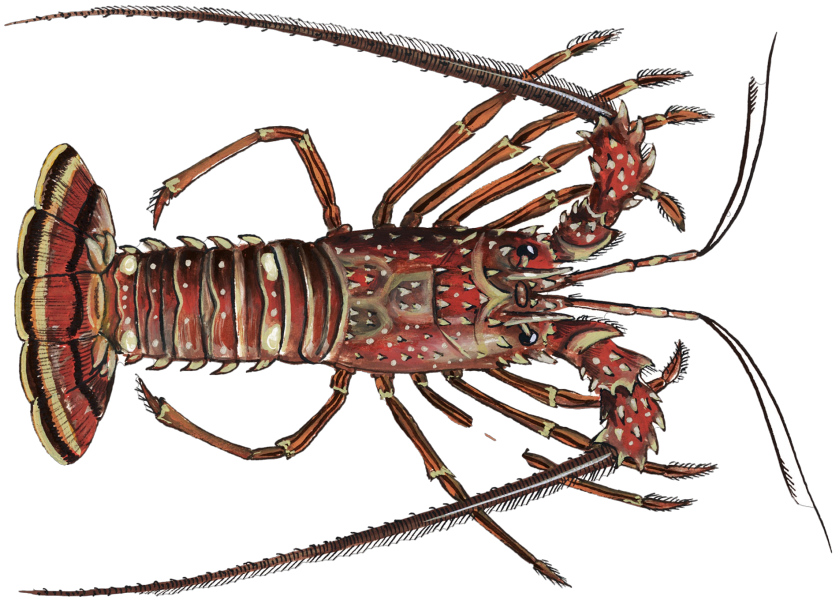
Monterey Bay Aquarium
Seafood Watch

Environmental sustainability assessment of wild-caught Caribbean spiny lobster from Mexico caught by divers and traps



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Species:	Caribbean spiny lobster (*Panulirus argus*)
Location:	Mexico: Gulf of Mexico, Caribbean Sea
Gear:	Diving, Traps
Type:	Wild Caught
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Assessed using Seafood Watch Fisheries Standard v3

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About Seafood Watch

Monterey Bay Aquarium's Seafood Watch program evaluates the environmental 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. 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.

Seafood Watch's science-based ratings are available at www.SeafoodWatch.org. Each rating is supported by a Seafood Watch assessment, in which the fishery or aquaculture operation is evaluated using the Seafood Watch standard.

Seafood Watch standards are built on our guiding principles, which outline the necessary environmental sustainability elements for fisheries and aquaculture operations. The guiding principles differ across standards, reflecting the different impacts of fisheries and aquaculture.

- Seafood rated Best Choice comes from sources that operate in a manner that's consistent with our guiding principles. The seafood is caught or farmed in ways that cause little or no harm to other wildlife or the environment.

- Seafood rated Good Alternative comes from sources that align with most of our guiding principles. However, one issue needs substantial improvement, or there's significant uncertainty about the impacts on wildlife or the environment.

- Seafood rated Avoid comes from sources that don't align with our guiding principles. The seafood is caught or farmed in ways that have a high risk of causing harm to wildlife or the environment. There's a critical conservation concern or many issues need substantial improvement.

Each assessment follows an eight-step process, which prioritizes rigor, impartiality, transparency and accessibility. They are conducted by Seafood Watch scientists, in collaboration with scientific, government, industry and conservation experts and are open for public comment prior to publication. Conditions in wild capture fisheries and aquaculture operations can change over time; as such assessments and ratings are updated regularly to reflect current practice.

More information on Seafood Watch guiding principles, standards, assessments and ratings are available at www.SeafoodWatch.org.

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, Seafood Watch develops an overall recommendation. Criteria ratings and the overall recommendation are color coded to correspond to the categories on the Seafood Watch pocket guides and online guide:

Best Choice/Green: Buy first; they're well managed and caught or farmed responsibly.

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

Avoid/Red: Take a pass on these for now; they're caught or farmed in ways that harm other marine life or the environment.

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

Summary

This report focuses on Caribbean spiny lobster (*Panulirus argus*) caught with traps in Yucatán in the Gulf of Mexico and with free, scuba, and hookah diving in Yucatán and Quintana Roo in the Mexican Caribbean Sea. We separated the fishery by state and, in the case of Quintana Roo, separated the North and South regions. Although the fishery is managed under federal legislation, there are specific differences in gears used by producers as well as in management in the south of Quintana Roo (Sian Ka'an and Banco Chinchorro Marine Protected Areas), which held an MSC certification until 2016 and was involved in a Fishery Improvement Project until 2021.

Trap fisheries occur primarily in one part of the eastern Yucatán region (zone 4; see Figure 2 in the Introduction); whereas in Quintana Roo North (zones 6 and 7), where concessions are in place, lobster is targeted by divers (scuba, skin, and hookah) who use artificial reefs known as casitas for their fishing activities. These structures are registered and geo-referenced, which differs from the western region of Yucatán (port of Celestún), where casitas were used in the past but are no longer used {pers comm, Poot, A., 2024}. Lobster production mostly occurs in areas with ridge and slab formations or in reef zones where lobsters seek shelter (ibid).

Stock assessments for the Caribbean spiny lobster are rare in Mexico, although some recent efforts have been made for specific peninsula regions. During the 2022 update of the fisheries profile, managers reported that the biomass has been around B_{MSY}. The authors estimated biomass and fishing mortality values at the maximum sustainable yield (B_{MSY} and F_{MSY}) at 1,892 tons and 0.09, respectively, in Yucatán and at 3,497 tons and 0.08, respectively, in Quintana Roo. Finally, managers estimated the biomass limit reference point to be around 510 tons in Yucatán and 269 tons in Quintana Roo {IMIPAS 2024}.

The most common, nontargeted species caught in the Caribbean spiny lobster trap fishery include finfish, which is classified as a main species with a moderate impact and a low discard rate. The Unknown Bycatch Matrix also included interactions between traps and finfish species and potential interactions with benthic invertebrates. No species of concern are reported to be caught or to interact with the fishery, and no impact on other species was found for diving.

Spiny lobster management in Mexico has been relatively effective at maintaining landings and a stable, abundant population. Regulations on the minimum legal size and a closed season are in place and have proved effective. Still, managers recognize that enforcing the regulations is complex, leading to incidences of illegal catches and the use of unauthorized gear (i.e., gillnets). Overall, management of the spiny lobster fisheries in the Yucatan Peninsula is considered "moderately effective." Enforcement and compliance have been reported as complicated, with more positive outcomes for the fisheries within the MPAs of Sian Ka'an and Banco Chinchorro, where enforcement is developed by community surveillance programs that are funded publicly and privately. A recent program led by communities and in coordination with authorities also promises positive results in Yucatán. Finally, for the Caribbean spiny lobster fisheries in Yucatán, traps or casitas have some impact on the benthic habitat due to their contact with the bottom. Still, some spatial regulations are in place to help limit those impacts. The ecosystem impacts from the trap and casita-based fisheries are considered low.

Overall, the Caribbean spiny lobster diving fishery in the South region of Quintana Roo is rated green. Both

the Caribbean spiny lobster diving fishery in Yucatán and Quintana Roo North and the Caribbean spiny lobster trap fishery in Yucatán are rated yellow.

Final Seafood Recommendations

SPECIES | FISHERY	C 1 TARGET SPECIES	C 2 OTHER SPECIES	C 3 MANAGEMENT	C 4 HABITAT	OVERALL	VOLUME (MT) YEAR
Caribbean spiny lobster | Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Quintana Roo South	4.284	5.000	3.000	4.000	**Best Choice (4.004)**	355
Caribbean spiny lobster | Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Yucatan and Quintana Roo North	1.916	2.236	3.000	4.000	**Good Alternative (2.678)**	1,016
Caribbean spiny lobster | Gulf of Mexico | Atlantic, Western Central | Traps | Yucatan	1.916	2.560	3.000	3.464	**Good Alternative (2.672)**	1,016

Summary

The Caribbean spiny lobster diving fishery in the South region of Quintana Roo is rated green. The Caribbean spiny lobster diving fishery in Yucatán and the North region of Quintana Roo is rated yellow. The Caribbean spiny lobster trap fishery in Yucatán is rated yellow.

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

Several distinct species of spiny lobster are located in various areas of the world. Caribbean spiny lobster (*Panulirus argus*) is the most important lobster species in the Caribbean region and is fished by several countries, including Mexico. Its distribution ranges from the Gulf of Mexico to Brazil (Holthuis 1991), and research has identified several genetically distinct stocks that can be found throughout its range. Spotted spiny lobster (*Panulirus guttatus*) is also caught incidentally in the Mexican Caribbean and the Alacranes Reef in Yucatán, and green lobster (*Panulirus laevicauda*) is incidentally caught in the Mexican Caribbean; however, the proportions are not significant (Rios-Lara et al 2013).

In Mexico, Caribbean spiny lobster is mainly targeted by small-scale fishers who use a variety of techniques and gears, from autonomous (free) to semi-autonomous (hooka and scuba) diving techniques, where divers use a "lazo" or loop to hook the lobster. In some areas, producers install artificial reefs (casitas) to aggregate lobsters (DOF 2012). Although official reports (INAPESCA 2013) (DOF 2014) (DOF 2016) have mentioned that in some regions of the Peninsula—mostly the north-northeast—fishers also used gillnets to target the species, only diving (with the use of casitas) and traps are the gears authorized by managers (DOF 2016). Rios-Lara et al. (2013) described the different gears producers use in the different zones (Table 1). This report provides ratings for Caribbean spiny lobster fished using traps and diving techniques in Yucatán and Quintana Roo, along with the Yucatán Peninsula (Gulf of Mexico and the Caribbean Sea).

Table 1

SFW region	Zone	Gear					
		Traps	Casitas	Diving (scuba)	Diving (hooka)	Diving (free)	Gillnets
Yucatán	1		X		X	X	
	2				X	X	
	3		X		X	X	
	4	X					
	5				X	X	
Quintana Roo North	6	X			X		X (seasonal)
	7	X		X	X		X (seasonal)
Quintana Roo South	8			X		X	
	9					X	

Species Overview

The spiny lobster of the genus *Panulirus* contains more than 20 different species that can be found worldwide in tropical and semitropical waters {Pollack 1995}. *Panulirus* species are more common in shallow tropical and subtropical waters (< 100 m in depth), where habitat diversity is larger and plays a role in the radiation of this genus (George and Main 1967) (George 2006), and which also allows the occurrence of two or more *Panulirus* species living in sympatry in various regions and parts of the world (Briones-Fourzán and Lozano-Álvarez 2013). As a result, *P. argus* and *P. guttatus* can both be found in the Mexican Caribbean (Figure 1). These species have a depth range from 1 to 90 m, which varies depending on the species (Holthuis 1991). In their early life stages, lobsters usually live near the shore in grass bed areas, then move to rocky substrates when they become adults (Briones-Fourzan 2014). Spiny lobsters are nocturnal and migrate among depths depending upon the season, generally moving deeper in winter months (CDFG 2001).

