Monterey Bay Aquarium

Seafood Watch®

California flounder and Cortez halibut

Paralichthys californicus, Paralichthys aestuarius

Mexico: Pacific and Gulf of California

Set gillnets, Bottom trawls

November 14, 2018

Seafood Watch Consulting Researcher

Seafood Watch Standard used in this assessment: Standard for Fisheries vF3

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About Seafood Watch

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

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

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

Guiding Principles

Seafood Watch defines sustainable seafood as originating from sources, whether fished[1] or farmed that can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems.

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

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

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

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

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

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

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

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

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

Summary

California halibut or California flounder (*Paralichthys californic*us) and Cortez halibut (*Paralichthys aestuarius*) are found along the Baja California peninsula (from the Quillayute River in Washington, to Magdalena Bay, Baja California Sur, Mexico), and in the Gulf of California, Mexico, respectively. This report addresses the artisanal bottom gillnet fishery that targets California halibut on the west coast of Baja and in the Northern Gulf of California, as well as the bottom gillnet and industrial finfish bottom trawl fisheries in the northern Gulf of California, Mexico.

Landings reports for flatfish fisheries in Mexico aggregate all flatfish species, which makes it difficult to measure abundance or the impact of fishing effort on a particular species. In addition, no stock assessments have been developed for any flatfish species in Mexico. In 2010, CONAPESCA—the governmental branch in charge of fisheries management—stated that flatfish fisheries in Mexico were at their maximum sustainable levels, and recommended the need to evaluate the status of these species' stocks, and to measure the impact of the different gears on these populations. However, there is no indication that these evaluations have been developed. Instead, managers monitor annual landings by state and compare them against minimum production reference points. If annual production for each state is below the minimum set value of that state, managers implement regulations, although it is unclear what kind of regulations are implemented. Fishing mortality is of moderate concern for both halibut species, as there are no appropriate reference points, and the stock status is unknown.

Recent reports on catch composition were not available for either fishing gear. However, the National Fisheries Chart listed eight species of rays and other flatfish species as associated species in the flatfish fisheries in Mexico, although no analysis of the proportion of each of these species or level of interaction with other organisms/fishing gears was available. Other species likely to interact with halibut fisheries are sea turtles, marine mammals, seabirds, and finfish. Where no abundance or fishing mortality information was available, the Seafood Watch Unknown Bycatch Matrices (UBMs) were used to score these species. Sea turtles, seabirds, and marine mammals were scored as "high" concern for abundance and fishing mortality and limited the Criterion 2 score.

Currently, minimal management restrictions are in place for these fisheries. Management of both fisheries is considered ineffective, as the fisheries lack specific reference points and instead are aggregated with other species, which may not give an accurate picture of the current status of these stocks. There are no quotas or strategies to ensure that stocks are maintained at a sustainable level, and there are no regulations on minimum size limit or mesh size limit that prevents capture of immature organisms. Management also lacks effective monitoring and scientific advice, as well as an effective stakeholder input process. Overall management of retained and discarded species is considered ineffective for California and Cortez halibut fisheries due to lack of information that may overrule the UBM scoring.

The industrial bottom trawl fishery operates predominately over soft sediment, and although some mitigation measures are in place, trawling is shown to have chronic disturbances on the benthos; therefore, impacts of "finfish" trawling on the habitat are of "high" concern. The gillnet fishery has a moderate impact on the benthos because, although it contacts the substrate, it is mostly over soft sediments. Moreover, some habitat impacts are mitigated through area restrictions and net length specifications.

Final Seafood Recommendations

SPECIES/FISHERY	CRITERION 1: IMPACTS ON THE SPECIES	CRITERION 2: IMPACTS ON OTHER SPECIES	CRITERION 3: MANAGEMENT EFFECTIVENESS	CRITERION 4: HABITAT AND ECOSYSTEM	OVERALL RECOMMENDATION
Cortez halibut Mexico Gulf of California, Set gillnets, Mexico	Yellow (2.644)	Red (1.000)	Red (2.000)	Yellow (3.000)	**Avoid (1.995)**
Cortez halibut Mexico Gulf of California, Bottom trawls, Mexico	Yellow (2.644)	Red (0.750)	Red (2.000)	Yellow (2.449)	**Avoid (1.765)**
California flounder:Southern stock Mexico Gulf of California, Bottom trawls, Mexico	Yellow (2.644)	Red (0.750)	Red (2.000)	Yellow (2.449)	**Avoid (1.765)**
California flounder:Southern stock Mexico Pacific, Set gillnets, Mexico	Yellow (2.644)	Red (1.000)	Red (2.000)	Yellow (2.449)	**Avoid (1.897)**

Scoring Guide

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

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

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

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

Introduction

Scope of the analysis and ensuing recommendation

California halibut, also known as California flounder (*Paralichthys californicus*), is found in the Eastern Pacific, from the Quillayute River in northern Washington, US to southern Baja California, Mexico (Hensley 1995). The species is also caught in the upper Gulf of California (INAPESCA 2016). The distribution of Cortez halibut (*Paralichthys aestuarius*) is restricted to the Gulf of California, Mexico (Froese and Pauly 2017). This report addresses the artisanal bottom gillnet fishery that targets California halibut on the West coast of Baja, and the bottom gillnet and industrial bottom trawl fisheries that target finfish species (including Cortez halibut) in the Northern Gulf of California, Mexico. We will refer to this fishery as "industrial finfish."

Species Overview

California halibut (*P. californicus*) inhabits waters of the eastern North Pacific. However, they are most commonly encountered from Bodega Bay, central California, to Bahia de San Quintin, in Baja California (Love and Brooks 1990). They can reach up to 152 cm in length, 33 kg in weight, are found most commonly on soft bottoms near vertical structures (e.g., rocky reef) and can live for up to 30 years (Frey 1971) (Eschemeyer et al., 1983) (Love and Brooks 1990) (Hensley 1995). Males become sexually mature between one and three years old, while females mature at four or five years old (Shanks and Eckert 2005) (CDFG 2012). California halibut are broadcast spawners. Females produce up to a million eggs per spawning event. Successful recruitment depends on favorable environmental conditions and the availability of suitable nursery habitat (CDFG 2012).

Cortez halibut (*Paralichthys aestuarius)* is distributed throughout the Sea of Cortez and the southern portion of the Pacific side of Baja California (Gonzalez-Felix et al. 2014). They can grow to a length of 58.3 cm and are found mostly in soft bottom estuaries up to 44 m of depth (Hensley 1995). Like California halibut, Cortez halibut are broadcast spawners (Breder and Rosen 1966).

In Mexico, two gear types are used to fish commercially for both species: industrial finfish bottom trawlers (Figure 1), and bottom gillnet (small-scale vessels; Figure 2).

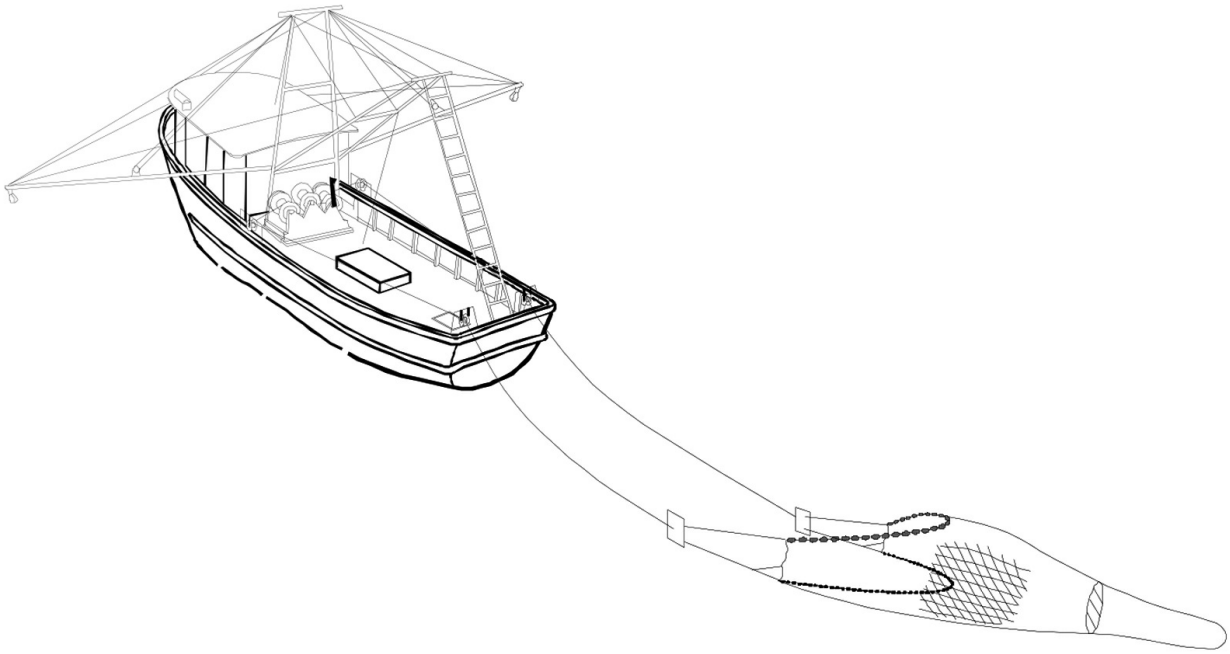

Figure 1

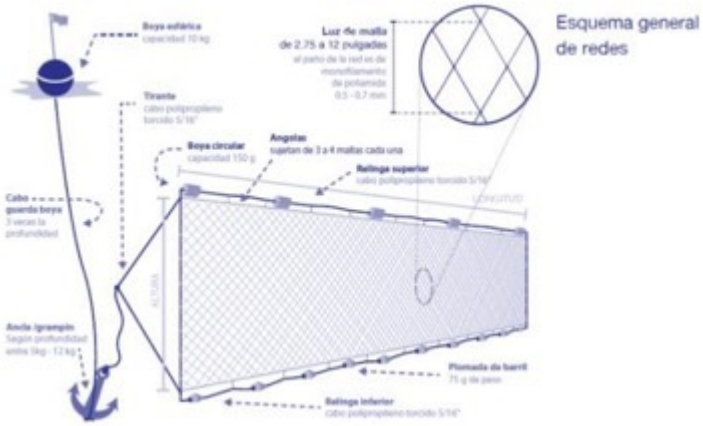

Figure 2

Production Statistics

The fishery is active year-round with highest landings between May and end of July (DOF 2010). Total landings for individual species (California and Cortez halibut) are not available due to the way landings are reported in Mexico (flatfish species are reported as a group). The four states of northwest Mexico (Sonora, Sinaloa, and the two Baja California states) are by far the most important in terms of production, averaging 95% of the total flatfish production (DOF 2010; Figure 3). In 2016, Sonora landed 37% of the total flatfish in the region; Baja California Sur, 25%; Sinaloa, 23%; Baja California, 9%; and the remaining states combined landed the last 6%

(CONAPESCA-SIAP 2016). It is important to mention that Baja California is the only state among these four that has landings from both fleets (industrial and artisanal) and from the Pacific and the Gulf of California (Figure 4). Baja California Sur only has landings from the west coast of Baja from the artisanal fleet; Sonora has landings from both fleets, but only from the Gulf of California; and Sinaloa only reports landings from the artisanal fleet, also only from the Gulf of California.

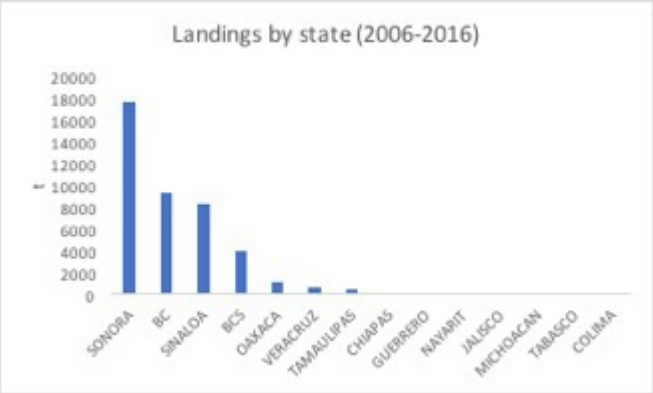

Figure 3 Commercial landings of flatfish by state (metric tons) from 2006 to 2016 (Data source: CONAPESCA-SIAP)

Flatfish landings in 2016 reached 5,500 tons (t) nationally. However, landings reports do not specify the source (e.g., trawlers, gillnet fisheries or shrimp bycatch). The Baja California state chart estimated that between 2005 and 2010, 74% of the state's production was captured by the industrial fleet that operates exclusively inside the Gulf of California (BC 2015) (Figure 4). Although this percentage of landings represents a significant proportion of the industrial fleet in Baja California, evidence that a similar pattern occurs in Sonora (the other state with an industrial fleet) was not available.

Figure 4 Fishing zones for flatfish in Baja California. Industrial vessels operate inside the Gulf, while small scale vessel operate on the West coast of Baja (Source: Baja California State Fisheries Chart, 2015)

Trawling occurs only in the Gulf of California, mostly in the north along the coast of Sonora (north of Tiburon Island), and the region in front of San Felipe in Baja California (Juan M. Caudillo pers. comm. 2018) (Figure 5) (BC 2015) (Caudillo, J 2017) (DOF 2012). These industrial vessels target different finfish species under a "finfish" (called *escama* in Spanish) permit that authorizes trawling vessels (usually shrimp trawlers) to modify their gear and trawl for finfish species (INAPESCA 2000)

Figure 5 Industrial vessels area of operation inside the Gulf of California (Source: Modified from DOF 2010)

Importance to the US/North American market.

Flatfish species in Mexico are mainly sold into the domestic market, although some species—in particular, California halibut—are exported to the US (DOF 2010) (BC 2015). However, it is unclear how much California halibut or other species are reaching the US market, since exports are classified as "flatfish," which likely includes several species. There were 15 MT of "unspecified halibut" imported from Mexico in 2015 (NMFS 2016).

Common and market names.

The common name for *P. californicus* is California halibut. The market name is halibut; other vernacular names include bastard halibut and Monterey halibut (FDA 2017).

