# FISHERY ASSESSMENT REPORT

## IFFO GLOBAL STANDARD FOR RESPONSIBLE SUPPLY OF FISHMEAL AND FISH OIL

photo source:fishbase

| | |
|---|---|
| **FISHERY:** | **Gulf menhaden (*Brevoortia patronus*)** |
| **LOCATION:** | **Gulf of Mexico, USA** |
| **DATE OF REPORT:** | **August 2018** |
| **ASSESSOR:** | **Deirdre Hoare** |

| 1. APPLICATION DETAILS AND SUMMARY OF THE ASSESSMENT OUTCOME | | | |
|---|---|---|---|
| **Name:** Daybrook Fisheries, Inc/ Omega Protein Inc. | | | |
| **Address:** | | | |
| **Country: USA** | | **Zip:** | |
| **Tel. No.** | | **Fax. No.** | |
| **Email address:** | | **Applicant Code** | |
| **Key Contact**: | | **Title:** | |
| **Certification Body Details** | | | |
| **Name of Certification Body:** | **Global Trust Certification Ltd.** | | |
| **Assessor Name** | **Peer Reviewer** | **Assessment Days** | **Initial/Surveillance/ Re-certification** |
| Deirdre Hoare | J Daly | 2 days | Surveillance Year 2 |
| **Assessment Period** | 2017 | | |
| | | | |
| **Scope Details** | | | |
| **1. Scope of Assessment** | IFFO Global Standard for Responsible Supply – Issue 1 | | |
| **2. Fishery** | Gulf menhaden (*Brevoortia patronus*) | | |
| **3. Fishery Location** | USA (Gulf of Mexico) | | |
| **4. Fishery Method** | Purse seine | | |
| **Outcome of Assessment** | | | |
| **5. Overall Fishery Compliance Rating** | High | | |
| **6. Sub Components of Low Compliance** | None | | |
| **7. Information deficiency** | Approve | | |

| | |
|---|---|
| **8. Peer Review Evaluation** | GSMFC coordinated a data workshop in June 2018 which should address ways to incorporate ecosystem based reference points in the assessment. These and other efforts to improve data on the impact of the fishery on bottlenose dolphins should be recorded during future assessments. A medium compliance rating is maintained for management measures ensuring that fishing gear and practices do not have a significant impact on non-target species and the physical environment. |
| **9. Recommendation** | Maintain fishery approval |

| |
|---|
| **2. QUALITY OF INFORMATION** |
| Good; primarily ASMFC and SEDAR reports and websites |
| **3. COMPLIANCE LEVEL ACHEIVED** |
| High |
| **Recommendation** |
| Maintain fishery approval. |
| **4. GUIDANCE FOR ONSITE ASSESSMENT** |
| |
| **Based on HIGH compliance findings** |
| n/a |
| **Based on MEDIUM compliance findings** |
| n/a |
| **Based on LOW compliance findings** |
| n/a |
| **5. ASSESSMENT DETERMINATION** |
| The Gulf menhaden fishery continues to score high compliance in almost every section. Management measures are applied at the state level, but coordinated by the Gulf States Marine Fisheries Commission (GSMFC), which also collates data and produces management recommendations. As detailed in the reassessment a new revision of the FMP was implemented in March 2015. The new FMP includes a detailed analysis of all aspects of the fishery, from the nature of the stock itself, to indirect impacts on habitats and the ecosystem, to the socio-economic structure of the menhaden industry. Following a report by the marine Mammal Commission in 2015 the assessment team recommends that the fishery implements measures to improve the data and reporting of any cetacean impacts of this fishery. Some uncertainty and lack of data around the impact on bottlenose dolphins remain. Overall, the management of the fishery and the content of the FMP further reinforces the extent to which the fishery continues to meet the requirements of the IFFO RS scheme for whole fish. The stock assessment is undergoing another benchmark in 2018. |

| HIGH Compliance |
| --- |
| A1, A2, A3, B1, B2, C1, D2, E1, E2 |
| **MEDIUM Compliance** |
| D3 |
| **LOW Compliance** |
| None |

| SUMMARY OF LEVEL OF COMPLIANCE | | | | | |
|---|---|---|---|---|---|
| | **The Management Framework and Procedures** | **Stock assessment procedures and management advice** | **Precautionary approach** | **Management measures** | **Implementation** |
| Legal and administrative basis | A1 | | | | |
| Fisheries management should be concerned with the whole stock unit | A2 | | | | |
| Management actions should be scientifically based | A3 | | | | |
| Research in support of fisheries conservation and management should exist | | B1 | | | |
| Best scientific evidence available should be taken into account when designing conservation and management measures | | B2 | | | |
| The precautionary approach is applied in the formulation of management plans | | | C1 | | |
| The level of fishing permitted should be set according to management advice given by research organisations | | | | D1 | |
| Where excess fishing capacity exist, mechanisms should be in established to reduced capacity | | | | D2 | |
| Management measures should ensure that fishing gear and fishing practices do not have a significant impact on non-target species and the physical environment | | | | D3 | |
| A framework for sanctions of violation of laws and regulations should be efficiently exists | | | | | E1 |
| A management system for fisheries control and enforcement should be established | | | | | E2 |

**KEY:** Low Compliance: Medium Compliance: High Compliance:

## 6. RATIONALE OF THE ASSESSMENT OUTCOME

### A. THE MANAGEMENT FRAMEWORK AND PROCEDURE

| LEVEL OF COMPLIANCE | |
|---|---|
| *A1. The management of the fishery must include a legal and administrative basis for the implementation of measures and controls to support the conservation of the fishery.* | |
| **LOW** | An administrative framework that ensures an efficient management of the fishery for its conservation is not established. |
| **MEDIUM** | An administrative framework that ensures an efficient management of the fishery for its conservation is somehow established, but there is evidence of not being efficient to ensure the conservation of the stock. |
| **HIGH** | A legal and administrative framework that ensures an efficient management of the fishery for its conservation is established and works efficiently toward the conservation of the stock. |

***Determination: There are effective legal and administrative frameworks in place at the state, regional and federal levels. There have been no substantial changes since the reassessment, and so a high compliance rating remains appropriate.***

The Gulf menhaden stock is distributed in both state waters within 3nm of shore and federal waters further out, but as the large majority of fishing occurs in state waters, the management of the fishery is largely the responsibility of state authorities. The five Gulf states which engage, to varying extents, in the menhaden fishery are Florida, Alabama, Mississippi, Louisiana, and Texas. Each state has an administrative governmental body tasked with the management of commercial and recreational fisheries. The Gulf States Marine Fisheries Commission (GSMFC) coordinates inter-state management of the stock. The GSMFC makes recommendations to the state governments based on the results of scientific studies carried out by state, federal and academic agencies. It is also responsible, within the Gulf region, for the Interjurisdictional Fisheries (IJF) Program designed to develop management plans for transboundary stocks such as Gulf menhaden.

The primary management authorities in relation to Gulf menhaden at the state level are the Florida Fish and Wildlife Conservation Commission; the Department of Conservation and Natural Resources (Alabama); the Department of Marine Resources (Mississippi); the Department of Wildlife and Fisheries (Louisiana) and the Texas Parks and Wildlife Department. Each state authority is legally empowered to introduce and enforce fisheries management regulations, through either the State administrative code, statutes, or specific legal instruments.

