding to an escapement rate of juvenile fish to the spawning stock biomass equivalent to 30% of those that would have escaped had there been no inshore fishery. This proxy is largely consistent with the state management objectives of achieving a 30% escapement (Florida has a 40% escapement rate target). It is generally assumed that a 30% escapement is approximately equivalent to 20% SPR, and it is objective and measurable as recommended by the NS1 guidelines. However, each state calculates its escapement rate differently, and the different methods may not be compatible. In order to determine if the Gulf-wide escapement rate is achieving its objective, a method would need to be developed to combine the escapement rates from each of the states. This MSY proxy provides positive benefits to the biological/ecological environment because, assuming that the state escapement rates can be combined, it assures that the current level of conservation will be maintained even if the EEZ is re-opened to red drum harvest. **Preferred Alternative 4 Option 4b** would set the MSY proxy for red drum at the yield at $F_{30\%\ SPR}$ and if assessed, **Option 4b** is thought to be more restrictive in terms of harvest than **Preferred Option 4a**.

Preferred Alternative 5 allows for a streamlined procedure to modify the MSY proxy defined in the Reef Fish or Red Drum FMP in the future. This objective of this alternative is to allow for more efficient management and most greatly effects the administrative process. Therefore, **Preferred Alternative 5** has no measurable effects to the biological or ecological environment.

Preferred Alternatives 2 - 4 address different species and species complexes, therefore it is difficult to compare them however, the general pattern of where MSY proxies based on lower SPR values is expected to allow larger harvests and more potential negative effects with the biological environment. **Preferred Alternative 5** is also not directly comparable to **Preferred Alternatives 2 – 4** but would apply in the same manner across each of these alternatives.

4.1.3 Direct and Indirect Effects on the Economic Environment

Alternative 1 (No Action) would not establish MSY proxies for stocks or complexes that do not have an MSY proxy. Therefore, **Alternative 1** would not be expected to affect the harvest of these stocks and stock complexes and would not be expected to result in economic effects. **Preferred Alternative 2** would define MSY proxies for stocks and stock complexes currently without an MSY proxy. **Option 2a** would set the MSY proxies as the yield when fishing at $F_{20\%\ SPR}$. **Preferred Option 2b** and **Option 2c** would set the MSY proxy for these stocks and stock complexes as the yield at $F_{30\%SPR}$ and $F_{40\%SPR}$, respectively. Any impacts from these alternatives would result only if the stock or stock complex is assessed and the proxy is used to determine catch levels. In addition, because none of these alternatives would be expected to directly affect the harvest of the stocks and stock complexes considered in this action, only indirect economic effects would be expected to result from these alternatives. Relative to **Option 2a, Preferred Option 2b** would set a more conservative MSY proxy for stocks and stock complexes currently without an MSY proxy. Therefore, **Preferred Option 2b** would be expected to result in more potential negative economic effects stemming from larger possible decreases in fishing opportunities in the short run. However, these potential losses would be counterbalanced by the anticipated decreases in the risk of stock depletion, which would be expected to result in positive economic effects in the long run. In turn, **Option 2c** would set more conservative MSY proxies than **Preferred Option 2b**. Therefore, compared to **Preferred Option 2b**, **Option 2c** would be expected to result in larger potential adverse economic effects in the short run due to forgone fishing opportunities. **Option 2c** would also be expected to result in greater economic benefits in the long run because it would further reduce the risk of stock (or stock complex) depletion relative to **Preferred Option 2b**.

Options in **Preferred Alternative 3** consider a range of MSY proxies for goliath grouper. Because the harvest of goliath grouper is currently prohibited, the potential economic effects discussed below would only be applicable once harvest of goliath grouper in the Gulf EEZ is allowed. **Option 3a** would set the MSY proxy for goliath grouper as the yield when fishing at $F_{30\%\ SPR}$. **Preferred Option 3b** and **Option 3c** would set the MSY proxy as the yield at $F_{40\%SPR}$ and $F_{50\%SPR}$, respectively. Of the MSY proxies for goliath grouper considered in **Preferred Alternative 3**, **Option 3c** would correspond to the most conservative MSY proxy, followed by **Preferred Option 3b**, and **Option 3a**. Net economic effects expected to result from the establishment of an MSY proxy are determined by adverse economic effects that may result from forgone fishing opportunities in the short term and by longer term benefits resulting from reductions in the risk of stock depletion. More conservative proxies would be associated with larger adverse short term adverse economic costs but would be expected to result in greater long-term benefits.

Because the harvest of red drum is prohibited in federal waters, potential economic effects expected to result from setting an MSY proxy in **Preferred Alternative 4** would only be applicable once harvests become allowed. **Option 4b** would set a more conservative MSY proxy than **Option 4a**. Therefore, **Preferred Option 4a** is expected to result in more short term adverse economic effects but would be expected to result in greater long-term economic benefits due to more substantial reductions in the risk of depletion of the red drum stock.

Preferred Alternative 5, which could be selected as a preferred alternative in conjunction with **Preferred Alternatives 2 - 4**, would provide flexibility to the determination of future MSY proxies by streamlining modifications to the proxy without the development of regulatory actions. With Council agreement, **Preferred Alternative 5** would allow the establishment of a proxy recommended by the Science and Statistical Committee (SSC) and based on a stock assessment. **Preferred Alternative 5** would be expected to result in economic effects stemming from the trade-off between short run fishing opportunities and long-term risks of stock depletion discussed above. **Preferred Alternative 5** would also be expected to result in positive indirect economic effects due to a timelier adjustment to the MSY proxy, when warranted. Net economic effects expected to result from **Preferred Alternative 5** would be determined by the MSY proxy selected by the SSC and by the timeliness of its implementation.

4.1.4 Direct and Indirect Effects on the Social Environment

Although additional effects are not usually expected from retaining **Alternative 1** (No Action), the lack of stock status determination criteria is not consistent with NS1 guidelines and an MSY or its proxy needs to be defined to determine overfished and overfishing status. **Preferred Alternative 2** would establish an MSY proxy for those stocks or complexes without one (Table 2.1.1). **Option 2a** would be the least conservative biologically ($F_{20\%\ SPR}$), **Option 2c** would be the most conservative ($F_{40\%\ SPR}$), and **Preferred Option 2b** would be intermediary ($F_{30\%\ SPR}$). In general, a more biologically conservative MSY proxy would be expected to result in fewer fishing opportunities in the short term, thereby resulting in negative effects, while a less conservative MSY proxy would be expected to result in more fishing opportunities in the short term (and fewer 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. Less conservative proxies could increase the risk of overharvest, potentially resulting in negative effects in the long term.

Harvest of goliath grouper has been closed since 1990 in the Gulf and South Atlantic. Thus, the establishment of stock status determination criteria for goliath grouper would have no social effects, as regardless of the MSY proxy selected, harvest will remain closed. Because goliath grouper is considered a single stock through the Gulf and South Atlantic regions, the MSY proxy should be consistent for both regions. The South Atlantic Council has established an MSY proxy for the stock of $F_{40\%\ SPR}$ (**Preferred Option 3b**). Some minimal benefits may be expected from selecting **Preferred Option 3b**, as the MSY proxy would be consistent between regions.

Although there is no harvest of red drum permitted in federal waters, harvest is allowed in state waters. Nevertheless, setting an MSY proxy for red drum (**Preferred Option 4a** or **Option 4b**) would not be expected to have any direct or indirect effects, as adopting an MSY proxy would be unlikely to affect the harvest opportunities established by the Gulf states in state waters. Streamlining the Council's procedure to modify the MSY proxy in the future (**Preferred Alternative 5**) could result in some minimal positive effects, although these effects would primarily be administrative.

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 this action would not result in added regulations, there would not be any immediate effect on the administrative environment from rulemaking.

Alternative 1 would result in no stock or stock complex MSY proxies being established and would be inconsistent with NS1 Guidance. **Preferred Alternatives 2-4** select the MSY values for the reef fish stocks without an MSY proxy, goliath grouper, and red drum. When compared to **Alternative 1**, **Preferred Alternatives 2-4** are administratively advantageous because they would result in a metric assisting to assure that harvest levels are set to reduce the likelihood that overfishing or stock depletion would occur.

