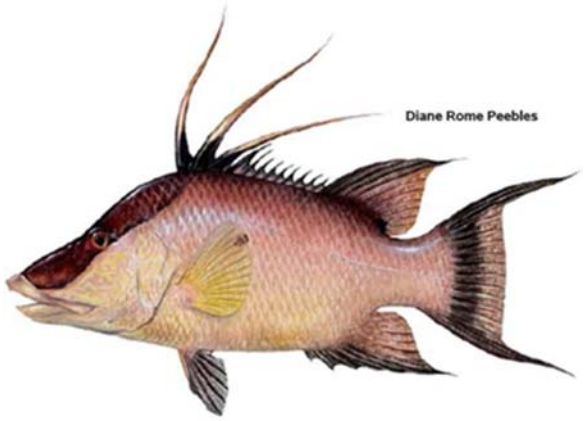
Tab B, No. 5
1/14/2016

Hogfish Stock Definition, Status Determination Criteria, Annual Catch Limit, and Size Limit



Draft Amendment 43

to the Fishery Management Plan for the Reef Fish Resources of the Gulf of Mexico

January 2016

This is a publication of the Gulf of Mexico Fishery Management Council Pursuant to National Oceanic and Atmospheric Administration Award No. NA15NMF4410011.

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ENVIRONMENTAL ASSESSMENT COVER SHEET

Name of Action

Draft Amendment 43 to the Fishery Management Plan for the Reef Fish Resources of the Gulf of Mexico: Hogfish Stock Definition, Status Determination Criteria, Annual Catch Limit, and Size Limit, including Environmental Assessment, Fishery Impact Statement, Regulatory Impact Review, and Regulatory Flexibility Act Analysis

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Type of Action

( ) Administrative
(X) Draft

( ) Legislative
( ) Final

ABBREVIATIONS USED IN THIS DOCUMENT

ABC	Acceptable biological catch
ACL	Annual catch limit
ACT	Annual catch target
ALS	Accumulated Landings System
AMs	Accountability measures
APA	Administrative Procedures Act
B	Biomass
B_{MSY}	Stock biomass level capable of producing an equilibrium yield of MSY
CDT	Commercial decision tool
CI	Confidence interval
Council	Gulf of Mexico Fishery Management Council
CPUE	Catch per unit effort
CS	consumer surplus
CZMA	Coastal Zone Management Act
DQA	Data Quality Act
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EFH	Essential fish habitat
EIS	Environmental impact statement
EJ	Environmental justice
ELMR	Estuarine living marine resources
ESA	Endangered Species Act
F	Instantaneous rate of fishing mortality
FL	fork length
FLS	Federal logbook system
F_{MSY}	Fishing mortality rate corresponding to an equilibrium yield of MSY
F_{OY}	Fishing mortality rate corresponding to an equilibrium yield of OY
$F_{30\% SPR}$	Fishing mortality corresponding to 30% spawning potential ratio
FMP	Fishery Management Plan
FTE	Full time equivalent
FWRI	Florida Wildlife Research Institute
GMFMC	Gulf of Mexico Fishery Management Council
HAPC	Habitat area of particular concern
HBS	Headboat Survey
IRFA	Initial regulatory flexibility analysis
LOF	List of fisheries
lq	location quotient
M	Mortality
Magnuson-Stevens Act	Magnuson-Stevens Fishery Conservation and Management Act
MFMT	Maximum fishing mortality threshold
MMPA	Marine Mammal Protection Act
mp	million pounds
MRFSS	Marine Recreational Fisheries Survey and Statistics
MRIP	Marine Recreational Information Program

MSST	Minimum stock size threshold
MSY	Maximum sustainable yield
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	Same as NMFS
nm	nautical mile
NOR	net operating revenues
NOS	National Ocean Service
NS1	National Standard 1 guidelines
OFL	Overfishing level
OMB	Office of Management and Budget
OY	Optimum yield
PCA	Principal component analysis
PRA	Paperwork Reduction Act
PS	Producer surplus
Pw	Product weight
QMS	Quota Monitoring System
RA	Regional Administrator
RFA	Regulatory Flexibility Act of 1980
RIR	Regulatory impact review
rq	regional quotient
SAV	Submerged aquatic vegetation
Secretary	Secretary of Commerce
SEDAR	Southeast Data, Assessment and Review
SEFSC	Southeast Fisheries Science Center
SERO	Southeast Regional Office
SMZ	Special Management Zone
SSBR	Spawning stock biomass per recruit
SSC	Scientific and Statistical Committee
SPR	Spawning potential ratio
TAC	Total allowable catch
TPWD	Texas Parks and Wildlife Department
ww	whole weight
YPR	Yield per recruit

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CHAPTER 1. INTRODUCTION

1.1 Background

In 2004, a hogfish stock assessment (SEDAR 6) was prepared by the University of Miami under contract to the Florida Fish and Wildlife Conservation Commission (FWC). However, when it was submitted to a SEDAR review panel, several errors in the analyses were discovered. Among the errors in the assessment; some of the age-length data was not handled correctly; the use of recreational catch rates based on hook-and-line catches was inappropriate given that spearfishing is the dominant method used to harvest hogfish; and the commercial catch-per-unit-index did not account for the implementation of a minimum size limit in 1994[1]. Consequently the SEDAR Review Panel was unable to provide management advice based on the assessment other than a qualitative suggestion that an increase in the size limit would likely give an increase in the yield to the fishery, and the Standing and Special Reef Fish Scientific and Statistical Committee (SSC) rejected the assessment as not being the best scientific information available[2].

The 2015, FWC conducted a new benchmark assessment for hogfish (SEDAR 37). This assessment divided hogfish into three stocks based upon genetic analysis. The three stocks were defined as:

- West Florida stock.
- East Florida/ Florida Keys stock.
- Georgia through North Carolina stock

Although hogfish occur throughout the Gulf of Mexico (Gulf), they are caught primarily off the Florida coast. Only small amounts of commercial and recreational hogfish landings have been reported from the other Gulf states (SEDAR 37 2013).

The assessment evaluated the stock status as of 2012 relative to several reference points: F_{MSY}, $F_{30\% SPR}$, $F_{35\% SPR}$, and $F_{40\% SPR}$. The Gulf hogfish stock has a maximum fishing mortality threshold (MFMT) of $F_{30\% SPR}$, but the minimum stock size threshold (MSST) is currently undefined. SEDAR 37 determined the status of the three hogfish stocks as follows:

- West Florida shelf (Gulf) stock: Under all reference points the stock is not overfished. The stock is experiencing overfishing at the $F_{40\% SPR}$ reference point, but is not experiencing overfishing under the other reference points.
- East Florida/Florida Keys stock: Under all reference points, the stock is overfished and experiencing overfishing.
- Georgia-North Carolina stock: The stock is overfished under all of the reference points except the F_{MSY} point. Under all reference points, the stock is experiencing overfishing.

[1] Testimony from SEDAR 6 Review Panel representative Mike Murphy to the Reef Fish Committee at the May 2004 Council meeting.
[2] Minutes of the April 29, 2004 Standing and Special Reef Fish SSC meeting

A small portion of the east Florida/Florida Keys stock extends into the Gulf Council's jurisdiction in south Florida, and would need to be included in the rebuilding plan that the South Atlantic Fishery Management Council is currently developing. When the Gulf Council's Scientific and Statistical Committee (SSC) reviewed the hogfish stock assessment, it felt that the South Atlantic SSC should take the lead in setting the overfishing limit (OFL) and acceptable biological catch (ABC) for that stock, and focused their attention on the west Florida shelf (Gulf) portion of the stock assessment. The assessment projections produced annual yields for OFL and ABC for the Gulf stock for 2016 through 2026 based on an overfishing threshold of $F_{30\% SPR}$. However, due to increasing uncertainty with long-range projections, the SSC only provided OFL and ABC yields for three years, 2016 through 2018.

The OFL is the yield when the stock is fished at F_{MSY} or the F_{MSY} proxy, is the yield beyond which overfishing is occurring, and is determined as part of the stock assessment output. However, there is always scientific uncertainty as to the true value of OFL. Consequently, ABC is a yield set below the OFL to take into account the scientific uncertainty. To determine the ABC yield, the SSC used the ABC control rule developed in the Generic Annual Catch Limits/Accountability Measures Amendment (GMFMC 2011). For the hogfish stock, the level for probability of overfishing (P*) was set at 0.4 based on the results of the tier 1 analysis in the control rule, and a coefficient of variance (CV) of 0.37 was used based on the results of pooled assessments compiled by the Pacific Fishery Management Council for stocks in their jurisdiction. The resulting annual OFL and ABC yields plus the equilibrium yields are shown in Table 1.1.

Table 1.1.1. OFL and ABC for west Florida shelf stock of hogfish for 2016-2018, plus equilibrium yields

Year	OFL	ABC
2016	257,100 lbs ww	240,400 lbs ww
2017	229,400 lbs ww	216,800 lbs ww
2018	211,000 lbs ww	200,800 lbs ww
Equilibrium	161,900 lbs ww	159,261 lbs ww

Source: Summary report of the May 20, 2015 meeting of the SSC.

1.2 Purpose and Need

The purpose is to consider: redefining the geographic range of the Gulf of Mexico hogfish stock, allowing the East Florida/Florida Keys stock to be managed as a single unit throughout its range; setting status determination criteria (maximum fishing mortality threshold, minimum stock size threshold, and maximum sustainable yield proxy); setting annual catch limits and annual catch targets based on a recent stock assessment (SEDAR 37) for the Gulf of Mexico hogfish stock; and revising the hogfish minimum size limit to reduce the likelihood of a season closure due to the annual catch limit being reached.

The need is to establish a stock definition that is consistent with the best scientific information available, to prevent overfishing, to adjust annual catch limits consistent with the SEDAR 37 stock assessment, and to achieve optimum yield consistent with the requirements of the Magnuson-Stevens Fishery Conservation and Management Act.

1.3 History of Management

This history of management covers events pertinent to the hogfish management unit, status determination criteria, annual catch limit, and minimum size limit. A complete history of management for the Fishery Management Plan (FMP) for the Reef Fish Resources of the Gulf of Mexico is available on the Council's website: http://www.gulfcouncil.org/fishery_management_plans/reef_fish_management.php including recent hogfish actions. The final rule for the Reef Fish FMP (with its associated environmental impact statement [EIS]) (GMFMC 1981) was effective November 8, 1984. Currently, the commercial sector fishing for hogfish is regulated by a 12-inch fork length (FL) minimum size limit. Recreational fishing for hogfish is managed with a 12-inch FL minimum size limit, 5-fish bag limit, and a season beginning on January 1 and ending when the recreational annual catch target is projected to be caught. Other reef fish fishery management measures that affect hogfish fishing include permit requirements for the commercial and for-hire sectors as well as season-area closures (see Section 3.1).

Hogfish management unit: Hogfish were labeled a species included in the fishery, but not in the fishery management unit in the original FMP. Hogfish were not added to the management unit until **Amendment 16B** (GMFMC 1999a; with its associated environmental assessment [EA], regulatory impact review [RIR], and regulatory flexibility analysis [RFA]). The rulemaking from this amendment was effective in November 1999.

Status determination criteria: The **Generic Sustainable Fisheries Act Amendment** (GMFMC 1999b; EA/RIR/RFA), was partially approved and implemented in November 1999. It set the MFMT for most reef fish stocks including hogfish at $F_{30\% SPR}$. Estimates of maximum sustainable yield, MSST, and optimum yield were disapproved because they were based on spawning potential ratio proxies rather than biomass based estimates.

Annual catch limits (ACL) and annual catch targets (ACT): The **Generic ACL/AM Amendment** (GMFMC 2011a), established a hogfish overfishing limit (OFL), ACL, and ACT. Hogfish were classified as a Tier 3a species in the Council's ABC control rule. This tier is applied to stocks where no assessment is available, but landings data do exist, and recent landings do appear sustainable. As a Tier 3a species, the OFL was set equal to the mean of 1999-2008 landings plus two standard deviations and equaled 0.272 mp ww. To account for scientific uncertainty, the Council's Scientific and Statistical Committee (SSC) applied the default buffer from the OFL using the formula ABC = mean of the landings plus 1.0 * standard deviation. This resulted in an ACL of 0.208 mp ww and a risk of exceeding OFL of 16%. This amendment also established an ACT for hogfish using the ACL/ACT control rule to account for management uncertainty. The control rule indicated a 14% buffer should be applied to the ACL resulting in an ACT of 0.179 mp ww.

Minimum size limit: The 12-inch FL minimum size limit (as well as the 5-fish bag limit) were implemented through Amendment 16B (GMFMC 1999) which also added the species to the fishery management unit (see discussion above).

CHAPTER 2 - ACTIONS AND ALTERNATIVES

2.1 Action 1 – Definition of the Management Unit

Alternative 1: No Action. The hogfish management unit in the Reef Fish FMP remains defined as all hogfish found in the Gulf of Mexico north and west of the GMFMC/SAFMC jurisdictional boundary.

Alternative 2: South of Cape Sable. The hogfish management unit in the Reef Fish FMP is defined as the west Florida shelf (or Gulf of Mexico) stock of hogfish. The geographical range of this unit is all waters of the Gulf of Mexico north of a line extending west from **25° 09' north latitude** to the outer boundary of the EEZ and northward and westward throughout the rest of the Gulf of Mexico.

Alternative 3: Shark Point. The hogfish management unit in the Reef Fish FMP is defined as the west Florida shelf (or Gulf of Mexico) stock of hogfish. The geographical range of this unit is all waters of the Gulf of Mexico north of a line extending west from **25° 23' north latitude** to the outer boundary of the EEZ and northward and westward throughout the rest of the Gulf of Mexico.

Alternative 4: Monroe/Collier county line. The hogfish management unit is the west Florida shelf (or Gulf of Mexico) stock of hogfish. The geographical range of this unit is defined as all waters of the Gulf of Mexico north of a line extending west from **25° 48' north latitude** to the outer boundary of the EEZ and northward and westward throughout the rest of the Gulf of Mexico.

Note: Under **Alternative 2**, **Alternative 3**, or **Alternative 4**, the Council will request the Secretary of Commerce designate the South Atlantic Fishery Management Council as the responsible Council for hogfish below the demarcation line.

Discussion:

The Reef Fish FMP includes a list of stocks in the management unit, but currently it does not explicitly define the geographic range of the management unit for each stock. Rather, for each stock listed the management unit, it includes all individuals in the Gulf of Mexico (Gulf). This implies that all of the individual fish are part of a single stock. However, the SEDAR 37 hogfish stock assessment (SEDAR 37 2013) identified three stocks based upon recent genetic analyses; Georgia/North Carolina, east Florida/Florida Keys, and west Florida shelf. The division between the west Florida shelf stock and the east Florida/Florida Keys stock occurs somewhere between Naples and the Florida Keys (Seyoum et al. 2014). The assessment used the Monroe/Collier county line, which is 21 nm south of Naples, as the dividing line between the west Florida shelf stock and the east Florida/Florida Keys stock. The assessment concluded that the west Florida shelf hogfish stock was neither overfished nor undergoing overfishing (except under the most conservative overfishing threshold of $F_{40\% SPR}$). The east Florida/Florida Key stock, however, was overfished and undergoing overfishing, and in need of a rebuilding plan.

Alternative 1 leaves the hogfish stock as all individuals in the Gulf. The jurisdictional boundary between the Gulf and South Atlantic councils follows in part along 24º 35' north latitude. This is 73 nautical miles (nm) south of the Monroe/Collier county line, which was the demarcation used in the SEDAR 37 stock assessment between the west Florida and east Florida/Florida Keys stocks. This alternative continues the implicit assumption that all hogfish in the Gulf are part of a single stock. This is inconsistent with the SEDAR 37 (2013) stock assessment, which determined that there are two hogfish stocks off the coast of Florida, with a dividing line south of Naples. While the west Florida shelf hogfish stock was found to be neither overfished nor undergoing overfishing (except under the most conservative overfishing threshold), the east Florida/Florida Keys stock was found to be both overfished and undergoing overfishing. This will require different management strategies and a rebuilding plan for those hogfish that comprise the east Florida/Florida Keys stock.

Alternatives 2, 3, and 4 define a boundary off southwest Florida below which the Gulf stock is undefined. Hogfish in this region will not be part of the reef fish fishery management unit, and will not be subject to management under the Reef Fish FMP. It is the intent of the Council that under **Alternatives 2, 3, and 4**, the Council will request the Secretary of Commerce to designate the South Atlantic Fishery Management Council as the responsible Council for hogfish below the demarcation line.

Alternative 2 defines the boundary for the hogfish management unit in the Gulf off Florida at 25° 09' north latitude, which is just south of Cape Sable on the west coast of Florida. It is 38 nm south of the Monroe/Collier county line. This line is currently used by the Florida Fish and Wildlife Conservation Commission (FWC) as a regulatory boundary for state managed species such as permit. It is also considered by FWC to be far enough north of the Keys and far enough south of Naples and Marco Island so that regulatory issues are not simply shifted north to Collier County. However, this creates a discontinuity with the SEDAR 37 stock assessment, which used the Monroe/Collier county line as the demarcation between hogfish stocks. The further south from the Monroe/Collier county line the boundary is set, the greater the discontinuity between the assessment and management, and the greater the likelihood that part of the east Florida/Florida Keys stock will be under Gulf Council jurisdiction rather than South Atlantic Council.

Alternative 3 defines the boundary for the hogfish management unit in the Gulf off Florida at 25° 23' north latitude, which corresponds to the Shark Point reference point in the Everglades on the west coast of Florida. It is 25 nm south of the Monroe/Collier county line. According to information provided by Council members, fishing trips originating south of this boundary rarely travel north of the boundary, and trip originating north of the boundary rarely travel south. Therefore, this boundary serves as a natural demarcation for fishermen, although there is some discontinuity with the stock assessment boundary. As with the previous alternative, this boundary creates a discontinuity with the SEDAR 37 stock assessment, which used the Monroe/Collier county line as the demarcation between hogfish stocks. However, the discontinuity is not as great (25 nm vs. 38 nm).

Alternative 4 defines the boundary for the hogfish management unit in the Gulf off the Monroe/Collier County line, which is consistent with the boundary used by the SEDAR 37 (2014) stock assessment. Commercial ALS, Florida trip ticket, MRFSS, and MRIP landings can all be resolved to the county level, allowing landings reports to be consistent with the stock boundary. However, unlike **Alternative 3**, vessels leaving from ports near this boundary may travel either north or south. Consequently, the region where the fish are landed may not necessarily reflect the region where they were caught.

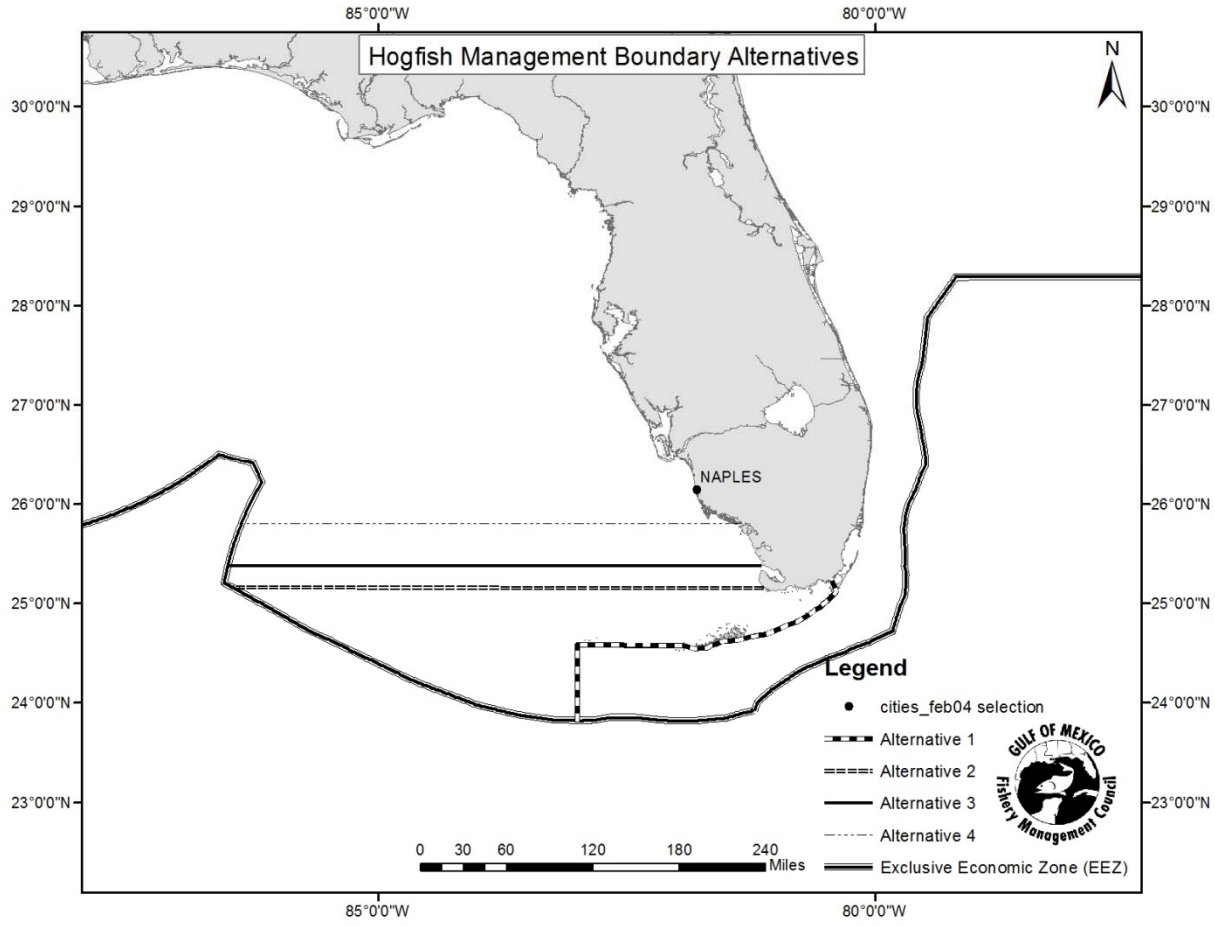

Figure 2.1.1. Hogfish management boundary alternatives

2.2 Action 2 –Status Determination Criteria for Hogfish in the Gulf of Mexico Fishery Management Unit

Alternative 1: No Action. Maximum sustainable yield (MSY) is undefined, minimum stock size threshold (MSST) is undefined, and maximum fishing mortality threshold (MFMT) = $F_{30\% SPR}$ where F is fishing mortality rate and SPR is spawning potential ratio.