The common name for *P. aestuarius* is Cortez halibut, another acceptable market name is flounder (FDA 2017)

Primary product forms

California halibut is primarily exported into the US as fresh fillets, and similarly with the category "flounder" where Cortez halibut might be included.

Assessment

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

Criterion 1: Impacts on the Species Under Assessment

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

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

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

Guiding Principles

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

Criterion 1 Summary

CALIFORNIA FLOUNDER / SOUTHERN STOCK			
Region | Method	**Abundance**	**Fishing Mortality**	**Score**
Mexico/Gulf of California | Bottom trawls | Mexico	2.33: Moderate Concern	3.00: Moderate Concern	Yellow (2.644)
Mexico/Pacific | Set gillnets | Mexico	2.33: Moderate Concern	3.00: Moderate Concern	Yellow (2.644)

CORTEZ HALIBUT			
Region | Method	**Abundance**	**Fishing Mortality**	**Score**
Mexico/Gulf of California | Set gillnets | Mexico	2.33: Moderate Concern	3.00: Moderate Concern	Yellow (2.644)
Mexico/Gulf of California | Bottom trawls | Mexico	2.33: Moderate Concern	3.00: Moderate Concern	Yellow (2.644)

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.*

CALIFORNIA FLOUNDER SOUTHERN STOCK

Factor 1.1 - Abundance

MEXICO/GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO
MEXICO/PACIFIC, SET GILLNETS, MEXICO

Moderate Concern

The IUCN lists California halibut as "Least Concern." The assessment is based on 2004 landings data from the US (Lea and van der Heiden 2010). However, not much information is generated from Mexico, and no formal stock assessment is available for California halibut in the country. For this reason, a Productivity-Susceptibility Analysis (PSA) was used to score this factor.

The PSA score = 3.07, hence this species has a medium vulnerability to fishing. Detailed scoring of each attribute is shown below. Because California halibut has a medium inherent vulnerability and there is no quantitative stock assessment, abundance is deemed a "moderate" concern.

Justification:

Productivity Attribute	Relevant Information	Score (1 = low risk, 2 = medium risk, 3 = high risk)
Average age at maturity	Males could become sexually mature between one and three years old (Shanks and Eckert 2005); females could become mature at four or five years old (CalCOFI 2012)	2
Average maximum age	Up to 30 y (Shanks and Eckert 2005)	3
Fecundity	Batch fecundity estimates around 500,000 oocytes. (Shanks and Eckert 2005)	1
Average maximum size (fish only)	Can reach up to 152 cm in length (Eschemeyer et al. 1983)	2
Average size at maturity (fish only)	50% Males mature at 27 cm fork length (FL) and 100% mature by 29%; 50% of females mature by 47.3 cm and 100% by 51.3 cm (Lesyna and Barnes 2016)	2
Reproductive strategy	Broadcast spawner (Breden and Rosen 1966)	1
Trophic level	4.5 (Froese and Pauly 2017)	3
Density dependence (invertebrates only)	-	-
Habitat quality score	N / A	N / A
Total Productivity (average)		2.0

Susceptibility Attribute	Relevant Information	Score (1 = low risk, 2 = medium risk, 3 = high risk)
Areal overlap (Considers all fisheries)	California halibut is fished throughout its range: from California in the US to south of the Baja Peninsula (Lea and van der Heiden 2010)	3
Vertical overlap (Considers all fisheries)	California halibut occurs from near shore to 183 m depth and feeds during the day (Froese and Pauly 2017); these areas are fished by the artisanal fleet (DOF 2010)	3
Selectivity of fishery (Specific to fishery under assessment)	Unknown. Default score is used.	2
Post-capture mortality (Specific to fishery under assessment)	Unknown. Default score is used.	3
Total Susceptibility (multiplicative)		2.33

PSA score for California halibut set gillnet fishery is calculated as follows:

Vulnerability (V) = √(P^2+ S^2)

V = √(〚2〛 ^2+ 〚2]^2+(2.33^2))

V = 3.07

Factor 1.2 - Fishing Mortality

MEXICO/GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO
MEXICO/PACIFIC, SET GILLNETS, MEXICO

Moderate Concern

Fishing mortality data were not available for California halibut. Managers rely on the production by each state as an indicator of the status of the fishery (e.g., if landings in Baja California are below 200 t/year, some management changes are introduced (DOF 2012)). Since fishing mortality is unknown, this factor is rated as a "moderate" concern.

Justification:

It is unclear how many boats are authorized and actively fishing on the west coast of Baja and the Gulf of California. According to a 2013 report, more than 100,000 small vessels known as “pangas” were operating in Mexico, with a high percentage of those in the northwestern states (IMCO et al 2013). It is uncertain, however, how many are actively fishing in the region, and of these, the number that actively target flatfish. Although Lopez-Martinez (2011) stated that at least 53 trawlers based in Puerto Peñasco, Sonora, owned a finfish permit in 2011 (Lopez-Martinez 2011), the exact number of trawlers actively fishing and targeting finfish in the upper Gulf of California is unknown.

CORTEZ HALIBUT

Factor 1.1 - Abundance

MEXICO/GULF OF CALIFORNIA, SET GILLNETS, MEXICO

Moderate Concern

There is no formal stock assessment for Cortez halibut, and the IUCN lists this species as "Data Deficient" (van der Heiden and Findley 2010). Consequently, we conducted a Productivity-Susceptibility Analysis (PSA) to score this factor.

The PSA score =2.91, which indicates a medium inherent vulnerability to fishing. Detailed scoring of each attribute is shown below. Because Cortez halibut has a medium vulnerability and there is no quantitative stock assessment, abundance is deemed a "moderate" concern.

Justification:

Productivity Attribute	Relevant Information	Score (1 = low risk, 2 = medium risk, 3 = high risk)
Average age at maturity	3 years. (value used from a similar species; (Shanks and Eckert, 2005)	1
Average maximum age	N/A	
Fecundity	N/A	
Average maximum size (fish only)	Can reach up to 58.3 cm in length (Froese and Pauly 2017)	1
Average size at maturity (fish only)	N/A	
Reproductive strategy	Broadcast spawner (Froese and Pauly 2017)	1
Trophic level	4.2 (Froese and Pauly 2017)	3
Density dependence (invertebrates only)	-	-
Total Productivity (average)		1.5

Susceptibility Attribute	Relevant Information	Score (1 = low risk, 2 = medium risk, 3 = high risk)
Areal overlap (Considers all fisheries)	Cortez halibut is endemic to the Mexican Pacific, found in the Gulf of California (Lea and van der Heiden 2010)	3
Vertical overlap (Considers all fisheries)	Cortez halibut inhabits soft bottoms, from estuaries and up to a depth of 93 m (Galvan-Magaña et al. 2000); these areas are fished by the artisanal fleet (DOF 2010)	3
Selectivity of fishery (Specific to fishery under assessment)	Unknown. Default score is used.	2
Post-capture mortality (Specific to fishery under assessment)	Unknown. Default score is used.	3
Total Susceptibility (multiplicative)		2.32

PSA score for California halibut bottom gillnet fishery is calculated as follows:

Vulnerability (V) =√(P^2+ S^2)

V = √(〖1.5〗 ^2+ 〖1.5^2+(2.32^2))

V = 2.91

MEXICO/GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO

Moderate Concern

It is believed that Cortez halibut stock targeted by the finfish industrial fishery (bottom trawlers) is the same stock that is targeted by the artisanal fleet (DOF 2012). Because Cortez halibut has a medium vulnerability to fishing and there is no quantitative stock assessment, abundance is deemed a "moderate" concern.

Factor 1.2 - Fishing Mortality

MEXICO/GULF OF CALIFORNIA, SET GILLNETS, MEXICO

Moderate Concern

Similar to California halibut on the West Coast, information related to the fishing effort is not available for Cortez halibut. Since information on fishing mortality is not available, and the levels of other sources of fishing mortality (industrial or shrimp trawlers) are also lacking; this factor is deemed a "moderate" concern.

Justification:

In 2006, (Rodriguez-Valencia and Cisneros-Mata 2006) estimated that at least 40,000 fishers were part of the small-scale fleet active in the Gulf of California.

In addition, it was found that flatfish species are incidentally caught in the industrial bottom trawls that target shrimp in the Gulf of California (INAPESCA 2017) (Lopez-Martinez and Morales-Bojorquez 2012) (Rabago-Quiroz et al. 2015). Managers reported that at least fourteen flatfish species, including Cortez halibut, are caught as bycatch by these bottom trawlers (INAPESCA 2016).

According to Rabago-Quiroz (2015), in 2003 flatfishes represented between 5 and 12% of the total bycatch of this fleet (Rabágo-Quiroz et al. 2015). The report concluded that most of the flatfishes incidentally captured by shrimp trawlers are small in size (5 to 25 cm TL), which likely means that they are catching juveniles, hence detrimentally affecting the halibut fishery through growth overfishing (Rabágo-Quiroz et al. 2015). However, Cortez halibut was not identified as one of the most important flatfish species reported in the bycatch by these authors.

MEXICO/GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO

Moderate Concern

Similar to California halibut on the West Coast, information related to the fishing effort is not available for Cortez halibut. Since information on fishing mortality is not available, and the levels of other sources of fishing mortality (artisanal or shrimp trawlers) are also lacking; this factor is deemed a "moderate" concern.

Justification:

The number of industrial finfish vessels targeting Cortez halibut is unknown. According to managers, at least three fleets take part in this fishery: Puerto Peñasco and Guaymas in Sonora, and San Felipe in Baja California (INAPESCA) (BC 2015). However, there is no information regarding the exact number of vessels that are actively fishing.

Furthermore, some flatfish species are incidentally caught in the industrial bottom trawls that target shrimp in the Gulf of California (Rabágo-Quiroz et al. 2015), although Cortez halibut is not one of the main species present in the bycatch.

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

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

CALIFORNIA FLOUNDER / SOUTHERN STOCK - MEXICO/GULF OF CALIFORNIA - BOTTOM TRAWLS - MEXICO					
Subscore:	**1.000**	**Discard Rate:**	**0.75**	**C2 Rate:**	**0.750**

Species	Abundance	Fishing Mortality	Subscore
Sea turtle (unspecified)	1.00:High Concern	1.00:High Concern	Red (1.000)
Mammals	1.00:High Concern	1.00:High Concern	Red (1.000)
Sharks	1.00:High Concern	1.00:High Concern	Red (1.000)
Seabirds	1.00:High Concern	1.00:High Concern	Red (1.000)
Rays (unspecified)	1.00:High Concern	3.00:Moderate Concern	Red (1.732)
Cortez halibut	2.33:Moderate Concern	3.00:Moderate Concern	Yellow (2.644)
Finescale triggerfish	2.33:Moderate Concern	3.00:Moderate Concern	Yellow (2.644)
Bigeye croaker	2.33:Moderate Concern	3.00:Moderate Concern	Yellow (2.644)
Spotted rose snapper	2.33:Moderate Concern	3.00:Moderate Concern	Yellow (2.644)

CALIFORNIA FLOUNDER / SOUTHERN STOCK - MEXICO/PACIFIC - SET GILLNETS - MEXICO					
Subscore:	**1.000**	**Discard Rate:**	**1.00**	**C2 Rate:**	**1.000**

Species	Abundance	Fishing Mortality	Subscore
Sea turtle (unspecified)	1.00:High Concern	1.00:High Concern	Red (1.000)
Mammals	1.00:High Concern	1.00:High Concern	Red (1.000)
Sharks	1.00:High Concern	1.00:High Concern	Red (1.000)
Seabirds	1.00:High Concern	1.00:High Concern	Red (1.000)
Finfish	2.33:Moderate Concern	1.00:High Concern	Red (1.526)
Rays (unspecified)	1.00:High Concern	3.00:Moderate Concern	Red (1.732)

CORTEZ HALIBUT - MEXICO/GULF OF CALIFORNIA - BOTTOM TRAWLS - MEXICO					
Subscore:	**1.000**	**Discard Rate:**	**0.75**	**C2 Rate:**	**0.750**

Species	Abundance	Fishing Mortality	Subscore
Sea turtle (unspecified)	1.00:High Concern	1.00:High Concern	Red (1.000)
Mammals	1.00:High Concern	1.00:High Concern	Red (1.000)
Sharks	1.00:High Concern	1.00:High Concern	Red (1.000)
Seabirds	1.00:High Concern	1.00:High Concern	Red (1.000)
Rays (unspecified)	1.00:High Concern	3.00:Moderate Concern	Red (1.732)
Finescale triggerfish	2.33:Moderate Concern	3.00:Moderate Concern	Yellow (2.644)
Bigeye croaker	2.33:Moderate Concern	3.00:Moderate Concern	Yellow (2.644)
Spotted rose snapper	2.33:Moderate Concern	3.00:Moderate Concern	Yellow (2.644)
California flounder / Southern stock	2.33:Moderate Concern	3.00:Moderate Concern	Yellow (2.644)

CORTEZ HALIBUT - MEXICO/GULF OF CALIFORNIA - SET GILLNETS - MEXICO					
Subscore:	**1.000**	**Discard Rate:**	**1.00**	**C2 Rate:**	**1.000**

Species	Abundance	Fishing Mortality	Subscore
Sea turtle (unspecified)	1.00:High Concern	1.00:High Concern	Red (1.000)
Mammals	1.00:High Concern	1.00:High Concern	Red (1.000)
Sharks	1.00:High Concern	1.00:High Concern	Red (1.000)
Seabirds	1.00:High Concern	1.00:High Concern	Red (1.000)
Finfish	2.33:Moderate Concern	1.00:High Concern	Red (1.526)
Rays (unspecified)	1.00:High Concern	3.00:Moderate Concern	Red (1.732)

The bycatch and other retained species caught in the Cortez and California halibut fisheries are unknown. The National Fisheries Chart (CNP) listed eight species of rays and other flatfish as associated species in the flatfish fisheries in Mexico (DOF 2010). They are as follows: fourspot flounder (*Hippoglossina tetropthalmus)*, diamond turbot *(Hypsopsetta guttulata)*, Pacific dove sole *(Microstomus pacificus)*, bigmouth sanddab *(Citharichthys gilberti)*, longfin sanddab *(C. xanthostigma)*, longnose eagle ray *(Myliobatis longirostris)*, bat eagle ray *(M. californica)*, diamond stingray *(Dasyatis dipterura)*, toothed flounder *(Cyclopsetta querna),* and three-spot flounder *(Ancyclopsetta dendritica)*.

