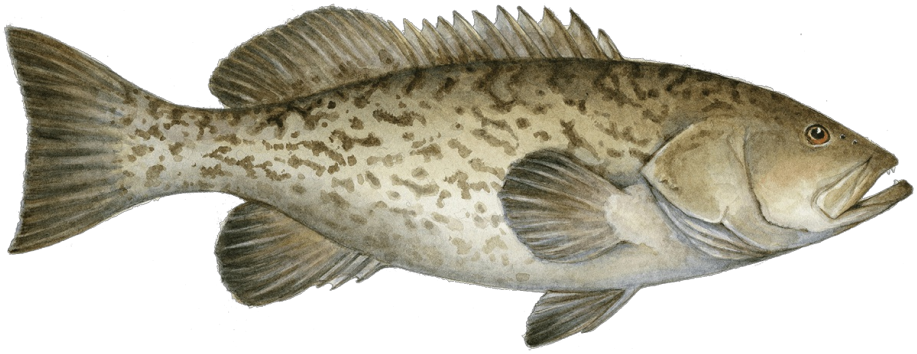
Monterey Bay Aquarium
Seafood Watch

Environmental sustainability assessment of wild-caught red grouper (*Ephinepelus morio*) and black grouper (*Mycteroperca bonaci*) from Mexico caught using set longlines



Species:	Red grouper (*Ephinepelus morio*) and black grouper (*Mycteroperca bonaci*)
Location:	Mexico/Gulf of Mexico
Gear:	Set longlines
Type:	Wild Caught
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Assessed using Seafood Watch Fisheries Standard v3

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About the Monterey Bay Aquarium Seafood Watch Program

The mission of the Monterey Bay Aquarium is to inspire conservation of the ocean and enable a future where the ocean flourishes and people thrive in a just and equitable world. To do this, the Aquarium is focused on creating extraordinary experiences that inspire awe and wonder, championing science-based solutions, and connecting people across the planet to protect and restore the ocean. We know that healthy ocean ecosystems are critical to enabling life on Earth to exist, and that our very survival depends on them. As such, our conservation objectives are to mobilize climate action, improve the sustainability of global fisheries and aquaculture, reduce sources of plastic pollution, and restore and protect ocean wildlife and ecosystems.

The aquarium is focused on improving the sustainability of fisheries and aquaculture given the role seafood plays in providing essential nutrition for 3 billion people globally, and in supporting hundreds of millions of livelihoods. Approximately 180 million metric tons of wild and farmed seafood is harvested each year (excluding seaweeds). Unfortunately, not all current harvest practices are sustainable and poorly managed fisheries and aquaculture pose the greatest immediate threat to the health of the ocean and the economic survival and food security of billions of people.

The Seafood Watch program was started 25 years ago as a small exhibit in the Monterey Bay Aquarium highlighting better fishing practices and grew into one of the leading sources of information on seafood sustainability, harnessing the power of consumer choice to mobilize change. The program's comprehensive open-source information and public outreach raises awareness about global sustainability issues, identifies areas for improvement, recognizes and rewards best practices and empowers individuals and businesses to make informed decisions when purchasing seafood.

We define sustainable seafood as seafood from sources, whether fished or farmed, that can maintain or increase production without jeopardizing the structure and function of affected ecosystems, minimize harmful environmental impacts, assure good and fair working conditions, and support livelihoods and economic benefits throughout the entire supply chain. As one aspect of this vision, Seafood Watch has developed trusted, rigorous standards for assessing the environmental impacts of fishing and aquaculture practices worldwide. Built on a solid foundation of science and collaboration, our standards reflect our guiding principles for defining environmental sustainability in seafood.

Seafood Watch Ratings

The Seafood Watch Standard for Fisheries is used to produce assessments for wild-capture fisheries resulting in a Seafood Watch rating of green, yellow, or red. Seafood Watch uses the assessment criteria to determine a final numerical score as well as numerical subscores and colors for each criterion. These scores are translated to a final Seafood Watch color rating according to the methodology described in the table below. The table also describes how Seafood Watch defines each of these categories. The narrative descriptions of each Seafood Watch rating, and the guiding principles listed below, compose the framework on which the criteria are based.

Green	Final Score >3.2, and either criterion 1 or criterion 3 (or both) is green, and no red criteria, and no critical scores	Wild-caught and farm-raised seafood rated green are environmentally sustainable, well managed and caught or farmed in ways that cause little or no harm to habitats or other wildlife. These operations align with all of our guiding principles.
Yellow	Final score >2.2, and no more than one red criterion, and no critical scores, and does not meet the criteria for green (above)	Wild-caught and farm-raised seafood rated yellow cannot be considered fully environmentally sustainable at this time. They align with most of our guiding principles, but there is either one conservation concern needing substantial improvement, or there is significant uncertainty associated with the impacts of the fishery or aquaculture operations.
Red	Final Score ≤2.2, or two or more red criteria, or one or more critical scores.	Wild-caught and farm-raised seafood rated red are caught or farmed in ways that have a high risk of causing significant harm to the environment. They do not align with our guiding principles and are considered environmentally unsustainable due to either a critical conservation concern, or multiple areas where improvement is needed.

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Guiding Principles

Monterey Bay Aquarium defines sustainable seafood as seafood from sources, whether fished or farmed, that can maintain or increase production without jeopardizing the structure and function of affected ecosystems, minimize harmful environmental impacts, assure good and fair working conditions, and support livelihoods and economic benefits throughout the entire supply chain.

As one aspect of this vision, Seafood Watch has developed trusted, rigorous standards for assessing the environmental impacts of fishing and aquaculture practices worldwide. Environmentally sustainable wild capture fisheries:

1. **Follow the principles of ecosystem-based fisheries management**

   The fishery is managed to ensure the integrity of the entire ecosystem, rather than solely focusing on maintenance of single species stock productivity. To the extent allowed by the current state of the science, ecological interactions affected by the fishery are understood and protected, and the structure and function of the ecosystem is maintained.

2. **Ensure all affected stocks[1] are healthy and abundant**

   Abundance, size, sex, age and genetic structure of the main species affected by the fishery (not limited to target species) is maintained at levels that do not impair recruitment or long-term productivity of the stocks or fulfillment of their role in the ecosystem and food web.

   Abundance of the main species affected by the fishery should be at, above, or fluctuating around levels that allow for the long-term production of maximum sustainable yield. Higher abundances are necessary in the case of forage species, in order to allow the species to fulfill its ecological role.

3. **Fish all affected stocks at sustainable levels**

   Fishing mortality for the main species affected by the fishery should be appropriate given current abundance and inherent resilience to fishing while accounting for scientific uncertainty, management uncertainty, and non-fishery impacts such as habitat degradation.

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[1]"Affected" stocks include all stocks affected by the fishery, no matter whether target or bycatch, or whether they are ultimately retained or discarded.

The cumulative fishing mortality experienced by affected species must be at or below the level that produces maximum sustainable yield for single-species fisheries on typical species that are at target levels.

Fishing mortality may need to be lower than the level that produces maximum sustainable yield in certain cases such as forage species, multispecies fisheries, highly vulnerable species, or fisheries with high uncertainty.

For species that are depleted below target levels, fishing mortality must be at or below a level that allows the species to recover to its target abundance.

4. **Minimize bycatch**

   Seafood Watch defines bycatch as all fisheries-related mortality or injury other than the retained catch. Examples include discards, endangered or threatened species catch, pre-catch mortality and ghost fishing. All discards, including those released alive, are considered bycatch unless there is valid scientific evidence of high post-release survival and there is no documented evidence of negative impacts at the population level.

   The fishery optimizes the utilization of marine and freshwater resources by minimizing post-harvest loss and by efficiently using marine and freshwater resources as bait.

5. **Have no more than a negligible impact on any threatened, endangered or protected species**

   The fishery avoids catch of any threatened, endangered or protected (ETP) species. If any ETP species are inadvertently caught, the fishery ensures and can demonstrate that it has no more than a negligible impact on these populations.

6. **Are managed to sustain the long-term productivity of all affected species**

   Management should be appropriate for the inherent resilience of affected marine and freshwater life and should incorporate data sufficient to assess the affected species and manage fishing mortality to ensure little risk of depletion. Measures should be implemented and enforced to ensure that fishery mortality does not threaten the long term productivity or ecological role of any species in the future.

   The management strategy has a high chance of preventing declines in stock productivity by taking into account the level of uncertainty, other impacts on the stock, and the potential for increased pressure in the future.

   The management strategy effectively prevents negative population impacts on bycatch species, particularly species of concern.

7. **Avoid negative impacts on the structure, function or associated biota of aquatic habitats where fishing occurs**

The fishery does not adversely affect the physical structure of the seafloor or associated biological communities.

If high-impact gears (e.g. trawls, dredges) are used, vulnerable seafloor habitats (e.g. corals, seamounts) are not fished, and potential damage to the seafloor is mitigated through substantial spatial protection, gear modifications and/or other highly effective methods.

8. **Maintain the trophic role of all aquatic life**

   All stocks are maintained at levels that allow them to fulfill their ecological role and to maintain a functioning ecosystem and food web, as informed by the best available science.

9. **Do not result in harmful ecological changes such as reduction of dependent predator populations, trophic cascades, or phase shifts**

   Fishing activities must not result in harmful changes such as depletion of dependent predators, trophic cascades, or phase shifts.

   This may require fishing certain species (e.g., forage species) well below maximum sustainable yield and maintaining populations of these species well above the biomass that produces maximum sustainable yield.

10. **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**

    Any enhancement activities are conducted at levels that do not negatively affect wild stocks by reducing diversity, abundance or genetic integrity.

    Management of fisheries targeting enhanced stocks ensures that there are no negative impacts on the wild stocks, in line with the guiding principles described above, as a result of the fisheries.

    Enhancement activities do not negatively affect the ecosystem through density dependent competition or any other means, as informed by the best available science.

Final Ratings

Ratings Details	C 1 Target Species	C 2 Other Species	C 3 Management	C 4 Habitat	Rating
Black grouper Mexico - Gulf of Mexico - Set longlines - 2,918 mt	1.000	1.000	1.000	2.646	Red (1.275)
Red grouper Mexico - Gulf of Mexico - Set longlines - 5,462 mt	1.000	1.000	1.000	2.646	Red (1.275)

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 Yucatán Peninsula) in the Gulf of Mexico (GOM). This fishery exports the majority of its production to the United States market. Many artisanal vessels target both species and largely supply 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 declined 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" and "Vulnerable" by the International Union for the Conservation of Nature (IUCN) (Carpenter et al. 2014) (Lindeman et al. 2015). The most recent stock assessment for red and black groupers was published in the fishery profile within the National Fisheries Chart, which concluded that red grouper is overfished and has been experiencing overfishing for several years (DOF 2024), while black grouper biomass was also below B_{MSY} and showing signs of overfishing (DOF 2024).

Regarding catch composition, red and black grouper are the main species (in terms of volume and value) in this multispecies fishery, but the fleet also targets several other species using the same gear and fishing in the same zones. These species are not considered bycatch but are counted as associated species by Mexican legislation (DOF 2014). 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 and those not included as associated species in the fishery. The species chosen 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.).

The 2014 fishery management plan included stricter management regulations and research activities. Some of these regulations include more frequent stock assessments and updates. Since this was launched, only one stock assessment has been publicly shared (in the fishery's 2022 profile). Overall, the target species' statuses have been showing signs of being overfished, with overfishing occurring, which is a sign that management needs to be more responsive to changes in stock biomass.

For these reasons, the overall Seafood Watch recommendation for red and black groupers from the industrial fleet in the Campeche Bank is red, because of the low stock status of many species in this multispecies fishery and the challenges with management.

Introduction

Scope of the analysis and ensuing rating

This report addresses red grouper (*Epinephelus morio*) and black grouper (*Mycteroperca bonaci*) targeted by the Mexican bottom longline fishery in the Campeche Bank in the Gulf of Mexico. 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 among the most important fisheries in terms of value for several communities in Mexico {DOF 2013}. In the Yucatán 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). Red grouper's lifespan ranges from 13 to 33 years, while black grouper's ranges from 18 to 30 years. The age at which 50% of individuals were mature was 9.3 years for *E. morio* and 13.6 years for *M. bonaci* (Brulé et al. 1999). Juveniles are generally found between 10 and 30 m deep, and adults are primarily found in deeper regions to 130 m (Burgos Rosas et al. 2003) (López-Rocha and Arreguín-Sanchez 2008; SAGARPA-INAPESCA 2014). Fishing vessels target the species at 20 *brazas* (33 meters or deeper; 1 *braza* = approximately 1.7 m) (Renán et al. 2022; Hernandez and Seijo 2003) (Monroy et al. 2000; SAGARPA-INAPESCA 2014).

Black grouper is also a hermaphroditic species (Ferrerira-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 (Bullock and Smith 1991). For black grouper, researchers have reported spawning aggregations in the Caribbean (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 (Brule et al. 2003).

Black grouper can be found from inshore to about 200 m deep {Craig et al. 2011}. Adults are generally found around hard bottom areas {Tupper and Rudd 2002}, such as coral reefs, ledges, caves, crevices, 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 {Randall 1996}, 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 (2010), the fleet that targets both species works in 30 to 100 m areas (Monroy 2010). These life-history characteristics make both species vulnerable to fishing and overexploitation (Huntsman and Schaal 1994).

