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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:

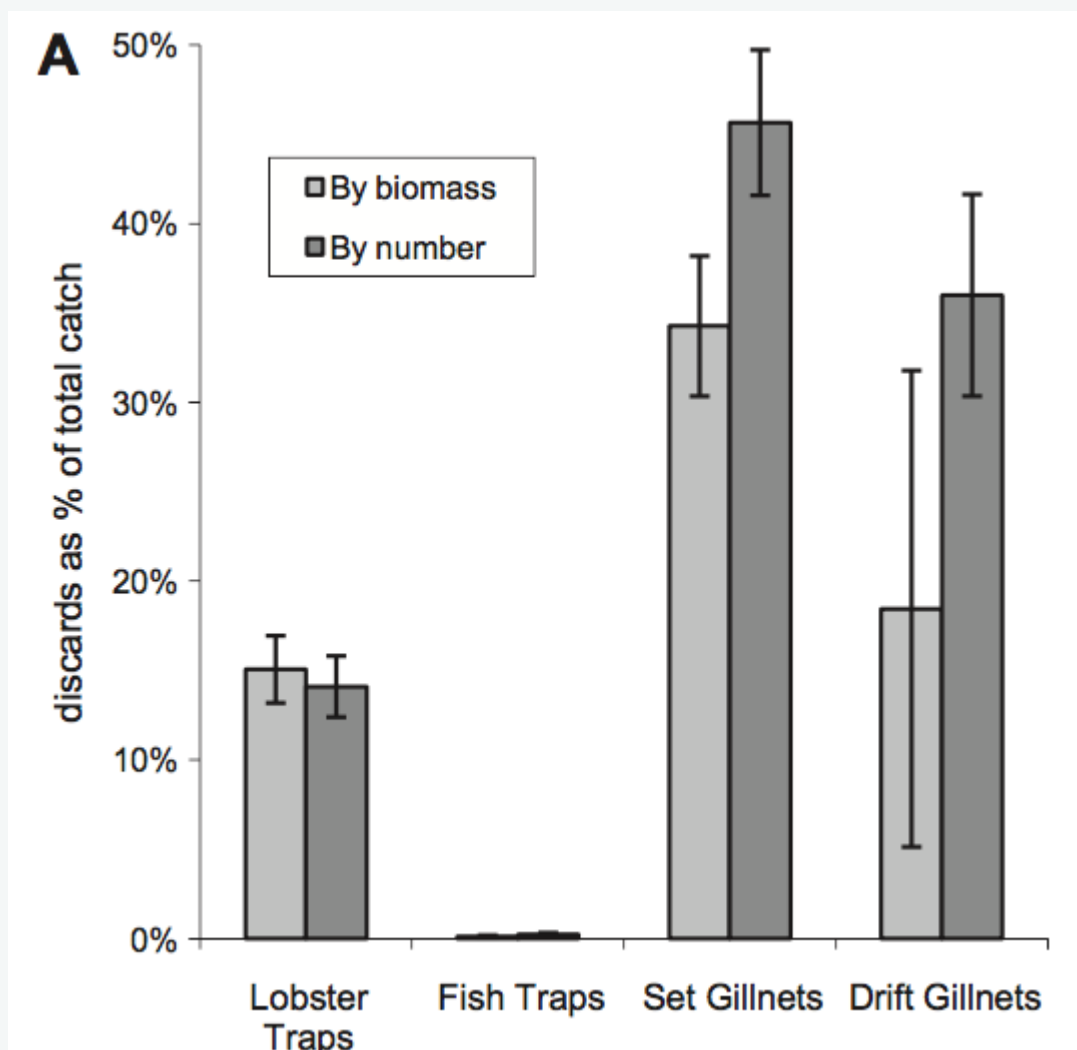


Figure 11 Percentage of discards in biomass and number of organisms in Baja California Sur (Source: Shester and Micheli, 2011)

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:

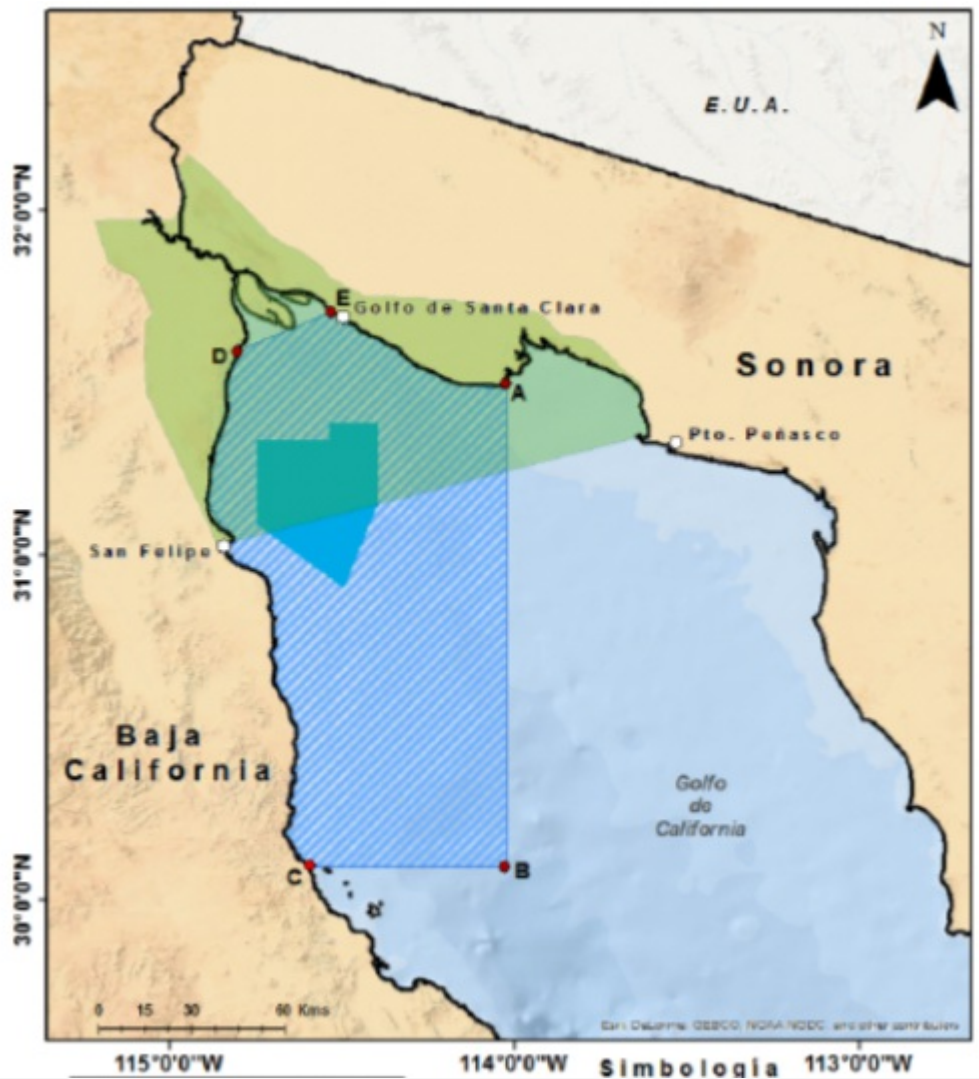


Figure 12 Area of permanent gillnet ban in the Upper Gulf of California (square blue lines).