Alternative 2: MSY = the point estimate of MSY in the most recent stock assessment.
MFMT = F_{MSY} in the most recent stock assessment
MSST =
Option 2a: (1-M)*SSB_{MSY}, where M (natural mortality rate) = 0.179 and SSB is the spawning stock biomass
Option 2b: 0.75*SSB_{MSY}
Option 2c: 0.50*SSB_{MSY}

Alternative 3: MSY = equilibrium yield at $F_{30\% SPR}$
MFMT = $F_{30\% SPR}$
MSST =
Option 3a: (1-M)*$SSB_{30\% SPR}$, where M = 0.179
Option 3b: 0.75*$SSB_{30\% SPR}$
Option 3c: 0.50*$SSB_{30\% SPR}$

Alternative 4: MSY = equilibrium yield at $F_{40\% SPR}$
MFMT = $F_{40\% SPR}$
MSST =
Option 4a: (1-M)*$SSB_{40\% SPR}$, where M = 0.179
Option 4b: 0.75*$SSB_{40\% SPR}$
Option 4c: 0.50*$SSB_{40\% SPR}$

Discussion:

The formula will be the controlling factor for defining the status determination criteria. The point values may change if a new stock assessment provides additional information, but as of SEDAR 37, the point values for each of the above alternatives are shown in Table 2.2.1.

Table 2.2.1 Status determination criteria values for several MSY proxies.

	Alt. 1 Proxy undef.	Alt. 2 Model MSY	Alt. 3 30% SPR	Alt. 4 40% SPR
MSY (1000 lb ww)	n/a	169	162	146
MFMT	0.095	0.150	0.095	0.062
Equilibrium SSB (1000 lb ww)	n/a	1,027	1,591	2,215
MSST (1000 lb ww)				
Option a	n/a	844	1,306	1,819
Option b	n/a	771	1,193	1,661
Option c	n/a	514	795	1,108

Source: SEDAR 37, Table 11.2.7.1.1. and NMFS SERO.

Current Stock Status

The west Florida hogfish stock is neither overfished nor undergoing overfishing under all of the Action 2 alternatives for status determination criteria. The current fishing mortality rate (based on the geometric mean for 2010-2012) is below all Action 2 options for the maximum fishing mortality threshold (MFMT) of F_{MSY} (or proxy). The spawning stock biomass (SSB) as of 2012 is estimated at 2.955 mp. This is above all Action 2 options for the minimum stock size threshold (MSST) (Table 2.2.1) and is also above the equilibrium stock size for all of the proxies capable of supporting maximum sustainable yield, SSB_{MSY} (or proxy) (Table 2.2.1).

MSY is defined in the National Standard Guidelines as the largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological, environmental conditions and fishery technological characteristics (e.g., gear selectivity), and the distribution of catch among fleets. MSY can usually be calculated within a stock assessment, but a confident estimate requires a strong stock-recruit relationship. If the spawner/recruit relationship is weak or uncertain, which is often the case, then a proxy can be used.

Alternative 1 leaves MSY and MSST undefined. MFMT was defined under the Sustainable Fisheries Act Generic Amendment (GMFMC 1999). These status determination criteria are required under the National Standard 1 guidelines for each stock being managed. If left undefined in this amendment, these criteria can be defined in the Minimum Stock Size Threshold Amendment which is currently under development.

Alternative 2 uses the model generated estimate of MSY. This produces the highest yield levels but at the lowest level of spawning stock biomass. The SEDAR 37 assessment did not make a recommendation as to whether the stock-recruit relationship was strong enough to use the estimated MSY. However, the assessment noted that the model produced relatively stable SSB levels predicted throughout the model period. This lack of contrast in stock-recruit data additionally led to a relatively flat likelihood profile for steepness in this stock and the sensitivity run where the steepness prior was removed led steepness to be estimated near the upper bounds of h=.9999. Under these conditions there is essentially no discernable relationship between stock and recruitment, and an MSY proxy is generally used.

Alternative 3 sets the MSY proxy at a conservative level and uses the equilibrium yield from fishing at $F_{30\% SPR}$. This is the proxy used for most Gulf reef fish stocks, and is consistent with the current MFMT for hogfish (MFMT= $F_{30\% SPR}$). This MFMT value was set in 1999 under the Generic Sustainable Fisheries Act Amendment (GMFMC 1999). However the MSST and a MSY proxy proposed in that amendment were disapproved by NMFS and are currently undefined. The Scientific and Statistical Committee (SSC) usually recommends MSY proxies in the 30% to 40% SPR range. This alternative would make the MSY proxy and MSST consistent with the MFMT.

Alternative 4 sets the MSY proxy at a more conservative level compared to **Alternative 3**. It would set the MSY proxy at the equilibrium yield from fishing at $F_{40\% SPR}$. This is at the upper end of the range of SPR proxies recommended by the SSC, but is more commonly used as a

proxy for optimum yield than for MSY. If this alternative is adopted, then based on the SEDAR 37 stock assessment, the current fishing mortality rate for hogfish exceeds $F_{40\% SPR}$, and the stock is therefore experiencing overfishing. The SSC would need to reevaluate its acceptable biological catch (ABC) recommendation, and the Council would likely be required to take action to end overfishing.

Under **Alternatives 2, 3, and 4**, three options are provided for determining MSST. In each option, MSST is set to (1-M)*SSB_{MSY} or proxy (**Options 2a, 3a, and 4a**), 75% of SSB_{MSY} or proxy (**Options 2b, 3b, and 4b**), or 50% of SSB_{MSY} or proxy (**Options 2c, 3c, and 4c**). The resulting MSST biomass levels corresponding to each option are shown in Table 2.2.1.

All of the options under each alternative provide benefit to the stock by declaring the stock overfished at some point of decline, thereby requiring a rebuilding plan be implemented. **Options 2a, 3a, and 4a** provide an MSST that is closest to the respective SSB_{MSY} or proxy. This provides the greatest benefit to the stock by declaring the stock overfished at an early stage of decline. However, they provide the highest likelihood of a stock being declared overfished due to year-to-year fluctuations in biomass. **Options 2b, 3b, and 4b** provide less benefit to the stock by declaring the stock overfished at an intermediate stage of decline. However, there is less likelihood of a stock being declared overfished due to year-to-year fluctuations, and greater management flexibility to reverse a decline before the stock becomes declared overfished. If the stock does fall below MSST and is declared overfished, it may require a more restrictive rebuilding plan than without the overfished determination. **Options 2c, 3c, and 4c** provide the least benefit to the stock by setting MSST at lowest level allowed under the Magnuson-Stevens Act and National Standard Guidelines. This allows the stock to drop to a large decline before being declared overfished. However, this also allows the greatest management flexibility to reverse a decline before the stock becomes declared overfished.

In summary, for each alternative, **Option a** provides the greatest benefit to the stock. **Option b** provides intermediate benefits to the stock. **Option c** provides the least benefits to the stock. However, decreased benefit to the stock is offset by increased flexibility for management to take less restrictive action to stop a decline than might be required under an overfished determination and rebuilding plan.

For each set of options, **Options 2a, 3a, and 4a** provide the same proportional reduction from the respective SSB_{MSY} or proxy, and therefore have the same relative impacts. This also applies to **Options 2b, 3b, and 4b**, and to **Options 2c, 3c, and 4c**.

The Council is working on a separate amendment to define MSST for all stocks. The MSST options in this action mirror the alternatives presently being considered in the MSST amendment.

2.3 Action 3 – Annual Catch Limit and Annual Catch Target for Hogfish

Alternative 1: No Action. ACL = 208,000 lbs ww, and ACT = 179,000 lbs ww. Weights are based on the Generic ACL/AM Amendment and Tier 3a (using 1999-2008 landings) of the ABC control rule.

Alternative 2: ACL equals the ABC for each year 2016-2018. The ACL for years following 2018 will then revert to the equilibrium ABC yield until modified by rulemaking.

2016 ACL = 240,400 lbs ww
2017 ACL = 216,800 lbs ww
2018 ACL = 200,800 lbs ww
2019+ ACL = 159,300 lbs ww

Option 2a: ACT will not be defined

Option 2b: ACT will be set based on the ACL/ACT control rule at 87% of the ACL

Alternative 3: A constant catch ACL is set at 219,000 lbs ww based on the constant catch ABC recommendation for the years 2016-2018 of the SSC. The ACL for years following 2018 will then revert to the equilibrium ABC yield of 159,300 lbs ww until modified by rulemaking.

Option 3a: ACT will not be defined

Option 3b: ACT will be set based on the ACL/ACT control rule at 87% of the ACL.

Alternative 4: A constant catch ACL is set at the equilibrium ABC level of 159,300 lbs ww. This ACL will remain in place in subsequent years until modified by rulemaking.

Option 4a: ACT will not be defined

Option 4b: ACT will be set based on the ACL/ACT control rule at 87% of the ACL.

Discussion:

Alternatives 2, 3, and 4 each include an option to set an ACT at 87% of the ACL. The ACT yields for each of these options is shown in Table 2.3.1.

Table 2.3.1. Annual catch targets (corresponding to 87% of ACL) under Option b for Alternatives 2, 3, and 4.

Year	ACT		
	Option 2b	**Option 3b**	**Option 4b**
2016	209,100	190,500	138,600
2017	188,600	190,500	138,600
2018	174,700	190,500	138,600
2019+	138,600	138,600	138,600

Yields are in lbs ww.

Under **Alternative 1**, the hogfish ACL and ACT will remain at the levels established in 2012 under the Generic Annual Catch Limits/Accountability Measures Amendment (GMFMC 2011a). These catch levels were set using ABC control rule tier 3a, a data poor method. The mean catch from 1999-2008 was calculated (mean = 143,500 lbs ww) and a standard deviation was calculated. The ACT was set at the mean plus one standard deviation (179,000 lbs ww) and the ACL was set at the mean plus two standard deviations (208,000 lbs ww). This allowed the stock some leeway to fluctuate above the mean landings. From 1986 through 2014, hogfish landings in the Gulf (excluding Monroe County) have ranged from 59,667 lbs ww to 366,615 lbs ww. Since the ACL was implemented in 2012, landings have averaged 190,724 lbs ww, and exceeded the 208,000 lb. ACL in one of the three years (2013) (Table 2.3.2)

Based on the SEDAR 37 convention of counting Monroe County landings as part of the east Florida/Florida Keys stock, hogfish landed in Monroe County, which previously accounted for about half the Gulf landings, are now counted as south Atlantic landings. Hogfish caught in the Keys have been smaller than average that hogfish caught in the rest of the Gulf. However, hogfish landed in Monroe County are included in the average weight estimate for Gulf hogfish (personal communication Nick Farmer). As a result, the estimates of pounds landed by the recreational sector may be underestimated. Table 2.3.2 shows the historical landings for Gulf-caught hogfish.

Alternative 2 sets an annual ABC for each year from 2016 through 2018 based on the annual yield projections recommended by the SSC when fishing at a constant fishing mortality rate. The overfishing limit (OFL) was set at the yield when fishing at $F_{30\% SPR}$, and the ABC was set a level below OFL to reduce the probability of overfishing to 40% (P* = 0.40). The ACL is set at ABC. If the Council chooses to set an MFMT other than $F_{30\% SPR}$, the SSC will need to reevaluate its ABC recommendation. The stock spawning stock biomass (SSB) is currently above its maximum sustainable yield (MSY) level, so this rate of fishing is projected to gradually reduce the stock to slightly above its MSY level (Figure 2.3.1). If there is no new stock assessment by 2018 (no assessment is currently planned), the ABC and ACL will revert to the equilibrium ABC level of 159,300 lbs ww. This is because, although the SSC recommended only three years of ABCs, the projected yield trend continues downward for several years (Figure 2.3.1). Maintaining the 2018 ABC and ACL indefinitely in the absence of a new assessment would likely to result in overfishing. For that reason, the SSC recommended at its September 2015 meeting that, if at the end of an ABC projection period, no new assessment is available, and the equilibrium ABC is below the ABCs for the projected period, the ABC should revert to the equilibrium ABC.

Table 2.3.2. Hogfish landings 1986-2014, with projected 2016 landings. Units are in lbs ww.

Year	Recreational Landings	Commercial Landings	Total Landings
1986	116,228	25,437	141,665
1987	190,156	28,713	218,869
1988	151,232	27,478	178,710
1989	121,167	55,301	176,468
1990	38,596	61,481	100,077
1991	238,806	53,974	292,780
1992	232,194	64,789	286,983
1993	224,964	94,073	319,037
1994	135,262	58,935	194,197
1995	181,757	25,408	207,165
1996	65,977	20,650	86,627
1997	117,811	23,401	141,212
1998	99,697	15,942	115,639
1999	120,607	23,111	143,718
2000	71,574	21,108	92,682
2001	110,311	27,059	137,370
2002	76,350	30,387	106,737
2003	205,684	28,036	233,720
2004	76,852	25,254	102,106
2005	45,547	20,110	65,657
2006	44,349	15,630	59,979
2007	48,849	18,112	66,961
2008	167,431	24,150	191,581
2009	97,656	32,316	129,972
2010	195,357	34,926	230,283
2011	72,500	45,995	118,495
2012	144,591	42,989	187,580
2013	242,292	24,874	267,166
2014	82,977	34,533	117,510
2015	*incomplete*	*incomplete*	*incomplete*
2016	*156,620*	*34,132*	*190,752*

Source: NMFS Southeast Regional Office, ACL dataset (October 2015)
Recreational landings have Monroe County landings included in Gulf mean weight computations but are excluded from Gulf landings, consistent with SEFSC Recreational ACL Datasets 2016-on. 2015 landings are incomplete. 2016 landings estimate are the average of 2012-2014

The Council can choose to either use an optional annual catch target (ACT) (**Option 2b**), or to not use an ACT (**Option 2a**). If used, the ACT would be set at 87% of the ACL based on the ACL/ACT control rule (Figure 2.3.3). This control rule evaluates several components of

management uncertainty under a point system and converts the point to an ACT buffer of between 0% and 25% below the ACL. Some stocks, such as red snapper, have an accountability measure that sets the season or other management measures based on the ACT in order to reduce the likelihood of the ACL being exceeded if there is an overage. There is no such accountability measure for hogfish, and therefore the ACT has no function. The accountability measure for hogfish is to monitor landings. If landings exceed the ACL in a given year, then in the subsequent year the season will be closed at such time as is projected to prevent the ACL from being exceeded again.

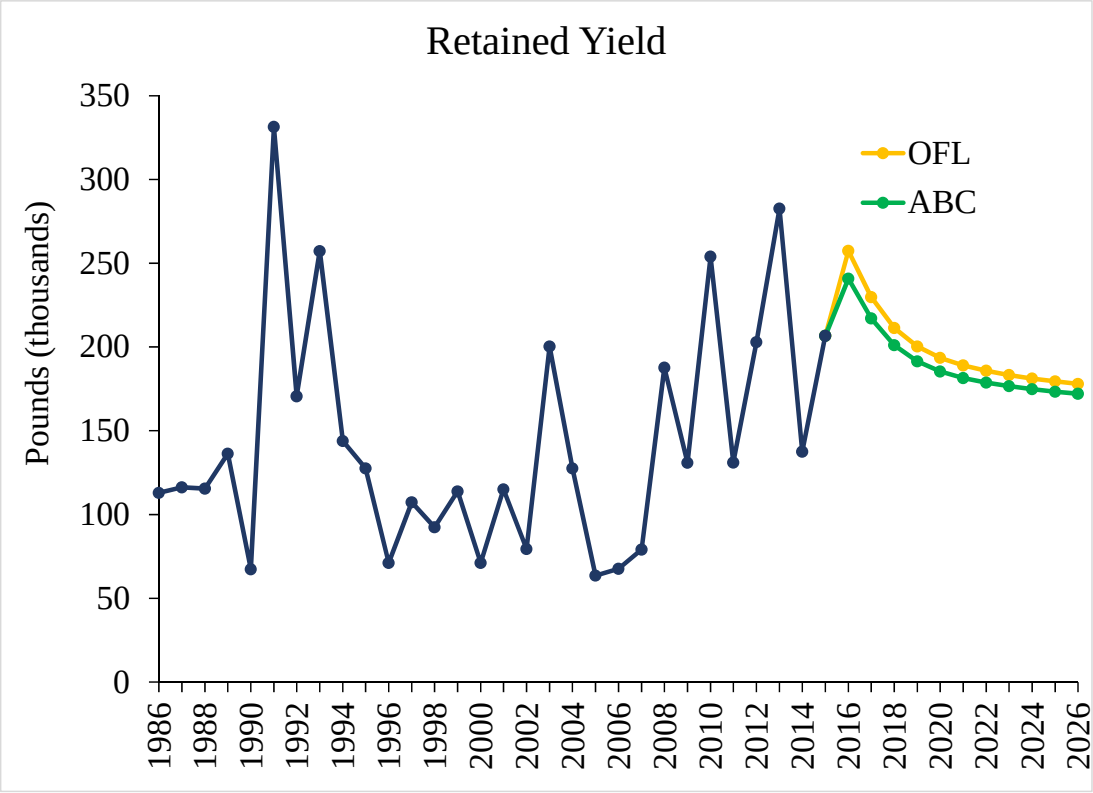

Figure 2.3.1. West Florida shelf hogfish stock landings (1986-2015) and projected OFL and ABC yields (2016-2026)

Alternative 3 sets a constant catch ACL for a specified number of years based on an alternative constant catch ABC recommended by the SSC of 219,000 lbs ww. This catch level has only been exceeded 5 times since 1986 (Table 2.3.2) This ABC has similar conservation equivalency to the constant F ABC yield stream in **Alternative 2**. As with **Alternative 2**, if there is no new stock assessment by 2018 (no assessment is currently planned), the ABC and ACL will revert to the equilibrium ABC level of 159,300 lbs ww. **Option 3a** would discontinue designation of an ACT. As discussed above, the ACT for hogfish has no function. **Option 3b** regarding the ACT are would result in a constant catch ACT that is lower than **Option 2b** in 2016, but a higher ACT in 2017 and 2018 (Table 2.3.1). Relative to Option 4b, Option 3b would result in a higher ACT for all three years, 2016-2019.

Alternative 4 sets a constant catch ACL at the equilibrium ABC of 159,300 lbs ww. From 1986-2014, Gulf hogfish landing have been below this level 16 years and have exceeded it in 13

years (Table 2.3.2) This is the level at which the yield is projected to remain constant without further declines in the stock level if fished over a long period of time. Overfishing is unlikely to occur at this level, and future adjustments to the ACL should theoretically be unnecessary. However, due to uncertainties in the data and likely fluctuations in recruitment which cannot be predicted, a new assessment should still be conducted periodically and the equilibrium ABC recalculated. **Option 4a** would discontinue designation of an ACT. As discussed above, the ACT for hogfish has no function. **Option 4b** would result in a constant catch ACT that is lower than **Option 2b** and **Option 3b** for 2016-2018 (Table 2.3.1).

For all ACT **Options 2b, 3b, and 4b**, ACT for 2019 and beyond will be the same value, 138,600 lbs ww, based on 87% of the equilibrium ABC.

ACL/ACT Buffer Spreadsheet			version 4.1 - April 2011	**Combined Hogfish**	
sum of points	6.5				
max points	9.5		Buffer between ACLand ACT (or ABC and ACL)	Unweighted	13
Min. Buffer	**0**	**min. buffer**	User adjustable	Weighted	**13**
Max Unw.Buff	19	max unwt. Buff			
Max Wtd Buff	**25**	**max wtd. buffer**	User adjustable		
	Component	Element score	Element	Selection	Element result
	Stock assemblage	0	This ACL/ACT is for a single stock.	x	0
		1	This ACL/ACT is for a stock assemblage, or an indicator species for a stock assemblage		
	Ability to Constrain Catch	0	Catch limit has been exceeded 0 or 1 times in last 4 years		3.5
		1	Catch limit has been exceeded 2 or more times in last 4 years	x	
			For the year with max. overage, add 0.5 pts. For every 10 percentage points (rounded up) above ACL	2.5	
			Not applicable (there is no catch limit)		
			Apply this component to recreational fisheries, not commercial or IFQ fisheries		
		0	Method of absolute counting		2
	Precision of	1	MRIP proportional standard error (PSE) <= 20		
	Landings Data	2	MRIP proportional standard error (PSE) > 20	x	
	Recreational		Not applicable (will not be included in buffer calculation)		
			Apply this component to commercial fisheries or any fishery under an IFQ program		
	Precision of	0	Landings from IFQ program		1
		1	Landings based on dealer reporting	x	
	Landings Data	2	Landings based on other		
	Commercial		Not applicable (will not be included in buffer calculation)		
	Timeliness	0	In-season accountability measures used or fishery is under an IFQ	x	0
		1	In-season accountability measures not used		
				Sum	6.5
	Weighting factor				
		Element weight	Element	Selection	Weighting
	Overfished status	0	1. Stock biomass is at or above B_{OY} (or proxy).	x	0
		0.1	2. Stock biomass is below B_{OY} (or proxy) but at or above B_{MSY} (or proxy).		
		0.2	3. Stock biomass is below B_{MSY} (or proxy) but at or above minimum stock size threshold (MSST).		
		0.3	4. Stock is overfished, below MSST.		
		0.3	5. Status criterion is unknown.		