For **Preferred Alternatives 2** and **3**, Options would be selected from a suite of increasing SPRs for a level of F (the yield at $F_{20\%SPR}$, $F_{30\%SPR}$, or $F_{40\%SPR}$ for **Alternative 2** and the yield at $F_{30\%SPR}$, $F_{40\%SPR}$, or $F_{50\%SPR}$ for **Preferred Alternative 3**). Between the SPR proxies considered by the alternatives, those that allow a higher MSY would likely have greater adverse effects on the administrative environment as described because they would allow a higher rate of harvest, increasing the likelihood that overfishing or a stock depletion could occur. Thus, for **Preferred Alternative 2**, $F_{20\%SPR}$ (**Option 2a**) would have the greatest likelihood for adversely affecting this environment, effects, with successively reduced likelihoods of adversely affecting this environment by the yields at $F_{30\%SPR}$ (**Preferred Option 2b**) and $F_{40\%SPR}$ (**Option 2c**), respectively. Similarly, for **Preferred Alternative 3**, $F_{30\%SPR}$ (**Option 3a**) would have the greatest likelihood of adversely affecting this environment compared to the yields at $F_{40\%SPR}$ (**Preferred Option 3b**), followed by the yield at $F_{50\%SPR}$ (**Option 3c**), respectively.

Preferred Alternative 4, **Preferred Option 4a** would set MSY equivalent to a red drum management target of 20% SPR. This would have a greater adverse effect on the administrative environment than if **Option 4b**, which would set MSY as the yield at $F_{30\%SPR}$, due to the disparate and incomparable nature with which escapement is quantified by the five Gulf states.

Preferred Alternative 5 would benefit the administrative environment if selected with other alternatives. It would streamline the process to adopt newly approved MSY and MSY proxies. Rather than conducting an alternatives analyses of different MSY and MSY proxies, the recommended value by the SSC would just be adopted in an amendment. Thus, this alternative in conjunction with **Preferred Alternatives 2-4** would reduce the burdens to the administrative environment.

Although these alternatives have different effects on the administrative environment, these effects are likely minor. Assessing stocks to determine MSY or an MSY proxy is routine for 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 the stock would be depleted triggering further management action.

4.2 Action 2 – Maximum Fishing Mortality Threshold (MFMT)

Alternative 1: No Action. Maintain current definitions of the maximum fishing mortality threshold (MFMT). These are: $F_{50\%\ SPR}$ for goliath grouper; and $F_{30\%\ SPR}$ for all other reef fish stocks considered in Action 1 and red drum.

Preferred Alternative 2: For stocks where an MSY proxy has not been defined, set the MFMT equal to the fishing mortality at the MSY proxy for each stock or stock complex as determined in Action 1.

4.2.1 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 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 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 the minimum stock size threshold (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 a determination of overfishing is based on whether or not the OFL is exceeded for a stock in a given year.

Preferred Alternative 2 sets the MFMT equal to the MSY F_{Proxy} for each stock as determined in Action 1. 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 **Preferred Alternative 2** are also expected to be similar to **Alternative 1** as the total harvest would continue to be constrained by the OFL. If a stock assessment is completed for a stock that is currently unassessed the effect relative to **Alternative 1** depends on if the allowable harvest increases or decreases relative to **Alternative 1**. Increases in allowable harvest would have additional negative effects on the physical environment whereas as reduction in harvest would be associated with fewer physical effects. Overall, increased effects to the physical environment could occur if fishing effort were to also increase as a result in a change in yield at the MSY proxy. Therefore, much of the effects on the physical environment in Action 2 are subject to decisions contained in Action 1.

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 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 a 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 affect 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 the total harvest is constrained by the OFL for each stock.

Preferred Alternative 2 sets the MFMT equal to the fishing mortality at the MSY 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. Harvest of stocks that do not a have stock assessment would continue to be limited by the OFL and biological or ecological effects for these stocks would be identical for **Alternative 1** and **Preferred Alternative 2**. If a stock assessment is completed for a stock that is currently unassessed, the effects of **Preferred Alternative 2** depend on the alternatives selected in Action 1, and thus the effects would be those described in Section 4.1.2. In general, lower SPRs will allow higher levels of fishing effort, producing potentially greater adverse effects of the physical environment. Thus $F_{20\%\ SPR}$ would have the greatest adverse impacts, with successively less adverse impact for $F_{30\%\ SPR}$, $F_{40\%\ SPR}$. Increased effects to the biology/ecological environment could occur if fishing effort were to also increase as a result in a change in yield at the MSY proxy. Therefore, much of the effects on the biology/ecological environment in Action 2 are subject to decisions contained in Action 1.

4.2.3 Direct and Indirect Effects on the Economic Environment

Alternative 1 (No Action) would not modify existing MFMT definitions. Therefore, **Alternative 1** would not be expected to result in economic effects because it would not be expected to affect the status of the stocks or alter the harvest of these species.

For stocks and complexes without an MSY proxy, **Preferred Alternative 2** would set the MFMT equal to the fishing mortality at the MSY proxy for each stock or stock complex as determined in Action 1. **Alternative 2** would not be expected to affect the harvest of these stocks or stock complexes and would therefore not be expected to result in direct economic effects. However, for a given stock (or complex), if **Preferred Alternative 2** results in a more conservative MFMT compared to **Alternative 1**, **Preferred Alternative 2** would be expected to require less restrictive measures to end overfishing (if overfishing occurs) thereby resulting in smaller adverse economic effects. Conversely, if a less conservative MFMT is established, **Preferred Alternative 2** would be expected to necessitate more stringent corrective measures should overfishing occur, thereby resulting in larger adverse economic effects relative to **Alternative 1**. **Preferred Alternative 2** would also be expected to result in indirect economic benefits relative to **Alternative 1** because it would ensure consistency between the MFMT and the MSY proxy for each stock or stock complex.

4.2.4 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 **Preferred Alternative 2**, but indirect effects could occur if changes to the MFMT results in a change that affects fishing activity. **Preferred Alternative 2** would only affect those stocks for which the MSY proxy is changed in Action 1. Because **Preferred 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.

4.2.5 Direct and Indirect Effects on the Administrative Environment

This action would directly affect the administrative environment by defining overfishing thresholds, a requirement of the Magnuson-Stevens Act. If these thresholds are not defined (**Alternative 1**), then MFMTs for the stocks and stock complexes would need to be defined one by one as they are assessed. This would be less efficient than to set them through one action (**Preferred Alternative 2**) and add to the administrative burden.

Based on the MSY proxy defined in Action 1, **Preferred Alternative 2** sets the MFMT consistent with the MSY proxy so there is no internal conflict between values. Setting MFMTs helps the stock assessment process by providing a metric to assess whether harvest rates are too high. If too high, then immediate action can be taken to reduce the harvest rate to end overfishing.

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 is conducted a part of assessments conducted under the Southeast Data, Assessment and Review (SEDAR) process. Actions to control harvest by the Council and NMFS are mostly routine and conducted through the Council system established by the Magnuson-Stevens Act. Through the use of OFLs, ACLs, and AMs, the Council and NMFS can determine if overfishing is occurring annually and take measures to reduce the likelihood a stock would get into an overfished condition. This minimizes the risk that the F for a stock would increase above MFMT and be considered undergoing overfishing.

4.3 Action 3: Minimum Stock Size Threshold (MSST)

Alternative 1: No Action. Do not define minimum stock size threshold (MSST) for stocks and stock complexes in action 1.

Alternative 2: MSST = (1-M)*B_{MSY} (or proxy) where M is the natural mortality rate. This alternative applies to stocks and stock complexes in Action 1.

Preferred Alternative 3: MSST = 0.75*B_{MSY} (or proxy). This alternative applies to stocks and stock complexes in Action 1.

Alternative 4: MSST = 0.50*B_{MSY} (or proxy). This alternative applies to stocks and stock complexes in Action 1.

