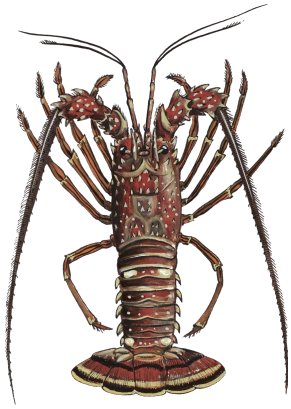
Monterey Bay Aquarium

Seafood Watch®

Caribbean spiny lobster

Panulirus argus



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Mexico: Gulf of Mexico & Caribbean Sea

Traps (unspecified), Diving

October 7, 2019

Seafood Watch Consulting Researcher

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

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About Seafood Watch

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

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

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

Guiding Principles

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

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

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

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

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

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

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

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

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

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

Summary

This report focused on the Caribbean lobster (Panulirus argus) caught with traps in Yucatan and hookah diving in Yucatan and Quintana, in the Mexican Caribbean. We separate the fishery by state, and in the case of Quintana Roo, separate North and South regions. Although the fishery is managed under federal legislation, there are specific differences in gears used by producers, as well as management in the South of Quintana Roo (Sian Ka'an and Banco Chinchorro Marine Protected Areas), which holds an MSC certification until 2016, and currently is involved in a Fishery Improvement Project.

Although trap fisheries occur mostly in one specific region in Yucatan, in the rest of the fishing area, lobsters are targeted by divers (SCUBA, skin, and hookah) that use artificial reefs known as casitas for their fishing activities.

Stock assessments for the Caribbean spiny lobster are not common in Mexico, although some recent efforts were developed for specific regions of the Peninsula; currently, no biomass target reference points are used by managers. And despite the fact that the fisheries seem to be experiencing steady landing rates, there has been a significant decline in landings when compared to other decades. Currently, there is no definitive information about abundance, and the available data was used by managers to state that the stock is close to its maximum levels. In relation to fishing mortality, this follows a clear correlation with landings (abundance) where fishing mortality increased and a decline in landings has been observed. No increase in fishing mortality has been developed—according to managers—however, experts suggest that current fishing capacity could have increased due to technological improvements developed by producers. Finally, although currently the impact of the Panulirus argus Virus 1 (PaV1) has not been reported as a significant source of mortality, managers and researchers recommend to closely monitor the virus, since it could have a significant impact on the population.

The most common, non-targeted species caught in the Caribbean spiny lobster trap fishery include various finfish, which were included as C2 species with moderate impact and a small discard rate. Interactions of traps and marine mammals were also included using the Unknown Bycatch Matrix, which is the main driver for C2 for traps. No species of concern are reported to be caught or to interact with the fishery, and for diving techniques, no impact on other species was found.

Management of spiny lobster in Mexico has been relatively effective at maintaining a stable, abundant population and landings. The lack of recent information on stock abundance and fishing mortality flags concerns. Regulations on the minimum legal size and a closed season are in place and have proven to be effective, but managers recognize that enforcing the regulations is complex and this has led to incidences of illegal catches and the use of non-authorized gears (i.e., gillnets). Overall, the management of the spiny lobster fisheries in the Yucatan Peninsula is scored as "high" concern, particularly due to problems with enforcement actions. However, for the fisheries within the MPAs of Sian Ka'an and Banco Chinchorro, where enforcement is developed by community surveillance programs funded both publicly and privately, enforcement and compliance has been reported as positive. Finally, for the Caribbean lobster in Yucatan, either traps or casitas have some impact on the benthic habitat due to its contact with the bottom, but some spatial regulations are in place to help limit those impacts. The ecosystem impacts from the trap and casita-based fisheries are considered moderate and low, respectively.

Overall, the Caribbean lobster fishery in the South region of Quintana Roo ranks as a "good alternative" or yellow for diving technique, while red or "avoid" for the rest of the regions and gears.

Final Seafood Recommendations

SPECIES/FISHERY	CRITERION 1: IMPACTS ON THE SPECIES	CRITERION 2: IMPACTS ON OTHER SPECIES	CRITERION 3: MANAGEMENT EFFECTIVENESS	CRITERION 4: HABITAT AND ECOSYSTEM	OVERALL RECOMMENDATION
Caribbean spiny lobster Mexico Gulf of Mexico, Traps (unspecified), Mexico, Yucatan	Red (1.732)	Red (1.299)	Red (2.000)	Green (3.464)	**Avoid (1.986)**
Caribbean spiny lobster Mexico Caribbean Sea, Diving, Mexico, Yucatan and Quintana Roo North	Red (1.732)	Yellow (2.236)	Red (2.000)	Green (4.000)	**Avoid (2.359)**
Caribbean spiny lobster Mexico, Diving, Quintana Roo South	Red (1.732)	Yellow (2.236)	Yellow (3.000)	Green (4.000)	**Good Alternative (2.610)**

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

There are several distinct species of spiny lobster located in various areas of the world. Caribbean spiny lobster (*Panulirus argus*) is the most important lobster species in the Caribbean region, which is fished by several countries including Mexico. With a distribution that ranges from the Gulf of Mexico to Brazil (Holthuis 1991), research has identified several genetically distinct stocks that can be found throughout its range.

In Mexico, the species is mostly targeted by small-scale fishers that use diving (autonomous and semi-autonomous) techniques and artificial reefs (called casitas) as the main fishing technique (DOF 2012). Although official reports (INAPESCA 2013) (DOF 2014) (DOF 2016) have mentioned that in some regions of the Peninsula —mostly north-northeast—fishers also used traps and gillnets to target the species, casitas and traps (used in diving) are the only gears authorized by managers (DOF 2016).

This report provides recommendations for spiny lobsters fished with traps and diving techniques in Yucatan and Quintana Roo, along with the Yucatan Peninsula (Gulf of Mexico and Caribbean).

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 occurrence of two or more Panulirus species living in sympatry in different regions and different parts of the world (Briones-Fourzán and Lozano-Álvarez 2013). This is the case of species that can be found in the Mexican Caribbean, where *P. argus* and *P. guttatus* can be found (Figure 1).

These species have a depth range from 1 to 90 meters (m), which varies depending on the species (Holthuis 1991). In their early life stages, lobsters usually live close to the shore, in grass bed areas, then move to rocky substrates when they become adults (Briones-Fourzan 2014). Spiny lobsters tend to be nocturnal and migrate among depths depending upon the season, generally moving deeper in winter months (CDFG 2001).

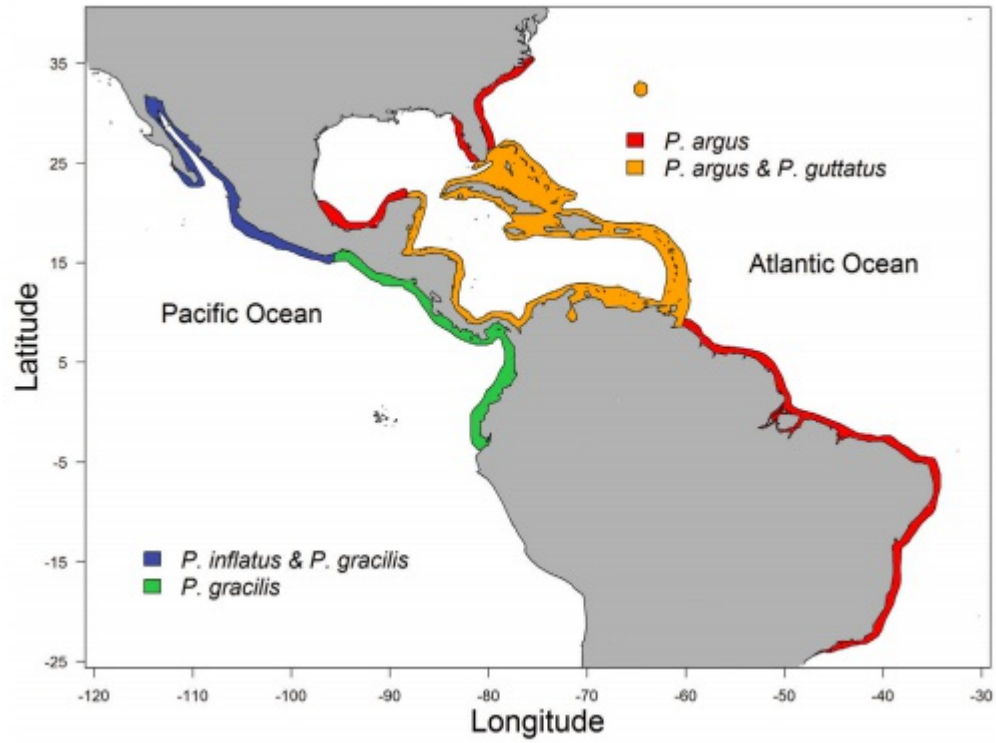

Figure 1 Figure 1. Geographic distribution of the two pairs of sympatric Panulirus species in Mexico -including Panulirus argus- (image taken from Briones-Fourzán, 2014)

In Mexico, Caribbean spiny lobster is regulated by the Yucatan Peninsula Lobster Management Plan (YPMP) enacted in 2014 (DOF 2014) and 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 National Fisheries Institute (INAPESCA). The main regulations include a closed season, a minimum legal size, a prohibition on the landing of berried females, restrictions on gear, and specific closed zones (DOF 2016) (DOF 2014).

The closed seasons for the various spiny lobster species vary across zones due to variations in the reproductive cycle resulting 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

The Caribbean spiny lobster fishery in Mexico is developed along the Yucatan Peninsula. The region has been divided into nine different areas by managers and researchers; however, management is similar throughout this region (Figure 2).

Alacranes (5)
Progreso-Celestun (1–4)
Yucatan 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, Majahualand Xcalak (9)

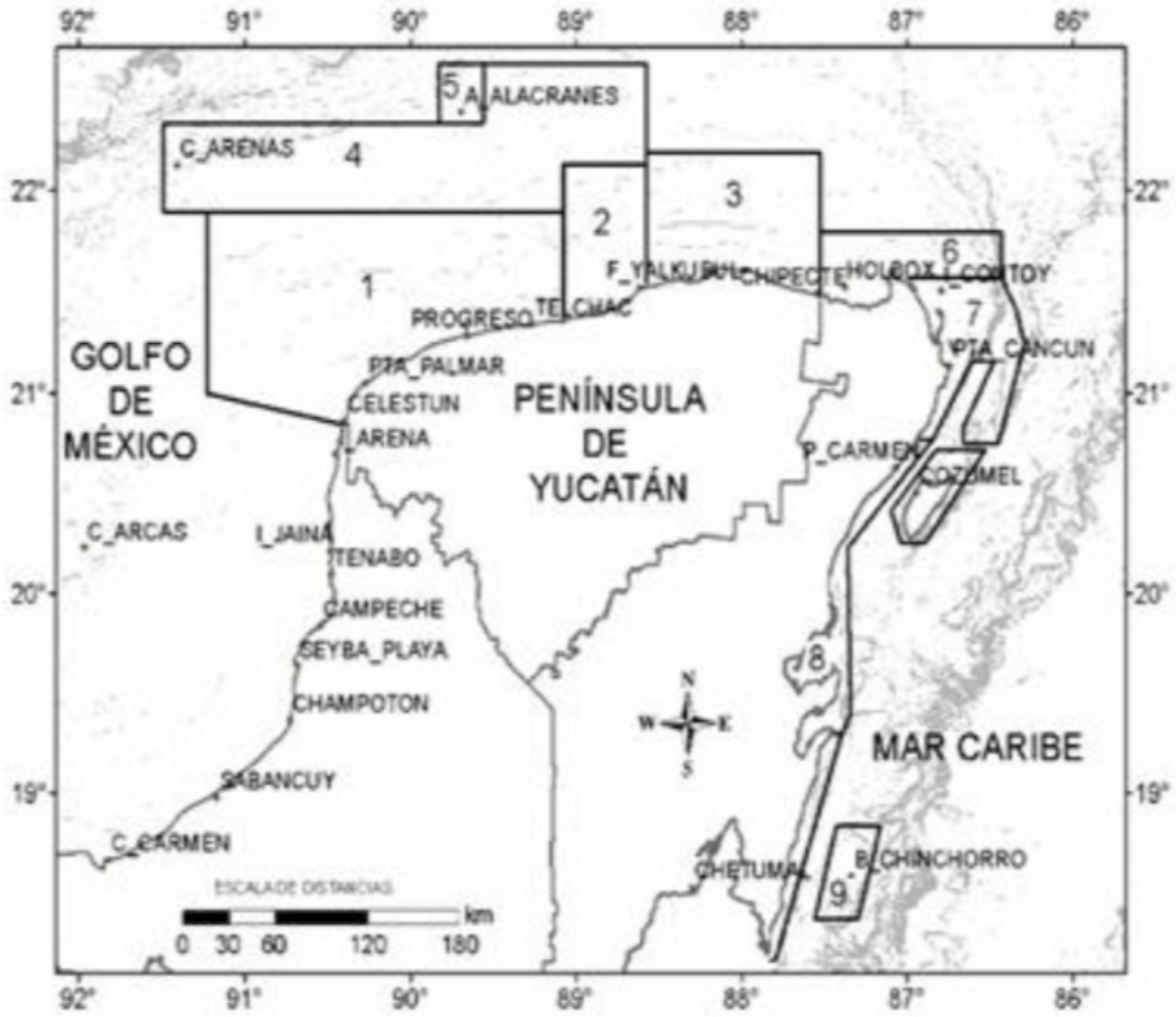

Figure 2 Figure 2. Lobster fishing zones in the Yucatan Peninsula (DOF 2014)

