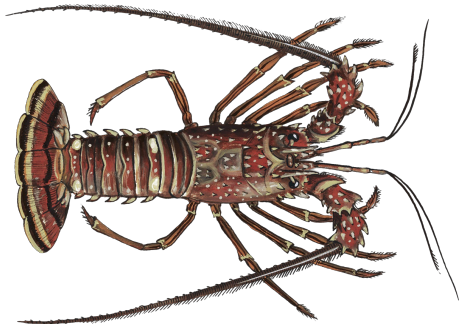
Caribbean spiny lobster

Panulirus argus



Brazil

Pots

Report ID 27951

January 9, 2023

Seafood Watch Standard used in this assessment: Fisheries Standard v3

Table of Contents

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

The spiny lobster is a commercially fished marine invertebrate. There are several distinct species of spiny lobster located in various areas of the world. This report provides information and recommendations for the Caribbean spiny lobster (*Panulirus argus*) fished in Brazil waters with traps called *manzuá.* The other fishing methods used to harvest spiny lobster in these waters include bottom gillnets called *caçoeira* (the most popular fishing method), free diving and diving with compressors (the most popular fishing methods), and in recent years, using the artificial lobster attractor devices called *marambaias.* But, the only legal fishing method are traps.

The Caribbean spiny lobster is moderately vulnerable to fishing pressure. It tends to mature quickly (around 3 years) compared to a life span of around 18 years in the Caribbean. Recently matured spiny lobsters tend to spawn once a year while older lobsters can spawn multiple times per year, and females produce around 3 million eggs; larvae can disperse widely upon hatching. The most recent stock assessments for the species in Brazil were published in 2016, 2017, 2018, and 2021. The Brazilian fishery is heavily overfished: the stock is fluctuating around a quite low level compared to that in the 1990s. There has been a gradual decline in landings since the 1990s, although fishing mortality is nearly double that of natural mortality. Hence, the stock is undergoing overfishing. The impact of the commercial fishery on the Caribbean spiny lobster in Brazil is ranked Red.

Bycatch information is limited in Brazil, but bycatch is thought to be low. There are no national bycatch studies, although a recent bycatch study in Cearà suggested that traps used in the fishery are nonselective. The main bycatch species are snapper and white grunt. Some endangered, threatened, and protected (ETP) species are caught, such as guitarfish. There are no recent discard rates available for the Brazil spiny lobster fishery, but discard rates in lobster fisheries are generally between 8% and 15%. Discards include many invertebrates, which are generally returned alive. The most common gear types used to catch spiny lobsters include gillnets and diving, which are illegal and are inadequately monitored and managed. Gillnets are nonselective, catching a variety of species including mainly corals, but can also result in the entanglement of whales and locally endangered species. About one-third of Brazilian coasts are covered in coral reefs, which are vulnerable and susceptible to gillnets. Dive fisheries could be more selective but are not monitored or managed and are utilized in shallow waters where juveniles are more abundant. The impact of the fishery on other species is ranked Red for Brazil.

Management of spiny lobster in Brazil has not been effective at maintaining a stable, abundant population. Recent stock assessment studies conclude that the stock is heavily overfished, with evidence showing that the stock may be close to collapse, but there is some evidence to show that its decline has stabilized. Brazil mandates a minimum legal size and a 6-month closed season; however, poor compliance rates and high rates of illegal, unregulated, and unreported (IUU) fishing significantly undermine these measures' progress. Overall, the management of the spiny lobster fisheries in Brazil is ranked as Critical because of the high levels of IUU fishing.

The only legal fishing gear used to catch spiny lobsters in Brazil is traps; however, the most utilized gears are diving and gillnets. Diving poses a small threat to the habitat, whereas gillnets (which are found in rocky habitats) pose a risk to corals, particularly through ghost fishing. Traps result in some damage to the benthic habitat, but there are some regulations to protect some portion of habitat in reserves. The

ecosystem impacts from the trap-based fisheries are considered moderate. The impact of the fishery on habitats and ecosystems is ranked Yellow.

The spiny lobster fishery in Brazil is engaged in a Fishery Improvement Project (FIP), which is limited to the analysis of data provided by export organizations, and no official monitoring program is being conducted. Engagement in a FIP does not affect the Seafood Watch score because we base our assessments on the current scientific evidence.

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 | Southwest Atlantic | Pots | Brazil	1.000	1.299	0.000	2.449	**Avoid (0.000)**	Unknown

Summary

Spiny lobster from Brazil is given an Avoid rating, because most of the lobsters are caught and landed using illegal fishing methods (diving and gillnets), resulting in a Critical score for fishery management.

Eco-Certification Information

A fishery improvement project is in place to improve the sustainability of the Brazilian lobster fishery; it is being implemented by CeDePesca.