None of these associated species are common (<5% of the total catch), nor are they of high conservation concern, although specific proportions of each of these species or the level of interaction with other organisms and fishing gears were not available. For this reason, these species were not assessed separately, but rather grouped under the "finfish" or "rays" taxa.

In addition, the hake fishery has an onboard observer program. These vessels also target finfish including halibut. According to a 2017 bycatch report, three species of finfish represent more than 86% of the finfish catch associated with the halibut—bigeye croaker (*Micropogonias megalops*), finescale triggerfish (*Balistes polylepis*), and spotted rose snapper (*Lutjanus guttatus*)—comprising 62.5%, 10.51%, and 4.67% of the bycatch, respectively. Thus, we also included these three species in C2.

Other taxa that are most likely to interact with the halibut fisheries include sea turtles, seabirds, marine mammals, sharks, and additional finfish species, which were included in the assessment. Since abundance and fishing mortality estimates are not available for these taxa in the halibut fisheries, they were scored using the SFW Unknown Bycatch Matrices (UBMs).

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)

SEA TURTLE (UNSPECIFIED)

Factor 2.1 - Abundance

MEXICO / GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO
MEXICO / GULF OF CALIFORNIA, SET GILLNETS, MEXICO
MEXICO / PACIFIC, SET GILLNETS, MEXICO

High Concern

Sea turtle abundance is scored as "high" concern due to their high inherent vulnerability and their "Endangered" or "Threatened" status under the IUCN and US ESA.

Justification:

Five species of marine turtles feed or nest in the Gulf of California (Brusca 2010): green turtle (*Chelonia midas*), loggerhead turtle (*Caretta caretta*), hawksbill (*Eretmochelys imbricate*), olive ridley (*Lepidochelys*

olivacea), and leatherback (*Dermochelys coriacea*).

Several areas inside the Gulf of California have been identified as important foraging sites: the Midriff Islands (Tiburon and Angel de la Guarda Island), Bahia de Los Angeles, and Loreto (Brusca 2010). On the west coast of Baja, the Gulf of Ulloa is one of the most important feeding and nesting areas of loggerhead and green turtles (Peckham et al 2017) (CONAPESCA 2014)

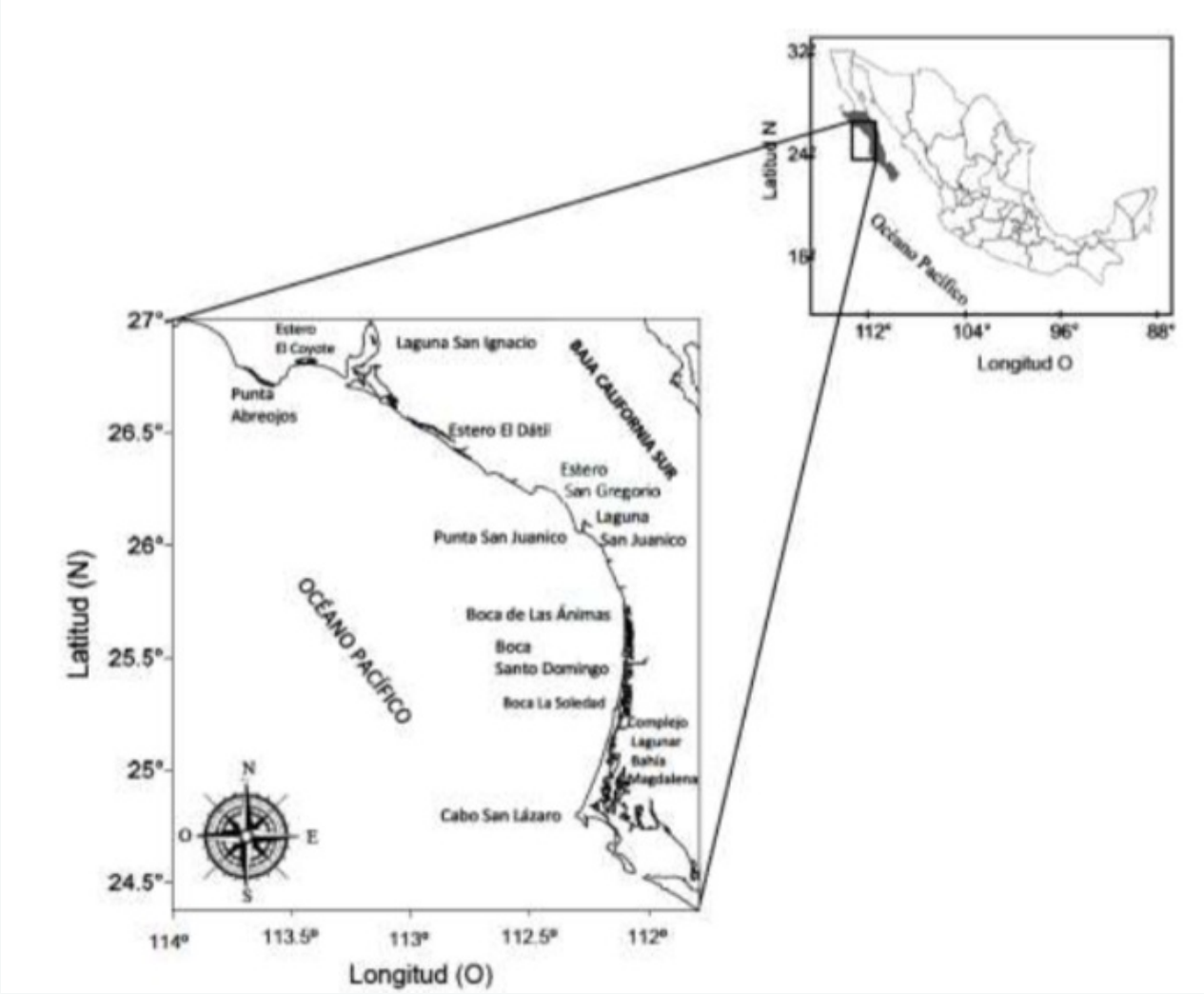

Figure 6 Gulf of Ulloa on the West Coast of Baja (Source: Valdez-Leyva, 2012)

Factor 2.2 - Fishing Mortality

MEXICO / GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO

High Concern

This score was calculated using the Seafood Watch Unknown Bycatch Matrix, which evaluates turtle bycatch susceptibility by regions and gear type. Based on the matrix, fishing mortality is scored as "high" concern because sea turtles are highly susceptible to interactions with gillnets and trawls in most regions, and currently there are no data that overrule the matrix.

Justification:

Currently, there is a federal, onboard observer program that operates on the shrimp vessels (CONAPESCA

2017). In addition, there is another observer program, paid by the industry, that focuses mostly on the trips that the industrial fleet operates targeting hake (Pers. comm. EDF Mexico 2018). Although these observers occasionally are on the vessels when the fleet targets finfish (including halibut), there are no reports or data available to measure the impact of the fishery on non-targeted species (including turtles). Considering that there is not enough information to override the use of the UBM, we used the tool to score this indicator.

MEXICO / GULF OF CALIFORNIA, SET GILLNETS, MEXICO
MEXICO / PACIFIC, SET GILLNETS, MEXICO

High Concern

For set gillnet fisheries in the eastern central Pacific, sea turtles are scored a 1 out of 5, or "high" concern, for fishing mortality using the SFW UBM.

Justification:

In Mexico, a total ban on sea turtle extraction has been in place since the 1990s (DOF 1993). Nevertheless, the Gulf of Ulloa along the Pacific coast of the BCS, which is a highly productive foraging hotspot with the highest concentration of North Pacific loggerheads, presents a large number of dead turtle during the flatfish season in spring/summer (Rodriguez-Valencia and Cisneros-Mata 2006) (Peckham et al. 2015). In 2012, a massive increase in turtle strandings (presumably bycatch that was discarded) was found in the Gulf of Ulloa (Excelsior 2014).

Since then, and under the pressure of a commercial embargo, managers established a two-year fishery reserve in the Gulf of Ulloa (DOF 2014). Loggerhead turtle mortality for commercial fishing vessels is limited to 90 individuals, and if that threshold is met, gillnet and longline activities are suspended for the rest of the year (DOF 2015). In addition, electronic monitoring of fishing and bycatch in the absence of an onboard observer is mandatory, and gear regulations to restrict soak time of gillnets to six continuous hours in the restricted area was enacted (DOF 2015). Although researchers agreed that fishing mortality of sea turtles in the region has decreased, it is still a problem in the region (Senko et al. 2017).

Information about the fatal interactions of gillnets with turtles are available only for loggerheads (see above). However, information about other turtle species that are known to inhabit the two regions (west coast of Baja and Gulf of California; e.g., highly endangered leatherback) (NOAA 2017) was not available, but was considered as part of the scoring.

Similar to the gillnet fishery on the west coast of Baja, some turtle interactions have been reported in the Gulf of California. A 2006 report funded by WWF compiled reports of turtle mortalities in Sonora and the east coast of Baja California (Rodriguez-Valencia and Cisneros-Mata 2006). The report concluded that sea turtle fishing mortality is still a problem in the region particularly with the use of gillnets (Rodriguez-Valencia and Cisneros-Mata 2006)

Factor 2.3 - Modifying Factor: Discards and Bait Use

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

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

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

MEXICO / GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO

≥ 100%

Information on the amount of discards from the industrial "scale" trawling fleet is lacking. If compared to the California halibut bottom trawl fishery, and the most recent observer data from 2014, discard rates appear to be greater than 100% (NWFSC 2016). Therefore, the discard rate/landings for this fishery is scored as >100%.

MEXICO / GULF OF CALIFORNIA, SET GILLNETS, MEXICO

< 100%

Information on the number of discards from the set gillnet fishery is lacking. Fishery experts state that most of the incidental, lower-value species caught in the Gulf of California fishery are retained for commercial or personal consumption (Rene Loaiza pers. comm. CEDO 2018); hence, a score of <100% is given.

MEXICO / PACIFIC, SET GILLNETS, MEXICO

< 100%

In their 2011 study on the impact of gillnets in Baja California, Shester and Micheli (2011) found that set gillnets discarded an average of 35% of the total biomass (45% in number) of the total catch (Figure 6). Therefore, the discard rate/landing is scored as <100%.

Justification:

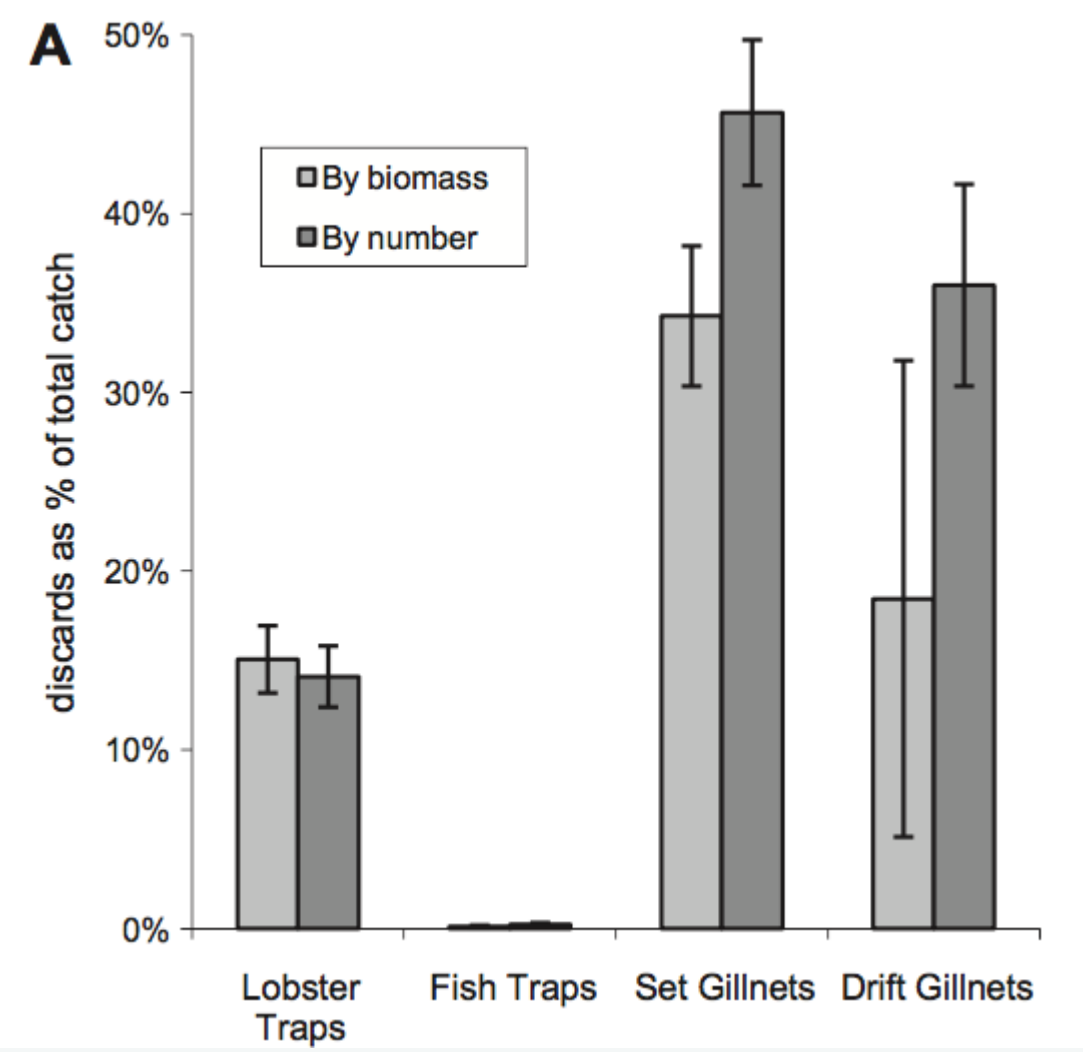

Figure 7 Percentage of discards in biomass and number of organisms in Baja California Sur (Source: Shester and Micheli, 2011)

MAMMALS

Factor 2.1 - Abundance

MEXICO / GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO
MEXICO / GULF OF CALIFORNIA, SET GILLNETS, MEXICO
MEXICO / PACIFIC, SET GILLNETS, MEXICO

High Concern

Marine mammal abundance is scored as "high" concern due to their high inherent vulnerability, their depleted status, and their endangered or threatened classification under the official Mexican norm, NOM-059-SEMARNAT, the U.S. Endangered Species Act, and the International Union for Conservation of Nature (IUCN).