**Inter-state coordination**

The Gulf States Marine Fisheries Commission (GSMFC) coordinates management of the Gulf menhaden stock. The GSMFC was established by an act of congress in 1949 with the objective of promoting sustainable utilization of fishery resources throughout the Gulf of Mexico seaboard. The Commission is composed of three members from each of the five Gulf States, including the head of the marine resource agency, a member of the legislature, and a citizen with knowledge of marine fisheries. The Commission makes recommendations to the governments of the Gulf States based on scientific studies carried out by state, federal and academic agencies. It is also responsible for the Interjurisdictional Fisheries (IJF) Program, which is designed to develop management plans for transboundary stocks such as the Gulf menhaden. The GSMFC was responsible for creating and publishing the 2002 regional FMP for Gulf menhaden.

For more detail on the legal and administrative bases of the management system in place at state and federal level, please refer to the 2015 FMP and the state specific websites listed in the References section.

**R1, R12, R15, R19, R22.**

| LEVEL OF COMPLIANCE | |
|---|---|
| *A2. Fisheries management should be concerned with the whole stock unit over its entire area of distribution and take into account fishery removals and the biology of the species.* | |
| **LOW** | Fisheries management is not concerned with the whole stock unit over its entire area of distribution and do not take into account any of the matters listed in 'A1'. |
| **MEDIUM** | Fisheries management is concerned with matters listed in 'A1' but not entirely. Fisheries, in relation to 'A1' statement, should improve to ensure the long term conservation of the marine resource. |
| **HIGH** | Fisheries management should be concerned with the whole stock unit over its entire area of distribution and take into account:<br>• All fishery removals<br>• The biology of the species |

***Determination: As at the time of the 2016 re-assessment, the management stock unit matches the best scientific understanding of the biological stock, and all fishery removals and the biology of the species are taken into account.***

Gulf menhaden is subject to separate management regimes in each of the five Gulf States. However, stock assessments and FMPs treat the stock as a single unit across the entire Gulf region, an approach which filters down to state level via the GSMFC. The results of two independent studies, carried out in 2006 and 2010, support the hypothesis that menhaden in the Gulf constitute a single biological stock. The studies found no evidence for independent populations.

The menhaden fishery in the Gulf of Mexico (Gulf) is primarily a single-species fishery for the Gulf menhaden, (*Brevoortia patronus*), however, small amounts of finescale menhaden (*B.gunteri*), yellowfin menhaden, (*B. smithi*), and Atlantic thread herring (*Opisthonema oglinum*), are sometimes taken (R1).

Instead, stock structure in gulf menhaden is more accurately described by an isolation-by-distance model, in which measurable genetic structure is shown to be largely a function of the upper limits on dispersal of individuals within a stock. In this model, genetic distance among samples is expected to increase linearly with geographic distance. Thus although there may be considerable genetic diversity between geographical locations, Gulf menhaden is a single biological stock. The current management definition reflects the best available science. The 2015 revision of the FMP confirms that this is still the case. The geographical range of the Gulf menhaden population is shown in Figure A2 (i).

The most recent stock assessments and the 2015 FMP include a "Life History" section which considers a wide range of biological characteristics. Stock assessments also utilise fishery landings, plus bait and recreational landings. The most recently available SEDAR benchmark assessment for Gulf menhaden was published in 2013 (R3). An update assessment was conducted in 2016 that updates the 2013 benchmark assessment and incorporates data from 2012-2015 (R33). The stock assessment is undergoing another benchmark in 2018. These stock assessments form the basis for the recommendations of the Menhaden Advisory Committee (MAC), a component of the GSMFC. Additionally, the MAC recommended that, as Gulf menhaden are a short-lived species, a shorter time between assessments such as 2 – 3 years would be beneficial. Management activity in each of the five participating states is guided by these recommendations, the original stock assessments and reports, and the activities of each state's scientific bodies.

The 2016 update assessment covers the period 1977 – 2015 and incorporates a number of datasets including reduction, bait, and recreational landings data, fishery-dependent age compositions, a coastwide juvenile abundance index based on seine surveys, an adult abundance index based on gillnet surveys and updated biological parameters such as estimates of mean weight at age and natural mortality. The assessment also includes full consideration of the habitats preferred and required by the species. The stock assessment utilised the fishery landings and effort data series which are available for the entire Gulf region and cover every year from around 1950 onwards. The SFSC carried out studies to ensure the accuracy of this data and consider it to be reliable.


**Figure A2 i).** Geographic range of the four menhaden species: Gulf menhaden (*Brevoortia patronus*) - smooth gray line, Gulf; Atlantic menhaden (*B. tyrannus*) - dotted grey line, Atlantic; fine-scale menhaden (*B. gunteri*) - dotted black line, western Gulf; and yellowfin menhaden *(B. smithi*) - dashed black line, eastern Gulf. Sample sites are indicated by black boxes (from Anderson 2007/2015 FMP).

For more information on the on the scientific research which supports the management of her the fishery, please refer to the 2015 FMP.

**R1, R3, R4, R29, R30, R31, R33**

| LEVEL OF COMPLIANCE | |
|---|---|
| *A3. Management actions should be based on long-term conservation objectives* | |
| **LOW** | Management actions are not based on long term management objectives. |
| **MEDIUM** | Management actions are based on long term management objectives. However the actions are not scientifically formulated. |
| **HIGH** | Management actions are based on long term management objectives, and actions are science based. |

***Determination: Gulf menhaden is managed using both specific long-term objectives and a generalised sustainability objective. Although there is no formal management plan agreed between the participating States, the reference points form the basis of the scientific advice, which in turn informs the management of the entire fishery at State level.***

Gulf Menhaden fishery was first managed according to a regional Fishery Management Plan (FMP) published in 2002. In March 2015 a revised version of the FMP was published and put into action. The stated overarching goal of the new FMP is "to provide a management strategy for Gulf menhaden that estimates an annual maximum harvest while allowing protection of the stock from overfishing on a continuing basis". The FMP also includes two 'Management Objectives', which are to conduct a comprehensive stock assessment every five years, and to establish standardised ageing programmes for Gulf menhaden by 2015. There are also 'Population Dynamics Objectives' and 'Environment Objectives'.

The primary model used in the last benchmark assessment of gulf menhaden did not successfully find a stock-recruitment relationship and could not produce a reliable estimate of MSY and FMSY; therefore MSY proxies

based on per recruit analyses were instead used to define limit and target reference points. According to values estimated in the 2016 update the FMP recommends that state agencies adopt Gulf-wide management reference points for the menhaden fishery of a target of 829,737 mt (F35% fecundity SSB) and a limit of 862,361 mt (F30% fecundity SSB).

While in normal circumstances, according to the FMP, review assessments of gulf menhaden will be conducted on a five year cycle should harvests exceed the F35% target in two consecutive years, or the F30% limit in a single year, an off-schedule updated stock assessment update will be requested.

In general, the Gulf menhaden fishery is not managed using a Total Allowable Catch (TAC) based system, but rather by technical measures such as closed seasons, areas, and limited entry. All five Gulf States manage the menhaden fishery with closed areas, restricted fishing seasons, limited licensing and other technical measures. Texas is currently the only Gulf state which sets a TAC for menhaden of 14,288 mt per year. Once this quantity has been landed, the fishery is closed Stock assessments indicate that these mechanisms have been effective at keeping fishing pressure below, and SSB (measured as fecundity) above, defined thresholds.

There is strong evidence from the stock assessments that the level of fishing pressure currently exerted on the Gulf menhaden stock is sustainable, is not overfished and overfishing is not occurring.