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

The spiny lobster is a commercially fished marine invertebrate. There are several distinct species of spiny lobster located in various areas of the world. This report will provide information and recommendations for the Caribbean spiny lobster, *Panulirus argus,* fished within Brazil using traps. This lobster is fished mainly using gillnets and diving (free diving and scuba diving), and there is an increasing use of lobster attractor devices (LADs), although the only legal method of fishing for lobster is traps.

It should be noted that a recent study has shown that spiny lobster caught off Brazil is genetically distinct from that found in the Caribbean and has been identified as a separate species, *Panulirus meripurpuratus;* however, this distinction has yet to be made by the U.S. Food and Drug Administration (which governs the labeling of seafood in the United States) or the FAO (which records global landings). Therefore, we continue to use the previous nomenclature. Several spiny lobster species are found in Brazil, including *Panulirus laevicauda* and *P. echinatus* (Andrade 2015), which are not considered in the scope of this assessment.

Species Overview

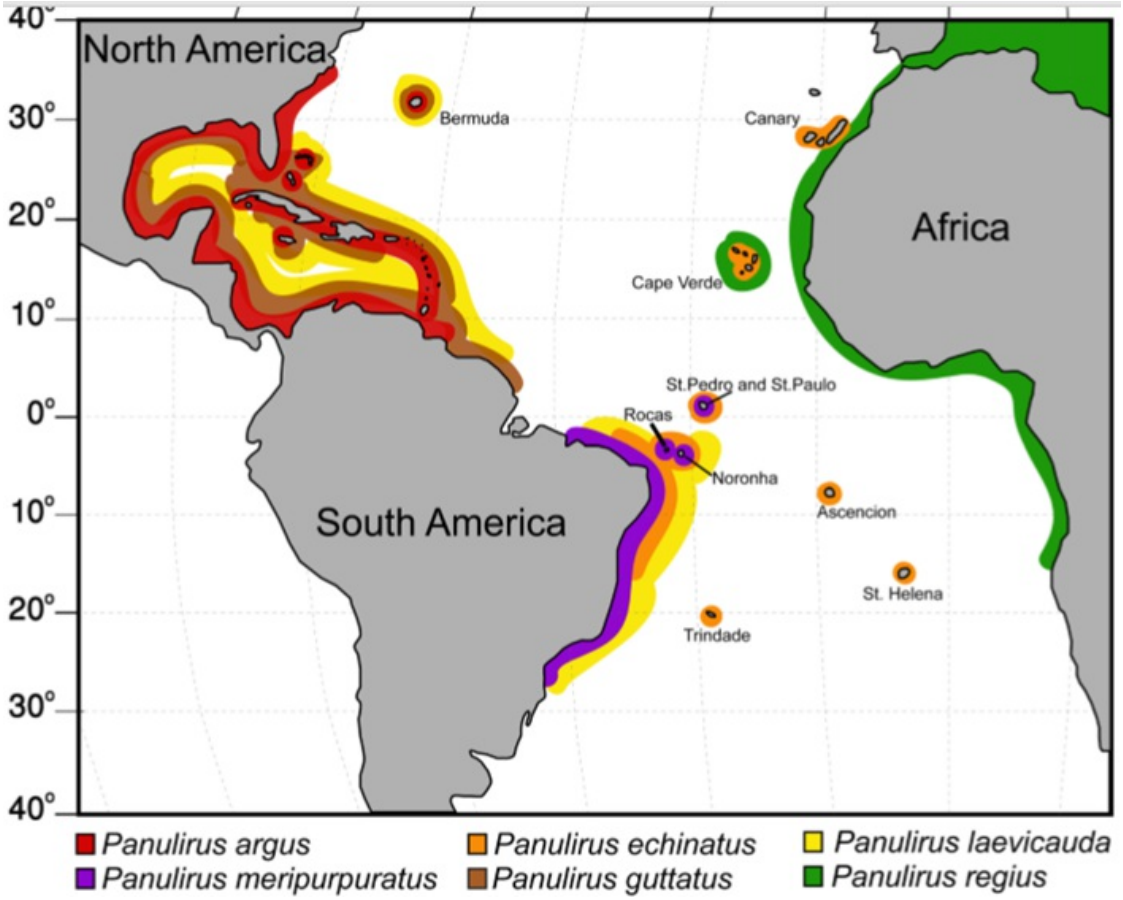


Figure 1: Map showing the distribution of species within the genus *Panulirus*. Source: (Giraldes and Smyth 2016).