Justification:

Several marine mammal species inhabit the Mexican Pacific (including the West coast of Baja) and the Gulf of California (Niño-Torres et al 2011). Some of these are included in the official Mexican norm, NOM-059-SEMARNAT, which contains species considered either endangered, threatened, or need special protection (DOF 1995).

In the upper Gulf of California, one species of special concern is the vaquita (*Phocoena sinus*). The vaquita is endemic to the Northern Gulf of California (CIRVA 2016) and its distribution overlaps with the area where the flatfish fisheries operate (see map). Vaquita abundance is critically low, with less than 30 animals left (CIRVA 2016). Experts attribute their interactions with gillnets that target totoaba (*Totoaba macdonaldi*) as the main source of mortality (CIRVA 2016).

Other important species listed in the norm and that are commonly found in the Mexican waters are gray whale (*Eschrichtius robustus*), humpback whale (*Megaptera novaeangliae*), blue whale (*Balaenoptera musculus musculus*), fin whale (*Balaenoptera physalus*), the common bottlenose dolphin (*Tursiops truncatus*) ,and the Californian sea lion (*Zalophus californianus*) (DOF 2010).

Factor 2.2 - Fishing Mortality

MEXICO / GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO
MEXICO / GULF OF CALIFORNIA, SET GILLNETS, MEXICO
MEXICO / PACIFIC, SET GILLNETS, MEXICO

High Concern

For set gillnet fisheries in the eastern central Pacific, marine mammals are scored 1 out of 5; bottom trawlers scored 2 out of 5, or "high" concern, for fishing mortality using the SFW UBM. Marine mammals are highly susceptible to interactions with gillnets and trawls; therefore, we rate this as "high" concern.

Justification:

Specific information about the interaction between halibut fisheries (artisanal and industrial) and marine mammals in Mexico is lacking. However, some information about the interaction of fishing gears (mainly gillnets) used to catch halibut and marine mammals are available on both the west coast of Baja and the Gulf of California, and are included in the assessment.

In 2003, Gallo-Reynoso analyzed the mortality of marine mammals related to fishing activities in Guaymas, Sonora (Gallo-Reynoso 2003). He found that gillnets were the main source of negative interactions with marine mammals in the region (Gallo-Reynoso 2003). The study listed at least seventeen documented cases of marine mammals that were found trapped in gillnets and died or were severely injured. Among the cases, the most common species were gray whales, California sea lions, dolphins, and sperm whales (Gallo-Reynoso 2003). The author concluded that the results of his research could be used as a reference for the rest of the Gulf of California where there are similar species and fisheries (Gallo-Reynoso 2003). It is important to reaffirm that the Gulf of California is a well-known calving ground for gray whales (DOF 2012).

The National Fisheries Chart reported that the different marine mammals in Mexico are at risk of being impacted by fishing activities. However, no data on level of interaction was estimated. The exception was humpback whales, where 39 animals were reported to be caught in gillnets inside the Gulf of California between 2000 and 2009 (DOF 2010). Managers stated that no program to report similar events existed on the west coast of Baja (DOF 2010).

There is a particular concern about humpback whales due to the endangered and threatened status of the two Distinct Population Segments (DPSs): the Mexican and Central American (Hanson et al 2017). They have been documented to interact with the California halibut fishery (SFW CA Halibut report), so it is likely that the Mexican fishery interacts with them as well. In addition, humpback winter aggregations reach the northern Gulf of California (DOF 2010) (Brusca 2010) (Hanson et al. 2017).

Factor 2.3 - Modifying Factor: Discards and Bait Use

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

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

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

MEXICO / GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO

≥ 100%

Information on the amount of discards from the industrial "scale" trawling fleet is lacking. If compared to the California halibut bottom trawl fishery, and the most recent observer data from 2014, discard rates appear to be greater than 100% (NWFSC 2016). Therefore, the discard rate/landings for this fishery is scored as >100%.

MEXICO / GULF OF CALIFORNIA, SET GILLNETS, MEXICO

< 100%

Information on the number of discards from the set gillnet fishery is lacking. Fishery experts state that most of the incidental, lower-value species caught in the Gulf of California fishery are retained for commercial or personal consumption (Rene Loaiza pers. comm. CEDO 2018); hence, a score of <100% is given.

MEXICO / PACIFIC, SET GILLNETS, MEXICO

< 100%

In their 2011 study on the impact of gillnets in Baja California, Shester and Micheli (2011) found that set gillnets discarded an average of 35% of the total biomass (45% in number) of the total catch (Figure 6). Therefore, the discard rate/landing is scored as <100%.

Justification:

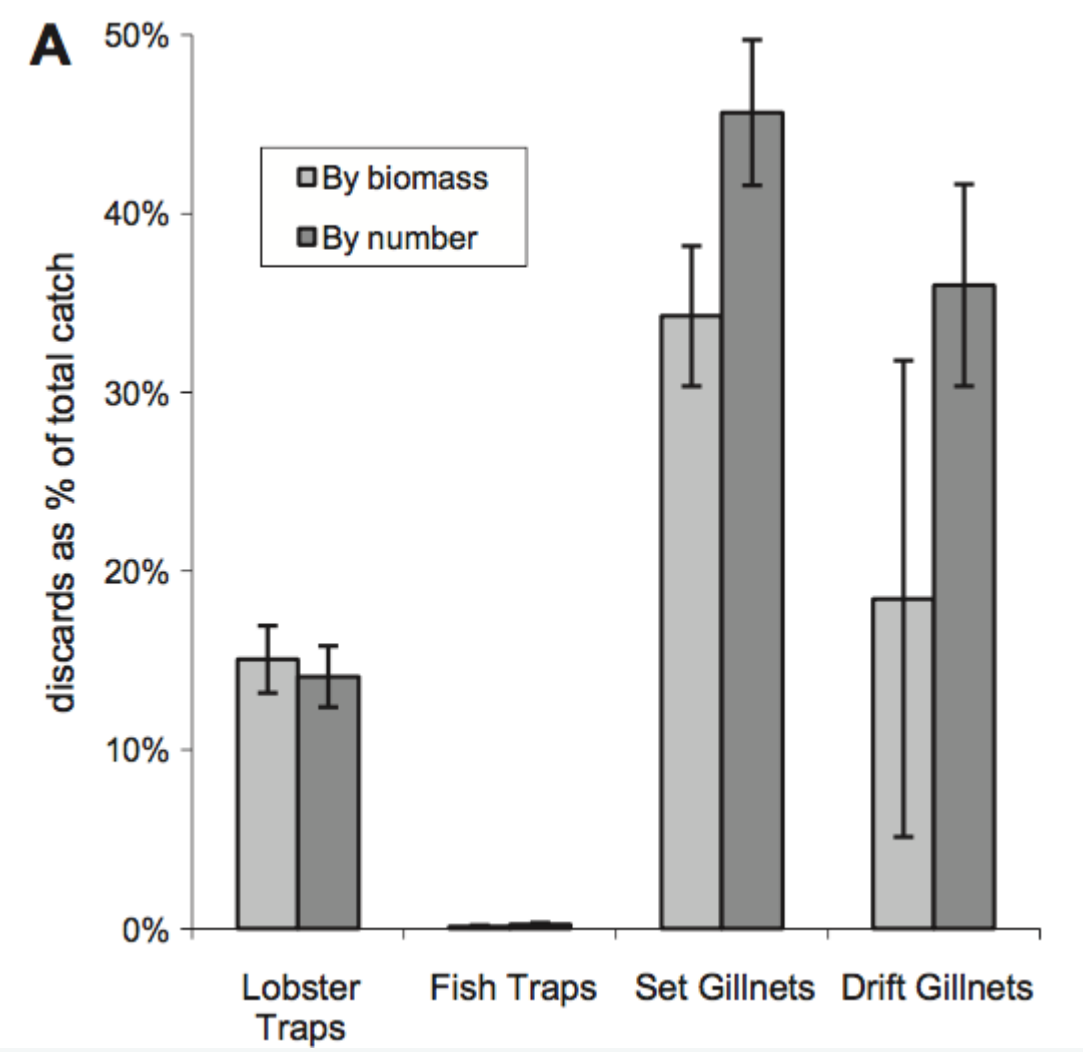

Figure 8 Percentage of discards in biomass and number of organisms in Baja California Sur (Source: Shester and Micheli, 2011)

SHARKS

Factor 2.1 - Abundance

MEXICO / GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO
MEXICO / GULF OF CALIFORNIA, SET GILLNETS, MEXICO
MEXICO / PACIFIC, SET GILLNETS, MEXICO

High Concern

Shark abundance is scored as "high" concern due to their high inherent vulnerability and the endangered or threatened status of some species in the area.

Justification:

Several species of sharks inhabit the waters of the west coast of Baja and the Gulf of California (DOF 2010). Some of these species, like the white shark, are listed in the NOM-059-SEMARNAT as species of special concern (DOF 1995). Although information related to interactions with halibut fisheries in Mexico are not available, interactions with similar gears in the US California Halibut fishery have been reported (SFW 2017) and included in this report for that reason.

Factor 2.2 - Fishing Mortality

MEXICO / GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO
MEXICO / GULF OF CALIFORNIA, SET GILLNETS, MEXICO
MEXICO / PACIFIC, SET GILLNETS, MEXICO

High Concern

This score was calculated using the Seafood Watch Unknown Bycatch Matrix. For sharks, bycatch susceptibility was evaluated by region and gear type. In the case of the eastern Pacific, fishing mortality of sharks was scored as a "high" concern because sharks are highly susceptible to interactions with trawls and gillnets.

Justification:

Similar to rays, Mexico has fisheries that target several species of sharks along the Pacific Coast (DOF 2010). In addition, several species are reported to be caught as bycatch in fisheries that use gillnets (Marquez-Farias 2011). The real impact of these fisheries on shark populations is unknown.

Recent results from an onboard observer program on the industrial vessels that target finfish reported that at least four species of sharks—Mexican hornshark (*Heterodontus mexicanus*), brown smoothhound (*Mustelus henlei), s*icklefin smoothhound (*M. lunulatus*), and Pacific angelshark (*Squatina californica*)—are present as bycatch in the fishery (Stravinsky 2017). Of these species, angel shark is listed as "Near Threatened" by the IUCN (Cailliet et al. 2016), while others are data deficient or "least" concern but with serious lack of information (Perez-Jimenez et al. 2016) (Garayzar 2016).

Factor 2.3 - Modifying Factor: Discards and Bait Use

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

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

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

MEXICO / GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO

≥ 100%

Information on the amount of discards from the industrial "scale" trawling fleet is lacking. If compared to the California halibut bottom trawl fishery, and the most recent observer data from 2014, discard rates appear to be greater than 100% (NWFSC 2016). Therefore, the discard rate/landings for this fishery is scored as >100%.

MEXICO / GULF OF CALIFORNIA, SET GILLNETS, MEXICO

< 100%

Information on the number of discards from the set gillnet fishery is lacking. Fishery experts state that most of the incidental, lower-value species caught in the Gulf of California fishery are retained for commercial or personal consumption (Rene Loaiza pers. comm. CEDO 2018); hence, a score of <100% is given.

MEXICO / PACIFIC, SET GILLNETS, MEXICO

< 100%

In their 2011 study on the impact of gillnets in Baja California, Shester and Micheli (2011) found that set gillnets discarded an average of 35% of the total biomass (45% in number) of the total catch (Figure 6). Therefore, the discard rate/landing is scored as <100%.

Justification:

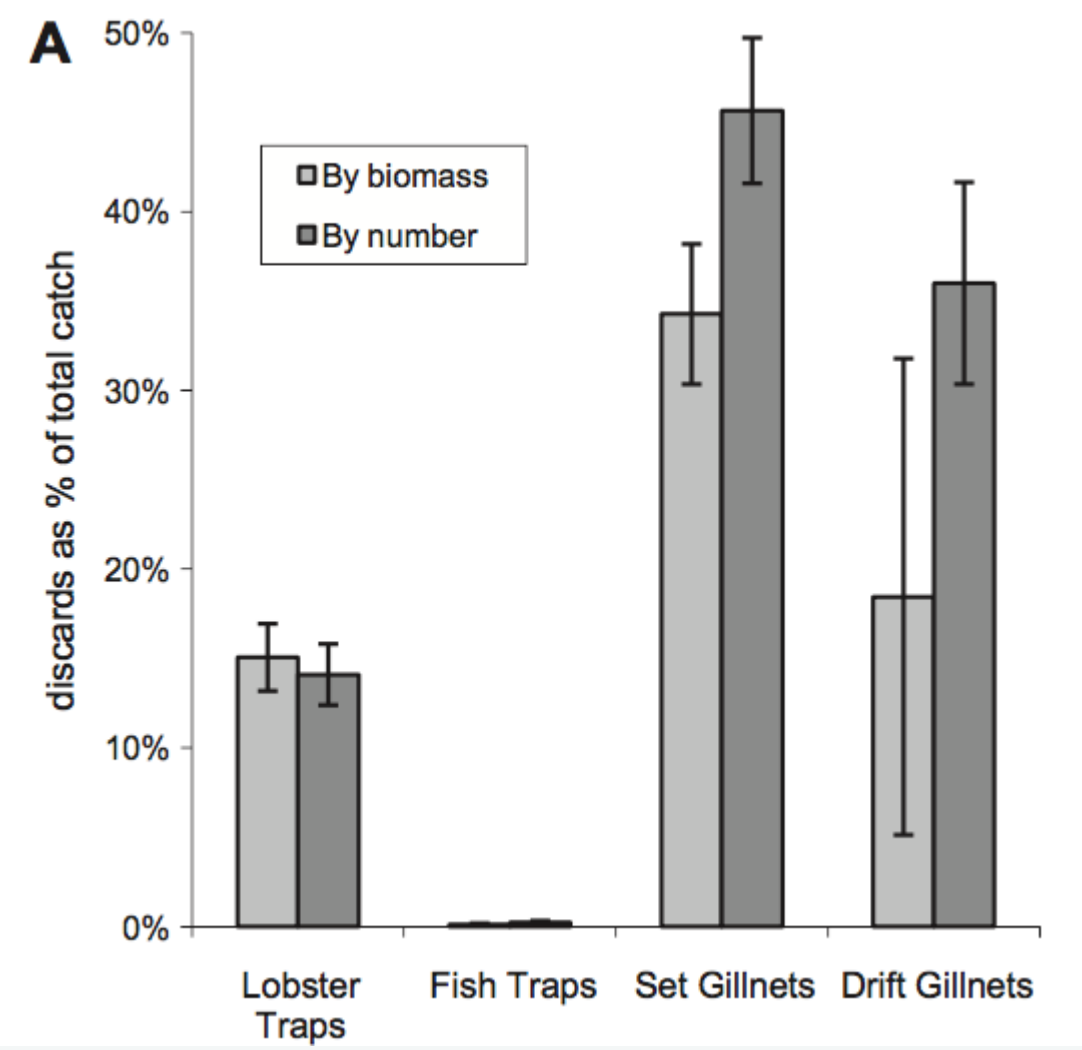

Figure 9 Percentage of discards in biomass and number of organisms in Baja California Sur (Source: Shester and Micheli, 2011)

SEABIRDS

Factor 2.1 - Abundance

MEXICO / GULF OF CALIFORNIA, SET GILLNETS, MEXICO
MEXICO / PACIFIC, SET GILLNETS, MEXICO
MEXICO / GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO

High Concern

Seabird abundance is scored as "high" concern due to their high inherent vulnerability and the endangered or threatened status of some species in the area.