Preferred Alternative 5: For stocks assessed across the South Atlantic and Gulf Councils' jurisdictions (goliath grouper, mutton snapper, yellowtail snapper, and black grouper). MSST for these species would use existing definitions of MSST defined by the South Atlantic Council.**

*Note: **Alternative 5** can be selected with **Alternative 2, 3,** or **4**.

** Note: If **Alternative 5** is selected as preferred, **Alternative 3** would not apply to the stocks considered in **Alternative 5**.

4.3.1 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 fewer gear interactions with the physical habitat, which would be beneficial to the environment. Therefore, alternatives that allow a larger decrease in stock biomass 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.

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-M)*B_{MSY} (or proxy) formula to all stocks considered in Action 1. Under this MSST proxy, the buffer between B_{MSY} and MSST depends on the natural mortality rate of the species. 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 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.

Preferred Alternative 3 would apply to 0.75*B_{MSY} (or proxy) formula to all stocks considered in Action 1. 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, and fewer adverse effects for stocks with a natural mortality rate greater than 0.25.

Alternative 4 would set MSST at 0.50*B_{MSY} for all stocks considered in Action 1, 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. In comparison to **Preferred Alternative 3, Alternative 4** 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.

Preferred Alternative 5 would use the existing definition of the definition of MSST defined for the South Atlantic portion of four stocks that occur in both the South Atlantic and Gulf Councils' jurisdictions and are considered a single stock throughout this region. **Preferred Alternative 5** is expected to have similar effects for these to **Alternative 1** as this would continue, yet clarify, the ongoing management practices for the affected stocks in the southeast region.

4.3.2 Direct and Indirect Effects on the Biological/Ecological Environment

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 effect on other reef fish stocks and red drum. 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 like gray snapper. As a result, any effects from this action are expected to be minor. For reef fish stocks and red drum, 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 undefined leaving no metric for determining if the stock is overfished. Therefore, **Alternative 1** has the potential result in the greatest adverse effects to the biological environment should the stock be allowed to decline.

For species with estimates of natural mortality less than 0.25, **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 mortality (M) greater than 0.25, **Preferred 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**, **Preferred Alternative 3**, and **Alternative 4**.

Preferred Alternative 5 would use the South Atlantic Council's existing definition of MSST for four species that are managed as a single stock in the southeast region. For black grouper, mutton snapper, and yellowtail snapper, MSST would be set at 75% * B_{MSY} (or proxy) and effects would be similar to **Preferred Alternative 3** for these stocks. MSST for goliath grouper is (1-M)*B_{MSY} and effects would be equivalent to **Alternative 2** for this stock.

4.3.3 Direct and Indirect Effects on the Economic Environment

Alternative 1 (No Action) would maintain MSST already established for some reef fish species, e.g., gag and red snapper, but would not define MSST for stocks and complexes in Action 1. An undefined MSST would not be consistent with the Magnuson-Stevens Act requirements. **Alternative 1** is not expected to affect harvest or the status of these stocks or stock complexes. Therefore, **Alternative 1** would not be expected to result in economic effects.

Alternative 2, Preferred Alternative 3 and **Alternative 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 smaller M the larger the resulting MSST). For a given stock or stock complex, the establishment of an MSST is an administrative action and would therefore not be expected to result in direct economic effects. For each of the stocks and stock complexes in Action 1, **Alternative 4** would set the lowest MSST value and would be expected to be associated with the lowest likelihood of classifying a stock (or complex) as overfished. **Alternative 4** would grant more flexibility to manage these stocks and complexes by establishing a wider buffer between the MSST and the biomass at MSY. Therefore, **Alternative 4** would be expected to result in indirect positive economic effects due to additional harvesting opportunities that could be made available by the increased management flexibility. The size of the potential indirect economic benefits would depend on the expected additional harvests afforded to recreational anglers and commercial fishermen. However, should a stock or complex be declared overfished, a smaller MSST would be expected to require more stringent 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 adjustments to the MSST for these stocks and complexes would be determined by the relative magnitude of these potential economic benefits and adverse economic effects.

Because **Preferred Alternative 3** would set a greater MSST than **Alternative 4**, potential economic benefits expected to result from management flexibility would be lessened compared to **Alternative 4**. However, relative to **Alternative 4**, **Preferred Alternative 3** would necessitate less restrictive rebuilding measures if a given stock or complex is overfished, thereby resulting in smaller negative effects during the rebuilding period. **Alternative 2**, when it sets a greater MSST than **Preferred Alternative 3**, would be expected to result in smaller adverse economic effects during the rebuilding period compared to **Preferred Alternative 3**. It follows that the converse would apply when **Alternative 2** sets a smaller MSST than **Preferred Alternative 3**.

For mutton snapper, yellowtail snapper, and black grouper, **Preferred Alternative 5** would set MSST values comparable to **Alternative 2**. Therefore, economic effects that would be expected to result from **Preferred Alternative 5** would be similar to the effects expected from **Alternative 2**. With a natural mortality estimate at 0.12, **Preferred Alternative 5** would set an MSST for goliath grouper equal to $0.88*B_{MSY}$. Because harvesting goliath grouper is currently prohibited, the establishment of an MSST is a purely administrative action and would not be expected to result in economic effects at this time.

4.3.4 Direct and Indirect Effects on the Social Environment

This action would define the threshold at which 23 reef fish stocks and the red drum stock would be considered overfished (Table 2.2.1). Direct effects would not be expected from establishing an overfished threshold. Indirect effects would be tied to future determinations of whether a stock is overfished, and to regulatory action in response to an overfished determination. 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 B_{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. **Alternative 1** would not define MSST for these reef fish stocks and red drum, and there would be no change in the management of these stocks, and thus, no social effects. However, **Alternative 1** is inconsistent with NS1 guidance and MSST needs to be defined.

Alternative 2 would provide a narrow buffer and would be the most conservative alternative for setting MSST as it would be most likely for the overfished threshold to be triggered. Using a narrow buffer for a stock with a low natural mortality rate (e.g., less than M = 0.25), may result in the stock being more likely to move 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 (such as **Preferred Alternative 3** and **Alternative 4**) that prevents a stock from moving into an overfished status may be preferable as stability would be preferable 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 4 would adopt the widest buffer allowed under the NS1 guidelines and also among the alternatives, and would apply the same buffer as 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, avoiding negative effects from an overfished determination that triggers development of a rebuilding plan. 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. **Preferred Alternative 3** would set a buffer that sets MSST at 75% of B_{MSY}, and is a wider buffer than **Alternative 2** and a narrower buffer than **Alternative 4**. Thus, the effects of **Preferred Alternative 3** would be intermediary between **Alternative 2** and **Alternative 4**.

In summary, the social effects from **Alternatives 2**, **4**, and **Preferred Alternative 3** would be indirect and occur subsequent to a determination of overfished status 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 a subsequent rebuilding plan could curtail existing fishing effort, but may allow for more consistent fishing activity over the long term.

Among the four stocks to which **Preferred Alternative 5** would apply, no effects would be expected for goliath grouper, as harvest would continue to be prohibited regardless of the MSST selected. For black grouper, mutton snapper, and yellowtail snapper, adopting the same MSST as the South Atlantic Council would be expected to provide some minimal positive effects by making the MSST consistent across jurisdictions that share management of each single stock.

4.3.5 Direct and Indirect Effects on the Administrative Environment

This action would directly affect the administrative environment. Under **Alternatives 2, 4** and **Preferred Alternatives 3** and **5**, 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 or species complex MSST through multiple future actions as each species or complex is assessed. A less efficient approach with greater adverse effects to the administrative environment would occur under **Alternative 1** (No Action), where MSSTs would have to be considered on a stock or stock complex basis and not all at once.