Lobster production by State has been relatively stable since 2006, with an average of 278 tons (t), in Quintana Roo and 284 t in Yucatan (Figure 3).

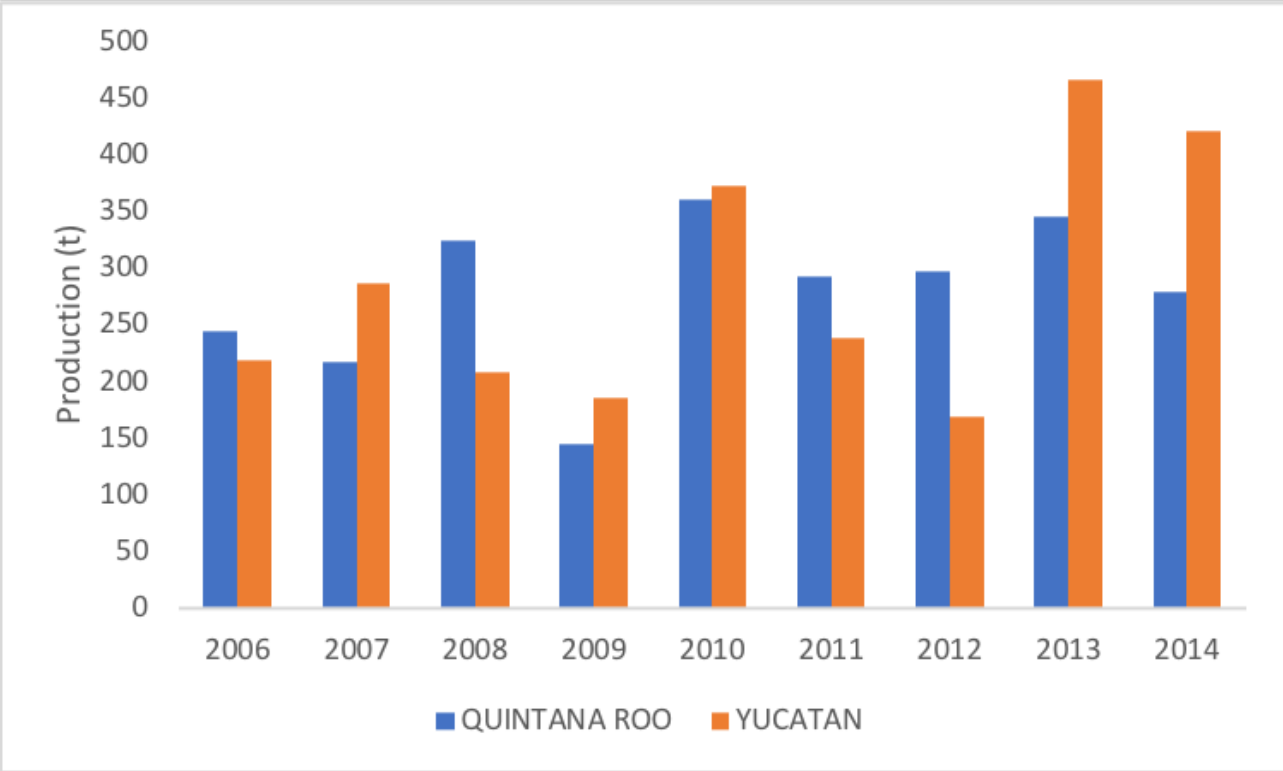

Figure 3 Figure 3. Lobster production by State from 2006-2014, CONAPESCA landing data.

Productions of P. argus have been declining steadily since 2000, mostly due to a combination of over exploitation, and changes in environmental and ecological conditions that impacted lobster habitats (Ehrhardt et al., 2011). However, researchers have also noted that another factor is the disease caused by a pathogenic virus, the *P. argusvirus 1* (PaV1; (Shields and Behringer, 2004)), which has become an important source of mortality for the juveniles of *P. argus* since its detection in 1999–2000 (Moss et al., 2013) (Candia-Zulbaran et al. 2015).

Importance to the US/North American market.

Yucatan spiny lobster production is sold locally, because of high tourist demand (MRAG 2012). A percentage is sold across the region, in major Mexican cities, and exported into the US (MRAG 2012). The United States imported >7 t of frozen Caribbean lobster in 2016, 16.1 t in 2017 and >25 t in 2018 (NMFS 2018).

Common and market names.

Spiny lobsters, in general, are also known as rock lobsters. The Caribbean spiny lobster is also known as the Bermuda spiny lobster, common spiny lobster, crawfish, Florida spiny lobster, West Indian langouste, and West Indian spiny lobster (Holthuis 1991).

Primary product forms

The spiny lobster is marketed whole and sold live domestically. For export markets it is sold mostly cooked and/or frozen. Tails are frozen or canned. There is also a small market that sells live lobster to Asia, with export companies in Quintana Roo, one in Puerto Morelos and a second one in Puerto Juarez.

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**
Mexico/Gulf of Mexico | Traps (unspecified) | Mexico | Yucatan	1.00: High Concern	3.00: Moderate Concern	Red (1.732)
Mexico/Caribbean Sea | Diving | Mexico | Yucatan and Quintana Roo North	1.00: High Concern	3.00: Moderate Concern	Red (1.732)
Mexico | Diving | Quintana Roo South	1.00: High Concern	3.00: Moderate Concern	Red (1.732)

Criterion 1 Assessment

SCORING GUIDELINES

Factor 1.1 - Abundance

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

- *5 (Very Low Concern) — Strong evidence exists that the population is above an appropriate target abundance level (given the species' ecological role), or near virgin biomass.*
- *3.67 (Low Concern) — Population may be below target abundance level, but is at least 75% of the target*

level, OR data-limited assessments suggest population is healthy and species is not highly vulnerable.

- *2.33 (Moderate Concern) — Population is not overfished but may be below 75% of the target abundance level, OR abundance is unknown and the species is not highly vulnerable.*
- *1 (High Concern) — Population is considered overfished/depleted, a species of concern, threatened or endangered, OR abundance is unknown and species is highly vulnerable.*

Factor 1.2 - Fishing Mortality

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

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

CARIBBEAN SPINY LOBSTER

Factor 1.1 - Abundance

MEXICO/GULF OF MEXICO, TRAPS (UNSPECIFIED), MEXICO, YUCATAN

High Concern

According to the most recent National Fisheries Chart—the federal tool used by managers to address fisheries status—the lobster fishery in the Yucatan Peninsula was exploited at its maximum sustainable levels (DOF 2012). This statement is a combination of the production and fishing effort, according to the chart. Managers use production levels per state as a reference to the status of the populations. In the case of Yucatan, managers established the reference point at 495 t of lobster tails, and Quintana Roo 517 t of tail production (DOF 2012).

In addition, in 2014, as part of the management plan, INAPESCA analyzed catch data from 1976 to 2010, and CPUE information from 1989 to 2010 as well as average weights from 1987 to 2010 to inform a Dynamic Biomass Model to evaluate the biomass in the Yucatan Platform and North-Northeast region of Quintana Roo (DOF 2014). As a result, the models estimated that:

- In Yucatan, the biomass that is vulnerable to be caught was ~1,410 t of live lobster (470 t of tails) with an average of 1,145 t live lobster (382 t tails) between 2001 and 2010. The initial biomass in 1965 (B_0) was estimated to be 5,256 t live lobster (1,752 t tails);
- For Quintana Roo, managers estimated the carrying capacity of the system (k) to be in the order of the 6,557 t of live lobster (2,189 t tails) with a MSY of 232 t live lobster (77 t tails) (DOF 2014). Also for Quintana Roo, managers found that average biomass has been declining from 79% of the K in the period of 1982 to 1988 to just 41% of the K during the 2000 to 2009 period. However, they reported that currently (2014) in the North-Northeast region of Quintana Roo the fishery represents around 78% of the MSY.

Although recent (no more than 10 years old) stock assessments have been developed for the species in Yucatan and Quintana Roo, it is also important to consider that, according to Buesa, there is a need to have a better understanding of the Caribbean-wide spiny lobster stock, its spawning biomass, and population-wide dynamics (Buesa 2018). In particular, management efforts should be based on more specific knowledge of population connectivity among Caribbean nations (Kough et al. 2013). In relation to this, studies of population structuring among Caribbean sub populations 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 sub populations, (Naro-Maciel et al. 2011) found no evidence of genetic differentiation among sub populations in Puerto Rico, the Bahamas, and Florida. However, the use of more powerful genetic tools, like polymorphic micro satellite 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 sub-regional population structure among marine protected areas (MPAs) in the Mesoamerican region using msatDNA. For these reasons, the Yucatan stocks should not be assessed in isolation, and should consider these connections.

Another factor to consider (mentioned within the Lobster Management Plan), is that research studies have reported a low proportion of organisms infected with the *Panulirus argus* Virus 1 (PaV1) in smaller lobsters in the Mexican Caribbean (Lozano-Alvarez et al. 2008) (Briones-Fourzan et al. 2009) (Ramirez-Esteves et al. 2010) and managers considered this a potentially large factor in the status of the population (DOF 2014).

After considering this, it is important to note that the Lobster Management Plan (DOF 2014) stated that the trend of lobster production over time has shown a decrease to a greater or lesser degree, excepting the Southern Zone in Quintana Roo, where there has been a slight increase in production in the last ten years (DOF 2014); considering recent assessments of the resource in the Yucatan platform that showed that exploitation rate has increased and the biomass has decreased considerably, this suggests that the population could be fully exploited and the fishery could be at risk in at least some fishing areas.

Finally, since no limit reference points exist for the fishery and, according to the Fisheries Management Plan (DOF 2014) and the Federal NOM-006 (DOF 2016), a declining trend in landings can be seen as a symptom of the status of the populations, this factor is scored as "high" concern for Yucatan and Quintana Roo.

