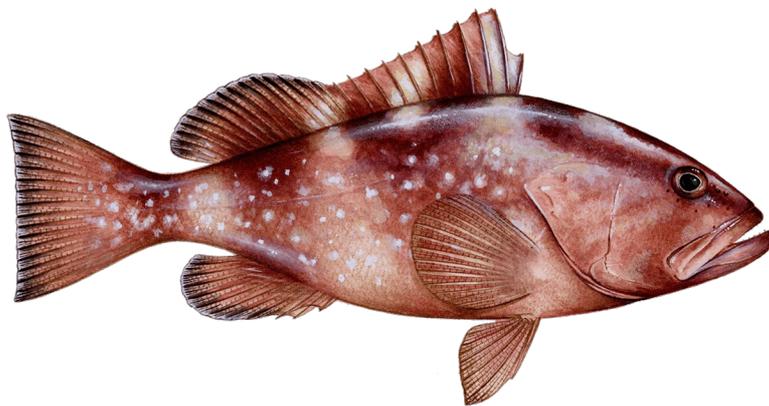


Monterey Bay Aquarium Seafood Watch®

Grouper (Mexico)

Ephinepelus morio and *Mycteroperca bonaci*



©Diane Rome Peebles

Mexico/Gulf of Mexico

Set longlines

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Seafood Watch Consulting Researcher

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About Seafood Watch

Monterey Bay Aquarium's Seafood Watch program evaluates the ecological sustainability of wild-caught and farmed seafood commonly found in the United States marketplace. Seafood Watch defines sustainable seafood as originating from sources, whether wild-caught or farmed, which can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems. Seafood Watch makes its science-based recommendations available to the public in the form of regional pocket guides that can be downloaded from www.seafoodwatch.org. The program's goals are to raise awareness of important ocean conservation issues and empower seafood consumers and businesses to make choices for healthy oceans.

Each sustainability recommendation on the regional pocket guides is supported by a Seafood Watch Assessment. Each assessment synthesizes and analyzes the most current ecological, fisheries and ecosystem science on a species, then evaluates this information against the program's conservation ethic to arrive at a recommendation of "Best Choices," "Good Alternatives" or "Avoid." This ethic is operationalized in the Seafood Watch standards, available on our website here. In producing the assessments, Seafood Watch seeks out research published in academic, peer-reviewed journals whenever possible. Other sources of information include government technical publications, fishery management plans and supporting documents, and other scientific reviews of ecological sustainability. Seafood Watch Research Analysts also communicate regularly with ecologists, fisheries and aquaculture scientists, and members of industry and conservation organizations when evaluating fisheries and aquaculture practices. Capture fisheries and aquaculture practices are highly dynamic; as the scientific information on each species changes, Seafood Watch's sustainability recommendations and the underlying assessments will be updated to reflect these changes.

Parties interested in capture fisheries, aquaculture practices and the sustainability of ocean ecosystems are welcome to use Seafood Watch assessments in any way they find useful.

Guiding Principles

Seafood Watch defines sustainable seafood as originating from sources, whether fished¹ or farmed that can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems.

The following guiding principles illustrate the qualities that fisheries must possess to be considered sustainable by the Seafood Watch program (these are explained further in the Seafood Watch Standard for Fisheries):

- Follow the principles of ecosystem-based fisheries management.
- Ensure all affected stocks are healthy and abundant.
- Fish all affected stocks at sustainable levels.
- Minimize bycatch.
- Have no more than a negligible impact on any threatened, endangered or protected species.
- Managed to sustain the long-term productivity of all affected species.
- Avoid negative impacts on the structure, function or associated biota of aquatic habitats where fishing occurs.
- Maintain the trophic role of all aquatic life.
- Do not result in harmful ecological changes such as reduction of dependent predator populations, trophic cascades, or phase shifts.
- Ensure that any enhancement activities and fishing activities on enhanced stocks do not negatively affect the diversity, abundance, productivity, or genetic integrity of wild stocks.

These guiding principles are operationalized in the four criteria in this standard. Each criterion includes:

- Factors to evaluate and score
- Guidelines for integrating these factors to produce a numerical score and rating

Once a rating has been assigned to each criterion, we develop an overall recommendation. Criteria ratings and the overall recommendation are color coded to correspond to the categories on the Seafood Watch pocket guide and online guide:

Best Choice/Green: Are well managed and caught in ways that cause little harm to habitats or other wildlife.

Good Alternative/Yellow: Buy, but be aware there are concerns with how they're caught.

Avoid/Red Take a pass on these for now. These items are overfished or caught in ways that harm other marine life or the environment.

¹ "Fish" is used throughout this document to refer to finfish, shellfish and other invertebrates

Summary

This report analyzes the Mexican bottom longline industrial fleet that targets red grouper (*Epinephelus morio*) and black grouper (*Mycteroperca bonaci*) in the Campeche Bank (offshore of the Yucatan Peninsula) in the Gulf of Mexico (GOM). This fishery exports the majority of its production to the U.S. market. A great number of artisanal vessels target both species, and largely supplies Mexican domestic markets. The impacts of the artisanal fleet on grouper stocks are considered in this report, but this fleet is not rated here. Although the GOM red grouper stock has been in decline for years, it is still the major component of the catch within the fishery, and accounts for approximately 60% of the total catch.

Groupers' life history characteristics make them vulnerable to fishing pressure. Red and black groupers in particular are listed as "Near Threatened" by the International Union for the Conservation of Nature (IUCN). The most recent stock assessment, conducted in 2013 by the National Fisheries Institute (INAPESCA) and the National Fisheries Commission (CONAPESCA) concluded that the fishery shows signs of being overfished and has been experiencing overfishing for several years.

Though red and black grouper are the main species (in terms of volume and value) in this multi-species fishery, several other species are also targeted by the fleet using the same gear and fishing in the same zones. These species are not considered bycatch; instead, they are counted as associated species by the Mexican legislation. Most of these associated species belong to two families (Serranidae and Lutjanidae). To select the species to assess in Criterion 2, we used the most recent reports on catch composition (selecting species that represent at least 5% of the total volume of catch) and those that are not included as associated species in the fishery. The species selected for Criterion 2 were red snapper, mutton snapper, Warsaw grouper, gag grouper, and sea turtles. Although researchers in the region and managers do not have reports of sea turtle catch or interactions with the fishing gear, sea turtles were included in the assessment because of their known interaction with similar fisheries that have observer coverage in the Gulf of Mexico (e.g., the grouper fishery in the U.S.).

In 2014, a new management plan for the fishery was approved that includes stricter management regulations and research activities. Some of these regulations include more frequent stock assessments and updates. Most of these regulations are not yet in place and managers have identified that the fishery needs significant improvement.

The overall Seafood Watch recommendation for red and black grouper from the industrial fleet in the Campeche Bank is "Avoid" due to the poor stock status of many species in this multi-species fishery, and the challenges with management.

Final Seafood Recommendations

SPECIES FISHERY	CRITERION 1: Impacts on the Species	CRITERION 2: Impacts on Other Species	CRITERION 3: Management Effectiveness	CRITERION 4: Habitat and Ecosystem	OVERALL RECOMMENDATION
Black grouper Mexico/Gulf of Mexico Set longlines Mexico	Red (1.732)	Red (1.000)	Red (1.000)	Yellow (2.449)	(1.435)
Red grouper Mexico/Gulf of Mexico Set longlines Mexico	Red (1.000)	Red (1.000)	Red (1.000)	Yellow (2.449)	(1.250)

Scoring Guide

Scores range from zero to five where zero indicates very poor performance and five indicates the fishing operations have no significant impact.

Final Score = geometric mean of the four Scores (Criterion 1, Criterion 2, Criterion 3, Criterion 4).

- **Best Choice/Green** = Final Score >3.2, and no Red Criteria, and no Critical scores
- **Good Alternative/Yellow** = Final score >2.2-3.2, and neither Harvest Strategy (Factor 3.1) nor Bycatch Management Strategy (Factor 3.2) are Very High Concern², and no more than one Red Criterion, and no Critical scores
- **Avoid/Red** = Final Score ≤2.2, or either Harvest Strategy (Factor 3.1) or Bycatch Management Strategy (Factor 3.2) is Very High Concern or two or more Red Criteria, or one or more Critical scores.

² Because effective management is an essential component of sustainable fisheries, Seafood Watch issues an Avoid recommendation for any fishery scored as a Very High Concern for either factor under Management (Criterion 3).

Introduction

Scope of the analysis and ensuing recommendation

This report addresses red grouper (*Ephinepelus morio*) and black grouper (*Mycteroperca bonaci*) targeted by the Mexican bottom longline fishery in the Campeche Bank in the Gulf of Mexico (GOM). In terms of volume and value, these are the two most important grouper species in the region that reach the U.S. market.

Species Overview

Grouper species are one of the most important fisheries in terms of value for several communities in Mexico (DOF 2013). In the Yucatan region, red and black grouper are two of the most important resources in terms of economic value and the number of people involved in their production; in 2013, this region produced around 97% of the total grouper landed in Mexico (SAGARPA-INAPESCA 2014).

Red grouper is a long-lived, slow-growing species, with protogynous behavior (hermaphrodite) (Moe 1969). This species tends to reach sexual maturity between 4 and 6 years old (Heemstra and Randall 1993), but it reaches maximum fecundity potential at 8 to 12 years old (Moe 1969). Juveniles are normally found between 10 and 30 meters (m) deep, and adults are mostly found in deeper regions up to 130 m (Valdes and Padron 1980) (Burgos-Rosas and Perez-Perez 2006)(Lopez-Rocha and Arreguin-Sanchez 2007)(SAGARPA-INAPESCA 2014). Fishing vessels target the species at 20 *brazas* (33 meters or deeper; 1 *braza* = approximately 1.7 m) (Hernandez et al. 2000)(Monroy et al. 2000)(Burgos-Rosas and Perez-Perez 2006)(SAGARPA-INAPESCA 2014).

Black grouper is also a hermaphrodite (Ferreira-Teixeira et al. 2004). Bullock and Smith (1991) found that females tend to mature between 50 and 100 cm in length, whereas males reach maturity between 96 and 116 cm in the GOM. For black grouper, researchers have reported spawning aggregations in the Caribbean (Fine 1990)(Carter and Perrine 1994)(Domeier and Colin 1997)(Eklund et al. 2000). But Brule *et al.* (2003) did not observe any spawning aggregations for *M. bonaci* in the Campeche Bank, and acknowledged that more sampling in this region is needed.

Black grouper can be found from inshore to about 200 m deep (Koch 2011). Adults are generally found around hard bottom areas (Tupper and Rudd 2002), such as coral reefs, ledges, caves, crevices (Smith 1961), rocky bottoms, and drop-offs, usually at depths greater than 30 m (Bullock and Smith 1991). Red grouper juveniles can be found on shallow seagrass beds and inshore reefs (Garcia-Moliner and Edlund 2004), larger juveniles are commonly found in rocky reef bottoms at depths of 5 to 25 m, and adults (4 to 6 years of age) migrate to deeper waters of around 50 to 300 m (Heemstra and Randall 1993). According to Monroy-Garcia (2010), the fleet that targets both species works in areas from 30 to 100 m. These life-history characteristics make both species vulnerable to fishing and overexploitation (Huntsman and Schaaf 1994).

In Mexico, the Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food (SAGARPA) is the Mexican government body that promotes the execution of policy to improve production practices for agricultural, livestock, and fisheries sectors. The National Aquaculture and Fishing Commission (CONAPESCA) is the branch of SAGARPA that is in charge of developing and executing management regulations. It is supported by its technical branch, the National Fisheries Institute (INAPESCA), which provides technical support and management recommendations based on scientific evidence. These bodies are in charge to create, implement, and enforce management strategies for fishing resources in the country.