**R1, R3**

| **B. STOCK ASSESSMENT PROCEDURES AND MANAGEMENT ADVICE** | |
|---|---|
| **LEVEL OF COMPLIANCE** | |
| *B1. Research in support of fisheries conservation and management should exist.* | |
| **LOW** | Research to support the conservation and management of the stock, non-target species and physical environment does not exist |
| **MEDIUM** | Research to support the conservation and the management of the stock, non-target species and physical environment exists, however research programmes could be significantly improved to decrease scientific advice uncertainty. |
| **HIGH** | Research to support the conservation and the management of the stock, non-target species and physical environment exist, and existent research is considered most adequate for the long term conservation of the target, non-target and physical environment |

***Determination: An update stock assessment was carried out by SEDAR in 2016, and incorporates data from 2012-2015. A benchmark is underway in 2018. Research to support the conservation and the management of the stock, non-target species and physical environment exist, and existent research is considered most adequate for the long-term conservation of the target, non-target and physical environment.***

The NMFS conducts assessments for the gulf menhaden stock through the Southeast Data Assessment and Review (SEDAR) process. SEDAR is a cooperative Fishery Management Council process initiated in 2002 to improve the quality and reliability of fishery stock assessments in the South Atlantic, Gulf of Mexico, and US Caribbean. SEDAR is managed by the Caribbean, Gulf of Mexico, and South Atlantic Regional Fishery Management Councils in coordination with NOAA Fisheries and the Atlantic and Gulf States Marine Fisheries Commissions. The most recent benchmark assessment for Gulf menhaden was published in 2013 (R3). An update assessment was conducted in 2016 that updates the 2013 benchmark assessment and incorporates data from 2012 – 2015 (GDAR02, 2016). In the 2016 update assessment the GSMFC Menhaden Advisory Committee (MAC) recommended that the next peer-reviewed assessment occur during 2018. Additionally, the MAC recommended that, with as Gulf menhaden are a short-lived species, a shorter time between assessments such as 2 – 3 years would be beneficial.

**Fishery-dependent data**

NMFS port samplers have had access to the catch at each processing plant for biostatistical and stock assessment purpose since 1964, and the menhaden companies report daily vessel unloads to the NMFS on a monthly basis throughout the fishing season. Vessel captains provide a daily log of each vessel's activities including catch estimates, fishing location, set duration, and weather conditions for each and every set. These

logs, or Captain's Daily Fishing Reports (CDFRs), are verified against each plant's pump-out records and provided to NMFS on a regular basis for compilation. The NMFS continues to publish monthly menhaden landings in the form of a status memo, which are available on the NOAA's Fishery Market News. Figure B1 (i) shows the landings of Gulf menhaden landings and nominal fishing effort between 1955 and 2017.

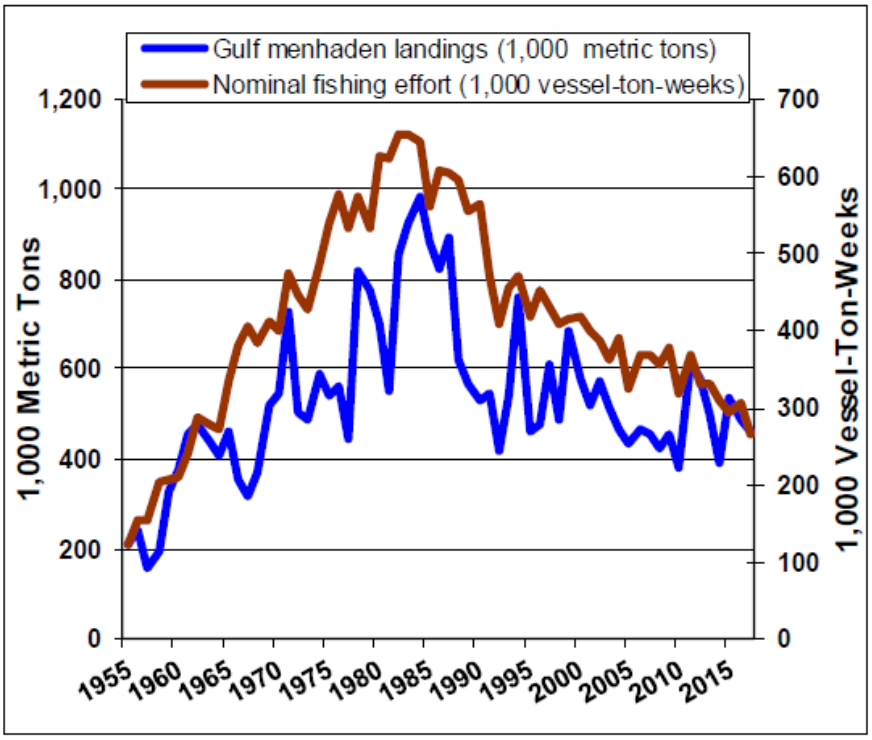


**Figure B1 i).** Gulf menhaden landings and nominal fishing effort, 1955-2017. From the 2018 NOAA forecast & review (R2).

According to the NMFS 2018 forecast & 2017 review (R2) final landings in 2017 totalled 460,707 metric tons, a decrease of 5.2% from total landings in 2016 (485,857 mt) and 7.5% less than the previous 5-year mean (Figure B1i). Nominal fishing effort for the Gulf Menhaden fishery during 2017 was estimated at 269,200 vessel-ton-weeks; this is 13% less than nominal fishing effort in 2016 (307,700 vessel-ton-weeks).

The NMFS Beaufort laboratory oversees a dockside biological sampling program conducted over the range of the fishery, both temporally and geographically. Port agents randomly select vessels and at dockside retrieve a bucket of fish from the top of the vessel's fish hold. The sample is assumed to represent fish from the last purse-seine set of the day, not the entire boat load or trip. The agent ascertains from the crew the location and date of the last set. From the bucket the agent randomly selects ten fish, which are measured (fork length in mm), weighed (grams), and have scales removed for ageing. This sampling regime permits landings in biomass to be converted to landings in numbers at age (see Figure B1 (ii)). For each port/week caught, biostatistical sampling provides an estimate of mean weight and the age distribution of fish caught.

**Fishery-independent data**

Each state agency has its own sampling protocols which identify juvenile gulf menhaden abundance based on catch per-unit-effort. Fishery-independent data are acquired from Mississippi, Louisiana, and Texas using bag seines, beam plankton nets, and otter trawls. These data are combined to create indices for use in stock

assessments. Similar data from Alabama and Florida are also included in the analysis. Juvenile and adult abundance indices are calculated from all these data sources. Additional independent data sources include the SEAMAP trawl survey (size and geographical location, not used in the most recent stock assessment); SEAMAP ichthyoplankton survey (larval location and abundance sampling, not used in the most recent stock assessment).

**Fishery-independent data – Louisiana**

The sampling design for Louisiana data consists of fixed stations selected by coastal study areas to target areas known to have fish/shellfish when the sampling programs started. Seine, trawl and gillnet sampling is conducted. Gulf menhaden size and geographical distribution are recorded. The Louisiana monitoring program does not estimate ages.

**Fishery-independent data – Mississippi**

Mississippi Department of Marine Resources (MDMR) and the Gulf Coast Research Laboratory (GCRL) collects fishery-independent data using trawls, seines, gillnets, and beam plankton nets. The majority of these data series date back to 1974, although the gillnet regime was first carried out in 2005. Menhaden lengths and weights are taken, but ages are not estimated.

**Fishery-independent data – Texas**

Texas Parks and Wildlife's fishery-independent data are collected as a stratified cluster sampling design; each bay system and Gulf area serves as non-overlapping strata with a fixed number of samples per month. Gill net and bag seine sample locations are randomly selected. For gulf menhaden, bag seines and monofilament gill nets are used in each of ten Texas estuarine systems. The Texas monitoring program collects size and geographical distribution data, but does not estimate ages.