In Mexico, SADER (the Secretariat of Agriculture and Rural Development), formerly known as

SAGARPA (Secretariat of Agriculture, Livestock, Rural Development, Fisheries, and Food), lost direct attribution and budget over fisheries and aquaculture. Since 2018, CONAPESCA (the National Aquaculture and Fishing Commission) has been responsible for developing and executing management regulations. Its technical branch, the Mexican Institute of Research in Sustainable Fisheries and Aquaculture (IMIPAS), supports it. These bodies are in charge of creating, implementing, and enforcing 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 Yucatán 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

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

Country	Production ('000 t)	% farmed
Indonesia	489.9	4%
China	280.5	65%
Malaysia	53.1	41%
Mexico	47.1	0%
India	36.8	0%
Philippines	36.2	1%
Brazil	23.2	0%
Taiwan	22.4	97%
Thailand	20.4	8%
Nigeria	15.2	0%
United Arab Emirates	14.8	1%
Iran	13.5	0%
Pakistan	10.8	0%
Oman	10.1	0%
Other	98.6	3%

Figure 1: Top producer countries of groupers and snappers (SFP 2022).

The Campeche Bank, a significant grouper production region in Mexico, is situated off the Yucatán Peninsula. This region sees active participation from fishers in Yucatán, Campeche, and Quintana Roo (DOF 2022). The Gulf of Mexico, where this region is located, is home to various species, but the red and black grouper stand out in volume and value (DOF

2012). Yucatán and Quintana Roo, the largest producers, contribute approximately 75.8% and 7.7% of the total production, respectively (DOF 2022).

The fishery started in the late 1950s with increased landings yearly, reaching a record high in 1972 at 19,886 metric tonnes (MT) landed (Figure 2). Since then, landings have been decreasing. Between 2018 and 2020, the average landings were at a record low of 5,350 MT (DOF 2022).

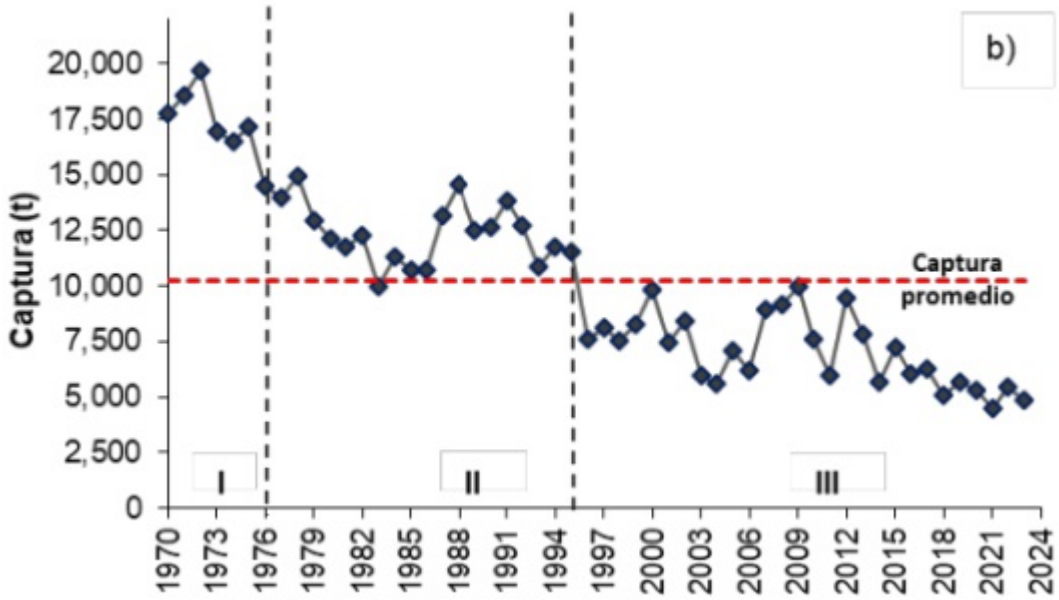

Figure 2: Red grouper landings (MT) in the Yucatán Peninsula between 1970 and 2024 (DOF 2024).

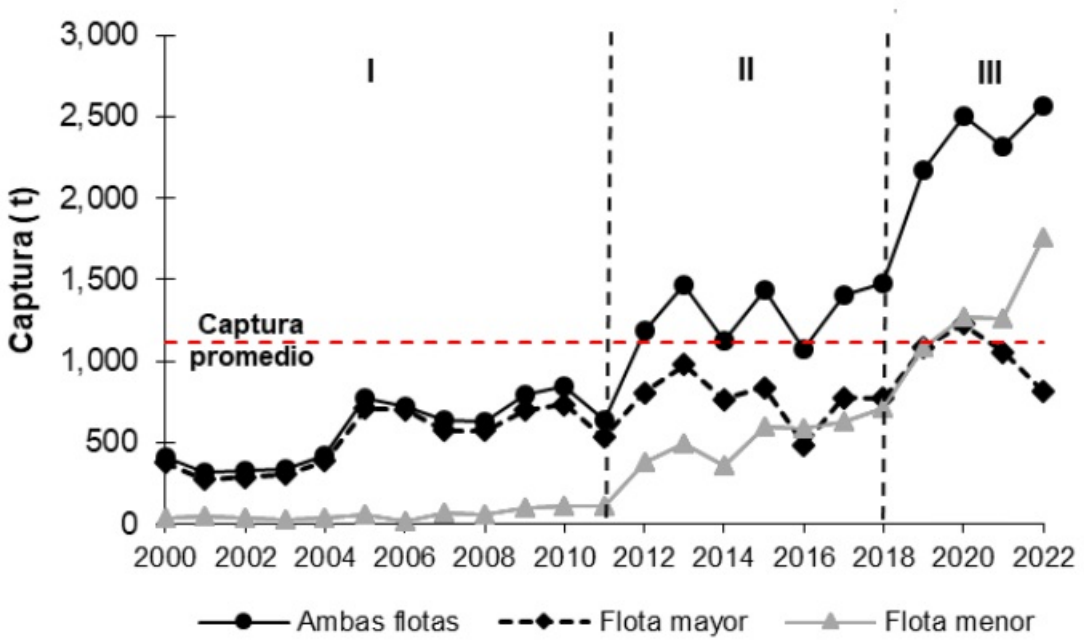

Figure 3: Black grouper landings (MT) in the Yucatán Peninsula between 2000 and 2022 (DOF 2024).

These species are targeted by two fleets: an artisanal fleet that uses mostly longlines and hook-and-line and that 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 the landings per fleet from 1970 to 2020 (DOF 2022).

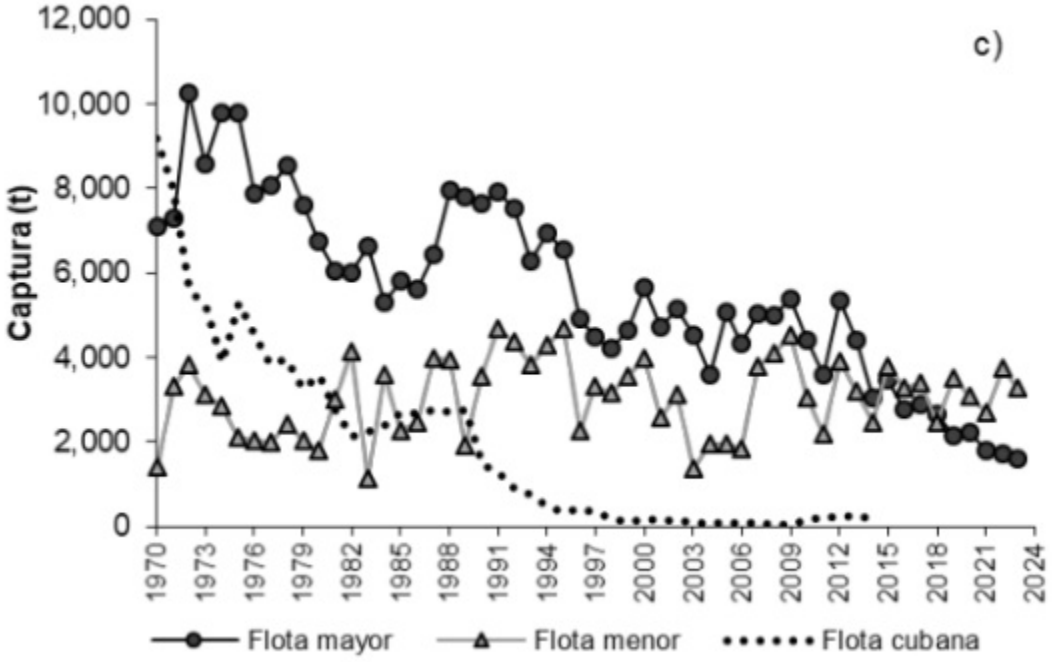

Figure 4: Grouper landings (MT) per fleet in the Gulf of Mexico between 1970 and 2023 (DOF 2024).

Importance to the US/North American market

The United States is one of the world's largest importers of groupers. In 2023, it imported more than 6,200 MT of grouper. Mexico, Brazil, Panama, and Venezuela were the main contributors, at ≈81% of the total grouper imported into the United States in 2023 (NMFS 2024). Mexican grouper from the GOM has been in the U.S. market for years {CONAPESCA 2014}. Exports are carried out mainly by Yucatán producers, and according to data from the National Oceanic and Atmospheric Administration (NOAA), the average annual export volume from Mexico between 2020 and 2023 was estimated at 2,935 MT (fresh and frozen combined), with an average annual economic value of approximately USD30 million (Figure 5). Although the exact magnitude of the contribution from Yucatán and Quintana Roo is unknown, there is evidence that much of this volume comprises red and black grouper from the Campeche Bank region (DOF 2022).

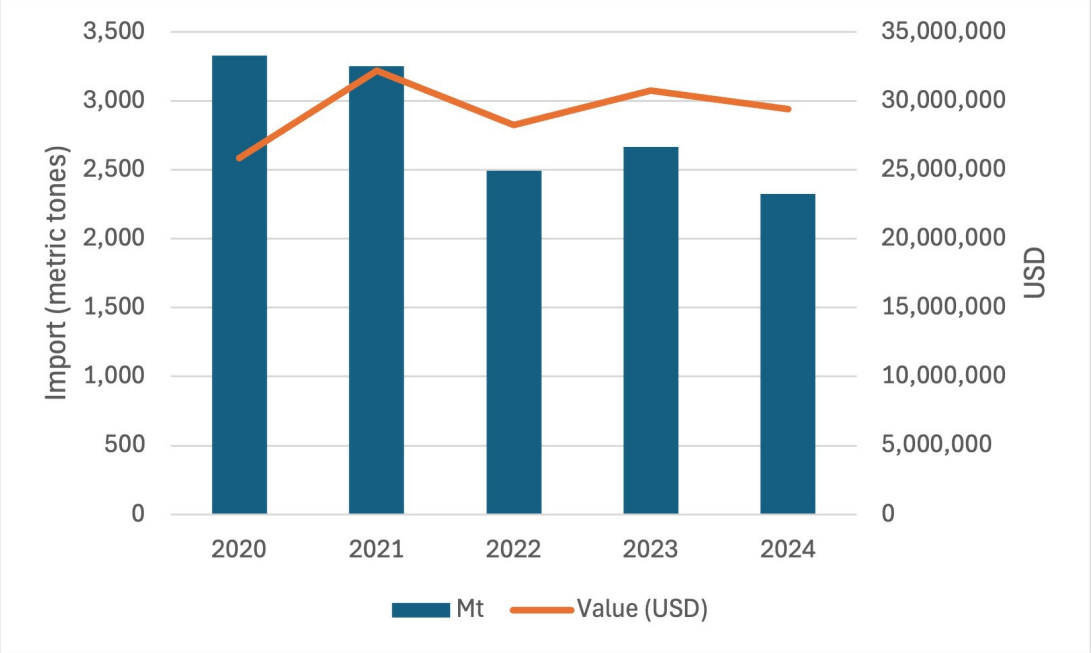

Figure 5: Volume and value of Mexican grouper imported into the U.S. from 2020 to 2024 (NOAA Fisheries 2024).

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* or *mero americano* and black grouper as *Mero negro* or *negrillo*.

Primary product forms

Grouper is mostly imported to the U.S. market as fresh fillets (NOAA Fisheries 2024). In the domestic market, it is commercialized as fresh fillets, frozen, or sealed vacuum-packed

(Cepeda-González and Salas 2021).

Production volume notes

Information on landings was obtained from the open source database from CONAPESCA at https://datos.gob.mx/busca/dataset/produccion-pesquera.

Summary

The multispecies grouper fishery in the Gulf of Mexico targets red and black groupers, primarily with set longlines. Both species in the fishery are rated red, driven mainly by concerns about the status of the stocks, the levels of fishing mortality on red grouper, the impacts on bycatch species, and the lack of adequate management strategy and implementation, where minimal regulations (e.g., official minimum size or off-season) are in place for the fishery. It is likely to have negative impacts on both target and retained species.

Eco-Certification information

A portion of the grouper fishery is engaged in a Fishery Improvement Project (FIP). Engagement in an FIP does not affect the Seafood Watch score per se because we base our assessments on the current situation. But data and information generated by the FIP can be used in our assessments.