In the GOM, red and black grouper are the two most important targeted species (in terms of volume and value) managed under the "Plan de Manejo Pesquero" (fisheries management plan) of the Yucatan Peninsula (DOF 2014), along with 13 other species (mostly groupers and snappers) that are recognized by the management plan as targeted and associated species. Despite signs of reduction in abundance, red and black groupers are still the most abundant species within the fishery.

Production Statistics

China, Philippines, Pakistan, Malaysia, and Mexico are the most important producers of groupers. The 10 top grouper producers represent more than 80% of the total global landings (Figure 1).

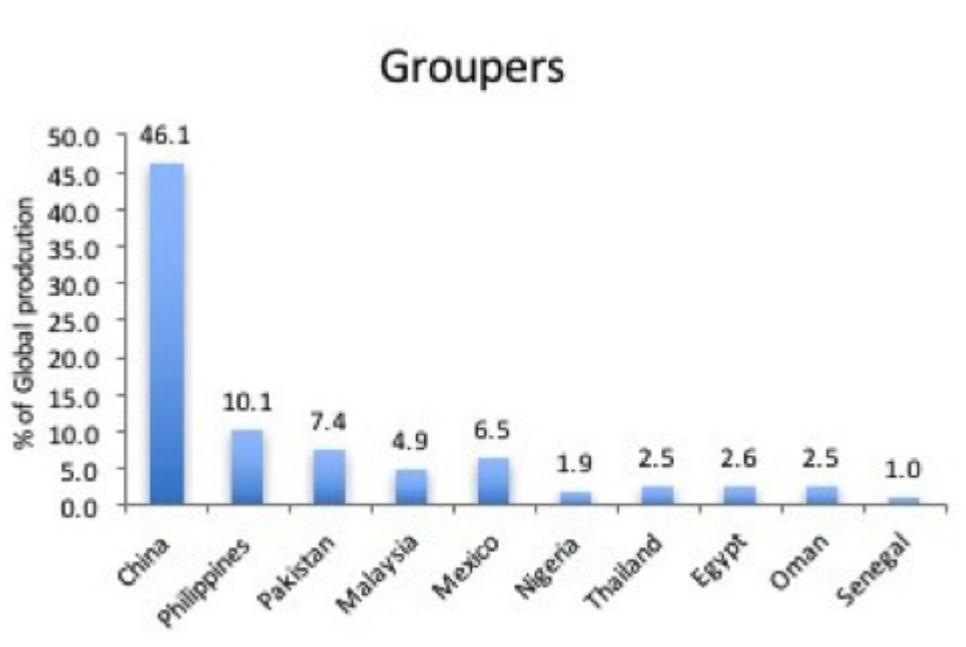


Figure 1 Top 10 producer countries of grouper based on the average landings between 2010 and 2013 (data from FishStat, FAO 2011–2015).

In Mexico, the most important grouper production region is located in the Campeche Bank off the Yucatan Peninsula; fishers from Yucatan, Campeche, and Quintana Roo take part in this fishery (DOF 2012). Of all the species caught in the Gulf of Mexico, the most important in terms of volume and value are red and black grouper (DOF 2012). Yucatan and Quintana Roo are the biggest producers, with approximately 84% and 7% of the total production, respectively (SAGARPA-INAPESCA 2014).

The fishery started in the late 1950s with an increase in landings each year, reaching a record high in 1972 at 19,886 tonnes (t) landed (Figure 2). Since then, landings have been decreasing. In 2014, reported landings were a record low 5,495 t (SAGARPA-CONAPESCA 2014).

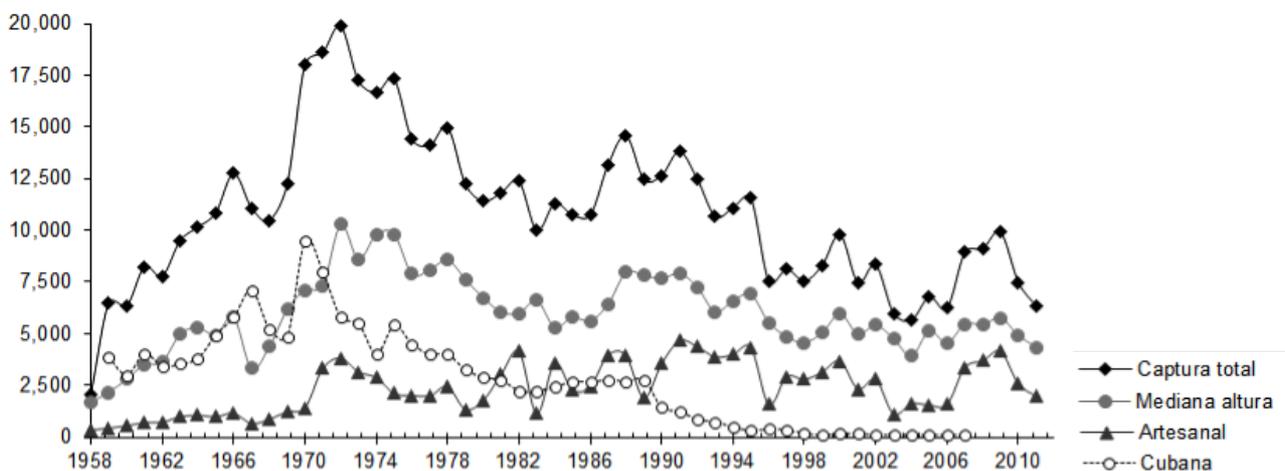


Figure 2 Grouper landings in the Yucatan peninsula by fleet from 1958 to 2012 (SAGARPA-CONAPESCA 2014).

Between 1960 and 2010, the National Fisheries Chart (CNP), which is the official fisheries tool that summarizes information on the status of all commercial fisheries, regulations, and management recommendations, reported declines of grouper biomass in the GOM (Figure 3). Grouper biomass reached a “stable” phase from 1995, which continued until 2010 (CONAPESCA 2012) (Figure 3).

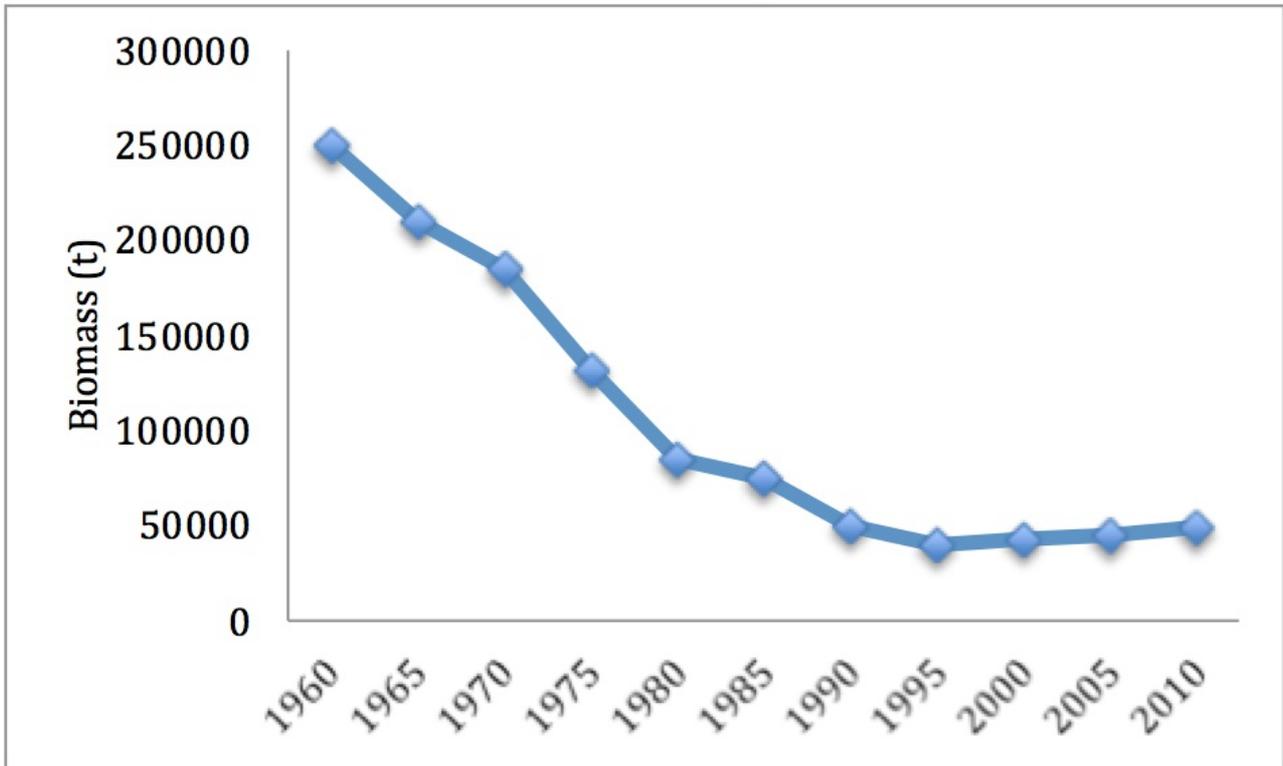


Figure 3 Grouper biomass from 1960 to 2010 (CNP 2012).

These species are targeted by two fleets: an artisanal fleet that uses mostly longlines and hook and line, and fishes closer to shore (with production staying in the domestic market); and an industrial fleet that is only authorized to use bottom longlines for the grouper fishery, and exports most of its grouper to the U.S. (CONAPESCA 2012). Figure 4 shows catch per yield for each fleet from 2000 to 2008.

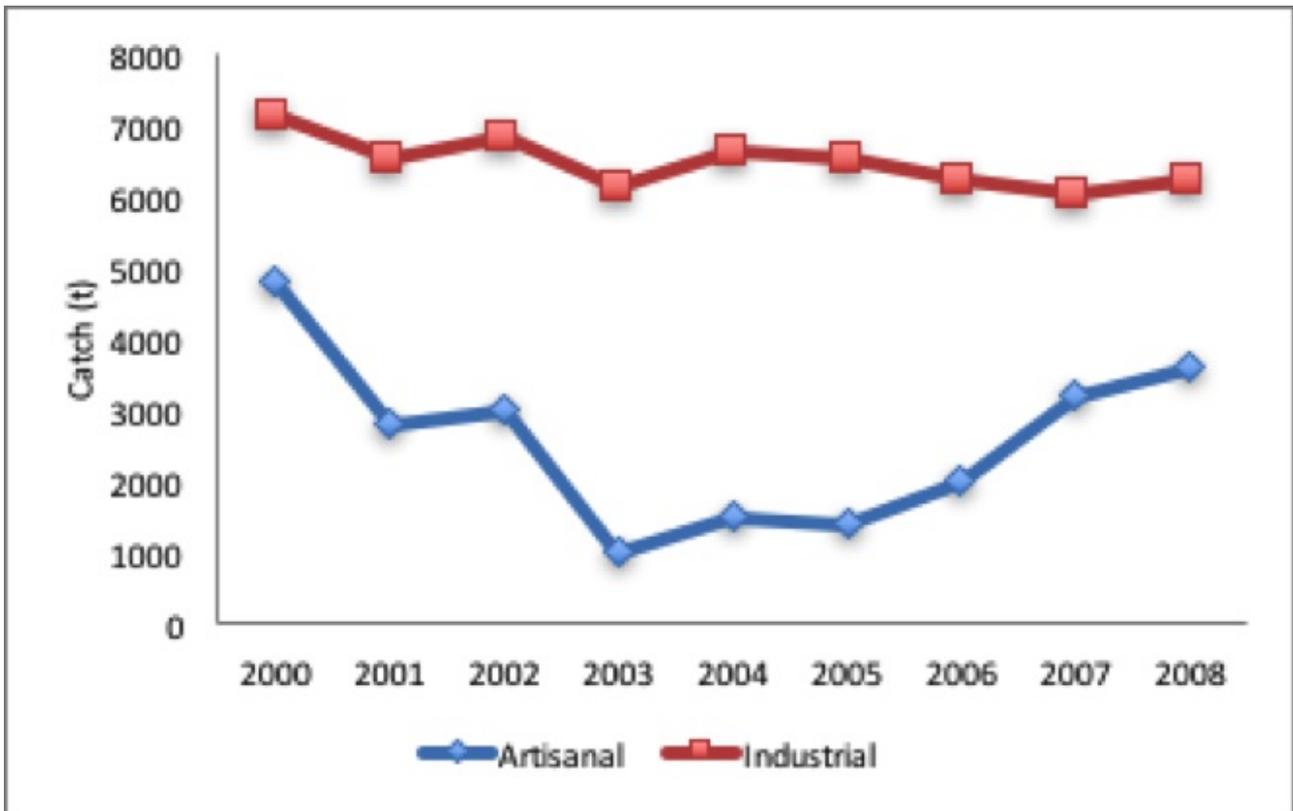


Figure 4 Grouper catch per yield for the artisanal and industrial fleets (CONAPESCA 2012).