Justification:

Information about interactions with seabirds and Mexican fisheries is scarce. To evaluate the presence of endangered species, we used the American Bird Conservancy mapping tool (http://www.fisheryandseabird.info/). Based on the area of operation of the halibut fishery, most of the species found in the region are listed as "Least Concern" by IUCN. However, three species, Laysan albatross (*Phoebastria*), sooty shearwater (*Ardenna grisea*), and Heermann's gull (*Larus heermanni*) have been documented as bycatch and are listed as "Near Threatened" (NT). Only the Guadalupe murrelet (S*ynthliboramphus hypoleucus*) was listed as "Endangered" and documented in gillnets. In the case of trawlers inside the Gulf, the mapping tool lists sooty shearwater and Heermann's gull ("Near Threatened") as documented in bycatch, but no threatened or endangered species. There is not enough information to override the use of the UBM for seabirds. For that reason, we scored the factor using the UBM tool.

Factor 2.2 - Fishing Mortality

MEXICO / GULF OF CALIFORNIA, SET GILLNETS, MEXICO
MEXICO / PACIFIC, SET GILLNETS, MEXICO
MEXICO / GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO

High Concern

This score was calculated using the Seafood Watch Unknown Bycatch Matrix. For seabirds, bycatch susceptibility is scored as a "high" concern because seabirds are highly susceptible to interactions with gillnets and trawling nets in most regions.

Factor 2.3 - Modifying Factor: Discards and Bait Use

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

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

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

MEXICO / GULF OF CALIFORNIA, SET GILLNETS, MEXICO

< 100%

Information on the number of discards from the set gillnet fishery is lacking. Fishery experts state that most of the incidental, lower-value species caught in the Gulf of California fishery are retained for commercial or personal consumption (Rene Loaiza pers. comm. CEDO 2018); hence, a score of <100% is given.

MEXICO / PACIFIC, SET GILLNETS, MEXICO

< 100%

In their 2011 study on the impact of gillnets in Baja California, Shester and Micheli (2011) found that set gillnets discarded an average of 35% of the total biomass (45% in number) of the total catch (Figure 6). Therefore, the discard rate/landing is scored as <100%.

Justification:

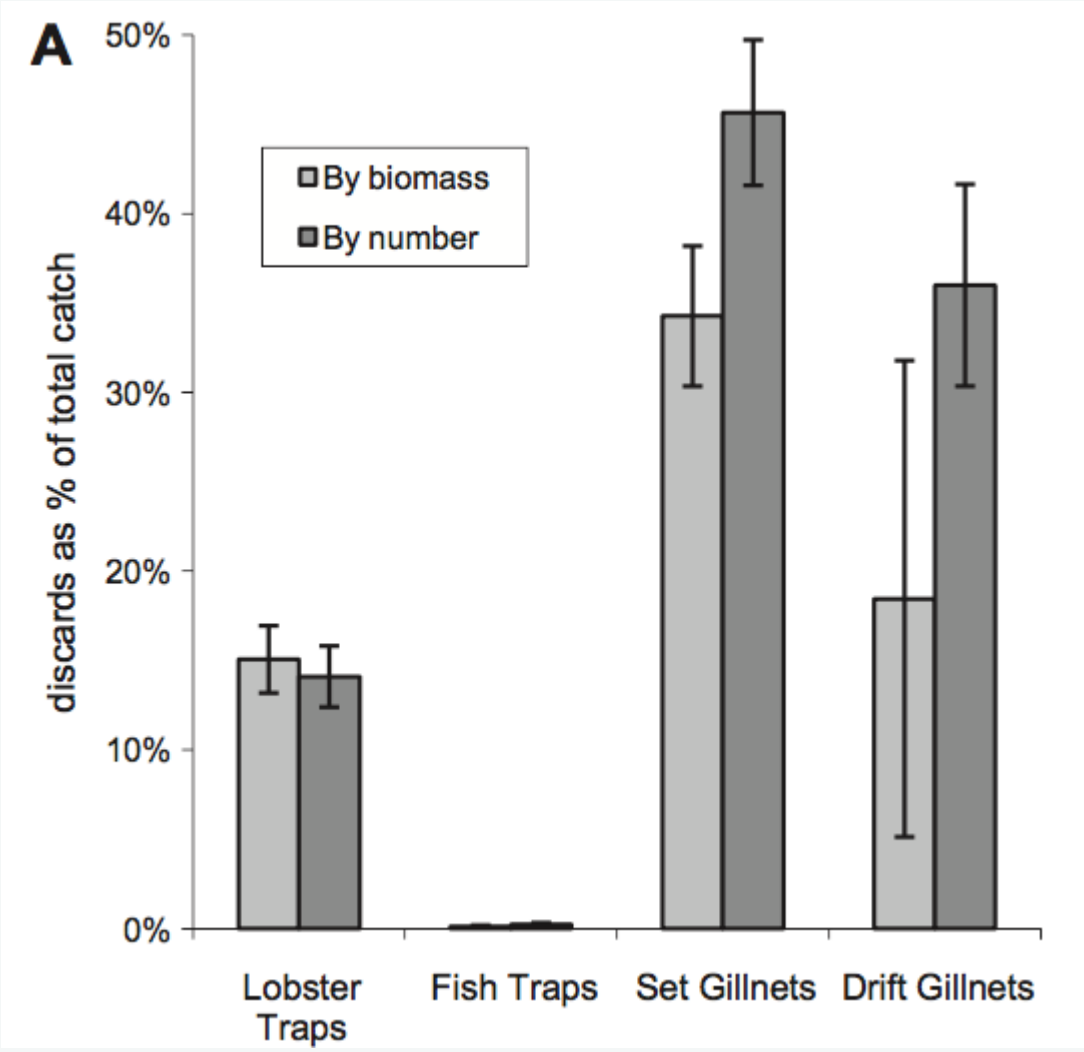

Figure 10 Percentage of discards in biomass and number of organisms in Baja California Sur (Source: Shester and Micheli, 2011)

MEXICO / GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO

≥ 100%

Information on the amount of discards from the industrial "scale" trawling fleet is lacking. If compared to the California halibut bottom trawl fishery, and the most recent observer data from 2014, discard rates appear to be greater than 100% (NWFSC 2016). Therefore, the discard rate/landings for this fishery is scored as >100%.

Criterion 3: Management Effectiveness

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

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

The Criterion 3 rating is determined as follows:

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

Rating is Critical if Management Strategy and Implementation is Critical.

GUIDING PRINCIPLE

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

Criterion 3 Summary

Fishery	Management Strategy	Bycatch Strategy	Research and Monitoring	Enforcement	Stakeholder Inclusion	Score
Fishery 1: Mexico / Gulf of California | Bottom trawls | Mexico	Moderately Effective	Moderately Effective	Ineffective	Moderately Effective	Ineffective	Red (2.000)
Fishery 2: Mexico / Gulf of California | Set gillnets | Mexico	Moderately Effective	Moderately Effective	Ineffective	Ineffective	Ineffective	Red (2.000)
Fishery 3: Mexico / Pacific | Set gillnets | Mexico	Moderately Effective	Moderately Effective	Ineffective	Ineffective	Ineffective	Red (2.000)

Criterion 3 Assessment

Factor 3.1 - Management Strategy and Implementation

Considerations: What type of management measures are in place? Are there appropriate management goals, and is there evidence that management goals are being met? Do 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.

MEXICO / GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO

Moderately Effective

Regulation of the flatfish fishery for the industrial finfish bottom trawlers in Mexico is minimal. Some area closures have been recently approved (e.g., vaquita protection area (DOF 2017)). However, no quota limits, minimum size limits or closed seasons are in place. The National Fisheries Chart in 2010 suggested that fishing effort should be reduced (DOF 2010). According to official data, there have been efforts to reduce the number of vessels within the industrial fleet, particularly shrimp vessels that also target finfish species, but information about the exact number of vessel reductions in the fleet is lacking (DOF 2012).

In compliance with official norms, the industrial vessels are not authorized to operate in areas of special concern (e.g., within protected areas like the Biosphere Reserve of the Upper Gulf of California buffer zone (DOF 2012) (DOFb 1993)). Industrial trawling is also prohibited within the marine section between 0 and 9.14 m of depth (DOF 2012) and within 9.25 km (5 miles) from the mouth of coastal lagoons and estuaries in the Mexican Pacific (DOF b 2014). All vessels are monitored through a VMS system that is verified by managers 24/7 in order to detect those vessels operating in restricted areas (DOF b 2014).

Despite these general regulations (which are not specific for flatfish species), no additional management is in place. The current status of halibut populations is unknown because landings are reported for all species combined. It is unclear if Cortez and California halibut are being fished above sustainable levels (see Criterion 1). However, some regulations are in place to protect some species of concern, although it is unclear how effective these are (see 3.2). For these reasons, management strategy and implementation for industrial finfish bottom trawl fisheries are considered "moderately effective."

MEXICO / GULF OF CALIFORNIA, SET GILLNETS, MEXICO
MEXICO / PACIFIC, SET GILLNETS, MEXICO

Moderately Effective

The "finfish" fishery in Mexico is composed of more than 270 species along the Mexican Pacific, according to the National Fisheries Chart (CNP) (DOF 2010). The flatfish species are considered a subgroup of the finfish fishery, and access is controlled by a permit system (DOF 2010). There are no closed seasons, quota limits or minimum size limits. To monitor the status of the fishery, managers used the landings reports by the state as a reference point (e.g., annual production in Sonora should remain above 500 t per year) (DOF 2010). The CNP recommended that INAPESCA's regional offices implement gear restrictions (dimensions, mesh size, etc.), which should be included as a requirement in each permit, but information of these practices was unavailable.

Due to the multispecies nature of the fishery, Mexican Official Norms (NOMs, federal documents with standards and regulations for diverse activities in Mexico) may limit the use of these vessels and their nets if fishers are targeting other species (DOF 2010). For example, if fishers are targeting sharks, NOM-029, which regulates shark and ray fisheries in the country, restricts the dimensions and use of these nets in certain areas (although these regulations focus on protecting shark and ray reproductive seasons and not flatfish species; (DOF 2007)).

When comparing the reference points of the top state producers (Sonora, Sinaloa, Baja California, and Baja California Sur) with production from the most recent years, landings are above these reference points (CONAPESCA-SIAP 2016). However, the current impact that these fisheries have on these species is unknown,

since landings are reported for all flatfish combined and no biological reference points are in place. Finally, considering that official norms are in place to reduce the impact of species of concern (e.g. NOM-029 to protect sharks) and effectiveness of management is unknown, this factor is scored as "moderately effective."

Factor 3.2 - Bycatch Strategy

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

MEXICO / GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO

Moderately Effective

The main concerns of trawl fisheries worldwide are the large amount of bycatch and the interaction with species of concern (i.e., sea turtles). In Mexico, all trawl fisheries have been required to use turtle excluder devices for nearly 20 years, including the industrial finfish trawl fishery (DOF 1996). Although these measures are likely to be effective in mitigating bycatch, no information is currently available about its effectiveness on this fleet.

According to INAPESCA reports, the minimum bottom trawl mesh size recommended for the wings of the net, the body, and the bag are five, four, and three inches, respectively (INAPESCA 2000). It is unclear, however, if these are designed to minimize bycatch and discard mortality or increase the efficiency of the net (INAPESCA 2000). Other vessel regulations include the prohibition of trawling between 0 and 9.14 m of depth, and within 9.25 km (5 miles) from the mouth of coastal lagoons and estuaries in the Mexican Pacific. These regulations aim to protect areas where juvenile finfish are found, as well as reproductive zones for sharks and rays (DOF 2007). The current regulations do not sufficiently address bycatch, since the bycatch to target species ratio is very high in the bottom trawl fishery. Aside from the trawling regulations, which are not necessarily intended to mitigate bycatch, and TED requirements, there are no management measures in place to minimize bycatch in the bottom trawl fishery. Therefore, bycatch management is considered "moderately effective."

MEXICO / GULF OF CALIFORNIA, SET GILLNETS, MEXICO
MEXICO / PACIFIC, SET GILLNETS, MEXICO

Moderately Effective

The greatest bycatch concern in Mexican gillnet fisheries in the upper Gulf of California is Vaquita (a critically endangered species of porpoise endemic to the region), which has been reported as incidental bycatch in gillnet fisheries in the Upper Gulf of California (CIRVA 2016). To protect Vaquita, the use of any type of gillnet has been permanently banned in the Vaquita's range (see map below) (DOF 2017).