How MSST is determined under **Alternatives 2,4,** and **Preferred Alternative 3** 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 5 stocks; Tables 2.3.1), then the MSST from **Alternative 2** is less than the MSST in **Preferred Alternative 3** because they would be less than 0.75*B_{MSY}. However, if M is greater than 0.25 (at least 1stock; Tables 2.3.1), then the MSST from **Alternative 2** is greater than the MSST from **Preferred Alternative 3** because they would be greater than (1-M)*B_{MSY}. For the case where M =0.25, **Alternative 2** and **Preferred Alternative 3** would be equivalent. **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 4.3.5.1, 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 ($\leq$ 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 **Preferred Alternative 3** (870,000 lbs) and least for **Alternative 4** (500,000 lbs).

Table 4.3.5.1. 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*B_{MSY}	Alternative 4 0.5*B_{MSY}
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 4.3.5.1, 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 **Preferred Alternative 3** (850,000 lbs and 750,000 lbs, depending on M).

Preferred Alternative 5 would set MSST values for mutton snapper, yellowtail snapper, goliath grouper, and black grouper equivalent to the MSST values set by the South Atlantic Council. Because the South Atlantic definition of MSST for goliath grouper (equivalent to **Alternative 2**) is different from the MSST definitions of mutton snapper, yellowtail snapper, and black grouper (equivalent to **Preferred Alternative 3**), the selection of **Alternatives 2, 4** or **Preferred**

Alternative 3 as preferred without the selection of **Alternative 5** would lead to future action to resolve the jurisdictional differences in the MSST definitions. This future action would add to the administrative burden and add to any adverse effects from **Alternatives 2, 4** or **Preferred Alternative**.

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 a routine part of stock assessments through the SEDAR process. 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.

4.4 Action 4: Optimum Yield (OY)

4.4.1 Action 4.1 – Optimum Yield for Action 1 Reef Fish Stocks and Hogfish

Alternative 1: No Action. Do not define optimum yield (OY) for stocks and stock complexes in Action 1. Do not define an OY for hogfish.

Preferred Alternative 2: For reef fish stocks from Action 1 and for hogfish, where OY is undefined, OY, implicitly accounting for relevant economic, social, or ecological factors, would be:

- **Option 2a:** 85% of MSY or MSYproxy.
- **Preferred Option 2b:** 90% of MSY or MSYproxy.
- **Option 2c:** 95% of MSY or MSYproxy.
- **Option 2d:** (ACL/OFL) * MSY or MSYproxy; or zero if the ACL equals zero.

Preferred Alternative 3: For shallow-water grouper, OY, implicitly accounting for relevant economic, social, or ecological factors, would be:

- **Option 3a:** 85% of MSY or MSYproxy.
- **Preferred Option 3b:** 90% of MSY or MSYproxy.
- **Option 3c:** 95% of MSY or MSYproxy.

Preferred Alternative 4: For goliath grouper, OY, implicitly accounting for relevant economic, social, or ecological factors, would be:

- **Option 4a:** 85% of MSY or MSYproxy.
- **Option 4b:** 90% of MSY or MSYproxy.
- **Option 4c:** 95% of MSY or MSYproxy.
- **Preferred Option 4d:** (ACL/OFL) * MSY or MSYproxy; or zero if the ACL equals zero.

4.4.1.1 Direct and Indirect Effects on the Physical Environment

This action does not affect the gear used in the reef fish fishery or how it is deployed. Therefore, this action would have no direct effects on the physical environment. However, the definition of OY could affect the long-term harvest levels, which could indirectly affect the physical environment.

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. There would be no change to the current effects on the physical environment.

Preferred Alternatives 2-4 would define OY for the stocks and stock complexes to provide a long-term harvest goal. For **Preferred Alternative 2** (all species but shallow-water grouper and goliath grouper), **Preferred Alternative 3** (shallow-water grouper), and **Preferred Alternative 4** (goliath grouper) would affect different species and so are not directly comparable; however, each Option for the respective alternative would have similar effects on this environment. For **Preferred Alternative 4**, the harvest of goliath grouper is currently zero, so at this time, regardless of the OY Option, the harvest would be zero. Should harvest be allowed in the future, the effects of the following discussion of the Options for **Preferred Alternatives 2** and **3** would apply for Options under **Preferred Alternative 4**.

Options 2a, **3a**, **2c**, **3c**, **Preferred Option 2b**, and **Preferred Option 3b** for **Preferred Alternatives 2** and **3** would define OY as a fixed percentage of stock or stock complex's MSY or MSY proxy while **Option 2d** (note that **Preferred Alternative 3** does not have an **Option d**) would set the percentage using the relationship between the ACL and OFL. The percentage applied to MSY or MSY proxy would depend upon which Option is selected. **Options 2a** and **3a** would set the percentage at the lowest level of MSY (85%) for the fixed percentage options, resulting in the lowest OY. The smaller long-term harvest goal would reduce fishing effort more than **Preferred Options 2b** and **3b** or **Options 2c** and **3c**, and likely reduce any adverse effects on the physical environment (fewer gear interactions). **Options 2c** and **3c**, 95% of MSY, would have the greatest adverse effect on the physical environment because it would influence larger ACLs to be set that would have greater potential fishing effort (more gear interactions). **Preferred Options 2b** and **3b**, 90% of MSY, would result in an intermediate level of harvest and intermediate level of adverse effects on the physical environment compared to **Options 2a, 3a** and **Options 2c, 3c**. In summary, the level of adverse effects to the physical environment for each fixed percentage option, from least to greatest, are **Option a**, **Option b**, and **Option c** for **Alternatives 2** and **3**.

The percentages derived using **Option 2d** are different for each stock and stock complex (Table 2.4.2). The effects of this Option are dependent on the stock as they range from 55.5% (mid-water snapper complex) to 93.9% (mutton snapper). Thus, any effects and how they relate to **Options 2a-2c** depend on the relationship between the ACL and OFL. The effects for five stocks/stock complexes (tilefishes, jacks complex, mid-water snapper, cubera snapper, and lane snapper), which have percentages below 85%, would be less than **Option 2a**. Hogfish and yellowtail snapper have percentages between 85% and 90%, thus the effects for these stocks would be between **Option 2a** and **Preferred Option 2b**. Finally, two stocks/stock complexes have percentages above 90% (deep-water grouper and mutton snapper), but below 95%, and so would be intermediate to **Preferred Option 2b** and **Option 2c**).

With year-to-year harvest levels being controlled through ACLs and AMs, it is difficult to assess how **Preferred Alternatives 2-4** compare to **Alternative 1.** Under all alternatives, the annual harvests would be limited to the ACLs for the stocks and stock complexes. All the Options for the alternatives have the potential to influence lower harvest levels and fewer adverse effects to the physical environment than if the stock were managed at MSY or MSY proxy levels (Action 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, which is species dependent.

4.4.1.2 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. Management measures that would be required to maintain harvests at or below OY would produce biological/ecological impacts. 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.

Alternative 1 would leave OY undefined for the Action 1 reef fish stocks and stock complexes as well as hogfish. This would provide no long-term harvest goal for these stocks until they are assessed and an OY action would then be developed.

Preferred Alternatives 2 to **4** would define OY for the stocks and stock complexes to provide a long-term harvest goal. For **Preferred Alternative 2** (all Action 4.1 species excluding shallow-water grouper and goliath grouper), **Preferred Alternative 3** (shallow-water grouper), and **Preferred Alternative 4** (goliath grouper) would affect different species and so are not directly comparable; however, each option within the respective alternatives, when compared to each other would have similar effects. For **Preferred Alternative 4**, the harvest of goliath grouper is prohibited, so at this time, regardless of the OY option, the harvest would be the same at zero. Should harvest be allowed in the future, the effects of the following **Preferred Alternative 2** and **Alternative 3** discussion of the options would apply for the options under **Preferred Alternative 3**.