Importance to the US/North American market.

The U.S. is one of the largest importers of groupers in the world. In 2015, the U.S. imported more than 500 t of grouper. Mexico and Panama were the main contributors, with almost 80% of the total grouper imported into the U.S. in 2015 (NOAA 2015) (Figure 5).

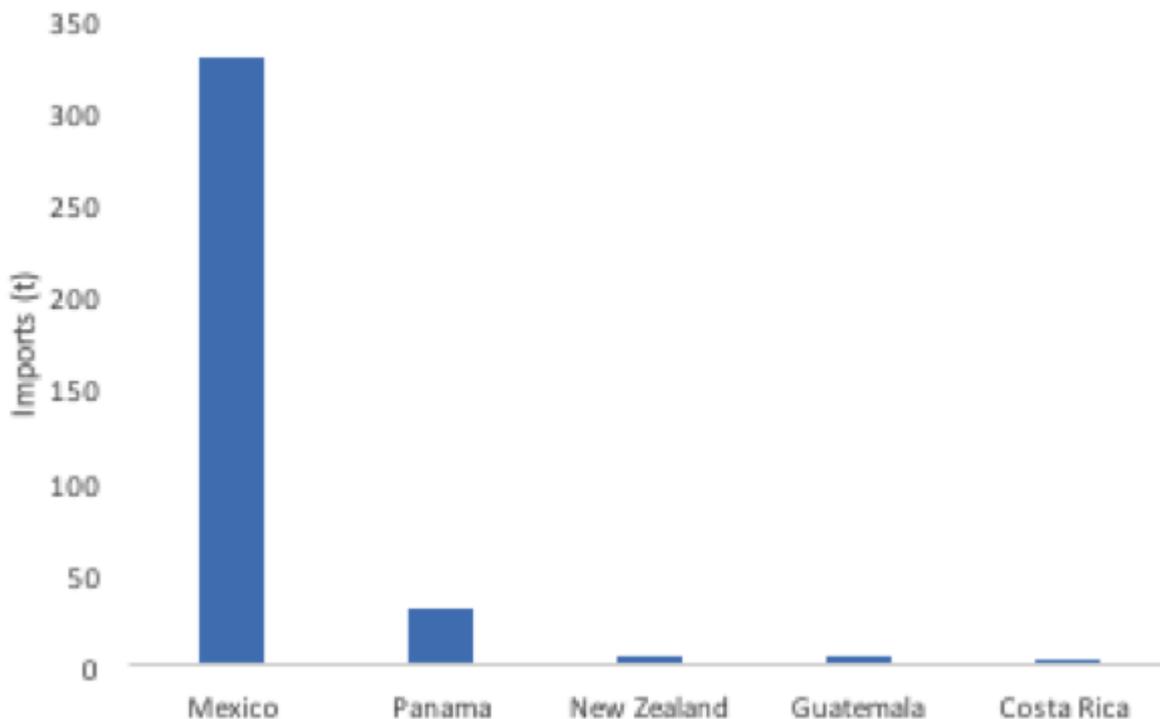


Figure 5 Most important countries that exported grouper into the U.S. in 2015 (NOAA 2016).

Mexican grouper from the GOM has been in the U.S. market for years (CONAPESCA 2014). Exports are carried out mainly by Yucatan producers, and according to data from the National Oceanic and Atmospheric Administration (NOAA), the average export volume from Mexico between 2001 and 2015 was estimated at 3,000 t/year (fresh and frozen), with an economic impact of 19 million USD per year (Figure 6).

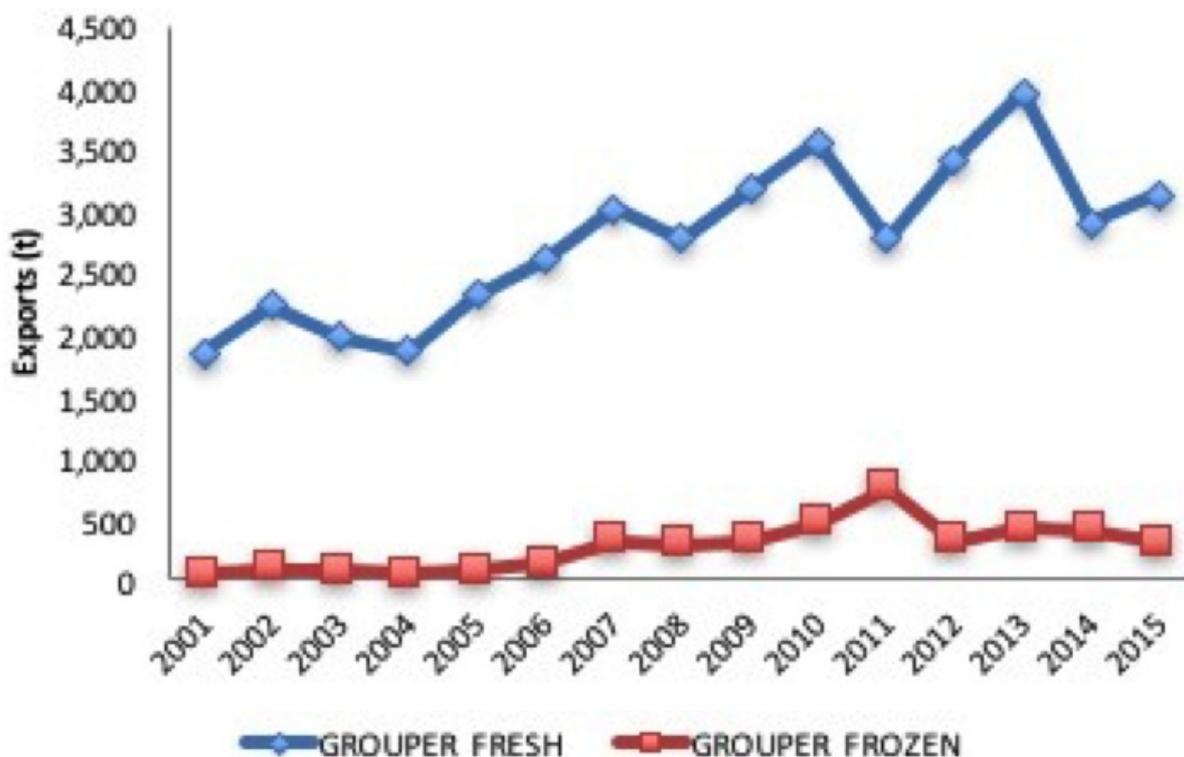


Figure 6 Mexican grouper imported into the U.S. (fresh and frozen) from 2001 to 2016 (NMFS trade data 2016).

Although the exact magnitude of the contribution from Yucatan and Quintana Roo is unknown, there is evidence that much of this volume consists of red and black grouper from the Campeche Bank region (DOF 2014).

Common and market names.

Red grouper has no other common names. Black grouper is also known as black rockfish and marbled rockfish. In Mexico, red grouper is known as *Mero rojo* and black grouper as *Mero negro*.

Primary product forms

Fresh and frozen fillets.

Assessment

This section assesses the sustainability of the fishery(s) relative to the Seafood Watch Standard for Fisheries, available at www.seafoodwatch.org. The specific standard used is referenced on the title page of all Seafood Watch assessments.

Criterion 1: Impacts on the Species Under Assessment

This criterion evaluates the impact of fishing mortality on the species, given its current abundance. When abundance is unknown, abundance is scored based on the species' inherent vulnerability, which is calculated using a Productivity-Susceptibility Analysis. The final Criterion 1 score is determined by taking the geometric mean of the abundance and fishing mortality scores. The Criterion 1 rating is determined as follows:

- Score >3.2=Green or Low Concern
- Score >2.2 and ≤3.2=Yellow or Moderate Concern
- Score ≤2.2=Red or High Concern

Rating is Critical if Factor 1.3 (Fishing Mortality) is Critical

Guiding Principles

- Ensure all affected stocks are healthy and abundant.
- Fish all affected stocks at sustainable level.

Criterion 1 Summary

BLACK GROUPER			
Region Method	Abundance	Fishing Mortality	Score
Mexico/Gulf of Mexico Set longlines Mexico	1.00: High Concern	3.00: Moderate Concern	Red (1.732)

RED GROUPER			
Region Method	Abundance	Fishing Mortality	Score
Mexico/Gulf of Mexico Set longlines Mexico	1.00: High Concern	1.00: High Concern	Red (1.000)

Criterion 1 Assessment

SCORING GUIDELINES

Factor 1.1 - Abundance

Goal: Stock abundance and size structure of native species is maintained at a level that does not impair recruitment or productivity.

- 5 (Very Low Concern) — Strong evidence exists that the population is above an appropriate target abundance level (given the species' ecological role), or near virgin biomass.
- 3.67 (Low Concern) — Population may be below target abundance level, but is at least 75% of the target level, OR data-limited assessments suggest population is healthy and species is not highly vulnerable.
- 2.33 (Moderate Concern) — Population is not overfished but may be below 75% of the target abundance level, OR abundance is unknown and the species is not highly vulnerable.
- 1 (High Concern) — Population is considered overfished/depleted, a species of concern, threatened or endangered, OR abundance is unknown and species is highly vulnerable.

Factor 1.2 - Fishing Mortality

Goal: Fishing mortality is appropriate for current state of the stock.

- 5 (Low Concern) — Probable (>50%) that fishing mortality from all sources is at or below a sustainable level, given the species ecological role, OR fishery does not target species and fishing mortality is low enough to not adversely affect its population.
- 3 (Moderate Concern) — Fishing mortality is fluctuating around sustainable levels, OR fishing mortality relative to a sustainable level is uncertain.
- 1 (High Concern) — Probable that fishing mortality from all source is above a sustainable level.

BLACK GROUPER

Factor 1.1 - Abundance

MEXICO/ GULF OF MEXICO

Set Longlines | Mexico

High Concern

A formal stock assessment is not available for black grouper. For this reason, a Productivity– Susceptibility Analysis (PSA) is used. The PSA score = 3.605, so the stock is deemed highly vulnerable (based on the PSA scoring tool). Detailed scoring of each attribute is shown below.