Figure 2.3.2. Spreadsheet for determining hogfish ACT buffer. The spreadsheet evaluates several management components and assigns points based on the level of uncertainty. Those points are then converted to a buffer between 0% and 25% below the ACL.

2.4 Action 4 – Hogfish Minimum Size Limit for Commercial and Recreational Sectors

Alternative 1: No Action. The hogfish minimum size limit remains at 12 inches fork length (FL).

Alternative 2: Set the hogfish minimum size limit at 14 inches FL.

Alternative 3: Set the hogfish minimum size limit at 15 inches FL.

Alternative 4: Set the hogfish minimum size limit at 16 inches FL.

Discussion:

Based on the von Bertalanffy growth equation[3] in SEDAR 37, it takes approximately 6 months for a hogfish to grow from 12" FL to 13" FL. This would not be enough time to allow any additional spawning to occur before the fish is large enough to retain. To grow from 12" FL to to 14" FL or larger takes approximately 11 months or longer (Table 2.4.1). Increasing the size limit to 14" FL or larger would allow at least one additional spawning season, while a 13" FL size limit increase would not. Therefore, 13" FL is not included in the range of size limits to be considered.

Table 2.4.1. Approximate time for a hogfish to grow from 12" FL to 13", 14, 15", or 16" FL.

Length	Approximate time to grow from 12"
12" FL	-
13" FL	6 months
14" FL	11 months
15" FL	17 months
16" FL	24 months

Although the west Florida hogfish stock is not overfished or undergoing overfishing, it could be subject to ACL closures under the ACL alternatives in Action 3. Under each of the ACL alternatives in action 3, hogfish landings since ACLs were adopted in 2012 have exceeded the proposed ACL at least once in the three years for which landings are available (Table 2.3.2). The accountability measures for hogfish state that if the ACL is exceeded in a given year, harvest will be closed in the following year on the date when the ACL is reached or projected to be reached (GMFMC 2011a). Increasing the minimum size limit could reduce the directed harvest rate and help to avoid an ACL closure, or extend the length of the season if there is an ACL closure.

The size limit alternatives in this action apply to both the recreational and commercial sectors.

[3] Von Bertalanffy growth equation for hogfish from SEDAR 37: $FL(cm) = 84.89885132*(1-e^{-0.1057678*(t+1.3290378)})$

Size of Female Maturity and Male Transition

Hogfish are protogynous hermaphrodites, meaning they mature initially as females and then transition to males. Life history studies have estimated female size and age at 50% maturity to occur between 6 inches FL and 7.5 inches FL and at approximately 1 to 1.5 years (McBride et al., 2008; Collins and McBride 2011). Males may occur as small as 7.8 inches FL, but size and age at which 50% of the hogfish have transitioned to males has been estimated at 16.8 inches FL and 6.5 years in the west Florida shelf (McBride et al., 2008). Additionally, subsequent work in the west Florida shelf demonstrated that hogfish in this region will transition to males earlier and younger in shallow water less than 30 meters (approximately 98 feet) (13.5 inches FL and 4.9 years versus 25.2 inches FL and 9.8 years within deep water) (SEDAR 37 2013).

All of the size limit alternatives including the no action alternative are above the mean size of female maturity. All of the alternatives are also below the mean size of transition to male, although **Alternative 4** is very close to that size.

Discard Mortality

The following is taken from SEDAR 37 (2013). Hogfish are primarily landed by spearfishing, so there are minimal data regarding catch-and-release mortality. Anecdotal reports indicate that hook-and-line gear are increasingly being used to target the species (Captains Pat Bennet and Ed Walker, personal communication); however, release mortality is still suspected to be minimal due to the fact that most hogfish in deeper water, greater than 30 meters (approximately 98 feet) (where barotrauma is more likely to occur) are of legal size (> 12 inches FL; Collins and McBride 2011), and are therefore unlikely to be released under the current management regime (12 inches FL minimum size limit and no closed seasons). The extent of mortality due to divers shooting sublegal fish is unknown. For the purpose of this assessment, a discard mortality rate of 10% was assumed for hook-and-line gear and 100% for spearfishing.

Table 2.4.2. Estimated commercial landings of west Florida hogfish by gear type in pounds whole weight.

Year	Commercial Spearfishing	Commercial Hook & Line	Commercial Pots & Traps	Total
2009	27,660	2,580	0	30,240
2010	27,882	5,465	146	33,493
2011	38,109	5,609	65	43,783
2012	39,951	3,884	0	43,835
Proportion	88%	12%	<1%	

Source: SEDAR 37, Table 6.2.2.4

Table 2.4.3. Recreational harvest (types A+B1) of west Florida hogfish by gear type from MRIP for the west Florida stock. Landings are in pounds whole weight.

Year	Recreational Spearfishing	Recreational Hook & Line	Total
2009	37,084	7,475	44,558
2010	76,890	13,031	89,921
2011	21,446	8,771	30,217
2012	44,235	10,522	54,757
Proportion	82%	18%	

Source: SEDAR 37, Table 7.2.1.3

Table 2.4.4. Hogfish total discards (live and dead) for the west Florida stock. Discard mortality from spearfishing is assumed to be 100%. Discard mortality from hook-and-line is assumed to be 10%. Discards are estimated in numbers of fish.

Year	Commercial Diving	Commercial Vertical Line	Recreational Spearfishing	Recreational Hook and Line	Total
2009	103	0	0	5,357	5,460
2010	141	0	0	7,165	7,306
2011	128	0	0	838	966

Note: Discard estimates for 2012 were incomplete.
Source: SEDAR 37, Tables 6.3.1.1 and 7.3.1.1, and Section 7.3.1

Although larger size limits are expected to increase discards and discard mortality in the hook-and-line fisheries, due to the low discard mortality rate the additional numbers of dead discards are expected to be small. Additional discard mortality from recreational spearfishing, which is the predominant method of capture, should be negligible since there are currently no reported discards, and spearfishing is sight fishing.

Alternative 1 (No action), leaves the minimum size limit at 12 inches FL. At this minimum size limit, discards and discard mortality is estimated to be low relative to total landings (Tables 2.3.2 and 2.4.1). This is likely because more than 80% of both the commercial and recreational harvest is from spearfishing (Tables 2.4.2 and 2.4.3), which reported a low amount of discards from the commercial sector, and no discards from the recreational sector (Table 2.4.4). Note that discard mortality from spear fishing is 100% and the discard mortality from hook-and-line fishing is 10%). However, the combined recreational and commercial hogfish landings have exceeded the ACL in two of the last three years even when ACL closures were in effect (Table 2.3.2). The highest ACL in the alternatives in Action 3 is 240,000 lbs in 2016. Landings in 2012 and 2013 exceeded even this relatively high ACL. This suggests that ACL closures will continue under any of the alternatives in Action 3 under the current size limit.

Alternative 2 increases the minimum size limit to 14 inches FL. This increase was recommended by the Reef Fish AP to reduce the harvest rate and extend the season length. This size limit is projected to reduce the recreational harvest rate by 10% to 35% depending upon wave and mode of fishing (headboat, charter, or private) (Table 2.4.5). This will extend the

season length until there is an ACL closure, and may avoid an ACL closure in the initial year under Action 2, Alternative 2.

Alternative 3 increases the minimum size limit to 15 inches FL. This size limit was recommended by one member of the Reef Fish AP. It is consistent with the size limit proposed by the South Atlantic Council for the east Florida/Florida Keys hogfish stock and would help simplify the regulations for fishermen in south Florida. This size limit is projected to reduce the recreational harvest rate by 18% to 56% depending upon wave and mode of fishing (headboat, charter, or private) (Table 2.4.5). Compared to **Alternative 2**, this alternative is expected to further extend the season and reduce the likelihood of ACL closures.

Alternative 4 increases the minimum size limit to 16 inches FL. This size limit is projected to reduce the recreational harvest rate by 41% to 84% depending upon wave and mode of fishing (headboat, charter, or private) (Table 2.4.2). This size limit is very close to the size at which 50% of the hogfish have transitioned to males, meaning that most of the hogfish caught above this size limit would be males. For protogynous stocks such as hogfish, disproportionate fishing on males increases the possibility of reduced fertilization rates. There is a general lack of information on the importance of sperm limitation for this hogfish (Brooks et al. 2008). However, the stock SSB is currently well above the SSB_{MSY} threshold under all proxies for MSY, which suggests that sperm limitation is not a constraining factor. The primary reason for this alternative would be consistency with the south Atlantic size limit, but it would also further extend the season and reduce the likelihood of an ACL closure compared to **Alternative 2** or **Alternative 3**.

Table 2.4.5. Percent reductions in Gulf of Mexico recreational landings (in pounds, whole weight), by mode, at different proposed minimum size limits

	Mode of Fishing												
	Headboat	**Charter**						**Private**					
Size Limit	**Annual**	**Jan/ Feb**	**Mar/ Apr**	**May/ June**	**July/ Aug**	**Sept/ Oct**	**Nov/ Dec**	**Jan/ Feb**	**Mar/ Apr**	**May/ June**	**July/ Aug**	**Sept/ Oct**	**Nov/ Dec**
12 (status quo)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
14	35%	33%	41%	32%	19%	27%	10%	11%	8%	20%	27%	24%	19%
15	56%	60%	59%	52%	69%	54%	52%	23%	18%	27%	31%	28%	40%
16	66%	76%	84%	74%	76%	73%	54%	50%	41%	46%	43%	45%	69%

2.5 Action 5 – Use of Powerheads to Harvest Hogfish in the Stressed Area

Alternative 1: No Action. The prohibition on the use of powerheads to take Gulf reef fish in the stressed area does not apply to hogfish.

Alternative 2: Remove the provision in 50 CFR 622.35(a)(1) that exempts hogfish from the prohibition on the use of powerheads to take Gulf reef fish in the stressed area.

Discussion:

The stressed area begins at the shoreward boundary of federal waters and generally follows the 10 fathom contour from the Dry Tortugas to Sanibel Island; the 20 fathom contour to Tarpon Springs; the 10 fathom contour to Cape San Blas; the 25 fathom contour to south of Mobile Bay; the 13 fathom contour to Ship Island, Mississippi; the 10 fathom contour off Louisiana; and the 30 fathom contour off Texas. Within the stressed area, the use of powerheads to take reef fish and the use of roller trawls is prohibited. Fish traps were also prohibited in the stressed area prior to their being banned from the entire Gulf EEZ in 2007.

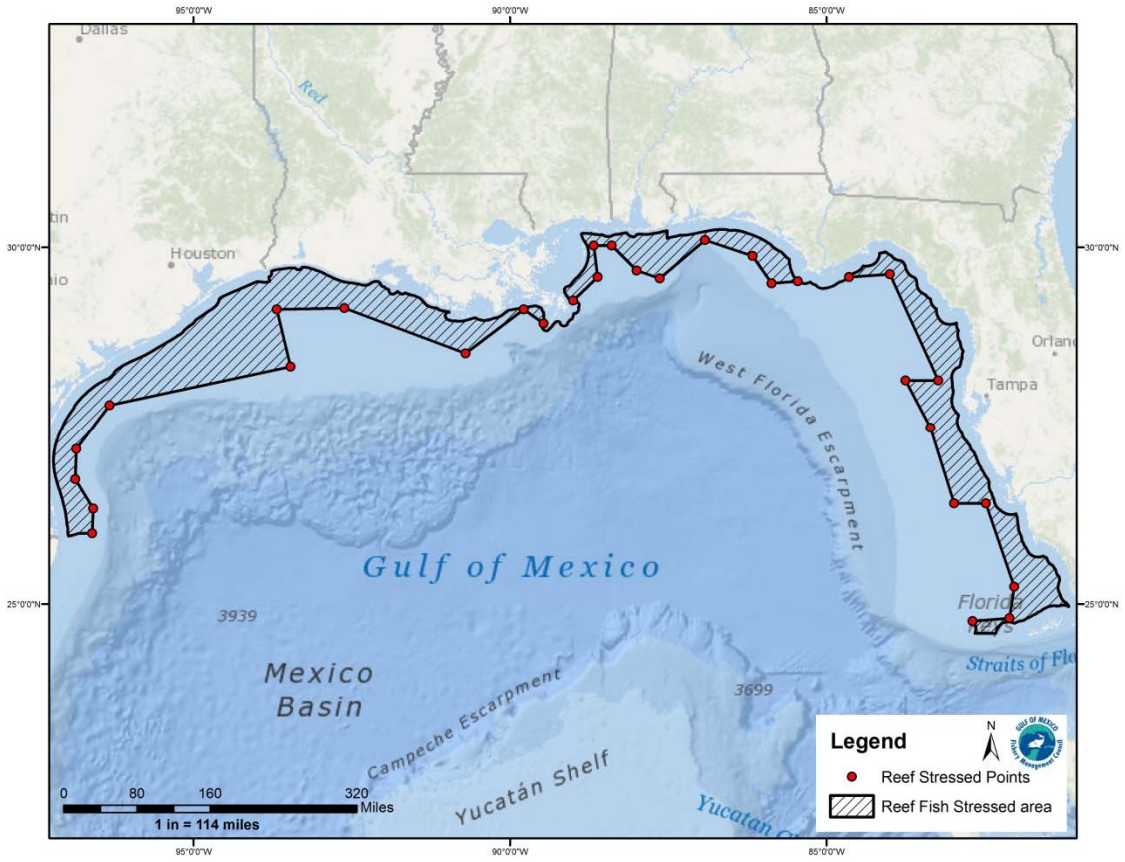

Figure 2.5.1. Gulf of Mexico stressed area. The state boundary line does not reflect recent changes in jurisdiction for reef fish management.

Powerhead means any device with an explosive charge, usually attached to a speargun, spear, pole, or stick, that fires a projectile upon contact (50 CFR 622.2). Damage to the fish is caused primarily by the percussion from the expanding gasses rather than from a projectile.

Section 622.35(a)(1) of the Code of Federal Regulations currently reads as follows:

> A powerhead may not be used in the stressed area to take Gulf reef fish. Possession of a powerhead and a mutilated Gulf reef fish in the stressed area or after having fished in the stressed area constitutes *prima facie* evidence that such reef fish was taken with a powerhead in the stressed area. The provisions of this paragraph do not apply to hogfish.

At one time, hogfish were included in the Reef Fish FMP in the list of "species in the fishery but not the management unit". That list was included for data collection purposes only, and management regulations including the stressed area restrictions did not apply to that list. In 1996, when the regulations for the fisheries of the Caribbean, Gulf, and South Atlantic were consolidated into one part, the distinction between reef fish "species in the management unit" and "species in the fishery but not in the management unit" was erroneously dropped. As a result, the powerhead prohibition was applied to both "species in the fishery but not the management unit" and to "species in the management unit".

Amendment 15 (GMFMC 1997) removed 25 species of sea basses, grunts and porgies from the Reef fish FMP. Most of these species were in the list of "species in the fishery but not the management unit". Amendment 15 also proposed removal of "species in the fishery but not the management unit" from the 20-reef fish aggregate bag limit. The NMFS partially approved that change and removed sand perch and dwarf sand perch, but left hogfish and Queen triggerfish subject to the 20-reef fish aggregate reef fish bag limit. In addition, NMFS added a provision which reinstated the allowance of powerheads in the stressed area to harvest the four remaining species in the list of "species in the fishery but not the management unit", i.e., hogfish, Queen triggerfish, sand perch, and dwarf sand perch.

In 1999 Amendment 16B (GMFMC 1999a) eliminated the distinction between reef fish species in the management unit and those in the fishery but not in the management unit. At the time, hogfish, sand perch, dwarf sand perch, and Queen triggerfish were the only species left on the "in the fishery" list. Even though the "species in the fishery but not the management unit" no longer existed, these species continued to be listed as exempt from the stressed area restrictions. Queen triggerfish was removed from the FMP in Amendment 16B (GMFMC 1999a), and sand perch and dwarf sand perch were removed in the Generic ACL/AM Amendment (GMFMC 2011a), leaving only hogfish from the old list. Powerheads are generally used against larger fish such as sharks and greater amberjack. It is unlikely that hogfish are harvested with powerheads.

Alternative 1 (no action) leaves in place the allowance to take hogfish with powerheads in the stressed area in place. Spearfishing is the dominant method for harvest of hogfish, but there are no records as to how many hogfish are taken using powerheads. Given the relative small size of hogfish compared to fish such as sharks and greater amberjack, and the amount of damage that be done to the fish by a powerhead discharge, it is unlikely that many, if any, hogfish in the stressed area are taken using a powerhead.

Alternative 2 removes the exemption in Section 622.35(a)(1) that reads, "The provisions of this paragraph do not apply to hogfish". Hogfish would then be subject to the same stressed area regulations as other reef fish. Specifically, the prohibition on the use of powerheads in the stressed area would apply to all reef fish including hogfish. Hogfish are subject to all other applicable reef fish regulations, including bag limits, minimum size limits, and ACLs. The exception allowing the use of powerheads in the stressed area is an artifact of hogfish being the only remaining species from the "list of species in the fishery but not the management unit". Reinstating the powerhead prohibition is likely to have little if any impact on hogfish spearfishing in the stressed area, but may improve enforcement by establishing the prohibition uniformly to all reef fish in the stressed area.

CHAPTER 3. AFFECTED ENVIRONMENT

3.1 Description of the Fishery

To be completed

3.2 Description of the Physical Environment

The Gulf has a total area of approximately 600,000 square miles (1.5 million km^2), including state waters (Gore 1992). It is a semi-enclosed, oceanic basin connected to the Atlantic Ocean by the Straits of Florida and to the Caribbean Sea by the Yucatan Channel (Figure 3.2.1). Oceanographic conditions are affected by the Loop Current, discharge of freshwater into the northern Gulf, and a semi-permanent, anti-cyclonic gyre in the western Gulf. The Gulf includes both temperate and tropical waters (McEachran and Fechhelm 2005). Gulf water temperatures range from 54º F to 84º F (12º C to 29º C) depending on time of year and depth of water. Mean annual sea surface temperatures ranged from 73 º F through 83º F (23-28º C) including bays and bayous (Figure 3.2.1) between 1982 and 2009, according to satellite-derived measurements (NODC 2012: http://accession.nodc.noaa.gov/0072888). In general, mean sea surface temperature increases from north to south with large seasonal variations in shallow waters.

The physical environment for Gulf reef fish, including hogfish, is also detailed in the EIS for the Generic EFH Amendment, the Generic ACL/AM Amendment, and Reef Fish Amendment 40 (refer to GMFMC 2004a; GMFMC 2011a; GMFMC 2014a) and are incorporated by reference and further summarized below. 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 2004a). Juvenile and adult reef fish are typically demersal and usually associated with bottom topographies on the continental shelf (<100m) 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, hogfish, some juvenile snapper (e.g. mutton, gray, red, dog, lane, and yellowtail snappers) and grouper (e.g. Goliath grouper, red, gag, and yellowfin groupers) have been documented in inshore seagrass beds, mangrove estuaries, lagoons, and larger bay systems.

In the Gulf, fish habitat for adult hogfish consists of reef and hard bottom habitats that provide structural cover, and have been observed at depths >60 m (GMFMC 2004a, SEDAR 37 2015). Juveniles are found in polyhaline estuarine seagrass beds or nearshore reef habitats. Detailed information pertaining to the Gulf of Mexico area closures and preserves is provided in Amendment 32 (GMFMC 2011b).

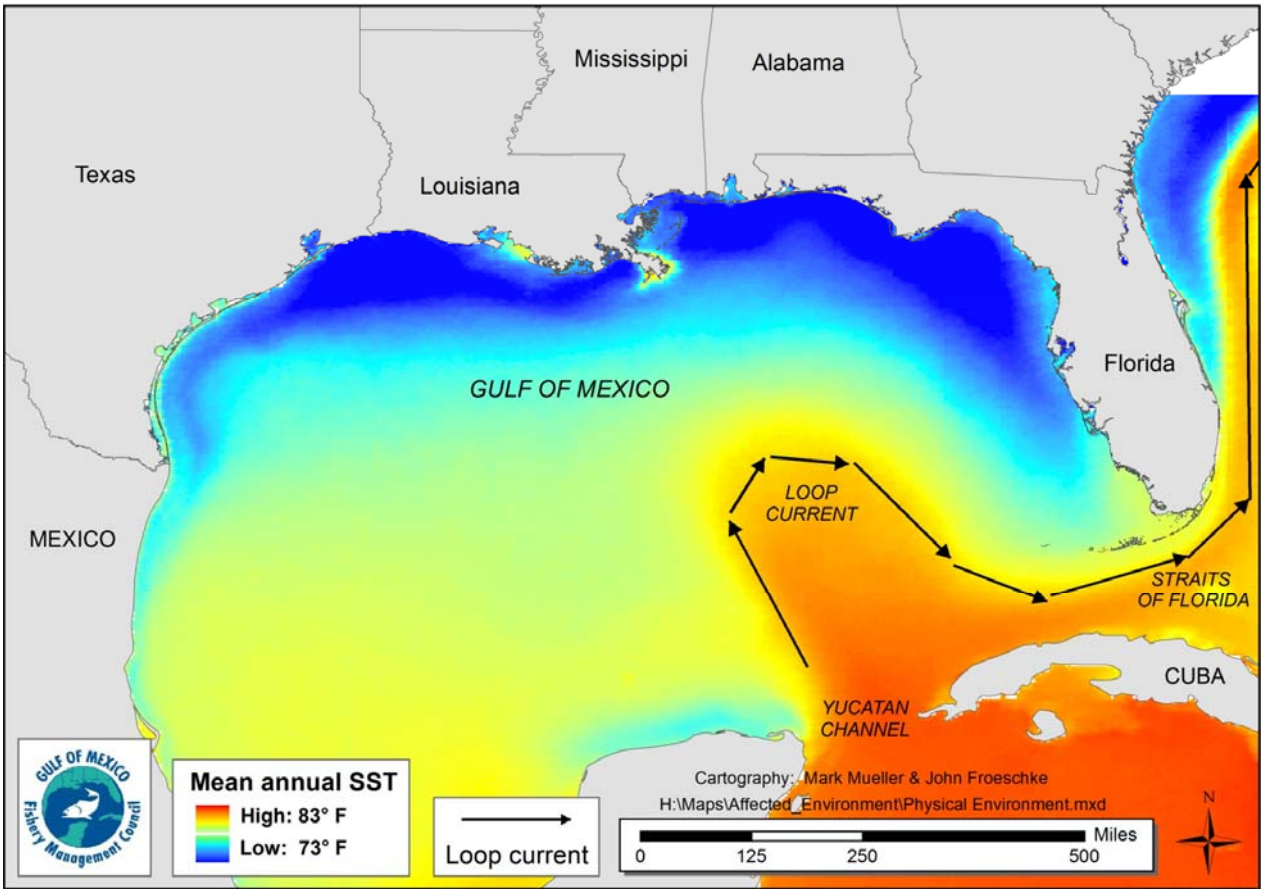

Figure 3.2.1. Physical environment of the Gulf including major feature names and mean annual sea surface temperature as derived from the Advanced Very High Resolution Radiometer Pathfinder Version 5 sea surface temperature data set (http://accession.nodc.noaa.gov/0072888)

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 final EISs for Generic EFH Amendment, the Generic ACL/AM Amendment, and Reef Fish Amendment 40 (refer to GMFMC 2004a; GMFMC 2011a; GMFMC 2014a) and is incorporated here by reference and further summarized below.