In other regions of the Gulf of California, the catch of species of concern like sharks, rays (Marquez-Farias 2011), and sea turtles (CIT 2006) as well as interactions with marine mammals, like sea lions and whales (Gayo-Reynoso 2006), is still a concern due to the vulnerability of these organisms to these gears. Currently, some general efforts to mitigate the impact on some of these species are in place, but their effectiveness is unclear. For these reasons the bycatch strategy scores as "moderately effective."

Justification:

The Mexican Official Norm, NOM-029-PESC-2006 for the protection of sharks and rays, contains specific rules

to reduce or completely eliminate the use of gillnets in known reproductive areas (i.e., coastal lagoons of La Reforma and Altata in Sinaloa and Almejas Bay in B.C.S.): creates sanctuaries (i.e., a five-km radius of Espiritu Santo Island in BCS), and establishes mesh size limits along the coast (DOF 2015).

All whales and turtle species are listed in the Official Norm NOM-059-SEMARNAT that protects all endangered species and prohibits all species use or extraction. In addition, several important areas were established as protected zones for whales in Northwestern Mexico (DOF 1972). Ojo de Liebre lagoon is the most important in Baja California Sur, where no fishing activities using gillnets or other gears that have a negative impact on the mammals is allowed (DOF 2016).

In relation to sea turtles, the Mexican government created a fishing refuge on the west coast of Baja California Sur, where several turtles—mostly loggerheads—were found stranded (Debate 2014) (DOF 2014). The purpose of the refuge was to reduce the possible interaction between turtles and fishing activities. A series of restrictions were established prohibiting the use of gillnets with six-inch mesh size or bigger inside the refuge and reducing the use of gillnets of less than six inches during the sea turtle nesting season (May to August each year) (DOF 2014) (see map below). As a result, a decrease in the number of stranded turtles in the area was reported (SDP 2017). Based on these new regulations, if the limit on the number of stranded loggerheads is achieved (90 individuals/season), gillnet activities are suspended for the rest of the year (DOF 2015). In addition, managers also restricted soak time of gillnets to six continuous hours in the restricted area to reduce impacts on turtles (DOF 2015). Finally, although researchers agreed that fishing mortality of sea turtles in the region has decreased, it is still considered a problem (Senko, et al. 2017).

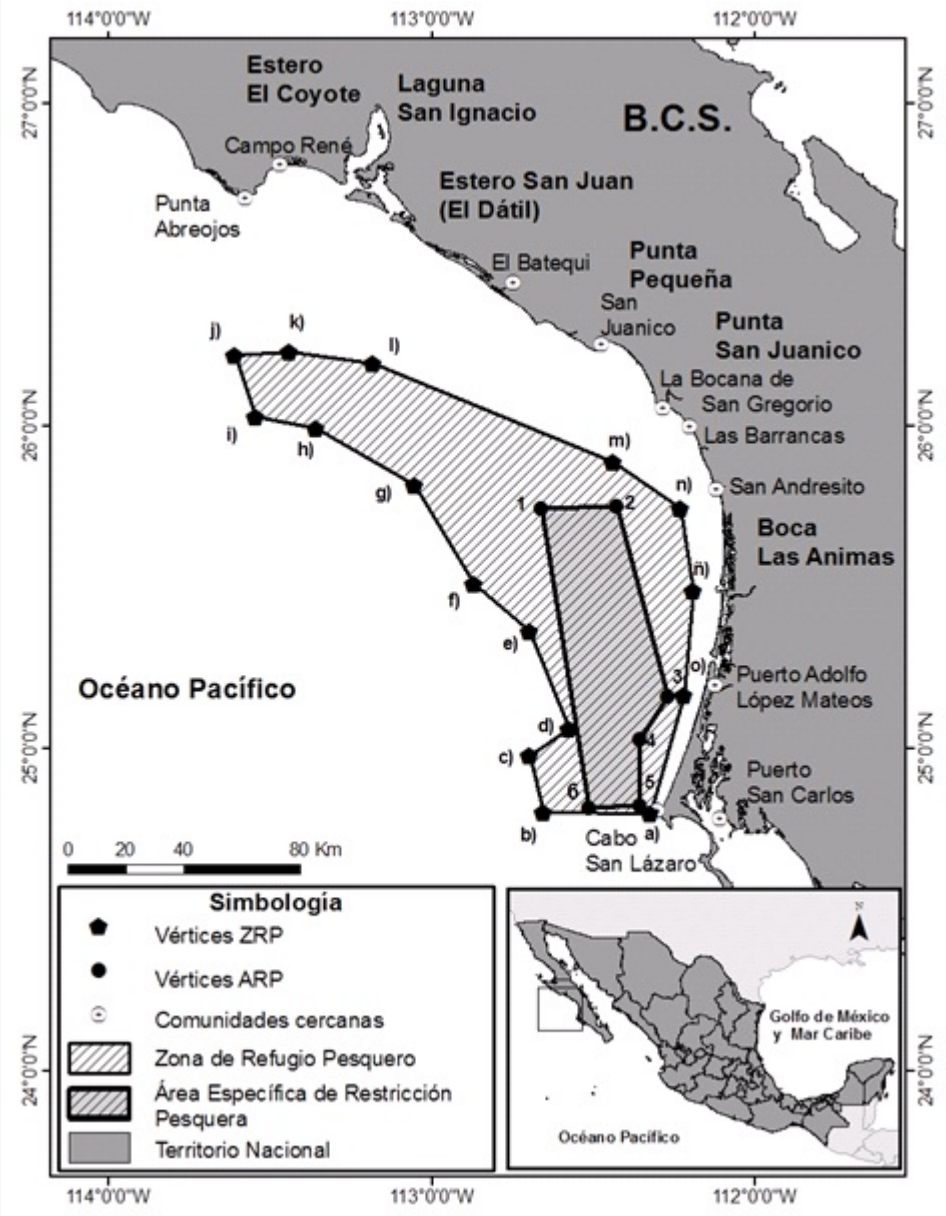

Figure 14 Fishing refugee to protect sea turtle of interactions with fisheries, particularly gillnets.

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.

MEXICO / GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO

Ineffective

The industrial fleet in Mexico is required to report bycatch in logbooks, and provide a copy of the report to local fisheries offices along the coast (DOF 2012). These reports were not available for review. In addition, the fishery's main, targeted species are currently unassessed and regulations to constrain fishing mortality for

these species are lacking.

An onboard observer program was recently reinstated, although most of the focus of the program is on vessels targeting shrimp for the 2015–2016 and 2016–2017 seasons (CONAPESCA-SIAP 2016). Data related to the program was not available. For these reasons, this factor is scored as "ineffective."

MEXICO / GULF OF CALIFORNIA, SET GILLNETS, MEXICO
MEXICO / PACIFIC, SET GILLNETS, MEXICO

Ineffective

Only landings data are collected and managers do not use any data-limited assessments or other management methods for the fishery. There is no bycatch monitoring or assessment, and information about the potential impacts of the fishery on bycatch species is lacking. For these reasons, this factor is scored as "ineffective."

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.

MEXICO / GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO

Moderately Effective

In Mexico, all industrial fleets (including industrial finfish trawlers) are monitored through a satellite vessel monitoring system (VMS) (DOF b 2014). This system allows managers to review specific vessel locations and detect if they are located in banned areas. Officials carry out random pre-departure inspections to corroborate that fishing gear specs comply with permit specifications (CONAPESCA 2017). In addition, random water enforcement activities, in collaboration with the Mexican Navy, are executed year-round (CONAPESCA 2017).

Reports from CONAPESCA indicate that the number of enforcement actions has increased over the last few years, and that compliance in the industrial fleet has increased (CONAPESCA 2017). For example, industrial vessel compliance with VMS transmitting requirements is now around 98%; consequently, the number of vessels found to be operating inside closed areas declined from 80 in 2013, to 12 in 2015 (CONAPESCA 2017). Thus, it is likely that the enforcement measures in place for the industrial finfish fleet are "moderately effective."

Justification:

The VMS has been in place since 2004 for the industrial fleet operating in Mexico (CONAPESCA 2006). The regulations of this program are contained in the Mexican official norm that regulates the use of the satellite systems and defines which vessels must have VMS (NOM062SAG/PESC2014). Among other things, it allows CONAPESCA to know the exact location of the route taken by boat along the trip and the fishing area; improves information for technical and scientific fisheries research; improves the management of fisheries resources and verifies compliance with closures, as well as areas that are restricted or prohibited; and it captures the degree of incidence or recurrence of boats. In 2015, there were 1,981 vessels monitored, of which 98% were recorded as transmitting appropriately (up from 34% in 2007) (CONAPESCA 2016). GPS data are provided every hour, 24 hours a day to CONAPESCA through the Sistema Satelital de Monitoreo de Embarcaciones Pesqueras (SISMEP), and an alert is given to the SISMEP and vessel operators when a vessel enters a closed area. The number of vessels found to be operating in a closed area has declined from 80 in 2013 to 12 in 2015 (CONAPESCA 2016).

As a signatory to the Inter‐American Convention for the Promotion and Conservation of Sea Turtles, Mexico implemented measures for the protection of sea turtles with the use of turtle excluder devices (TEDs), which are required by law (NOM‐002‐SAG/PESC‐2013) (DOF 1993).

Managers in CONAPESCA collaborate with the Secretary of Environment and its enforcement agents in the field, PROFEPA (Environmental Protection Agency), as well as the Mexican Navy to develop enforcement actions on the correct use of TEDs in the water (CONAPESCA 2016). According to the 2010 to 2012 enforcement plan and the inter‐agency collaboration, at least 70% of enforcement activities must be conducted while vessels are fishing, and 30% of these actions should be conducted during night operations.

CONAPESCA reports state that between 2013 and 2015, more than 4,000 inspection actions were conducted with the industrial fleet in the Pacific; as a result, 17 sanctions were issued (four in 2013, four in 2014, and eight in 2015) (CONAPESCA 2016).

MEXICO / GULF OF CALIFORNIA, SET GILLNETS, MEXICO
MEXICO / PACIFIC, SET GILLNETS, MEXICO

Ineffective

CONAPESCA's national enforcement plan includes a series of actions that range from inspections in the water, in port and highways (SAGARPA-CONAPESCA 2014). These actions are developed in coordination with other agencies (e.g., local police, Mexican Navy, etc. (CONAPESCA 2017)). However, there is little information on the level of compliance for the artisanal fisheries. A 2013 study estimated that illegal fishing occurred 45 to 90% more often than the National Official Production in Mexico reported (IMCO et al 2013); this factor is therefore rated as "ineffective" for gillnets.

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.

MEXICO / GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO
MEXICO / GULF OF CALIFORNIA, SET GILLNETS, MEXICO
MEXICO / PACIFIC, SET GILLNETS, MEXICO

Ineffective

The lack of a transparent decision-making process and inclusion of stakeholders is considered "ineffective" for all gears and all regions.

Criterion 4: Impacts on the Habitat and Ecosystem

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

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

GUIDING PRINCIPLES

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

Rating cannot be Critical for Criterion 4.

Criterion 4 Summary

Region / Method	Gear Type and Substrate	Mitigation of Gear Impacts	EBFM	Score
Mexico / Gulf of California / Bottom trawls / Mexico	2	0	Moderate Concern	Yellow (2.449)
Mexico / Gulf of California / Set gillnets / Mexico	3	0	Moderate Concern	Yellow (3.000)
Mexico / Pacific / Set gillnets / Mexico	2	0	Moderate Concern	Yellow (2.449)

Criterion 4 Assessment

SCORING GUIDELINES

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

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

- *5 - Fishing gear does not contact the bottom*
- *4 - Vertical line gear*
- *3 - Gears that contacts the bottom, but is not dragged along the bottom (e.g. gillnet, bottom longline, trap)*

and is not fished on sensitive habitats. Or bottom seine on resilient mud/sand habitats. Or midwater trawl that is known to contact bottom occasionally. Or purse seine known to commonly contact the bottom.

- *2 - Bottom dragging gears (dredge, trawl) fished on resilient mud/sand habitats. Or gillnet, trap, or bottom longline fished on sensitive boulder or coral reef habitat. Or bottom seine except on mud/sand. Or there is known trampling of coral reef habitat.*
- *1 - Hydraulic clam dredge. Or dredge or trawl gear fished on moderately sensitive habitats (e.g., cobble or boulder)*
- *0 - Dredge or trawl fished on biogenic habitat, (e.g., deep-sea corals, eelgrass and maerl)*
  Note: When multiple habitat types are commonly encountered, and/or the habitat classification is uncertain, the score will be based on the most sensitive, plausible habitat type.

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

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

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

Factor 4.3 - Ecosystem-Based Fisheries Management

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

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

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

MEXICO / GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO

2

The industrial finfish bottom trawl fishery operates mainly over soft sediments (Gomez-Guana et al. 2014). Studies conducted by managers found chronic disturbances due to trawling in the Gulf of California (Lopez-Martinez and Morales-Bojorquez 2012). However, specific information about the industrial finfish trawl is not available. For these reasons, the impact of fishing gear in trawls in the Gulf of California is scored as 2, based on the SFW standard.

MEXICO / GULF OF CALIFORNIA, SET GILLNETS, MEXICO

3

In the case of the Gulf of California, managers stated that bottom gillnets, though not mobile, do come into contact with the seafloor although no more information about impact has been described. For these reasons, these gear types are deemed a "moderate" concern (3).

MEXICO / PACIFIC, SET GILLNETS, MEXICO

2

(Micheli et al. 2014) examined habitat impacts of set gillnets used by fishers in Baja California Sur. Authors found that set gillnets entangled and removed Eisenia kelp plants and gorgonian corals, and concluded that most of the interactions between nets and habitat-forming species resulted in the organism's removal or partial damage (Micheli et al. 2014). Consequently, set gillnets in the west coast of Baja are scored a 2.

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

MEXICO / GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO

0

Trawling within five fathoms from the shore is illegal, as well as areas identified as important reproductive areas for species like sharks and rays (see factor 3.2 above) (DOF 2006) (DOF 2007). However, this area represents a small proportion of Cortez halibut habitat that is protected from trawling.

MEXICO / GULF OF CALIFORNIA, SET GILLNETS, MEXICO
MEXICO / PACIFIC, SET GILLNETS, MEXICO

0

Currently, no substantial proportion of the habitats have special protection from all bottom contact, and no gear modifications have been implemented.