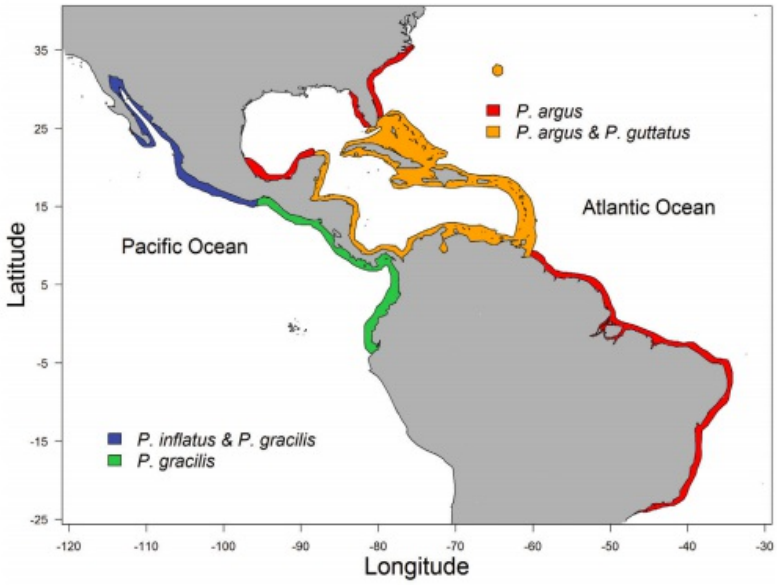

Figure 1: Geographic distribution of the two pairs of sympatric *Panulirus* species in Mexico, including *P. argus* (image taken from Briones-Fourzán, 2014).

In Mexico, Caribbean spiny lobster is regulated by the Yucatán Peninsula Lobster Management Plan (YPMP) enacted in 2014 (DOF 2014) and by the Mexican Official Norm (NORM-006-PESC-1993) {NOM 2016}. The federal body in charge of reviewing the application of these regulations is the National Commission for Fisheries and Aquaculture (CONAPESCA) {DOF 1993}, and its technical branch, the Mexican Institute of Sustainable Aquaculture and Fisheries (IMIPAS, formerly known as INAPESCA). The main regulations include a closed season, a minimum legal size (135 mm of abdominal length), a prohibition on the landing of berried females, restrictions on gear, and specific closed zones (DOF 2016) (DOF 2014). The closed seasons for the spiny lobster species vary across zones due to variations in the reproductive cycle that result from latitudinal changes (Briones-Fourzan and Lozano-Alvarez 2000). The spiny lobster fisheries of Mexico are also regulated through limited access rights, via concessions or permits, that limit the fishing areas and the number of boats and/or traps proposed by the various fishing cooperatives. A small portion of the Caribbean spiny lobster fishery (inside Sian Ka'an and in Banco Chinchorro in the central part of the State of Quintana Roo) was certified by MSC standards in July 2012 (MRAG 2012) (MRAG 2015), but did not renew its certification in 2017; for that reason, it is also included in the overall scoring of this report.

Production Statistics

In Mexico, the Caribbean spiny lobster fishery operates along the Yucatán Peninsula. The region has been divided into nine different areas by managers and researchers; however, management is similar throughout the region (Figure 2) (DOF 2022). In terms of management, managers divide the region into the Yucatán Shelf (zones 1-5) and the North-Central or the Caribbean (zones 6-9) (ibid).

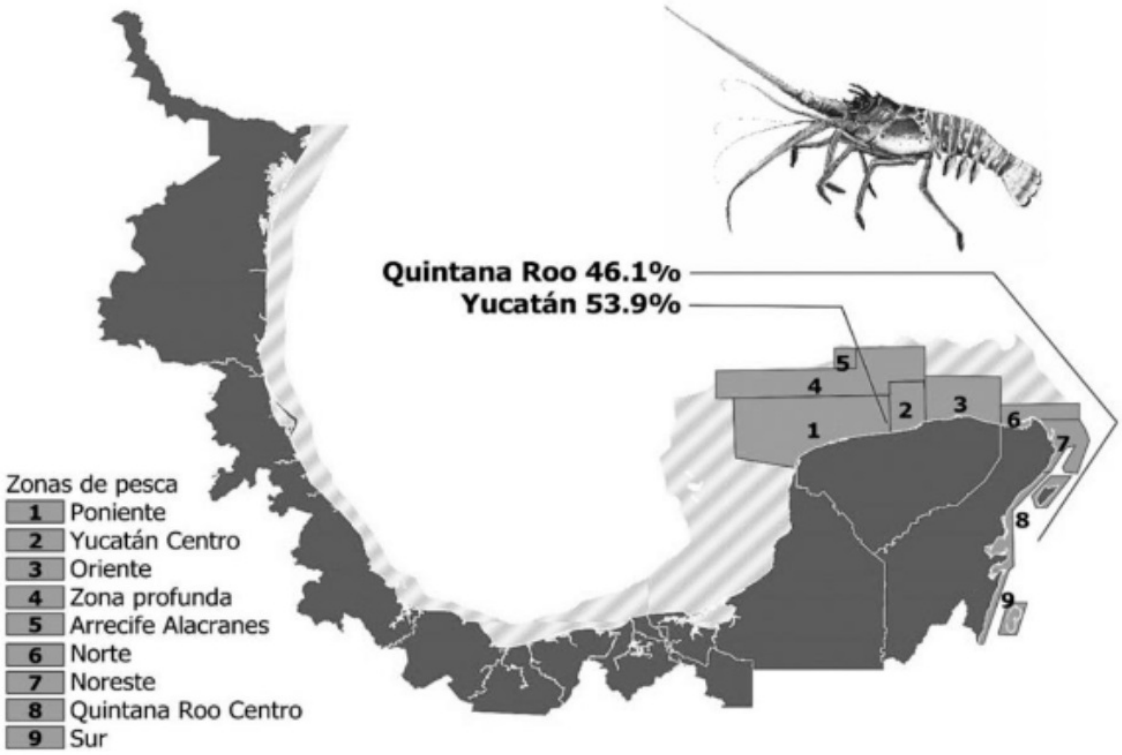

Figure 2: Lobster fishing zones in the Yucatán Peninsula and Mexican Caribbean: Alacranes (5), Progreso-Celestun (1–4), Yucatán Center-Dzilam de Bravo (2), San Felipe to El Cuyo (3), Yalahau Lagoon, Holbox, and Cabo Catoche (6), Contoy, Isla Mujeres, Puerto Morelos, and Arrowsmith Bank (7), Cozumel, Tulum, Bahias de la Ascension, Espiritu Santo, and Punta Herrero (8), Chinchorro Bank and Majahualand Xcalak (9) (DOF 2022).

Lobster production by state has been relatively stable since 2012, with an average of 444.4 MT in Quintana Roo and 543 MT in Yucatán in 2023 (Figure 3).

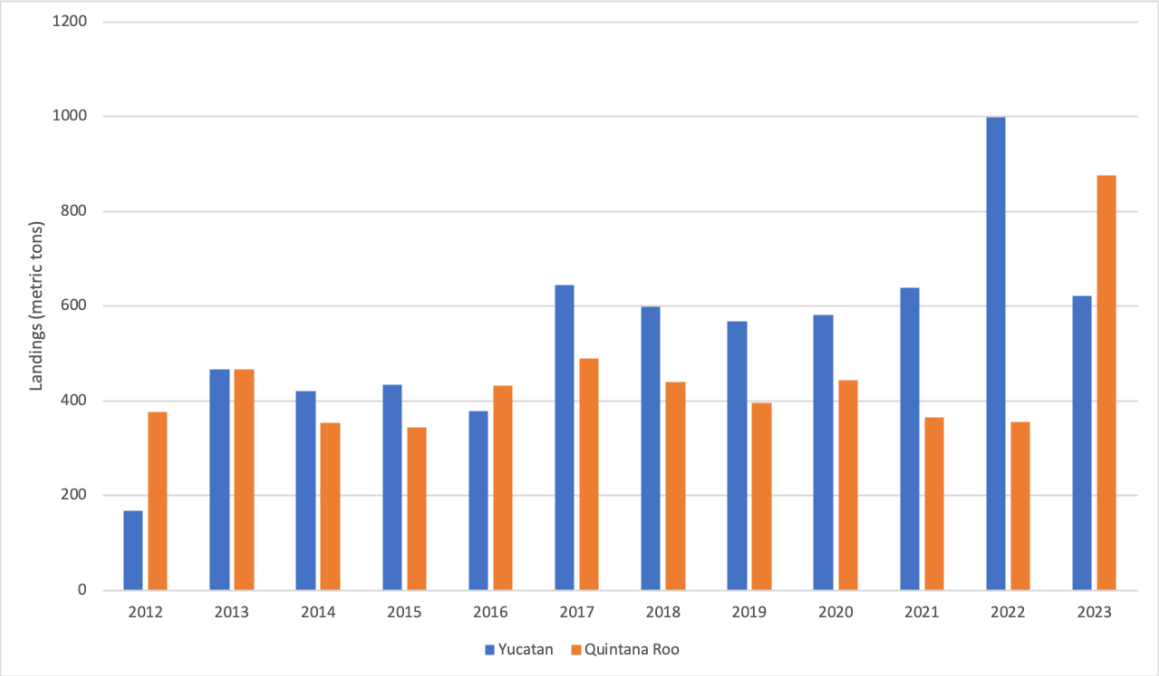

Figure 3: Lobster production by state from 2012 to 2023 (CONAPESCA landing data 2023) (Arámbula et al. 2021).

Importance to the US/North American market.