Black grouper is highly vulnerable (according to the PSA analysis), there is no quantitative stock assessment, and the IUCN lists it as “Near Threatened,” so abundance is deemed a “high” concern.

Justification:

Productivity-Susceptibility Analysis:

Scoring Guidelines

1.) Productivity score (P) = average of the productivity attribute scores (p1, p2, p3, p4 (finfish only), p5 (finfish only), p6, p7, and p8 (invertebrates only))

2.) Susceptibility score (S) = product of the susceptibility attribute scores (s1, s2, s3, s4), rescaled

as follows: $PSA = [((p1 * p2 * p3 * p4) - 1/ 40) + 1 .$

3.) Vulnerability score (V) = the Euclidean distance of P and S using the following formula: $V =$

$$\sqrt{(P2 + S)2}$$

Productivity Attribute	Relevant Information	Score (1 = low risk, 2 = medium risk, 3 = high risk)
Average age at maturity	5 years (Ferreira et al. 2008)	2
Average maximum age	34 years (Renan et al. 2012)	3
Fecundity	500,000 (Brule et al. 2003)	1
Average maximum size (fish only)	133 cm (Renan et al. 2012)	2
Average size at maturity (fish only)	72.1 cm (Renan et al. 2003)	2
Reproductive strategy	Broadcast spawner (Paz and Sedberry 2007)	1
Trophic level	4.3 (Ferreira et al. 2008)	3
Density dependence (invertebrates only)	-	-

Susceptibility Attribute	Relevant Information	Score (1 = low risk, 2 = medium risk, 3 = high risk)
Areal overlap (Considers all fisheries)	Black grouper is fished throughout its range along the Campeche Bank (Coronado-Sala 2011)(DOF 2014)	3
Vertical overlap (Considers all fisheries)	There is a high overlap of target species and retained species with the gear (DOF 2014)	3
Selectivity of fishery (Specific to fishery under assessment)	The industrial fleet captures mostly mature black grouper (Coronado-Salas 2011). This species forms spawning aggregations, but they have not been observed in the Campeche Bank (Brule 2003).	3
Post-capture mortality (Specific to fishery under assessment)	Most of the catch is retained (Brule et al. 2008)	3

Factor 1.2 - Fishing Mortality

MEXICO/ GULF OF MEXICO

Set Longlines | Mexico

Moderate Concern

Fishing mortality data are not available for GOM black grouper. As red grouper catches decreased, the industrial fleet shifted towards targeting black grouper, resulting in increased landings of black grouper (SAGARPA-INAPESCA 2014). Both species are targeted using the same gear; however, because of the difference in species distribution and lack of specific data on when vessels are targeting one or the other, simultaneously or separately on gear deployments, it is unclear as to how much effort has been directed towards black grouper. Therefore, black grouper fishing mortality is considered unknown, and this factor is therefore scored as "moderate" concern.

RED GROUPE

Factor 1.1 - Abundance

MEXICO/ GULF OF MEXICO

Set Longlines | Mexico

High Concern

The most recent effort to measure stock status in the region was developed by INAPESCA researchers in 2013 (Monroy et al. 2013). Researchers used data recorded in the fishing logbooks from 1984 to 2009 by the industrial fleet (i.e. no fishery-independent data were used). Catch per unit effort (CPUE) as kilograms of grouper per fishing trip was used in the Schaefer excess production model (1954) to produce biomass estimates and to calculate biomass at maximum sustainable yield (B_{MSY}) (Monroy et al. 2013). This is a simple model without age structure and with uniform population growth and mortality rates. The data requirements are not as demanding; for example, there is no need to determine cohorts (Sparre and Venema 1998).

Managers concluded that the data fit well with the Schaefer model, and accepted the results for management (DOF 2014). These results showed a decreasing trend in Mexican red grouper biomass from the 200,000 t estimated in the 1970s to around 50,000 t in recent years, which is equivalent to 25% of the 1970 estimation (Figure 7). In comparison, U.S. red grouper stocks were reported as healthy in the most recent Red Grouper Stock Assessment Report (SEDAR 2015). Based on biophysical transport models used by the SouthEast Data, Assessment, and Review group (SEDAR), "little connectivity exists for red grouper mixing of Mexico and U.S. stocks" (unpublished data, M. Karnauskas, SEFSC/NMFS Miami, FL).

The biomass estimated by the model (B_{2009}) was 48,524 t and B_{MSY} was 97,433 t, confirming that the stock was overfished (SAGARPA-CONAPESCA 2014). Signs of the Yucatan stock being overfished had been observed for years; for example, in the reduction of landings and the decrease of the CPUE since the 1970s (Diario Oficial de la Federation) (DOF 2014)(Figure 7).

Abundance is deemed a "high" concern because available evidence suggests that the stock remains overfished.

Justification:

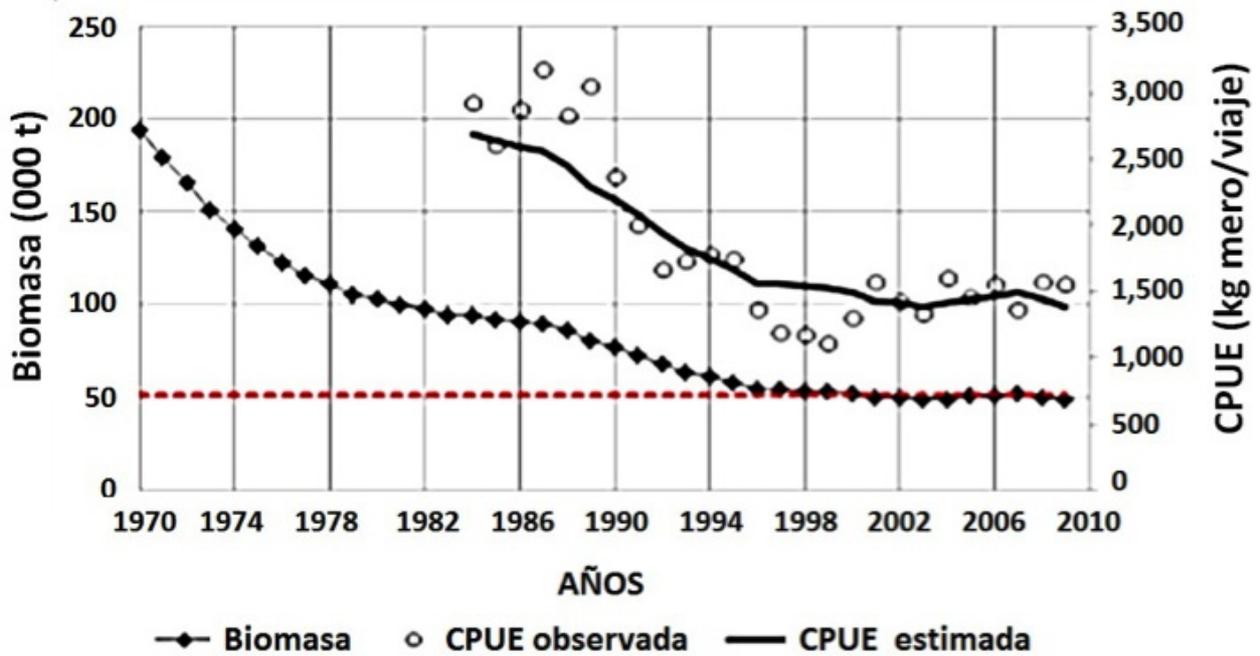


Figure 7 Estimated biomass and CPUE using the Schaefer model and observed CPUE using industrial fleet data (DOF 2014).

Researchers and managers have recognized that the Mexican stocks of red grouper in the Campeche Bank have declined (Figure 8), and management regulations are needed in order to allow stocks to recover (Hernandez et al. 2000)(Monroy et al. 2000)(Burgos-Rosas and Perez-Perez 2003)(SAGARPA 2006, 2010 in (SAGARPA-INAPESCA 2014).

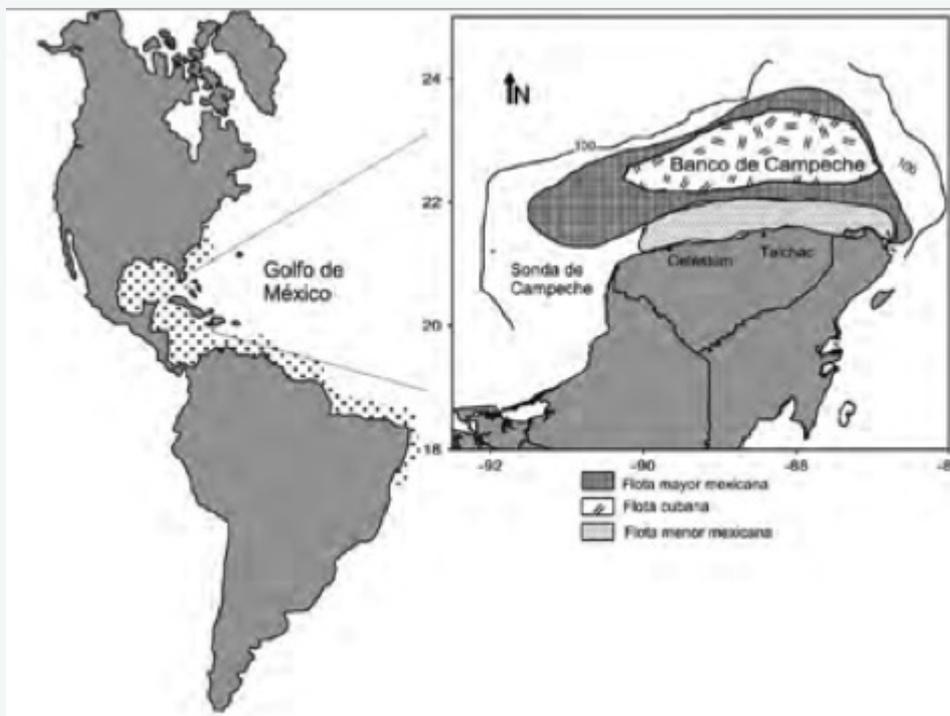


Figure 8 Distribution of red grouper stock (*Epinephelus morio*) in the Campeche Bank (SAGARPA-INAPESCA 2014).

Past stock assessments showed important reductions of the stock biomass, from approximately 240,000 t

estimated in 1958 to 61,000 t by 2000 (Salas 2000). In 2002, managers defined the red grouper fishery as overfished in the national fisheries chart (CNP) (DOF 2002). By 2003, the estimated biomass of red grouper was calculated to be at 45,500 t, well below the Limit Reference Point (LRP) of 74,500 t (established by managers; (DOF 2012)).

In 2005, INAPESCA concluded that the stock was overexploited, and by 2012 a new, lower LRP was set at 52,000 t, which is the average of the estimated biomass from the last 14 years (1995–2008) (DOF 2012). Reference points are based on the average biomass over the last 14 years, not on virgin biomass, so as biomass has decreased, so have the reference points.

Factor 1.2 - Fishing Mortality

MEXICO/ GULF OF MEXICO

Set Longlines | Mexico

High Concern

In addition to the formal stock assessment, there is a 2013 Virtual Population Analysis (VPA) that estimated the biomass vulnerable to fishing (DOF 2014). The model generated fishing mortality rates (F) where F increased between 1990 and 1995 (Figure 9), which was the period when the artisanal fleet's size increased (DOF 2014).