Assessments

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 - 2,918 mt	1.000 High Concern	1.000 High Concern	**Red (1.000)**

Red grouper			
Region / Method	**Abundance**	**Fishing Mortality**	**Score**
Mexico - Gulf of Mexico - Set longlines - 5,462 mt	1.000 High Concern	1.000 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 *(Mycteroperca bonaci)*

1.1 Abundance

Gulf of Mexico - Atlantic, Western Central - Set longlines

High Concern

A recent formal stock assessment for black grouper, which managers released in the most recent update of the National Fisheries Chart, showed that $B_{2021} < B_{MSY}$ (see Kobe plot in Figure 6) (DOF 2024). Managers stated that, within the Campeche Bank, the black grouper stock "is deteriorated based on an increase in fishing pressure, with biomass starting to show values under the MSY" (DOF 2024). Because managers consider the stock to be deteriorated (DOF 2024), abundance is scored a "high concern" (per line 1 in table 1.1.1 of the Seafood Watch Standard).

Supplementary Information

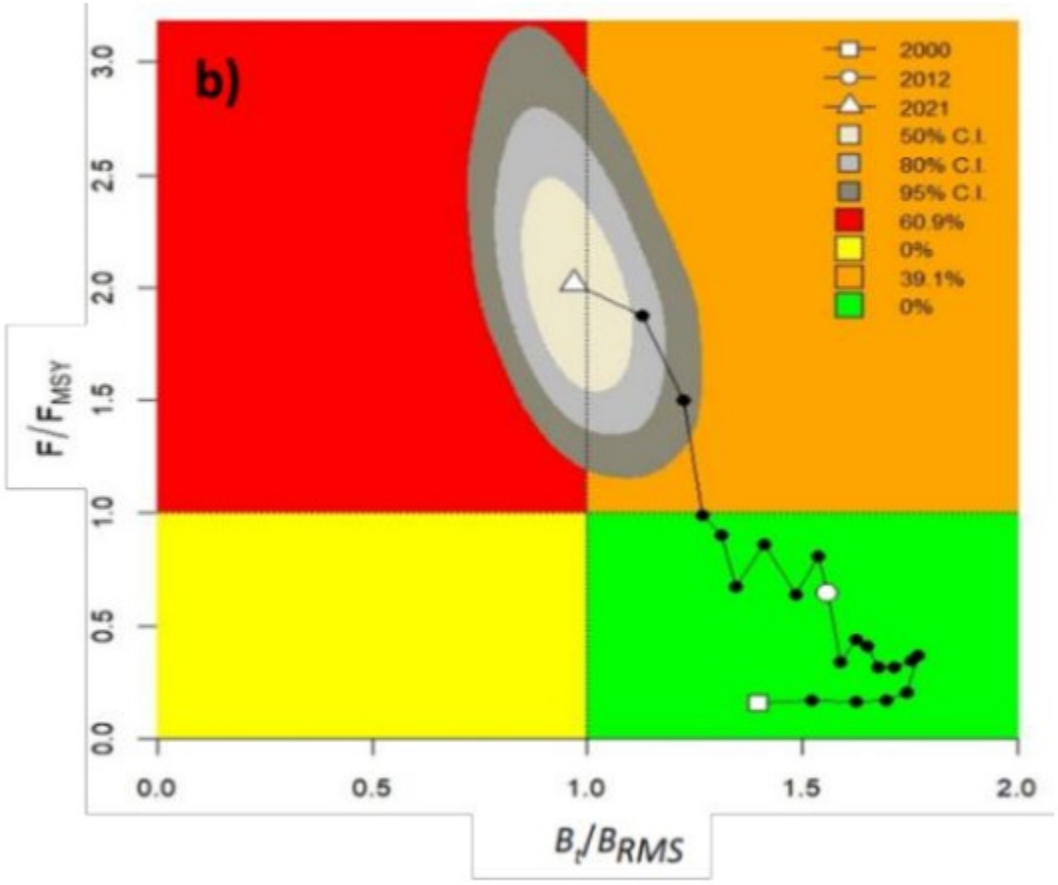

Figure 6: Kobe plot of black grouper stock status, released by managers in 2024 (DOF 2024).

1.2 Fishing Mortality

Gulf of Mexico - Atlantic, Western Central - Set longlines

High Concern

Fishing mortality for black grouper in the GOM was released by managers in 2024 (DOF 2024). The fleets target black and red grouper, though the industrial fleet has shifted more toward targeting black grouper, resulting in increased landings of black grouper (SAGARPA-INAPESCA 2014). According to the most recent update of the fishery's profile, this increase in fishing mortality has a direct negative impact on the species' biomass (see Figure 6) (DOF 2024). This was corroborated in a way by Sosa et al. (2023), who calculated F for black grouper in the Banco Chinchorro area (on the South Mexican Caribbean) and concluded from their findings that the species should be considered subject to excessive fishing pressure, showing signs of increased vulnerability to fishing (Sosa et al. 2023). Therefore, fishing mortality is considered to be above sustainable levels, and it is scored a "high concern" (per line 1 in table 1.2.1 of the Seafood Watch Standard).

Red grouper *(Epinephelus morio)*

1.1 Abundance

Gulf of Mexico - Atlantic, Western Central - Set longlines

High Concern

Red grouper biomass was most recently reported by managers in 2024 within the fishery's profile in the National Fisheries Chart (DOF 2024). Managers confirmed that the species has been showing signs of being overfished since 1993 (see Kobe plot in Figure 7). These results corroborate the findings of the previous assessment that the estimated biomass was ≈48,524 MT and B_{MSY} was 97,433 MT (2009), confirming that the stock was overfished (SAGARPA-INAPESCA 2014). Because evidence suggests the stock has been overfished for several years, abundance is deemed a "high concern" (per line 2 in table 1.1.1 of the Seafood Watch Standard).

Supplementary Information

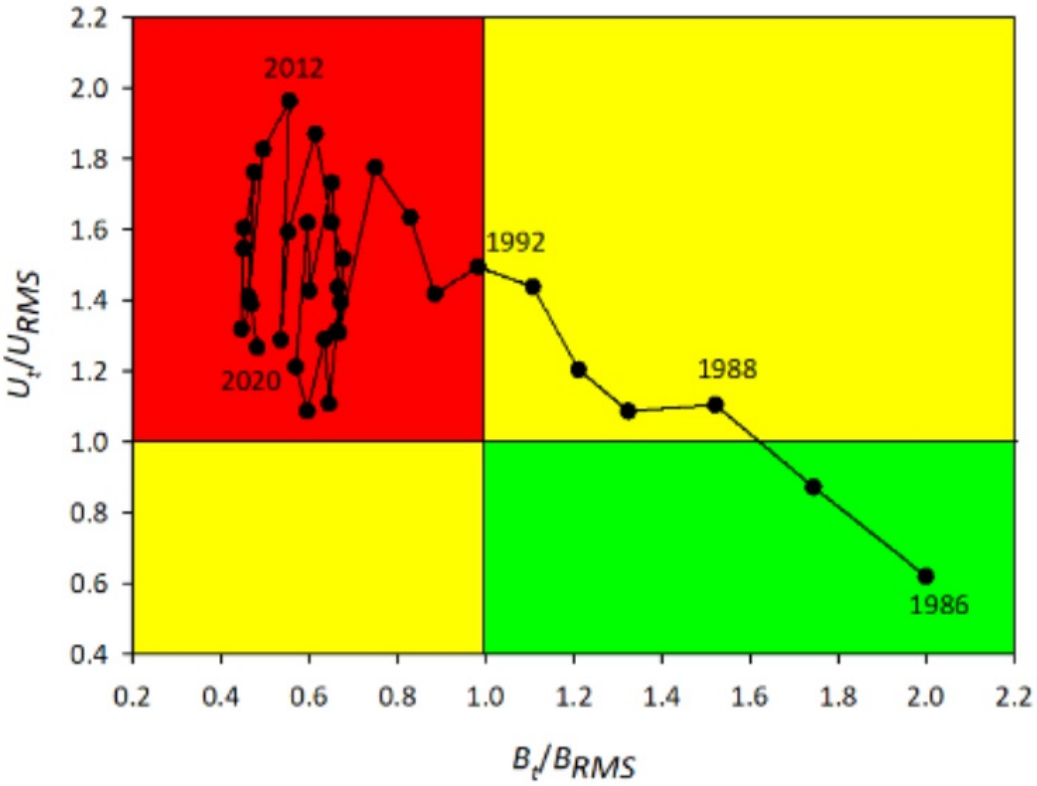

Figure 7: Kobe plot of red grouper biomass against B_{MSY} and fishing mortality against F_{MSY} in the Gulf of Mexico (DOF 2022).

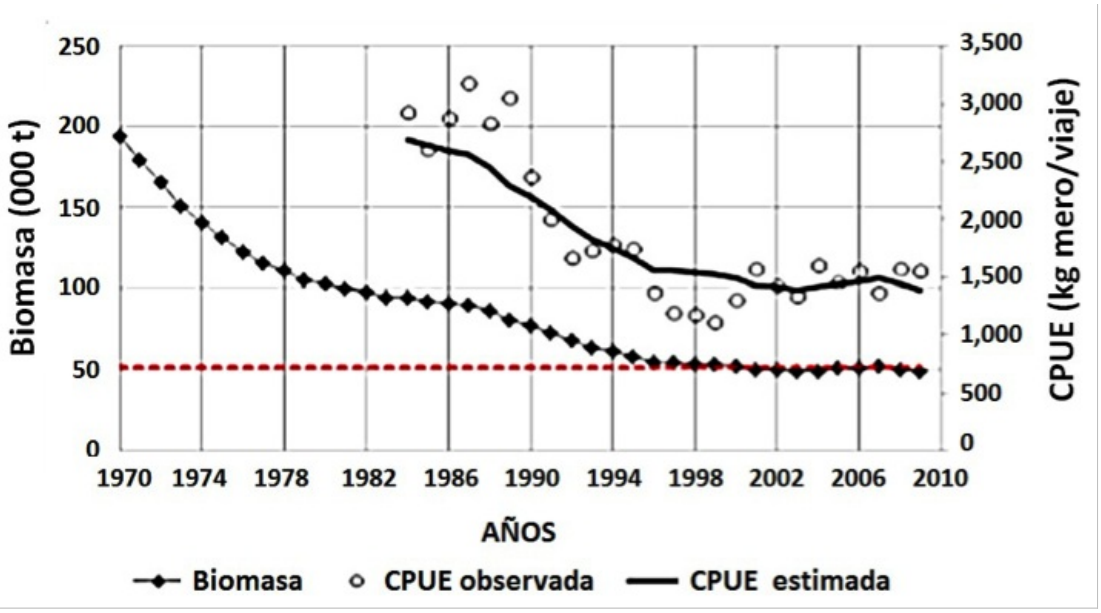

Figure 8: Red grouper estimated biomass in the Campeche Bank using the Schaefer dynamic model. The limit reference point (LRP) was estimated by the authors as the average biomass calculated for the past 15 years ($B_{1995–2009}$ = 52,000 MT) (red line).

Past stock assessments showed important reductions of the stock biomass, from approximately 240,000 MT estimated in 1958 to 61,000 MT by 2000 (Coronado and Salas 2011). In 2002, managers defined the red grouper stock as overfished in the National Fisheries Chart (CNP) (DOF 2002). By 2003, the estimated biomass of red grouper was calculated at 45,500 MT, well below the limit reference point (LRP) of 74,500 MT (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 MT, which was the average of the estimated biomass from the past 14 years (1995–2008) (Figure 8) (DOF 2012). Reference points are based on the average biomass over the previous 14 years, not on virgin biomass, so as biomass has decreased, so have the reference points. The 2022 profile confirmed these findings (DOF 2022).

1.2 Fishing Mortality

Gulf of Mexico - Atlantic, Western Central - Set longlines

High Concern

Coronado and Salas (2011) identified that the current regulations aimed to prevent growth and recruitment overfishing for red grouper; however, the regulations are ineffective, given that around 30–50% of the red grouper landed and commercialized by fishing fleets are juveniles (under the minimum size limit, MSL) and that 50% are between the MSL and L50 (50.9 cm fork length, FL) (Rincón-Sandoval & López-Rocha 2024).

In 2024, managers released the results of an assessment developed to estimate the status of the stock and the fishing effort in place for red grouper (DOF 2024). Managers concluded that there is a high fishing pressure in place and the fishery is far from reaching its maximum sustainable yield (DOF 2024) (see Figure 7). For this reason, this factor is scored a “high concern” (per line 1 in table 1.2.1 of the Seafood Watch Standard).

Supplementary Information

According to official data, 517 vessels compose the industrial fleet in Yucatán (DOF 2014). Of these, 491 possess finfish permits, which means they are authorized to target red and black grouper and other finfish species (DOF 2014). Any given industrial vessel may carry multiple gear types and target other resources, depending on its permits (DOF 2014), so its fishing effort may be dispersed over several resources. The artisanal fleet, which comprises ≈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 undersized fish that have not reached maturity {Coronado-Salas 2011; DOF 2014; SAGARPA-INAPESCA 2014). In 2010, Monroy estimated fishing efforts using logbooks from 2000 to 2003 (Monroy 2010). During the timeframe, the author 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).