Factor 4.3 - Ecosystem-Based Fisheries Management

MEXICO / GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO
MEXICO / GULF OF CALIFORNIA, SET GILLNETS, MEXICO

Moderate Concern

In the Gulf of California, some approaches to evaluate the trophic structure of the fish communities have been developed (Ainsworth et al. 2010), (Jara-Marini et al. 2014), (Turk-Boyer et al. 2014). However, neither the specific role of Cortez halibut nor the role of flatfishes in general in the ecosystem have been described. Management of the halibut fisheries in Mexico have some spatial management regulations (e.g., trawling bans in certain regions and/or during certain seasons), but it is unclear if these regulations have been effective.

Since no ecosystem impact assessment of Cortez halibut fisheries has been conducted, and no information about the likelihood of detrimental impacts to the food web due to the fishery was found, this factor is scored as "moderate" concern.

MEXICO / PACIFIC, SET GILLNETS, MEXICO

Moderate Concern

There have been some regional studies on the west coast of Baja California, which identified California halibut as a key species (one of 12 species) in the food web of the Vizcaino Bay area (Rocchi et al. 2016). Authors confirmed that most of these species, including California halibut, are considered at risk of cumulative effects from multiple fisheries (Micheli et al. 2014). The authors concluded that, although the system can support the removal of up to four of these key species without altering the overall food web, a continuous removal of more than four of these species may affect ecological function and the food web (Rocchi et al. 2016). For these reasons, the west coast of Baja is scored as "moderate" concern.

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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: Extra By Catch Species

RAYS (UNSPECIFIED)

Factor 2.1 - Abundance

MEXICO / GULF OF CALIFORNIA, SET GILLNETS, MEXICO
MEXICO / PACIFIC, SET GILLNETS, MEXICO
MEXICO / GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO

High Concern

The abundance of rays is scored as "high" concern due to the unknown abundance, and IUCN status of some species as "Near Threatened" (Smith et al. 2006) (van Hees et al. 2015) (Smith et al. 2016).

Justification:

In Mexico, several species of rays are commercially targeted (DOF 2010) or reported as bycatch in fisheries that use gillnets (Marquez-Farias 2011) or bottom trawls (DOF 2010). However, no formal stock assessments have been developed for these species, and the current status of these species is unknown.

The national fisheries chart lists at least three ray species associated with the halibut fisheries in Mexico: longnose eagle ray (*Myliobatis longirostris*), bat ray (*M. californicus*), and diamond stingray (*Dasyatis dipterura*). Of these, the longnose eagle ray was classified as "Near Threatened," bat ray as "Least Concern," and diamond stingray as "Data Deficient" by the IUCN (Smith et al. 2006) (van Hees et al. 2015) (Smith et al. 2016). In addition, other ray species are commonly caught in gillnets (Marquez-Farias 2011), like the shovelnose guitarfish (*Pseudobatus productus*), which is "Near Threatened" and also lacks an abundance assessment.

Factor 2.2 - Fishing Mortality

MEXICO / GULF OF CALIFORNIA, SET GILLNETS, MEXICO
MEXICO / PACIFIC, SET GILLNETS, MEXICO
MEXICO / GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO

Moderate Concern

The level of fishing mortality of the halibut fisheries on ray species is unknown. There is no information about how much volume of which species are caught by these fisheries when targeting flatfish. In Mexico, fisheries that target rays and sharks show some stability in landings, and managers reported those fisheries were at their maximum level of exploitation (DOF 2010). Since the contribution for individual fisheries is unknown, this factor is deemed a "moderate" concern for all halibut fisheries in Mexico.

Justification:

At least 24 species of rays have been reported to be caught in the artisanal fishery of the Gulf of California (Marquez-Farias and Pilar-Blanco 2006), and at least seven species of rays were identified in trawling nets also in the Gulf of California (Lara-Mendoza et al. 2016). One of the most important species in terms of value and abundance is the shovelnose guitarfish, which is highly susceptible to gillnets (Marquez-Farias 2011). Researchers in Mexico agree that most of the elasmobranchs species are poorly studied (Marquez-Farias 2011) (Lara-Mendoza et al. 2016) and suggest the need for additional research to identify species caught in the fisheries. This should help determine the impact of these fisheries on abundance and structure of the populations of ray species (Lara-Mendoza et al. 2016).

Factor 2.3 - Discard Rate

MEXICO / GULF OF CALIFORNIA, SET GILLNETS, MEXICO

< 100%

Information on the number of discards from the set gillnet fishery is lacking. Fishery experts state that most of the incidental, lower-value species caught in the Gulf of California fishery are retained for commercial or personal consumption (Rene Loaiza pers. comm. CEDO 2018); hence, a score of <100% is given.

MEXICO / PACIFIC, SET GILLNETS, MEXICO

< 100%

In their 2011 study on the impact of gillnets in Baja California, Shester and Micheli (2011) found that set gillnets discarded an average of 35% of the total biomass (45% in number) of the total catch (Figure 6). Therefore, the discard rate/landing is scored as <100%.

Justification:

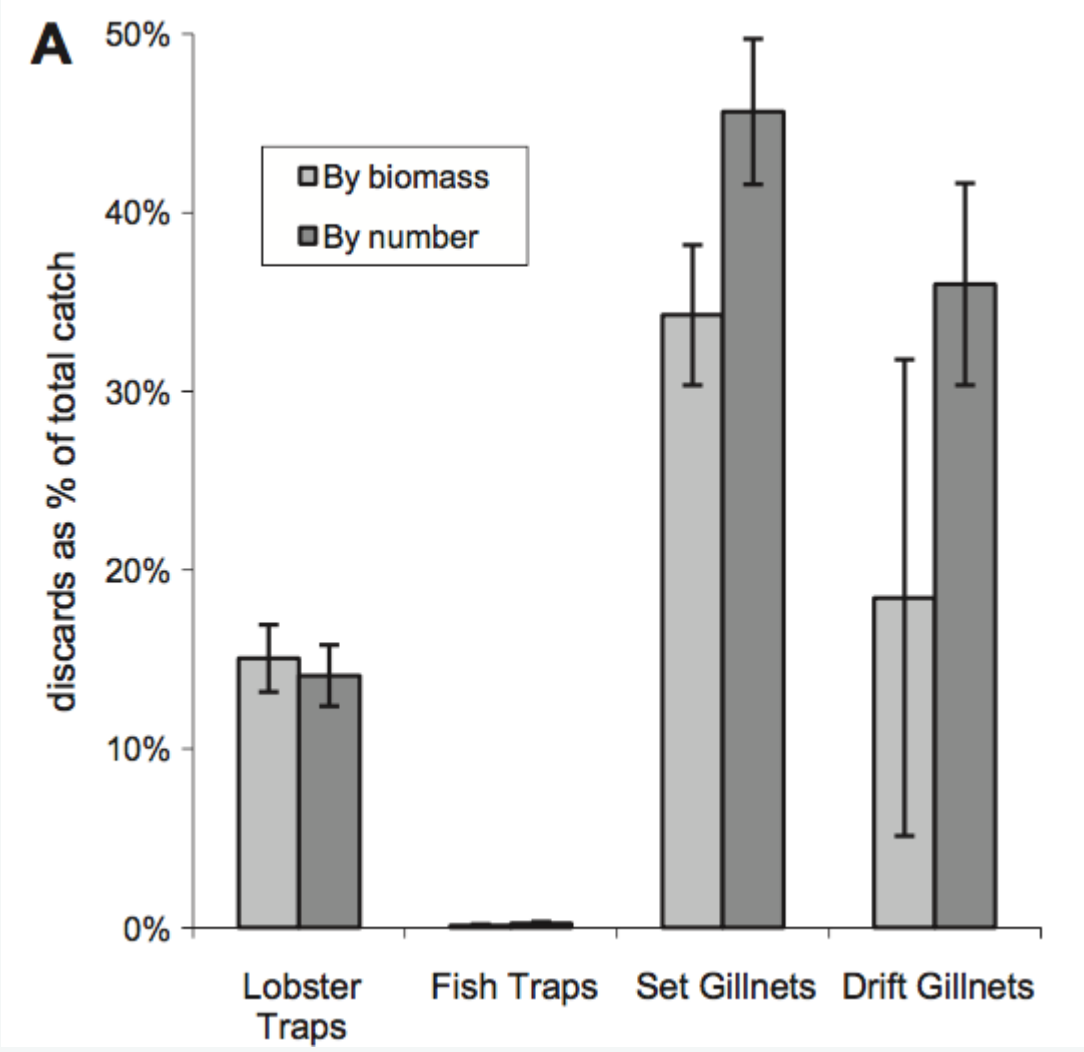

Figure 11 Percentage of discards in biomass and number of organisms in Baja California Sur (Source: Shester and Micheli, 2011)

MEXICO / GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO

≥ 100%

Information on the amount of discards from the industrial "scale" trawling fleet is lacking. If compared to the California halibut bottom trawl fishery, and the most recent observer data from 2014, discard rates appear to be greater than 100% (NWFSC 2016). Therefore, the discard rate/landings for this fishery is scored as >100%.

FINFISH

Factor 2.1 - Abundance

MEXICO / GULF OF CALIFORNIA, SET GILLNETS, MEXICO
MEXICO / PACIFIC, SET GILLNETS, MEXICO

Moderate Concern

Unknown species of finfish are considered to be of medium inherent vulnerability according to the Seafood Watch criteria. The stock status of unknown species of finfish are considered to be of "moderate" concern according to the Seafood Watch criteria.

Factor 2.2 - Fishing Mortality

MEXICO / GULF OF CALIFORNIA, SET GILLNETS, MEXICO
MEXICO / PACIFIC, SET GILLNETS, MEXICO

High Concern

The unknown bycatch matrix suggests a score of "high" concern for fishing mortality for finfish bycatch in drift gillnets and bottom trawl in tropical waters (SFW 2016). This score takes into account current fisheries regulations (e.g., closed areas for gillnets or no-trawling zones) that aim to control the impact of the fishing activities on the species.

In the upper Gulf of California, due to the protection of the vaquita (*Phocoena sinus*), a permanent ban restricting the use of gillnets was issued in 2017 (DOF b 2017). However, the use of gillnets is allowed outside this area, which is most of the area where the halibut fishery occurs (see the figure in justification). In addition, trawling activities between zero and 9.14 m of depth are prohibited (DOF 2006). However, these areas do not represent a significant portion of the fishing grounds for Halibut. Finally, no other regulations are in place to control fishing mortality of bycatch species in either trawlers or gillnets inside the Gulf of California. In the case of the west coast of the Baja Peninsula, regulations like soaking time (6 hours maximum) are in place, but no information regarding the real effect in other species was available, for these reasons, the information available is not enough to override the UBM tool.

For these reasons, fishing mortality on unknown finfish in the gillnet fishery and bottom trawl fisheries is considered a "high" concern.

Justification:

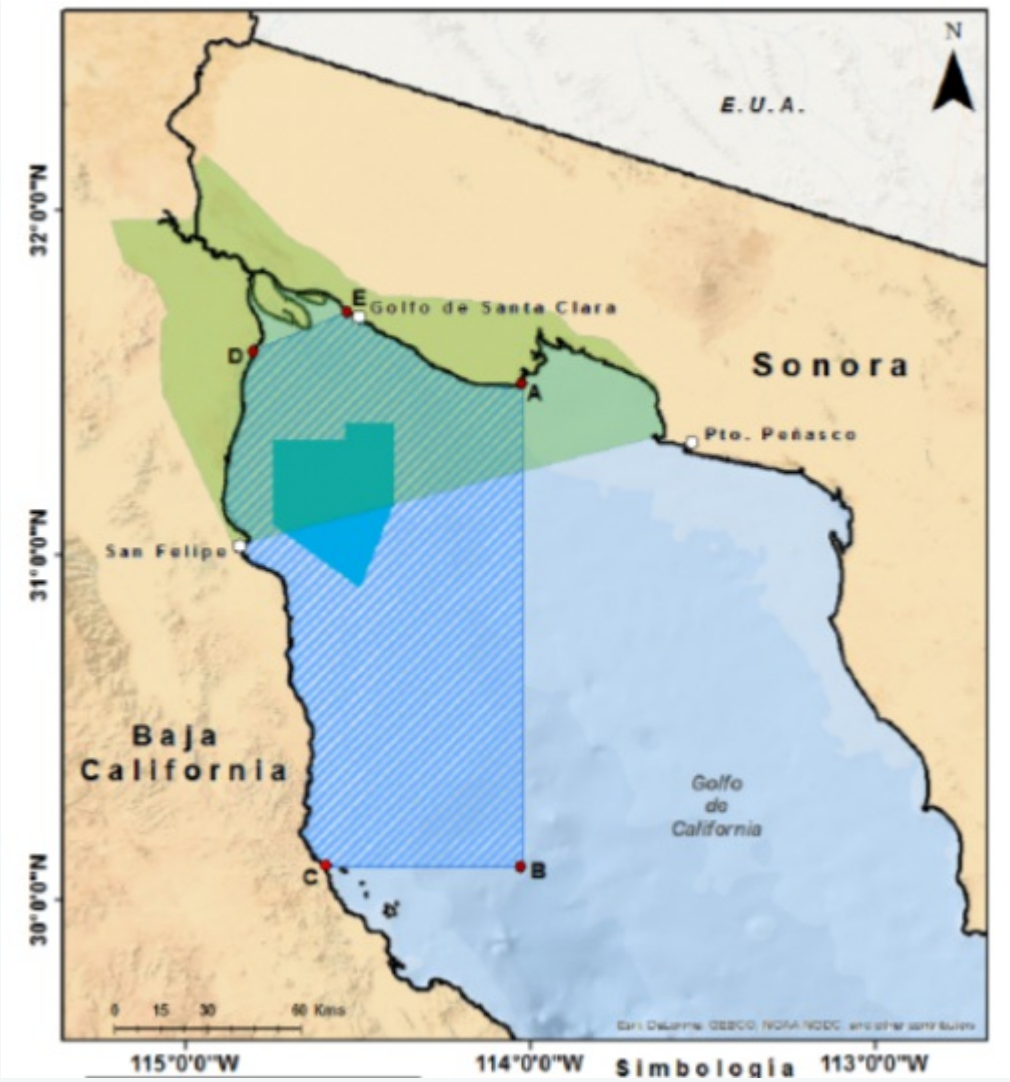

Figure 12 Area of permanent gillnet ban in the Upper Gulf of California (square blue lines).