For **Preferred Alternatives 2** and **3**, **Option a** is the most conservative of the OY proxies (85% of MSY or MSY proxy) because any management actions based on this OY would limit fishing effort the most and have the highest associated biomass level after a stock is assessed. Thus, it would have the lowest risk of allowing the stock size becoming depleted and would be the more beneficial to this environment than **Preferred Options 2b** and **2c** for **Preferred Alternative 2** and **Preferred Option 3b** and **Option 3c** for **Preferred Alternative 3**. **Option 2c** and **3c** are the least precautionary within their respective alternative because any management actions based on this OY would allow the highest fishing effort and the lowest associated biomass levels (95% of MSY). Maintaining this OY proxy would be most adverse of the **Preferred Alternative 2** and **Preferred Alternative 3** options. For **Preferred Alternatives 2** and **3, Preferred Option 2b** and **3b** (90% of MSY) are intermediate to **Options 2a/3a** and **2c/3c**.

The percentages derived using **Option 2d** are different for each stock and stock complex (Table 2.4.2). The effects of this option are dependent on the stock as they range from 55.5% (mid-water snapper complex) to 93.9% (mutton snapper). Thus, any effects and how they relate to **Options 2a-2c** depend on the relationship between the ACL and OFL. The effects for five stocks/stock complexes (tilefishes, jacks complex, mid-water snapper, cubera snapper, and lane snapper), which have percentages below 85%, would be less than **Option 2a**. Hogfish and yellowtail snapper have percentages between 85% and 90%, thus the effects for these stocks would be between **Option 2a** and **Preferred Option 2b**. Finally, two stocks/stock complexes have percentages above 90% (deep-water grouper and mutton snapper), but below 95%, and so would be intermediate to **Preferred Option 2b** and **Option 2c**).

With year-to-year harvest levels being controlled through ACLs and AMs, it is difficult to assess how For **Preferred Alternatives 2-4** compare to **Alternative 1.** Under all alternatives, the annual harvests would be limited to the ACLs for the stocks and stock complexes. 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, which is species dependent.

4.4.1.3 Direct and Indirect Effects on the Economic Environment

Alternative 1 (No Action) would not define OY for stocks and stock complexes in Action 1. Under **Alternative 1**, this reference point could be defined in future regulatory actions as the need arises. Therefore, **Alternative 1** would not be expected to affect fishing practices or harvests of these stocks and stock complexes and would not be expected to result in economic effects.

For hogfish and each stock and stock complex in Action 1, **Preferred Alternative 2** would define OY as a percentage of MSY or of MSY proxy. The percentages considered range from 85% (**Option 2a**) to 95% (**Option 2c**). **Preferred Option 2b** would set OY at 90% of MSY or MSY proxy. When the stock ACL is different from zero, **Option 2d** would set OY based on the ratio between the ACL and OFL. For the stocks and complexes considered, the ratio fluctuates between 55.5% (mid-water snapper) and 93.9% (mutton snapper) of MSY or MSY proxy.

The definition of OY for these stocks and complexes would not be expected to affect fishing practices or harvest levels for these stocks and complexes. Therefore, **Preferred Alternative 2** would not be expected to result in direct economic effects. However, once the ACL for each stock or complex is linked to future OY definitions, then **Preferred Alternative 2** may be expected to result in indirect economic effects. The direction as well as the magnitude of these potential indirect economic effects would be determined by the relationship between the stock or complex ACL and OY. Although **Option 2d** explicitly ties OY to ACL, current management measures constrain harvest levels based on ACL values and do not necessarily account for OY, which is a long-term measure. Therefore, as **Option 2a, Preferred Option 2b** and **Option 2c**, **Option 2d** would also not be expected to result in direct economic effects. However, in the longer term, once management measures include OY considerations in setting harvest levels, indirect economic effects would be expected to result from **Option 2d**.

Preferred Alternative 3 would set OY for shallow-water grouper as a fixed percentage of MSY or MSY proxy. The percentages proposed range from 85% (**Option 3a**) to 95% (**Option 3c**). **Preferred Option 3b** would define OY at 90% of MSY or MSY proxy. The definition of OY for shallow-water grouper would not be expected to affect fishing practices or shallow-water grouper harvest levels. Therefore, **Preferred Alternative 3-Preferred Option 3b** and **Options 3a and 3c** would not be expected to result in direct economic effects. However, once the shallow-water grouper ACL is affected by future OY definitions, then **Preferred Alternative 3-Preferred Option 3b** and **Options 3a and 3c** may be expected to result in indirect economic effects. The direction as well as the magnitude of these potential indirect economic effects would depend on the relationship between the shallow-water grouper ACL and OY.

For goliath grouper, **Preferred Alternative 4** would define OY as a percentage of MSY or MSY proxy. **Options 4a, 4b,** and **4c** would set OY for goliath grouper at 85%, 90%, and 95% of MSY or MSY proxy, respectively. When the goliath grouper ACL is different from zero, i.e., once harvesting goliath grouper is no longer prohibited, **Preferred Option 4d** would set OY by multiplying MSY or MSY proxy by a ratio between the ACL and OFL. Because the harvest of goliath grouper is currently prohibited, the establishment of an OY for goliath grouper is a purely administrative measure. Therefore, none of the options in **Preferred Alternative 4,** including **Preferred Option 4d,** would be expected to result in economic effects at this time. In the future, should the harvest of goliath grouper be allowed, indirect economic effects determined by the extent to which OY and ACL levels are linked would be expected to result from **Preferred Alternative 4**.

4.4.1.4 Direct and Indirect Effects on the Social Environment

Additional effects would not be expected under **Alternative 1**, but OY would remain undefined for the stocks and stock complexes in Action 1 (plus hogfish) and the reference point would need to be defined for these stocks in a subsequent plan amendment. OY is not directly tied to the setting of ACLs. Any effects from **Preferred Alternatives 2** and **3** would be indirect, long-term, and relate 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.

Preferred Alternative 2 would establish OY for the reef fish stocks and stock complexes in Action 1 (except shallow-water grouper) and including hogfish. **Preferred Alternative 3** would establish OY for shallow-water grouper. It has been assumed that long-term benefits would result from setting OY at some percentage below MSY or its proxy, as there may be less chance of overfishing or a stock becoming overfished. Without knowing what economic or social benefits are foregone, however, it is difficult to determine whether OY is truly being attained. **Options 2a**, **2c**, **3a**, **3c** and **Preferred Options 2b** and **3b** would specify fixed percentages of MSY (or MSY_{Proxy}) at which OY would be defined. **Options 2a** and **3a** would result in a definition of OY that is reduced the most from MSY or its proxy, and could result in the greatest negative effects among the options, as the least amount of the respective reef fish stock could be caught. **Options 2c** and **3c** would set OY the closest to the MSY proxy, resulting in the least short-term effects by allowing the most of the respective reef 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. Any effects from **Preferred Options 2b** or **3b** would be intermediary between **Options 2a** or **3a**, and **Options 2c** or **3c**.

Although **Option 2d** uses the ratio between the ACL and OFL to determine the amount MSY should be reduced to achieve OY, it is not directly tied to the ACL meaning that no direct effects would be expected. The greater the difference between the ACL and OFL for a given stock or stock complex, the greater the difference would be between MSY and OY. Consistent with the discussion above for the options, the greatest indirect effects would be expected when OY is farthest from MSY, while fewer indirect effects would be expected when OY is closer to MSY. There is no **Option 3d** provided, as there is no OFL for shallow-water grouper.

Preferred Alternative 4 would establish OY for goliath grouper, which has an ACL of zero (i.e., all harvest is prohibited). No effects would be expected under any of the **Preferred Alternative 4** options, including **Preferred Option 4d**, as harvest would remain closed. Should harvest of goliath grouper be allowed in the future, it would be necessary to establish new reference points for the stock and to revisit OY.

4.4.1.5 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. Under **Alternative 1**, reef fish stocks in Action 1 and hogfish would be without a defined OY, which would be in conflict with NS 1 guidelines. Selecting either of **Alternatives 2-4** as preferred would be administratively more efficient than approving OY on a species or species complex through multiple future actions as each species or complex is assessed. This less efficient approach would occur under **Alternative 1** and would result in greater adverse effects to the administrative environment.