Hogfish Life History and Biology

Hogfish occur in warm temperate to tropical waters of the western Atlantic Ocean from Brazil to Bermuda and occur throughout the Caribbean and Gulf of Mexico. Hogfish demonstrate the typical reef fish life history pattern (Appendix C). Eggs and larvae are pelagic while juveniles are found associated with shallow-water coastal habitats. Hogfish are protogynous hermaphrodites. Female size and age at 50% maturity to occur between 151.6 – 192.7 mm fork length (FL) and 0.9 – 1.6 years (SEDAR 37 2014). Females may transition into males as small as approximately 200 mm FL, however the size and age of 50% maturity for the west Florida Shelf stock is 426 mm FL and 6.5 years (SEDAR 37 2014). Spawning occurs during the winter and spring months with larger fish in deeper waters having a longer spawning

season (SEDAR 37 2015). Hogfish have been aged up to 23 years (McBride and Richardson 2007) with the oldest female being aged to 10 years (Collins and McBride 2011). A more complete description of hogfish life history can be found in the EIS for the Generic EFH Amendment (GMFMC 2004a) and in SEDAR 37 (2014).

Recent genetic analyses by Seyoum et al. (2014) have suggested three distinct stocks in the Gulf and South Atlantic waters. A suite of 24 microsatellite loci were used to examine the genetic structure of hogfish collected in the southeast. Although there were some gaps in sample coverage (primarily between the central east coast of Florida and South Carolina), three distinct groups emerged. The west Florida stock included samples collected from the Panhandle of Florida south along the west Florida shelf, and converged with the Florida Keys/eastern Florida south of Naples. The Florida Keys/eastern Florida stock included samples collected south of Naples, through the Florida Keys and up the southeastern coast of Florida. The third group included hogfish collected off the coast of the Carolinas and was genetically distinct from the two Florida groups.

Status of the Hogfish Stock

The Southeast Data, Assessment, and Review (SEDAR) 37 for hogfish used the Stock Synthesis (Methot and Wetzel 2013). This is an integrated statistical catch-at-age model and is widely used for stock assessments in the United States. For more information on the model, see SEDAR 37 (2014). SEDAR 37 (2014) used data through 2012. Commercial and recreational landings for 2013 and 2014 were obtained from FWRI Trip Tickets and Discard logbook program, the Marine Recreational Information Program (MRIP) and the Southeast Region Headboat Survey. Catches for 2015 were assumed to be the average of 2013 and 2014 catches. Three stocks were considered in the assessment based a genetic analysis described above. The stocks were West Florida, East Florida including the Florida Keys and Dry Tortugas, and the Carolinas (Georgia through North Carolina). Nearly all landings of hogfish from the Gulf came from Florida, so the stock was described as a West Florida stock for the purpose of the assessment although the WFL stock included limited catch data from other Gulf states. A more detailed description of the assessment can be found at http://sedarweb.org/sedar-37.

The Gulf Council's Scientific and Statistical Committee (SSC) evaluated the stock using a proxy for F_{MSY} of $F_{30\%SPR}$ where F is fishing mortality, MSY is maximum sustainable yield, and SPR is spawning potential ratio. For West Florida, the stock was found not to be overfished or undergoing overfishing[4]; however, the East Florida/Florida Keys hogfish stock was considered overfished and undergoing overfishing by the South Atlantic Fishery Management Council's SSC. In evaluating the assessments output, the Gulf Council's SSC recommended an overfishing limit (OFL) and acceptable biological catch (ABC) yield streams for 2015-2018. The OFL yield stream was produced using a P* = 0.5 and the ABC yield stream was produced using a P* = 0.4 with a CV of 0.37 using the Council's ABC control rule. The OFL and ABC yield streams are shown in Table 1.1.1.

General Information on Reef Fish Species

[4] Note that if an $F_{40\%SPR}$ proxy is used for F_{MSY}, the west Florida stock is considered overfished (SEDAR 37 2014)

The National Ocean Service collaborated with NMFS and the Council to develop distributions of reef fish (and other species) in the Gulf (SEA 1998). The National Ocean Service obtained fishery-independent data sets for the Gulf, including SEAMAP, and state trawl surveys. Data from the Estuarine Living Marine Resources Program 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 >25 parts per thousand). National Ocean Service staff analyzed these data to determine relative abundance of the mapped species by estuary, salinity zone, and month. For some species not in the Estuarine Living Marine Resources Program database, distribution was classified as only observed or not observed for adult, juvenile, and spawning stages.

In general, reef fish are widely distributed in the Gulf, occupying both pelagic and benthic habitats during their life cycle. Habitat types and life history stages are summarized in Appendix C and can be found in more detail in GMFMC (2004a). In general, both eggs and larval stages are planktonic. Larvae feed on zooplankton and phytoplankton. Exceptions to these generalizations include the gray triggerfish that lay their eggs in depressions in the sandy bottom, 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 (<328 feet; <100 m) which have high relief, i.e., coral reefs, artificial reefs, rocky hard-bottom substrates, ledges and caves, sloping soft-bottom areas, and limestone outcroppings. However, several species are found over sand and soft-bottom substrates. Juvenile red snapper are common on mud bottoms in the northern Gulf, particularly from Texas to Alabama. Also, some juvenile snappers (e.g. mutton, gray, red, dog, lane, and yellowtail snappers) and groupers (e.g. goliath grouper, red, gag, and yellowfin groupers) have been documented in inshore seagrass beds, mangrove estuaries, lagoons, and larger bay systems (GMFMC 1981). More detail on hard bottom substrate and coral can be found in the Fishery Management Plan (FMP) for Corals and Coral Reefs (GMFMC and SAFMC 1982).

Many of these species co-occur with hogfish and can be incidentally caught during hogfish fishing. In some cases, these fish may be discarded for regulatory reasons and thus are considered bycatch. Appendix D (bycatch practicability analysis) examines the effects of fishing on these species. In general, this analysis coupled with previous analyses has 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. In these cases, there is some biological benefit to the managed species that outweighs any increases in discards.

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). Stock assessments and stock assessment reviews have been conducted for 13 species and can be found on the Council (www.gulfcouncil.org) and SEDAR (www.sefsc.noaa.gov/sedar) websites. The assessed species are:

- Red Snapper (SEDAR 7 2005; SEDAR 7 Update 2009; SEDAR 31 2013; SEDAR 31 Update 2015)
- Vermilion Snapper (Porch and Cass-Calay 2001; SEDAR 9 2006c; SEDAR 9 Update 2011a)
- Yellowtail Snapper (Muller et al. 2003; SEDAR 3 2003; O'Hop et al. 2012)
- Mutton Snapper (SEDAR 15A 2008)
- Gray Triggerfish (Valle et al. 2001; SEDAR 9 2006a; SEDAR 9 Update 2011b, SEDAR 43 2015)
- Greater Amberjack (Turner et al. 2000; SEDAR 9 2006b; SEDAR 9 Update 2010; SEDAR 33 2014a)
- Hogfish (Ault et al. 2003; SEDAR 6 2004b; Cooper et al. 2013; SEDAR 37 2015)
- Red Grouper (NMFS 2002; SEDAR 12 2007; SEDAR 12 Update 2009, SEDAR 42 2015)
- Gag (Turner et al. 2001; SEDAR 10 2006; SEDAR 10 Update 2009; SEDAR 33 2014b)
- Black Grouper (SEDAR 19 2010)
- Yellowedge Grouper (Cass-Calay and Bahnick 2002; SEDAR 22 2011b)
- Tilefish (Golden) (SEDAR 22 2011a)
- Atlantic Goliath Grouper (Porch et al. 2003; SEDAR 6 2004a; SEDAR 23 2011)

The NMFS Office of Sustainable Fisheries updates its Status of U.S. Fisheries Report to Congress on a quarterly basis utilizing the most current stock assessment information. The most recent update can be found at: http://www.nmfs.noaa.gov/sfa/fisheries_eco/status_of_fisheries/. The status of both assessed and unassessed stocks as of the writing of this report is shown in Table 3.3.1.

Table 3.3.1. Species of the Reef Fish FMP grouped by family.

Common Name	Scientific Name	Stock Status
Family Balistidae – Triggerfishes		
Gray Triggerfish	*Balistes capriscus*	Overfished, overfishing
Family Carangidae – Jacks		
Greater Amberjack	*Seriola dumerili*	Overfished, overfishing
Lesser Amberjack	*Seriola fasciata*	Unknown
Almaco Jack	*Seriola rivoliana*	Unknown
Banded Rudderfish	*Seriola zonata*	Unknown
Family Labridae - Wrasses		
*Hogfish	*Lachnolaimus maximus*	Not overfished, no overfishing
Family Malacanthidae - Tilefishes		
Tilefish (Golden)	*Lopholatilus chamaeleonticeps*	Not overfished, no overfishing
Blueline Tilefish	*Caulolatilus microps*	Unknown
Goldface Tilefish	*Caulolatilus chrysops*	Unknown
Family Serranidae - Groupers		
Gag	*Mycteroperca microlepis*	Not overfished, no overfishing
Red Grouper	*Epinephelus morio*	Not overfished, no overfishing
Scamp	*Mycteroperca phenax*	Unknown
Black Grouper	*Mycteroperca bonaci*	Not overfished, no overfishing
Yellowedge Grouper	***Hyporthodus flavolimbatus*	Not overfished, no overfishing
Snowy Grouper	***Hyporthodus niveatus*	Unknown
Speckled Hind	*Epinephelus drummondhayi*	Unknown
Yellowmouth Grouper	*Mycteroperca interstitialis*	Unknown
Yellowfin Grouper	*Mycteroperca venenosa*	Unknown
Warsaw Grouper	***Hyporthodus nigritus*	Unknown
***Atlantic Goliath Grouper	*Epinephelus itajara*	Unknown
Family Lutjanidae - Snappers		
Queen Snapper	*Etelis oculatus*	Unknown
Mutton Snapper	*Lutjanus analis*	Not overfished, no overfishing
Blackfin Snapper	*Lutjanus buccanella*	Unknown
Red Snapper	*Lutjanus campechanus*	Overfished, no overfishing
Cubera Snapper	*Lutjanus cyanopterus*	Unknown, no overfishing
Gray Snapper	*Lutjanus griseus*	Unknown, no overfishing
Lane Snapper	*Lutjanus synagris*	Unknown, no overfishing
Silk Snapper	*Lutjanus vivanus*	Unknown
Yellowtail Snapper	*Ocyurus chrysurus*	Not overfished, no overfishing
Vermilion Snapper	*Rhomboplites aurorubens*	Not overfished, no overfishing
Wenchman	*Pristipomoides aquilonaris*	Unknown

Notes: *The East Florida/Florida Keys hogfish stock is considered overfished and undergoing overfishing.
**In 2013 the genus for yellowedge grouper, snowy grouper, and warsaw grouper was changed by the American Fisheries Society from *Epinephelus* to *Hyporthodus* (American Fisheries Society 2013).
***Atlantic goliath grouper is a protected grouper and benchmarks do not reflect appropriate stock dynamics. In 2013 the common name was changed from goliath grouper to Atlantic goliath grouper by the American Fisheries Society to differentiate from the Pacific goliath grouper, a newly named species (American Fisheries Society 2013).

Protected Species

There are 40 species protected by federal law that may occur in the Gulf. Thirty-nine of these are under the jurisdiction of NMFS, while the West Indian manatee (*Trichechus manatus*) is managed by the U.S. Fish and Wildlife Service. Of the species under NMFS's jurisdiction, 27 are marine mammals that are protected under the Marine Mammal Protection Act (MMPA). The MMPA requires that each commercial fishery be classified by the number of marine mammals they seriously injure or kill. NMFS's List of Fisheries (LOF) classifies U.S. commercial fisheries into three categories based on the number of incidental mortality or serious injury they cause to marine mammals. More information about the LOF and the classification process can be found at: http://www.nmfs.noaa.gov/pr/interactions/lof/. Five of these marine mammal species are also listed as endangered under the Endangered Species Act (ESA) (i.e., sperm, sei, fin, blue, and humpback). In addition to those five marine mammals, five sea turtle species (Kemp's ridley, loggerhead, green, leatherback, and hawksbill), two fish species (Gulf sturgeon and smalltooth sawfish), and five coral species (elkhorn, staghorn, lobed star, mountainous star, and boulder star) are also protected under the ESA. Designated critical habitat for smalltooth sawfish, Gulf sturgeon, and the Northwest Atlantic Ocean distinct population segment of loggerhead sea turtles also occur within nearshore waters of the Gulf, though only loggerhead critical habitat occurs in federal waters.

NMFS has conducted specific analyses ("Section 7 consultations") to evaluate potential effects from the Gulf reef fish fishery on species and critical habitats protected under the ESA. On September 30, 2011, the Protected Resources Division released a biological opinion (Opinion), which concluded that the continued operation of the Gulf reef fish fishery is not likely to jeopardize the continued existence of sea turtles (loggerhead, Kemp's ridley, green, hawksbill, and leatherback) or smalltooth sawfish (NMFS 2011a). The Opinion also concluded that other ESA-listed species are not likely to be adversely affected by the FMP. An incidental take statement was issued specifying the amount and extent of anticipated take, along with reasonable and prudent measures and associated terms and conditions deemed necessary and appropriate to minimize the impact of these takes. The Council addressed further measures to reduce take in the reef fish fishery's longline component in Amendment 31 (GMFMC 2009).

Subsequent to the completion of the biological opinion, NMFS published final rules listing 20 new coral species (September 10, 2014), and designating critical habitat for the Northwest Atlantic Ocean distinct population segment of loggerhead sea turtles (July 10, 2014). NMFS addressed these changes in a series of consultation memoranda. In consultation memoranda dated September 16, 2014, and October 7, 2014, NMFS assessed the continued operation of the Gulf reef fish fishery's potential impact on the newly-listed coral species occurring in the Gulf (3 species of *Orbicella* and *Mycetophyllia ferox*) and concluded the fishery is not likely to adversely affect any of the protected coral species. Similarly, in consultation memoranda dated September 16, 2014, NMFS assessed the continued authorization of South Atlantic and Gulf of Mexico fisheries' potential impacts on loggerhead critical habitat and concluded the Gulf reef fish fishery is not likely to adversely affect the newly designated critical habitat. The effects of reef fish fishing on these species is further considered in a bycatch practicability analysis in Appendix D.

Marine Mammals

The gear used by the Gulf reef fish fishery is classified in the Marine Mammal Protection Act 2015 List of Fisheries as a Category III fishery (79 FR 77919). This classification indicates the annual mortality and serious injury of a marine mammal stock resulting from any fishery is less than or equal to 1% of the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population. Dolphins are the only species documented as interacting with these fisheries. Bottlenose dolphins prey upon on the 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: http://www.nmfs.noaa.gov/pr/sspecies/.

Turtles

Green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles are all highly migratory and travel widely throughout the Gulf. The following sections are a brief overview of the general life history characteristics of the sea turtles found in the Gulf region. Several volumes exist that cover the biology and ecology of these species more thoroughly (i.e., Lutz and Musick (eds.) 1997, Lutz et al. (eds.) 2003).

Green sea turtle hatchlings are thought to occupy pelagic areas of the open ocean and are often associated with *Sargassum* rafts (Carr 1987, Walker 1994). Pelagic stage green sea turtles are thought to be carnivorous. Stomach samples of these animals found ctenophores and pelagic snails (Frick 1976, Hughes 1974). At approximately 20 to 25 cm carapace length, juveniles migrate from pelagic habitats to benthic foraging areas (Bjorndal 1997). As juveniles move into benthic foraging areas a diet shift towards herbivory occurs. They consume primarily seagrasses and algae, but are also know to consume jellyfish, salps, and sponges (Bjorndal 1980, 1997; Paredes 1969; Mortimer 1981, 1982). The diving abilities of all sea turtles species vary by their life stages. The maximum diving range of green sea turtles is estimated at 110 m (360 ft) (Frick 1976), but they are most frequently making dives of less than 20 m (65 ft.) (Walker 1994). The time of these dives also varies by life stage. The maximum dive length is estimated at 66 minutes with most dives lasting from 9 to 23 minutes (Walker 1994).

The **hawksbill's** pelagic stage lasts from the time they leave the nesting beach as hatchlings until they are approximately 22-25 cm in straight carapace length (Meylan 1988, Meylan and Donnelly 1999). The pelagic stage is followed by residency in developmental habitats (foraging areas where juveniles reside and grow) in coastal waters. Little is known about the diet of pelagic stage hawksbills. Adult foraging typically occurs over coral reefs, although other hard-bottom communities and mangrove-fringed areas are occupied occasionally. Hawksbills show fidelity to their foraging areas over several years (van Dam and Diéz 1998). The hawksbill's diet is highly specialized and consists primarily of sponges (Meylan 1988). Gravid females have been noted ingesting coralline substrate (Meylan 1984) and calcareous algae (Anderes Alvarez and Uchida 1994), which are believed to be possible sources of calcium to aid in eggshell

production. The maximum diving depths of these animals are not known, but the maximum length of dives is estimated at 73.5 minutes. More routinely, dives last about 56 minutes (Hughes 1974).

Kemp's ridley hatchlings are also pelagic during the early stages of life and feed in surface waters (Carr 1987, Ogren 1989). Once the juveniles reach approximately 20 cm carapace length they move to relatively shallow (less than 50m) benthic foraging habitat over unconsolidated substrates (Márquez-M. 1994). They have also been observed transiting long distances between foraging habitats (Ogren 1989). Kemp's ridleys feeding in these nearshore areas primarily prey on crabs, though they are also known to ingest mollusks, fish, marine vegetation, and shrimp (Shaver 1991). The fish and shrimp Kemp's ridleys ingest are not thought to be a primary prey item but instead may be scavenged opportunistically from bycatch discards or from discarded bait (Shaver 1991). Given their predilection for shallower water, Kemp's ridleys most routinely make dives of 50 m or less (Soma 1985, Byles 1988). Their maximum diving range is unknown. Depending on the life stage a Kemp's ridleys may be able to stay submerged anywhere from 167 minutes to 300 minutes, though dives of 12.7 minutes to 16.7 minutes are much more common (Soma 1985, Mendonca and Pritchard 1986, Byles 1988). Kemp's ridleys may also spend as much as 96% of their time underwater (Soma 1985, Byles 1988).

Leatherbacks are the most pelagic of all ESA-listed sea turtles and spend most of their time in the open ocean. Although they will enter coastal waters and are seen over the continental shelf on a seasonal basis to feed in areas where jellyfish are concentrated. Leatherbacks feed primarily on cnidarians (medusae, siphonophores) and tunicates. Unlike other sea turtles, leatherbacks' diets do not shift during their life cycles. Because leatherbacks' ability to capture and eat jellyfish is not constrained by size or age, they continue to feed on these species regardless of life stage (Bjorndal 1997). Leatherbacks are the deepest diving of all sea turtles. It is estimated that these species can dive in excess of 1000 m (Eckert et al. 1989) but more frequently dive to depths of 50 m to 84 m (Eckert et al. 1986). Dive times range from a maximum of 37 minutes to more routines dives of 4 to 14.5 minutes (Standora et al. 1984, Eckert et al. 1986, Eckert et al. 1989, Keinath and Musick 1993). Leatherbacks may spend 74% to 91% of their time submerged (Standora et al. 1984).

Loggerhead hatchlings forage in the open ocean and are often associated with *Sargassum* rafts (Hughes 1974, Carr 1987, Walker 1994, Bolten and Balazs 1995). The pelagic stage of these sea turtles are known to eat a wide range of things including salps, jellyfish, amphipods, crabs, syngnathid fish, squid, and pelagic snails (Brongersma 1972). Stranding records indicate that when pelagic immature loggerheads reach 40-60 cm straight-line carapace length they begin to live in coastal inshore and nearshore waters of the continental shelf throughout the U.S. Atlantic (Witzell 2002). Here they forage over hard- and soft-bottom habitats (Carr 1986). Benthic foraging loggerheads eat a variety of invertebrates with crabs and mollusks being an important prey source (Burke et al. 1993). Estimates of the maximum diving depths of loggerheads range from 211 m to 233 m (692-764ft.) (Thayer et al. 1984, Limpus and Nichols 1988). The lengths of loggerhead dives are frequently between 17 and 30 minutes (Thayer et al. 1984, Limpus and Nichols 1988, Limpus and Nichols 1994, Lanyon et al. 1989) and they may spend anywhere from 80 to 94% of their time submerged (Limpus and Nichols 1994, Lanyon et al. 1989).