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 Crtitical

Guiding principles

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

Criterion 2 Summary

Criterion 2 score(s) overview

This table(s) provides an overview of the Criterion 2 subscore, discards+bait modifier, and final Criterion 2 score for each fishery. A separate table is provided for each species/stock that we want an overall rating for.

Black grouper			
Region / Method	**Sub Score**	**Discard Rate/Landings**	**Score**
Mexico - Gulf of Mexico - Set longlines - 2,918 mt	1.000	1.000: < 100%	Red (1.000)

Red grouper			
Region / Method	**Sub Score**	**Discard Rate/Landings**	**Score**
Mexico - Gulf of Mexico - Set longlines - 5,462 mt	1.000	1.000: < 100%	Red (1.000)

Criterion 2 main assessed species/stocks table(s)

This table(s) provides a list of all species/stocks included in this assessment for each 'fishery' (as defined by a region/method combination). The text following this table(s) provides an explanation of the reasons the listed species were selected for inclusion in the assessment.

Gulf of Mexico - Atlantic, Western Central - Set longlines			
Sub Score: 1.000	**Discard Rate: 1.000**		**Score: 1.000**
Species	**Abundance**	**Fishing Mortality**	**Score**
Black grouper	1.000: High Concern	1.000: High Concern	Red (1.000)
Red grouper	1.000: High Concern	1.000: High Concern	Red (1.000)
Sea turtles	1.000: High Concern	1.000: High Concern	Red (1.000)
Gag	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Mutton snapper	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Warsaw grouper	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Red snapper	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

The grouper fishery in the Campeche Bank is a multispecies fishery that targets at least 19 species of groupers and snappers. Still, red and black groupers 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. nigritus*), 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 revealed significant changes in the region (Gimenez-Hurtado and Mompie-Nueva 2010; Monroy 2010; Coronado and Salas 2011; Coronado-Castro et al. 2011; SAGARPA-INAPESCA 2014). These changes, especially the fluctuation in the amount of red grouper (Monroy 2010; DOF 2014), underline the need for adaptive management strategies. According to the most recent catch composition data (SAGARPA-INAPESCA 2014), the semi-industrial fleet that targets groupers using bottom longline in the Campeche Bank catches red grouper (approximately 55% of the catch), black grouper (≈32%), red snapper (≈5%), mutton snapper (≈4%), gag grouper (≈2%), and at least another 10 species that compose less than 2% of the catch (SAGARPA-INAPESCA 2014). Finally, a basic fishery improvement project (FIP), active since 2014, released a report titled "Clarification on determining secondary species according to MSC CR v2.0 Small scale Fishery" (CEDEPESCA 2018). The report presented a list of species captured by the active participants of the FIP and concluded that the catches were represented by 82% red grouper and 4% black grouper. In comparison, the rest of the species were present in the catch with percentages below 5%; for example, cobia and mutton snapper (3%), graysby grouper (2%), and yellowtail snapper, gag, and yellowmouth grouper (1%). But it is unclear how much fishing effort was covered for this report or the analyzed timeline.

According to the SFW standards for Criterion 2, "main species 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 instances where the species is overfished, endangered, or threatened. Based on these standards, the species included as main species for Criterion 2 are red snapper (*Lutjanus campechanus*), mutton snapper (*Lutjanus analis*), gag grouper (*Mycteroperca microlepis*), and Warsaw grouper (*Hyporthodus nigritus*) (listed as "Near Threatened" by the IUCN (Cowan et al 2015)).

Although reports of gag grouper catch are low, it is included in Criterion 2 because it is potentially overfished (listed as "Vulnerable" by the IUCN) and it has been reported that it can be confused with black grouper {SEDAR 2009}. In addition, there are five species of turtles in the areas where the fishery occurs: hawksbill turtle (*Eretmochelys imbricata*), which is classified as "Critically Endangered" in the IUCN Red List (Mortimer and Donnelly 2008), loggerhead turtle (*Caretta caretta*), classified as "Vulnerable" in the IUCN Red List (Casale and Tucker 2017), green turtle (*Chelonia mydas*), classified as "Endangered" in the IUCN Red List (Seminoff 2023), leatherback turtle (*Dermochelys coriacea*), classified as "Vulnerable" in the IUCN Red List (Wallace et al. 2013), and Kemp's ridley turtle (*Lepidochelys kempii*), classified as "Critically Endangered" {Wibbels & Bevan 2019). Sea turtle interactions with longlines in the region were recently assessed by Cuevas et al. (2018). The authors used a spatially explicit participatory approach to collect fishing effort and sea turtle bycatch data from local fishers using gillnets and longlines gears from 15 ports in the Yucatán Peninsula. The authors reported that gillnets were the most dangerous for sea turtles, with the greatest incidence of dead turtles caught (Cuevas et al. 2018). Hawksbill turtle was the most frequently caught bycatch species, followed by loggerhead turtle (*Caretta caretta*) and green turtle (*Chelonia mydas*) (ibid). In the case of longlines, three areas presented the highest bycatch values, with averages of 0.70, 0.72, and 0.53 individuals/1000 fishing hooks (Cuevas et al. 2018). When we compared the total number of turtles caught dead between gillnets and longlines, the numbers indicated that gillnets captured most of the turtles. When these nets are used for long periods of soaking time (> 10 hrs), they are the most dangerous fishing gear for sea turtles (Cuevas et al. 2018). Finally, the authors estimated that longline fishing efforts vary between two different zones (north and west of the peninsula) but ranged from 10,000 to > 40,000 hooks a year (ibid). The authors concluded that sea turtle bycatch per unit effort for gillnets (caught turtles/m^2/fishing season) and longline (caught turtles/1000 hooks/fishing season) varied, depending on the area (Cuevas et al. 2018). The high-magnitude areas of estimated CPUE of sea turtles by gillnets range between 9.1 to 16, while for longlines, it was estimated between 0.79 and 1.49 (Cuevas et al. 2018). Overall, though longlines catch fewer turtles than gillnets, they cannot be considered nonsubstantial contributors, based on the numbers provided in Cuevas et al. (2018). For this reason, sea turtles as a taxon were also included as a main species for this criterion.

Overall, the impact of the deep-set longline on target species and sea turtles is the primary driver limiting the score of Criterion 2, because of concerns about the species' abundance and fishing mortality levels.

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)

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

Gag *(Mycteroperca microlepis)*

2.1 Abundance

Gulf of Mexico - Atlantic, Western Central - Set longlines

High Concern

A formal stock assessment and abundance data are unavailable for gag grouper in the region. The species is listed as "Vulnerable" by the IUCN (Koenig et al. 2018), and for this reason, abundance is considered a "high concern" (per line 1 in table 1.1.1 of the Seafood Watch Standard).

2.2 Fishing Mortality

Gulf of Mexico - Atlantic, Western Central - Set longlines

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 misidentified (Cass-Calay 2013). Because fishing mortality from this and other fisheries is unknown, this factor is scored a "moderate concern" (per line 2 in table 1.2.1 of the Seafood Watch Standard).

Mutton snapper *(Lutjanus analis)*

2.1 Abundance

Gulf of Mexico - Atlantic, Western Central - Set longlines

High Concern

A formal stock assessment and abundance data are not available for mutton snapper. But the species is listed as "Near Threatened" in the region by the IUCN (Lindeman et al. 2016), so abundance is scored a "high concern" (per line 1 in table 1.1.1 of the Seafood Watch Standard).

2.2 Fishing Mortality

Gulf of Mexico - Atlantic, Western Central - Set longlines

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 a frequent component of the grouper fishery's catch (DOF 2022). Because fishing mortality from this and other fisheries is unknown, this factor is rated a "moderate concern" (per line 2 in table 1.2.1 of the Seafood Watch Standard).

Red snapper *(Lutjanus campechanus)*

2.1 Abundance

Gulf of Mexico - Atlantic, Western Central - Set longlines

Moderate Concern

Managers assessed the red snapper stock, and the results were released in the fisheries profile update in the National Fisheries Chart (NFC) of 2023 (DOF 2023). In these updates, managers concluded that:

> "...the biomass of red snapper was very close to the biomass that would generate the Maximum Sustainable Yield and within the levels of a relatively healthy fishery. However, the trend in biomass indicated that it could decrease in the coming years. Due to the above, it is considered that this fishery is exploited to the maximum sustainable extent with a tendency to deteriorate in the future" (DOF 2023).

In 2015, the B/B_{MSY} estimates were close to 0.5 B/B_{MSY} (Figure 9). These results only cover biomass estimates up to 2016, and the methodology used was not discussed in the update.

Garcia-Caudillo et al. (2024) released a more recent red snapper assessment. The authors used historical landing records (MT/year) and the Catch-MSY method to estimate MSY and B_{MSY} for red snapper in the Gulf of Mexico (GOM) (Garcia-Caudillo et al. 2024). As a result, the authors reported that MSY for red snapper was 4,964 MT, and the biomass associated with MSY (or the biomass target reference point, B_{TRP}) was 17,554 MT (ibid). Based on their results, the stock biomass has oscillated above the B_{TRP}, although it has a declining trend from 2015 until the most recent year (2019) (Figure 10) (ibid). Using a Kobe plot (Figure 11), the authors concluded that the red snapper stock remained at healthy levels (green quadrant), with a 94.3% probability that the current status (2019) was above the B_{TRP}, with a small probability (4.1%) that the stock was below the B_{TRP} but not overfished (yellow quadrant) (ibid).

Finally, Garcia-Rodriguez et al. (2024) assessed the status of 10 finfish stocks along both coasts of Mexico, including the northern red snapper (*Lutjanus campechanus*), using official landing statistics reported by managers (CONAPESCA) and the CMSY model, to

produce estimates of the reference points for stock size (B/BMSY). As a result, the authors reported that the B/BMSY for red snapper was 1.07 in 2019, recovering from low levels in previous years (Figure 12) {Garcia-Rodriguez et al. 2024}.

Both Garcia-Caudillo et al. (2024) and Garcia-Rodriguez et al. (2024) developed Kobe plots and reported that red snapper biomass fluctuates around B/BMSY. But Garcia-Caudillo et al. added that unrecorded fishing data in Mexico are on the order of 40%, which can affect the stock biomass estimates; and based on this level of uncertainty, it was essential to focus more on biomass trajectories than specific point estimates. On the other hand, Garcia-Rodriguez et al. also mentioned that one of the significant sources of uncertainty is the data used and the need to incorporate more details regarding the catch structure (in terms of length). Considering that these results provide conclusions that conflict with those provided by managers (DOF 2023), we ran a productivity-susceptibility analysis (PSA) to assess the species' vulnerability, which scored as low (Tables 1–2). Therefore, abundance is considered a "moderate concern" (per line 2 in table 1.1.1 of the Seafood Watch Standard).

Supplementary Information

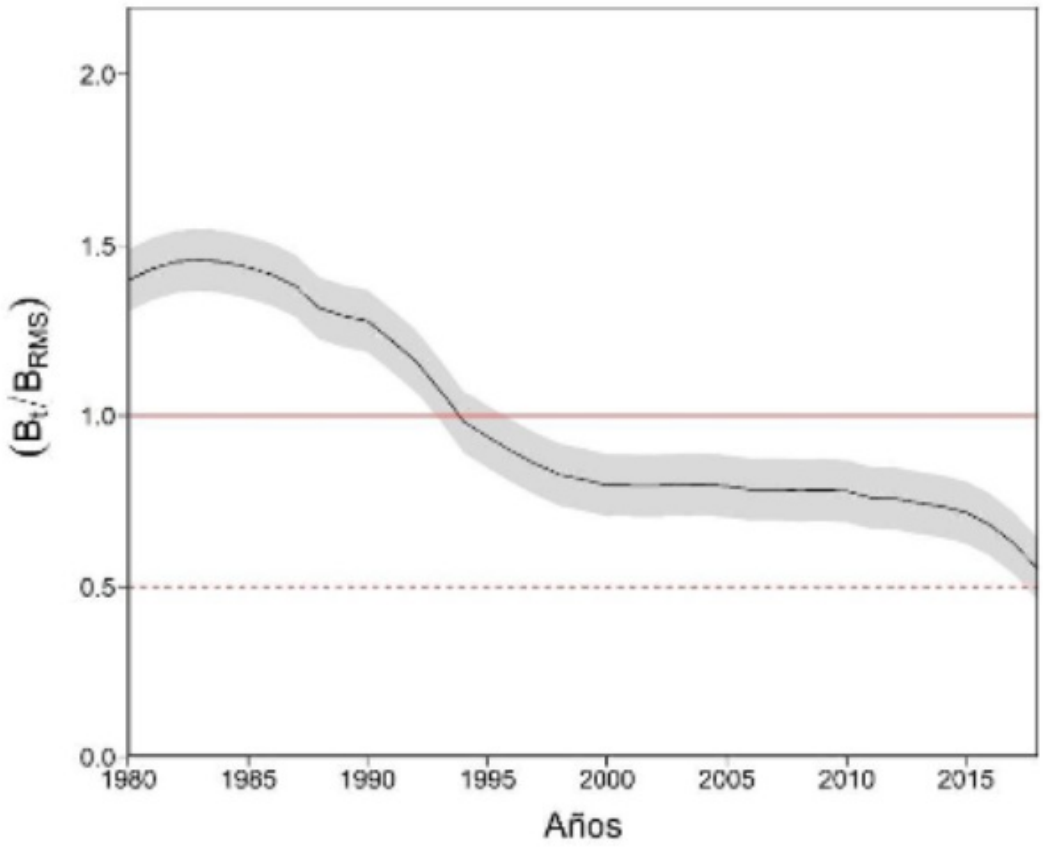

Figure 9: Biomass levels relative to the B_{MSY} (red line) between 1980 and 2018. "The dotted line represents the limit where the fishery can be considered on the risk of deterioration." (DOF 2023).