Justification:

Productivity Attribute	**Relevant Information**	**Score (1 = low risk, 2 = medium risk, 3 = high risk)**
Average age at maturity	2 to 3 years (Ehrhardt 2005)	1
Average maximum age	13 yrs in the Caribbean (range of 10 to 25 yrs) (Chavez 2009)	2
Fecundity	Between 147,000 and 1,952,000 at 72 to 141 mm CL respectively in Florida Keys (Bertelsen and Mathews 2001) (Fonseca-Larios and Briones-Fourzán 1998) estimated *P. argus* fecundity in Puerto Morelos to be between 173,000 to 1,076,000 in females of *P. argus* over a size range of 76.1 to 137 mm CL. However, in this research total production of eggs per year was estimated and found to be greater than that reported in Florida, considering the multiple spawns per female a year (Fonseca-Larios and Briones-Fourzán 1998).	1
Reproductive strategy	Brooder (eggs are held before hatching)	2
Trophic level	2.98 (2.75 to 3.25) (Vidal and Basurto 2003)	2
Density dependence (invertebrates only)	No density dependence suggested (Gutzler et al. 2015)	2
Habitat Quality	N/A	
Total Productivity (average)	1.66	

Susceptibility Attribute	Relevant Information	Score (1 = low risk, 2 = medium risk, 3 = high risk)
Areal overlap (Considers all fisheries)	The combined overlap of fishing activity with the target stock range of the species is estimated to be between 45 and 60% (Lozano-Alvarez et al. 1993) (MRAG 2012).	3
Vertical overlap (Considers all fisheries)	There is a high vertical overlap of all fishing activity with the vertical range of lobster. Producers that dive and use casitas target the species in shallow waters; use of traps is normally because producers are targeting the species on deeper waters (DOF 2012).	3
Selectivity of fishery (Specific to fishery under assessment)	The species is targeted by producers is not likely to escape the fishers; however, conditions under "high risk" do not apply.	2
Post-capture mortality (Specific to fishery under assessment)	All species are retained.	3
Total Susceptibility (multiplicative)		2.32

PSA score for Lobster fishery is calculated as follows:

Vulnerability (V) =√(P^2+ S^2)

V = √1.66 〖〗 ^2+ 〖1.66^2+(2.32^2))

V = 2.80

Factor 1.2 - Fishing Mortality

MEXICO/GULF OF MEXICO, TRAPS (UNSPECIFIED), MEXICO, YUCATAN

Moderate Concern

According to the Yucatan Lobster Management Plan (YLMP), 936 small-scale vessels and 42 industrial vessels (that operate as a mother ship for small canoes with no motor also known as alijos) were registered to target lobster in 2013 (DOF 2014). Fishing effort, however, is not homogeneous among the different fishing areas in the Peninsula. According to the YLMP, the Oriente (East) area, is the area where the highest number of vessels operate and target lobster (Figure 4).

In the Management Plan, authorities included information related to changes in the exploitation rates that occurred in the fishery between 1965 to 2010 in Yucatan. As a result of these changes, managers found a relationship between the increments in F that had a direct impact on the species biomass (Figure 5).

Although managers stated that the fishery is performing at maximum sustainable level, they recommended not to increase the fishing effort. However, some researchers estimated that recent improvements of the fleet (e.g., more efficient engines) (Rios and Peniche-Ayora 2011) (Rios-Lara et al. 2012) should be considered as an addition to the fishing effort. Considering these and recent trends in production, this factor is scored as "moderate" concern for both states.

Justification:

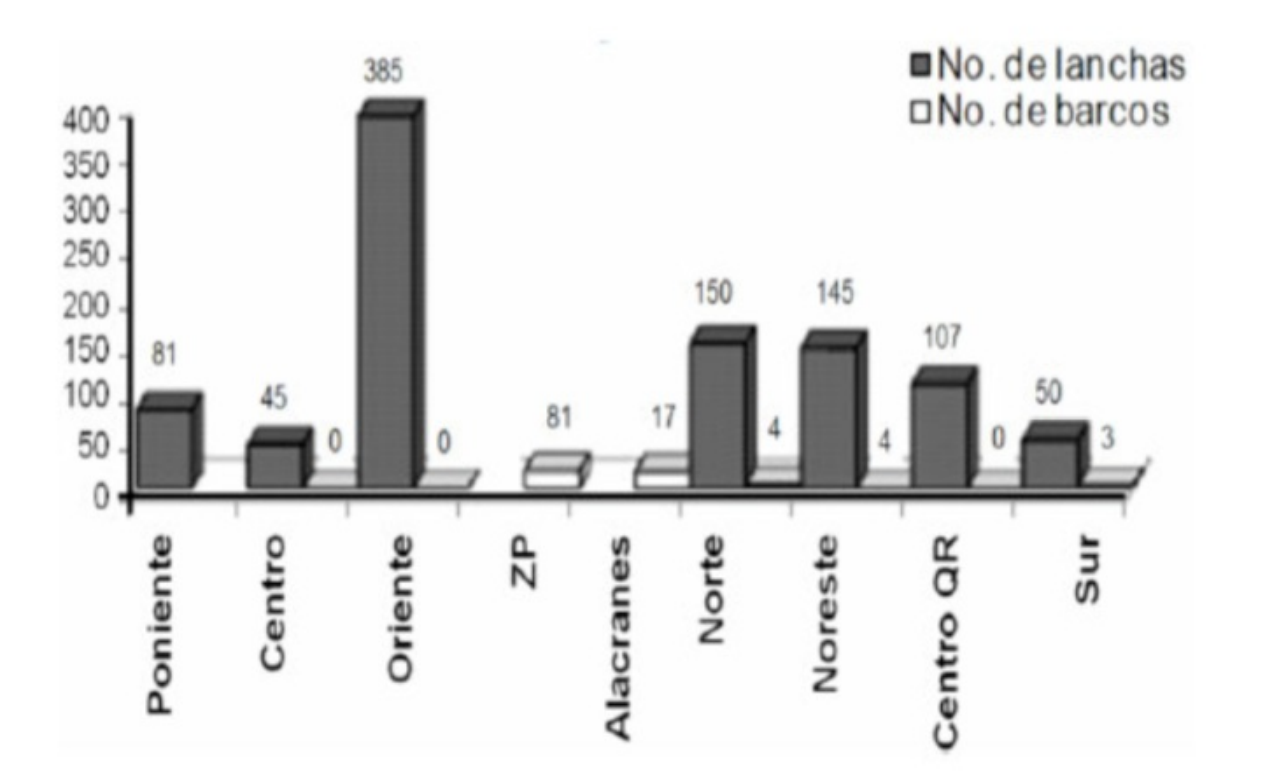

Figure 4 Figure 4. Number of small-scale vessels (Lanchas) and mothership vessels (barcos) in the Yucatan Peninsula (figure taken from Plan de Manejo Langosta SAGARPA 2012).

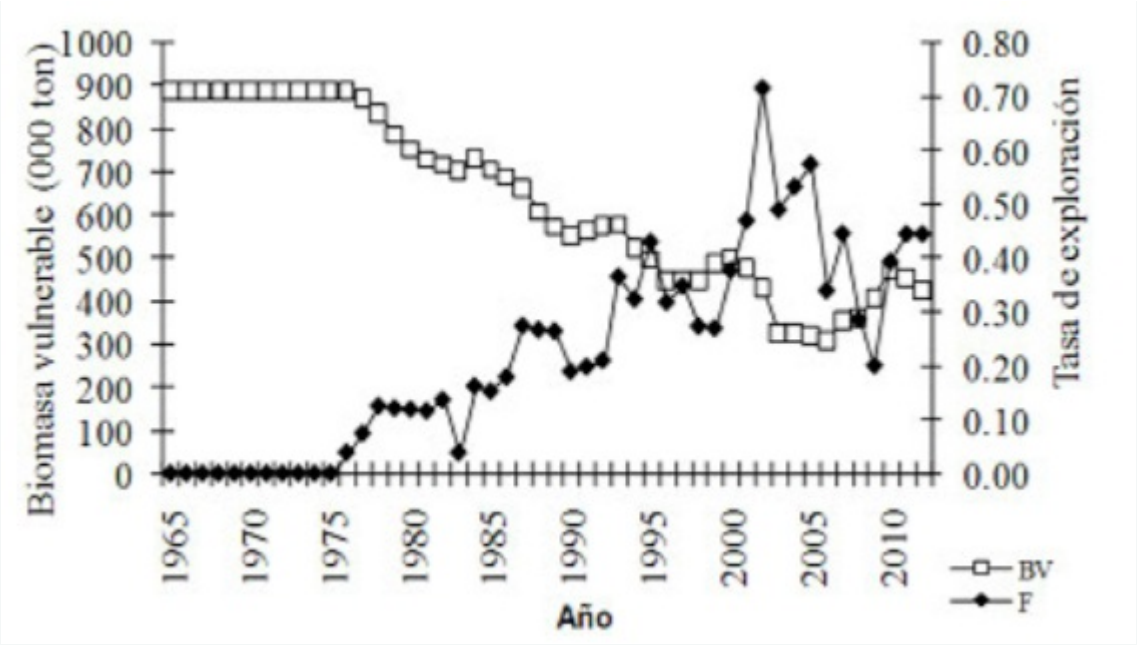

Figure 5 Figure 5. Changes in fishing effort and biomass in Yucatan ((figure taken from Plan de Manejo Langosta SAGARPA 2014).

CARIBBEAN SPINY LOBSTER

Factor 1.1 - Abundance

MEXICO/CARIBBEAN SEA, DIVING, MEXICO, YUCATAN AND QUINTANA ROO NORTH

High Concern

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- In Yucatan, the biomass that is vulnerable to be caught was ~1,410 t of live lobster (470 t of tails) with an average of 1,145 t live lobster (382 t tails) between 2001 and 2010. The initial biomass in 1965 (B_0) was estimated to be 5,256 t live lobster (1,752 t tails);
- For Quintana Roo, managers estimated the carrying capacity of the system (k) to be in the order of the 6,557 t of live lobster (2,189 t tails) with a MSY of 232 t live lobster (77 t tails) (DOF 2014). Also for Quintana Roo, managers found that average biomass has been declining from 79% of the K in the period of 1982 to 1988 to just 41% of the K during the 2000 to 2009 period. However, they reported that currently (2014) in the North-Northeast region of Quintana Roo the fishery represents around 78% of the MSY.

Although recent (no more than 10 years old) stock assessments have been developed for the species in Yucatan and Quintana Roo, it is also important to consider that, according to Buesa, there is a need to have a better understanding of the Caribbean-wide spiny lobster stock, its spawning biomass, and population-wide dynamics (Buesa 2018). In particular, management efforts should be based on more specific knowledge of population connectivity among Caribbean nations (Kough et al. 2013). In relation to this, studies of population structuring among Caribbean sub populations 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 sub populations, (Naro-Maciel et al. 2011) found no evidence of genetic differentiation among sub populations in Puerto Rico, the Bahamas, and Florida. However, the use of more powerful genetic tools, like polymorphic micro satellite 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 sub-regional population structure among marine protected areas (MPAs) in the Mesoamerican region using msatDNA. For these reasons, the Yucatan stocks should not be assessed in isolation, and should consider these connections.

Another factor to consider (mentioned within the Lobster Management Plan), is that research studies have reported a low proportion of organisms infected with the *Panulirus argus* Virus 1 (PaV1) in smaller lobsters in the Mexican Caribbean (Lozano-Alvarez et al. 2008) (Briones-Fourzan et al. 2009) (Ramirez-Esteves et al. 2010) and managers considered this a potentially large factor in the status of the population (DOF 2014).

After considering this, it is important to note that the Lobster Management Plan (DOF 2014) stated that the trend of lobster production over time has shown a decrease to a greater or lesser degree, excepting the Southern Zone in Quintana Roo, where there has been a slight increase in production in the last ten years (DOF 2014); considering recent assessments of the resource in the Yucatan platform that showed that exploitation rate has increased and the biomass has decreased considerably, this suggests that the population could be fully exploited and the fishery could be at risk in at least some fishing areas.

Finally, since no limit reference points exist for the fishery and, according to the Fisheries Management Plan (DOF 2014) and the Federal NOM-006 (DOF 2016), a declining trend in landings can be seen as a symptom of the status of the populations, this factor is scored as "high" concern for Yucatan and Quintana Roo.