Preferred Alternatives 2-3 would set OY as a percentage of MSY or MSY proxy for the subject stocks and stock complexes. The lower OY is set, the less likely any management measures based on that OY would allow the stock to become depleted and require a stock rebuilding plan. Therefore, of the **Preferred Alternatives 2** and **3** fixed percentage Options, **Option 2a/3a** would be the least adverse to the administrative environment and **Options 2c/3c** the most adverse. **Preferred Options 2b** and **3b**.

The percentages derived using **Option 2d** are different for each stock and stock complex (Table 2.4.2). The effects of this Option are dependent on the stock as they range from 55.5% (mid-water snapper complex) to 93.9% (mutton snapper). Thus, any effects and how they relate to **Options 2a-2c** depend on the relationship between the ACL and OFL. The effects for five stocks/stock complexes (tilefishes, jacks complex, mid-water snapper, cubera snapper, and lane snapper), which have percentages below 85%, would be less than **Option 2a**. Hogfish and yellowtail snapper have percentages between 85% and 90%, thus the effects for these stocks would be between **Option 2a** and **Preferred Option 2b**. Finally, two stocks/stock complexes have percentages above 90% (deep-water grouper and mutton snapper), but below 95%, and so would be intermediate to **Preferred Option 2b** and **Option 2c**).

Because the harvest of goliath grouper is zero, regardless of the OY option, the harvest would be zero under **Preferred Alternative 4**. However, should a harvest be allowed for this species, the effects of the **Preferred Alternative 4** Options would be similar to those described above for **Alternative 2**.

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 measures of stock status is routine for 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.

4.4.2 Action 4.2 – Optimum Yield for Red Drum

Preferred Alternative 1: No Action. Maintain the red drum optimum yield (OY) for red drum:

- All red drum recreationally and commercially harvested from state waters landed consistent with state laws and regulations under a goal of allowing 30% escapement of the juvenile population.

- All red drum commercially or recreationally harvested from the Primary Area of the exclusive economic zone (EEZ) under the total allowable catch (TAC) level and allocations specified under the provisions of the FMP, and a zero-retention level from the Secondary Areas of the EEZ. (Note: TAC for the EEZ has been set at zero since 1988.)

Alternative 2: For red drum, OY, implicitly accounting for relevant economic, social, or ecological factors, would be:

Option 2a: 85% of MSY or MSY_{Proxy}.
Option 2b: 90% of MSY or MSY_{Proxy}.
Option 2c: 95% of MSY or MSY_{Proxy}.

4.4.2.1 Direct and Indirect Effects on the Physical Environment

This action does not affect the gear used in the red drum fishery or how it is deployed. Therefore, this action would have no direct effects on the physical environment. However, the definition of OY could affect the long-term harvest levels, which could indirectly affect the physical environment.

Alternative 1 would maintain the OY definition put in place through Amendment 2 to the Red Drum FMP. Harvest levels would continue to be prohibited in federal waters and managed in state waters to achieve a 30% escapement rate, which is associated with managing the stock at 20% SPR. There would be no change to the current effects on the physical environment.

Alternative 2, **Options 2a-2c** would define OY as a fixed percentage of the red drum MSY or MSY proxy defined in Action 1. The percentage applied to MSY or MSY proxy would depend upon which Option is selected. **Option 2a** would set that percentage at the lowest level of MSY (85%), resulting in the lowest OY. If this smaller OY translates in the setting of lower catch levels, management actions might be needed to reduce fishing effort below levels associated with the higher OYs of **Option 2b** or **Option 2c**. This would likely reduce any adverse effects on the physical environment (fewer gear interactions). **Option 2c**, 95% of MSY, could have the greatest adverse effects on the physical environment if it influences catch levels and associated fishing effort to be higher (more gear interactions). **Option 2b**, 90% of MSY, would result in effects intermediate to **Option 2a** and **Option 2c**. 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**.

4.4.2.2 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. Management measures that would be required to maintain harvests at or below OY would produce biological/ecological impacts. 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.

Preferred Alternative 1 would maintain the OY definition put in place through Amendment 2 to the Red Drum FMP. Harvest levels would continue to be prohibited in federal waters and managed in state waters to achieve a 30% escapement rate. There would be no change to the current effects on the biological/ecological environment.

For **Alternative 2**, **Option 2a** is the most conservative of the OY proxies (85% of MSY or MSY proxy) and would result in management measures that would reduce fishing effort over the long-term the most and allow for the highest long-term stock biomass level 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 (95% of MSY) and would allow management measures with higher fishing effort levels and the lowest associated stock biomass level. Maintaining this OY proxy would be most averse to the biological/ecological environment of the **Alternative 2** Options. **Option 2b** (90% of MSY) is intermediate to **Options 2a** and **2c**.

The effects between **Preferred Alternative 1** and **Alternative 2** are dependent on what level of MSY is selected in Action 1. **Preferred Alternative 1** would be equivalent to Action 1, Alternative 4, Option 4a and would be equivalent to managing the stock at 20% SPR. Option 4b would manage the stock at 30% SPR. Option 4b would be inconsistent with **Preferred Alternative 1** as OY would be greater than MSY. Regardless of which option is selected in

Action 1, Alternative 4, any of the **Alternative 2** options would manage the stock at a more conservative level and provide better protection to the stock than **Preferred Alternative 1**.

4.4.2.3 Direct and Indirect Effects on the Economic Environment

Preferred Alternative 1 (No Action) would maintain the current OY definition for red drum. Therefore, **Preferred Alternative 1** would not be expected to result in economic effects (even if red drum harvest in federal waters is allowed).

Alternative 2 would define OY for red drum as a fixed percentage of MSY or proxy. The percentages considered range from 85% (**Option 2a**) to 95% (**Option 2c**). **Option 2b** would set OY at 90% of MSY or MSY proxy. The definition of OY for red drum would not be expected to affect fishing practices or harvest levels once harvest is permitted in the Gulf EEZ. Therefore, **Alternative 2** would not be expected to result in direct economic effects. However, once the future ACL for red drum is linked to the future OY definition, then **Alternative 2** would be expected to result in indirect economic effects. The direction as well as the size of these potential indirect economic effects would be determined by the relationship between the ACL and OY for red drum.

4.4.2.4 Direct and Indirect Effects on the Social Environment

Additional effects would not be expected under **Preferred Alternative 1** as the existing OY for red drum would be retained. No effects would be expected from any of the options under **Alternative 2**, as there is no allowable harvest of red drum from federal waters, and modifying OY would not be expected to result in changes to the availability of harvest opportunities in state waters. In the event harvest in federal waters would be opened in the future, it would be necessary to establish new reference points for the stock and to revisit OY.

4.4.2.5 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 red drum stock assuming equilibrium levels. Both alternatives would adversely affect the administrative environment.

Under **Preferred Alternative 1**, the red drum stock would be managed at a level approximately equivalent to 20% SPR level. However, to be consistent with Alternative 4 in Action 1, Option 4a would need to be selected such that MSY does not fall below OY. If Option 4b were selected as preferred, MSY and OY would be inconsistent and require further action by the Council and NMFS, adversely affecting the administrative environment.

Alternative 2 would set OY as a percentage of MSY or MSY proxy for the subject stocks and stock complexes. If **Alternative 2** is selected as preferred, further action may need to be taken no matter which Option is selected because OY would be less than the current management target based on 20% SPR. Further action regarding the stock may also need to be taken in the Red Drum FMP by the Council and NMFS relative to fishery management objectives. In addition, the Gulf states would need to revise their regulations to increase escapement percentages to the degree necessary to comply with the **Alternative 2** OY management target. Concerning the **Alternative 2** Options, the lower OY is set, the less likely any management measures based on that OY would allow the stock to become depleted and require a stock rebuilding plan. Therefore, of the **Alternatives 2** Options, **Option 2a** would be the least adverse to the administrative environment and **Option 2c** the most adverse. **Option 2b** would be intermediate to **Option 2a** and **Option 2c**.

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 (RFFA), 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 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 also should not affect red drum in federal waters as harvest of this species is prohibited. Red drum fishing in state waters is regulated by state marine resource agencies.