The Yucatán spiny lobster fishery products are sold regionally for the tourism sector in Cancún, Playa del Carmen, Cozumel, and other markets in the Yucatán Peninsula (DOF 2014). A recent evaluation of the supply chain reported that a small fraction of the production goes to international markets, mainly France and the United States (Casado & Crespo 2023). But, the authors reported that live export of lobster to Honk Kong will play a new role on the supply dynamics of this fishery (ibid). United States imports of Mexican lobster have decreased in recent years, from around 146 MT in 2021 to just 51 MT in 2023 (NMFS 2024).

Common and market names.

Spiny lobsters, in general, are also known as rock lobsters. In the U.S., the species should be labeled “Caribbean spiny lobster” (the common name allowable by the U.S. Food and Drug Administration) or simply “spiny lobster” (the acceptable market name) (FDA 2024). Other, nonmarket names include crawfish, rock lobster, bug, Florida lobster (FDA 2024), Bermuda spiny lobster, common spiny lobster, West Indian langouste, and West Indian spiny lobster (Holthuis 1991).

Primary product forms

Spiny lobster is marketed whole and sold live domestically, mainly in the region (Casado & Crespo 2023). For export markets, it is sold primarily cooked and frozen. Tails are frozen or canned. In recent years, there has been an increase in the proportion of live lobster to Asia, with export companies in Quintana Roo, one in Puerto Morelos, and a second one in Puerto Juarez (ibid).

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

CARIBBEAN SPINY LOBSTER			
REGION / METHOD	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Quintana Roo South	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Yucatan and Quintana Roo North	3.670: Low Concern	1.000: High Concern	Red (1.916)
Gulf of Mexico | Atlantic, Western Central | Traps | Yucatan	3.670: Low Concern	1.000: High Concern	Red (1.916)

Criterion 1 Assessments

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.*

Caribbean spiny lobster (Panulirus argusS)

Factor 1.1 - Abundance

Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Quintana Roo South

Low Concern

According to the 2022 version of the National Fisheries Chart (the federal tool used by managers to address fisheries status), the lobster fishery in the Yucatán Peninsula was exploited at its maximum sustainable levels among the different regions (Figure 4) (DOF 2022). Managers used a catch/maximum catch model to assess the status of the populations in the region. They generated Kobe plots for the Yucatán fishing platform and the north-central Caribbean areas. But it is unclear what considerations were made by managers regarding previous statements about needing to understand better the Caribbean-wide spiny lobster stock, its spawning biomass, and population-wide dynamics (Buesa 2018). According to Kough et al. (2013), management efforts should be based on more specific knowledge of population connectivity among Caribbean nations. Concerning this, studies of population structuring among the Caribbean subpopulations (using mtDNA markers) have provided conflicting results {Truelove et al. 2015}. For instance, although Diniz et al. (2005) reported distinctions between northern and southern Caribbean subpopulations, Naro-Maciel et al. (2011) found no evidence of genetic differentiation among the Puerto Rico, Bahamas, and Florida subpopulations. But more powerful genetic tools (polymorphic microsatellite markers [msatDNA]) have been used to try to resolve population structure questions {Hellberg 2009}{Lukoschek et al. 2008}. In 2012, Truelove et al. (2012) found potential subregional population structure among marine protected areas in the Mesoamerican region using msatDNA. For these reasons, the Yucatán stocks should not be assessed in isolation, and should consider these connections; however, no more recent assessments related to this connectivity have been conducted.

Therefore, abundance is considered a “low concern” because a quantitative stock assessment is no more than 10 years old. Still, it is unclear if the evaluation included in the National Fisheries Chart has been approved through a robust scientific peer review. The assessments are usually conducted by regional researchers within the Institute, and the results are shared with CONAPESCA and other administrative bodies, such as the Secretary of Environmental and Natural Resources (SEMARNAT); however, the 2022 assessment used mostly administrative reviewers who are not related to the results and methodology (Balmori, A. 2024) (pers comm, IMIPAS). In addition, although managers use no target reference points within the National Fisheries Chart profile, these were calculated during the assessment and show that biomass levels have been above a reference point appropriate for the species’ ecological role for the past 10 years (DOF 2022).

Justification:

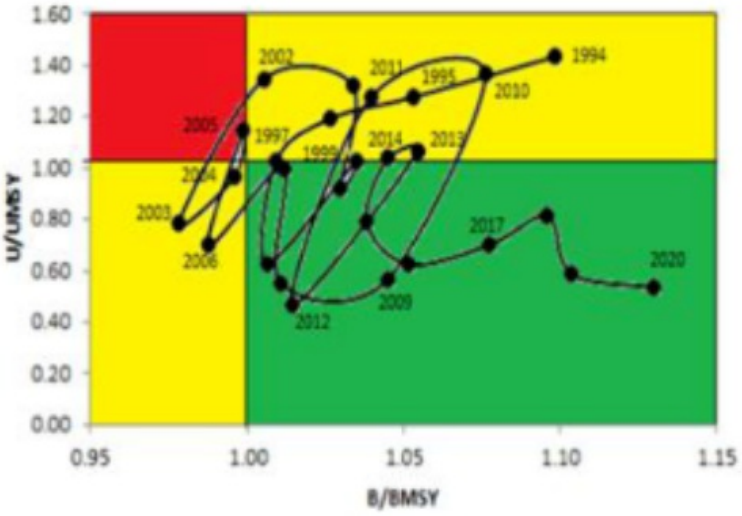

Figure 4: Kobe plot with Caribbean lobster biomass and exploitation rates against B_{MSY} and F_{MSY} for the Quintana Roo South region (DOF 2022).

Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Yucatan and Quintana Roo North Gulf of Mexico | Atlantic, Western Central | Traps | Yucatan

Low Concern

According to the 2022 version of the National Fisheries Chart (the federal tool used by managers to address fisheries status), the lobster fishery in the Yucatán Peninsula was exploited at its maximum sustainable levels (DOF 2022). Managers used a catch/maximum catch model to assess the status of the populations in the region and generated Kobe plots for the Yucatán fishing platform and the North-central Caribbean areas. But it is unclear what considerations were made by managers regarding previous statements about the need to have a better understanding of the Caribbean-wide spiny lobster stock, its spawning biomass, and population-wide dynamics (Buesa 2018). According to Kough et al. (2013), management efforts should be based on more specific knowledge of population connectivity among Caribbean nations. In relation to this, studies of population structuring among the Caribbean subpopulations (using mtDNA markers) have provided conflicting results {Truelove et al. 2015}. For instance, although Diniz et al. (2005) reported distinctions between northern and southern Caribbean subpopulations, Naro-Maciel et al. (2011) found no evidence of genetic differentiation among subpopulations in Puerto Rico, the Bahamas, and Florida. But more powerful genetic tools (polymorphic microsatellite markers [msatDNA]) have been used to try to resolve population structure questions {Hellberg 2009} {Lukoschek et al. 2008}. In 2012, Truelove et al. (2012) found potential subregional population structure among marine protected areas in the Mesoamerican region, using msatDNA. For these reasons, the Yucatán stocks should not be assessed in isolation, and should consider these connections.

Overall, there is a quantitative stock assessment that is no more than 10 years old, but it is unclear if the assessment included in the National Fisheries Chart has been approved through a robust scientific peer review. The assessment results show that biomass levels have been above B_{MSY}; however, there is a trend toward the limit of B/B_{MSY} for Yucatán and North Quintana Roo (Figure 5).

Considering this, it can be estimated that biomass is above a target reference point that is appropriate, given the species' ecological role, but does not meet all the requirements for a rating of "very low concern." For these reasons, abundance is considered a "low concern."

Justification:

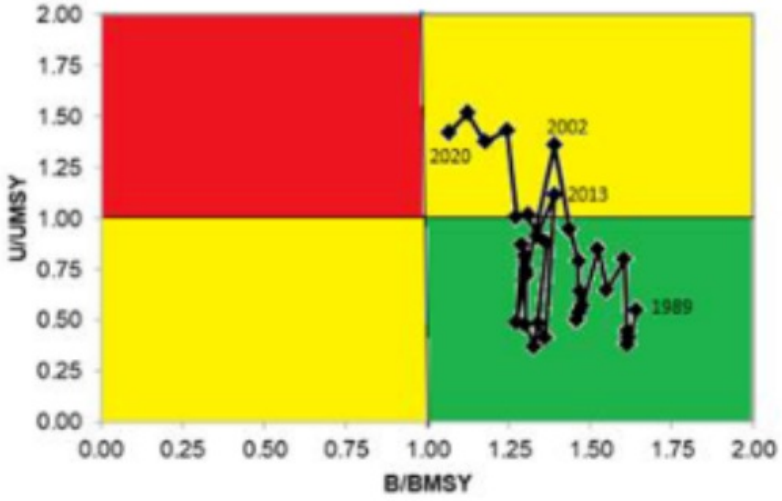

Figure 5: Kobe plot on Caribbean lobster B/B_{MSY} and F/F_{MSY} in the Yucatán shelf and Quintana Roo north (DOF 2022).

Factor 1.2 - Fishing Mortality

Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Quintana Roo South

Low Concern

According to the Yucatan Lobster Management Plan (YLMP), 452 small-scale vessels and 7 industrial vessels (that operate as motherships for small canoes with no motor, also known as alijos) were registered to target lobster in Quintana Roo in 2014 (DOF 2014). But according to (Casado & Crespo 2023), an average of 320 small-scale vessels and 25 industrial vessels were actively targeting lobster between 2017 and 2021.

According to the 2022 National Fisheries Chart's lobster profile, fishing mortality for the fishery in Quintana Roo has been below F_{MSY} for the past 10 years, except from 2013 to 2014 (where values were around F_{MSY}) (see Figure 4). Based on the most recent assessment, it is probable that fishing mortality is below a sustainable level; therefore, this factor is considered a "low concern" for the fishery.

Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Yucatan and Quintana Roo North
Gulf of Mexico | Atlantic, Western Central | Traps | Yucatan

High Concern

According to the Yucatán Lobster Management Plan (YLMP), 511 small-scale vessels and 35 industrial vessels (that operate as motherships for small canoes with no motor, also known as alijos) were registered to target lobster in 2014 in Yucatán (DOF 2014). But according to (Casado &

Crespo 2023), an average of 320 small-scale vessels and 25 industrial vessels were actively targeting lobster between 2017 and 2021.

Authorities included information in the YLMP related to changes in the exploitation rates in the fishery between 1965 and 2010 in Yucatán (Figure 6) (DOF 2014). As a result of these changes, managers found a relationship between the increments in F that directly affected the species' biomass (see Figure 5). According to the 2022 National Fisheries Chart's lobster profile, fishing mortality for the fishery in Yucatán was above F_{MSY} between 2017 and 2020, and around F/F_{MSY} between 2012 and 2016, except for 2010 and 2011 (see Figure 5) (DOF 2022).