The spiny lobster, of the genus *Panulirus,* comprises approximately 20 different species occurring worldwide in tropical and subtropical waters (Pollack 1995). The spiny lobster can be easily distinguished by the long, spiny antennae and by the lack of claws on the first four pairs of legs (Holthuis 1991). Spiny lobsters are typically found at depths from 0 to 90 meters (m), depending on the species (Holthuis 1991). Juvenile lobsters may spend their first few years in nearshore surfgrass or algal beds, while adults favor rocky substrates and reef areas that provide protection {GMFMC and SAFMC 2011}. Spiny lobsters tend to be nocturnal, and live in shelters during the day (Giraldes and Smyth 2016). How lobsters migrate is debated: some studies show that spiny lobsters migrate among depths, depending on the season, and generally move deeper in winter months (Holthuis 1991).

Brazil has a Lobster Management Plan, and the key management measures include a minimum carapace length, season closures, various gear restrictions, license limits, and marine protected areas (MPAs) (FAO 2015a). But, compared to many other countries that catch Caribbean spiny lobster, Brazil lacks in measures, such as prohibitions of harvesting berried and molting lobster, and escape gaps in traps (FAO 2015a). New measures are expected to be implemented under the Fishery Management Plan (SCC/CGPL 2017).

The spiny lobster fisheries have been managed by various governmental institutions, which has created uncertainty and hindered progress in the fisheries' management. In the last 15 years, a shared process between the Ministry of Fisheries and Aquaculture (MPA) and the Ministry of Environment (MMA) was established. The MPA was dissolved in 2015 and replaced by the Secretary of Agriculture of Fisheries, now integrating the structure of the Precedence of the Republic (SEAP/PR). The management system includes a participatory body, the Management Committee for Spiny Lobster Fishery (CGPL), and incorporates a scientific, technical spiny lobster subcommittee working group that includes many stakeholders (FAO 2003); however, the working group is considered to be ineffective, because of the lack of support from the government to implement a proposed monitoring program for the fishery (SCC/CGPL 2017).

The Brazilian lobster fishery predominantly comprises small-scale fisheries (FAO 2015a) and mid-sized boats for gillnets, hookas, or traps and drums {Tallaksen and Pocklington 2013}. Traps (called *manzuá* in Brazil) are the only legal fishing gear to harvest lobster in Brazil. The fishery used traps until the early 1990s, although their popularity lessened because of their perceived low productivity and low profitability. Traps were replaced by bottom gillnet; free diving and compressor diving; and more recently with *marambaias*, which are artificial lobster attractor devices (LAD) and are similar to *casitas*, which are found in other Caribbean spiny lobster fisheries. They are mainly constructed using empty oil drums and are modified to a "box" shape to act as an attractant and shelter for lobsters (FAO 2015a). Currently, fishing in most areas is dominated by bottom gillnet gear (FAO 2015a). There are considerable issues with illegal harvesting in Brazilian fisheries, which is estimated to represent over 85% of the Brazilian catch (Andrade 2015).

Production Statistics

Spiny lobsters are fished throughout the Caribbean and along the Central and South American coastlines. The main producers of *P. argus* in the Americas are shown in Table 1.

Table 1. Largest producers of *P. argus*. Landings measured in tonnes in 2019 and 2020. Source (FAO 2022).

LAND AREA	2020 (PRODUCTION TONNES)	2019 (PRODUCTION TONNES)	Gears
Brazil	7,300	205	Traps and gillnets (level of gillnet use is unknown and is illegal)
Bahamas	5,965.863	277	Casitas, traps
Nicaragua	4,975	6,225.72	Traps, free and assisted diving
Cuba	3,956.5	800	Casitas (62%), cages (26%), traps (14%)
United States	1,621	6	Commercial: Traps, scuba, bully net. Recreational: No traps, scuba diving, free diving, bully net
Dominican Republic	1,554.33	27	Traps, free and assisted diving
Honduras	1,091.82	95	Traps (30%) and scuba diving with hooks (70%)
Belize	850	7,300	Traps, casitas, and skin diving

The Caribbean spiny lobster is captured throughout its range. Global capture production has varied widely, with a minimum of ≈3,000 metric tons (mt) in 1950 and a maximum of 42,000 mt in 1995, and trade of Caribbean spiny lobster is worth around USD 900 million annually (FAO 2015a). Production over the last decade has fluctuated between 31,720 mt in 2009 to the highest reported production of 39,326 mt in 2016 (FAO 2022). The catch production from Brazil has fluctuated around 7,000 mt for the past decade (FAO 2018a). The amount of landings from each gear is unknown in Brazil because the catch is mostly harvested using illegal gear (FAO 2015a). The largest area of production within Brazil is Cearà State, producing around 60% of Brazilian spiny lobster catches and 80% of its exports {Tallaksen and Pocklington 2013}.

Importance to the US/North American market.