All five species of sea turtles are adversely affected by the Gulf reef fish fishery. Incidental captures are relatively infrequent, but occur in all commercial and recreational hook-and-line and longline components of the reef fish fishery. Captured sea turtles can be released alive or can be found dead upon retrieval of the gear as a result of forced submergence. Sea turtles released alive may later succumb to injuries sustained at the time of capture or from exacerbated trauma from fishing hooks or lines that were ingested, entangled, or otherwise still attached when they were released. Sea turtle release gear and handling protocols are required in the commercial and for-hire reef fish fisheries to minimize post-release mortality.

Fish

Historically the **smalltooth sawfish** in the U.S. ranged from New York to the Mexico border. Their current range is poorly understood but believed to have contracted from these historical areas. In the South Atlantic region, they are most commonly found in Florida, primarily off the Florida Keys (Simpfendorfer and Wiley 2004). Only two smalltooth sawfish have been recorded north of Florida since 1963 (the first was captured off North Carolina in 1963 and the other off Georgia in 2002 (National Smalltooth Sawfish Database, Florida Museum of Natural History)). Historical accounts and recent encounter data suggest that immature individuals are most common in shallow coastal waters less than 25 meters (Bigelow and Schroeder 1953, Adams and Wilson 1995), while mature animals occur in waters in excess of 100 meters (Simpfendorfer pers. comm. 2006). Smalltooth sawfish feed primarily on fish. Mullet, jacks, and ladyfish are believed to be their primary food resources (Simpfendorfer 2001). Smalltooth sawfish also prey on crustaceans (mostly shrimp and crabs) by disturbing bottom sediment with their saw (Norman and Fraser 1938, Bigelow and Schroeder 1953).

Smalltooth sawfish are also adversely affected by the Gulf reef fish fishery, but to a much lesser extent. Smalltooth sawfish primarily occur in the Gulf off peninsular Florida. Incidental captures in the commercial and recreational hook-and-line components of the reef fish fishery are rare events, with only eight smalltooth sawfish estimated to be incidentally caught annually, and none are expected to result in mortality (NMFS 2005). Fishermen in this fishery are required to follow smalltooth sawfish safe handling guidelines. The long, toothed rostrum of the smalltooth sawfish causes this species to be particularly vulnerable to entanglement in fishing gear.

Northern Gulf of Mexico Hypoxic Zone

Every summer in the northern Gulf, a large hypoxic zone forms. It is the result of allochthonous materials and runoff from agricultural lands by rivers to the Gulf increasing nutrient inputs from the Mississippi River and a seasonal layering of waters in the Gulf (see http://www.gulfhypoxia.net/). The layering of the water is temperature and salinity dependent and prevents the mixing of higher oxygen content surface water with oxygen-poor bottom water. For 2014, the extent of the hypoxic area was estimated to be 5,052 square miles and is similar the running average for over the past five years of 5,543 square miles Gulf (see http://www.gulfhypoxia.net/). However, hogfish are not commonly found in the northern Gulf, so any impact of the hypoxic zone on hogfish should be minimal.

Climate change

Climate change projections show increases in sea-surface temperature and sea level; decreases in sea-ice cover; and changes in salinity, wave climate, and ocean circulation (Intergovernmental Panel on Climate Change http://www.ipcc.ch/). These changes are likely to affect plankton biomass and fish larvae abundance that could adversely impact fish, marine mammals, seabirds, and ocean biodiversity. Kennedy et al. (2002) and Osgood (2008) have suggested global climate change could 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 which 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 ecosystems such as wetlands, estuaries, and coral reefs. NOAA's Climate Change Web Portal (http://www.esrl.noaa.gov/psd/ipcc/ocn/) indicates the average sea surface temperature in the Gulf will increase by 1.2-1.4ºC for 2006-2055 compared to the average over the years 1956-2005. For reef fishes, Burton (2008) speculated climate change could cause shifts in spawning seasons, changes in migration patterns, and changes to basic life history parameters such as growth rates. It is unclear if hogfish distribution in the Gulf has been effected. Hogfish have not been used in the OceanAdapt model (http://oceanadapt.rutgers.edu/regional_data/) that shows distributional trends both in latitude and depth over the time period 1985-1013. For some reef fish species such as the smooth puffer, there has been a distributional trend to the north in the Gulf. For other species such as red snapper and the dwarf sand perch, there has been a distributional trend towards deeper waters. Finally, for other reef 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.

Deepwater Horizon MC252 Oil Spill

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

As reported by the National Oceanic and Atmospheric Administration Office of Response and Restoration (NOAA 2010), the oil from the Deepwater Horizon MC252 spill is relatively high in

alkanes, which can readily be used by microorganisms as a food source. As a result, the oil from this spill is likely to biodegrade more readily than crude oil in general. The Deepwater Horizon MC252 oil is also relatively much lower in polyaromatic hydrocarbons. Polyaromatic hydrocarbons are highly toxic chemicals that tend to persist in the environment for long periods of time, especially if the spilled oil penetrates into the substrate on beaches or shorelines. Like all crude oils, MC252 oil contains volatile organic compounds (VOCs) such as benzene, toluene, and xylene. Some VOCs are acutely toxic but because they evaporate readily, they are generally a concern only when oil is fresh.[5]

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 well head (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. However, a study found that, while Corexit 9500A® and oil are similar in their toxicity, when Corexit 9500A® and oil were mixed in lab tests, toxicity to microscopic rotifers increased up to 52-fold (Rico-Martínez et al. 2013). This suggests that the toxicity of the oil and dispersant combined may be greater than anticipated.

Oil could exacerbate development of the hypoxic "dead" zone in the Gulf as could higher than normal input of water from the Mississippi River drainage. For example, oil on the surface of the water could restrict the normal process of atmospheric oxygen mixing into and replenishing oxygen concentrations in the water column. In addition, microbes in the water that break down oil and dispersant also consume oxygen; this could lead to further oxygen depletion.

Changes have occurred in the amount and distribution of fishing effort in the Gulf in response to the oil spill. This has made the analysis of the number of days needed for the recreational sector to fill its quota more complex and uncertain, and will make the requirement to allow the recreational sector to harvest its quota of red snapper while not exceeding the quota particularly challenging. Nevertheless, substantial portions of the red snapper population are found in the northwestern and western Gulf (western Louisiana and Texas) and an increasing population of red snapper is developing off the west Florida continental shelf. Thus, spawning by this segment of the stock may not be impacted, which would mitigate the overall impact of a failed spawn by that portion of the stock located in oil-affected areas. An increase in lesions were found in red snapper in the area affected by the oil, but Murowski et al. (2014) found that the incidence of lesions had declined between 2011 and 2012. The 2013 stock assessment for red snapper (SEDAR 31, 2013) showed a steep decline in the 2010 recruitment; however, the recruitment increased in 2011 and 2012.

As a result of the Deepwater Horizon MC252 spill, a consultation pursuant to ESA Section 7(a)(2) was reinitiated. As discussed above, on September 30, 2011, the Protected Resources Division released a biological opinion, which after analyzing best available data, the current status of the species, environmental baseline (including the impacts of the recent Deepwater Horizon MC252 oil release event in the northern Gulf), effects of the proposed action, and cumulative effects, concluded that the continued operation of the Gulf reef fish fishery is not

[5] Source: http://sero.nmfs.noaa.gov/sf/deepwater_horizon/OilCharacteristics.pdf

likely to jeopardize the continued existence of green, hawksbill, Kemp's ridley, leatherback, or loggerhead sea turtles, nor the continued existence of smalltooth sawfish (NMFS 2011a).

For additional information on the Deepwater Horizon MC252 oil spill and associated closures, see:
http://sero.nmfs.noaa.gov/deepwater_horizon_oil_spill.htm.

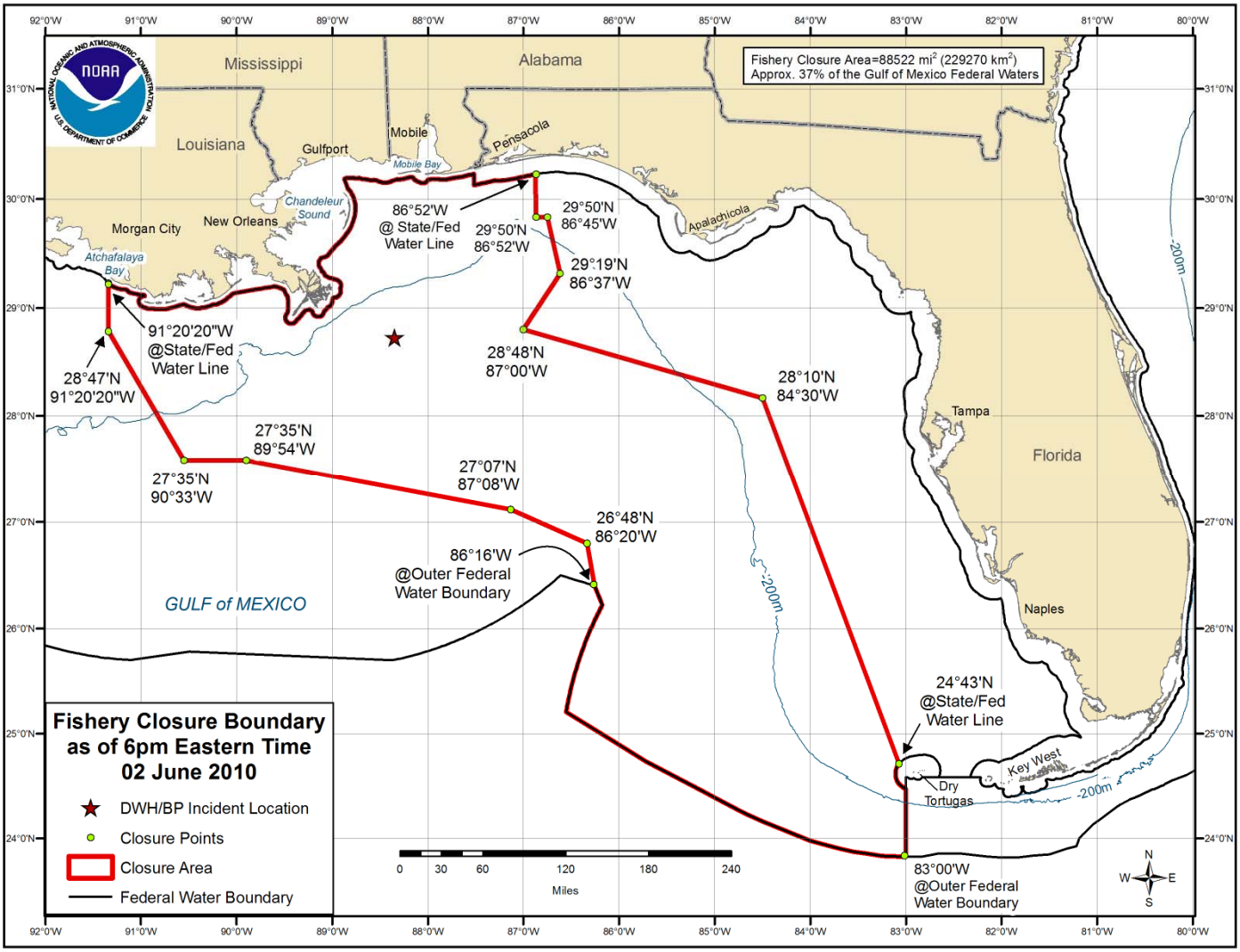

Figure 3.3.1. Fishery closure at the height of the Deepwater Horizon MC252 oil spill.

3.4 Description of the Economic Environment

3.4.1 Commercial Sector

Vessel Activity

Tables 3.4.1.1 and 3.4.1.2 contain information on vessel performance for commercial vessels that harvested hogfish in the Gulf in 2010-2014. The tables contain vessel counts from the NMFS Southeast Fisheries Science Center (SEFSC) logbook (logbook) data (vessel count, trips, and landings). Dockside values were generated using landings information from logbook data and price information from the NMFS SEFSC Accumulated Landings System (ALS) data. These data only contain information on the harvest of finfish by these vessels and not the harvest from any non-finfish fisheries that these vessels may participate in.

On average, 61 commercial vessels per year landed hogfish in the Gulf (Table 3.4.1.1). These vessels, combined, averaged 318 trips per year in the Gulf on which hogfish was landed and 633 trips in the Gulf without hogfish or in the South Atlantic (Table 3.4.1.1). The average annual total dockside revenue (2014 dollars) was approximately $132,000 from hogfish, approximately $489,500 from other species co-harvested with hogfish (on the same trip), and approximately $1.53 million from other trips by these vessels (Table 3.4.1.2). Total average annual revenue from all finfish species harvested by vessels harvesting hogfish in the Gulf was approximately $2.15 million, or approximately $35,600 per vessel (Table 3.4.1.2).

Table 3.4.1.1. Summary of vessel counts, trips, and logbook landings (pounds gutted weight (lbs gw)) or vessels landing at least one pound of hogfish, 2010-2014.

Year	Number of Vessels	Number of Gulf Trips on which Hogfish were Caught	Hogfish Landings (lbs gw)	"Other Species" Landings Jointly Caught with Hogfish (lbs gw)	Number of Other Trips*	Landings on Other Trips (lbs gw)
2010	55	313	35,606	130,864	585	295,624
2011	57	336	41,384	140,861	999	595,420
2012	58	348	42,588	154,978	673	548,368
2013	59	235	19,854	112,333	768	638,025
2014	75	356	33,521	190,243	887	474,325
Average	61	318	34,591	145,856	633	510,352

Source: NMFS SEFSC Logbook data.
*Includes Gulf trips on which hogfish were not harvested and trips in the South Atlantic on which hogfish may have been harvested.

Table 3.4.1.2. Summary of vessel counts and revenue (thousand 2014 dollars) for vessels landing at least one pound of hogfish, 2010-2014.

Year	Number of Vessels	Dockside Revenue from Gulf Hogfish	Dockside Revenue from "Other Species" Jointly Caught with Hogfish	Dockside Revenue on Other Trips*	Total Dockside Revenue	Average Total Dockside Revenue per Vessel
2010	55	$122,969	$414,305	$801,035	$1,338,309	$24,333
2011	57	$156,792	$469,841	$1,802,306	$2,428,939	$42,613
2012	58	$164,975	$510,848	$1,593,436	$2,269,258	$39,125
2013	59	$78,171	$393,474	$1,908,415	$2,380,060	$40,340
2014	75	$137,045	$659,034	$1,560,099	$2,356,178	$31,416
Average	61	$131,990	$489,500	$1,533,058	$2,154,549	$35,565

Source: NMFS SEFSC Logbook and ALS data.
*Includes Gulf trips on which hogfish were not harvested and trips in the South Atlantic on which hogfish may have been harvested.

Ex-vessel Prices

The dockside or ex-vessel price is the price the vessel receives at the first sale of harvest. Over the period 2010-2014, the average annual ex-vessel price per lb for hogfish harvested in the Gulf was $3.82 (2014 dollars), and ranged from $3.45 in 2010 to $4.09 in 2014.

Commercial Sector Business Activity

Estimates of the business activity (economic impacts) in the U.S. associated with the Gulf hogfish commercial harvests were derived using the model developed for and applied in NMFS (2011b) and are provided in Table 3.4.1.3. Business activity for the commercial sector is characterized in the form of full-time equivalent (FTE) jobs, income impacts (wages, salaries, and self-employed income), and output (sales) impacts (gross business sales). Income impacts should not be added to output (sales) impacts because this would result in double counting. The estimates of economic activity include the direct effects (effects in the sector where an expenditure is actually made), indirect effects (effects in sectors providing goods and services to directly affected sectors), and induced effects (effects induced by the personal consumption expenditures of employees in the direct and indirectly affected sectors).

Table 3.4.1.3. Average annual business activity associated with the harvests of vessels that harvest hogfish, 2010-2014.

Species	Average Annual Dockside Revenue[1]	Total Jobs	Harvester Jobs	Output (Sales) Impacts (thousands)[1]	Income Impacts (thousands)[1]
Hogfish	$131,990	20	5	$1,309	$481
All species[2]	$2,154,549	323	77	$21,366	$7,846

[1]2014 dollars.
[2]Includes dockside revenues and economic activity associated with the average annual harvests of all species, including hogfish, harvested by vessels that harvested hogfish in the Gulf.

As discussed above, vessels that harvested hogfish in the Gulf also harvested other species on trips where hogfish were harvested, took other trips in the Gulf on which no hogfish were harvested, and some vessels took trips in the South Atlantic. All revenues from all species harvested on all of these trips contributed towards making these vessels economically viable and contribute to the economic activity associated with these vessels. The average annual total ex-vessel revenues from all species (including hogfish) harvested during this period (2010-2014) by vessels that harvested hogfish in the Gulf was approximately $2.15 million (2014 dollars). The business activity associated with this revenue is estimated to support 323 FTE jobs (77 in the harvesting sector) and are associated with approximately $21.37 million in output (sales) impacts and approximately $7.84 million in income impacts.

Dealers

Commercial vessels landing hogfish can only sell their catch to federally permitted fish dealers. On November 4, 2015, 411 dealers possessed the necessary federal dealer permit to receive hogfish harvested in the Gulf. There are no income or sales requirements to acquire a federal dealer permit. As a result, the total number of dealers can vary over the course of the year and from year to year. Because the amount of hogfish average annual harvest in the Gulf is so low (see Tables 3.4.1.1 and 3.4.1.2), no dealers are expected to be dependent on hogfish sales.

Imports

Information on the imports of all snapper and grouper species, either fresh or frozen, are available at: http://www.st.nmfs.noaa.gov/st1/trade/cumulative_data/TradeDataProduct.html. Information on the imports of individual snapper or grouper species is not available. In 2012, imports of all snapper and grouper species (fresh and frozen) were approximately 44.51 million pounds valued at approximately $138.81 million (2014 dollars). More recent data is not currently available. These amounts are contrasted with the domestic harvest of all snapper and grouper in the U.S. in 2014 of approximately 20.32 mp valued at approximately $78.80 million (2014 dollars; data available at: http://www.st.nmfs.noaa.gov/commercial-fisheries/publications/index). Although the levels of domestic production and imports are not totally comparable for several reasons, including considerations of different product form such as fresh versus frozen, and possible product mislabeling, the difference in the magnitude of imports

relative to amount of domestic harvest is indicative of the dominance of imports in the domestic market.

3.4.2 Recreational Sector

Angler Effort

Recreational effort derived from the Marine Recreational Information Program (MRIP) database can be characterized in terms of the number of trips as follows:

- Target effort – 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 second primary target for the trip. The species did not have to be caught.
- Catch effort – 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 possible, such as directed trips (the number of individual angler trips that either targeted or caught a particular species), among other measures. Estimates of the number of hogfish target trips and catch trips for the shore, charter, and private/rental boat modes in the Gulf for 2011-2014 are provided in Table 3.4.2.1 and Table 3.4.2.2. Because these estimates are survey-based, they may be more useful in demonstrating trends and ranking across modes rather than documenting absolute amounts of activity. For example, in the shore mode, the single positive value for target trips in 2011 (Table 3.4.2.1) may be better described as showing that some shore anglers target hogfish (i.e., targeting is not non-existent), but these anglers are less consistently encountered in the shore mode than in the other modes. For catch trips (Table 3.4.2.2), the shore mode estimates demonstrate an increasing trend in hogfish encounters, whereas the number of catch trips in the charter mode have been stable, despite the 2013 estimate, which may simply reflect a sampling anomaly.

Table 3.4.2.1. Number of hogfish recreational target trips, by mode, Florida, 2011-2014*.

	Shore Mode**	Charter Mode	Private/Rental Mode	All Modes
2010	0	5,346	29,023	34,369
2011	4,569	722	27,560	28,282
2012	0	2,574	65,344	67,918
2013	0	282	60,606	60,888
2014	0	477	64,441	64,918
Average	914	1,880	49,395	51,275

*Florida was the only Gulf state with recorded target effort for hogfish.
Source: MRIP database, NMFS, SERO.

Note: these effort estimates do not include hogfish effort recorded for Monroe County, FL, because hogfish harvest in this area is managed by the South Atlantic Fishery Management Council (SAFMC).

Table 3.4.2.2. Number of hogfish recreational catch trips, by mode, Florida, 2010-2014*.

	Shore Mode	Charter Mode	Private/Rental Mode	All Modes
2010	363	5,346	49,433	55,142
2011	722	2,026	44,814	47,562
2012	1,742	3,380	91,419	96,541
2013	6,507	412	99,011	105,930
2014	13,113	3,992	78,914	96,019
Average	4,489	3,031	72,718	80,239

*Florida was the only Gulf state with recorded target effort for hogfish.
Source: MRIP database, NMFS, SERO.
Note: these effort estimates do not include hogfish effort recorded for Monroe County, FL, because hogfish harvest in this area is managed by the SAFMC.

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.

The distribution of headboat effort (angler days) by geographic area is presented in Table 3.4.2.3. Headboat data is collected by the NMFS Southeast Region Headboat Survey (SRHS). Because hogfish target and catch effort for shore, private/rental, and charter anglers were only recorded in Florida, only estimates for headboat angler days from Florida are relevant to the hogfish analysis. However, the SRHS data collection program combines Alabama with north Florida for confidentiality purposes. As a result, estimates of the headboat angler days in Alabama are also included in Table 3.4.2.3. Also, similar to the target and catch effort estimates provided in Tables 3.4.2.1 and 3.4.2.2, the estimates of angler days exclude trips taken in Monroe County, FL (area designation "Dry Tortugas" in the SRHS). On average (2010 through 2014), 158,525 headboat angler days were taken in the area of focus per year.