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

Other Fishery related actions - The cumulative effects from managing the reef fish fishery have been analyzed in Amendments 30A (GMFMC 2008b), 30B (GMFMC 2008a), 31 (GMFMC

2009), 32 (GMFMC 2011b), 40 (GMFMC 2014a), and 28 (GMFMC 2015b) and are incorporated here by reference. Amendment 3 is the last stand-alone amendment to the Red Drum FMP and was approved by the Council in May 1992 (GMFMC 1991). However, several generic amendments that included red drum and had a cumulative effects analysis have been approved since then and are: the Generic Sustainable Fisheries Act Amendment (GMFMC 1999), Generic Amendment Addressing The Establishment of the Tortugas Marine Reserves (GMFMC 2001), the Generic Amendment Number 3 for Addressing Essential Fish Habitat Requirements, Habitat Areas of Particular Concern, and Adverse Effects of Fishing (GMFMC 2005); Generic Annual Catch Limits/Accountability Measures Amendment (GMFMC 2011); and the Generic Amendment to the fishery management plans for the Gulf of Mexico and South Atlantic Regions for Modifications to Federally Permitted Seafood Dealer Reporting Requirements (GMFMC and SAFMC 2013). Additional pertinent past actions are summarized in the history of management (Section 1.3). RFFAs include: Amendments 36B and 36C, which would further revise the red snapper and grouper-tilefish commercial individual fishing quota programs; Amendment 51, which addresses gray snapper status determination criteria and ACLs; Amendment 52, which address red snapper allocation; Amendment 53, which would revise red grouper allocations and ACLs; action to revise the ABC control rule and framework procedures; and framework actions addressing lane snapper, historical captain's permits, and trolling in marine reserves. Descriptions of these actions can be found on the Council's website.[38]

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 developing.

Non-fishery related actions - Actions affecting the reef fish fishery have been described in previous cumulative effect analyses (e.g., Amendment 40). Four important events include impacts of the *Deepwater Horizon* MC252 oil spill, the Northern Gulf Hypoxic Zone, red tide and climate change. Reef fish species and red drum are mobile and are able to avoid hypoxic conditions, so any effects from the Northern Gulf Hypoxic Zone on these 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 status determination criteria and OY would have any significant cumulative effect given the primarily administrative function of this action. Although fish may be able to avoid high concentrations of red tide, red tide does cause fish kills primarily in coastal waters and these fish kills do include reef fish and red drum. They are most common off the central and southwestern coasts of Florida, they may occur anywhere in the Gulf. As with the *Deepwater Horizon* MC252 oil spill, it is unlikely that red tide in conjunction with the management criteria in this amendment 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 has numerous reports addressing

[38] http://gulfcouncil.org/

their assessments of climate change. [39] 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 proposed 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 would only minimally affect current fishing practices. Nor would this action be expected to have significant effects on the social and economic environments. Any negative effects would be expected to be minimal as the proposed actions, along with past and RFFAs, are not expected to alter the manner in which the reef fish fishery is prosecuted. Effects would not be expected for the red drum fishery as there is no allowable harvest in federal waters. Establishing or modifying the reference points for red drum would have no effect on the access to fishing opportunities provided in state waters. Because it is unlikely there would be any changes in how the fisheries are 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 Cumulative Effects Analysis 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.

[39] http://www.ipcc.ch/publications_and_data/publications_and_data.shtml

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GMFMC = Gulf of Mexico Fishery Management Council; NOAA GC = National Oceanic and Atmospheric Administration General Counsel; SEFSC = Southeast Fisheries Science Center; SERO = Southeast Regional Office of the National Marine Fisheries Service

CHAPTER 6. LIST OF AGENCIES, ORGANIZATIONS AND PERSONS CONSULTED

National Marine Fisheries Service
- Southeast Fisheries Science Center
- Southeast Regional Office
- Office for Law Enforcement

National Oceanic Atmospheric Administration General Counsel
United States Coast Guard
United States Fish and Wildlife Services
Texas Parks and Wildlife Department
Alabama Department of Conservation and Natural Resources/Marine Resources Division
Louisiana Department of Wildlife and Fisheries
Mississippi Department of Marine Resources
Florida Fish and Wildlife Conservation Commission

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APPENDIX A. 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 2011). For a more detailed description of the analysis, refer to the analysis report by Farmer and Malinowski (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 and Malinowski (2010) for purposes of establishing the stock complexes in the Generic ACL/AM Amendment (GMFMC 2011), and used here.

The objectives of the National Marine Fisheries Service (NMFS) stock groupings analysis specified in Farmer and Malinowski (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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APPENDIX B. ALTERNATIVES CONSIDERED BUT REJECTED

Further explanation of MSY proxies

Alternative MSY proxies can include proxies based on reference points other than SPR. Below is a brief description of some alternative reference points and the reasons why they are not being considered in this amendment.

Yield at maximum yield per recruit (F_{MAX})

In addition to SPR-based MSY proxies, SEDAR standard assessment for Gulf of Mexico (Gulf) vermilion snapper (SEDAR 45 2016) investigated two maximum yield-per-recruit based proxies for MSY. Maximum yield-per-recruit means the maximum pounds of fish that can be harvested per individual fish recruited to the stock. Computing F_{MAX} entails finding the fishing mortality rate and age at first capture (assuming knife-edge selectivity for a single fleet) that produces the maximum yield per recruit. In practice, F_{MAX} is not particularly useful as an MSY proxy for management purposes, because many of the assumptions made during its calculation are not reflective of reality. For example, F_{MAX} assumes knife-edge selectivity (i.e., all fish are caught at a specific size or age). In reality, the fishery consists of multiple fleets, operating with disparate non-knife-edged selectivities, which are overlaid with substantial bycatch and discard mortality. Furthermore, F_{MAX} is calculated assuming no stock recruitment relationship, which nearly always results in F_{MAX} overestimating F_{MSY} (Gabriel and Mace 1999). In the case of SEDAR 45 (Gulf vermilion snapper), setting the age at first capture to 3 or 4 years resulted in nearly the same yield-per-recruit and corresponded with SPR values of 13% and 20%, respectively (Figure B.1). Given the nearly identical yield-per-recruits associated with the two SPR values, the more conservative 20% SPR was the preferred result from the analysis. However, because this knife-edge age-based selectivity is dramatically different from the actual fleet selectivity dynamics, the Southeast Fisheries Science Center (SEFSC) recommended that these values should not be put forward as plausible alternatives for management[40].

[40] E-mail from Matthew Smith, SEFSC to Steven Atran, Gulf Council, dated July 11, 2016.

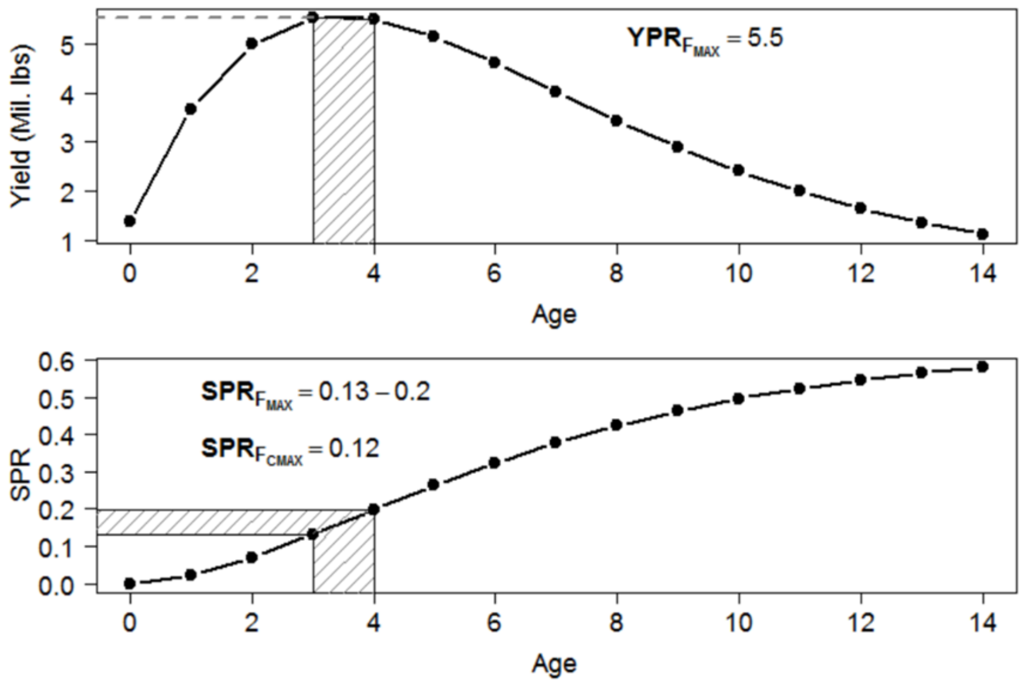

Figure B.1. Results of the global yield per recruit projections assuming a single fleet with optimal knife-edge selectivity at a given age, no bycatch or discards, and near infinite fishing mortality. The maximum yield occurs with recruitment to the fishery between ages 3 and 4 and results in a SPR between 13% and 20%. SPR associated with FCMAX analysis is displayed for reference.
Source: SEDAR 45 (2016)