Although managers stated that the fishery is performing at a maximum sustainable level, they recommended not increasing the fishing effort (DOF 2022). Researchers estimated that improvements to the fleet (e.g., more efficient engines) in recent years (Rios and Peniche-Ayora 2011) (Rios-Lara et al. 2012) should be considered as an addition to the fishing effort. Finally, managers stated that, based on the analysis of the catch and the results of the C-Max model (C/C-Max), a maximum level of exploitation was found for most of the fishing areas (Alacranes, Deep Zone, Oriente, Quintana Roo Center, Northeast, and South), including "red flags" in three of these that indicated overexploitation (West, Yucatán Center and North) (DOF 2022). Considering the reports on the 2022 fishery profile, it is probable (> 50% chance) that fishing mortality is above a sustainable level that is appropriate, given the species' ecological role (overfishing is occurring). Therefore, this factor is considered a "high concern" for Yucatán and Quintana Roo North.

Justification:

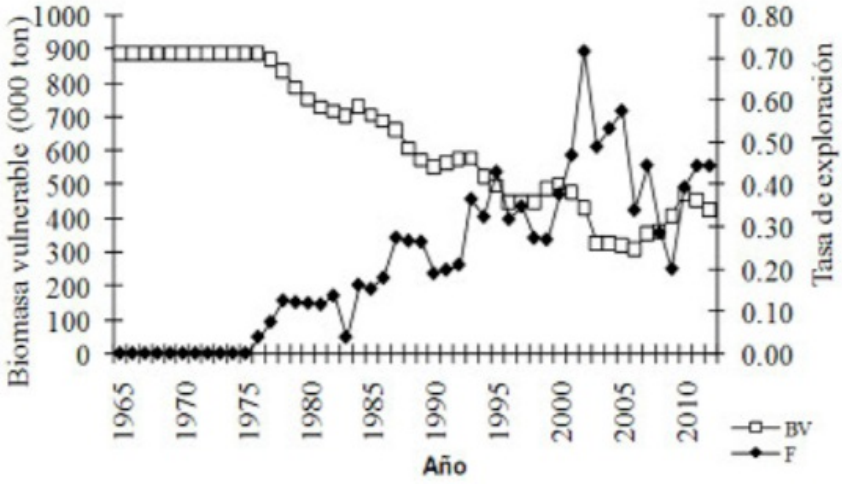

Figure 6: Changes in fishing effort and biomass in Yucatán (figure taken from Plan de Manejo Langosta SAGARPA 2014).

Criterion 2: Impacts on Other Species

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

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

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

Guiding principles

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

Criterion 2 Summary

Criterion 2 score(s) overview

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

CARIBBEAN SPINY LOBSTER			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Quintana Roo South	5.000	1.000: < 100%	Green (5.000)
Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Yucatan and Quintana Roo North	2.236	1.000: < 100%	Yellow (2.236)
Gulf of Mexico | Atlantic, Western Central | Traps | Yucatan	3.413	0.750: >= 100%	Yellow (2.560)

Criterion 2 main assessed species/stocks table(s)

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

CARIBBEAN SEA | ATLANTIC, WESTERN CENTRAL | MEXICO | DIVING | QUINTANA ROO SOUTH			
SUB SCORE: 5.000	DISCARD RATE: 1.000	SCORE: 5.000	
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Caribbean spiny lobster	3.670: Low Concern	5.000: Low Concern	Green (4.284)

CARIBBEAN SEA | ATLANTIC, WESTERN CENTRAL | MEXICO | DIVING | YUCATAN AND QUINTANA ROO NORTH			
SUB SCORE: 2.236	DISCARD RATE: 1.000	SCORE: 2.236	
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Caribbean spiny lobster	3.670: Low Concern	1.000: High Concern	Red (1.916)
Finfish	1.000: High Concern	5.000: Low Concern	Yellow (2.236)

GULF OF MEXICO | ATLANTIC, WESTERN CENTRAL | TRAPS | YUCATAN			
SUB SCORE: 3.413	DISCARD RATE: 0.750	SCORE: 2.560	
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Caribbean spiny lobster	3.670: Low Concern	1.000: High Concern	Red (1.916)
Benthic inverts	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Finfish	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)

According to information regarding traps in the lobster fishery, traps are used in at least two regions in

Yucatán; however, information about catch composition needs to be clearer to determine the impacts on other species. The Lobster Official Norm NOM-006-1993 (DOF 2016) and the Lobster Management Plan (DOF 2014) mention that mutton snapper (*Lutjanus analis*) and species of the genus *Calamus* are among the most important finfish species caught by the traps, but information about the volume of these species in the catch is not available; for this reason, the finfish taxon was included in the Criterion 2 species. In addition, information regarding the impacts of gear on other taxa or species of concern was not found; thus, we used the Unknown Bycatch Matrix to measure the potential impacts of the fishery on different taxa, such as corals and other biogenic habitats as well as benthic invertebrates taxa. Concerning the risk of traps to marine mammals, this was assumed to be low because there is no line used in trap fisheries in the region (similar to fisheries in Honduras and Belize) (SFW 2023)(SFW b 2023), and interactions between these species and the gear are unheard (Coronado, E. 2024). Therefore, marine mammals are not assessed in this report. Finally, managers stated that traps are used in areas of hard bottoms {Logan et al. 1969}{DOF 2013}—these are described by (Rios-Lara et al 2013) as substrates formed of composite sedimentary carbonate rock that is almost entirely composed of shell fragments of mollusks and invertebrates, and they concluded that it is unlikely that the traps come in contact with rocky reef/boulder and corals. For this reason, corals and biogenic habitats are not included in this fishery. Overall, the UBM was used to score abundance and fishing mortality.

Regarding the lobster dive fishery in Yucatán and Quintana Roo North, the 2014 management plan mentions that significant volumes of different fish species are captured, mainly groupers (*Epinephelus morio*, *Mycteroperca microlepis*, and *Mycteroperca bonaci*), snappers (*Lutjanus* spp.) and hogfish (*Lachnolaimus maximus*) (DOF 2014). The production levels of these species were unavailable; however, considering that some vulnerable species (e.g., groupers) are reported, we are including the finfish taxa and using the UBM to score these for the diving technique.

The diving fishery in Quintana Roo South was MSC-certified between 2012 and 2016; the fishery impacts on bycatch species were assessed during the certification process. The assessment reported that hand nets or “jamo” are used by diving fishers, and as part of their fishing activities, fishers may catch small numbers of a common species of stone crab (*Menippe mercenaria*) for domestic consumption only. The authors mentioned that the species is not marketed and has no commercial value, and because of the quite low rate of capture (< 5% of the total catch weight) and that the small quantity provides no influence on the operation of the fleet that would cause a risk to *M. mercenaria*, the catch is considered a “minor” species (MRAG 2012). During the last audit, developed in 2015, the authors declared that there was no new information on bycatch for the certified fishery. The assessors confirmed that the fishery in that region remained a highly selective, hand-held, free diving operation, and it scored 100 under the outcomes of the retained and bycatch species indicator {MRAG, 2015}. Based on the information available, it is considered that the Quintana Roo South diving fishery does not have any impact on other species.

Criterion 2 Assessment

SCORING GUIDELINES

Factor 2.1 - Abundance
(same as Factor 1.1 above)

Factor 2.2 - Fishing Mortality
(same as Factor 1.2 above)

Factor 2.3 - Modifying Factor: Discards and Bait Use
Goal: Fishery optimizes the utilization of marine and freshwater resources by minimizing post-harvest loss. For fisheries that use bait, bait is used efficiently.

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

Ratio of bait + discards/landings	Factor 2.3 score
<100%	1
>=100	0.75

Benthic inverts (Unknown benthic invertebrate spp.S)

Factor 2.1 - Abundance

Gulf of Mexico | Atlantic, Western Central | Traps | Yucatan

Moderate Concern

We included this taxonomic group based on results of the Seafood Watch Unknown Bycatch Matrix. This taxonomic group is considered a “moderate concern" for abundance using the UBM, considering that the potential impact of the fishery on this taxa is not over highly vulnerable species.

Factor 2.2 - Fishing Mortality

Gulf of Mexico | Atlantic, Western Central | Traps | Yucatan

Low Concern

This factor is considered a “low concern” using the Seafood Watch Unknown Bycatch Matrix for benthic invertebrates.

Finfish (Unknown finfish spp.S)

Factor 2.1 - Abundance

Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Yucatan and Quintana Roo North

High Concern

In the Yucatán peninsula, the lobster fishery (diving) has also been considered a multispecies fishery, because producers sometimes target other species (mostly finfish) while diving for lobster (Torres-Irineo and Salas 2008)(DOF 2014). Some of these species include groupers, a taxon known to be of high inherent vulnerability. Using the UBM, this factor is considered a “high concern.”

Gulf of Mexico | Atlantic, Western Central | Traps | Yucatan

Moderate Concern

Based on the Seafood Watch Unknown Bycatch Matrix, this taxonomic group is scored a “moderate concern" because most stocks of teleost fish are not from highly vulnerable taxa and have low vulnerability to interactions with pots/traps in this region.

Factor 2.2 - Fishing Mortality

Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Yucatan and Quintana Roo North

Low Concern

Data related to the impact of the fishery on finfish species were not available. For this reason, we used the UBM to score this factor a “low concern.”

Gulf of Mexico | Atlantic, Western Central | Traps | Yucatan

Low Concern

According to the Seafood Watch Unknown Bycatch Matrix, which uses data to evaluate species bycatch susceptibility by region and gear type, finfish have a low susceptibility to interactions with pot/trap fisheries. Therefore, a score of “low concern” was given.

Factor 2.3 - Discard Rate/Landings

Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Quintana Roo South
Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Yucatan and Quintana Roo North

< 100%

It has been reported that, when fishers target lobster by hand-harvest with casitas for lobster shelter, fishers also target other species, particularly finfish (DOF 2014). The proportion of these species is unclear, although managers have reported that the proportions are highly variable, depending on the zone and season {Rios-Lara et al. 2013}. Finally, considering that producers do not use bait when using the casitas and that lobster is the most notable species targeted, this factor is scored as < 100%.