Table 3.4.2.3. Headboat angler days and percent distribution, by state, 2010-2014.

	West Florida	Florida/Alabama*	Total
2010	69,113	40,594	109,707
2011	78,317	77,303	155,620
2012	83,365	77,770	161,135
2013	94,752	80,048	174,800
2014	102,841	88,524	191,365
Average	85,678	72,848	158,525

*Starting in 2013, SRHS data has been reported separately for NW Florida and Alabama, but has been combined in this table for consistency with previous years.
Source: NMFS Southeast Region Headboat Survey (SRHS).
FLW = Southwest Florida through the Florida Middle Grounds, FL-AL = northwest Florida and Alabama.

Permits

The for-hire 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 (RF). On October 30, 2015, there were 1,306 vessels with a valid (non-expired) or renewable Gulf for-hire RF permit (including historical captain permits). A renewable permit is an expired limited access permit that may not be actively fished, but is renewable for up to one year after expiration. The Gulf RF for-hire permits are limited access permits. Most for-hire vessels possess more than one for-hire permit. Among the 1,306 vessels with a Gulf Reef Fish for-hire permit, 1,250 also had a Gulf Charter/Headboat permit for Coastal Migratory Pelagic species for-hire permit and 56 had only a RF for-hire permit. Additionally, 167 of these vessels (all vessels with Gulf RF for-hire permit) had a Gulf commercial reef fish permit and 353 vessels had at least one for-hire permit required to fish for species managed by the South Atlantic Fishery Management Council (Atlantic dolphin/wahoo, Atlantic CMP species, or snapper-grouper species).

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 NMFS Southeast Region Headboat Survey (SRHS) and is selected to report by the Science Research Director of the Southeast Fishery Science Center, it is determined to operate primarily as a headboat and is required to submit harvest and effort information to the SRHS. As of May 6, 2015, 69 Gulf headboats were registered in the SRHS (K. Fitzpatrick, NMFS SEFSC, pers. comm.).

Information on Gulf charter boat and headboat operating characteristics is included in Savolainen et al. (2012) and is incorporated herein by reference.

There are no specific federal permitting requirements for recreational anglers to fish for or harvest reef fish. Instead, 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. For the for-hire sector, customers are authorized to fish under the charter or headboat vessel license and are not required to hold their own fishing licenses. As a result, it is not possible to identify with available data how many individual anglers would be expected to be affected by this proposed action.

Economic Value

Economic value for for-hire vessels can be measured by producer surplus (PS) per passenger trip (the amount of money that a vessel owner earns in excess of the cost of providing the trip). Estimates of the PS per for-hire passenger trip are not available. Instead, net operating revenue (NOR), which is the return used to pay all labor wages, returns to capital, and owner profits, is used as a proxy for PS. For vessels in the Gulf, the estimated NOR value is $151 (2013 dollars) per charter angler trip (Liese and Carter 2011). The estimated NOR value per headboat angler trip is $52 (2013 dollars) (C. Liese, NMFS SEFSC, pers. comm.).

Business Activity

To be completed prior to public hearing.

3.5 Description of the Social Environment

Hogfish is harvested commercially and recreationally primarily off Florida. Hogfish are primarily caught by spear while diving and secondarily by hook-and-line. Recreational and commercial landings for the years 1986 through 2014 are provided in Table 2.3.2.

Commercial Fishing

Commercial landings of red snapper have averaged 28,037 lbs per year from 1999 (when hogfish was added to the reef fish management unit) through 2014, with a range of 15,630 lbs in 2006 to 45,995 lbs in 2011. Hogfish are primarily caught by spearfishing, although hogfish are targeted by hook-and-line, too (Table 3.5.1).

Table 3.5.1. Gear type used for commercial hogfish landings.

Year	Spear	Hook/Line	Unknown
1999	34.0%	32.2%	33.9%
2000	41.2%	48.3%	10.5%
2001	55.1%	26.4%	18.5%
2002	63.3%	18.8%	17.9%
2003	69.3%	24.6%	6.1%
2004	85.4%	10.5%	4.0%
2005	80.5%	16.0%	3.5%
2006	88.4%	9.3%	2.3%
2007	87.0%	10.5%	2.5%
2008	66.8%	9.1%	24.1%
2009	77.2%	7.2%	15.6%
2010	81.6%	16.0%	2.4%
2011	83.0%	12.2%	4.8%
2012	90.5%	9.5%	0.0%

Source: SEDAR 37, Table 6.2.2.3 (from the ALS-SEFSC dataset).

A regional quotient (RQ) measure was used to identify commercial engagement and reliance on hogfish. The RQ measures the relative importance of a given species across all communities in the region and represents the proportional distribution of commercial landings of a particular species. This proportional measure does not provide the number of pounds or the value of the catch; data that might be confidential at the community level for many places. The RQ is calculated by dividing the total pounds (or value) of a species landed in a given community, by the total pounds (or value) for that species for all communities in the region. The measure is a way to quantify the importance of hogfish to communities around the Gulf coast and suggest where impacts from management actions are more likely to be experienced. The data used for the RQ measure were assembled from the accumulated landings system (ALS), which includes commercial landings of all species from both state and federal waters and is based on dealers' reports. These data were converted to provide landings by (dealer's) address. Because of this, the address of a dealer may not be the coastal community where the dealer's facility is located.

As noted, commercial fishing for hogfish is prosecuted primarily in Florida. Based on the RQ measure, the top 15 communities with the greatest landings of hogfish in 2014 are identified in Figure 3.5.1. Of the top five communities, four are located in Pinellas County, Florida (Largo, St Petersburg, Tarpon Springs, and Redington Shores).

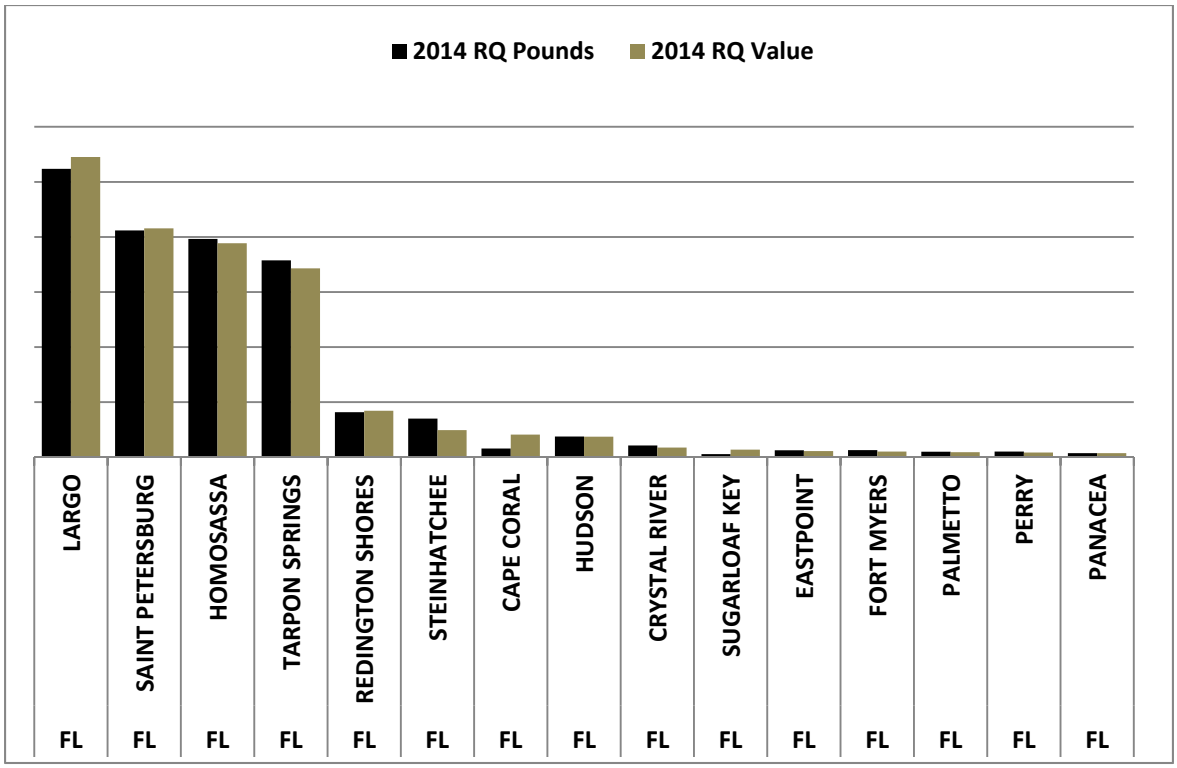

Figure 3.5.1. Top 15 commercial communities with the greatest landings of hogfish in 2014 Source: NMFS ALS 2014.

A community's proportion of total landings is not static and changes over time. Nevertheless, in recent years, Pinellas County communities have ranked highest for commercial hogfish landings. In 2013, three of the top five communities with the greatest landings were in Pinellas County, while in 2012, four out of the top five communities were in Pinellas County. Each year from 2010 through 2014, St Petersburg and Tarpon Springs, in Pinellas County have ranked within the top five communities, along with Homosassa in Citrus County (annual NMFS ALS data provided by M. Jepson, pers. comm.).

Recreational Fishing

Although landings of hogfish by hook-and-line are increasing, hogfish are associated with spearfishing, being one of the most targeted and landed reef fish by spear (SEDAR 37).

Hogfish landings for the recreational sector are not available at the community level making it difficult to identify communities as dependent or reliant on recreational fishing for hogfish. Data reflecting commercial landings of hogfish may or may not reflect areas of importance for recreational fishing of hogfish. It cannot be assumed that the proportion of commercial hogfish landings among other species in a community would be similar to its proportion among recreational landings within the same community because of sector differences in fishing practices and preferences.

While there are no landings data at the community level for the recreational sector, Table 3.5.2 provides the number of charter/headboat permits for reef fish held in each Florida County. This

is a crude measure of the reliance upon recreational reef fish fishing, is general in nature, and not specific to hogfish. Ideally, additional variables quantifying the importance of recreational fishing to a community would be included (such as the amount of recreational landings in a community by species, availability of recreational fishing related businesses and infrastructure, etc.); however, these data are not available at this time. Further, an analysis based on discrete geo-political boundaries at the community level would result in both Panama City and Panama City Beach, in Bay County, ranking high enough to appear independently, while the numerous communities of Pinellas County, which has the most permits of any Florida County, would not appear. Thus, the aggregate number of permits by county is used to identify areas with a greater concentration of reef fish for-hire vessels.

Table 3.5.2. Number of valid and renewable charter/headboat reef fish permits in the Gulf of Mexico by Florida west coastal county as of May 28, 2015.

County	# of Permits
Pinellas	97
Okaloosa	93
Bay	77
Collier	51
Lee	37
Sarasota	36
Escambia	34
Hillsborough	18
Manatee	17
Santa Rosa	17
Franklin	16
Gulf	16
Citrus	15
Walton	12
Charlotte	11
Pasco	11
Hernando	7
Wakulla	6
Other Florida Counties	26
West Florida TOTAL	**597**

At this time it is not possible to examine the intensity of recreational fishing activity at the community level for a specific species, i.e., hogfish. However, it is likely that those communities that have a higher rank in terms of charter for-hire activity and have a dynamic commercial fishery for hogfish will likely have an engagement in recreational fishing for hogfish. There is very little overlap among the commercial communities with hogfish landings and recreational communities with for-hire operators. However, at the county level, Pinellas County ranks highest for the value and volume of commercial hogfish landings, and the number

of for-hire operators, suggesting that any social effects resulting from actions taken in this plan amendment would likely be greatest in Pinellas County communities.

3.5.1 Environmental Justice Considerations

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*.), 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 exclusive economic zone, 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 exclusive economic zone.

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 nine-mile seaward boundary of the states of Florida and Texas, and the three-mile seaward boundary of the states of Alabama, Mississippi, and Louisiana. 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). Action 1 of this action proposes to cede regulatory authority of hogfish in the southernmost region (Florida Keys and off the Everglades) to the South Atlantic Council. The South Atlantic Council is responsible for reef fish fishery resources in federal waters off North Carolina, South Carolina, Georgia and east Florida to Key West (http://www.safmc.net/).

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 the National Oceanic and Atmospheric Administration'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 Advisory Panel and the Gulf States Marine Fisheries Commission's Law Enforcement Committee, which have developed joint enforcement agreements and cooperative enforcement programs (www.gsmfc.org).

The hogfish stock in the Gulf is classified as not overfished and not undergoing overfishing. Various hogfish management measures have been implemented and are outlined in Section 1.3. Periodic adjustments to the stock's ACL and other management measures needed to prevent overfishing and 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 of Mexico state marine resource agencies and Web pages.

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

CHAPTER 4. ENVIRONMENTAL CONSEQUENCES

4.1 Action 1: Definition of the Management Unit

4.1.1 Direct and Indirect Effects on the Physical Environment

With respect to Action 1, 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 as described in Section 3.1.1. For commercial harvest, the primary gear used for harvest of hogfish are spearfishing, hook-and-line, and prior to 2007, traps. Traps were prohibited in 2007. Between 2007 and 2012, in the Gulf spearfishing accounted for 88% of the commercial harvest and hook-and-line accounted for 12% of the harvest (SEDAR 37 2013).

For recreational harvest, hogfish are taken primarily by spearfishing, being one of the most targeted and caught species using spear. Between 2007 and 2012, in the Gulf spearfishing accounted for 83% of the recreational harvest and hook-and-line accounted for 17% of the harvest. Recreational harvest of hogfish is primarily from private boats, with only a small proportion from either charter boats, shore-based fishing (SEDAR 37 2013).

Fishing gear can damage or disturb bottom structures and occasionally incidentally harvest such habitat. The degree a habitat is affected by fishing gear depends largely on the vulnerability of the affected habitat to disturbance, and on the rate that the habitat can recover from disturbance (Barnette 2001). For example, the complex structure and vertical growth pattern of coral reef species makes reef habitat more vulnerable to adverse impacts from fishing gear and slower to recover from such impacts than is sand and mud bottom habitat (Barnette 2001).

Vertical lines

Concentrations of many managed reef fish species are higher on hard bottom areas than on sand or mud bottoms, thus vertical line gear fishing generally occurs over hard bottom areas (GMFMC 2004a). Vertical lines include multi-hook lines known as bandit gear, handlines, and rod-and-reels. Vertical-line gear has the potential to snag and entangle bottom structures and cause tear-offs or abrasions (Barnette 2001). In using bandit gear, a weighted line is lowered to the bottom, and then the lead 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). Commercial or recreational fishing with rod-and-reel and handlines also puts gear on the bottom. The terminal part of the gear is either lifted off the bottom like fishing with bandit gear, or left contacting the bottom. Sometimes the fishing line can become entangled on coral and hard bottom outcroppings. The subsequent algal growth can foul and eventually kill the underlying coral (Barnette 2001). Researchers conducting studies in the restricted fishing area at Madison-Swanson reported seeing lost fishing line on the bottom, much of which appeared to be fairly old and covered with growth (personal communication, Andrew David), a clear indication that bottom fishing has had an impact on the physical

environment prior to fishing being prohibited in the area (GMFMC 2003). The National Fish and Wildlife Foundation, in issuing grants to remove marine debris, established monofilament fishing line is a priority marine debris issue.

Anchor damage is also associated with vertical-line fishing vessels, particularly by the recreational sector where fishermen may repeatedly visit well marked fishing locations. Bohnsack (in Hamilton 2000) showed that "favorite" fishing areas such as reefs are targeted and revisited multiple times, particularly with the advent of global positioning technology. The cumulative effects of repeated anchoring could damage the hard bottom areas where fishing for grouper occurs.

Spearfishing

Although spearfishing us a relatively minor component for harvest of other reef fish such as grouper, it is the dominant gear for both commercial and recreational harvest of hogfish. Barnette (2001) cited a study by Gomez (1987) that concluded that spearfishing on reef habitat may result in some coral breakage, but damage is probably negligible. In addition, there could be some impacts from divers touching coral with hands or from resuspension of sediment by fins (Barnette 2001). Such impacts should be negligible to non-existent for well-trained and experienced spearfishermen who stay in the water column and avoid contact with the bottom.

Powerheads

Powerheads are devices attached to the ends of a spear or stick that, when struck with sufficient force against a fish, fire a cartridge. Damage to the fish is caused primarily by the percussion from the expanding gasses rather than from a projectile. Stressed areas for reef fish begin at the shoreward boundary of federal waters and generally follow the 10 fathom contour from the Dry Tortugas to Sanibel Island; the 20 fathom contour to Tarpon Springs; the 10 fathom contour to Cape San Blas; the 25 fathom contour to south of Mobile Bay; the 13 fathom contour to Ship Island, Mississippi; the 10 fathom contour off Louisiana; and the 30 fathom contour off Texas. Within the stressed area, the use of powerheads against stocks in the reef fish management unit is prohibited. However, hogfish are exempt from the powerhead prohibition (§ 622.35(a)(1)). At one time, hogfish were included in the Reef Fish FMP in the list of "species in the fishery but not the management unit", and the stressed area restrictions did not apply to that list. In 1999 Amendment 16B (GMFMC 1999a) eliminated the distinction between reef fish species in the management unit and those in the fishery but not in the management unit. At the time, hogfish, sand perch, dwarf sand perch, and Queen triggerfish were the only species left on the "in the fishery" list. Even though the "species in the fishery but not the management unit" no longer existed, these species continued to be listed as exempt from the stressed area restrictions. Queen triggerfish was removed from the FMP in Amendment 16B (GMFMC 1999a), and sand perch and dwarf sand perch were removed in the Generic ACL/AM Amendment (GMFMC 2011a), leaving only hogfish from the old list. Powerheads are generally used against larger fish such as sharks and greater amberjack. It is unlikely that hogfish are harvested with powerheads.

The alternatives in this action establish the management boundary between the west Florida shelf hogfish stock and the south Atlantic/Florida Keys hogfish stock. The south Atlantic/Florida

Keys hogfish stock has been determined to be overfished and is in need of a rebuilding plan, whereas the west Florida stock is neither overfished nor experiencing overfishing. Hogfish managed under the rebuilding plan established by the South Atlantic Fishery Management Council are likely to be subject to greater fishing restrictions than hogfish management by the Gulf Council, and therefore will be subject to less fishing activity directed toward the stock. The larger the area under the Gulf Council's jurisdiction that is reassigned to the South Atlantic Council for management of hogfish, the more positive the benefit will be to the physical environment in terms of gear interactions. In this respect, **Alternative 1**, the no action alternative, will continue to allow the greatest amount of fishing and gear interactions in the south Florida region. **Alternative 2** will have slightly less adverse gear interactions since a small part or the area in the Gulf Council's jurisdiction will be designated for hogfish management by the South Atlantic Council. **Alternative 3** will provide slightly less adverse impacts than **Alternative 2**, and **Alternative 4** will provide the least adverse impacts. It should be noted, however, that fishing for other stocks will continue to occur using the same gear types. Consequently, while small relative differences can be identified between the alternatives, such differences are likely to be insignificant within the context of all fishing activities.

4.1.2 Direct and Indirect Effects on the Biological/Ecological Environment

Hogfish occur in warm temperate to tropical waters of the western Atlantic Ocean, and are observed from Brazil to Bermuda, as well as throughout the Caribbean and Gulf of Mexico. In the Gulf of Mexico, they are caught primarily off the coast of Florida, with the majority of the landings coming from South/Southeastern and Western Florida. Only a small number of landings reported west of Florida. Recent genetic analysis indicates that there are two distinct stocks of hogfish off the Florida coast that converge south of Naples (SEDAR 37 2013). In addition, there is a third distinct stock in the Atlantic off the Carolinas, but this third stock does not occur in Gulf waters and is not impacted by actions in the Reef Fish FMP. Trips where hogfish are caught are associated with mutton snapper, and yellowtail snapper, although not strongly. This may be because these three stocks are predominantly concentrated in the Florida Keys (Farmer et al. 2010). The primary method for catching hogfish is spearfishing (Tables 2.4.2 and 2.4.3). Spearfishing is a line-of-sight method of fishing, so incidental bycatch of other species while targeting hogfish is likely minimal. In previous years, hogfish were considered a species that rarely takes a hook. However, as annual catch limits have resulted in closures of other species, hook-and-line targeting of hogfish has become more common[6]. Therefore, while some of the hook-and-line caught hogfish may be bycatch from fishermen targeting snapper or other species, an increasing portion of the catch is likely to be from fishermen specifically targeting the species. Bycatch of hogfish from fishermen targeting other species, and vice-versa, is unlikely to change significantly under any of the alternatives in this action.

The SEDAR 37 hogfish stock assessment used the Monroe/Collier county line (**Alternative 4**) as the dividing point between the west Florida shelf stock and the Atlantic/Florida Keys stock. All of the alternatives set the boundary for the hogfish management unit at the Monroe/Collier county line of further south. Therefore, all of the alternatives keep the entire west Florida shelf stock as defined in SEDAR 37 under Gulf management. Consequently, there will be no change

[6] http://www.bradenton.com/sports/outdoors/fishing-boating/article34753368.html

in the biological and ecological effects on the west Florida shelf stock regardless of which alternative is adopted. However, **Alternatives 1, 2, and 3** include a portion of the stock that is defined in the assessment as Atlantic/Florida Keys stock. The two stocks will be subject to different management regimes because the Atlantic/Florida Keys stock is overfished and in need of a rebuilding plan while the west Florida shelf stock is not overfished. Hogfish caught south of the Monroe/Collier county line will be counted as south Atlantic catch even if they are fished under Gulf regulations. The larger the portion of the Atlantic/Florida Keys stock included under Gulf management, the more difficult it will be for the Atlantic/Florida Keys rebuilding plan to be effective.