Managers estimated that the industrial fleet's fishing effort should be capped at the equivalent production of 320 vessels ($F_{MSY} = 320$ industrial vessels) (DOF 2012)(SAGARPA-INAPESCA 2014).

According to official data, 517 vessels composed the industrial fleet in Yucatan (DOF 2014). Of the industrial vessels, 491 possess finfish permits, which means that they are authorized to target red and black grouper along with other finfish species (DOF 2014). Any given industrial vessel may carry multiple gear types and target other resources, depending on the permits it possesses, such as for octopus (307 permits) and lobster (28 permits) (DOF 2014), so their fishing effort may be dispersed over several resources. The artisanal fleet, which comprises $\approx 4,200$ small vessels (DOF 2014), also targets red grouper and significantly contributes to this species' fishing mortality. According to researchers and managers, the artisanal fleet's catch is mostly made up of undersized fish that have not reached maturity (Coronado-Salas 2011)(DOF 2014)(SAGARPA-INAPESCA 2014).

It is difficult to estimate the industrial fleet's fishing effort because of the multispecies authorization and because vessels use a diverse number of gears depending on what they target. But in 2010, Monroy estimated fishing effort using logbooks from 2000 to 2003 (Monroy 2010). During the timeframe, she found that only 56% of the industrial bottom longline fleet was active (mostly due to low economic returns) (Monroy 2010). In 2014, managers reported that the number of vessels active in 2009 (378 vessels) represented a 15% excess of fishing effort (the recommended fishing effort is 320 active vessels) (SAGARPA-INAPESCA 2014). The total number of vessels authorized to target red grouper (491 vessels) or actively targeting red grouper (378 vessels) is above the effort limit defined by managers (320) (SAGARPA-INAPESCA 2014). This rating is score as "high" concern for the industrial fleet.

Justification:

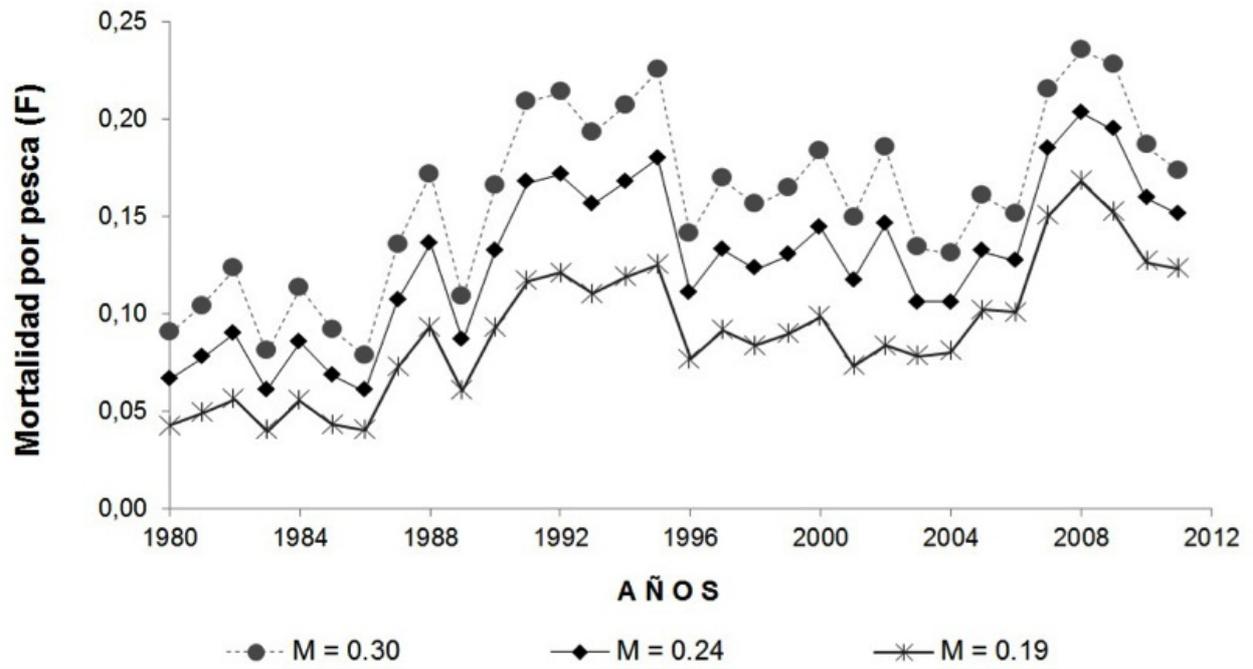


Figure 9 Estimated values of Fishing mortality (F) in the red grouper fishery in the GOM using different natural mortality values (M) (DOF 2014).

Criterion 2: Impacts on Other Species

All main retained and bycatch species in the fishery are evaluated under Criterion 2. Seafood Watch defines bycatch as all fisheries-related mortality or injury to species other than the retained catch. Examples include discards, endangered or threatened species catch, and ghost fishing. Species are evaluated using the same guidelines as in Criterion 1. When information on other species caught in the fishery is unavailable, the fishery's potential impacts on other species is scored according to the Unknown Bycatch Matrices, which are based on a synthesis of peer-reviewed literature and expert opinion on the bycatch impacts of each gear type. The fishery is also scored for the amount of non-retained catch (discards) and bait use relative to the retained catch. To determine the final Criterion 2 score, the score for the lowest scoring retained/bycatch species is multiplied by the discard/bait score. The Criterion 2 rating is determined as follows:

- Score >3.2=Green or Low Concern
- Score >2.2 and ≤3.2=Yellow or Moderate Concern
- Score ≤2.2=Red or High Concern

Rating is Critical if Factor 2.3 (Fishing Mortality) is Critical

Guiding Principles

- Ensure all affected stocks are healthy and abundant.
- Fish all affected stocks at sustainable level.
- Minimize bycatch.

Criterion 2 Summary

Only the lowest scoring main species is/are listed in the table and text in this Criterion 2 section; a full list and assessment of the main species can be found in Appendix A.

BLACK GROUPE					
Mexico/Gulf Of Mexico Set Longlines Mexico					
Subscore:	1.000	Discard Rate:	1.00	C2 Rate:	1.000
Species Stock	Abundance	Fishing Mortality	Subscore		
Red grouper	1.00:High Concern	1.00:High Concern	Red (1.000)		
Red snapper	1.00:High Concern	1.00:High Concern	Red (1.000)		
Sea turtle (unspecified)	1.00:High Concern	3.00:Moderate Concern	Red (1.732)		
Warsaw grouper	1.00:High Concern	3.00:Moderate Concern	Red (1.732)		
Gag	1.00:High Concern	3.00:Moderate Concern	Red (1.732)		
Mutton snapper	1.00:High Concern	3.00:Moderate Concern	Red (1.732)		

RED GROUPE					
Mexico/Gulf Of Mexico Set Longlines Mexico					
Subscore:	1.000	Discard Rate:	1.00	C2 Rate:	1.000

Species Stock	Abundance	Fishing Mortality	Subscore
Red snapper	1.00:High Concern	1.00:High Concern	Red (1.000)
Black grouper	1.00:High Concern	3.00:Moderate Concern	Red (1.732)
Sea turtle (unspecified)	1.00:High Concern	3.00:Moderate Concern	Red (1.732)
Warsaw grouper	1.00:High Concern	3.00:Moderate Concern	Red (1.732)
Gag	1.00:High Concern	3.00:Moderate Concern	Red (1.732)
Mutton snapper	1.00:High Concern	3.00:Moderate Concern	Red (1.732)

The grouper fishery in the Campeche Bank is a multispecies fishery that targets at least 19 species of groupers and snappers, but red and black grouper are the most important species in terms of value and volume (DOF 2014)(SAGARPA-CONAPESCA 2014). The other species included in the Grouper Management Plan are gag grouper (*Mycteroperca microlepis*), scamp grouper (*M. phenax*), yellowmouth grouper (*M. interstitialis*), yellowfin grouper (*M. venenosa*), Poey's grouper (*Hyporthodus flavolimbatus*), Warsaw grouper (*H. nigrurus*), Nassau grouper (*Epinephelus striatus*), red hind (*E. guttatus*), snowy grouper (*E. niveatus*), coney (*Cephalopholis fulva*), Atlantic goliath grouper (*E. itajara*), rock hind (*E. adscensionis*), calico grouper (*E. drummondhayi*), misty grouper (*H. mystacinus*), graysby (*Cephalopholis cruentata*), marbled grouper (*Dermatolepis inermis*), Spanish flag grouper (*Gonioplectrus hispanus*), creole fish (*Paranthias furcifer*), and tiger grouper (*M. tigris*).

The management plan also considers the following finfish as associated species: red snapper (*Lutjanus campechanus*), mutton snapper (*L. analis*), grey snapper (*L. griseus*), lane snapper (*L. synagris*), blackfin snapper (*L. buccanella*), silk snapper (*L. vivanus*), dog snapper (*L. jocu*), cobia (*Rachycentron canadum*), yellowtail snapper (*Ocyurus chrysurus*), jolthead porgy (*Calamus bajonado*), Campeche porgy (*Calamus campechanus*), white grunt (*Haemulon plumieri*), banded rudderfish (*Seriola zonata*), vermilion snapper (*Rhomboplites aurorubens*), hogfish (*Lachnolaimus maximus*), and golden tilefish (*Lopholatilus chamaelonticeps*) (SAGARPA-CONAPESCA 2014).

Studies on catch composition for the industrial fleet have been developed in the region (Gimenez-Hurtado and Mompie-Nueva 2010)(Monroy 2010)(Coronado and Salas 2011)(Coronado-Castro et al. 2011)(SAGARPA-INAPESCA 2014). Managers and researchers agree that catch composition has changed through time, especially the amount of red grouper (Monroy 2010)(DOF 2014). According to the most recent catch composition data (SAGARPA-INAPESCA 2014), the industrial fleet that targets groupers using bottom longline in the Campeche Bank catches red grouper (approximately 55% of the catch) black grouper (approx. 32%), red snapper (approx. 5%), mutton snapper (approx. 4%) gag grouper (approx. 2%), and at least another 10 species that compose less than 2% of the catch (SAGARPA-INAPESCA 2014).

According to the SFW standards for Criteria 2, "main species for this criteria can include species that are either targeted or not targeted and are caught with the stock under assessment and either retained or discarded, as well as species that interact with the fishing gear used to capture the stock under assessment," and the species has to be a common component of the catch (at least 5% of the catch in most cases), or in some cases when the species is overfished, endangered, or threatened. Based on these standards, the species included as main species for Criteria 2 are red snapper (*Lutjanus campechanus*), mutton snapper (*Lutjanus analis*), gag grouper (*Mycteroperca microlepis*) and Warsaw grouper (*Hyporthodus nigrurus*).

Although reports of gag grouper catch are low, it is included in Criterion 2 because it is potentially overfished and has been reported that it can be confused with black grouper (SEDAR 2009). In addition, information on sea turtle interactions with the fishery is not available; however, sea turtles are commonly reported to be

incidentally caught in bottom longlines around the world. For this reason, sea turtles are also included as main species for this criterion.

Criterion 2 Assessment

SCORING GUIDELINES

Factor 2.1 - Abundance

(same as Factor 1.1 above)

Factor 2.2 - Fishing Mortality

(same as Factor 1.2 above)

RED SNAPPER

Factor 2.1 - Abundance

MEXICO/ GULF OF MEXICO

Set Longlines | Mexico

High Concern

Red Snapper is a high economic value species that inhabits the Campeche Bank. Its biomass declined considerably in the area from an estimated initial biomass of 33,740 t to around 17,000 t in 1999, when the last stock assessment was developed (SAGARPA-INAPESCA 2000). According to official reports in the National Fisheries Chart, landings declined by 58% between 1980 and 2013 (CONAPESCA 2015). Therefore, it is inferred that a population decline of at least 58% has occurred in the fishery. The species is assessed as "Vulnerable" by the IUCN (IUCN 2016). There is no evidence that the stock status has improved from the outdated 1999 stock assessment, and this species is listed as Vulnerable by IUCN (Anderson et al. 2015), so red snapper abundance is deemed a "high" concern.