Gulf of Mexico | Atlantic, Western Central | Traps | Yucatan

>= 100%

Total discard rates for the Caribbean lobster trap fishery are unknown. The Baja California fishery, which also uses traps, has ≈15% of species discards (Shester and Micheli 2011). The amount of bait is also unknown but is high, based on a study developed for the Australian lobster fishery that reported an average of 11,000 MT of lobster captured using ≈14,000 MT of bait annually (Waddington and Meeuwig 2009) and on a study that reported for the Mexican Baja lobster fishery in 2016, where bait represented 294% of overall lobster landings by weight (Alvarez-Flores et al 2016). Considering this information, the ratio 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.

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

Criterion 3 Summary

FISHERY	MANAGEMENT STRATEGY	BYCATCH STRATEGY	RESEARCH AND MONITORING	ENFORCEMENT	INCLUSION	SCORE
Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Quintana Roo South	Moderately Effective	Highly effective	Moderately Effective	Moderately Effective	Highly effective	**Yellow (3.000)**
Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Yucatan and Quintana Roo North	Moderately Effective	Highly effective	Moderately Effective	Moderately Effective	Highly effective	**Yellow (3.000)**

Gulf of Mexico | Atlantic, Western Central | Traps | Yucatan	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Highly effective	**Yellow (3.000)**

Criterion 3 Assessment

SCORING GUIDELINES

Factor 3.1 - Management Strategy and Implementation
Considerations: What type of management measures are in place? Are there appropriate management goals, and is there evidence that management goals are being met? Do manages followscientific advice? To achieve a highly effective rating, there must be appropriately defined management goals, precautionary policies that are based on scientific advice, and evidence that the measures in place have been successful at maintaining/rebuilding species.

Factor 3.2 - Bycatch Strategy
Considerations: What type of management strategy/measures are in place to reduce the impacts of the fishery on bycatch species and when applicable, to minimize ghost fishing? Howsuccessful are these management measures? To achieve a Highly Effective rating, the fishery must have no or lowbycatch, or if there are bycatch or ghost fishing concerns, there must be effective measures in place to minimize impacts.

Factor 3.3 - Scientific Research and Monitoring
Considerations: Howmuch and what types of data are collected to evaluate the fishery's impact on the species? Is there adequate monitoring of bycatch? To achieve a Highly Effective rating, regular, robust population assessments must be conducted for target or retained species, and an adequate bycatch data collection program must be in place to ensure bycatch management goals are met.

Factor 3.4 - Enforcement of Management Regulations
Considerations: Do fishermen comply with regulations, and howis this monitored? To achieve a Highly Effective rating, there must be regular enforcement of regulations and verification of compliance.

Factor 3.5 - Stakeholder Inclusion
Considerations: Are stakeholders involved/included in the decision-making process? Stakeholders are individuals/groups/organizations that have an interest in the fishery or that may be affected by the management of the fishery (e.g., fishermen, conservation groups, etc.). A Highly Effective rating is given if the management process is transparent, if high participation by all stakeholders is encouraged, and if there a mechanism to effectively address user conflicts.

Factor 3.1 - Management Strategy And Implementation

Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Quintana Roo South
Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Yucatan and Quintana Roo North
Gulf of Mexico | Atlantic, Western Central | Traps | Yucatan

Moderately Effective

Management of the spiny lobster fishery in the Yucatán Peninsula has been relatively effective, considering the general stability of production within the most recent 10 years (see Criterion 1). Regulations in place are contained within a National Federal Mexican Norm (NOM-006, enacted in 1993 and updated five times, most recently in 2009) and a Federal Management Plan (YPMP, released in 2014, although it has not been updated). These regulations include a series of measures such as a minimum size limit (135 mm abdomen length, equivalent to ≈74.6 mm of cephalothorax) {DOF, 2016}, technical specifications of the traps, as well as the maximum size of boats (10.5 m) and the engine power (115 hp) of the vessels authorized to target the species (DOF 2016). In addition, an annual four-month seasonal closure from March 1 to June 30 is in place, as well as a prohibition on catching mature females (DOF 2014). These regulations allow managers to protect species recruitment. But the management plans do not include the recovery of the species biomass, compared to past years, and the only reference point used by managers in the National Fisheries Chart is linked to production levels. It does not consider the most recent status of the species.

Fishing cooperatives in Quintana Roo South (Sian Ka'an and Banco Chinchorro) have internal rules (Reglamento Interno) in addition to the federal regulations. Considering that these are MPAs ruled by the National Commission of Natural Protected Areas (CONANP-SEMARNAT), the management plans include extra regulations, such as the prohibition on catching lobsters using scuba or hookah diving within the Banco Chinchorro and Sian Ka'an Biosphere Reserves (Sosa-Cordero et al. 2008). Finally, as part of the YPMP developed by INAPESCA (currently IMIPAS) and CONAPESCA, four strategic objectives to achieve a sustainable lobster fishery in the Yucatán Peninsula were announced {DOF 2014}; one of these actions was to develop reference points per fishing area within the Peninsula, based on optimal biomass and fishing effort to achieve MSY (ibid). Although reference points were estimated in the most recent assessment (DOF 2022), these are not public and it is unclear if they are used for management purposes. Finally, it is unclear how many of the other actions are in progress, because information about their progress was not found.

Considering that the fishery has several management measures in place and that regulations are expected to be effective (which can be reflected in production remaining relatively stable in recent years), there is a need to increase precaution due to the most recent findings of the biomass against historical levels (DOF 2022). Thus, this factor is considered "moderately effective."

Factor 3.2 - Bycatch Strategy

Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Quintana Roo South
Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Yucatan and Quintana Roo North

Highly effective

The hand-harvest lobster fishery through diving, and with the use of casitas, is a quite selective technique and does not discard bycatch. Therefore, this factor is considered “highly effective.”

Gulf of Mexico | Atlantic, Western Central | Traps | Yucatan

Moderately Effective

Information regarding the level of bycatch in the lobster traps was not available. According to the Fisheries Management Plan {DOF 2014}, species like mutton snapper (*Lutjanus analis*) and several species of the genus *Calamus* are among the most common species that get trapped. But local experts mentioned that these organisms are kept either to be sold or for personal consumption (pers comm, F. Fernandez, 2018). Mutton snapper is part of the multispecies fishery known as “snapper” or “huachinango” in the region. There is no management plan in place for the fishery, and one of the few regulations is related to the hook size when targeting snappers with long lines; however, this limit is based only on the red snapper ecology and does not consider other species in the group (DOF 2012). Another factor to consider is the potential loss of traps that could increase the risk of ghost fishing; current information about this was not available, but considering the experience in Florida, where significant issues with ghost traps have been reported (Butler and Matthews 2015), it will be important to measure the scale of this potential impact in the region. Finally, as mentioned in Criterion 2, one taxa was included as potentially affected by the fishery (benthic invertebrates). It is yet to be determined if there is enough information available related to the species that interact with the fishery. Considering these reasons, this factor is considered “moderately effective” for traps.

Factor 3.3 - Scientific Research And Monitoring

Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Quintana Roo South
Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Yucatan and Quintana Roo North
Gulf of Mexico | Atlantic, Western Central | Traps | Yucatan

Moderately Effective

Managers, in collaboration with producers, local nongovernmental organizations, academic institutions, and researchers, have a comprehensive data collection system in place (particularly in the Quintana Roo North and South regions) due to the species’ high value and the fishery’s social importance in the area (Sosa-Cordero 2018). In addition, between 2012 and 2017, the Sian Ka’an cooperative in Quintana Roo held an MSC certification, a management plan was created (DOF 2014), and the Federal Norm for Lobster (NOM-006) was updated (DOF 2016). But after the expiration of the MSC Certificate in 2017, the fishery withdrew from the process and launched an FIP that also stopped reporting in 2021, and it is currently inactive. A local characteristic is that producers (fishers) are well organized in fishing cooperatives, and this arrangement allows them to access information on monthly landings per fisher or group of fishers for administrative purposes. This information related to fishing activity can be obtained from the fishing cooperatives, which allows

for the extraction of fishing effort indicators and CPUE that can be used for resource monitoring purposes (pers comm, Sosa, 2019). Currently, data collection is limited to production and is used to report the status of the fishery against historical production by state; for these reasons, this factor is considered “moderately effective.”

Factor 3.4 - Enforcement Of Management Regulations

Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Quintana Roo South

Moderately Effective

Although access to the fishery in the north region of the Peninsula mostly follows permit-based access, most of the management system in the Quintana Roo South region relies on exclusive fishing rights through 20-year fishing concessions granted by managers (CONAPESCA) (MRAG 2015). These concessions refer explicitly to geographical areas authorized as fishing grounds (Sosa-Cordero et al. 2008). These systems allow enforcement actions (led by the cooperatives) to become more efficient {Miller, 1989}{Seijo and Fuentes 1989}{Seijo, 1993}. In addition, lobster fishing within the Biosphere Reserves of Sian Ka’an and Banco Chinchorro had been certified by MSC in part because of their good fishing practices and high level of local enforcement of regulations (pers comm, Lozano-Alvarez, 2019). This coincides with what was reported in the 2015 audit developed by MRAG, which reported that fishery participants in Sian Ka’an and Banco Chinchorro displayed a high level of responsibility, and in Sian Ka’an, a community surveillance program was running that was funded by federal and private resources (MRAG 2015). In June 2016, fishery producers announced their interest to withdraw their MSC certification (which was good until 2017) and they were involved in a fishery improvement project in order to continue implementing high standard operations, including enforcement and compliance with federal and local regulations (pers comm, Sosa-Cordero, 2019). Enforcement within these concession areas remains under the combination of official enforcement and voluntary, community-driven efforts. For these reasons, this factor is considered “moderately effective.”

Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Yucatan and Quintana Roo North
Gulf of Mexico | Atlantic, Western Central | Traps | Yucatan

Moderately Effective

Fishery access is controlled by permits and/or concessions that provide exclusive access to the species to the holders (DOF 2016) (DOF 2012). Permits are the main system to access the fishery in the Yucatán shelf and the north area of Quintana Roo, which is different from the rest of Quintana Roo, where concessions are the management tool (DOF 2022). The enforcement of regulations is carried out by CONAPESCA officials (federal officers), whose number of federal inspectors has decreased from approximately 210 in 2012 (IMCO 2013) to 161 in 2022 (Oceana 2024). This low number of officers is potentially insufficient, considering that the officers are in charge of patrolling more than 11,000 km of coastline. To help this situation, some agreements between local officials and local communities were implemented to improve enforcement actions (MRAG 2012)(MRAG 2015), although results about these programs remain unavailable. These findings were reinforced by a 2016 diagnostic that concluded that the most important problems for the lobster fishery in Yucatán

were the lack of effective enforcement as well as a lack of control on the number of vessels (including recreational fishers) (Benitez et al 2016).