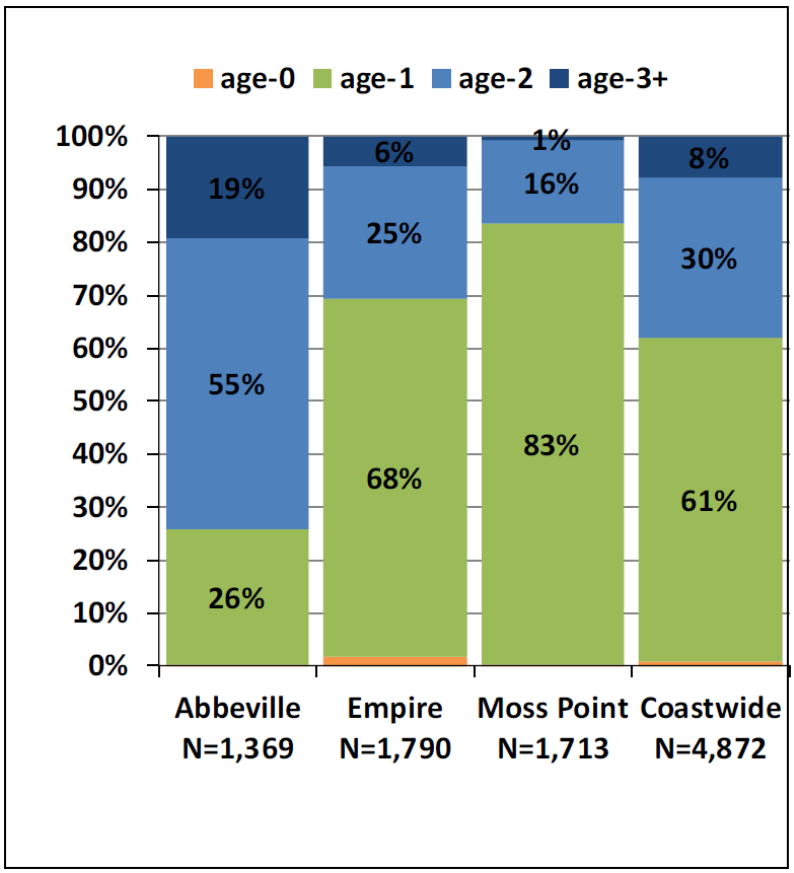

**Figure B1 ii).** Percent estimated numbers-at-age of gulf menhaden by port in 2017. From the 2018 forecast & review (R2).

**R1, R2**

| LEVEL OF COMPLIANCE | |
|---|---|
| *B2. Best scientific evidence available should be taken into account when designing conservation and management measures.* | |
| **LOW** | Scientific advice is not taken into account when designing conservation and management measures. |
| **MEDIUM** | Scientific advice is taken into account, when designing conservation and management measures. However some areas of discrepancy are identified that could have a significant impact in the long term conservation of the marine environment. |
| **HIGH** | Scientific advice is taken into account, when designing conservation and management measures, in a comprehensive manner. |

***Determination: Management of the Gulf menhaden fishery is supported by a periodical stock assessment, the results of which are used to inform the management decisions of each of the five participating states and inform the management decisions outlined in the FMP. There is no evidence that any substantial scientific recommendations have been ignored.***

The NMFS conducts assessments for the gulf menhaden stock through the Southeast Data Assessment and Review (SEDAR) process. SEDAR is a cooperative Fishery Management Council process initiated in 2002 to improve the quality and reliability of fishery stock assessments in the South Atlantic, Gulf of Mexico, and US Caribbean. SEDAR is managed by the Caribbean, Gulf of Mexico, and South Atlantic Regional Fishery Management Councils in coordination with NOAA Fisheries and the Atlantic and Gulf States Marine Fisheries Commissions. The most recently available SEDAR benchmark stock assessment for Gulf menhaden was published in 2013 (R3). The most recently available update stock assessment was published in 2016 (R33). These stock assessments form the basis for the recommendations of the Menhaden Advisory Committee (MAC), a component of the GSMFC. Management activity in each of the five participating states is guided by these recommendations, the original stock assessments and reports, and the activities of each state's scientific bodies. Figures B2 (i) below show the some of the data produced by the 2016 SEDAR stock assessments.

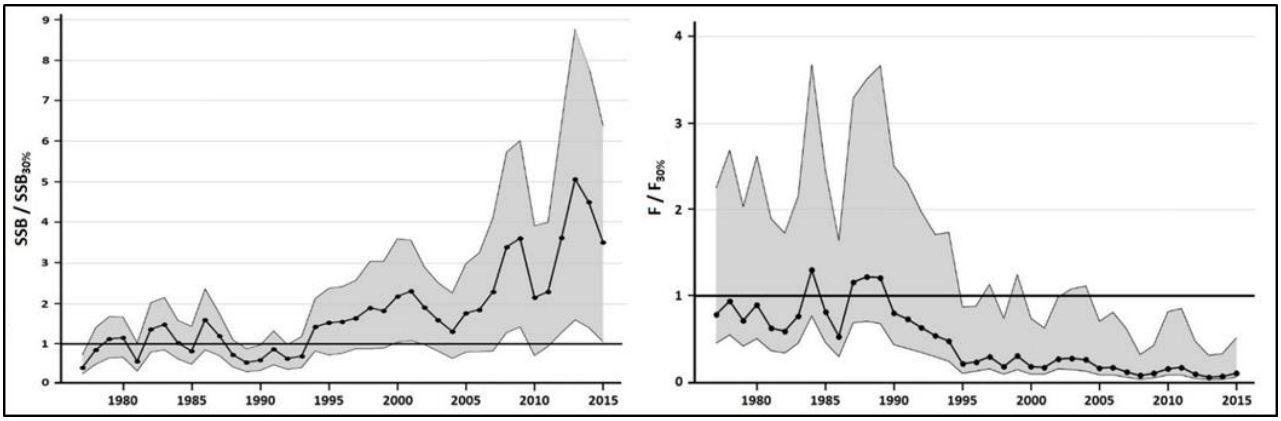


**Figure B2 i).** SSB (measured as fecundity) relative to $SSB_{30\%}$ (Left) and F relative to $F_{30\%}$ (Right) from the 2016 update assessment of Gulf menhaden. Solid black line indicates estimates from BAM base run; gray error bands indicate 5th and 95th percentiles generated during Monti Carlo Bootstrap (MCB) trials (Source: Data from GDAR02 2016).

**R1, R3, R33**

## C. THE PRECAUTIONARY APPROACH

| LEVEL OF COMPLIANCE | |
|---|---|
| *C1. The precautionary approach is applied in the formulation of management plans.* | |
| **LOW** | The precautionary approach is not applied in the formulation of management plans. |
| **MEDIUM** | The precautionary approach is applied, however not all uncertainties are taken into account. |

| | |
|---|---|
| **HIGH** | The precautionary approach is applied, taking into account uncertainties relating to the dynamic of fish population (recruitment, mortality, growth and fecundity), and the impact of the fishing activities, such as discards and by-catch of non-target species as well as on the physical environment (Habitats). |

***Determination: The precautionary approach is recognised and implemented in the US federal fishery management approach, and also to varying extents within individual state systems. As at the time of the reassessment a high compliance rating remains appropriate.***

At the federal level, the Magnuson-Stevens Fisheries Conservation and Management Act (MSA) has guided marine fishery management in the United States since 1976. Although the MSA does not mention the precautionary principle specifically, it contains provisions which bear directly on the approach. The extent to which similar objectives are codified in the management approaches of the individual states varies, although there is no evidence that a lack of information has been used to justify delaying the implementation of sustainable management measures.
In the 2016 update assessment uncertainty was explored using the sensitivity runs and a mixed Monte Carlo and bootstrap procedure (MCBs). MCBs were configured as they were configured during the benchmark stock assessment. The MCBs captured the full expectation of uncertainty given the input data, fixed parameters, and the life history data.