Alternative 1 (no action) leaves the demarcation for management of the two stocks as the jurisdictional boundary between the South Atlantic and Gulf of Mexico. This is 73 nautical miles (nm) south of the Monroe County line. Catch data cannot be resolved below the county level, so the amount of hogfish from the Atlantic/Florida Keys stock that is caught under Gulf management cannot be quantitatively estimated. However, qualitatively, **Alternative 1** will allow the largest portion of the Atlantic/Florida Keys stock to be caught under Gulf management, and therefore will have the greatest adverse impact on the effectiveness of the Atlantic/Florida Keys stock rebuilding plan.

Under **Alternatives 2, 3, and 4**, it is the Council's intent to request that management of hogfish south of the demarcation line be delegated to the South Atlantic Council. This analysis assumes that this delegation will occur.

Alternative 2 sets the demarcation line for hogfish management at 25º 09' north latitude (south of Cape Sable), which is 38 nm south of the Monroe Collier county line and 35 nm north of the **Alternative 1** jurisdictional boundary. This demarcation line is currently used by Florida FWC for some state managed species such as permit. In addition, it is far enough north of the Keys and far enough south of Naples and Marco Island that does not simply shift regulatory issues north to Collier County. This will allow almost half of the Monroe County Gulf coast to come under South Atlantic jurisdiction for purposes of hogfish management, and will allow the Atlantic/Florida Keys stock rebuilding plan to control a larger proportion of the stock. However, it will still leave a portion of the Atlantic/Florida Keys stock under Gulf management, which may hinder the rebuilding plan. Increased enforceability from using a known, pre-existing boundary may offset the adverse impacts from leaving a portion of the Atlantic/Florida Keys stock under Gulf management, but from a purely biological perspective, **Alternative 2** will have less adverse biological/ecological impacts that **Alternative 1**, but more than **Alternatives 3 and 4**.

Alternative 3 sets the demarcation line for hogfish management at 25º 23' north latitude (Shark Point), which is 25 nm south of the Monroe Collier county line and 48 nm north of the **Alternative 1** jurisdictional boundary. This is considered a natural demarcation line because fishing trips originating south of this line rarely travel north of the boundary, and trips originating north of the boundary rarely travel south. This line allows more of the hogfish occurring off Monroe County to be managed under the Atlantic/Florida Keys stock rebuilding plan than either **Alternative 1** or **Alternative 2**, and therefore has less adverse impacts than those alternatives. However, a portion of the Atlantic/Florida Keys stock will remain under Gulf

management, which may hinder the rebuilding plan. Therefore, **Alternative 2** will have less adverse biological/ecological impacts than **Alternative 1** or **Alternative 2**, but more than **Alternative 4**.

Alternative 4 sets the demarcation line at the Monroe/Collier county line, which is consistent with the boundary used by the SEDAR 37 (2013) stock assessment. Although the assessment used this as the demarcation line, it stated that convergence of the two stocks occurs south of Naples. Naples is north of the county line, so it is still possible that a small portion of the Atlantic/Florida Keys stock will come under Gulf management. Nevertheless, **Alternative 4** places the largest amount of the Atlantic/Florida Keys stock under South Atlantic management and provides the least adverse impacts to the rebuilding plan relative to **Alternatives 1, 2, and 3**.

4.1.3 Direct and Indirect Effects on the Economic Environment

4.1.4 Direct and Indirect Effects on the Social Environment

4.1.5 Direct and Indirect Effects on the Administrative Environment

The setting of a geographic boundary separate from the South Atlantic Council/Gulf Council jurisdictional boundary to define the hogfish management unit in the Reef Fish FMP is an administrative action and will have direct and indirect effects on the administrative environment through additional rulemaking to establish the boundary and designation of the South Atlantic Council as the responsible Council for hogfish below the boundary. **Alternative 1** would retain the South Atlantic Council/Gulf Council jurisdictional boundary for hogfish management and would result in no direct change to the administrative environment. However, it would leave a portion of the overfished Atlantic/Florida Keys hogfish stock, as defined in the SEDAR 37 assessment, subject to Gulf Council management which may indirectly affect the administrative environment by hindering attempts by the South Atlantic Council to effectively implement a rebuilding plan for the overfished stock. The remaining alternatives place more of the Atlantic/Florida Keys stock under South Atlantic jurisdiction. Therefore, the indirect impacts on the rebuilding plan would be less for **Alternative 2**, even less for **Alternative 3**, and would be eliminated for **Alternative 4** since **Alternative 4** uses the same boundary line as the SEDAR 37 assessment.

Alternative 2 and **Alternative 3** would both set the hogfish management boundary between the South Atlantic Council/Gulf Council jurisdictional boundary and the Monroe/Collier County line, which was used by SEDAR 37 to separate Gulf stock landings from Atlantic/Florida Keys stock landings. These alternatives would have adverse impacts on the administrative environment compared to **Alternative 1** by creating additional boundaries in the EEZ requiring additional federal enforcement. They would also complicate the regulatory environment by creating a region off of southwest Florida where some species (hogfish) are subject to South Atlantic regulations, while other species (other reef fish) are subject to Gulf regulations. The

Alternative 2 boundary is an extension of an existing state boundary into federal waters. Since it uses an existing boundary, the adverse administrative impacts of **Alternative 2** relative to **Alternative 1** are expected to be small. The **Alternative 3** boundary occurs at a location that is a natural break between vessels that fish south of the boundary and vessels that fish north of the boundary. Although it creates an entirely new boundary, enforceability is unlikely to be a major concern. Therefore, the relative adverse administrative impacts of **Alternative 3** relative to **Alternative 1** and **Alternative 2**, while slightly greater due to the creation of a new boundary, are also expected to be small.

Alternative 4 would set the hogfish management boundary at the Monroe/Collier County line, which was used by SEDAR 37 to separate Gulf stock landings from Atlantic/Florida Keys stock landings. As discussed above, this would eliminate indirect adverse impacts on the Atlantic/Florida Keys stock rebuilding plan by placing the entire stock, as defined in SEDAR 37, under South Atlantic jurisdiction. However, as with **Alternative 3**, it would create an entirely new management boundary, and unlike **Alternative 3**, there is no natural separation of fishermen north and south of the line. Therefore, **Alternative 4** would create the greatest enforcement issues and would have the greatest adverse impacts on the administrative environment.

4.2 Action 2: Status Determination Criteria for Hogfish

4.2.1 Direct and Indirect Effects on the Physical Environment

Hogfish status determination criteria do not directly affect the physical environment. However, specifying these criteria may indirectly affect the physical environment by defining the future level of fishing effort that would 1) end overfishing in the short term should it occur and 2) sustain the stock over the long term. As mentioned in Section 4.1.1, effects on the physical environment from fishing are associated with gear coming into contact with bottom. Different gears have different levels of impact. Spearfishing and hook-and-line gear, the primary gears used to harvest hogfish, have minimal adverse effects on the physical environment. In general, the alternatives that allow fishing effort to increase (more gear being used) would have greater affects.

Of the different status determination criteria, the MFMT would help to determine management measures to reduce fishing effort to a level designed to prevent overfishing. Therefore, the lower the MFMT value, the less fishing effort. **Alternative 2** is expected to have the most adverse effect on the physical environment because it has the highest MFMT value (0.150; Table 2.2.1), followed by **Alternative 1** and **Alternative 3**, which have equal MFMT values (0.95). **Alternative 4**, with the lowest MFMT value (0.62), is expected to have the least adverse effect on the physical environment. Note that any reduction in fishing effort as a result of tailoring fishery management measures to these status determination criteria would likely be minimal. The reef fish fishery is a multispecies fishery. If fishermen are not able to fish for one species, they often shift their effort to other species, maintaining over all reef fish fishing effort.

With respect to the options for MSST, the SSB values from which the MSST is calculated are highest for **Alternative 4,** followed by **Alternative 3**, then **Alternative 2**. The higher the

MSST, the more restrictive fishing measures (least adverse to the physical environment) need to be to prevent the stock from being fished below overfished threshold. Within each alternative, **Option a** would require more restrictive management measures, then **Option b**, then **Option c** (Table 2.2.1). Between alternatives, **Option 4a** would require more restrictive management measures, then **Option 3a**, then **Option 2a**. The same trend would also apply to **Options b** and **c** between alternatives (i.e., **Option 4b**>**3b**>**2b** and **Option 4c**>**3c**>**2c**). Alternative 1 would not have an overfished threshold, so management measures to restrict fishing would be based on MFMT and not consider MFMT.

4.2.2 Direct and Indirect Effects on the Biological/Ecological Environment

Establishing status determination criteria for hogfish should not directly affect the biological/ecological environment because they simply provide fishery managers with defined harvest thresholds to consider in developing fishery management measures. Managers use these measures in part to evaluate whether the stock removal (fishing) and fishing mortality rates are within desirable ranges. Therefore, **Alternatives 1-4** should have no direct effect on the biological/ecological environment. However, specifying these values would indirectly affect the biological/ecological environment by defining the future level of harvest that would 1) reduce the likelihood of overfishing occurring and 2) sustain the stock over the long term in accordance with the national standard guidelines.

Alternative 1, if selected as preferred would still require management measures to minimize the likelihood of overfishing of the hogfish stock with the current MFMT; however, MSY and MSST would not be established. No criterion for an overfished level for the stock (MSST) could lead to the stock becoming depleted. If this depletion caused the stock to be reduced to a very low level, stock recovery could be lengthy.

Alternative 4 would set the MFMT, MSY, and MSST at the most conservative levels of the considered alternatives using an MSY proxy of the yield of fishing at $F_{40\%SPR}$. Because the stock is at a level below 40% SPR and management goals under this alternative would be associated with fishing at $F_{40\%SPR}$ and $SSB_{40\%SPR}$, harvests would need to limited to achieving a greater stock size. This would provide a biological benefit to the stock by allowing the stock to grow.

Alternative 2 would set the MFMT, MSY, and MSST to the most liberal level of the alternatives. This alternative, which is based on fishing at MSY and not a proxy, assumes a more productive stock that can sustain higher levels of fishing effort. However, if the estimate of MSY is optimistic compared to the actual productivity of the stock, selecting this alternative compared to the other alternatives would have an increased likelihood of overfishing and ultimately lead to an overfished stock.

Alternative 3 would set the MFMT, MSY, and MSST using the MSY proxy based on the yield of fishing at $F_{30\%SPR}$. This is the proxy recommended by the Council's SSC and it is intermediate to **Alternatives 2** and **4**. Thus, in terms of ranking the alternatives from having the least to most adverse effects on the hogfish stock, they would be **Alternative 4**, **Alternative 3**, **Alternative 2**, and **Alternative 1**. Although the MFMT for **Alternatives 1** and **3** are the same, **Alternative 1** does not provide an overfished threshold and would not provide a basis for

establishing a rebuilding plan.

With respect to the options to set MSST (**Options a-c**), once the stock achieves equilibrium, the overfished threshold provides a buffer to the stock and its ability to sustain MSY. Because **Option a** has the MSST biomass level closest to SSB under each alternative, the trigger to establish a rebuilding plan is more likely to be tripped than **Options b** and **c**. As long as the SSB does not fall too far below MSST, the stock can be rebuilt more quickly than if the stock biomass were to fall below the thresholds set by **Options b** and **c**. Therefore, **Option a** for each alternative provides greater assurances the stock can be rebuilt should the stock biomass be reduced below B_{MSY}. The tradeoff associated with this assurance is that natural variation in recruitment could cause the hogfish stock to more frequently alternate between an overfished and rebuilt condition, even if the fishing mortality rate applied to the stocks was within the limits specified by the MFMT. However, the likelihood of this occurring could be reduced if the hogfish stock were managed at a more conservative ACL (see Action 3). Because **Option b** for each alternative would provide a buffer between **Option c** and **Option a**, the effects from this option would be expected to be intermediate.

The relationships among species in marine ecosystems are complex and poorly understood, making the nature and magnitude of ecological effects difficult to predict with any accuracy. The most recent hogfish stock assessment (SEDAR 37 2014) indicated the west Florida shelf stock is not overfished and not experiencing overfishing. It is possible that forage species and competitor species could increase or decrease in abundance in response to a decrease or increase in hogfish abundance. This action, regardless of the alternative, should not directly affect hogfish abundance, thus any effects on forage species and competitor species would not likely be different from no action. Although birds, dolphins, and other predators may feed on hogfish discards, there is no evidence that any of these species rely on hogfish discards for food. Changes in the prosecution of the reef fish fishery are not expected from this action, so no additional effects to protected resources (see Section 3.3.1) are anticipated.

4.2.3 Direct and Indirect Effects on the Economic Environment

4.2.4 Direct and Indirect Effects on the Social Environment

4.2.5 Direct and Indirect Effects on the Administrative Environment

The setting of status determination criteria is an administrative action and will have effects on the administrative environment through additional rulemaking (direct effect), addressing overfished and overfishing conditions (direct effect), and monitoring the harvest (indirect effect). Because **Alternatives 1-4** would not require rulemaking, there would not be any immediate effect on the administrative environment from rulemaking. However, the Magnuson-Stevens Act requires NMFS to end overfishing as soon as possible and develop rebuilding plans for stocks considered overfished. Alternatives that have a higher degree of likelihood determining

the hogfish stock to be overfished or undergoing overfishing are more likely to result in further action to correct these conditions. Because **Alternative 4** has a very conservative MSY proxy, the probability of F exceeding the MFMT and the SSB falling below the MSST are greater than the other alternatives (Table 2.2.1). Therefore, this alternative would adversely affect the administrative environment more than the other alternatives as the likelihood of needing to take corrective action is greater. In addition, this alternative's MSST is more likely to be triggered because of natural fluctuations in SSB (see the discussion in Section 2.2) and lead to the implementation of a rebuilding plan when one may not be needed. **Alternative 2**, which is based on MSY rather than a proxy, has the highest MFMT and lowest respective MSST values (**Options a-c**; Table 2.2.1). Therefore, the likelihood of the stock being declared undergoing overfishing or overfished is lower and would have the least adverse effect on the administrative environment. With respect to overfishing, both **Alternative 1** and **Alternative 3** have MFMT values that are in-between **Alternatives 2** and **4**. Therefore, these alternatives would have intermediate adverse effects on the administrative environment relative to **Alternatives 2** and **4**. **Alternative 1** would not set an MSY or MSST value and so is in violation of the Magnuson-Stevens Act. As a result, if action is not taken in this amendment to rectify this need, another action would need to be initiated of provide the missing status determination criteria. The respective **Alternative 3** MSST values (**Options a-c**) are in-between **Alternatives 2** and **4**, and therefore the effects from this alternative would be intermediate to **Alternatives 2** and **4**.

With respect to the MSST options, within an alternative, **Option a** would set the highest MSST value and **Option c** the lowest MSST value for **Alternatives 2-4**. Thus the likelihood of the stock being reduced from overfishing to an overfished condition and in need of a rebuilding plan is greater than **Options b** and **c** (Table 2.2.1). **Option b** is intermediate to **Options a** and **c**. In order, **Option a** would have the greatest chance of adversely affecting the administrative environment through additional management measures, followed by **Option b**, and then **Option c**.

Indirect effects of status determination criteria require monitoring of the harvests and evaluating the stock condition through stock assessments. Regardless of which alternative is selected as preferred, these management activities need to continue. Therefore, the indirect effects from each alternative should be similar.

4.3 Action 3: Annual Catch Limit and Annual Catch Target

4.3.1 Direct and Indirect Effects on the Physical Environment

Setting a hogfish ACL or ACT does not directly affect the physical environment. However, specifying these values may indirectly affect the physical environment by defining the future level of fishing effort needed to harvest either value. As mentioned in Section 4.1.1, effects on the physical environment from fishing are associated with gear coming into contact with bottom. Different gears have different levels of impact. Spearfishing and hook-and-line gear, the primary gears used to harvest hogfish, have minimal adverse effects on the physical environment. In general, the alternatives that allow greater levels of fishing effort (more gear being used) would have greater affects. Note that any reduction in fishing effort as a result of tailoring fishery

management measures to limit the harvest to not exceed the ACL would likely be minimal. The reef fish fishery is a multispecies fishery. If fishermen are not able to fish for one species, they often shift their effort to other species, maintaining over all reef fish fishing effort.

Alternative 4 would set the lowest ACL of the alternatives being considered (Table 4.3.1; ACL = 159,300 lbs ww). Therefore, management measures to constrain the harvest to this level (e.g., fishing season and bag limit) would limit fishing effort the most and have the least adverse effect on the physical environment over the 2016-2018 time period. **Alternatives 2** and **3** would set higher ACLs than **Alternative 4** (Table 4.3.1.1). Therefore, management measures to constrain harvest would be less restrictive than under **Alternative 4**. This in turn could lead to higher fishing effort and greater adverse effects on the physical environment than **Alternative 4**. If the ACLs for **Alternatives 2** and **3** are summed over the 2016-2018 time period, they are approximately the same (Table 4.3.1.1). **Alternative 1** (no action) would have a cumulative 2016-2018 ACL that is intermediate to **Alternatives 2** and **3**, and **Alternative 4**. Thus any adverse effects from this alternative would be in-between these alternatives.

Unless additional management action is taken prior to 2019, **Alternatives 2-4** would have the same ACL (159,300 lbs ww), which is less than **Alternative 1** (208,000 lbs ww). Therefore, management actions to constrain the harvest to the ACL after 2018 under **Alternatives 2-4** would need to be more restrictive than under the no action alternative. Thus, **Alternative 1** from 2019 onward would more adversely affect the physical environment than the other alternatives.

Table 4.3.1.1. Proposed hogfish annual catch limits (pounds whole weight) for 2015-2019 as well as the sum of the 2016-2018 annual catch limits for each Action 3 alternative.

Year	Alternative 1	Alternative 2	Alternative 3	Alternative 4
2016	208,000	240,400	219,000	159,300
2017	208,000	216,800	219,000	159,300
2018	208,000	200,800	219,000	159,300
2019	208,000	159,300	159,300	159,300
Sum 2016-2018	624,000	658,000	657,000	477,900

Options a and **b** determine whether or not an ACT should be established for **Alternatives 2-4**. Whether to set an ACT or not should have no additional effects on how **Alternatives 1-4** influence the physical environment. This is because the current ACT (**Alternative 1**) is not being used to manage hogfish and no management measures constraining the hogfish harvest based on an ACT are being proposed in Amendment 43.

4.3.2 Direct and Indirect Effects on the Biological/Ecological Environment

Establishing ACLs and ACTs for hogfish should not directly affect the biological/ecological environment because they simply provide fishery managers with defined harvest levels to consider in developing fishery management measures. Managers use ACLs and ACTs in part to evaluate whether the harvest within a year is below or above recommended limits. Therefore,

Alternatives 1-4 should have no direct effect on the biological/ecological environment. However, specifying these values would indirectly affect the biological/ecological environment by defining the future level of harvest that is not to be exceeded.

Over the 2016-2018 time period, **Alternative 4** would provide the lowest harvest limit (Table 4.3.1.1; summed ACL = 477,900 lbs ww). This lower limit should reduce the removals of hogfish from the stock more than the other alternatives. **Alternatives 2** and **3** would result in the highest summed ACL over the 2016-2018 time period (summed ACL of 658,000 and 657,000 lbs ww, respectively). Thus, **Alternatives 2** and **3** would more adversely affect the hogfish stock than **Alternative 4** through greater removals over this time period. The likelihood of overfishing if the ACL were exceeded would be lower under **Alternative 4** than under **Alternatives 2** and **3**, further protecting the stock. **Alternative 1** (no action) would have intermediate effects to **Alternatives 2** and **3**, and **Alternative 4** (Table 4.3.1.1).

As explained in Section 4.3.2.1, **Options a** and **b** determine whether or not an ACT should be established for **Alternatives 2-4**. Whether to set an ACT or not should have no additional effects on how **Alternatives 1-4** influence the biological environment. This is because the current ACT (**Alternative 1**) is not being used to manage hogfish and no management measures constraining the hogfish harvest based on an ACT are being proposed in Amendment 43.

The relationships among species in marine ecosystems are complex and poorly understood, making the nature and magnitude of ecological effects difficult to predict with any accuracy. The most recent hogfish stock assessment (SEDAR 37 2014) indicated the west Florida shelf stock is not overfished and not experiencing overfishing. It is possible that forage species and competitor species could increase or decrease in abundance in response to a decrease or increase in hogfish abundance. This action, regardless of the alternative, should not directly affect hogfish abundance, thus any effects on forage species and competitor species would not likely be different from no action. Although birds, dolphins, and other predators may feed on hogfish discards, there is no evidence that any of these species rely on hogfish discards for food. Changes in the prosecution of the reef fish fishery are not expected from this action, so no additional effects to protected resources (see Section 3.3.1) are anticipated. Additionally, because of the multispecies nature of this fishery (as discussed in Section 3.2) and that the primary gear used to harvest hogfish is spearfishing (as discussed in Section 4.1.1), this action should have minimal impacts in terms of bycatch.

4.3.3 Direct and Indirect Effects on the Economic Environment

4.3.4 Direct and Indirect Effects on the Social Environment

4.3.5 Direct and Indirect Effects on the Administrative Environment

Setting ACLs and ACTs is an administrative action and would have effects on the administrative environment through additional rulemaking (direct effect), addressing overfished and overfishing conditions (direct effect), and monitoring harvests (indirect effect). Because **Alternative 1**, the no-action alternative, would not require rulemaking, there would not be any immediate effect on the administrative environment from rulemaking. For **Alternatives 2-4**, rulemaking would be required to codify a new hogfish ACL and potentially ACT (**Option b**).

ACLs can have direct effects on the administrative environment should they be exceeded. Currently, if the sum of the commercial and recreational landings exceeds the stock ACL, then during the following fishing year, if the sum of commercial and recreational landings reaches or is projected to reach the stock ACL, a notification will be filed by NMFS with the Office of the Federal Register to close the commercial and recreational sectors for the remainder of that fishing year. Therefore, the higher the ACL, the probability of it being exceeded and the need to close the commercial and recreational sectors to hogfish fishing is lower. Thus, alternatives with lower ACLs would likely adversely affect the administrative environment more than alternatives with higher ACLs.