Justification:

Productivity Attribute	Relevant Information	Score (1 = low risk, 2 = medium risk, 3 = high risk)
Average age at maturity	2 to 3 years (Ehrhardt 2005)	1
Average maximum age	13 yrs in the Caribbean (range of 10 to 25 yrs) (Chavez 2009)	2
Fecundity	Between 147,000 and 1,952,000 at 72 to 141 mm CL respectively in Florida Keys (Bertelsen and Mathews 2001) (Fonseca-Larios and Briones-Fourzán 1998) estimated *P. argus* fecundity in Puerto Morelos to be between 173,000 to 1,076,000 in females of *P. argus* over a size range of 76.1 to 137 mm CL. However, in this research total production of eggs per year was estimated and found to be greater than that reported in Florida, considering the multiple spawns per female a year (Fonseca-Larios and Briones-Fourzán 1998).	1
Reproductive strategy	Brooder (eggs are held before hatching)	2
Trophic level	2.98 (2.75 to 3.25) (Vidal and Basurto 2003)	2
Density dependence (invertebrates only)	No density dependence suggested (Gutzler et al. 2015)	2
Habitat Quality	N/A	
Total Productivity (average)	1.66	

Susceptibility Attribute	Relevant Information	Score (1 = low risk, 2 = medium risk, 3 = high risk)
Areal overlap (Considers all fisheries)	The combined overlap of fishing activity with the target stock range of the species is estimated to be between 45 and 60% (Lozano-Alvarez et al. 1993) (MRAG 2012).	3
Vertical overlap (Considers all fisheries)	There is a high vertical overlap of all fishing activity with the vertical range of lobster. Producers that dive and use casitas target the species in shallow waters; use of traps is normally because producers are targeting the species on deeper waters (DOF 2012).	3
Selectivity of fishery (Specific to fishery under assessment)	The species is targeted by producers is not likely to escape the fishers; however, conditions under "high risk" do not apply.	2
Post-capture mortality (Specific to fishery under assessment)	All species are retained.	3
Total Susceptibility (multiplicative)		2.32

PSA score for Lobster fishery is calculated as follows:

Vulnerability (V) =√(P^2+ S^2)

V = √1.66 〖〗 ^2+ 〖1.66^2+(2.32^2))

V = 2.80

Factor 1.2 - Fishing Mortality

MEXICO/CARIBBEAN SEA, DIVING, MEXICO, YUCATAN AND QUINTANA ROO NORTH

Moderate Concern

According to the Yucatan Lobster Management Plan (YLMP), 936 small-scale vessels and 42 industrial vessels (that operate as a mother ship for small canoes with no motor also known as alijos) were registered to target lobster in 2013 (DOF 2014). Fishing effort, however, is not homogeneous among the different fishing areas in the Peninsula. According to the YLMP, the Oriente (East) area, is the area where the highest number of vessels operate and target lobster (Figure 4).

In the Management Plan, authorities included information related to changes in the exploitation rates that occurred in the fishery between 1965 to 2010 in Yucatan. As a result of these changes, managers found a relationship between the increments in F that had a direct impact on the species biomass (Figure 5).

Although managers stated that the fishery is performing at maximum sustainable level, they recommended not to increase the fishing effort. However, some researchers estimated that recent improvements of the fleet (e.g., more efficient engines) (Rios and Peniche-Ayora 2011) (Rios-Lara et al. 2012) should be considered as an addition to the fishing effort. Considering these and recent trends in production, this factor is scored as "moderate" concern for both states.

Justification:

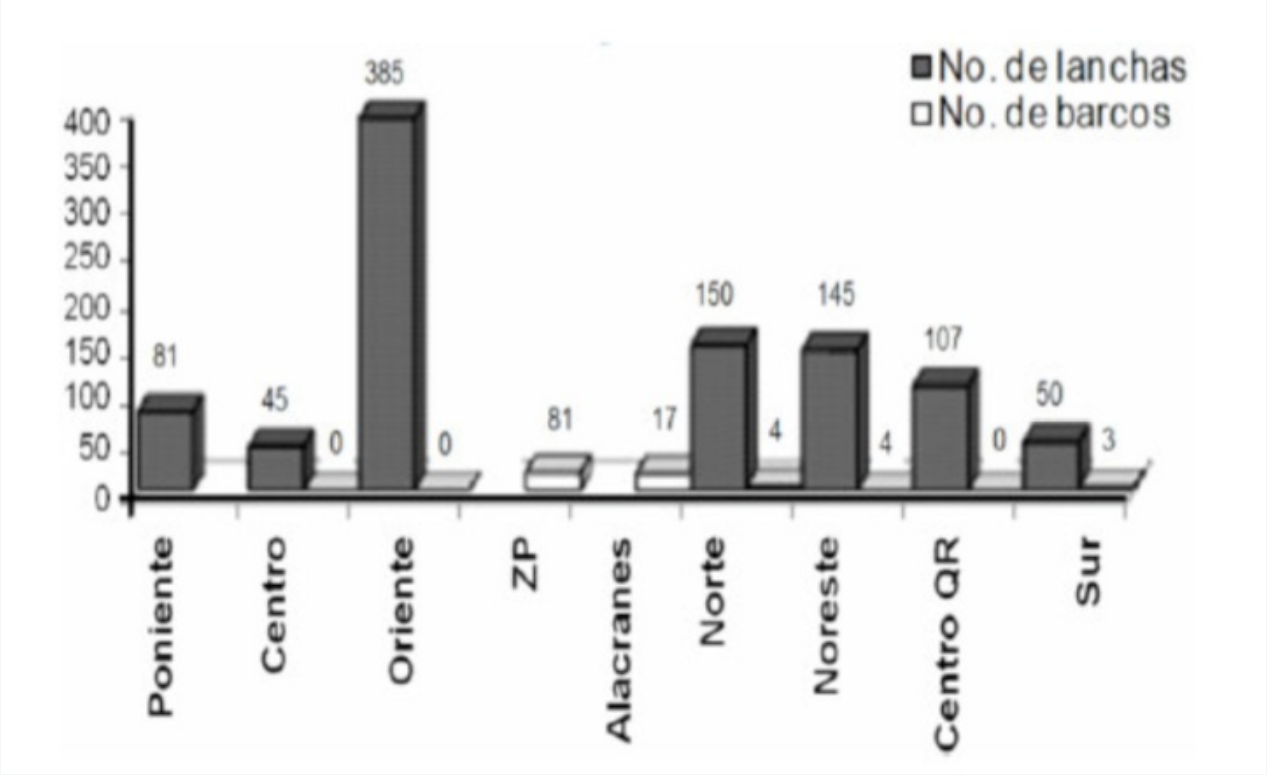

Figure 6 Figure 4. Number of small-scale vessels (Lanchas) and mothership vessels (barcos) in the Yucatan Peninsula (figure taken from Plan de Manejo Langosta SAGARPA 2012).

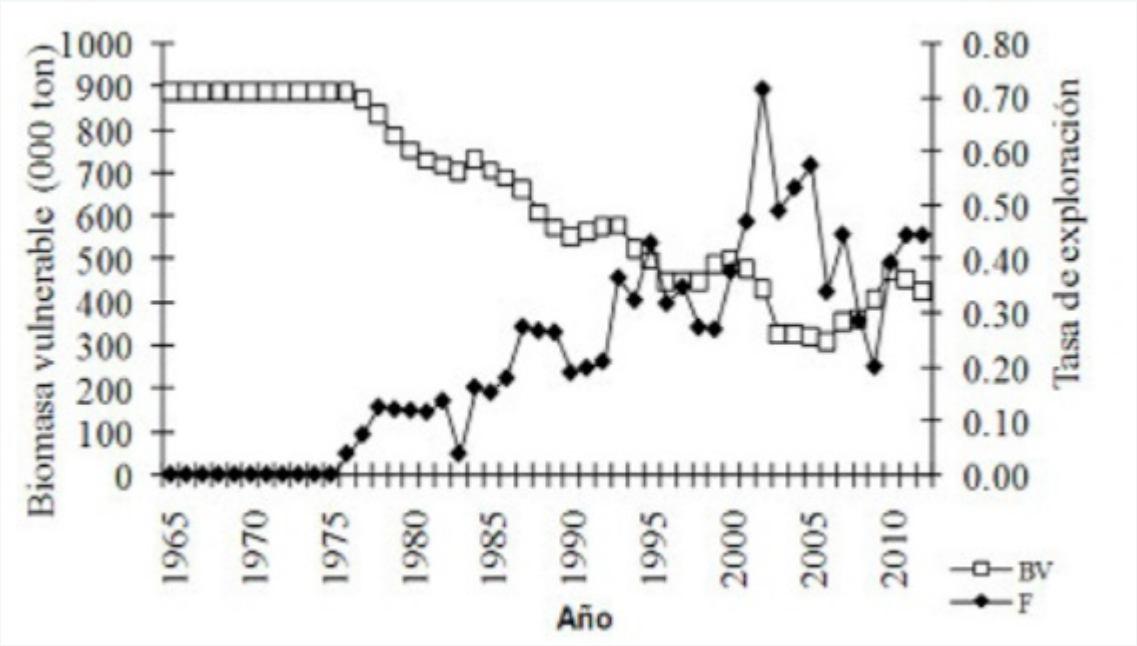

Figure 7 Figure 5. Changes in fishing effort and biomass in Yucatan ((figure taken from Plan de Manejo Langosta SAGARPA 2014).

Factor 1.1 - Abundance

MEXICO, DIVING, QUINTANA ROO SOUTH

High Concern

According to the most recent National Fisheries Chart—the federal tool used by managers to address fisheries status—the lobster fishery in the Yucatan Peninsula was exploited at its maximum sustainable levels (DOF 2012). This statement is a combination of the production and fishing effort, according to the chart. Managers use production levels per state as a reference to the status of the populations. In the case of Yucatan, managers established the reference point at 495 t of lobster tails, and Quintana Roo 517 t of tail production (DOF 2012).

In addition, in 2014, as part of the management plan, INAPESCA analyzed catch data from 1976 to 2010, and CPUE information from 1989 to 2010 as well as average weights from 1987 to 2010 to inform a Dynamic Biomass Model to evaluate the biomass in the Yucatan Platform and North-Northeast region of Quintana Roo (DOF 2014). As a result, the models estimated that:

- In Yucatan, the biomass that is vulnerable to be caught was ~1,410 t of live lobster (470 t of tails) with an average of 1,145 t live lobster (382 t tails) between 2001 and 2010. The initial biomass in 1965 (B_0) was estimated to be 5,256 t live lobster (1,752 t tails);
- For Quintana Roo, managers estimated the carrying capacity of the system (k) to be in the order of the 6,557 t of live lobster (2,189 t tails) with a MSY of 232 t live lobster (77 t tails) (DOF 2014). Also for Quintana Roo, managers found that average biomass has been declining from 79% of the K in the period of 1982 to 1988 to just 41% of the K during the 2000 to 2009 period. However, they reported that currently (2014) in the North-Northeast region of Quintana Roo the fishery represents around 78% of the MSY.

Although recent (no more than 10 years old) stock assessments have been developed for the species in Yucatan and Quintana Roo, it is also important to consider that, according to Buesa, there is a need to have a better understanding of the Caribbean-wide spiny lobster stock, its spawning biomass, and population-wide dynamics (Buesa 2018). In particular, management efforts should be based on more specific knowledge of population connectivity among Caribbean nations (Kough et al. 2013). In relation to this, studies of population structuring among Caribbean sub populations 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 sub populations, (Naro-Maciel et al. 2011) found no evidence of genetic differentiation among sub populations in Puerto Rico, the Bahamas, and Florida. However, the use of more powerful genetic tools, like polymorphic micro satellite 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 sub-regional population structure among marine protected areas (MPAs) in the Mesoamerican region using msatDNA. For these reasons, the Yucatan stocks should not be assessed in isolation, and should consider these connections.