As identified in the 2015 surveillance audit, the 2013 SEDAR stock assessment highlights some of the same research needs as in 2011, including the need for fishery-independent age estimates and improved species identification procedures, additional fishery-dependent surveys, and improved understanding of stock structure. These were not discussed in the 2016 update assessment. However, the 2015 FMP includes detailed consideration of a wide range of variables and sets out recommendations for continued improvements in research and stock assessment activities.

For more information on the on the research needs to improve the Gulf menhaden stock assessment, please refer to the research recommendations highlighted in the 2013 assessment report by SEDAR.

**R1, R3**

## D. MANAGEMENT MEASURES

| LEVEL OF COMPLIANCE | |
|---|---|
| *D1. The level of fishing permitted should be set according to management advice given by research organisations.* | |
| **LOW** | The level of fishing permitted is not set according to management advice given by research organisations. |
| **MEDIUM** | The level of fishing permitted is higher than management advice given by research organisations. However, the difference is not considered to have a significant impact of the sustainability of the stock |
| **HIGH** | The level of fishing permitted is set according to management advice given by research organisations. |

***Determination: The Gulf menhaden stock is not managed using a quota-based system, but rather by technical measures such as closed seasons, areas, and limited entry. These mechanisms have been demonstrated in annual stock assessments to be effective at keeping fishing pressure below the defined target reference point, and the stock is not considered to be overfished.***

In general, state menhaden fisheries are not subject to fishing effort restrictions; Texas is currently the only state which sets a TAC for reduction removals of Gulf menhaden, fixed at of 31,500,000lb (14,288t) each year. Once this quantity has been landed, the fishery is closed. All five states manage the fishery with closed areas, restricted fishing seasons, limited licensing and other technical measures.

The effectiveness of these measures at maintaining fishing mortality below sustainable levels (and stock biomass at the target reference point) is assessed in the SEDAR reports. The results of the most recent assessment are in Figure D1 (i) below. The 2016 update assessment generated point estimates for the biological reference points (benchmarks) of $F_{30\%}$ = 5.98, $F_{35\%}$ = 4.28, $SSB_{30\%}$ = 41,605, and $SSB_{35\%}$ = 50,635. Equilibrium landings for SPR values of 30% and 35% were 862,361 mt and 829,737 mt, respectively. Current stock status was estimated to be $SSB_{2015}/SSB_{30\%}$ = 3.51. MCB analysis suggested there the chances of the stock being overfished (i.e., SSB < $SSB_{30\%}$) were extremely low with over 99% of MCB runs estimating $SSB_{2015} > SSB_{30\%}$. The assessment concluded that both fishing mortality and spawning biomass criteria indicated that overfishing was not occurring; all the various stock assessment models trialed supported this result.

There is strong evidence from the stock assessments that the level of fishing pressure currently exerted on the stock is sustainable, is not overfished and overfishing is not occurring.

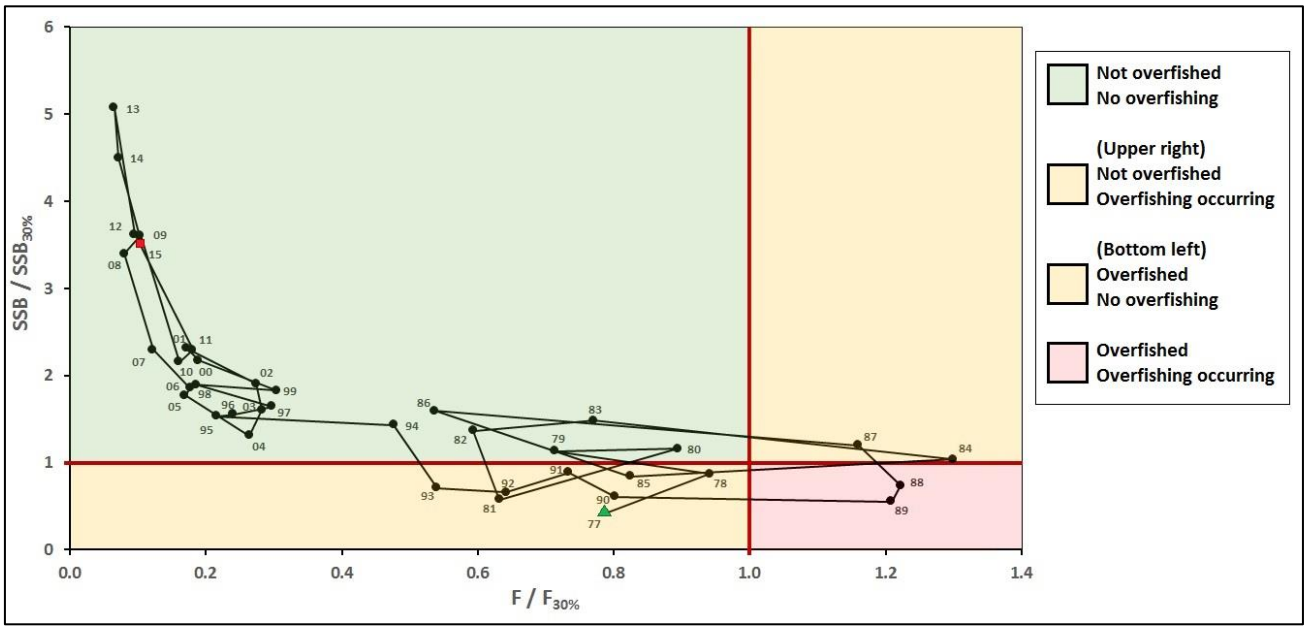


**Figure D1.** Phase plot of annual estimates of fishing mortality and SSB (measured as fecundity) relative to biological reference points (benchmarks) $F_{30\%}$ and $SSB_{30\%}$ from the base BAM model. Year is displayed beside

each data point with the green triangle marking the first year of the assessment and the red square marking the terminal year (2015) (Source: Data from GDAR02 2016).

**R3,33**

| LEVEL OF COMPLIANCE | |
|---|---|
| *D2. Where excess fishing capacity exist, mechanisms should be in established to reduced capacity to allow for the recovery of the stock to sustainable levels.* | |
| **LOW** | Mechanisms to allow for recovery of the stock to sustainable levels are not established. |
| **MEDIUM** | Mechanisms to allow for recovery of the stock to sustainable levels are somehow established. However there is no evidence of the efficiency of the methods used. |
| **HIGH** | Mechanisms are established to reduce capacity to allow for the recovery of the stock to sustainable levels and there are evidences of recovery. |

***Determination: There have been no significant changes to capacity management in the USA since the reassessment. Managers continue to consider the Gulf menhaden fishery not to be over-capacity.***

In August 2004 the NMFS published the United States National Plan of Action for the Management of Fishing Capacity. The main pledges by NMFS set out within were as follows:

- Establish and, when necessary and appropriate, revise the medium and long-term national capacity reduction targets.
- Prepare regular assessments of overcapacity in federally managed fisheries.
- Work with the regional fisheries Councils to reduce overcapacity in fisheries under their jurisdiction.
- Convene a national meeting in 2005 that addresses, among other things, the capacity issue, where NOAA Fisheries and its constituents can review progress and focus on future priorities.
- Help the Councils develop/ prioritize goals for capacity reduction in specific fisheries.