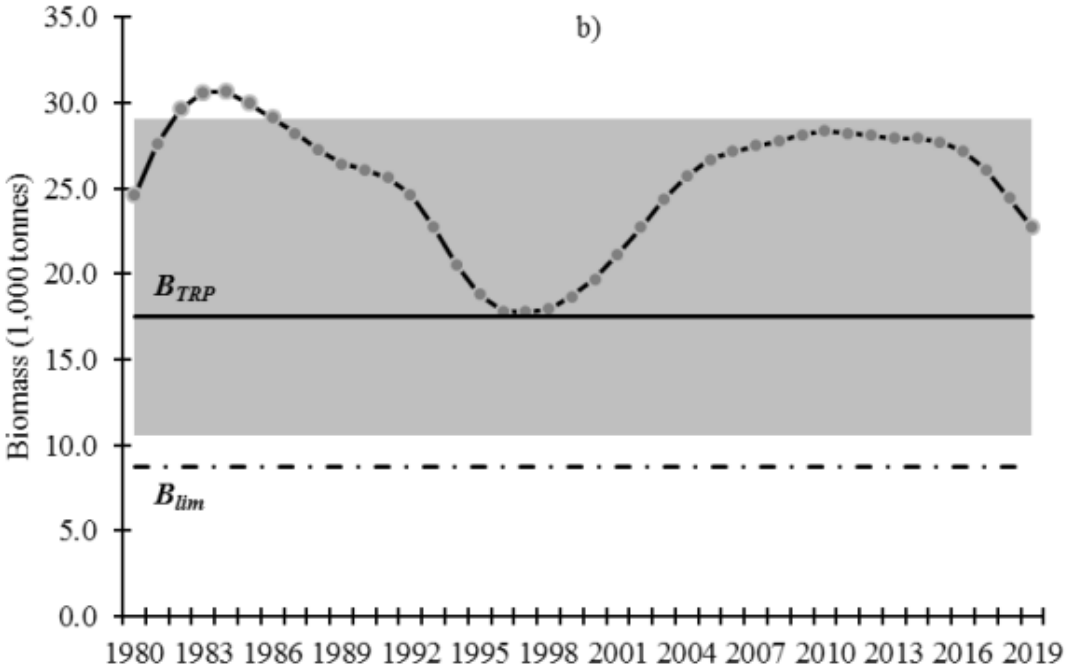

Figure 10: Red snapper stock biomass trajectory and biomass target reference point (B_{TRP}) with 95% confidence interval (gray area) and B_{lim} (dash-dot line) (Garcia-Caudillo et al. 2024).

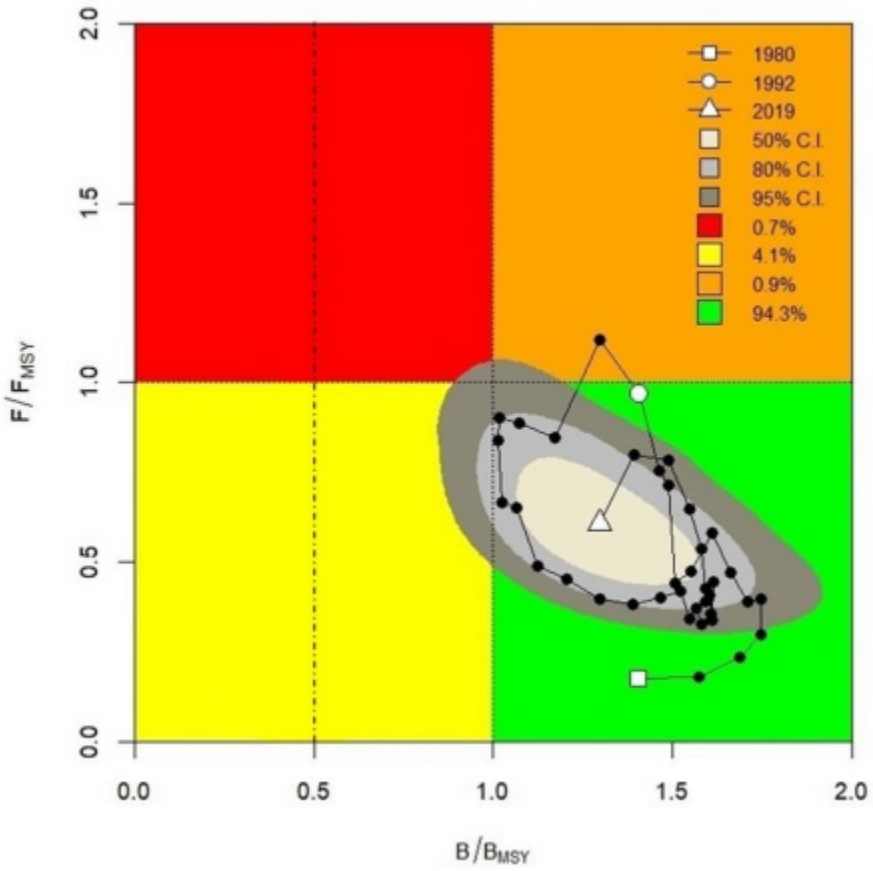

Figure 11: Red snapper biomass Kobe plot by (Garcia-Caudillo et al. 2024).

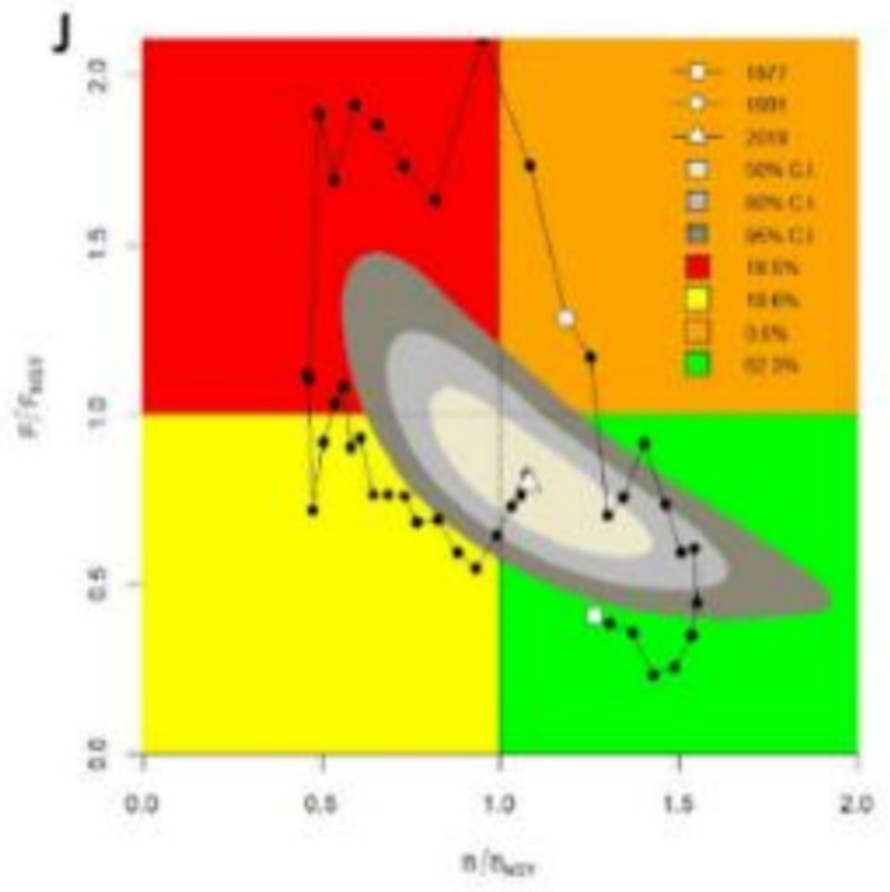

Figure 12: Red snapper biomass Kobe plot by {Garcia-Rodriguez et al 2024}.

Productivity-Susceptibility Analysis for red snapper (*Lutjanus campechanus*)

Table 1

Productivity attribute	High productivity (score = 1)	Medium productivity (score = 2)	Low productivity (score = 3)	Score	Notes/References
Average age at maturity (years)	< 5 years	5–15 years	> 15 years	1	In Alabama, the species reaches its maturity between 2 and 4.5 years of age {Kulaw et al. 2017}.

Average maximum age (years)	< 10 years	10–25 years	> 25 years	3	The species can reach up to 57 years old {Allman et al. 2002}.
Fecundity	> 20,000	100 to 20,000	< 100	1	Fecundity of females has been reported to range between 9.3 to 59 million eggs {Allen 1985}.
Average maximum size	< 100	100–300	> 300	2	The maximum length reported is 104 cm {Wilson and Nieland 2001}.
Average size at maturity	< 40	40–200	> 200	1	According to IMIPAS, average size at maturity has been estimated at 34.5 cm of length.
Reproductive strategy	Broadcast spawner	Demersal egg layer or brooder	Live bearer	1	Broadcast spawner
Trophic level	< 2.75	2.75–3.25	> 3.25	3	Trophic level of 3.9 {Fishbase c 2024}
Quality of Habitat	Habitat is robust, with no known degradation from nonfishery impacts	Habitat has been moderately altered by nonfishery impacts	Habitat has been substantially compromised from nonfishery impacts		Not available information regarding this element.
Productivity score (mean of attribute scores)				**1.71**	

Table 2

Susceptibility attribute (default scores in bold)	Low (score = 1)	Medium (score = 2)	High (score = 3)	Score	Notes/Reference
Areal overlap (all fisheries)	Vast majority (> 90%) of species concentration (main geographic range) is unfished (considering all fisheries).	Most (70–90%) of species concentration is unfished by any fishery (must have evidence).	> 30% of the species concentration is fished, considering all fisheries.	3	The species distributes throughout the Gulf of Mexico, with fisheries targeting it along all its distribution. The species is fished in > 30% of its concentration.
Vertical overlap (all fisheries)	Low overlap between fishing depths and depth range of species; i.e., most of the species depth range (≥ 66%) is unfished (considering all fisheries). (Must have evidence; unlikely for any "main species.")	Medium overlap between fishing depths of depth range of species, considering all fisheries; i.e., species has considerable portion (≥ 33%) of depth range that is unfished (must have evidence).	High degree of overlap between fishing depths and depth range of species. Default score for target species, as well as any air-breathing animal, or when unknown.	2	The specie' depth ranges from 10 to 190 m {Allen 1985}. The fishery takes place along the continental shelf of the Gulf of Mexico (DOF 2023), and the gears used might have a medium degree of overlap with the species' depth range.
			Species is targeted or is incidentally encountered AND attributes		

Selectivity of fishery (specific to fishery under assessment)	Species is not targeted AND is not likely to be captured by gear; e.g., average body size at maturity is smaller than mesh size (net fisheries), or species is not attracted to the bait used (line fisheries), or is too large to enter trap (pot/trap fisheries). (If known, < 33% of individuals of this species encountering gear are captured). Must have evidence.	Species is targeted, or is incidentally encountered AND is not likely to escape the gear, BUT conditions under "high risk" do not apply. Default score when conditions under "high risk" do not apply.	of the fishery, combined with the species' biology or behavior—e.g., migratory bottlenecks, spawning aggregation, site fidelity, unusual attraction to gear, sequential hermaphrodite, semelparity, or segregation by sex—increase its susceptibility to the gear; e.g., net mesh size allows retention of individuals below size at maturation, or fishery targets spawning aggregations or BOFFFFs (Hixon et al. 2014). If effective management measures are in place to mitigate the effect of the behavior or requirement, the behavior and/or requirement need not be	2	The species is targeted by this fishery, it is incidentally captured by other fisheries (e.g., shrimp) BUT conditions under "high risk" do not apply because there are some measures in place that aim to mitigate the impacts (DOF 2022).

Post-capture mortality (specific to fishery under assessment)	Evidence of majority of captured individuals (> 66%) released and survive post-capture.	Evidence of some (33–66%) individuals released and survive post-capture.	Retained species, or majority dead when released, or unknown. Default score for retained species or unknown.	3	Default score is used, considering that this species is retained.
Susceptibility score [(S1 × S2 × S3 × S4 – 1) ÷ 40 + 1]				1.88	
Productivity-Susceptibility Score [$V = \sqrt{(P^2 + S^2)}$]				2.54	
Vulnerability Rating: < 2.64 = Low vulnerability; ≥ 2.64 and ≤ 3.18 = Medium vulnerability; > 3.18 = High vulnerability				Low vulnerability	

2.2 Fishing Mortality

Gulf of Mexico - Atlantic, Western Central - Set longlines

Moderate Concern

Fishing mortality for the snapper fishery has been historically driven by red snapper (DOF 2012) (DOF 2023). Landings peaked in 1993, with landings reaching more than 7,000 MT (DOF 2023) and then started to decline, following a negative trend and stabilizing at around 4,000 MT annually between 2000 and 2015 (Figure 13). The species is targeted by industrial longline, artisanal longline, and handline fishers (DOF 2012). Access to the fishery is controlled through permits and gear restrictions (DOF 2023). Managers recommended reducing fishing efforts, not granting new licenses, reducing fleet size, and limiting landings in the Gulf of Mexico to 4,295 MT included in the 2012 fishery profile (DOF 2012). But the most recent versions of the fishery profile do not provide evidence that effort has been reduced, and there is no quota and no off-fishing season has been established for the species.