Factor 2.2 - Fishing Mortality

MEXICO/ GULF OF MEXICO

Set Longlines | Mexico

High Concern

Snappers in the Campeche Bank are targeted by industrial longline, artisanal longline, and handline fishers (DOF 2012). Red snapper is the main species within the snapper fishery, with 62% of the total volume (CONAPESCA 2016). Snapper landings have been declining and effort is assumed to have been constant, according to a 16-year-old management document (DOF 2000). Access to the fishery is controlled through permits and gear restrictions (DOF 2012), and managers recommend reducing fishing effort, not granting new permits, reducing fleet size, and setting a limit on the landings in the Gulf of Mexico to 4,295 t (SAGARPA 2012).

However, there is no indication that these recommendations have been implemented successfully. Total snapper landings in the Gulf of Mexico from 2012 to 2014 have been above the managers' recommendation of 4,295 t per year (DOF 2012), at 4,939 t, 5,019 t, and 5,381 t, respectively (CONAPESCA 2016), and it is highly likely that cumulative fishing mortality is above a sustainable level.

Catch composition of the grouper fishery reveals that red snapper accounts for around 5% of the catch in the industrial grouper longline fishery. This means that around 270 t of red snapper were potentially caught by the

grouper fishery in 2014 (based on 2014 landings reported by CONAPESCA). This amount represents around 6% of the recommended limit (4,295 t) for the snapper fishery. Because the snapper fishery is recognized by managers as a deteriorated fishery (DOF 2012), the impact of the grouper fishery could be considered detrimental. For these reasons, this factor is scored as “high” concern for red snapper.

Factor 2.3 - Modifying Factor: Discards and Bait Use

Goal: Fishery optimizes the utilization of marine and freshwater resources by minimizing post-harvest loss. For fisheries that use bait, bait is used efficiently.

Scoring Guidelines: The discard rate is the sum of all dead discards (i.e. non-retained catch) plus bait use divided by the total retained catch.

RATIO OF BAIT + DISCARDS/LANDINGS	FACTOR 2.3 SCORE
<100%	1
>=100	0.75

MEXICO/ GULF OF MEXICO

Set Longlines | Mexico

< 100%

There are not enough data to estimate the discards + bait/landings ratio for the red and black grouper fishery in the Yucatan. Although the Mexican longline fishery uses the same gear type and targets similar species as the U.S. Gulf of Mexico longline reef fish fishery (which has a discard to landings ratio of 111% (Scott-Denton and Williams 2013)), most if not all the catch in the Mexican fishery is retained and brought to port. For this reason, the factor is rated at < 100%.

Criterion 3: Management Effectiveness

Five factors are evaluated in Criterion 3: Management Strategy and Implementation, Bycatch Strategy, Scientific Research/Monitoring, Enforcement of Regulations, and Inclusion of Stakeholders. Each is scored as either 'highly effective,' 'moderately effective,' 'ineffective,' or 'critical'. The final Criterion 3 score is determined as follows:

- 5 (Very Low Concern) — Meets the standards of 'highly effective' for all five factors considered.
- 4 (Low Concern) — Meets the standards of 'highly effective' for 'management strategy and implementation' and at least 'moderately effective' for all other factors.
- 3 (Moderate Concern) — Meets the standards for at least 'moderately effective' for all five factors.
- 2 (High Concern) — At a minimum, meets standards for 'moderately effective' for Management Strategy and Implementation and Bycatch Strategy, but at least one other factor is rated 'ineffective.'
- 1 (Very High Concern) — Management Strategy and Implementation and/or Bycatch Management are 'ineffective.'
- 0 (Critical) — Management Strategy and Implementation is 'critical'.

The Criterion 3 rating is determined as follows:

- Score >3.2=Green or Low Concern
- Score >2.2 and ≤3.2=Yellow or Moderate Concern
- Score ≤2.2 = Red or High Concern

Rating is Critical if Management Strategy and Implementation is Critical.

GUIDING PRINCIPLE

- The fishery is managed to sustain the long-term productivity of all impacted species.

Criterion 3 Summary

Fishery	Management Strategy	Bycatch Strategy	Research and Monitoring	Enforcement	Stakeholder Inclusion	Score
Fishery 1: Mexico/Gulf of Mexico Set longlines Mexico	Ineffective	Moderately Effective				Red (1.000)

Criterion 3 Assessment

Factor 3.1 - Management Strategy and Implementation

Considerations: What type of management measures are in place? Are there appropriate management goals, and is there evidence that management goals are being met? Do managers follow scientific advice? To achieve a highly effective rating, there must be appropriately defined management goals, precautionary policies that are based on scientific advice, and evidence that the measures in place have been successful at maintaining/rebuilding species.

MEXICO/ GULF OF MEXICO
Set Longlines | Mexico

Ineffective

The grouper fishery, which targets at least 19 species between objective and associated species (DOF 2014), has been regulated by an Official Mexican Norm (Norma Oficial Mexicana, NOM-065-PESC-2007) since 2007. This NOM—a federal document with standards and regulations for diverse activities in Mexico (DOF 2009)—was generally applied to all the grouper species in the Gulf of Mexico and the Caribbean (DOF 2009) for both fleets (industrial and artisanal).

The management plan “Fishery Management Plan for Grouper (*Epinephelus morio*) and associated species in the Yucatan Peninsula” was developed in 2014 (DOF 2014). This document states that the objective species for the plan is red grouper, but includes the other associated species (included in the NOM) captured by both fleets in the Yucatan area (DOF 2014). To have access to the fishery, participants need to own a finfish permit (either industrial or artisanal) (DOF 2014). These permits are not specific for grouper species, and normally include a large list of species that permit owners are authorized to land (DOF 2014). Applicable fishery regulations are included in these permits. The current regulations are:

- Minimum size limit (just for red grouper): 36.3 cm, which applies to both fleets.
- Number and specifications of fishing gear:
 - Artisanal: One bottom longline no longer than 750 m long and a maximum of 250 Eagle Claw hooks #7.
 - Industrial fleet: No more than four bottom longlines with 500 Eagle Claw hooks each, or one longline with no more than 2,000 eagle claw hooks #6.
- An annual off-season for the whole fishery (both fleets) from February 15 to March 15. In 2014, a second off-season was proposed as part of the new management plan (DOF 2014), but has not yet been implemented.
- In addition to the regulations mentioned above, the industrial fleet is required to install satellite-based Vessel Monitoring Systems (VMS) to constantly monitor fishing activities (NOM- 062-PESC-2007) (DOF 2008).

There are no quotas or limits set for catch for grouper species; as described above, the fishery is managed via permits, which include restrictions on gear and a minimum landing size. These regulations have been in place through the norm NOM-065-PESC-2007 for both fleets.

It is thought that, as a result of the hook regulations, the average size of red grouper captured by the industrial fleet increased (from 44.3 cm to 51.3 cm fork length) (SAGARPA- INAPESCA 2014). Also, with the VMS requirements, there has been more control on the expansion of the industrial fleet in size, as well as limiting its fishing in prohibited areas. This type of information is unavailable for the artisanal fleet, however (SAGARPA-INAPESCA 2014).

In addition, managers recognize that intense fishing pressure on juveniles is still a problem, particularly with the artisanal fleet. In 2012, a catch composition study found that up to 40% of individuals were under the minimum size limit (for red grouper), and this has affected recruitment and the status of the stocks (Coronado-Salas 2012)(SAGARPA-INAPESCA 2014). It is important to point out that the NOM-065 and the Management Plan regulations are heavily driven by red grouper ecology and do not include regulations for other species, mostly because of a lack of knowledge (SAGARPA-INAPESCA 2014). Although managers have created a new work plan to improve the status of the fishery, most of the measures are not yet in place (DOF 2014). Also, it is questionable whether the plan, even once in effect, will curtail the negative impacts of the artisanal fleet on grouper stocks.

Currently, management has not improved the status of the fishery, and it is likely that the fishery is having serious negative impacts on retained populations. Though some improvements have been documented (change in average size of red grouper caught by the industrial fleet), the harvest management strategy and implementation factor is scored as “ineffective.”

Justification:

Other management regulations (designation of no-fishing areas, annual stock assessments, etc.) have been included in the management plan as recommendations from the Fisheries Improvement Project (FIP) for this fishery (CeDePesca 2014). Also, managers recommended that fishing effort should not be higher than an effort of 352 industrial vessels, and they proposed a limit reference point of 52,419 t (Monroy-Garcia et al. 2013). Nevertheless, none of these new management measures are in place, and management currently relies only on access controls, gear specifications, and CPUE monitoring (DOF 2014).

Factor 3.2 - Bycatch Strategy

Considerations: What type of management strategy/measures are in place to reduce the impacts of the fishery on bycatch species and when applicable, to minimize ghost fishing? How successful are these management measures? To achieve a Highly Effective rating, the fishery must have no or low bycatch, or if there are bycatch or ghost fishing concerns, there must be effective measures in place to minimize impacts.

MEXICO/ GULF OF MEXICO

Set Longlines | Mexico

Moderately Effective

The national fisheries chart (NFC) considers at least 17 species associated with the fishery (DOF 2014), in addition to the 19 species defined as targeted species (DOF 2012). Bycatch in this fishery is low because most, if not all, of the species caught by the fleet are retained and either sold, or kept for personal consumption (Minerva Alonso, pers. comm., 2016).

In terms of management, some gear restrictions are in place, although these are aimed at reducing the impact of the fishery on undersized targeted and other retained species (DOF 2014). Managers regulate the size and type of hook for both fleets (Hook “huachinanguero” or Eagle Claw; size #15 or #14 for industrial and #10 to #12 for artisanal) (DOF 2014). Yet, there is no clear indication that this strategy is properly implemented because there is no evidence that a monitoring program is in place. Although there are no data on fishery interactions with sea turtles, similar fisheries in the region (U.S. bottom longline reef fish fishery in the Gulf of Mexico) report turtle catches and interactions (NMFS 2009), so it is important for managers to collect this information. There are regulations that could help reduce potential interactions with, or catch of, other non-targeted species (bycatch), but the impact is unknown, so this factor is rated “moderately effective.”

Factor 3.3 - Scientific Research and Monitoring

Considerations: How much and what types of data are collected to evaluate the fishery’s impact on the species? Is there adequate monitoring of bycatch? To achieve a Highly Effective rating, regular, robust population assessments must be conducted for target or retained species, and an adequate bycatch data collection program must be in place to ensure bycatch management goals are met.

Factor 3.4 - Enforcement of Management Regulations

Considerations: Do fishermen comply with regulations, and how is this monitored? To achieve a Highly Effective rating, there must be regular enforcement of regulations and verification of compliance.

Factor 3.5 - Stakeholder Inclusion

Considerations: Are stakeholders involved/included in the decision-making process? Stakeholders are individuals/groups/organizations that have an interest in the fishery or that may be affected by the management of the fishery (e.g., fishermen, conservation groups, etc.). A Highly Effective rating is given if the management process is transparent, if high participation by all stakeholders is encouraged, and if there a mechanism to effectively address user conflicts.