Management measures that have an effect on fishing capacity and which have been implemented in the USA include limited entry, exclusive quota programs, individual transferrable quotas, community development quotas and fishing cooperatives. A final effective approach, which has been taken in some fisheries is the implementation of buyout schemes.

Throughout the 1990's the Gulf menhaden fishery underwent a period of consolidation, and is not currently considered to be operating with excess fishing capacity.

**R11**

| LEVEL OF COMPLIANCE | |
|---|---|
| *D3. Management measures should ensure that fishing gear and fishing practices do not have a significant impact on non-target species and the physical environment.* | |
| **LOW** | There are no management measures to prevent the impact of the fishing methods and fishing practices on non-target species and the physical environment. |
| **MEDIUM** | There are management measures to prevent the impact of the fishing methods and fishing practices on non-target species and the physical environment. However it is not science based. |
| **HIGH** | There are management measures to prevent the impact of the fishing methods and fishing practices on non-target species and the physical environment. Measures are based on scientific information. |

***Determination: Technical measures are generally applied by state authorities, but are based largely on the outcomes of the regular stock assessments, which include consideration of ecosystem factors. There have been no major changes since the reassessment, some uncertainty and lack of data around the impact on bottlenose dolphins remains, therefore we award the fishery a medium compliance rating.***

Bycatch in the commercial Gulf menhaden fishery is one of the lowest of all the fisheries in the United States, and most studies related to menhaden indicate a very low level of bycatch. The United Nations Food and

Agriculture Organisation has listed purse seine fisheries as one of the three fisheries worldwide with the lowest bycatch. Additionally, purse seine gear is widely recognised to have minimal impact on the physical environment. The majority of states have technical measures in place restricting total bycatch (usually to a maximum of 5% by weight), and implement closed areas where pelagic trawling is prohibited.

**Non-target species**

Individual states regulate incidental bycatch in the menhaden fisheries. Bycatch in the commercial gulf menhaden fishery is one of the lowest of all the commercial fisheries in the United States, and most of the studies related to menhaden indicate a very low level of bycatch. Data from different studies shows bycatch percentages ranging from 1 to 2.8% by weight (VanderKooy et al., 2002 and SEDAR, 2013), which is supported by routine monitoring by state agencies. Currently, the industry employs a hose cage designed to prevent the larger fish from being drawn up into the fish hose and pump system. The United Nations Food and Agriculture Organization has listed purse seine fisheries as one of the three fisheries worldwide with lowest bycatch.

**ETP species**

The federal Endangered Species Act of 1973 (ESA) provides for the conservation of species that are endangered or threatened throughout all or a significant portion of their range, and the conservation of the ecosystems on which they depend. The ESA requires NMFS to designate critical habitat and to develop and implement recovery plans for 94 threatened and endangered aquatic species. Individual states may have additional restrictions on which species are permitted (see below).

The GOM menhaden fishery is classified as a category II fishery under the MMPA. Fishers participating in a Category I or II fishery are required to accommodate an onboard observer upon request and comply with any applicable take reduction plans. NMFS may develop and implement take reduction plans for any Category I or II fishery that interacts with a strategic stock.

In addition in accordance with the MMPA (16 U.S.C. 1387(e)) and 50 CFR 229.6 (R30), any vessel owner or operator, or gear owner or operator (in the case of non-vessel fisheries), participating in a fishery listed on the LOF must report to NMFS all incidental mortalities and injuries of marine mammals that occur during commercial fishing operations, regardless of the category in which the fishery is placed (I, II, or III) within 48 hours of the end of the fishing trip or, in the case of non-vessel fisheries, fishing activity.

A report by the Marine Mammal Commission in 2015 (R31) stated that observer coverage has been limited in this fishery with only a pilot program in 2011. Three takes were observed, and all were released alive and uninjured. There have been 13 self-reported takes from 2000-2013, and previous analyses suggest as many as 57 mortalities occurred between 1992-1995. The assessment team recommends that the fishery should implement measures to improve the data and reporting of any cetacean impacts of this fishery.

**Ecosystems**

Gulf of Mexico menhaden are known forage for important commercial and recreational species in the Gulf of Mexico (GSMFC 2015, GDAR 2013). Numerous ecosystem models have shown their overall importance to the ecosystem (as reviewed by O'Farrell et al. 2017). While the Gulf Menhaden peer review panel suggested ways of incorporating ecosystem-based reference points during the last benchmark assessment (GDAR, 2013) managers have yet to adopt such. Poor data quality and lack of analytic ability has often been cited. However, efforts to re-examine this issue are expected after the current benchmark is completed in late 2018.

**Physical environment**

Habitat effects are generally low for purse seines, although occasional contact is known to occur and, in these cases, can cause damage to fragile ecosystems (e.g. corals), particularly when targeting bentho-pelagic schooling species. The risk of ghostfishing by lost gear is also very low for purse seines. The GOM menhaden

fishery is different in that it is prosecuted in shallow where the bottom is contacted in the majority of sets. This results in sediment suspension. However, the habitat impacts resulting from this gear are not known in detail (Barnette, 2001).

**Individual state technical measures - Louisiana**
**Bycatch** - anyone legally taking menhaden shall not have in their possession more than 5% by weight, of any species of fish other than menhaden and herring-like species.

**Closed areas** - harvesting menhaden is restricted to waters seaward of an inside-outside line described in state legislation; all other inside waters and passes are permanently closed to menhaden fishing. Additional areas are designated closed zones. These waters are closed to the taking of fish with saltwater netting, trawls, and seines from May 1 to September 15.

**Individual state technical measures - Mississippi**
**Bycatch** – illegal for any purse seine vessel to catch in excess of 5% by weight in any single set of the net or to possess in excess of 10% by weight of the total catch of any of the following species: spotted seatrout, bluefish, Spanish mackerel, king mackerel, dolphinfish, pompano, cobia, or jack crevalle. Also illegal for any vessel to have any quantity of red drum on board.

**Closed areas** - purse-seine fishing is prohibited within one mile of the shoreline of Hancock and Harrison counties and the adjacent barrier islands. Jackson County has no restrictions relative to the shoreline other than around the barrier islands. Commercial fishing (including purse seining for menhaden) is prohibited north of the CSX bridge in the Pascagoula River system.

**Individual state technical measures - Texas**
**Bycatch** - purse seines used in taking menhaden may not be used to harvest any other edible products for sale, barter, or exchange. Purse-seine catches may not contain more than 5% by volume of other edible products.

**Closed areas** - purse seines for taking menhaden may not be used in any bay, river, pass or tributary, nor within one mile of any barrier, jetty, island or pass, nor within 1/2 mile offshore in the Gulf of Mexico.

**Individual state technical measures - Florida**
**Bycatch** – no bycatch restrictions
In 1995, Florida banned all gill/entangling nets, and any nets greater than 500 square feet in state waters; thus, purse-seine reduction vessels are virtually excluded from Florida waters.

**Individual state technical measures - Alabama**
**Bycatch** - menhaden purse-seine boats may not possess more than 5% by number of species (excluding game fish) other than menhaden, herrings, and anchovies.

**Closed areas** - reduction fishing is restricted to Mississippi Sound and the Gulf of Mexico west of roughly Point aux Pines, Bayou La Batre, and Isle aux Herbes (Coffee Island). There is also no purse fishing allowed within a radius of one mile from the western point of Dauphin Island.