Another factor to consider (mentioned within the Lobster Management Plan), is that research studies have reported a low proportion of organisms infected with the *Panulirus argus* Virus 1 (PaV1) in smaller lobsters in the Mexican Caribbean (Lozano-Alvarez et al. 2008) (Briones-Fourzan et al. 2009) (Ramirez-Esteves et al. 2010) and managers considered this a potentially large factor in the status of the population (DOF 2014).

After considering this, it is important to note that the Lobster Management Plan (DOF 2014) stated that the trend of lobster production over time has shown a decrease to a greater or lesser degree, excepting the Southern Zone in Quintana Roo, where there has been a slight increase in production in the last ten years (DOF 2014); considering recent assessments of the resource in the Yucatan platform that showed that exploitation rate has increased and the biomass has decreased considerably, this suggests that the population

could be fully exploited and the fishery could be at risk in at least some fishing areas.

Finally, since no limit reference points exist for the fishery and, according to the Fisheries Management Plan (DOF 2014) and the Federal NOM-006 (DOF 2016), a declining trend in landings can be seen as a symptom of the status of the populations, this factor is scored as "high" concern for Yucatan and Quintana Roo.

Justification:

Productivity Attribute	**Relevant Information**	**Score (1 = low risk, 2 = medium risk, 3 = high risk)**
Average age at maturity	2 to 3 years (Ehrhardt 2005)	1
Average maximum age	13 yrs in the Caribbean (range of 10 to 25 yrs) (Chavez 2009)	2
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Reproductive strategy	Brooder (eggs are held before hatching)	2
Trophic level	2.98 (2.75 to 3.25) (Vidal and Basurto 2003)	2
Density dependence (invertebrates only)	No density dependence suggested (Gutzler et al. 2015)	2
Habitat Quality	N/A	
Total Productivity (average)	1.66	

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Areal overlap (Considers all fisheries)	The combined overlap of fishing activity with the target stock range of the species is estimated to be between 45 and 60% (Lozano-Alvarez et al. 1993) (MRAG 2012).	3
Vertical overlap (Considers all fisheries)	There is a high vertical overlap of all fishing activity with the vertical range of lobster. Producers that dive and use casitas target the species in shallow waters; use of traps is normally because producers are targeting the species on deeper waters (DOF 2012).	3
Selectivity of fishery (Specific to fishery under assessment)	The species is targeted by producers is not likely to escape the fishers; however, conditions under "high risk" do not apply.	2
Post-capture mortality (Specific to fishery under assessment)	All species are retained.	3
Total Susceptibility (multiplicative)		2.32

PSA score for Lobster fishery is calculated as follows:

Vulnerability (V) =√(P^2+ S^2)

V = √1.66 〖〗 ^2+ 〖1.66^2+(2.32^2))

V = 2.80

Factor 1.2 - Fishing Mortality

MEXICO, DIVING, QUINTANA ROO SOUTH

Moderate Concern

According to the Yucatan Lobster Management Plan (YLMP), 936 small-scale vessels and 42 industrial vessels (that operate as a mother ship for small canoes with no motor also known as alijos) were registered to target lobster in 2013 (DOF 2014). Fishing effort, however, is not homogeneous among the different fishing areas in the Peninsula. According to the YLMP, the Oriente (East) area, is the area where the highest number of vessels operate and target lobster (Figure 4).

In the Management Plan, authorities included information related to changes in the exploitation rates that occurred in the fishery between 1965 to 2010 in Yucatan. As a result of these changes, managers found a relationship between the increments in F that had a direct impact on the species biomass (Figure 5).

Although managers stated that the fishery is performing at maximum sustainable level, they recommended not to increase the fishing effort. However, some researchers estimated that recent improvements of the fleet (e.g., more efficient engines) (Rios and Peniche-Ayora 2011) (Rios-Lara et al. 2012) should be considered as an addition to the fishing effort. Considering these and recent trends in production, this factor is scored as "moderate" concern for both states.

Justification:

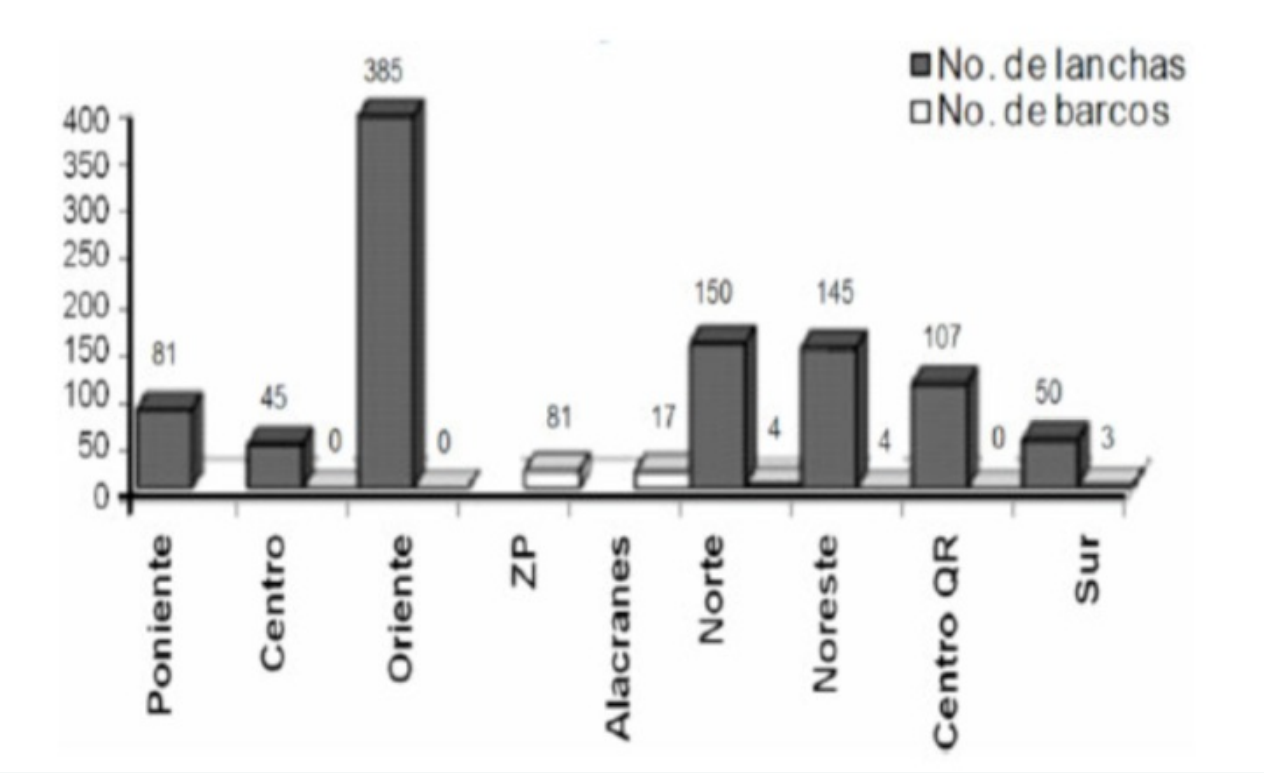

Figure 8 Figure 4. Number of small-scale vessels (Lanchas) and mothership vessels (barcos) in the Yucatan Peninsula (figure taken from Plan de Manejo Langosta SAGARPA 2012).

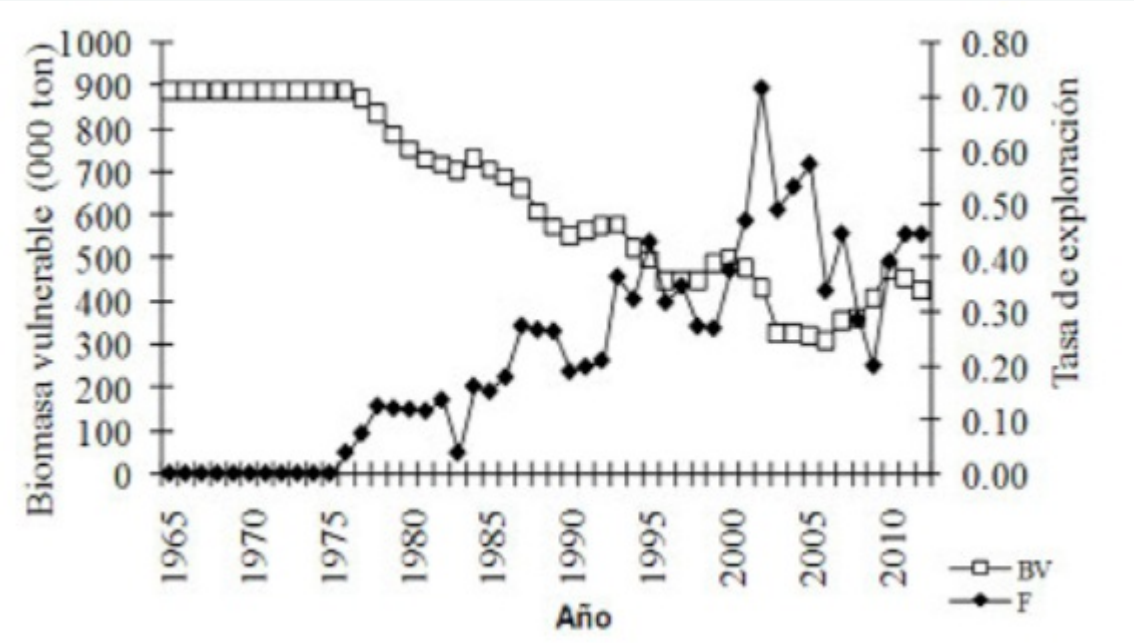

Figure 9 Figure 5. Changes in fishing effort and biomass in Yucatan ((figure taken from Plan de Manejo Langosta SAGARPA 2014).

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

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

CARIBBEAN SPINY LOBSTER - MEXICO - DIVING - QUINTANA ROO SOUTH					
Subscore:	**2.236**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.236**
Species	**Abundance**	**Fishing Mortality**	**Subscore**		
Finfish	1.00:High Concern	5.00:Low Concern	Yellow (2.236)		

CARIBBEAN SPINY LOBSTER - MEXICO/CARIBBEAN SEA - DIVING - MEXICO - YUCATAN AND QUINTANA ROO NORTH					
Subscore:	**2.236**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.236**
Species	**Abundance**	**Fishing Mortality**	**Subscore**		
Finfish	1.00:High Concern	5.00:Low Concern	Yellow (2.236)		

CARIBBEAN SPINY LOBSTER - MEXICO/GULF OF MEXICO - TRAPS (UNSPECIFIED) - MEXICO - YUCATAN					
Subscore:	**1.732**	**Discard Rate:**	**0.75**	**C2 Rate:**	**1.299**
Species	**Abundance**	**Fishing Mortality**	**Subscore**		
Mammals	1.00:High Concern	3.00:Moderate Concern	Red (1.732)		

Corals and other biogenic habitats	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Finfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Benthic inverts	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)

According to information regarding the use of traps in the lobster fishery, traps are used in at least two regions in Yucatan. However, information about catch composition is not clear enough to determine the impact 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 as part of the C2 species. In addition, information regarding the impact of gear on other taxa or species of concern was not found; for this reason, we used the Unknown Bycatch Matrix to measure the potential impact of the fishery in other taxa, we included marine mammals, corals, and other biogenic habitats and benthic invertebrates taxa. Similarly, the UBM was used to scored abundance and fishing mortality. After the analysis, the potential impact of the fishery in marine mammals species drives the score of C2 for the trap fishery.

Regarding the lobster dive fishery, the 2014 management plan mentions that important volumes of different fish species are captured, mainly the groupers (*Epinephelus morio, Mycteroperca microlepis and Mycteroperca bonaci*), snappers (Lutjanus sp.) and the hogfish (*Lachnolaimus maximus*) (DOF 2014). The level of production of these species was not available; however, considering that some vulnerable species (e.g., groupers) are reported, we are including the finfish taxa and used the UBM to score these for the diving technique.