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:

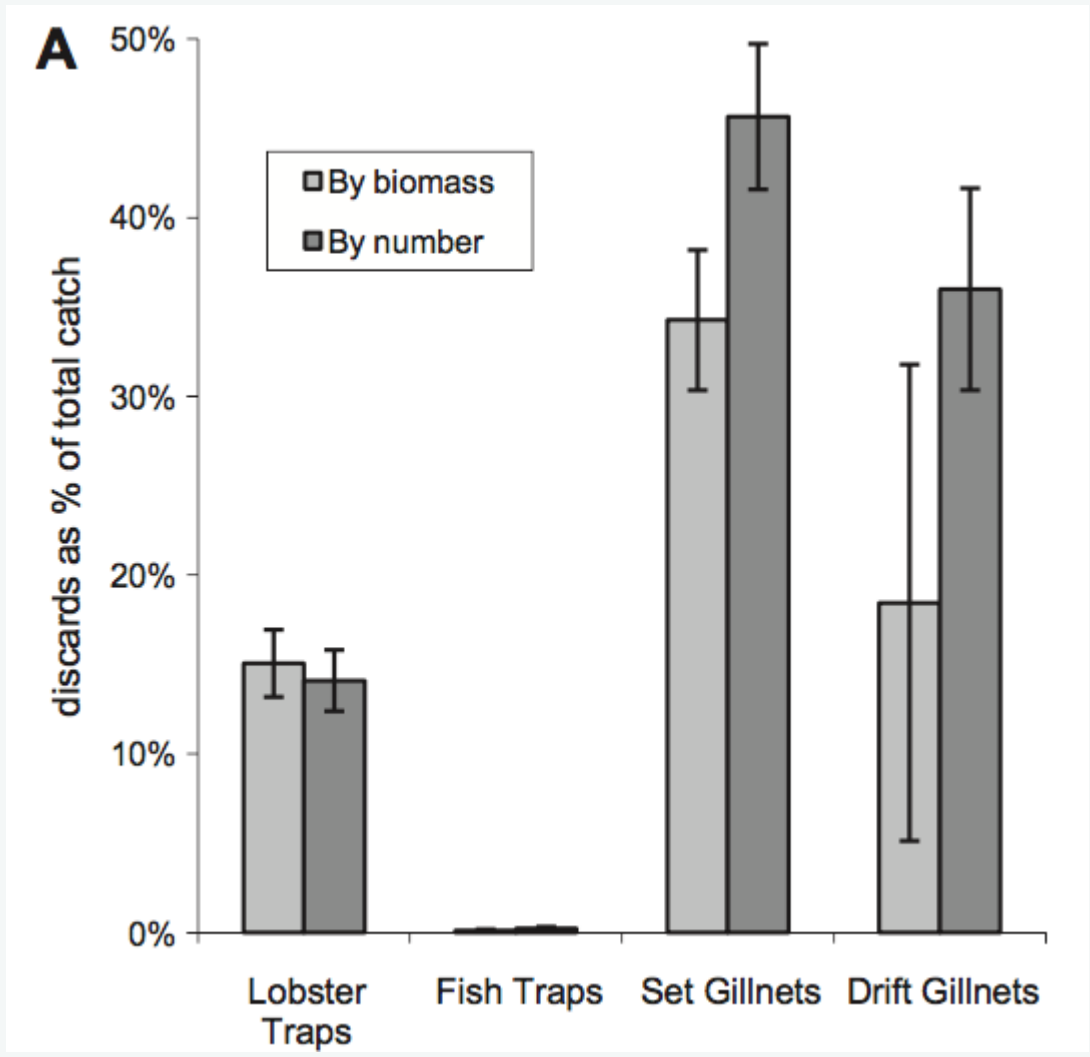


Figure 13 Percentage of discards in biomass and number of organisms in Baja California Sur (Source: Shester and Micheli, 2011)

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:

$$\text{Vulnerability (V)} = \sqrt{(P^2 + S^2)}$$

$$V = \sqrt{([1.4])^2 + ([1.4^2 + (2.32^2)])}$$

$$V = 2.82$$

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:

$$\text{Vulnerability (V)} = \sqrt{P^2 + S^2}$$

$$V = \sqrt{[1.46]^2 + [1.6^2 + (2.32^2)]}$$

$$V = 2.82$$

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:

$$\text{Vulnerability (V)} = \sqrt{P^2 + S^2}$$

$$V = \sqrt{(1.42)^2 + (1.42^2 + (2.32^2))}$$

$$V = 2.82$$

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%.