For more detail on the technical measures in place at state and federal level, please refer to the 2015 FMP (R1) and the state specific websites listed in the References section

**R1, R28, R30 -36**

| E. IMPLEMENTATION | |
|---|---|
| **LEVEL OF COMPLIANCE** | |
| *E1. There should be a framework for sanctions of violation of Laws and regulations.* | |
| **LOW** | A framework for sanctions of violation of Laws and regulations do not efficiently exist. |
| **MEDIUM** | A framework for sanctions of violation of Laws and regulations do exist but do not work efficiently. |
| **HIGH** | A framework for sanctions of violation of Laws and regulations exists and is proven to be efficient. |

***Determination: Each of the five States engaged in the Gulf menhaden fishery has a robust legal framework of sanctions for violations of fishery laws and regulations. Sanctioning the violation of laws and regulations is the responsibility of the individual states involved in the menhaden fishery.***

**Louisiana**

Sanctions for violations of laws and regulations are set out in Title 56 of the Louisiana Revised Statutes. Violations are classified from Class 1 to Class 8, with Class 8 being the most serious. Punishments include:

- Class 1 - For the first offense, a fine of US$50 or imprisonment for not more than fifteen days, or both. For the second offense, a fine of not less than US$75 nor more than US$250 or imprisonment for not less than thirty days nor more than sixty days, or both. For the third offense and all subsequent offenses, a fine of not less than US$200 nor more than US$550 dollars and imprisonment for not less than thirty days nor more than ninety days
- Class 8 - For each offense, the fine shall not be less than US$5,000 nor more than US$7,000 and the violator may be imprisoned in jail for not less than sixty days nor more than six months.

More general powers of the legislature include the seizure of assets related to the transgression, and revocation of fishing licences.

**Mississippi**

Violation of any provision of the saltwater fishing regulations is classified as a misdemeanor, and upon conviction is punishable by a fine of up to US$500. Each day of a continuing violation constitutes a separate violation. Violations of more than 1 section or subsection of the regulations or parts thereof are considered separate offenses and punished as such. Any person or vessel convicted of a 2nd or subsequent violation of any provisions of these regulations is considered guilty of a misdemeanor and upon conviction can be punished by a fine of up to US$10,000.

**Texas**

When a Texas Game Warden encounters a violation of hunting and fishing regulations, there will be a criminal complaint filed in either a justice court or a county court. Fines for such violations are assessed by the presiding judge hearing the case. In addition to assessed fines that may be associated with a criminal complaint, violators are also liable to civil restitution for the loss of or damage to wildlife resources that have resulted from the violation. Civil restitution will be assessed following each violation and each violator will receive an invoice for this restitution from the department. Failure to pay the civil recovery value will result in the department's refusal to issue any license, tag or permit in the violator's name until restitution is made. An individual who hunts or fishes after such a refusal commits a Class A misdemeanor which is punishable by a fine not less than US$500 or more than US$4,000; punishment in jail not to exceed one year; or both fine and confinement.

**Florida**

The 2012 Florida Statutes, Title XXVIII, Chapter 379, Section 407 states:

"(1) Base penalties - Unless otherwise provided by law, any person, firm, or corporation who violates any provision of this chapter, or any rule of the Fish and Wildlife Conservation Commission relating to the conservation of marine resources, shall be punished:

a) Upon a first conviction, by imprisonment for a period of not more than 60 days or by a fine of not less than $100 nor more than $500, or by both such fine and imprisonment.

b) On a second or subsequent conviction within 12 months, by imprisonment for not more than 6 months or by a fine of not less than $250 nor more than $1,000, or by both such fine and imprisonment."

Additional, more severe penalties are laid out for repeat violations, major violations, and specific violations such as possession of protected species, undersize fish, or fishing in protected areas.

**Alabama**

Title 9, Section 11 of the 2009 Alabama Code Section 9-11-156 describes "Penalties for violations of provisions of article", as follows:

"Any person, firm, co-partnership, association or corporation violating any of the provisions of this article or rules and regulations based thereon shall be guilty of a Class A misdemeanor and, upon conviction for the first offense, shall be punished by a fine of not more than $2,000.00 and/or sentenced to imprisonment for not more than one year; upon conviction for the second or any subsequent offense, the punishment shall be by a fine of not less than $500.00 nor more than $2,000.00, and/or by imprisonment for not less than one month nor more than one year.

In addition, thereto, all commercial fishing gear, boats, motors, implements, instruments, appliances or things of whatsoever nature used in connection with the commission of such misdemeanor, if the owner is unknown, shall be seized and confiscated and shall become the property of the Division of Wildlife and Freshwater Fisheries of the Department of Conservation and Natural Resources and shall be disposed of as ordered by the Commissioner of Conservation and Natural Resources. Such fishing gear, boats, motors, implements, instruments, appliances or things of whatsoever nature used in connection with the commission of such misdemeanor, if the owner is known, shall be seized and confiscated and shall be disposed of as ordered by the court having jurisdiction thereof.

For more detail on the technical measures in place at state and federal level, please refer to the 2015 FMP and the state specific websites listed in the references section.

**R1, R12 - R15, R19 - R22.**

| LEVEL OF COMPLIANCE | |
|---|---|
| *E2. A management system for fisheries control and enforcement should be established.* | |
| **LOW** | A management system for fisheries control and enforcement is not established. |
| **MEDIUM** | A management system for fisheries control and enforcement is established but do not work efficiently. |
| **HIGH** | A management system for fisheries control and enforcement is established and work efficiently. |

***Determination: There are well funded, fully staffed management systems in place in each of the five States which prosecute the Gulf menhaden fishery.***

Enforcement of fishing regulations is the responsibility of the individual states engaged in the menhaden Fishery:

Louisiana – Enforcement Division of the Louisiana Department of Wildlife and Fisheries

Mississippi – Marine Patrol of the Mississippi Department of Marine Resources

Texas – Marine Enforcement Section of the Texas Parks and Wildlife Department

Florida – Division of Law Enforcement of the Florida Fish and Wildlife Conservation Commission

Alabama – Marine Police Division of the Alabama Marine Resources Division

**Louisiana**

Fisheries enforcement in Louisiana is the responsibility of the Enforcement Division of the Department of Wildlife and Fisheries. The Mission of the Enforcement Division is to establish and maintain compliance through the execution and enforcement of laws, rules and regulations of the state relative to the management, conservation and protection of renewable natural wildlife and fisheries resources and relative

to providing public safety on the state's waterways and lands for the continued use and enjoyment by current and future generations. Beyond the traditional role of ensuring compliance with licensing and harvesting regulations, the Enforcement Division also conducts search and rescue missions, enforces boating safety laws, investigates boating and hunting accidents and provides boater education classes for thousands of citizens each year.

**Mississippi**
Saltwater fisheries enforcement in Mississippi is the responsibility of the Marine Patrol of the Mississippi Department of Marine Resources. The Marine Patrol provides marine enforcement of federal and state laws and the ordinances of the Commission on Marine Resources for the protection, propagation, preservation and conservation of Mississippi's seafood, aquatic life and associated coastal wetland habitats. Marine Patrol also carries out the enforcement of state and federal laws pertaining to boating safety and provides emergency assistance to marine boaters.