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)

FINFISH

Factor 2.1 - Abundance

MEXICO / GULF OF MEXICO, TRAPS (UNSPECIFIED), MEXICO, YUCATAN

Moderate Concern

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

MEXICO / CARIBBEAN SEA, DIVING, MEXICO, YUCATAN AND QUINTANA ROO NORTH
MEXICO, DIVING, QUINTANA ROO SOUTH

High Concern

In the Yucatan peninsula, the lobster fishery (diving) has been also been considered multispecies, since producers sometimes also 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 we scored this factor as "high" concern under the abundance factor.

Factor 2.2 - Fishing Mortality

MEXICO / GULF OF MEXICO, TRAPS (UNSPECIFIED), MEXICO, YUCATAN

Low Concern

This score of "low" concern was calculated using the Seafood Watch Unknown Bycatch Matrix, which uses data to evaluate species bycatch susceptibility by region and gear type, and finfish have a low susceptibility to interactions with pot/trap fisheries.

MEXICO / CARIBBEAN SEA, DIVING, MEXICO, YUCATAN AND QUINTANA ROO NORTH
MEXICO, DIVING, QUINTANA ROO SOUTH

Low Concern

Data related to the impact of the fishery on finfish species was not available. For this reason, we used the UBM to score this factor as "low" concern.

Factor 2.3 - Modifying Factor: Discards and Bait Use

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

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

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

MEXICO / GULF OF MEXICO, TRAPS (UNSPECIFIED), MEXICO, 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, according to (Shester and Micheli 2011). The amount of bait is also unknown, but apparently is quite high, based on a study developed for the Australian lobster fishery that reported an average of 11,000 tonnes (MT) of lobster captured using ~14,000 MT of bait annually (Waddington and Meeuwig 2009), or that reported for the Mexican Baja lobster fishery in 2016, where it was reported that bait represented 294% of overall lobster landings by weight (Alvarez-Flores et al 2016). Considering this information, the ratio for this fishery following a precautionary approach is scored as >100%.

MEXICO / CARIBBEAN SEA, DIVING, MEXICO, YUCATAN AND QUINTANA ROO NORTH
MEXICO, DIVING, QUINTANA ROO SOUTH

< 100%

When targeting lobster by hand-harvest with the use of casitas for lobster shelter, the fishery is extremely selective and results in very little to no incidental catch. Producers do not use bait when using the casitas. For these reasons, this factor is scored as <100%.

MAMMALS

Factor 2.1 - Abundance

MEXICO / GULF OF MEXICO, TRAPS (UNSPECIFIED), MEXICO, YUCATAN

High Concern

We included this taxonomic group based on results of the Seafood Watch Unknown Bycatch Matrix. This taxonomic group was scored as "high" concern because one of the following applies:

1. Most of the species in this group are highly vulnerable to interactions with fishing gear. Highly vulnerable taxa include, but are not limited to sharks, sea turtles, marine mammals, seabirds, and corals. In addition, some families or genera of fish and invertebrates also are known to have a high vulnerability.

2. The species have not been assessed in the fishing area, but closely related species or neighboring stocks of known status are generally of "high" concern.

3. Most of the species in this taxonomic group are overfished, endangered, or threatened within the range of the fishery.

Factor 2.2 - Fishing Mortality

MEXICO / GULF OF MEXICO, TRAPS (UNSPECIFIED), MEXICO, YUCATAN

Moderate Concern

This score was calculated using the Seafood Watch Unknown Bycatch Matrix. For marine mammals, bycatch susceptibility was evaluated by region and gear type. In the case of the Caribbean/Gulf of Mexico with pots fisheries, Marine mammals are scored as "moderate" concern, because it was found that marine mammals have a moderate susceptibility to pots in nearly all regions.

Factor 2.3 - Modifying Factor: Discards and Bait Use

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

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

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

MEXICO / GULF OF MEXICO, TRAPS (UNSPECIFIED), MEXICO, 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, according to (Shester and Micheli 2011). The amount of bait is also unknown, but apparently is quite high, based on a study developed for the Australian lobster fishery that reported an average of 11,000 tonnes (MT) of lobster captured using ~14,000 MT of bait annually (Waddington and Meeuwig 2009), or that reported for the Mexican Baja lobster fishery in 2016, where it was reported that bait represented 294% of overall lobster landings by weight (Alvarez-Flores et al 2016). Considering this information, the ratio for this fishery following a precautionary approach is scored as >100%.

Criterion 3: Management Effectiveness

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

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

The Criterion 3 rating is determined as follows:

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

Rating is Critical if Management Strategy and Implementation is Critical.

GUIDING PRINCIPLE

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

Criterion 3 Summary

Fishery	Management Strategy	Bycatch Strategy	Research and Monitoring	Enforcement	Stakeholder Inclusion	Score
Fishery 1: Mexico | Diving | Quintana Roo South	Moderately Effective	Highly Effective	Moderately Effective	Moderately Effective	Highly Effective	Yellow (3.000)
Fishery 2: Mexico / Caribbean Sea | Diving | Mexico | Yucatan and Quintana Roo North	Moderately Effective	Highly Effective	Moderately Effective	Ineffective	Highly Effective	Red (2.000)
Fishery 3: Mexico / Gulf of Mexico | Traps (unspecified) | Mexico | Yucatan	Moderately Effective	Moderately Effective	Moderately Effective	Ineffective	Highly Effective	Red (2.000)

Criterion 3 Assessment

Factor 3.1 - Management Strategy and Implementation

Considerations: What type of management measures are in place? Are there appropriate management goals,

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

MEXICO, DIVING, QUINTANA ROO SOUTH
MEXICO / CARIBBEAN SEA, DIVING, MEXICO, YUCATAN AND QUINTANA ROO NORTH
MEXICO / GULF OF MEXICO, TRAPS (UNSPECIFIED), MEXICO, YUCATAN

Moderately Effective

Management of the spiny lobster fishery in the Yucatan Peninsula has been relatively effective, considering the general stability of production during the last 10 years (See C1). Regulations in place are contained within a National Federal Mexican Norm (NOM-006, enacted in 1993 and updated five times since then) and a Federal Management Plan (LMP, released in 2014). These regulations include a minimum size limit (135 mm of abdomen length, equivalent to ~74.6 mm of cephalothorax) (DOF, 2016), technical specifications of the traps, as well as the maximum size (10.5 m max) and engine power (115 hp max) of the vessels authorized to target the species (DOF 2016). In addition, an annual four-month seasonal closure from 1 March to 30 June is in place, as well as a prohibition to catch mature females. These regulations allow managers to protect species recruitment. However, the 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, and does not consider the most recent status of the species.

Also, 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 marine protected areas (MPAs) ruled by the National Commision of Natural Protected Areas (CONANP-SEMARNAT), the management plans for these MPAs include extra regulations, including 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 LMP developed by INAPESCA and CONAPESCA, four strategic objectives to achieve a sustainable lobster fishery in the Yucatan 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. To date, no information related to these reference points was available and it is unclear how many of these actions have been completed.

Considering that managers have recently produced a local management plan (2014), that regulations are expected to be effective, and that there is a need to increase precaution due to the most recent findings of the biomass against historical levels, this factor is scored as "moderately effective."

Factor 3.2 - Bycatch Strategy

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

MEXICO, DIVING, QUINTANA ROO SOUTH
MEXICO / CARIBBEAN SEA, DIVING, MEXICO, YUCATAN AND QUINTANA ROO NORTH

Highly Effective

The hand-harvest lobster fishery through diving, and with the use of casitas, is a very selective technique and does not discard bycatch. For this reason, this factor is scored as "highly effective."

MEXICO / GULF OF MEXICO, TRAPS (UNSPECIFIED), MEXICO, 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 the Mutton snapper (*Lutjanus analis*) and several species of the genus Calamus (*Calamus* spp.) are among the most common species that get trapped. However, local experts mentioned that these organisms are kept either to be sold or for personal consumption (F. Fernandez, personal communication 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 on C2, three more taxa were included as potentially impacted by the fishery (Marine mammal, corals, and 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, and the fact that no species of concern have been reported to be caught by the gear, this factor is scored as "moderately effective" for traps.

Factor 3.3 - Scientific Research and Monitoring

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

MEXICO, DIVING, QUINTANA ROO SOUTH
MEXICO / CARIBBEAN SEA, DIVING, MEXICO, YUCATAN AND QUINTANA ROO NORTH
MEXICO / GULF OF MEXICO, TRAPS (UNSPECIFIED), MEXICO, YUCATAN

Moderately Effective

Due to the high value of the species, as well as the social importance of the fishery in the region, managers in collaboration with producers, local non-governmental organizations, academic institutions, and researchers have been developing more information that allows management of the fishery to move closer to sustainable levels (e.g., Sian Ka'an cooperative in Quintana Roo held a MSC certification from 2012 to 2017). During the last 10 years, a management plan was created (DOF 2014) and the Federal Norm for Lobster (NOM-006) was updated (DOF 2016).

A local characteristic is that producers (fishers) are well organized in fishing cooperatives and this

arrangement allows them to have access to information of monthly landings per fisher or group of fishers for administrative purposes. This kind of information and others related to fishing activity can be obtained from files of the fishing cooperatives, allows extraction of simple indicators of fishing effort and catch per unit effort for resource monitoring purposes (Sosa, personal communication 2019).

Finally, as part of the management plan, several research lines were proposed in order to improve management, establish reference points and improve regulations. Currently, data collection is limited to production and it is used to report the status of the fishery against historical production by state; for these reasons, this factor is scored as "moderately effective."

Factor 3.4 - Enforcement of Management Regulations

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

MEXICO, 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). One example of these concessions is that which was granted to the cooperative "Pescadores de Vigía Chico," which covers an area of 850 km^2 or ~100 ha.

According to (Miller, 1989) (Seijo and Fuentes 1989) and (Seijo, 1993), these systems allow enforcement actions led by the cooperatives to become more efficient. (Lozano-Alvarez personal communication 2019) mentioned that lobster fishing within the Biosphere Reserves of Sian Ka'an and Banco Chinchorro were, until recently, certified by MSC in part because of their good fishing practices and high level of local enforcement of regulations. 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 the case of 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 certification (which was good until 2017) and they are currently involved in a fishery improvement project in order to continue implementing high standard operations, including enforcement and compliance with federal and local regulations (Sosa-Cordero, personal communication 2019). For these reasons, this factor is scored as "moderately effective."

MEXICO / CARIBBEAN SEA, DIVING, MEXICO, YUCATAN AND QUINTANA ROO NORTH
MEXICO / GULF OF MEXICO, TRAPS (UNSPECIFIED), MEXICO, YUCATAN

Ineffective

Fishery access is controlled by permits and/or concessions that provide exclusive access of the species to the holders (DOF 2016) (DOF 2012). The enforcement of regulations is carried out by the CONAPESCA officials (federal officers). According to an available report, approx. 210 federal inspectors were actively working in Mexico (IMCO 2012) and in charge of patrolling the more than 11,000 km of coastline, for which this may be an insufficient number of agents. In order to help with this situation, some agreements between local officials and local communities were put in place to improve enforcement actions (MRAG 2012) (MRAG 2015), although

results about these programs were not available.

Finally, although several protected areas in the region (e.g., the Biosphere Reserve 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]), managers (DOF 2014) and producers (Yucatan 2018) have described the enforcement actions as deficient; for these reasons enforcement is scored as "ineffective."