In 2022, Garcia-Caudillo et al. (2024) calculated the values of fishing mortality for the red snapper fishery between 1980 and 2019. The authors reported that annual fishing mortality throughout most of the time series was below the fishing mortality limit (F_{lim}) value (0.28), reaching a maximum value of 0.31 in 1993 and a value of 0.17 in 2019 (Figure 14) (Garcia-Caudillo et al. 2024). During 2019, landings reached ≈4,600 MT {CONAPESCA 2020}, above the limit set by managers in 2012 but below the limit of 4,964 t calculated by Garcia-Caudillo et al. (2024).

But juvenile red snapper has been reported to be susceptible to shrimp trawling in the Gulf

of Mexico, which has significantly reduced recruitment (Anderson et al. 2015). In addition, red snapper is a bycatch species in the grouper fishery that could account for up to 8% of the catch (Brule et al. 2008). In 2019, grouper landings reached around 7,000 MT {CONAPESCA 2020}, which could mean that red snapper fishing mortality from the grouper fishery could reach ≈500 MT and surpass the recommended limit suggested by managers in 2012 (4,295 MT) (DOF 2012) and the 2019 limit (4,964 MT) estimated by Garcia-Caudillo et al. (2024).

Based on the available information, fishing mortality from all sources (including commercial, recreational, and subsistence) is uncertain, as is the reference point; for these reasons, fishing mortality is scored a "moderate concern" (per line 2 in table 1.2.1 of the Seafood Watch Standard).

Supplementary Information

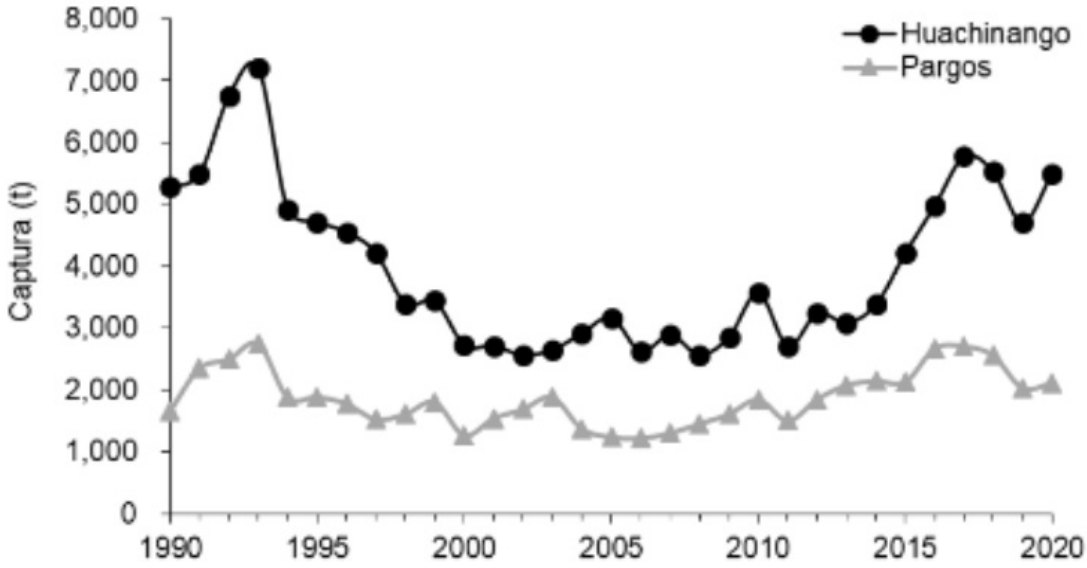

Figure 13: Landings of red snapper and other huachinango species (Huachinango) and related snapper species in the Gulf of Mexico (DOF 2023).

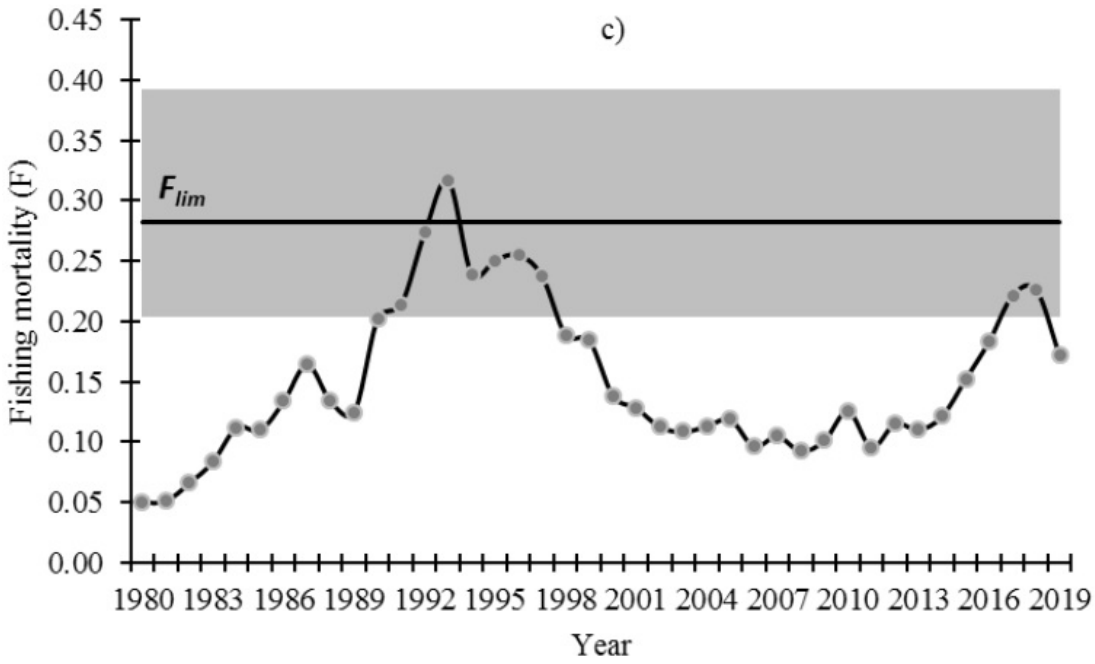

Figure 14: Fishing mortality values for red snapper in the Gulf of Mexico (Garcia-Caudillo et al. 2024).

Sea turtles *(Dermochelyidae, Cheloniidae)*

2.1 Abundance

Gulf of Mexico - Atlantic, Western Central - Set longlines

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). In addition, these species are considered highly vulnerable, according to Seafood Watch. For these reasons, abundance is rated a "high concern" (per line 1 in table 1.1.1 of the Seafood Watch Standard).

2.2 Fishing Mortality

Gulf of Mexico - Atlantic, Western Central - Set longlines

High Concern

There is limited information about mortality or gear interaction with sea turtles in the Campeche Bank region. Cuevas et al. (2018) assessed the level of interactions between the fleets in the Campeche Bank and sea turtles. The estimates were based on interviews with fishers and the use of data linked to turtle behavior. As a result, the authors concluded

that, for longline fishers, the level of catches was around 0.5 to 0.7 individuals per 1000 hooks per season in the region (Figures 15–16) (Cuevas et al. 2018). The authors concluded that these numbers are significantly lower than those from the gillnet fisheries, which are considered the most dangerous for sea turtles, with the most significant incidence of dead turtles caught. The report clarified that hawksbill turtle was the most frequently caught, followed by loggerhead and green turtles, but did not clarify if this was for longlines alone or both gears. Finally, although it has been reported that hawksbill was the most important species in terms of bycatch against the other species, it is unclear if levels of bycatch on the longline represent < 5% of the bycatch impacts.

Overall, with the available information, it is not possible to confirm that longline impacts do not substantially contribute to fishing mortality of sea turtles. Based on the Unknown Bycatch Matrices of the SFW criteria, this factor is scored a "high concern" for all the sea turtle species identified as potential bycatch or potentially interacting with bottom longline gear (per line 1 in table 1.2.1 of the Seafood Watch Standard).

Supplementary Information

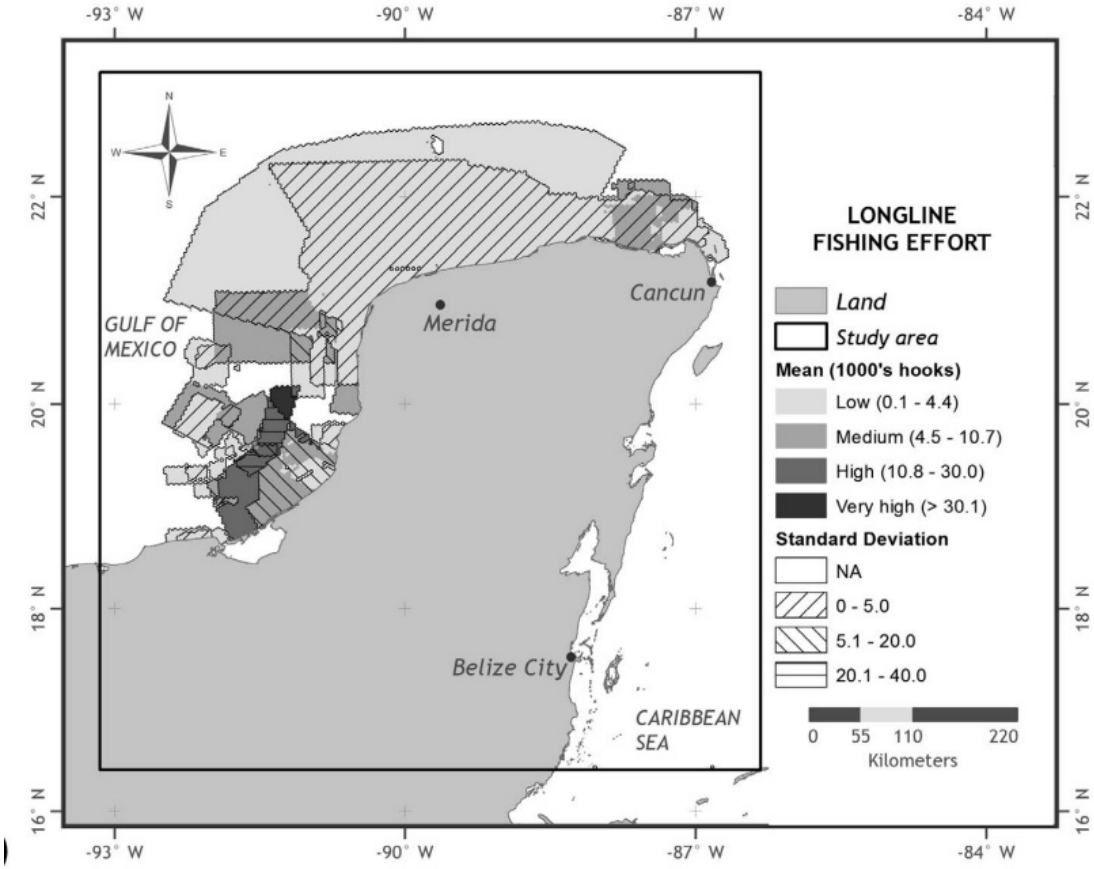

Figure 15: Result of the estimates developed by Cuevas et al. (2018) that assessed the levels of potential interactions between the fishing fleets in the region (longline) and turtle hotspots (Cuevas et al. 2018).

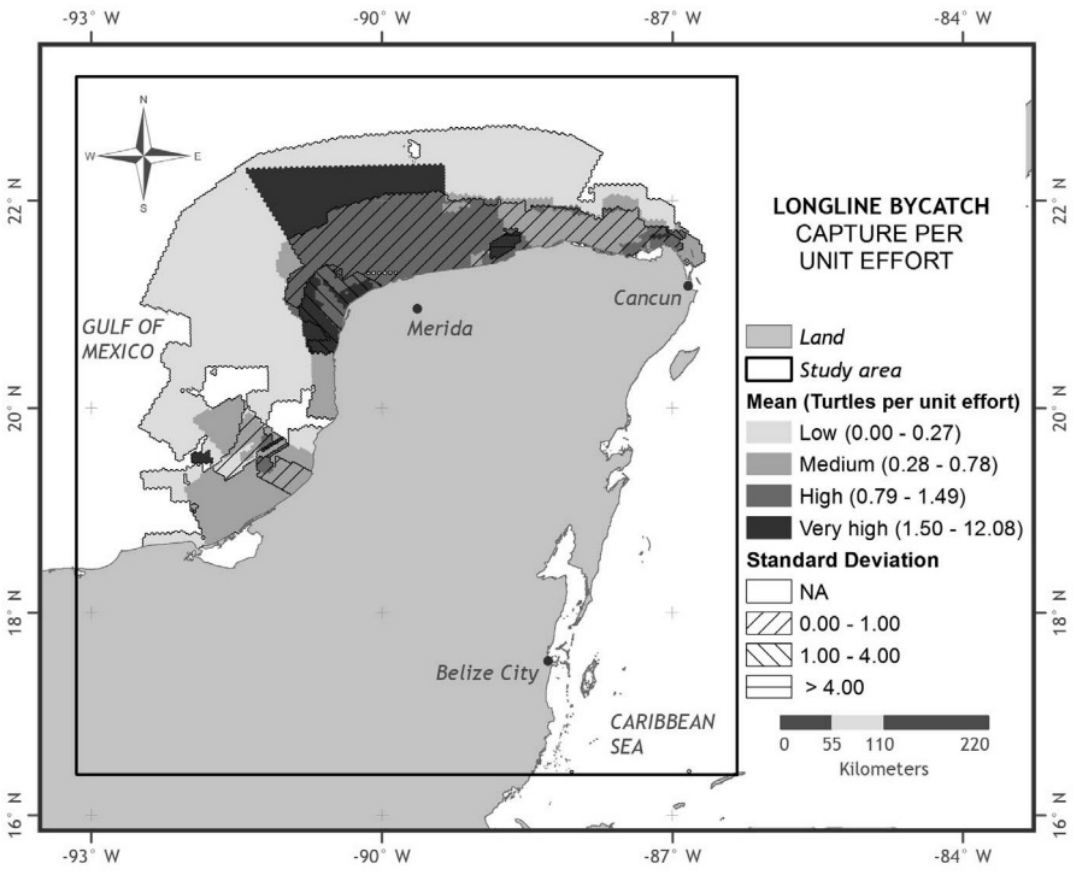

Figure 16: Bycatch per unit effort participatory mapping, as determined by interviewing local fishers for longline (caught turtles per 1000 hooks/fishing season) in 15 ports in the north and west coasts of the Yucatán Peninsula, Mexico (Cuevas et al. 2018).