Criterion 4: Impacts on the Habitat and Ecosystem

This Criterion assesses the impact of the fishery on seafloor habitats, and increases that base score if there are measures in place to mitigate any impacts. The fishery's overall impact on the ecosystem and food web and the use of ecosystem-based fisheries management (EBFM) principles is also evaluated. Ecosystem Based Fisheries Management aims to consider the interconnections among species and all natural and human stressors on the environment. The final score is the geometric mean of the impact of fishing gear on habitat score (factor 4.1 + factor 4.2) and the Ecosystem Based Fishery Management score. The Criterion 4 rating is determined as follows:

- *Score >3.2=Green or Low Concern*
- *Score >2.2 and ≤3.2=Yellow or Moderate Concern*
- *Score ≤2.2=Red or High Concern*

GUIDING PRINCIPLES

- Avoid negative impacts on the structure, function or associated biota of marine habitats where fishing occurs.
- Maintain the trophic role of all aquatic life.
- Do not result in harmful ecological changes such as reduction of dependent predator populations, trophic cascades, or phase shifts.
- Ensure that any enhancement activities and fishing activities on enhanced stocks do not negatively affect the diversity, abundance, productivity, or genetic integrity of wild stocks.
- Follow the principles of ecosystem-based fisheries management.

Rating cannot be Critical for Criterion 4.

Criterion 4 Summary

Region Method	Gear Type and Substrate	Mitigation of Gear Impacts	EBFM	Score
Mexico/Gulf of Mexico Set longlines Mexico	3	0	High Concern	Yellow (2.449)

Criterion 4 Assessment

SCORING GUIDELINES

Factor 4.1 - Physical Impact of Fishing Gear on the Habitat/Substrate

Goal: The fishery does not adversely impact the physical structure of the ocean habitat, seafloor or associated biological communities.

- *5 - Fishing gear does not contact the bottom*
- *4 - Vertical line gear*
- *3 - Gears that contacts the bottom, but is not dragged along the bottom (e.g. gillnet, bottom longline, trap) and is not fished on sensitive habitats. Or bottom seine on resilient mud/sand habitats. Or midwater trawl that is known to contact bottom occasionally. Or purse seine known to commonly contact the bottom.*
- *2 - Bottom dragging gears (dredge, trawl) fished on resilient mud/sand habitats. Or gillnet, trap, or bottom longline fished on sensitive boulder or coral reef habitat. Or bottom seine except on mud/sand. Or there is*

known trampling of coral reef habitat.

- *1 - Hydraulic clam dredge. Or dredge or trawl gear fished on moderately sensitive habitats (e.g., cobble or boulder)*
- *0 - Dredge or trawl fished on biogenic habitat, (e.g., deep-sea corals, eelgrass and maerl)*
Note: When multiple habitat types are commonly encountered, and/or the habitat classification is uncertain, the score will be based on the most sensitive, plausible habitat type.

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

Goal: Damage to the seafloor is mitigated through protection of sensitive or vulnerable seafloor habitats, and limits on the spatial footprint of fishing on fishing effort.

- *+1 —>50% of the habitat is protected from fishing with the gear type. Or fishing intensity is very low/limited and for trawled fisheries, expansion of fishery's footprint is prohibited. Or gear is specifically modified to reduce damage to seafloor and modifications have been shown to be effective at reducing damage. Or there is an effective combination of 'moderate' mitigation measures.*
- *+0.5 —At least 20% of all representative habitats are protected from fishing with the gear type and for trawl fisheries, expansion of the fishery's footprint is prohibited. Or gear modification measures or other measures are in place to limit fishing effort, fishing intensity, and spatial footprint of damage caused from fishing that are expected to be effective.*
- *0 —No effective measures are in place to limit gear impacts on habitats or not applicable because gear used is benign and received a score of 5 in factor 4.1*

Factor 4.3 - Ecosystem-Based Fisheries Management

Goal: All stocks are maintained at levels that allow them to fulfill their ecological role and to maintain a functioning ecosystem and food web. Fishing activities should not seriously reduce ecosystem services provided by any retained species or result in harmful changes such as trophic cascades, phase shifts or reduction of genetic diversity. Even non-native species should be considered with respect to ecosystem impacts. If a fishery is managed in order to eradicate a non-native, the potential impacts of that strategy on native species in the ecosystem should be considered and rated below.

- *5 — Policies that have been shown to be effective are in place to protect species' ecological roles and ecosystem functioning (e.g. catch limits that ensure species' abundance is maintained at sufficient levels to provide food to predators) and effective spatial management is used to protect spawning and foraging areas, and prevent localized depletion. Or it has been scientifically demonstrated that fishing practices do not have negative ecological effects.*
- *4 — Policies are in place to protect species' ecological roles and ecosystem functioning but have not proven to be effective and at least some spatial management is used.*
- *3 — Policies are not in place to protect species' ecological roles and ecosystem functioning but detrimental food web impacts are not likely or policies in place may not be sufficient to protect species' ecological roles and ecosystem functioning.*
- *2 — Policies are not in place to protect species' ecological roles and ecosystem functioning and the likelihood of detrimental food impacts are likely (e.g. trophic cascades, alternate stable states, etc.), but conclusive scientific evidence is not available for this fishery.*
- *1 — Scientifically demonstrated trophic cascades, alternate stable states or other detrimental food web impact are resulting from this fishery.*

Factor 4.1 - Physical Impact of Fishing Gear on the Habitat/Substrate

MEXICO/ GULF OF MEXICO

Set Longlines | Mexico

3

The wide continental shelf region called Campeche Bank contains a variety of habitats including rocky areas (DOF 2014). Several authors have pointed out that red grouper moves through its range depending on the season (Padron Valdes and 1980)(Arreguín-Sánchez et al. 1997)(Hernandez and Seiko 2003) and its life history stage (Albañez-Lucero and Arreguin-Sanchez 2009). In 2009, Albañez-Lucero and Arreguin-Sanchez found that red grouper juveniles live closer to the coast in shallow waters and are normally associated with coral habitats, while pre-adults are associated with hard bottom substrates in deeper waters. Adults were found in deeper waters on sandy substrates (Albañez-Lucero and Arreguin-Sanchez 2009) (Figure 10). On the other hand, catch composition for the industrial fleet has shown that this fleet primarily captures adults (Coronado-Salas 2011)(SAGARPA-INAPESCA 2014) and its work area is within the overlapping area identified by the authors in Figure 10 (Coronado-Salas 2011)(DOF 2014) where adults are normally found (Albañez-Lucero and Arreguin-Sanchez 2009). This subfactor receives a score of 3 out of 5 because adult groupers in the Campeche Bank are associated with sandy bottoms and there is evidence that the fishery primarily occurs over sandy bottom substrates (Albañez-Lucero and Arreguin-Sanchez 2009).

Justification:

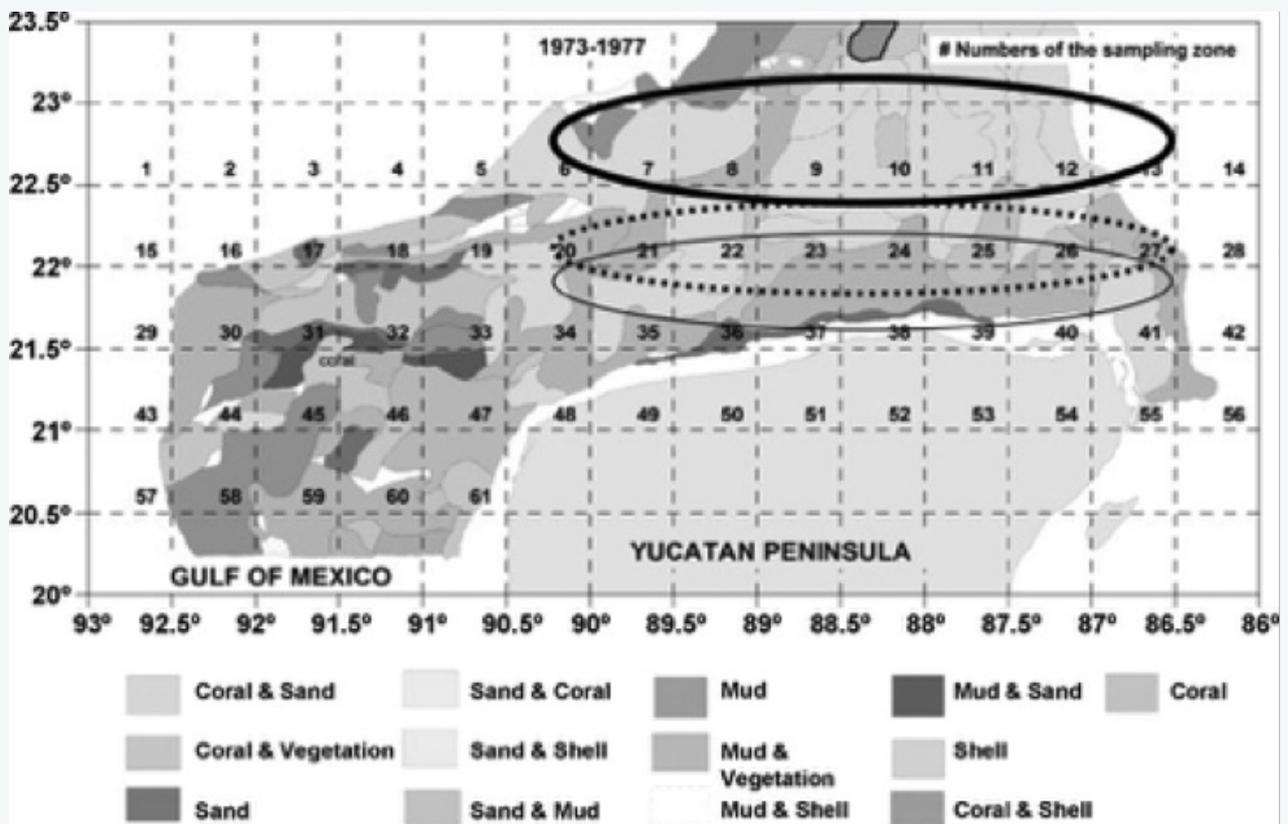


Figure 10 Campeche Bank continental shelf bottom types. Ellipses indicate gross spatial distribution of red grouper. The thin line encloses juvenile distribution, the dashed line pre-adult, and the bold line adult (Image from Garcia 1980 in Alvarez-Lucero and Arreguin-Sanchez 2009).

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

MEXICO/ GULF OF MEXICO

Set Longlines | Mexico

0

The fishery's new management plan includes some gear restrictions in the Campeche Bank that will mitigate gear impacts (DOF 2014). One restriction includes the reduction of fishing effort (by reducing the actual number of vessels in the water) (CONAPESCA-SAGARPA 2014) and the creation of refuge areas (DOF 2014). However, no measures are currently in place to limit gear impacts on the habitat, so no mitigation credit is awarded.

Factor 4.3 - Ecosystem-Based Fisheries Management

MEXICO/ GULF OF MEXICO

Set Longlines | Mexico

High Concern

The Campeche Bank has been studied in detail for several reasons (e.g., fishing activities, oil exploration, ecology of the region) (Tunell and Chapman 1999)(Zarco et al. 2013). Nonetheless, additional research is needed to understand the role of the targeted and associated species in the ecosystem, and the impact of their harvest on the food web. The grouper fishery maintains one of the Campeche Bank's main fisheries, which has a close relationship with the amount of biomass available in the natural environment, and has a direct impact on the abundance of other species in lower trophic levels (DOF 2014). In 2011, a study on the Campeche Bank found that, if there is a decrease in red grouper biomass, there is an increase in biomass of other predators (Arreguín-Sanchez and Arcos-Huitrón 2011). Plans to increase the level of protection for red grouper and research programs to identify critical habitats and designate no-fishing areas have been proposed, but are not yet in place (DOF 2014). Because authors found that there is a likelihood of ecosystem deterioration (if management does not intervene and spatial management is not in place) (Arreguin-Sanchez & Arcos-Huitron 2011), this factor is rated as "high" concern.