Factor 3.5 - Stakeholder Inclusion

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

MEXICO, DIVING, QUINTANA ROO SOUTH
MEXICO / CARIBBEAN SEA, DIVING, MEXICO, YUCATAN AND QUINTANA ROO NORTH
MEXICO / GULF OF MEXICO, TRAPS (UNSPECIFIED), MEXICO, YUCATAN

Highly Effective

Lobster regulations and management have been inclusive and transparent, allowing the participation of different stakeholders in recent management developments (e.g., management plan and update of Official Norm). 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). Since cooperatives play a key 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 scored as "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

Region / Method	Gear Type and Substrate	Mitigation of Gear Impacts	EBFM	Score
Mexico / Diving / Quintana Roo South	4	0	Low Concern	Green (4.000)
Mexico / Caribbean Sea / Diving / Mexico / Yucatan and Quintana Roo North	4	0	Low Concern	Green (4.000)
Mexico / Gulf of Mexico / Traps (unspecified) / Mexico / Yucatan	3	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 - Physical Impact of Fishing Gear on the Habitat/Substrate

MEXICO, DIVING, QUINTANA ROO SOUTH
MEXICO / CARIBBEAN SEA, DIVING, MEXICO, YUCATAN AND QUINTANA ROO NORTH

4

Although diving for lobster does not have a direct impact on the substrate, the use of casitas could have an impact on the substrate. However, there is 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. 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 direct impact of these structures on the benthic habitat is highly unlikely to reduce habitat structure and function. For these reasons, the casitas are scored as "4."

Justification:

*SICA= Qualitative Risk Analysis, which is a formalized assessment system where there is insufficient information for a quantitative analysis (FAO 2018).

MEXICO / GULF OF MEXICO, TRAPS (UNSPECIFIED), MEXICO, YUCATAN

3

According to managers, these traps are used on deeper areas (~>50 m) in the Yucatan peninsula shelf (DOF 2013). This region was classified as been composed mostly by hard bottoms by Logan et al (Logan et al 1969). ***In the past, the effect of passive gears -like the traps- as was assumed that little impact on the benthos was caused by these (Eno et al. 2001), however, these gears may pose a threat of cumulative habitat injury when they get lost. (Uhrin and Fonseca 2015) reported that lobster traps resting on top of seagrass for extended periods cause blades to become broken or abraded, which may disrupt normal blade function. It is unclear the level of impact of the traps in the Yucatan region, considering that in this case, the traps are mostly used on hard bottom areas, for this reason, this factor is scored as 3.***

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

MEXICO, DIVING, QUINTANA ROO SOUTH
MEXICO / CARIBBEAN SEA, DIVING, MEXICO, YUCATAN AND QUINTANA ROO NORTH

0

The Yucatan Peninsula has up of 25 Natural Protected Areas that add up to 8,562,758.47 ha (CONANP 2018). However, the most important ones having a direct relationship with the lobster fishery are the Biosphere Reserves of Sian Ka'an (Figure 6), Banco Chinchorro (Figure 7), and Caribe Mexicano (Figure 8)—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). However, in order to achieve an improvement on the score, at least 25% of the area should be protected for extraction; current closed areas are not up to that percentage. For this reason, no extra points are added to the fishery.

Justification:

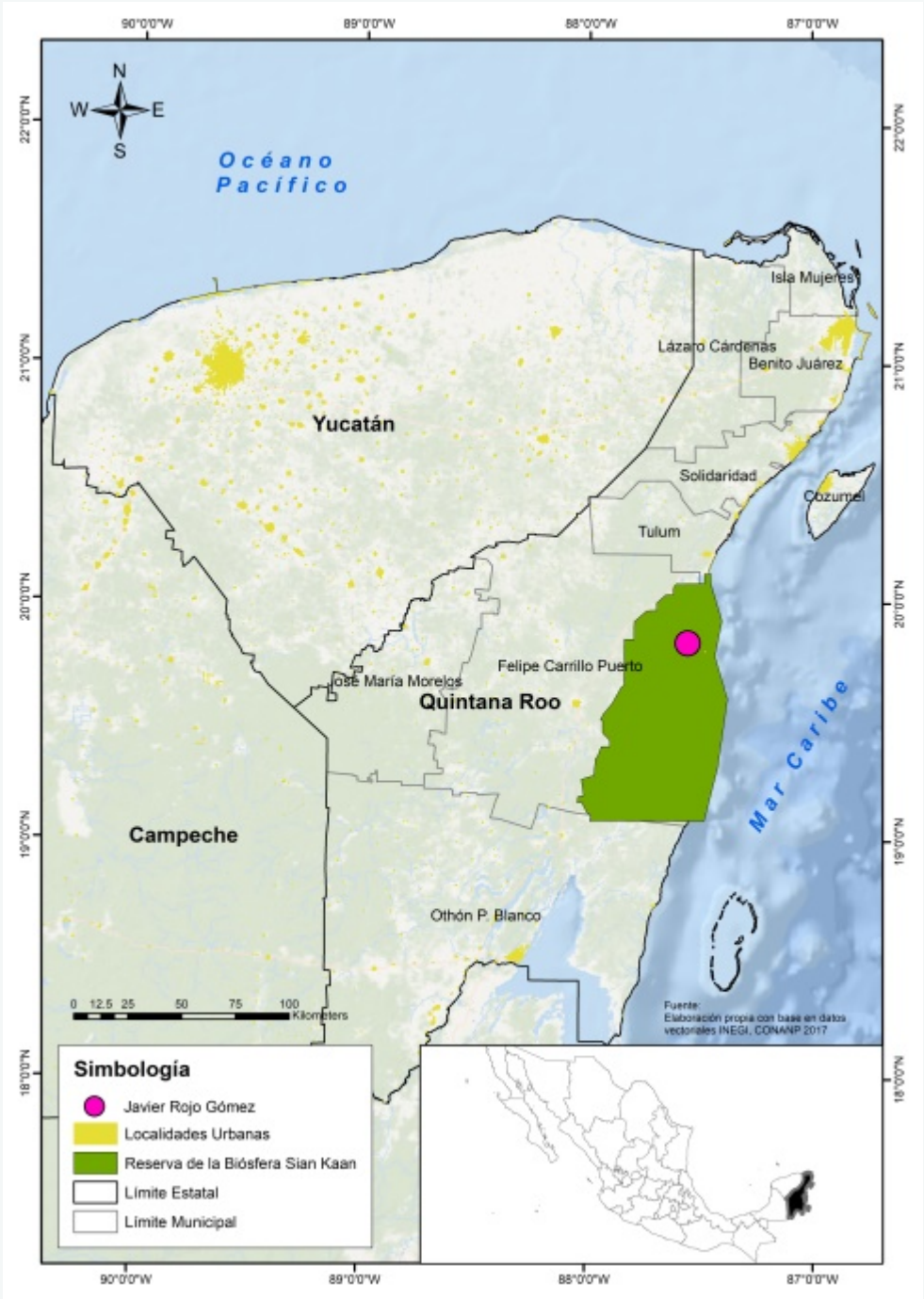

Figure 10 Figure 6. Sian kan Biosphere reserve (image taken from Rojas-Correa and Palafox Muñoz 2018)

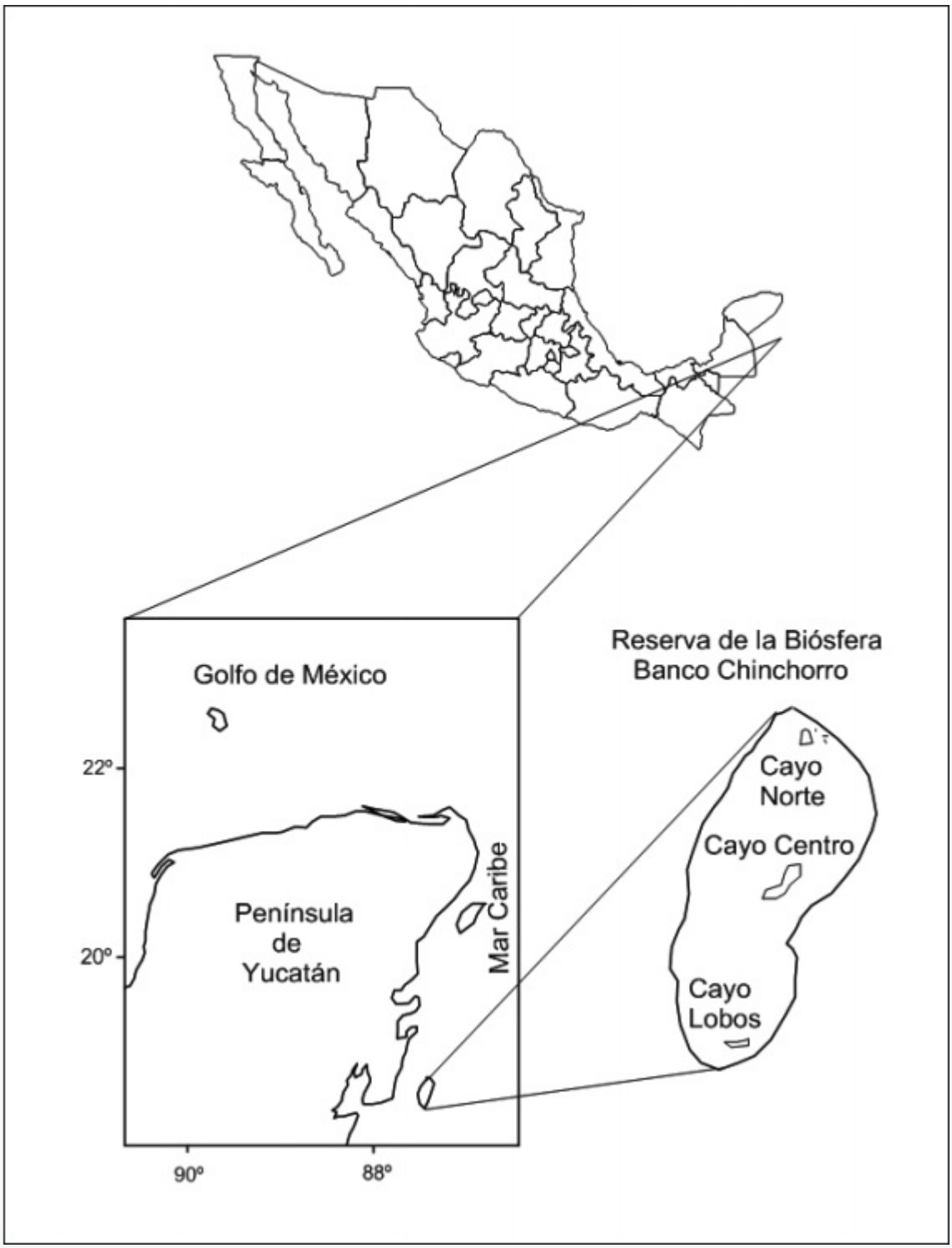

Figure 11 Figure 7. Banco Chinchorro Biosphere Reserve (imagen taken from Ramirez-Estevez et al. 2010)