Warsaw grouper *(Epinephelus nigritus)*

2.1 Abundance

Gulf of Mexico - Atlantic, Western Central - Set longlines

High Concern

Assessments on the status of the stock are not available. The IUCN lists the species as "Near Threatened" in the Gulf of Mexico (Aguilar-Perera et al. 2018), resulting in a "high concern" score (per line 1 in table 1.1.1 of the Seafood Watch Standard).

2.2 Fishing Mortality

Gulf of Mexico - Atlantic, Western Central - Set longlines

Moderate Concern

Fishing mortality data are not available for Warsaw grouper in Mexico (DOF 2012; DOF 2014; SAGARPA-INAPESCA 2014). As with mutton snapper, managers recognize warsaw grouper as an associated species in the grouper fishery (DOF 2012). This factor is rated a "moderate concern" because fishing mortality from this and other fisheries is unknown (per line 2 in table 1.2.1 of the Seafood Watch Standard).

2.3 Discard Rate/Landings

Gulf of Mexico - Atlantic, Western Central - Set longlines

< 100%

There are not enough data to estimate the discards + bait/landings ratio for the red and black grouper fishery in the Yucatán. But the Mexican longline fishery uses the same gear type and targets species similar to those of the U.S. Gulf of Mexico longline reef fishery. Recent observer data indicate that most of the catch is retained (Figure 17), though the weights presented do not include sharks (because observers do not routinely measure weight). No information was found on bait use in the fisheries. Based on the available information, it is assumed that the weight of discards + bait does not exceed the weight of the retained catch, thus allowing for a maximum score modifier of 1.0. For this reason, the factor is rated at < 100% (per table 2.3.1 of the Seafood Watch Standard).

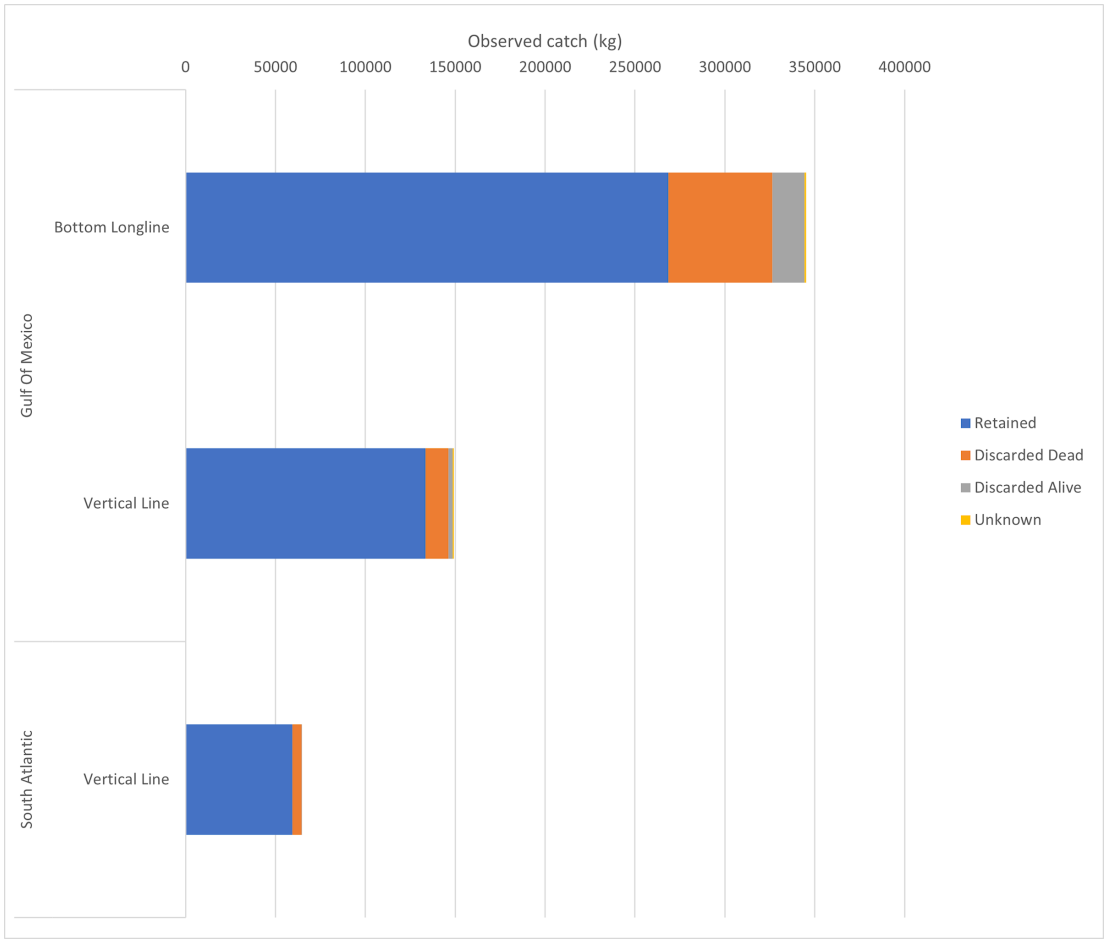

Figure 17: Observed catch of all species by region, gear, and disposition for 2018–22 (summed). Data from the Reef Fish Observer Program and South Atlantic Vertical Line Observer Program (Fitzpatrick 2022).

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.

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:

Criterion 3 Summary

Fishery	Management Strategy And Implementation	Bycatch Strategy	Scientific Research And Monitoring	Enforcement Of Management Regulations	Stakeholder Inclusion	Score
Gulf of Mexico - Atlantic, Western Central - Set longlines	Ineffective	Moderately Effective	Moderately Effective	Moderately Effective	Highly effective	**Red (1.000)**

Criterion 3 Assessment

Scoring Guidelines

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 manages 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.

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.

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.

3.1 Management Strategy And Implementation

Gulf of Mexico - Atlantic, Western Central - Set longlines

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 Yucatán Peninsula," was developed in 2014 (DOF 2014). This document states that the objective species for the plan is red grouper. Still, it includes the other associated species (included in the NOM) captured by both fleets in the Yucatán area (DOF 2014). To access the fishery, participants must own a finfish permit (either industrial or artisanal) (DOF 2014). These permits are not specific for grouper species, and normally include an extensive list of species that permit owners are authorized to land (DOF 2014). Applicable fishery regulations are included in these permits. The current regulations are:

- The minimum size limit (just for red grouper) is 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 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 preceding regulations, the industrial fleet is required to install satellite-based vessel monitoring systems (VMS) to constantly monitor fishing activities (NOM-062-PESC-2007) (DOF 2008).

No quotas or limits are set for grouper catch; as described, the fishery is managed via permits, including restrictions and specifications 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 expanding the industrial fleet in size and limiting its fishing in prohibited areas. But this type of information is unavailable for the artisanal fleet (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.

Despite recent efforts to improve the management plan for the fishery (EDF 2024), the management plan has not been enhanced, the fishery's status continues to deteriorate, and the fishery is likely having severe negative impacts on retained populations. Though some improvements have been documented (change in the average size of red grouper caught by the industrial fleet), the harvest management strategy and implementation factor are scored "ineffective" (per line 1 in table 3.1.1 of the Seafood Watch Standard).

Supplementary Information

Other management regulations (e.g., designation of no-fishing areas, annual stock assessments) 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 that of 352 industrial vessels, and they proposed a limit reference point of 52,419 MT (Monroy et al. 2010). Nevertheless, none of these new management measures is in place, and management currently relies only on access controls, gear specifications, and CPUE monitoring (DOF 2014).

3.2 Bycatch Strategy

Gulf of Mexico - Atlantic, Western Central - Set longlines

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). The bycatch in this fishery is low because most, if not all, of the species caught by the fleet are retained, sold, or kept for personal consumption (Minerva Alonso 2024, pers comm).

Regarding management, some gear restrictions are in place, although these aim to reduce the fishery's impact 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 implemented correctly, because there is no evidence that a monitoring program exists.

Cuevas et al. (2018) analyzed interactions of the small-scale fleet in the Campeche Bank with turtle hotspots. The authors estimated relatively low levels of interactions between longlines and sea turtles, with a range between 0.53 and 0.72 individuals/1000 hooks per season (Cuevas et al. 2018) and concluded that, in comparison, "... gillnets are more dangerous and lethal fishing gear compared with longlines" (Cuevas et al. 2018).

In Mexico, sea turtles are listed within the Mexican Official NOM-059 (DOF b 2010), and in 2022, the National Program to Preserve Sea Turtles was enacted (CONANP 2022). The plan consists of a series of measures that include a ban on the possession and commercialization of any species of sea turtles, the creation of sanctuary beaches known to be critical nesting sites, and in terms of fishing regulations, a ban on the use of drift gillnets, mandatory use of circular hooks, and a minimum depth to operate longlines within the shark fishery (NOM-029) (DOF 2015).

Overall, some measures are in place to limit the impact of species of concern; however, the effectiveness of these measures remains uncertain, so this factor is scored "moderately effective" (per line 2 in table 3.2.1 of the Seafood Watch Standard).

3.3 Scientific Research And Monitoring

Gulf of Mexico - Atlantic, Western Central - Set longlines

Moderately Effective

The Mexican Institute of Research in Fisheries and Aquaculture (IMIPAS, formerly the National Fisheries Institute or INAPESCA) coordinates and conducts scientific and technological research on fisheries and aquaculture resources and provides advice for CONAPESCA (the main management branch in the country). IMIPAS uses the National Fisheries Chart (Carta Nacional Pesquera, CNP) to define guidelines, strategies, and measures for fishing resource conservation, protection, and management. Up to the review of this update, there was no formal scientific advice for a catch limit for the grouper fishery; instead, there were only recommendations based on the status of the stock, which was recently evaluated and was reported to be overfished with overfishing occurring for red grouper (DOF 2022). The assessment was developed by managers using data related to stock abundance, which is used to monitor and maintain the stock.

The most recent update of the CNP (2022) recommended not increasing fishing efforts in order to implement the actions established in the management plan, improving the

monitoring program, establishing new protected zones regarding juvenile nursery areas, and enhancing monitoring and surveillance programs for this fishery (DOF 2022). In addition, Brule et al. (2008) recommended that fishing during the spawning season and the capture of juveniles needs to be reduced (Brule et al. 2008). Finally, a basic FIP has been active in the region since 2014; based on the project profile, this effort covers a small portion of the production (300 MT of the ≈4,500 MT are part of the FIP) {FP.org 2024}. The project put in place a data collection program that was then handed to regional researchers and shared with authorities. Still, the action was finalized in 2019, so it is unclear if the program continues to collect information and, if so, if this is used for management purposes.

Based on the available information, managers collect and analyze some stock abundance data; however, the 2022 stock status evaluation for red grouper is the most recent one developed by managers, and it is unclear if the process was externally peer reviewed. Finally, although a program was in place to collect data on catch composition, it is unclear if bycatch data is enough to meet the "highly effective" category. As a result, this factor is scored "moderately effective" (per line 1 in table 3.3.1 of the Seafood Watch Standard).

3.4 Enforcement Of Management Regulations

Gulf of Mexico - Atlantic, Western Central - Set longlines

Moderately Effective

Fishery access is controlled by permits that provide access to the species to the holders (DOF 2022). The enforcement of regulations is carried out by CONAPESCA officials (via federal officers). But in recent years, the number of federal inspectors has decreased from approximately 210 in 2012 to 161 in 2022 (Oceana 2024), and they are in charge of patrolling the more than 11,000 km of coastline, for which this may be an insufficient number of agents.