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Appendix A: Extra By Catch Species

SEA TURTLE (UNSPECIFIED)

Factor 2.1 - Abundance

MEXICO/ GULF OF MEXICO

Set Longlines | Mexico

High Concern

In the Gulf of Mexico, five sea turtle species are found: green, loggerhead, hawksbill, leatherback, and Kemp's ridley (SEMARNAT 2010). No current abundance data exist for these species in the region. In Mexico, all sea turtles are listed as "Endangered" by the NOM-059- SEMARNAT (DOF 2010) as well as the IUCN (IUCN 2016). In addition, these species are considered highly vulnerable according to Seafood Watch. For these reasons, abundance is rated as "high" concern.

Factor 2.2 - Fishing Mortality

MEXICO/ GULF OF MEXICO

Set Longlines | Mexico

Moderate Concern

There is no information about mortality or gear interaction with sea turtles in the Campeche Bank region. But a similar fishery in the U.S. reports that, in 2009, the number of loggerhead turtles taken in the Gulf of Mexico bottom longline fishery exceeded the number authorized by the National Marine Fisheries Service's (NMFS) Biological Opinion (BO) (NMFS 2009). Considering this information as a reference, and based on the Unknown Bycatch Matrices of the SFW criteria, this factor is rated as "moderate" concern for all the sea turtle species identified as potential bycatch or that potentially interact with bottom longline gear.

Factor 2.3 - Discard Rate

MEXICO/ GULF OF MEXICO

Set Longlines | Mexico

< 100%

There are not enough data to estimate the discards + bait/landings ratio for the red and black grouper fishery in the Yucatan. Although the Mexican longline fishery uses the same gear type and targets similar species as the U.S. Gulf of Mexico longline reef fish fishery (which has a discard to landings ratio of 111% (Scott-Denton and Williams 2013)), most if not all the catch in the Mexican fishery is retained and brought to port. For this reason, the factor is rated at < 100%.

WARSAW GROUPER

Factor 2.1 - Abundance

MEXICO/ GULF OF MEXICO

Set Longlines | Mexico

High Concern

Warsaw grouper is caught incidentally in deep waters by the U.S. Snapper-Grouper fishery, and the South Atlantic Fisheries Management Council (SAFMC) considered the species as overfished and undergoing overfishing (NMFS 2003). In addition, the IUCN lists the species as "Critically Endangered" in the Gulf of Mexico (Ng Wai Chuen and Huntsman 2006) resulting in a "high" concern score.

Factor 2.2 - Fishing Mortality

MEXICO/ GULF OF MEXICO

Set Longlines | Mexico

Moderate Concern

Fishing mortality data are not available for Warsaw grouper in Mexico (DOF 2012)(DOF 2014)(SAGARPA-INAPESCA 2014). Similar to mutton snapper, managers recognize Warsaw grouper as an associated species in the grouper fishery (DOF 2012). This factor is rated as "moderate" concern because fishing mortality from this and other fisheries is unknown.

Factor 2.3 - Discard Rate

MEXICO/ GULF OF MEXICO

Set Longlines | Mexico

< 100%

There are not enough data to estimate the discards + bait/landings ratio for the red and black grouper fishery in the Yucatan. Although the Mexican longline fishery uses the same gear type and targets similar species as the U.S. Gulf of Mexico longline reef fish fishery (which has a discard to landings ratio of 111% (Scott-Denton and Williams 2013)), most if not all the catch in the Mexican fishery is retained and brought to port. For this reason, the factor is rated at < 100%.

GAG

Factor 2.1 - Abundance

MEXICO/ GULF OF MEXICO

Set Longlines | Mexico

High Concern

A formal stock assessment and abundance data are not available for gag grouper in the region, but the IUCN lists the species as "Least Concern" (Bertoncini et al. 2008). For these reasons, a Productivity-Susceptibility Analysis (PSA) is used. The PSA score = 3.455, so the species is deemed to have high vulnerability. Detailed scoring of each attribute is shown below.

Gag grouper is highly vulnerable (according to the PSA analysis) and there is no quantitative stock assessment, so abundance is considered a "high" concern.

Justification:

Productivity-Susceptibility Analysis:

Scoring Guidelines

1.) Productivity score (P) = average of the productivity attribute scores (p1, p2, p3, p4 (finfish only), p5 (finfish only), p6, p7, and p8 (invertebrates only))

2.) Susceptibility score (S) = product of the susceptibility attribute scores (s1, s2, s3, s4), rescaled

as follows: $\frac{S}{40} = [(\frac{S}{40} \cdot 1 * \frac{S}{40} \cdot 2 * \frac{S}{40} \cdot 3 * \frac{S}{40} \cdot 4) - 1/40] + 1$.

3.) Vulnerability score (V) = the Euclidean distance of P and S using the following formula: $\frac{V}{40} =$

$\sqrt{(P^2 + S^2)}$

Productivity Attribute	Relevant Information	Score (1 = low risk, 2 = medium risk, 3 = high risk)
Average age at maturity	3.7 years (SEDAR 2006)	1
Average maximum age	22 years (Jarzhombek 2007)	2
Fecundity	170,000 to 1,470,000 (Martinez et al. 2000)	1
Average maximum size (fish only)	145 cm (Craig et al. 2011)	2
Average size at maturity (fish only)	72 cm (Martinez et al. 2000)	2
Reproductive strategy	Broadcast spawner (Jue et al. 2015)	1
Trophic level	3.7 (Rainer et al. 2002)	3
Density dependence (invertebrates only)	-	-

Susceptibility Attribute	Relevant Information	Score (1 = low risk, 2 = medium risk, 3 = high risk)
Areal overlap (Considers all fisheries)	Gag ranges from North Carolina to the Yucatan Peninsula (Bertoncini et al. 2008), which overlaps with the fishing area of the Mexican fleet.	3

Vertical overlap (Considers all fisheries)	Gag is a reef-associated species, found on rocky bottoms. Female juveniles were reported to be caught offshore at depths of 33 to 167 m (Brule et al. 2003).	3
Selectivity of fishery (Specific to fishery under assessment)	Gag is known to form spawning aggregations, and it is highly vulnerable to fish pressure (Jue et al. 2015)	3
Post-capture mortality (Specific to fishery under assessment)	Unknown—Default Value	3

Factor 2.2 - Fishing Mortality

MEXICO/ GULF OF MEXICO

Set Longlines | Mexico

Moderate Concern

Fishing mortality data are not available for gag grouper in the Campeche Bank, Mexico (DOF 2012)(DOF 2014) (SAGARPA-INAPESCA 2014). Gag is not considered a primary target in the grouper fishery; however, it is important to note that, although reported landings of gag grouper are low, actual landings may be higher because black grouper and gag could be confused (SEDAR 2009). Because fishing mortality from this and other fisheries is unknown, this factor is scored as “moderate” concern.

Factor 2.3 - Discard Rate

MEXICO/ GULF OF MEXICO

Set Longlines | Mexico

< 100%

There are not enough data to estimate the discards + bait/landings ratio for the red and black grouper fishery in the Yucatan. Although the Mexican longline fishery uses the same gear type and targets similar species as the U.S. Gulf of Mexico longline reef fish fishery (which has a discard to landings ratio of 111% (Scott-Denton and Williams 2013)), most if not all the catch in the Mexican fishery is retained and brought to port. For this reason, the factor is rated at < 100%.

MUTTON SNAPPER

Factor 2.1 - Abundance

MEXICO/ GULF OF MEXICO

Set Longlines | Mexico

High Concern

A formal stock assessment and abundance data are not available for mutton snapper. For this reason, a Productivity-Susceptibility Analysis (PSA) is used for the species. The PSA score = 3.528, so the species is deemed to have high vulnerability. Detailed scoring of each attribute is shown below.

Mutton snapper is highly vulnerable (according to the PSA analysis), there is no formal stock assessment, and it is recognized as "Near Threatened" in the region by the IUCN (Lindeman et al. 2016), so abundance is scored as "high" concern.

Justification:

Productivity-Susceptibility Analysis:

Scoring Guidelines

1.) Productivity score (P) = average of the productivity attribute scores (p1, p2, p3, p4 (finfish only), p5 (finfish only), p6, p7, and p8 (invertebrates only))

2.) Susceptibility score (S) = product of the susceptibility attribute scores (s1, s2, s3, s4), rescaled

as follows: $SSSS = [((SSSS1 * SSSSS2 * SSSSS3 * SSSSS4) - 1/40) + 1]$.

3.) Vulnerability score (V) = the Euclidean distance of P and S using the following formula: $SSSS =$

$\sqrt{(P^2 + S)^2}$

Productivity Attribute	Relevant Information	Score (1 = low risk, 2 = medium risk, 3 = high risk)
Average age at maturity	5 years (Claro 1981)	2
Average maximum age	29 years (Burton 2002)	3
Fecundity	186,500 to 603,000 (Watanabe 2001)	1
Average maximum size (fish only)	88 cm (Burton 2002)	2
Average size at maturity (fish only)	52 cm (Claro 1981)	2
Reproductive strategy	Broadcast spawner	1
Trophic level	3.9 (Froese and Pauly 2016)	3
Density dependence (invertebrates only)	-	-

Susceptibility Attribute	Relevant Information	Score (1 = low risk, 2 = medium risk, 3 = high risk)
Areal overlap (Considers all fisheries)	Mutton snapper is fished throughout its range along the Campeche Bank (DOF 2012)	3
Vertical overlap (Considers all fisheries)	There is a high overlap of target species and retained species with the gear (DOF 2014)	3
Selectivity of fishery (Specific to fishery under assessment)	This species is known to form spawning aggregations and is vulnerable to fishing (Claro and Lindeman 2003)	3
Post-capture mortality (Specific to fishery under assessment)	According to experts, fishers retained most of the catch. But there are no official data, so the default value is used.	3

Factor 2.2 - Fishing Mortality

MEXICO/ GULF OF MEXICO

Set Longlines | Mexico

Moderate Concern

Fishing mortality data are not available for mutton snapper (DOF 2012)(DOF 2014)(SAGARPA-INAPESCA 2014). This species is considered an associated species of the grouper fishery in the Gulf of Mexico (CNP 2012). Mexican managers do not consider mutton snapper to be a frequent component of the grouper fishery's catch (CONAPESCA 2014). Because fishing mortality from this and other fisheries is unknown, this factor is rated "moderate" concern.

Factor 2.3 - Discard Rate

MEXICO/ GULF OF MEXICO

Set Longlines | Mexico

< 100%

There are not enough data to estimate the discards + bait/landings ratio for the red and black grouper fishery in the Yucatan. Although the Mexican longline fishery uses the same gear type and targets similar species as the U.S. Gulf of Mexico longline reef fish fishery (which has a discard to landings ratio of 111% (Scott-Denton and Williams 2013)), most if not all the catch in the Mexican fishery is retained and brought to port. For this reason, the factor is rated at < 100%.

Appendix B: Updates to Grouper Report

This report was reviewed for any significant stock status and management updates to the fishery on December 10, 2019. None were found that would indicate the final ratings are no longer accurate.