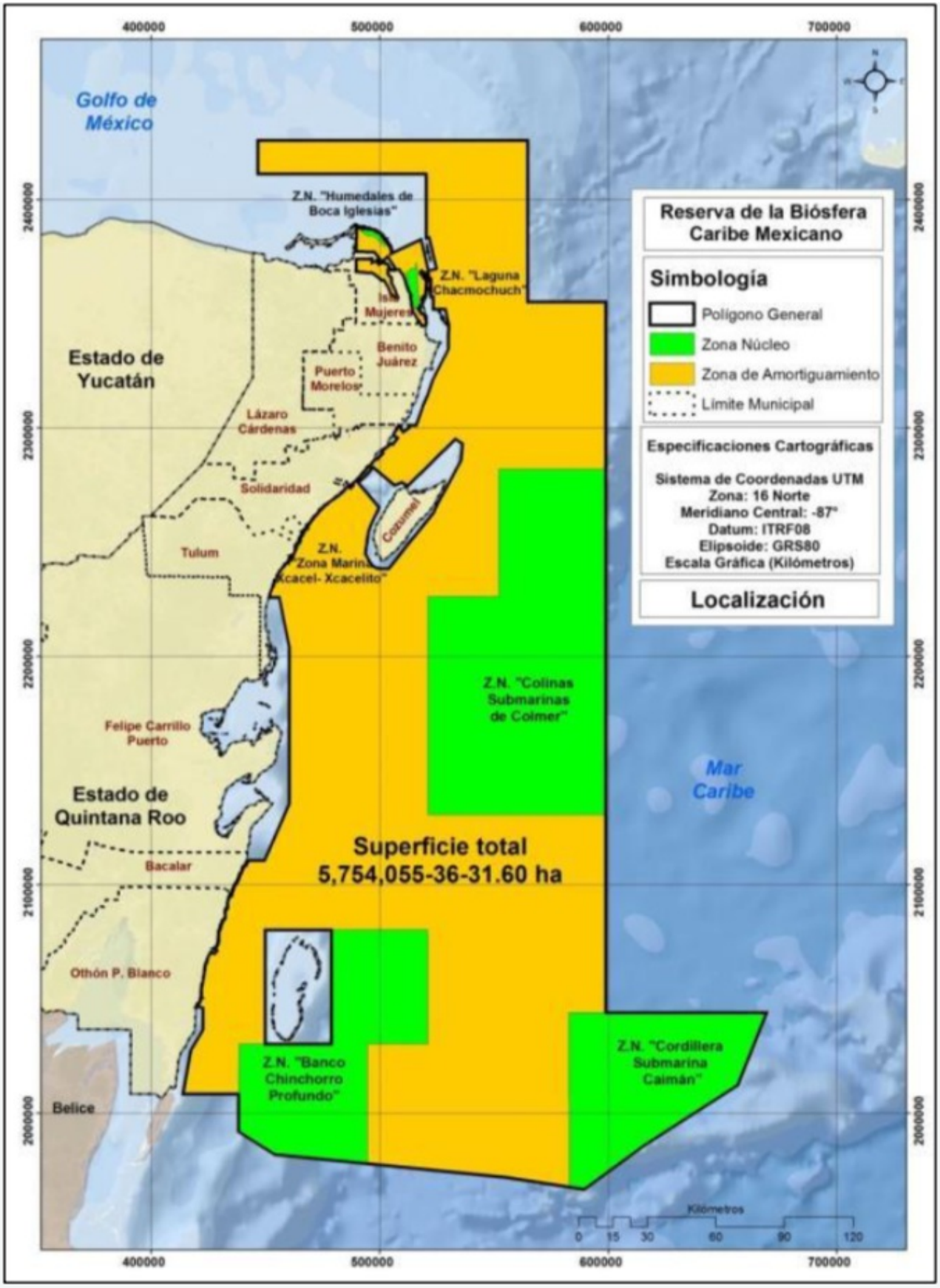

Figure 12 Figure 8. Mexican Caribbean Biosphere Reserve zoning. Yellow zone= buffer area; Green: Core zone (no commercial activities allowed) (figure taken from Biosphere reserve management program, CONANP-SEMARNAT 2016)

MEXICO / GULF OF MEXICO, TRAPS (UNSPECIFIED), MEXICO, YUCATAN

0

No current efforts to limit the impact of traps in the bottom are in place. No extra points are included for the fishery.

Factor 4.3 - Ecosystem-Based Fisheries Management

MEXICO, DIVING, QUINTANA ROO SOUTH
MEXICO / CARIBBEAN SEA, DIVING, MEXICO, YUCATAN AND QUINTANA ROO NORTH
MEXICO / GULF OF MEXICO, TRAPS (UNSPECIFIED), MEXICO, YUCATAN

Low Concern

As mentioned before, the lobster fishery in the Yucatan Peninsula has been divided by managers into nine regions (see Production Statistics) with five of these areas in Yucatan and four in Quintana Roo. The Quintana Roo region has in place three marine protected areas that have spatial regulations as part of their management programs.

The Sian Ka'an Biosphere **(created in 2012 and a size of 1,049 has), the Banco Chinchorro Biosphere (created in 2013 and 1,238 has) and the Mexican Caribbean Biosphere Reserve (created in 2016 and more than 5 million has)** (see figure X) covered a significant amount of the lobster fishing zones in Quintana Roo. The management plans of the three MPA spatial planning that regulates areas where fishing activities are allowed or banned (CONANP-SEMARNAT 2014) (SEMARNAP 2000) (CONANP-SEMARNAT 2016).

These management programs have been created using the large amount of 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 Yucatan Peninsula has been studied by different researchers. In 2003, a focal research was developed in Ascension Bay in Quintana Roo. The study provided a description of the marine ecosystem and mass fluctuations using Ecopath. The author reported lobster as a key resource in the ecosystem, due to its value and high abundance, and concluded that changes in biomass of lobsters due to fishing could introduce important seasonal differences in the tropic dynamics of the ecosystem, given that lobster is one of the most abundant groups in the bay (Vidal and Basurto 2003). However, these responses could vary depending on abundance and fishing effort in place.

Considering that academic institutions have been working closely with managers and communities of producers, and that management programs of various MPA have been using this research with the aim of protecting ecosystem function, this factor is scored as "low" concern.

Justification:

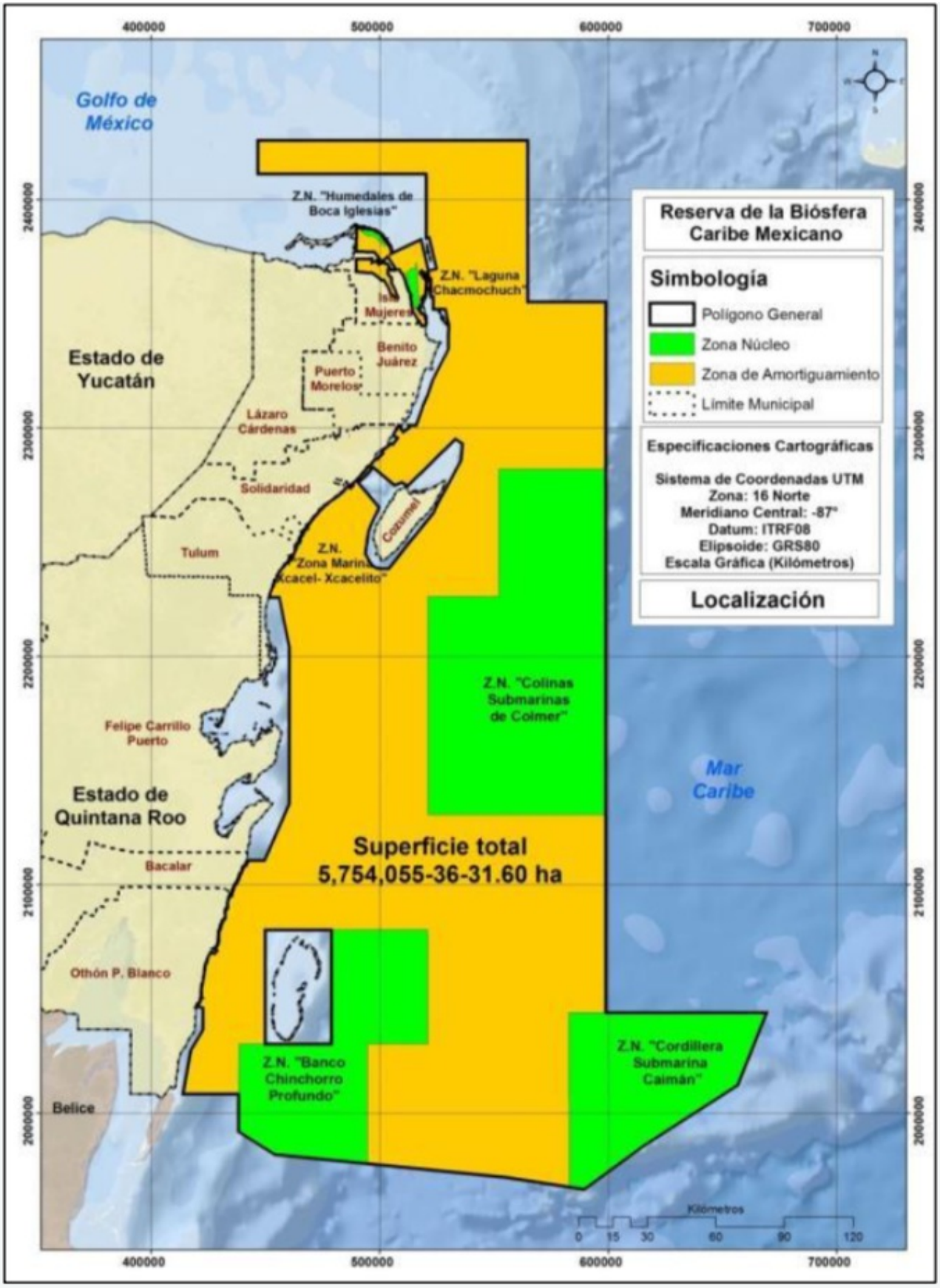

Figure 13 Figure 8. Mexican Caribbean Biosphere Reserve zoning. Yellow zone= buffer area; Green: Core zone (no commercial activities allowed) (figure taken from Biosphere reserve management program, CONANP-SEMARNAT 2016)

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

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Appendix A: Extra By Catch Species

BENTHIC INVERTS

Factor 2.1 - Abundance

MEXICO / GULF OF MEXICO, TRAPS (UNSPECIFIED), MEXICO, YUCATAN

Moderate Concern

We included this taxonomic group based on results of the Seafood Watch Unknown Bycatch Matrix. This taxonomic group was scored as "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

MEXICO / GULF OF MEXICO, TRAPS (UNSPECIFIED), MEXICO, YUCATAN

Low Concern

This taxon is scored as "low" concern using the Seafood Watch Unknown Bycatch Matrix for benthic invertebrates.

Factor 2.3 - Discard Rate

MEXICO / GULF OF MEXICO, TRAPS (UNSPECIFIED), MEXICO, 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, according to (Shester and Micheli 2011). The amount of bait is also unknown, but apparently is quite high, based on a study developed for the Australian lobster fishery that reported an average of 11,000 tonnes (MT) of lobster captured using ~14,000 MT of bait annually (Waddington and Meeuwig 2009), or that reported for the Mexican Baja lobster fishery in 2016, where it was reported that bait represented 294% of overall lobster landings by weight (Alvarez-Flores et al 2016). Considering this information, the ratio for this fishery following a precautionary approach is scored as >100%.

CORALS AND OTHER BIOGENIC HABITATS

Factor 2.1 - Abundance

MEXICO / GULF OF MEXICO, TRAPS (UNSPECIFIED), MEXICO, YUCATAN

High Concern

We included this taxonomic group based on results of the Seafood Watch Unknown Bycatch Matrix. This taxonomic group was scored as "high" concern because one of the following applies:

1. Most of the species in this group are highly vulnerable to interactions with fishing gear. Highly vulnerable taxa include corals.

2. The species have not been assessed in the fishing area, but closely related species or neighboring stocks of known status are generally of "high" concern.

3. Most of the species in this taxonomic group are overfished, endangered, or threatened within the range of the fishery.

Factor 2.2 - Fishing Mortality

MEXICO / GULF OF MEXICO, TRAPS (UNSPECIFIED), MEXICO, YUCATAN

Low Concern

This score was calculated using the Seafood Watch Unknown Bycatch Matrix. For corals and another biogenic habitat, bycatch susceptibility was evaluated by region and gear type. According to the UBM, this taxon is scored as "low" concern since corals/biogenic habitats have a low susceptibility to interactions with pot fisheries.

Factor 2.3 - Discard Rate

MEXICO / GULF OF MEXICO, TRAPS (UNSPECIFIED), MEXICO, 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, according to (Shester and Micheli 2011). The amount of bait is also unknown, but apparently is quite high, based on a study developed for the Australian lobster fishery that reported an average of 11,000 tonnes (MT) of lobster captured using ~14,000 MT of bait annually (Waddington and Meeuwig 2009), or that reported for the Mexican Baja lobster fishery in 2016, where it was reported that bait represented 294% of overall lobster landings by weight (Alvarez-Flores et al 2016). Considering this information, the ratio for this fishery following a precautionary approach is scored as >100%.