Most recently, Oceana Mexico released a report where they analyzed official information related to five components associated with enforcement actions: (1) the number of federal enforcement agents, (2) the number of enforcement actions (in water and land), (3) the amount of fish products and gears retained as part of enforcement actions, (4) the level of coverage of the vessel management system (VMS) for the industrial fleet, and (5) the number of sanctions and infractions applied (Oceana 2024). Based on the analysis of the information on those five components, the report concludes that, in the best of cases, there has been a stagnation of effective enforcement actions by the authorities, while in the worst case, the results represent a clear disregard for the state to fulfill its duties (Oceana 2024).

During the 2023 season, CONAPESCA reported more than 1,700 enforcement actions in Yucatán, and as a result, 427 vehicles, 214 vessels, and 17 people were detained and around 1,600 MT of product were confiscated (Datos abiertos CONAPESCA 2023). At the state level, in 2021, Wild Aid, Impact Blue, and the Regional Federation of Cooperatives of Oriente in Yucatán agreed to design and implement a model for the effective protection and conservation of marine resources and their fishing zones {WildAid & Impact Blue 2021}. The diagnostic results prompted a Marine Protection System with the octopus fishery as a target species. But considering the multispecies nature of the fishery, this may apply to other fisheries, including lobster. Among the recommendations to improve the local and regional efforts in terms of enforcement and compliance was the need to establish a community surveillance committee with clear roles and responsibilities and to coordinate these efforts with the federal protocols (led by the Mexican Navy and CONAPESCA). It was recommended that a specific enforcement plan should be defined per area and consolidated at a regional level, and that an interinstitutional communication hub for the eastern region should be created {WildAid & Impact Blue 2021}. According to reports on the Wild Aid website, in 2022, the program covered three fishing areas in Yucatán and implemented more than 680 hours of patrolling led by the fishing federations, resulting in at least 17 fishing vessel seizures and an increase in lobster production of at least 50% (Wild Aid 2022)(Wild Aid 2024).

Finally, several protected areas in the region (e.g., the Biosphere Reserves of Sian Ka'an and Banco Chinchorro) count on the support of other agencies and enforcement staff (e.g., the National Commission of Protected Areas [CONANP] and the Environmental Protection Agency [PROFEPA]). Considering that managers (DOF 2014) and producers (Yucatan 2018) have described the enforcement actions as insufficient, but some efforts are in place that aim to increase enforcement and compliance (Wild Aid & Impact Blue 2021)(Wild Aid 2024)—though their effectiveness remains uncertain—this factor is considered "moderately effective."

Factor 3.5 - Stakeholder Inclusion

Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Quintana Roo South
Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Yucatan and Quintana Roo North

Gulf of Mexico | Atlantic, Western Central | Traps | Yucatan

Highly effective

Lobster regulations and management have been inclusive and transparent, allowing the participation of different stakeholders in recent management developments (e.g., the lobster management plan and updates of the Official Norm (DOF 2014) and the analysis of the fisheries impacts in Yucatán (Tuz-Sulub & Valdez 2017)). The most recent regulations are the result of coordination between stakeholders (mostly producers) to discuss issues and concerns at the state level (MRAG 2012) (DOF 2014). Because cooperatives play a crucial role in providing catch and effort data to managers, and these groups maintain communication and interactions about important fishery issues with authorities, this factor is considered “highly effective.”

Criterion 4: Impacts on the Habitat and Ecosystem

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

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

Guiding principles

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

Rating cannot be Critical for Criterion 4.

Criterion 4 Summary

FISHERY	FISHING GEAR ON THE SUBSTRATE	MITIGATION OF GEAR IMPACTS	ECOSYSTEM-BASED FISHERIES MGMT	SCORE
Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Quintana Roo South	Score: 4	Score: 0	Low Concern	**Green (4.000)**
Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Yucatan and Quintana Roo North	Score: 4	Score: 0	Low Concern	**Green (4.000)**
Gulf of Mexico | Atlantic, Western Central | Traps | Yucatan	Score: 3	Score: 0	Low Concern	**Green (3.464)**

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 - Impact of Fishing Gear on the Habitat/Substrate

Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Quintana Roo South
Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Yucatan and Quintana Roo North

Score: 4

When diving for lobster, fishers have quite limited interactions with the substrate (Figure 7). It could impact the substrate in areas where the casitas are installed and used (zones 1 and 3); however, there was not enough information related to measuring this impact. In 2012, as part of the MSC pre-assessment for the Sian Ka'an lobster fishery, the assessment team ran a SICA analysis (Qualitative Risk Analysis, which is a formalized assessment system when there is insufficient information for a quantitative analysis {FAO 2018}). As a result, it was concluded that the impact of the fishery (casitas) on the status of the habitat was minor (and scored 80 for that principal indicator) (MRAG 2012). For the analysis, stakeholders indicated that casitas are not placed on hard substrates (including coral reefs) and concluded that the direct impact of these structures on the benthic habitat is highly unlikely to reduce habitat structure and function (MRAG 2012). Overall, considering that there is some level of interaction with the bottom when diving and the available information on casitas has shown limited to no impacts, the diving fishery is scored a "4."

Justification:

Figure 7: Free dive fisher targeting lobster {Martinez, I. 2024}.

Gulf of Mexico | Atlantic, Western Central | Traps | Yucatan

Score: 3

According to managers, the traps are used on deeper areas (approximately > 50 m) in the Yucatán Peninsula shelf, which is composed mostly of hard bottoms {Logan et al. 1969}{DOF 2013}. Rios-Lara et al. (2013) described these “hard bottoms” or “coquina” as substrates formed of composite sedimentary carbonate rock that is almost entirely composed of shell fragments of mollusks and invertebrates, which are transported, eroded, and dispersed mechanically by currents and waves (Rios-Lara et al 2013). The little, consolidated coquina are poorly cemented and are considered grains of stone (gravel) in the system of Dunham’s classification (ibid). Finally, the rocks that are well cemented are known as biosporites, according to the classification of sedimentary rocks (Figure 8 shows the average lobster habitat substrate). Based on these descriptions, it is unlikely that the traps come in contact with rocky reef/boulder and corals. In addition, in the past, the effect of passive gears (like the traps) was assumed to have little impact on the sea bottom {Eno et al. 2001}. But these gears may pose a threat of cumulative habitat injury when they get lost. Cumulatively, this factor is scored a “3.”

Justification:

Figure 8: General view of the lobster habitat on the Yucatan shelf {Rios-Lara et al. 2013}.

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Quintana Roo South
Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Yucatan and Quintana Roo North

Score: 0

The Yucatán Peninsula has 25 Natural Protected Areas that add up to 8,562,758.47 ha (CONANP 2018). But the most important ones that have a direct relationship with the lobster fishery are the Biosphere Reserves of Sian Ka'an (Figure 9), Banco Chinchorro (Figure 10), and Caribe Mexicano (Figure 11)—all in Quintana Roo. Some management plans for these areas have extra regulations that limit the extraction of lobster in certain areas or the use of compressors/dive tanks when diving for lobster (i.e., Banco Chinchorro Management program) (CONANP 2000). In addition, Yucatán has one designated refuge zone in Celestún, with three additional zones in the process of being established in San Felipe/Dzilam de Bravo, Tizimín, and Chabihau as part of mitigation and restoration efforts. But to improve the score, at least 25% of the area should be protected for extraction; current closed regions do not add up to that percentage. For this reason, no extra points are added to the fishery.

Justification:

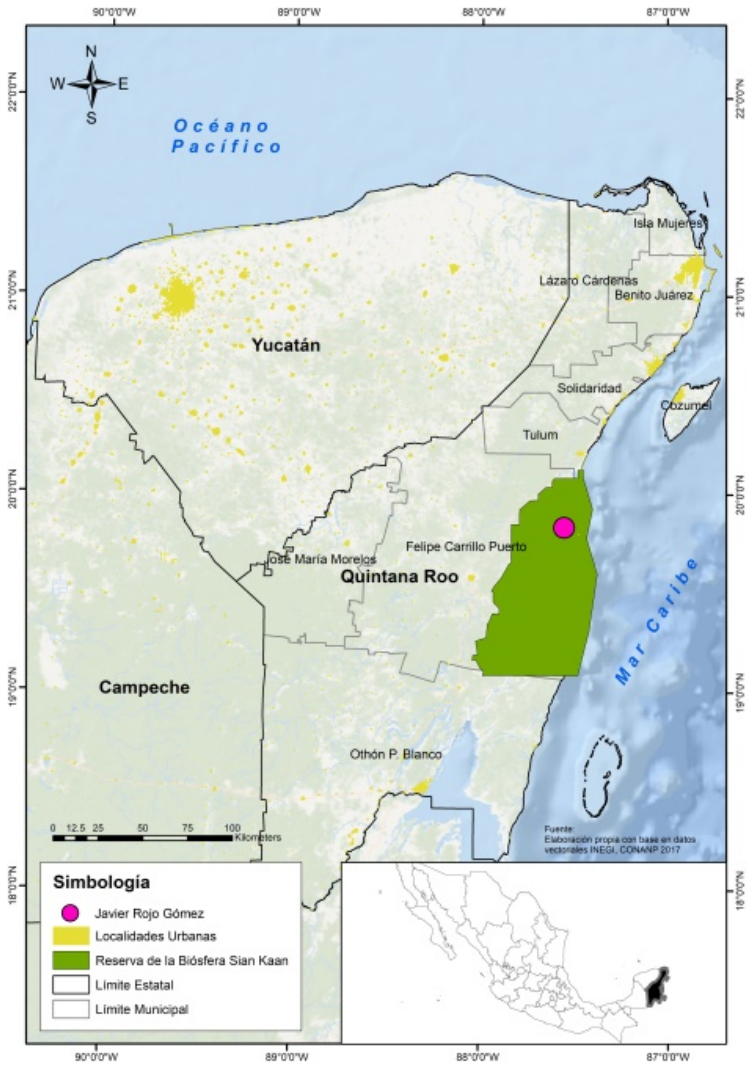

Figure 9: Sian Ka'an Biosphere Reserve (image taken from {Rojas-Correa and Palafox Muñoz 2018}).