**Texas**
Commercial fisheries enforcement in Texas is the responsibility of the Marine Enforcement Section of the Texas Parks and Wildlife Department. Texas game wardens have authority granted under the Texas Water Safety Act to provide law enforcement, boating safety and education, and resource protection for all of the public waters of the state and the Gulf of Mexico out to nine nautical miles. All Texas game wardens are certified Marine Safety Enforcement Officers. The enforcement of regulations regarding the commercial fishing and shrimping industries, oyster reef and harvest management, invasive species, protection of environmentally sensitive areas, recreational sport hunting and fishing activities, and the protection of water quality are all the responsibility of the Marine Enforcement Section. TPWD assists in the enforcement of federal regulations, working hand in hand with the National Marine Fisheries, U.S. Coast Guard, and other federal resource protection agencies.

**Florida**
Fisheries enforcement in Florida is the responsibility of the Division of Law Enforcement within the Florida Fish and Wildlife Conservation Commission. The Division's four core missions are resource protection, environmental protection, boating and waterways, and public safety. The Division of Law Enforcement represents a large part of the FWC's personnel, with over 1,000 employees, over 800 of whom are sworn officers. In 2012, under direction of the Florida Legislature and Governor Scott, the FWC Division of Law Enforcement was combined with the Department of Environmental Protection's Division of Law Enforcement and parts of the Department of Agriculture and Consumer Services' Office of Agricultural Law Enforcement, including the officers assigned to patrol state forests and the investigator responsible for commercial aquaculture violations. Alabama Marine fisheries enforcement in Alabama is the responsibility of the Marine Police Division of the Alabama Marine Resources Division.

For more detail on on each of the enforcement authorities, please refer to the 2015 FMP and the state specific websites listed in section 8 (references).

**R1, R12, R13, R14, R15, R19, R20, R21, R22.**

## 7. KEY STAKEHOLDERS

Monterey Bay Aquarium/Seafood Watch programme

## 8. REFERENCES

R1 - Gulf Menhaden FMP, 2015 revision:
http://www.gsmfc.org/publications/GSMFC%20Number%20240.pdf

R2 - NMFS Gulf Menhaden 2018 forecast & 2017 review (March 2018):
file:///C:/Users/deird/Documents/IFFO%20reports%20August%202018/Forecast2018.pdf 7pp

R3 - SEDAR Gulf Menhaden stock assessment, September 2013:
http://sedarweb.org/docs/sar/S32A_GoM_Menhaden_SAR_Final_9.26.2013.pdf

R4 - SEDAR Gulf Menhaden stock assessment, December 2011:
http://www.cio.noaa.gov/services_programs/prplans/pdfs/Final%20Work%20Product%20SEDAR27%20Menhaden.pdf

R5 - GSMFC Menhaden Factsheet: http://menhaden.gsmfc.org/2010%20FAQ.shtm

R6 - Gulf Menhaden FMP, 2002 edition: http://menhaden.gsmfc.org/pdf/Menhaden%20FMP.pdf

R7 – GSMFC, 'about': http://menhaden.gsmfc.org/2010%20About%20Us.shtm

R8 – Florida Menhaden info: http://myfwc.com/media/195461/menhaden.pdf

R9 – Gulf Menhaden data collection 'about':
http://menhaden.gsmfc.org/2010%20Data%20Collection.shtm

R10 – SEDAR 'about': http://www.sefsc.noaa.gov/sedar/

R11 – US national plan of action for the management of fishing capacity:
http://www.nmfs.noaa.gov/op/pds/documents/01/113/01-113-01.pdf

R12 – Louisiana Enforcement Division 'about':
http://www.wlf.louisiana.gov/enforcement/enforcement-mission-statement

R13 – Mississippi Marine Patrol, 'about': http://www.dmr.state.ms.us/marine-patrol

R14 – Texas Marine Enforcement Section vessel assets:
http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_bk_l2000_1168.pdf

R15 – Florida Division of Law Enforcement 'about': http://myfwc.com/law/

R16 – FAO species information web page, Gulf Menhaden:
http://www.fao.org/fishery/species/2899/en

R17 – Guide to commercial fishing in Texas:
http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_bk_v3400_0074.pdf

R18 – Louisiana 2016 commercial fishing regulations:

http://www.wlf.louisiana.gov/fishing/commercial-fishing

R19 – Louisiana Revised Statutes, Title 56:
http://www.legis.state.la.us/lss/lss.asp?folder=130

R20 – Mississippi fishing regulations digest:
http://www.dmr.ms.gov/index.php/commercial-fishing

R21 – Florida statutes, fish and wildlife conservation
http://myfwc.com/license/saltwater/commercial-fishing/

R22 – Alabama Code 2009, Section 9-11-156:
http://law.justia.com/codes/alabama/2009/Title9/Chapter11/9-11-156.html

R23 – GSMFC menhaden facts: http://menhaden.gsmfc.org/2010%20FAQ.shtm

R24 – Fishbase species page, Gulf menhaden: http://www.fishbase.org/summary/Brevoortia-patronus.html

R25 – Gulf menhaden stock assessment 2007 (peer reviewed):
http://menhaden.gsmfc.org/FishRes_Vaughan_etal_2007-GM.pdf

R26 – NMFS endangered species overview: http://www.nmfs.noaa.gov/pr/species/esa/

R27 – The precautionary principle in US groundfish fisheries:
http://www.afsc.noaa.gov/refm/stocks/grant/precaut.html

R28 - Monterey Bay Aquarium's Seafood Watch - Atlantic Menhaden (Brevoortia tyrannus), , Gulf Menhaden (Brevoortia patronus) US Atlantic, US Gulf of Mexico, Purse seine fishery assessment report, June 4, 2015 37pp.

R29 - Anderson, J.D., and D.L. McDonald. 2007. Morphological and genetic investigations of two western Gulf of Mexico menhadens (Brevoortia spp.). Journal of Fish Biology 70:139-147.

R30 – NMFS Review of marine mammal bycatch for Gulf of Mexico Menhaden Purse Seine Fishery
http://www.nmfs.noaa.gov/pr/pdfs/fisheries/2011final/gom__menhaden_purse_seine.pdf

R31 – U.S. Federal Register of Fisheries – List of Fisheries 2016
https://www.federalregister.gov/articles/2016/04/08/2016-08114/list-of-fisheries-for-2016#h-20

R32 - Cornish, V. (ed.). 2015. Gulf of Mexico Marine Mammal Research and Monitoring Meeting: SummaryReport. Marine Mammal Commission, Bethesda, MD 20910. 110 pages. http://www.mmc.gov/wp-content/uploads/GOM-MM-Mtg-Summary-Report_Nov2015.pdf

R33 - GDAR (2016) GDAR 02 Gulf Menhaden Stock Assessment 2016 Update. Prepared by Schueller, A.:
http://www.gsmfc.org/publications/GSMFC%20Number%20254.pdf

R34 - SEDAR. 2013. SEDAR 32A - Gulf of Mexico menhaden Stock Assessment Report. SEDAR, North Charleston SC. 422 pphttp://sedarweb.org/docs/sar/S32A_GoM_Menhaden_SAR_Final_9.26.2013.pdf

R35 - VanderKooy, Steven J. and Smith, Joseph W., 2002. The Menhaden Fishery of the Gulf of Mexico, United States: A Regional Management Plan. Gulf States Marine Fisheries Commission (GSMFC). Number 99, March 2002. 143 pp.http://www.gsmfc.org/publications/GSMFC%20Number%20099.pdf

R36 - Barnette, M.C. 2001. A review of the fishing gear utilized within the Southeast Region and their potential impacts on essential fish habitat. NOAA Technical Memorandum NMFS-SEF SC-44 9, 62 pp. https://www.sefsc.noaa.gov/P_QryLDS/download/TM430_TM-449.pdf?id=LDS