Alternative 4 has the lowest ACL (159,300 lbs ww) and, unless management measures are stringent enough, has the greatest probably being exceeded (Table 4.3.1.1). Thus, this alternative could adversely affect the administrative environment more than any of the other alternatives. **Alternative 1**, with the next highest ACL (208,000 lbs ww), would be next, followed by **Alternative 3** (219,000 lbs ww). It is difficult to assess how **Alternative 2** compares to **Alternatives 1** and **3** as **Alternative 2**, with its declining yield stream, has the highest ACL of all the alternatives in 2016 (240,400 lbs ww) and is lower than **Alternative 1** and **3** in 2018 (200,800 lbs ww and 219,000 lbs ww, respectively). It is likely intermediate in its effects to **Alternative 1** and **Alternative 3**. Unless further action is taken prior to 2019, the effects from **Alternatives 2-4** would be similar as the ACLs become equal at 159,300 lbs ww onward (Table 4.3.1). This ACL is less than **Alternative 1** for these years.

Currently, there are no actions associated with using ACTs to manage hogfish. Therefore, whether to set an ACT (**Option b**) or not set an ACT (**Option a**) should not affect the administrative environment other than codifying a new ACT under **Alternatives 2-4** if **Option b** were selected as preferred. Alternative 1 would maintain the current ACT established in the Generic ACL/AM Amendment (GMFMC 2011a). Should accountability measures based on an ACT be developed in the future (e.g., basing season closures on the ACT rather than ACL), there could be administrative effects. However, until these actions are defined, it is difficult to assess how these measures would affect this environment.

Indirect effects of ACLs and ACTs require monitoring of the harvests and evaluating annual harvests relative to these values. Regardless of which alternative is selected as preferred, these management activities need to continue. Therefore, the indirect effects from each alternative should be similar.

4.4 Action 4: Hogfish Minimum Size Limit

4.4.1 Direct and Indirect Effects on the Physical Environment

In general, direct effects on the physical environment occur when fishing gear and anchors interact with the substrate and attached organisms. However, setting a large amount of bottom gear with hooks and weights over one area and continued anchoring on fragile substrate is expected to increase the potential for negative impacts to the physical environment (Hamilton 2000). No direct effects from fishing on the physical environment are expected to occur from alternatives in Action 4.

Alternative 1 (No Action) would retain the current minimum size limit of 12 inches fork length (FL) for both commercial and recreational sectors and is not expected to result in any direct or indirect impacts to the physical environment. **Alternatives 2**, **3**, and **4** would increase the minimum size limit for hogfish to 14, 15, and 16 inches FL, respectively. Compared to **Alternative 1** increasing the minimum size limit to **Alternatives 2**, **3**, or **4** is expected to result in minimum adverse impacts to the physical environment. For example, a small number of anglers use hook-and-line gear to harvest hogfish which may result in fishermen staying at various fishing sites longer or move their fishing vessel several times over one area potentially resetting the anchoring in an effort to land a legal size hogfish. If this type of fishing behavior occurs, gear interactions with the bottom substrate could increase, including resetting the anchor several times or changing fishing locations. However, anglers that are targeting hogfish using spearguns, which is the primarily gear used are not anticipated to result in any different negative impacts on the physical environment, regardless if the minimum size limit is increased compared to the no action alternatives (Barnette 2001).

Generally, increasing the minimum size limit is expected to slow the harvest rate initially that could result in recreational and commercial anglers fishing harder to land legal sized hogfish. However, since hogfish is part of the reef fish aggregate and they are not the only reef fish harvested on most trips increasing the minimum size limit is expected to have minimal to no indirect negative impacts on the physical environment compared to **Alternative 1** (No Action).

4.4.2 Direct and Indirect Effects on the Biological/Ecological Environment

Action 4 is expected to have minimum positive indirect effects on the biological/ecological environment. These effects are described in Section 4.1.2 and summarized here. Increasing the minimum size limit of hogfish for the recreational and commercial sector could allow hogfish to reproduce a longer period of time before being removed from the population thereby increasing the reproductive potential of the stock. However, the tradeoff could be an increase in regulatory discards and discard mortality at least in the short term. Hogfish are primarily landed by spearfishers so little information is available on discard mortality. In SEDAR 37 (2013) a 10% discard mortality rate was assumed for commercial and recreational hook-and-line gear and 100% for spearfishing. The quantity of undersized fish that are shot by spearfishing is unknown. Further, the impacts of increasing the minimum size limit and whether regulatory discards by spearfishing are exacerbated until fishers are educated on the management changes are also unknown. Generally, lower minimum size limits result in a more rapid harvest of higher numbers of smaller fish, potentially filling the quota more quickly. Therefore, increasing the minimum size limit is expected to slow recreational and commercial landings; however,

regulatory discards and discard mortality are anticipated to increase (see Table 2.4.2 and discussion in section 2).

Based on the length-weight relationship of hogfish used during SEDAR 37 (2013), a 12-inch FL hogfish (**Alternative 1**) is estimated to weigh 1.4 pounds whole weight (lbs ww). In the last three years the recreational sector has landed hogfish that are heavier and therefore estimated to be larger fish than the current 12-inch FL minimum size limit (Table 4.4.2.1). Based on recent recreational landings the average size of hogfish landed is closer to the 14 and 15-inch FL minimum size limit estimated in SEDAR 37 (2013) (Figure 4.4.2.1). For example, a 14-inch FL (**Alternative 2**) hogfish is estimated to weigh 2.1 lbs ww; a 15 inch FL hogfish (**Alternative 3**) is estimated to weigh 2.5 lbs ww; and a 16-inch FL (**Alternative 4**) hogfish is estimated to weigh 3 lbs ww (Figure 4.4.2.1). A data request is currently being process for the average size of commercial hogfish landed in recent years.

Table 4.4.2.1. Average weight (lbs ww) of hogfish landed by the recreational and commercial sector from 2013-2015.

Year	Recreational Landings	Commercial Landings
2013	2.30	TBC
2014	1.85	TBC
2015	2.11	TBC

Source: N. Farmer, SERO, December 14, 2015.

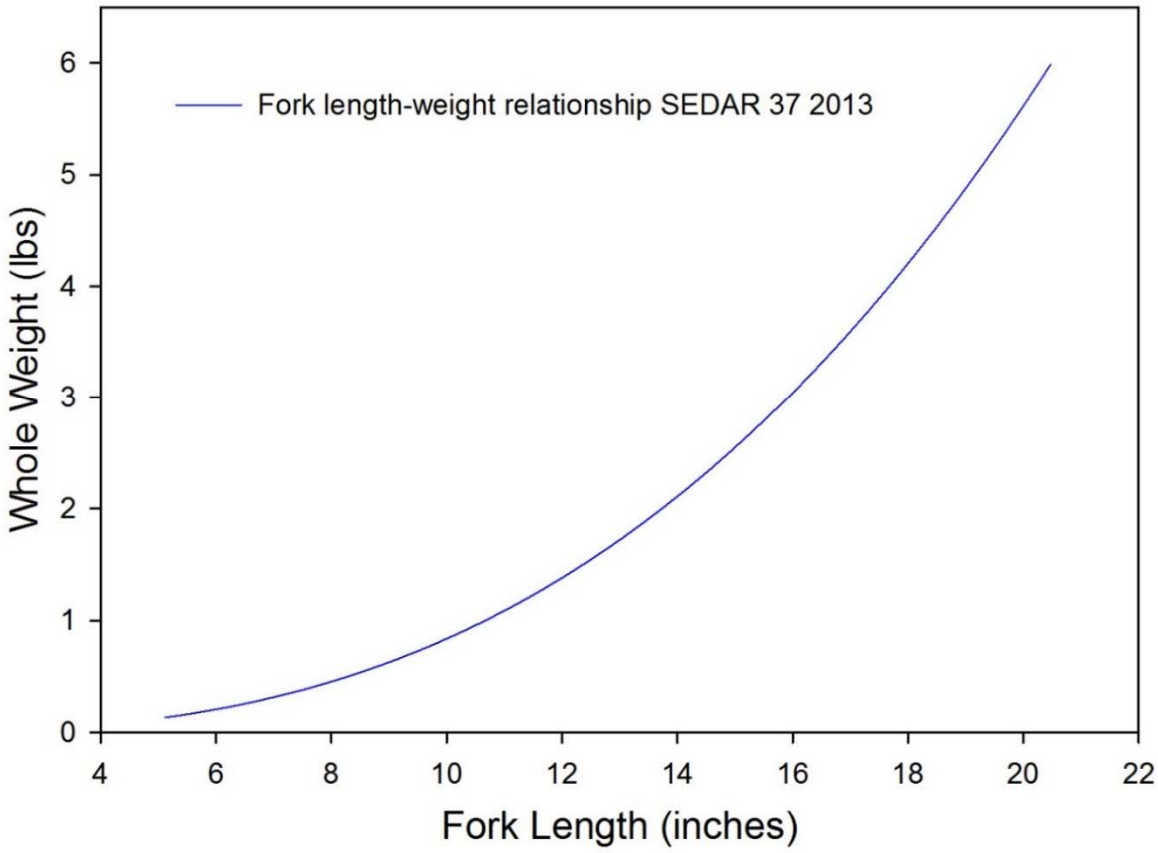

Figure 4.4.2.1. Hogfish length-weight relationship. Source: Conversion factors from SEDAR 37 (2013): weight (g) = 0.000095*FL(mm)2.74522.

All of the minimum size limit alternatives considered in this action are above the mean size of female reproductive maturity (7.5 inches FL). However, hogfish are protogynous hermaphrodites meaning they transition from females to males at approximately 17 inches FL. Therefore, all of the alternatives considered in this action are below the mean size of transition from female to male. For protogynous stocks such as hogfish, disproportionate fishing on males in the population could increases the possibility of reduced fertilization rates; however, there is a little information on the importance of sperm limitation, if any for hogfish (Brooks et al. 2008).

Alternative 4 (16 inches FL) is very close to the mean size of transition. Based on the von Bertalanffy growth curve in SEDAR 37 (2013) hogfish take approximately six months to grow 1 inch (Figure 4.4.2.2). Based on the growth curve conversion factor in SEDAR 37 (2013) the estimated size at ages for **Alternatives 1-4** are shown in Table 4.4.2.2. This suggests if the Council increases the minimum size limit from **Alternative 1** (12 inches FL) to **Alternative 4** (16 inches FL) it could take a hogfish up to 2 years to reach this minimum size limit, which could increase regulatory discards for a couple of years.

Table 4.4.2.2. Estimated size (fork length inches) and age (years) for Alternatives 1-4.

Alternative	Fork Length (inches)	Age (years)
1	12	3
2	14	4
3	15	4.3
4	16	5

Source: Conversion factors from SEDAR 37 (2013): FL (cm) = 84.89885132*(1-e-$^{0.1057678*(t+1.3290378)}$).

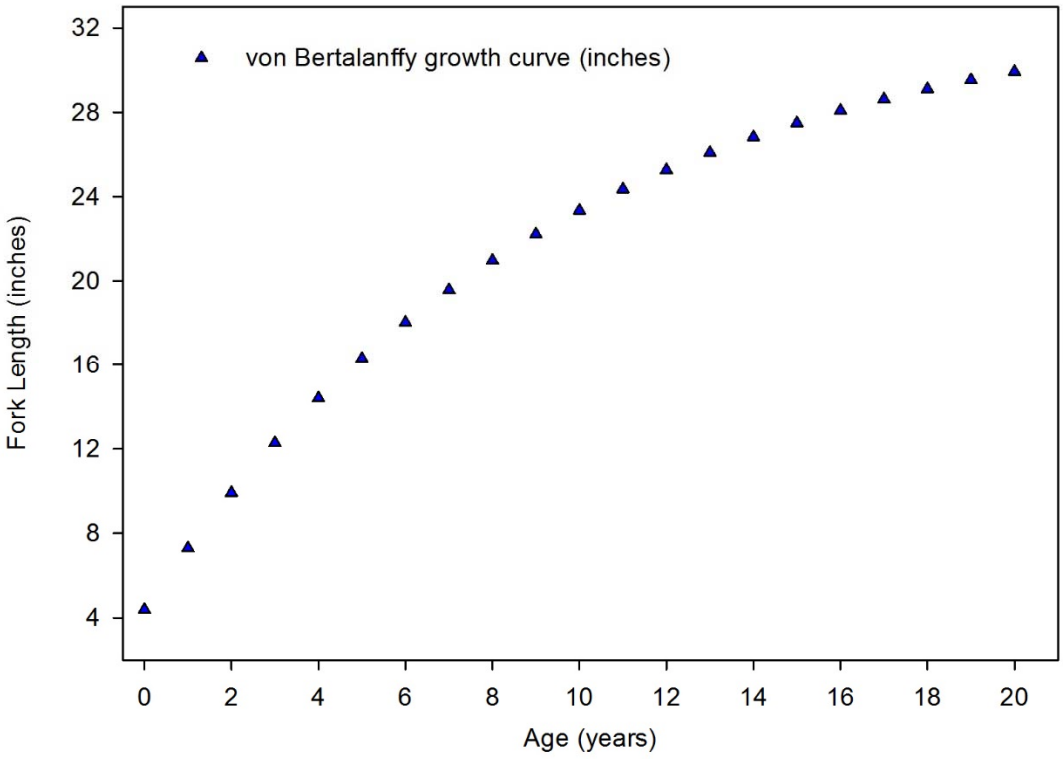

Figure 4.4.2.2. Hogfish von Bertalanffy growth curve converted to inches. Source: Conversion factors from SEDAR 37 (2013): FL (cm) = 84.89885132*(1-e-0.1057678*(t+1.3290378)).

The size-at-age and average weight information summarized above suggests that any minimum size limit modification for hogfish the Council considers in **Alternatives 2-4** compared to **Alternative 1** (no action) would likely have minimal effects on the biological/ecological environment. There would likely be short-term minimum negative impacts on discards and discard mortality for the stock with increasing minimum size limits, but in the long-term there could be a positive tradeoffs. For example, as the minimum size limit is increased there would be a greater number of larger females, and potentially some females that had transitioned to males in the population. These larger females and smaller males are anticipated to contribute to reproductive potential and provide positive impacts on the biological/ecological environment.

4.4.3 Direct and Indirect Effects on the Economic Environment

4.4.4 Direct and Indirect Effects on the Social Environment

4.4.5 Direct and Indirect Effects on the Administrative Environment

The alternatives in Action 4 are expected to have minimal impacts to the administrative environment compared to no action. **Alternative 1** maintains the 12-inch FL minimum size limit, which is enforced by NMFS, the U.S. Coast Guard, and state enforcement along with other reef fish minimum size limits. **Alternatives 2**, **3** and **4** increase the minimum size limit to 14 inches FL, 15 inches FL, and 16 inches FL respectively. Increasing the minimum size limit could extend the fishing season and possibly avoid an ACL closure, which would be a beneficial effect on the administrative environment. From this perspective, **Alternative 4** would provide the greatest administrative benefit because it would have the highest likelihood of avoiding an ACL closure, followed by **Alternative 3** and **Alternative 2**. **Alternative 1** would have the least benefit because it would result in the greatest likelihood of an ACL closure. Florida currently has a 12-inch FL minimum size limit, and as of the writing of this section, the South Atlantic Council is proposing a 15-inch minimum size limit for hogfish in the Atlantic/Florida Keys stock. A portion of the Atlantic/Florida Keys stock occurs off south Florida in Gulf waters, but would be designated for management by the South Atlantic under the Action 1 alternatives (other than no action). If Florida, the South Atlantic Council, and the Gulf Council adopt inconsistent size limits, there could be some adverse effects to enforceability due to the complexity of the size limit regulations. This adverse effect would be avoided if the three management agencies adopt consistent minimum size limit regulations.

4.5 Action 5: Use of Powerheads to Harvest Hogfish in the Stressed Area

4.5.1 Direct and Indirect Effects on the Physical Environment

Spearfishing on coral habitat may result in some coral breakage. Damage from a spear striking the hard bottom with a powerhead would be greater than from a non-powerhead spear if the powerhead discharges. However, unless the powerhead is shot directly into the hard bottom, which is unlikely, the powerhead is not likely to discharge, and would therefore cause no greater damage than a non-powerhead spear. Other adverse impacts could result not only from the spear hitting the coral, but also from divers touching the coral or from resuspension of sediment by fins (Barnette 2001). However, these impacts would occur regardless of whether the dive is using a powerhead or not. Other than the slight possibility of a powerhead discharging into the coral or hard bottom under **Alternative 1**, there is no difference in the adverse impacts to the physical environment between **Alternative 1** and **Alternative 2**.

4.5.2 Direct and Indirect Effects on the Biological/Ecological Environment

Spearfishing is highly selective, both in terms of species and size, and thus has minimal direct impact on non-target species (Frisch et al. 2012). However, because of its capability to be selective, spearfishing targets larger fish relative to other fishing gears and can significantly alter abundance and size structure of target species toward fewer and smaller fish (Chapman and Kramer 1999, Matos-Caraballo et al. 2006, National Marine Sanctuaries 2012). Hogfish are protogynous hermaphrodites (meaning that they mature as females and transition to males later in life). They form harems for spawning consisting of single male and 5 – 15 females (SEDAR 37 2013). Powerheads are impracticable for use with smaller fish, so to the extent that powerhead spearfishing might occur in the stressed area, it would selectively target the largest individuals, which are generally the males. Removal of the dominant male has the potential to significantly affect harem stability and decrease reproductive potential (Munoz et al., 2010). Therefore, **Alternative 1**, which allows harvest of hogfish using powerheads has greater potential adverse impacts on the hogfish stock than **Alternative 2**, which prohibits the use of powerheads in the stressed area.

4.5.3 Direct and Indirect Effects on the Economic Environment

4.5.4 Direct and Indirect Effects on the Social Environment

4.5.5 Direct and Indirect Effects on the Administrative Environment

The alternative in Action 5 is expected to have minor beneficial impacts to the administrative environment compared to no action. **Alternative 1** maintains the exception to the stressed area prohibition on use of powerheads for taking hogfish. This allows a diver to possess a powerhead spear in the stressed area, which may complicate enforcement of the prohibition on its use for other reef fish. Some divers carry a powerhead for protection against sharks, but this is often in the form of a bangstick, which is a powerhead mounted on a metal shaft or wooden pole. **Alternative 2** benefits the administrative environment by simplifying the regulations and enforcement, and by applying the stressed area powerhead prohibition consistently to all reef fish.

4.6 Cumulative Effects Analysis

CHAPTER 5. REGULATORY IMPACT REVIEW

CHAPTER 6. REGULATORY FLEXIBILITY ACT ANALYSIS

CHAPTER 7. LIST OF PREPARERS

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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 8. LIST OF AGENCIES CONSULTED

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- Southeast Fisheries Science Center
- Southeast Regional Office
- Office for Law Enforcement

NOAA General Counsel

Environmental Protection Agency
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 – OTHER APPLICABLE LAW

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

Administrative Procedures Act

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

Coastal Zone Management Act

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

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

Data Quality Act

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

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

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

Endangered Species Act

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

On September 30, 2011, the Protected Resources Division released a biological opinion which, after analyzing best available data, the current status of the species, environmental baseline (including the impacts of the recent Deepwater Horizon MC 252 oil release event in the northern Gulf of Mexico), effects of the proposed action, and cumulative effects, concluded that the continued operation of the Gulf of Mexico reef fish fishery is also not likely to jeopardize the continued existence of green, hawksbill, Kemp's ridley, leatherback, or loggerhead sea turtles, nor the continued existence of smalltooth sawfish (NMFS 2011a). On December 7, 2012, NMFS published a proposed rule to list 66 coral species under the ESA and reclassify *Acropora* from threatened to endangered (77 FR 73220). In a memorandum dated February 13, 2013, NMFS determined the reef fish fishery was not likely to adversely affect *Acropora* because of where the fishery operates, the types of gear used in the fishery, and that other regulations protect *Acropora* where they are most likely to occur.

Marine Mammal Protection Act

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

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

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

Under Section 118 of the MMPA, NMFS must publish, at least annually, a List of Fisheries that places all U.S. commercial fisheries into one of three categories based on the level of incidental serious injury and mortality of marine mammals that occurs in each fishery. The categorization of a fishery in the List of Fisheries determines whether participants in that fishery may be required to comply with certain provisions of the MMPA, such as registration, observer coverage, and take reduction plan requirements. The primary gears used in the Gulf of Mexico reef fish fishery are still classified in the proposed 2014 MMPA List of Fisheries as Category III fishery (December 6, 2013; 78 FR 73477). The conclusions of the most recent List of Fisheries for gear used by the reef fish fishery can be found in Section 3.3.

Paperwork Reduction Act

The Paperwork Reduction Act of 1995 (PRA) (44 U.S.C. 3501 et seq.) regulates the collection of public information by federal agencies to ensure the public is not overburdened with information requests, the federal government's information collection procedures are efficient, and federal agencies adhere to appropriate rules governing the confidentiality of such information. The PRA requires NMFS to obtain approval from the Office of Management and Budget before requesting most types of fishery information from the public. Revising the definition of the hogfish management unit, setting status determination criteria and annual catch limits, and revising the hogfish minimum size limit would likely not have PRA consequences.

Executive Orders

E.O. 12630: Takings

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

E.O. 12866: Regulatory Planning and Review

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

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

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

E.O. 12962: Recreational Fisheries

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

E.O. 13132: Federalism

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

E.O. 13158: Marine Protected Areas

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

Essential Fish Habitat

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

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APPENDIX B – BYCATCH PRACTICABILITY ANALYSIS

APPENDIX C – SUMMARY OF COMMENTS RECEIVED