Yield at conditional maximum yield per recruit (F_{CMAX})

In addition to F_{MAX}, which uses knife-edge selectivity at either age 3 or age 4, the fishing mortality rate that maximizes yield-per-recruit conditional on existing selectivity, bycatch, and discard patterns (F_{CMAX}) was calculated. Discards of the directed fleets were minimal and not incorporated into the model for SEDAR 45; however, bycatch from the shrimp fishery was included, and for the purpose of F_{CMAX} calculations, assumed to remain fixed at recent levels. Like the traditional F_{MAX} calculation, stock recruitment dynamics are not included in F_{CMAX} computations. F_{CMAX} was estimated to be 0.246 for Gulf vermilion snapper, which was projected to result in equilibrium SPR of 12%.

Despite the fact that F_{MAX}, for the reasons stated above, is generally a poor proxy for F_{MSY}, ongoing research being conducted at the SEFSC has shown that the estimated equilibrium spawning stock biomass (SSB_{MAX}) and corresponding SPR value associated with F_{MAX} can be considered minimum biomass thresholds for sustainable management. Consequently, the SEDAR 45 stock assessment report recommended that any F_{MSY} proxy used to manage Gulf vermilion snapper result in a SPR value greater than or equal to 20%. Consequently, when the results of SEDAR 45 were presented to the Scientific and Statistical Committee (SSC), SEFSC staff did not recommend the use of F_{CMAX} as a viable proxy for F_{MSY} since it resulted in an SPR value well below the 20% threshold associated with F_{MAX}.

Yield at $F_{0.1}$

Because of the issues associated with using F_{MAX}, an alternative referred to as $F_{0.1}$ was developed and promoted as a more prudent alternative (Gulland and Boerema 1973). Technically, $F_{0.1}$ is defined as the fishing mortality rate corresponding to 10% of the slope of the yield-per-recruit curve at the origin. Although $F_{0.1}$ is commonly interpreted as a conservative or cautious estimate of F_{MSY}, this is not always the case (Mace 1994; Mace and Sissenwine 1993). Even when $F_{0.1}$ does underestimate F_{MSY}, the equilibrium yields associated with the two reference points may be relatively very close (based on the argument that the difference between the equilibrium yields associated with F_{MAX} and $F_{0.1}$ are usually small, and F_{MSY} is usually less than F_{MAX}) (Gabriel and Mace 1999). Therefore, $F_{0.1}$ is also considered not to be plausible for management.

APPENDIX C. 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 management of stocks included in fishery management plans in federal waters of the exclusive economic zone. However, 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 include the Endangered Species Act and Marine Mammals Protection Act (Section 3.3), E.O. 12866 (Regulatory Planning and Review, Chapter 5) and E.O. 12898 (Environmental Justice, Section 3.5.2). Other applicable laws are summarized below.

Administrative Procedure Act

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

Coastal Zone Management Act

Section 307(c)(1) of the federal Coastal Zone Management Act of 1972 (CZMA), as amended, requires federal activities that affect any land or water use or natural resource of a state’s coastal zone be conducted in a manner consistent, to the maximum extent practicable, with approved state coastal management programs. The requirements for such a consistency determination are set forth in NOAA regulations at 15 CFR 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 of Commerce, NMFS will determine if this plan amendment is consistent with the Coastal Zone Management programs of the states of Alabama, Florida, Louisiana, Mississippi, and Texas to the maximum extent possible. Their determination will then be submitted to the responsible state agencies under Section 307 of the CZMA administering approved Coastal Zone Management programs for these states.

Data Quality Act

The Data Quality Act (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 Act directs the Office of Management and Budget 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.

Fish and Wildlife Coordination Act

Fish and Wildlife Coordination Act of 1934 (16 U.S.C. 661-667e) provides the basic authority for the USFWS's involvement in evaluating impacts to fish and wildlife from proposed water resource development projects. It also requires federal agencies that construct, license or permit water resource development projects to first consult with the Service (and NMFS in some instances) and State fish and wildlife agency regarding the impacts on fish and wildlife resources and measures to mitigate these impacts.

The fishery management actions in the Gulf of Mexico are not likely to affect wildlife resources pertaining to water resource development as the economic exclusive zone is from the state water boundary extending to 200 nm from shore.

National Historic Preservation Act

The National Historic Preservation Act (NHPA) of 1966, (Public Law 89-665; 16 U.S.C. 470 *et seq.*) is intended to preserve historical and archaeological sites in the United States of America. Section 106 of the NHPA requires federal agencies to evaluate the impact of all federally funded or permitted projects for sites listed on, or eligible for listing on, the National Register of Historic Places and aims to minimize damage to such places.

Typically, fishery management actions in the Gulf of Mexico are not likely to affect historic places with exception of the *U.S.S. Hatteras*, located in federal waters off Texas, which is listed in the National Register of Historic Places. Reef fish and red drum fishing does occur off Texas;

therefore, the proposed actions are a part of the normal fishing activities that occur at this site. Thus, no additional impacts to the *U.S.S. Hatteras* would be expected.

Executive Orders (E.O.)

E.O. 12630: Takings

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

E.O. 12962: Recreational Fisheries

This E.O. 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 (NRFCC) 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 NRFCC 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 E.O. requires NMFS and the USFWS to develop a joint agency policy for administering the ESA.

E.O. 13089: Coral Reef Protection

The E.O. on Coral Reef Protection requires federal agencies whose actions may affect U.S. coral reef ecosystems to identify those actions, utilize their programs and authorities to protect and enhance the conditions of such ecosystems, and, to the extent permitted by law, ensure actions that they authorize, fund, or carry out do not degrade the condition of that ecosystem. By definition, a U.S. coral reef ecosystem means those species, habitats, and other national resources associated with coral reefs in all maritime areas and zones subject to the jurisdiction or control of the United States (e.g., federal, state, territorial, or commonwealth waters).

Regulations are already in place to limit or reduce habitat impacts within the Flower Garden Banks National Marine Sanctuary. Additionally, NMFS approved and implemented Generic

Amendment 3 for Essential Fish Habitat (GMFMC 2005), which established additional habitat areas of particular concern (HAPCs) and gear restrictions to protect corals throughout the Gulf of Mexico. There are no implications to coral reefs by the actions proposed in this amendment.

E.O. 13132: Federalism

The E.O. on Federalism requires agencies in formulating and implementing policies, to be guided by the fundamental Federalism principles. The E.O. 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 E.O. 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).

No Federalism issues were identified relative to the action to modify the management of mutton snapper and gag. Therefore, consultation with state officials under Executive Order 12612 was not necessary. Consequently, consultation with state officials under Executive Order 12612 remains unnecessary.

E.O. 13158: Marine Protected Areas

This E.O. 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, HAPCs, and gear-restricted areas in the eastern and northwestern Gulf of Mexico. The existing areas are entirely within federal waters of the Gulf of Mexico. They do not affect any areas reserved by federal, state, territorial, tribal or local jurisdictions.