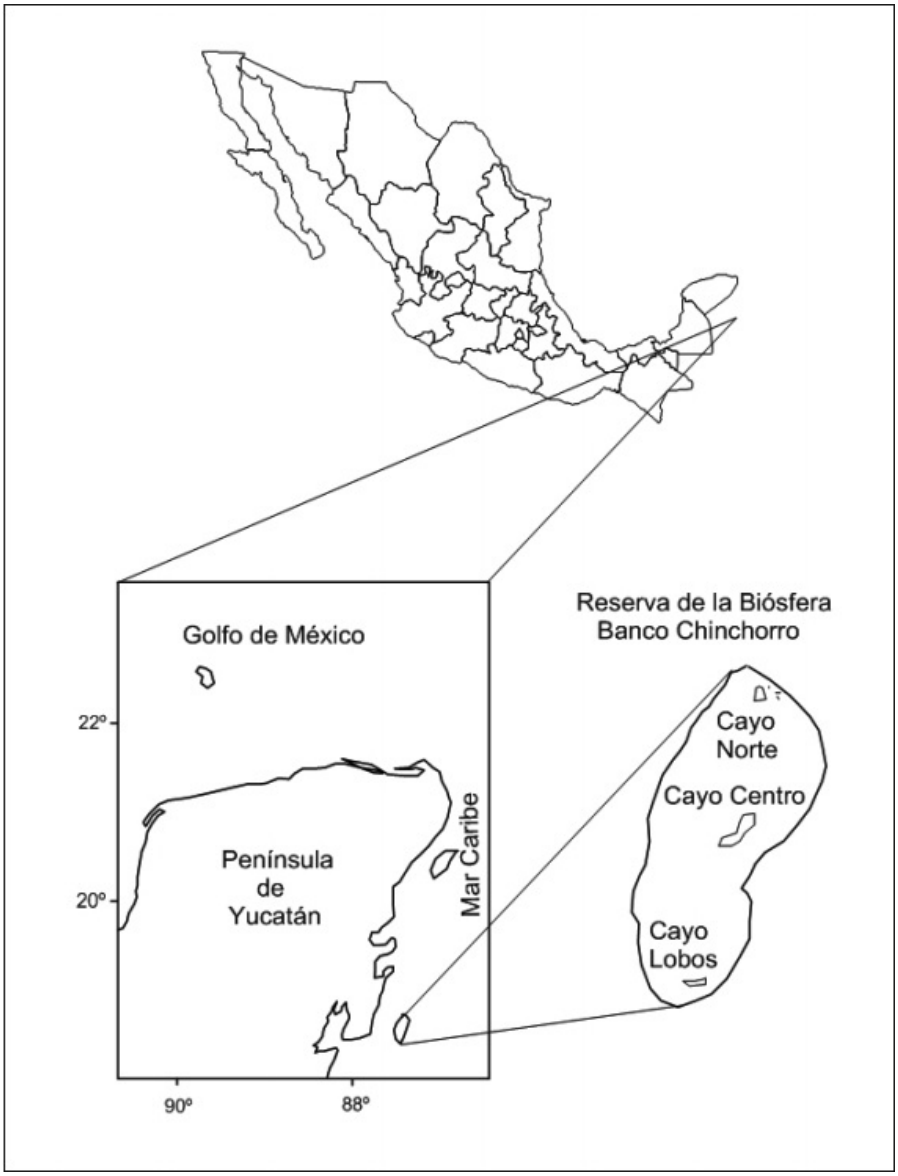

Figure 10: Banco Chinchorro Biosphere Reserve (image taken from (Ramirez-Estevez et al. 2010)).

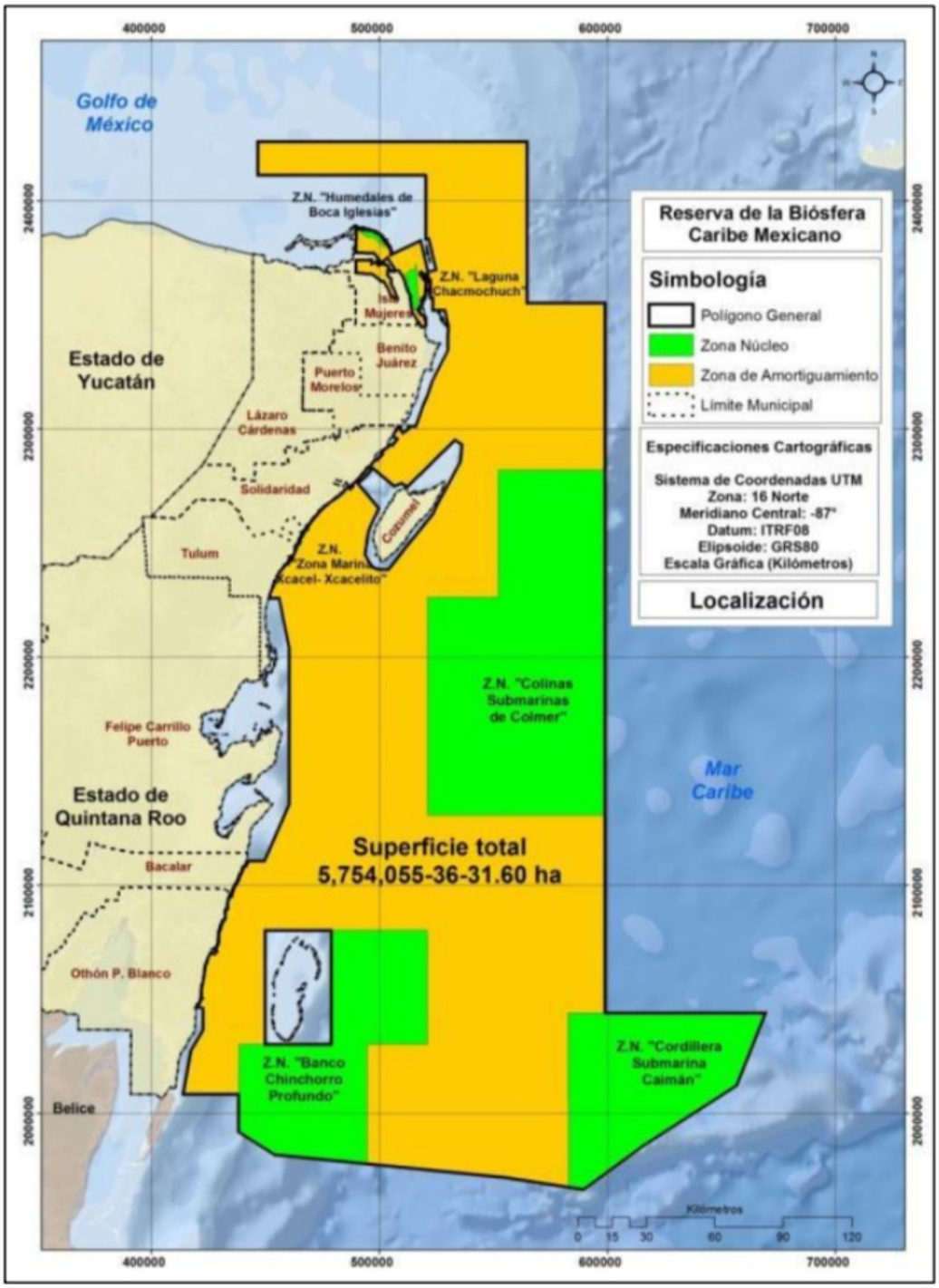

Figure 11: Mexican Caribbean Biosphere Reserve zoning. Yellow zone: buffer area; green: core zone (no commercial activities allowed) (figure taken from Biosphere reserve management program (CONANP-SEMARNAT 2016)).

Gulf of Mexico | Atlantic, Western Central | Traps | Yucatan

Score: 0

In the Yucatán Peninsula (particularly in fishing zones 2, 4, and 5), a newly created Marine Protected

Area was designed in 2024 (CONANP 2024). The Bajos del Norte National Park, created on January 2024, has a coverage of 1,304,000 ha (Figure 12) (ibid). The regions that overlap with the recently created MPA and the lobster fishing activities are mostly related to the trap fishery. But based on the map of the MPA, it is not clear that a substantial proportion of the habitat is protected from all bottom contact (ibid). Therefore, the trap fishery does not achieve extra points.

Justification:

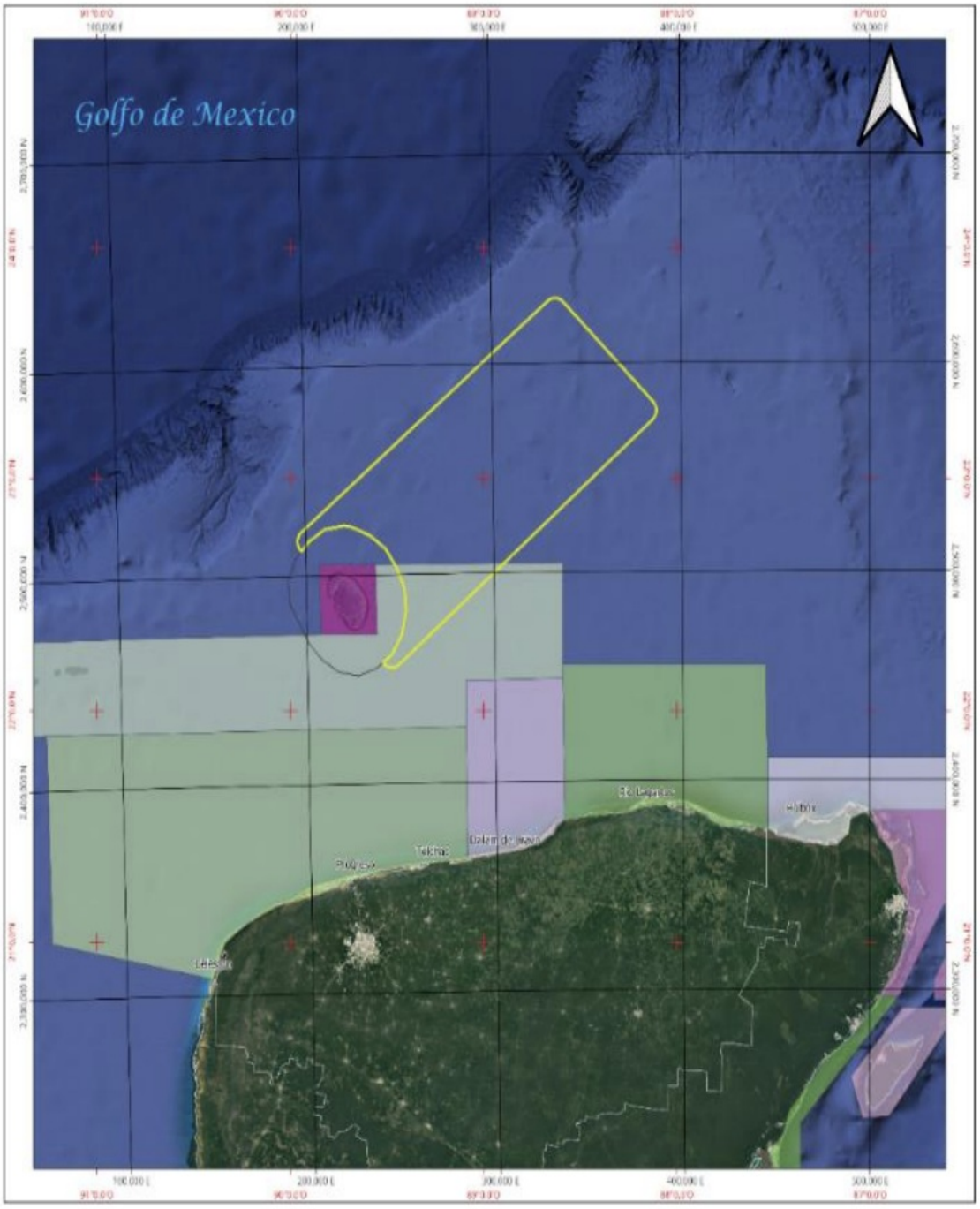

Figure 12: Marine Protected Area Bajos del Norte (line) and its overlap with the trap lobster fishery in the Yucatán slope (light green box) (CONANP 2024).

Factor 4.3 - Ecosystem-based Fisheries Management

Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Quintana Roo South
Caribbean Sea | Atlantic, Western Central | Mexico | Diving | Yucatan and Quintana Roo North
Gulf of Mexico | Atlantic, Western Central | Traps | Yucatan

Low Concern

The lobster fishery in the Yucatán Peninsula is divided into nine regions, with five of these areas in Yucatán and four in Quintana Roo (see Figure 2 in the Introduction). The Quintana Roo region has three marine protected areas with spatial regulations as part of their management programs. Similarly, Yucatán has several protected areas that overlap with the species' distribution. Although the interactions between the fleet that targets the species and these areas, the protected zones might directly affect the species' status. These include Flora and Fauna Protection Area Yum Balam, National Park Arrecife Alacranes or the state-protected area Dzilam, the Alacranes Reef Biosphere Reserve, and the recently established Bajos del Norte National Park (CONANP 2024). In Quintana Roo, the Sian Ka'an Biosphere Reserve (created in 2012 and with a marine protection area of 153,135 ha) (SIMEC-CONANP 2024), the Banco Chinchorro Biosphere Reserve (created in 2013 and with a marine protection area of 143,774 ha) (SIMEC-CONANP 2022), and the Mexican Caribbean Biosphere Reserve (created in 2016 and with a marine protection area of 5.7 million ha) cover a significant amount of the lobster fishing zones (Figure 13) (SIMEC-CONANP b 2022). The management plans of the three MPAs include an establishment of regulatory areas where fishing activities are allowed or banned (CONANP-SEMARNAT 2014)(SEMARNAP 2000)(CONANP-SEMARNAT 2016). The spatial planning established in the management programs has been created using information available generated by local academic institutions in the region (e.g., UNAM CINVESTAV, ECOSUR). Research studies that explained preferential habitats for lobsters (Rios-Lara et al. 2007)(Briones-Fourzán and Lozano-Álvarez 2013), lobster interaction with other species (e.g., morays (Lozano-Alvarez et al. 2010)), or how reef degradation affects lobster feeding ecology (Briones-Fourzan et al. 2019) were used to define the spatial planning. In addition, the role of the lobster in the ecosystem in the Yucatán Peninsula has been studied by different researchers. In 2003, a focal research study was developed in Ascension Bay in Quintana Roo (Vidal and Basurto 2003). The study described the marine ecosystem and mass fluctuations using Ecopath (ibid). The author reported lobster as a key resource in the ecosystem because of its value and high abundance, and concluded that changes in the biomass of lobsters due to fishing could introduce important seasonal differences in the tropical dynamics of the ecosystem, given that lobster is one of the most abundant groups in the bay (ibid). But these responses could vary, depending on the abundance and fishing effort in place (ibid). Because academic institutions have been working closely with managers and producer communities, and management programs of various MPAs have been using this research to protect ecosystem function, this factor is considered a "low concern."

Justification:

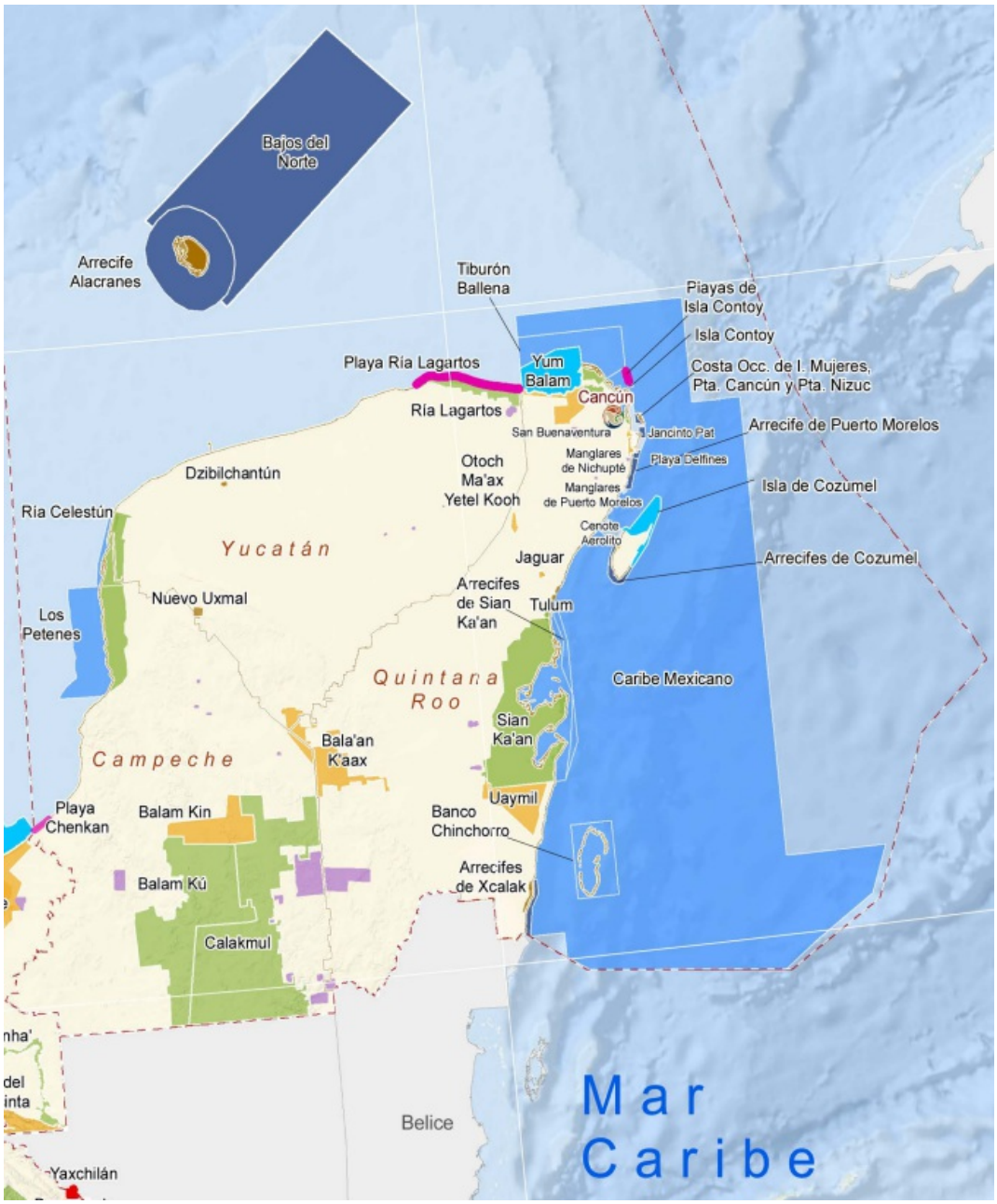

Figure 13: Marine Protected Areas in the Yucatán and Mexican Caribbean (CONANP-SEMARNAT 2016).

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Scientific reviewdoes 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: Updates to Caribbean spiny lobster Gulf of Mexico & Caribbean Sea

Updates to the October 7, 2019 Mexico Caribbean spiny lobster report were made on October 21, 2024. The report was reviewed for technical accurarcy and the following key changes were made:

Criterion 1

- *Factor 1.1 Abundance:* During the 2019 version of this assessment, a PSA and landings data were used to score this factor. Abundance at that time was scored 1 ("high concern"). In 2022, managers released more robust information on stock health (DOF 2022), which allowed for a score of 3.67 ("low concern") for all fisheries.
- *Factor 1.2 Fishing mortality:* The 2019 version of this assessment scored this factor 3.00 ("moderate concern") based on the limited information available. Using the most recent estimates released by managers in 2022 (DOF 2022), this factor was updated to 3.67 ("low concern") for the Quintana Roo South region and to 1 ("high concern") for the Yucatán shelf region (Yucatán and Quintana Roo North).

Criterion 2

The diving fishery in Quintana Roo South improved from 2.236 to 5, driven by the available information regarding the low impact of the fishery on nontarget species (finfish species). In addition, the trap fishery in Yucatán improved from 1.299 to 2.236, which was driven by the potential impact on finfish taxa.

Criterion 3

Factor 3.4 Enforcement of Management Regulations: the fisheries in Yucatán and Quintana Roo North improved from "ineffective" to "moderately effective" because of recent efforts put in place to ensure an increase in enforcement and compliance (Wild Aid & Impact Blue 2021) (Wild Aid 2024).

Criterion 4

No changes were made to Criterion 4, primarily because of the lack of more recent information or improvements that would trigger a shift in scoring.

Overall, the rating improved from yellow to green for the Quintana Roo South diving fishery, and improved from red to yellow for the trap fishery in Yucatán and the dive fishery in Yucatán and Quintana Roo North.