Factor 2.3 - Discard Rate

MEXICO / GULF OF CALIFORNIA, SET GILLNETS, MEXICO

< 100%

Information on the number of discards from the set gillnet fishery is lacking. Fishery experts state that most of the incidental, lower-value species caught in the Gulf of California fishery are retained for commercial or personal consumption (Rene Loaiza pers. comm. CEDO 2018); hence, a score of <100% is given.

MEXICO / PACIFIC, SET GILLNETS, MEXICO

< 100%

In their 2011 study on the impact of gillnets in Baja California, Shester and Micheli (2011) found that set gillnets discarded an average of 35% of the total biomass (45% in number) of the total catch (Figure 6). Therefore, the discard rate/landing is scored as <100%.

Justification:

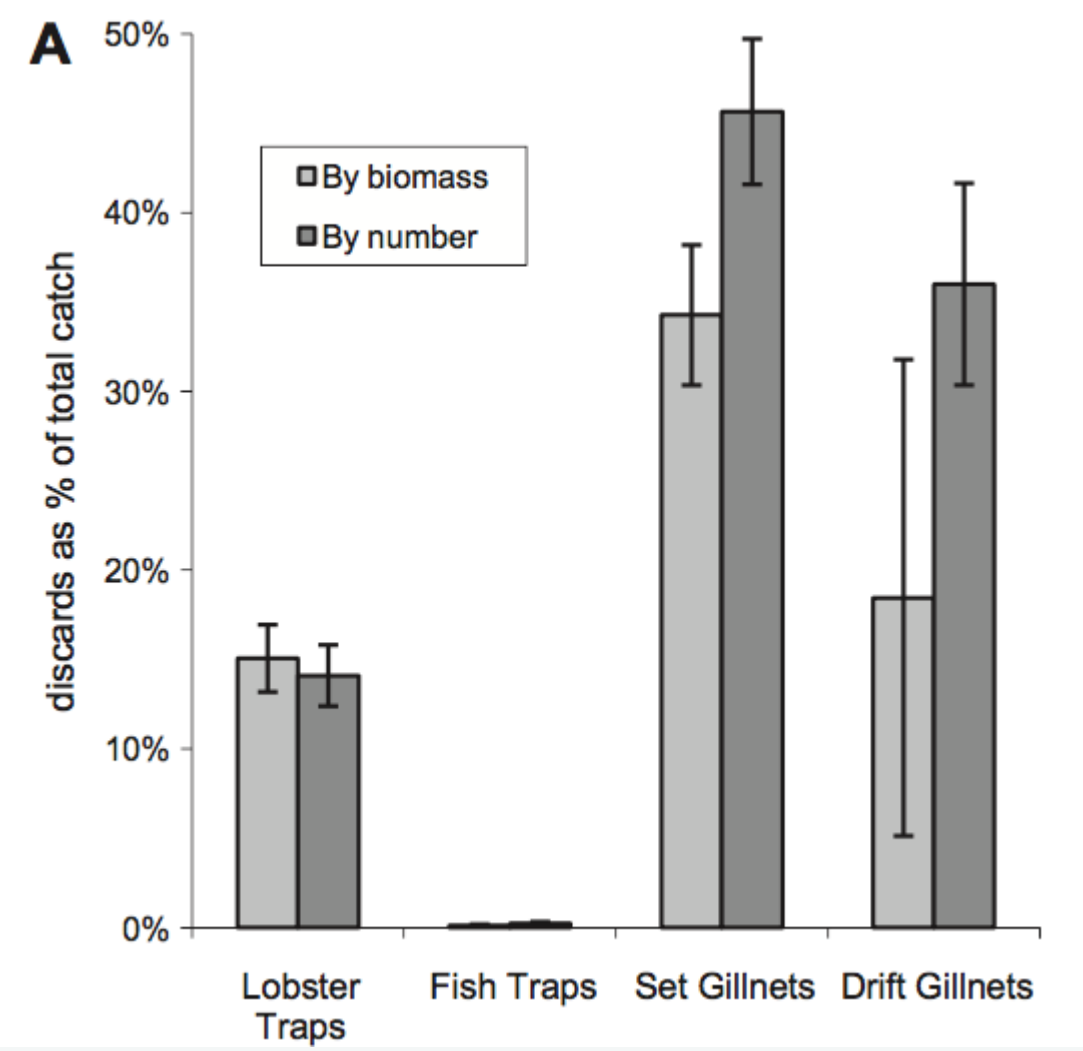

Figure 13 Percentage of discards in biomass and number of organisms in Baja California Sur (Source: Shester and Micheli, 2011)

FINESCALE TRIGGERFISH

Factor 2.1 - Abundance

MEXICO / GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO

Moderate Concern

There is no formal stock assessment for Finescale triggerfish in the Gulf of California. Currently, the IUCN lists this species as "Least Concern" (Nielsen, et al 2010). Consequently, we conducted a Productivity-Susceptibility Analysis (PSA) to help score this factor.

The PSA score =2.71, which indicates a medium inherent vulnerability to fishing. Detailed scoring of each attribute is shown below. Because bigeye croaker has a medium vulnerability and there is no quantitative stock assessment, abundance is deemed a "moderate" concern.

Justification:

Productivity Attribute	Relevant Information	Score (1 = low risk, 2 = medium risk, 3 = high risk)
Average age at maturity	N / A	
Average maximum age	7 (Froese and Pauly 2017)	1
Fecundity	N/A	
Average maximum size (fish only)	76 cm (Froese and Pauly 2017)	1
Average size at maturity (fish only)	cm	1
Reproductive strategy	Broadcast spawner	1
Trophic level	3.3 (Froese and Pauly 2017)	3
Quality of the habitat	N /A	
Density dependence (invertebrates only)	-	-
Total Productivity (average)		1.4

Susceptibility Attribute	Relevant Information	Score (1 = low risk, 2 = medium risk, 3 = high risk)
Areal overlap (Considers all fisheries)	Finescale triggerfish is abundant in the Gulf of California (DOF 2012); it is targeted by both artisanal fleets along its distribution (DOF 2012) and is commonly found on shrimp trawlers bycatch (DOF 2012).	3
Vertical overlap (Considers all fisheries)	The species can be found in depth from 3 to 60 m (Froese and Pauly 2018), areas of operation of the artisanal fleet (DOF 2012), to deeper zones where the industrial fleets target them (DOF 2012).	3
Selectivity of fishery (Specific to fishery under assessment)	Unknown. Default score is used.	2
Post-capture mortality (Specific to fishery under assessment)	Unknown. Default score is used.	3
Total Susceptibility (multiplicative)		2.32

PSA score for finescale triggerfish catch by the trawler fishery is calculated as follows:

Vulnerability (V) =√(P^2+ S^2)

V = √(〖1.4〗 ^2+ 〖1.4^2+(2.32^2))

V =2.82

Factor 2.2 - Fishing Mortality

MEXICO / GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO

Moderate Concern

Current levels of fishing mortality for Finescale triggerfish are unknown, the species is part of the finfish multispecies fishery in the Gulf of California and information related to the number of small-scale vessels is not available. The species is not categorized as endangered by either the IUCN or Mexican norms. For these reasons, the factor is scored as "moderate" concern.

Factor 2.3 - Discard Rate

MEXICO / GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO

≥ 100%

Information on the amount of discards from the industrial "scale" trawling fleet is lacking. If compared to the California halibut bottom trawl fishery, and the most recent observer data from 2014, discard rates appear to be greater than 100% (NWFSC 2016). Therefore, the discard rate/landings for this fishery is scored as >100%.

BIGEYE CROAKER

Factor 2.1 - Abundance

MEXICO / GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO

Moderate Concern

There is no formal stock assessment for bigeye croaker in the Gulf of California, currently the IUCN lists this species as "Least Concern" (Chao et al 2010). Consequently, we conducted a Productivity-Susceptibility Analysis (PSA) to help score this factor.

The PSA score =2.82, which indicates a medium inherent vulnerability to fishing. Detailed scoring of each attribute is shown below. Because Bigeye croaker has a medium vulnerability and there is no quantitative stock assessment, abundance is deemed a "moderate" concern.

Justification:

Productivity Attribute	Relevant Information	Score (1 = low risk, 2 = medium risk, 3 = high risk)
Average age at maturity	N / A	
Average maximum age	16 (Froese and Pauly 2018)	2
Fecundity	N/A	
Average maximum size (fish only)	40 cm (Arzola et al. 2018)	1
Average size at maturity (fish only)	35 cm (Arzola et al. 2018)	1
Reproductive strategy	Broadcast spawner	1
Trophic level	3.2 (Froese and Pauly 2017)	3
Quality of the habitat	N /A	
Density dependence (invertebrates only)	-	-
Total Productivity (average)		1.5

Susceptibility Attribute	Relevant Information	Score (1 = low risk, 2 = medium risk, 3 = high risk)
Areal overlap (Considers all fisheries)	Bigeye croaker is abundant in the northern Gulf of California (Arzola et al 2018); it is targeted by both artisanal and industrial fleets along its distribution in this area (Arzola et al 2018).	3
Vertical overlap (Considers all fisheries)	The species can be found in depth ranges from close to the surface to ~30 m (Froese and Pauly 2018), close to brackish areas, where it can be fished by the artisanal fleet (DOF 2010), to deeper zones where the industrial fleets target them (DOF 2010).	3
Selectivity of fishery (Specific to fishery under assessment)	Unknown. Default score is used.	2
Post-capture mortality (Specific to fishery under assessment)	Unknown. Default score is used.	3
Total Susceptibility (multiplicative)		2.32

PSA score for bigeye croaker trawler fishery is calculated as follows:

Vulnerability (V) =√(P^2+ S^2)

V = √(〖1.46〗 ^2+ 〖1.6^2+(2.32^2))

V =2.82

Factor 2.2 - Fishing Mortality

MEXICO / GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO

Moderate Concern

Current levels of fishing mortality for the Bigeye croaker are unknown. The species is part of the finfish multispecies fishery in the Gulf of California and information related to the number of vessels (both industrial and small-scale) is not available. The species is not categorized as "Endangered" by either IUCN or Mexican norms. For these reasons, the factor is scored as a "moderate" concern.

Factor 2.3 - Discard Rate

MEXICO / GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO

≥ 100%

Information on the amount of discards from the industrial "scale" trawling fleet is lacking. If compared to the California halibut bottom trawl fishery, and the most recent observer data from 2014, discard rates appear to be greater than 100% (NWFSC 2016). Therefore, the discard rate/landings for this fishery is scored as >100%.

SPOTTED ROSE SNAPPER

Factor 2.1 - Abundance

MEXICO / GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO

Moderate Concern

There is no formal stock assessment for Lutjanus guttatus in the Gulf of California. Currently, the IUCN lists this species as "Least Concern" (Rojas, et al 2010). Consequently, we conducted a Productivity-Susceptibility Analysis (PSA) to help score this factor.

The PSA score =2.73, which indicates a medium inherent vulnerability to fishing. Detailed scoring of each attribute is shown below. Because bigeye croaker has a medium vulnerability and there is no quantitative stock assessment, abundance is deemed a "moderate" concern.

Justification:

Productivity Attribute	Relevant Information	Score (1 = low risk, 2 = medium risk, 3 = high risk)
Average age at maturity	2	1
Average maximum age	11 (Froese and Pauly 2017)	2
Fecundity	66,400 to 2.1 million (Froese and Pauly 2017)	1
Average maximum size (fish only)	80 cm (Froese and Pauly 2017)	1
Average size at maturity (fish only)	18 cm (Froese and Pauly 2017)	1
Reproductive strategy	Broadcast spawner	1
Trophic level	4 (Froese and Pauly 2017)	3
Quality of the habitat	N /A	
Density dependence (invertebrates only)	-	-
Total Productivity (average)		1.42

Susceptibility Attribute	Relevant Information	Score (1 = low risk, 2 = medium risk, 3 = high risk)
Areal overlap (Considers all fisheries)	Lutjanus guttatus has a large distribution in the Pacific from Mexico—including the Gulf of California—to Peru (Froese and Pauly 2017). In Mexico, it is targeted by artisanal fleets along its distribution (DOF 2010); it is also commonly found in shrimp trawlers' bycatch (Lopez-Martinez and Morales-Bojorquez 2012).	3
Vertical overlap (Considers all fisheries)	The species can be found in depth from 10 to 60 m (Froese and Pauly 2018) The fishing areas for the artisanal fleet can reach those depths (depending on the gear used); shrimp trawlers can reach the species in the deepest zones (Lopez-Martinez and Morales-Bojorquez 2012).	3
Selectivity of fishery (Specific to fishery under assessment)	Unknown. Default score is used.	2
Post-capture mortality (Specific to fishery under assessment)	Unknown. Default score is used.	3
Total Susceptibility (multiplicative)		2.32

PSA score for Lutjanus guttatus caught by the halibut trawler fishery is calculated as follows:

Vulnerability (V) =√(P^2+ S^2)

V = √(〖1.42〗 ^2+ 〖1.42^2+(2.32^2))

V =2.82

Factor 2.2 - Fishing Mortality

MEXICO / GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO

Moderate Concern

Current levels of fishing mortality for the spotted rose snapper are unknown. The species is part of the snapper multispecies fishery in the Mexican Pacific (DOF 2010), including the Gulf of California. Information related to the number of small-scale vessels that actively target the species is not available. The species is not categorized as endangered by either IUCN or Mexican norms. For these reasons, the factor is scored as "moderate" concern.

Factor 2.3 - Discard Rate

MEXICO / GULF OF CALIFORNIA, BOTTOM TRAWLS, MEXICO

≥ 100%

Information on the amount of discards from the industrial "scale" trawling fleet is lacking. If compared to the California halibut bottom trawl fishery, and the most recent observer data from 2014, discard rates appear to be greater than 100% (NWFSC 2016). Therefore, the discard rate/landings for this fishery is scored as >100%.