In 2020, the Mexican organization Causa Natura released the "Effectiveness Index for the Fishery Inspection and Enforcement in Mexico" (Pescando Datos 2020). The authors measure the effectiveness of fisheries surveillance per each state of the Mexican Republic, using information on the level of actions deployed, the resources invested in inspection and surveillance, and how these were reflected in the results obtained. The authors built an index that included information provided by the National Aquaculture and Fisheries Commission (CONAPESCA) through different information requests made in 2018 and 2019. Based on the most recent data, Yucatán scored a value of 0.4941 (on a scale of 0 to 1) (Figure 18), which puts the state in the middle of the scale.

Finally, in 2024, Oceana Mexico released a report analyzing official information related to five elements of enforcement actions. These elements were:

- the number of federal enforcement agents,

- the number of enforcement actions (in water and land),
- the amount of fish products and gears retained as part of enforcement actions,
- the level of coverage of the VMS system (for industrial fleet), and
- the number of sanctions and infractions applied.

Based on the analysis of the information on these five components, the report concludes that, in the best case, there has been a stagnation of effective enforcement actions by the authorities. At the same time, at the worst case, the results represent a clear disregard for the State to fulfill its duties (Oceana 2024).

Enforcement actions are in place to promote management benefits; however, the effectiveness of enforcement may be uncertain, considering the status of the target species. The independent revision of these actions shows relatively positive results in Yucatán compared with other regions of Mexico. For this reason, this factor is scored "moderately effective" (per table 3.4.1 of the Seafood Watch Standard).

Supplementary Information

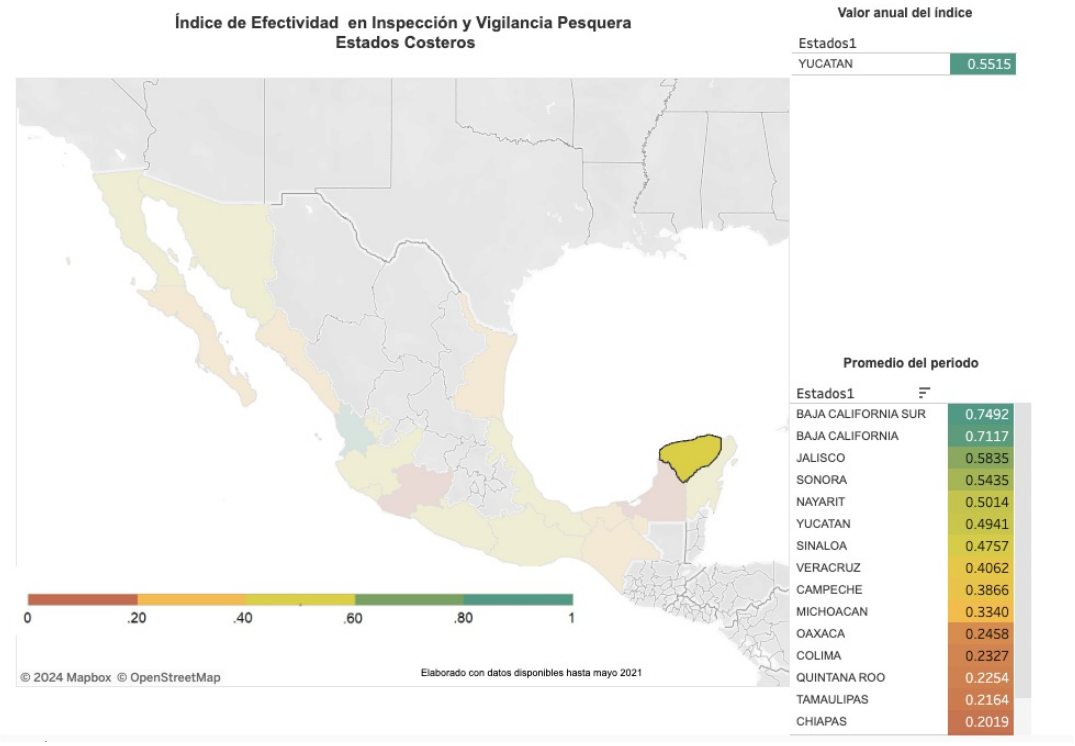

Figure 18: Results of the Effective Enforcement Index developed by Causa Natura for Yucatán, Mexico (Pescando Datos 2024).

3.5 Stakeholder Inclusion

Gulf of Mexico - Atlantic, Western Central - Set longlines

Highly effective

The federal fishery management was completed through the participation of different actors, including users and local/regional experts (DOF 2014). The cooperative process involved state and federal fishery management officials and representatives of research institutions. In addition, in December 2017, the State Consulting Committee for the Grouper Fishery was officially created (CEDEPESCA 2018). The committee's primary objectives were to support the implementation of the management plan actions, review and help with any updates to research lines, support the data generation and analysis, and enhance users' participation in management activities and decisions (CEDEPESCA 2018).

The current structure of the committee includes eight representatives of the fishing sector (four from the semi-industrial and four from the small-scale fleet), as well as managers, research institutions, and national NGOs (DOF 2014). This makeup ensures that industry and public input are incorporated into management decisions and allows an avenue to address user conflicts. Before final decision-making, the committee receives technical and stakeholder input from management representatives (IMIPAS).

Overall, the committee's current level of engagement, the managers' open and direct participation in the process, the cooperation between managers, scientists, and user groups, and the numerous opportunities to incorporate public and stakeholder involvement in the management process meet all the requirements for a score of "highly effective" for stakeholder inclusion (per lines 1–5 in table 3.5.1 of the Seafood Watch Standard).

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

Fishery	Impact of Fishing Gear on the Habitat/Substrate	Modifying Factor: Mitigation of Gear Impacts	Ecosystem-based Fisheries Management	Score
Gulf of Mexico - Atlantic, Western Central - Set longlines	Score: 3	+.5	High Concern	Yellow (2.646)

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.*

4.1 Impact of Fishing Gear on the Habitat/Substrate

Gulf of Mexico - Atlantic, Western Central - Set longlines

Score: 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 {López-Rocha and Arreguín-Sánchez 2008; Hernandez and Seijo 2003) and its life history stage (Albañez-Lucero and Arreguín-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 (Figure 19) {Albañez-Lucero and Arreguin-Sanchez 2009}.

On the other hand, data on catch composition for the semi-industrial fleet have shown that this fleet primarily captures adults {Coronado-Salas 2011; SAGARPA-INAPESCA 2014). Its work area is within the overlapping area identified by the authors in Figure 19 (Coronado and Salas 2011) (DOF 2014), where adults are typically found {Albañez-Lucero and Arreguin-Sanchez 2009}.

Because there are no interactions with rocky reefs or corals {Albañez-Lucero and Arreguin-Sanchez 2009}, adult groupers in the Campeche Bank are associated with sandy bottoms, and there is evidence that the use of bottom longlines is developed primarily over sandy bottom substrates, impact of fishing gear on the habitat/substrate receives a score of 3 out of 5 (per table 4.1.1 of the Seafood Watch Standard).

Supplementary Information

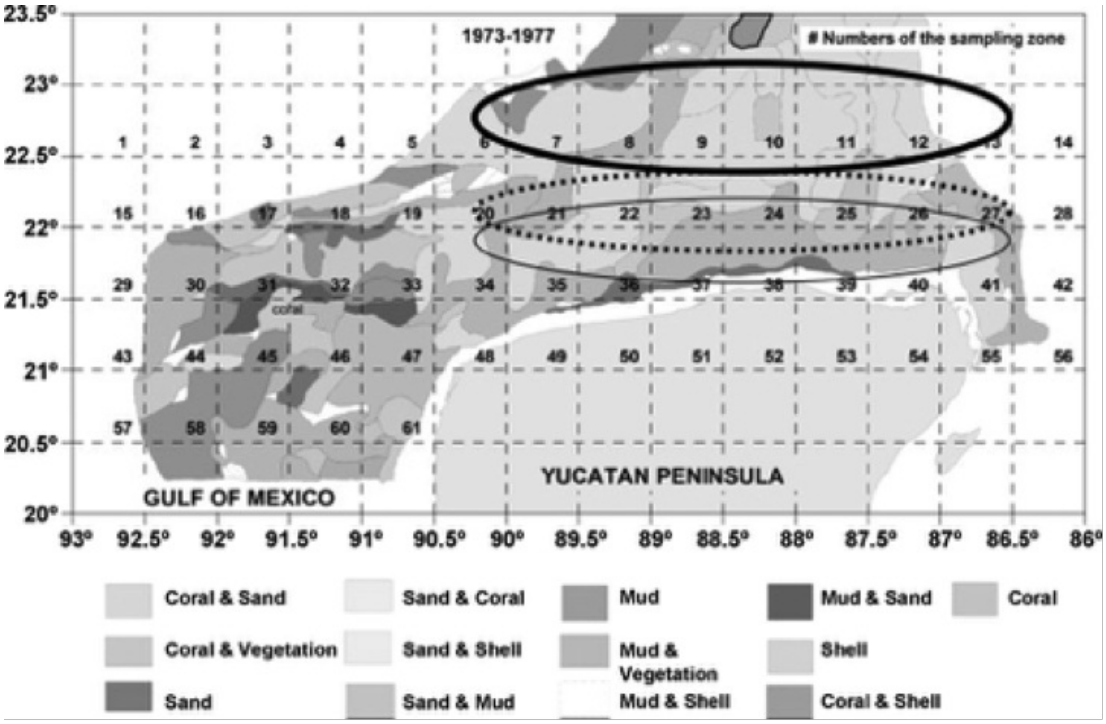

Figure 19: Campeche Bank continental shelf bottom types. Ellipses indicate the gross spatial distribution of red grouper. The thin line encloses juvenile distribution, the dashed line pre-adult, and the bold line adult (image from Garcia 1980 in Albarez-Lucero and Arreguin-Sanchez 2009).

4.2 Modifying Factor: Mitigation of Gear Impacts

Gulf of Mexico - Atlantic, Western Central - Set longlines

+.5

The fishery's new management plan includes some gear restrictions in the Campeche Bank that will mitigate gear impacts (DOF 2014). One restriction comprises the reduction of fishing effort (by reducing the actual number of vessels in the water) {CONAPESCA-SAGARPA 2014} and the creation of fishing refuge areas (DOF 2014). The Celestun fishing refugee was officially created in October 2019; its main objective was to protect red and black grouper areas of importance (CEDEPESCA 2022). It is located opposite Celestun on the eastern coast of the Yucatán Peninsula. Within the refugee zone, the only authorized activity is to catch octopus using the limited impact fishing technique (SADER 2019).

Although the longline restrictions were not intended explicitly for habitat protection, their implementation protected large areas of nearshore waters where coral and live-bottom habitats are common. Although the proportion of protected areas relative to fishing areas could not be quantified for this report, the fishing refugee zone covers an area close to 32,500 ha (Pescando Datos 2024) that could be considered a substantial proportion of the habitats. A +0.5 is deemed adequate to mitigate gear impacts (per line 1

in Table 4.2.1 of the Seafood Watch Standard).

4.3 Ecosystem-based Fisheries Management

Gulf of Mexico - Atlantic, Western Central - Set longlines

High Concern

The Campeche Bank has been studied in detail for several reasons (e.g., fishing activities, oil exploration, and ecology of the region) (Tunnell and Chapman 2000) (Zarco-Perelló 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 is closely related to the amount of biomass available in the natural environment and directly affects 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 the biomass of other predators {Arreguín-Sanchez and Arcos-Huitrón 2011}. In particular, the authors analyzed the average trophic level of landings (ATL). The historical trends for the Campeche Bank indicated that the ATL value was above the limit value of NT = 3.25, called "the marine trophic index" (MTI) by Pauly and Watson (2005). The authors concluded that the trend in the value was mainly driven by the contribution of grouper, of which fishery catch volumes reached close to 20,000 MT in the 1970s. They mentioned that the oscillation of the MTI values was an essential indication of the change in the trophic structure of the catches that could reflect adverse effects on the ecosystem (ibid).

A basic FIP has been in place since 2014 (according to the project profiles, it covers ≈300 MT of the > 4,500 MT produced by the fishery (Fishery Progress 2024). The project had an action item related to improving information regarding the impacts of the fishery on the ecosystem; however, only a report with PSA for the bycatch species within the fishery was published (Alonso-Alemán 2022). 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; except for the Celestun fishing refuge (Pescando Datos 2024), others are not yet in place (DOF 2014).

Overall, because authors have found that there is a likelihood of ecosystem deterioration (if management does not intervene and spatial management is not in place) (Arreguín-Sánchez and Arcos-Huitrón 2011), this factor is rated a "high concern" (per line 1 in table 4.3.1 of the Seafood Watch Standard).

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Scientific review does not constitute an endorsement of the Seafood Watch® program, or its seafood recommendations, on the part of the reviewing scientists. Seafood Watch® is solely responsible for the conclusions reached in this report.

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Appendix A: Update Recommendation

Updates to the Mexican grouper assessment and ratings were made in March 2025. There were no changes in the overall score; however, the following summarizes some updates that were made to the content:

Criterion 1
Abundance and fishing mortality for both species were scored using a recent assessment completed by managers; this evaluation was not available during the previous report.

Criterion 3
Although management remained "ineffective," the rest of the Criterion 3 elements were scored, and included scores of "moderately effective" for research and monitoring and for enforcement, and "highly effective" for inclusion.

Criterion 4
An improvement of 0.5 was added to the mitigation of gear impacts because of the addition of refugee zones that protected a substantial proportion of the habitats.