The United States imports spiny lobster, including the Caribbean spiny lobster, from several countries in the Caribbean, Central America, and South America. There is a lack of species-specific import data because Caribbean spiny lobster imports can be named "Lobster Rock Caribbean Spiny," "Lobster Rock NSPF Frozen," or terms to that effect. Of the total Caribbean spiny lobster recorded imports to the United States in 2021, ≈23% is from Brazil (NMFS 2022). Brazil exports most of its spiny lobster to the United States (MDICT-ALICEWEB 2018)(FAO 2015a).

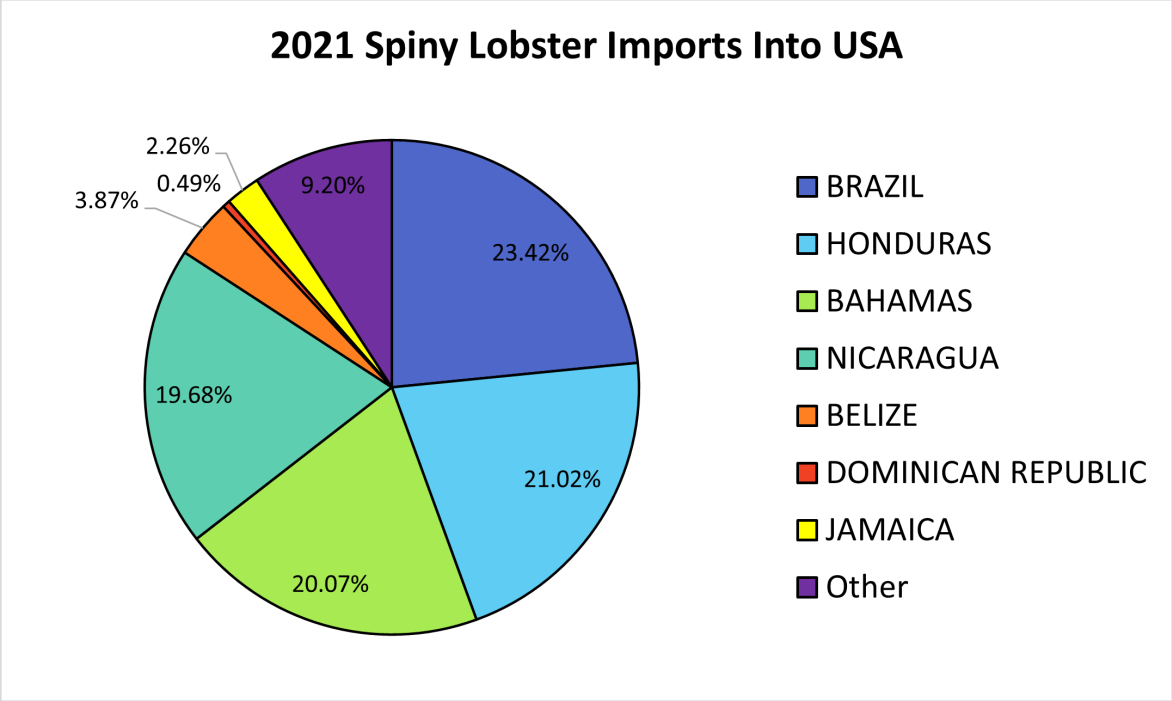


Figure 2: 2021 Caribbean spiny lobster imports into United States. "Other" includes: Mexico, Colombia, St. Helena, Panama, St. Vincent-Grenadine, Ecuador, Venezuela, Turks & Caicos Is., Haiti, Trinidad & Tobago, Chile, and Guatemala. Source: (NMFS 2022).

Common and market names.

Spiny lobsters are also known as rock lobsters. The Caribbean spiny lobster is also known as Bermuda spiny lobster, common spiny lobster, crawfish, crayfish, Florida (spiny) lobster, bug, West Indian langouste, and West Indian spiny lobster (Holthuis 1991)(NOAA 2015).

Primary product forms

Spiny lobster is sold as fresh or frozen either in the form of raw tails, meat, or whole, and either blanched or fully cooked (FishChoice 2017).

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**
Southwest Atlantic | Pots | Brazil	1.000: High Concern	1.000: High Concern	Red (1.000)

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

Factor 1.1 - Abundance

Southwest Atlantic | Pots | Brazil

High Concern

The most recent stock assessment for Caribbean spiny lobster (*Panulirus argus*) in Brazil was conducted in 2021 utilizing both a length-based pseudo-cohort analysis model and an integrated production model (Canales and Ibarra 2021). Landings data from 1955 to 2020 were used and obtained from previous studies and export records generated by CeDePesca. The maximum sustainable yield (MSY) was defined by 40% of the virgin biomass (B_0). It was estimated that biomass is reduced to around 25% of B_0 or between 10% and 20% of B_0, depending on the model used (Canales and Ibarra 2021). Therefore, Canales and Ibarra (2021) deemed the stock to be overfished ($B/B_0 < 0.4$), so abundance is scored a high concern.

Justification:

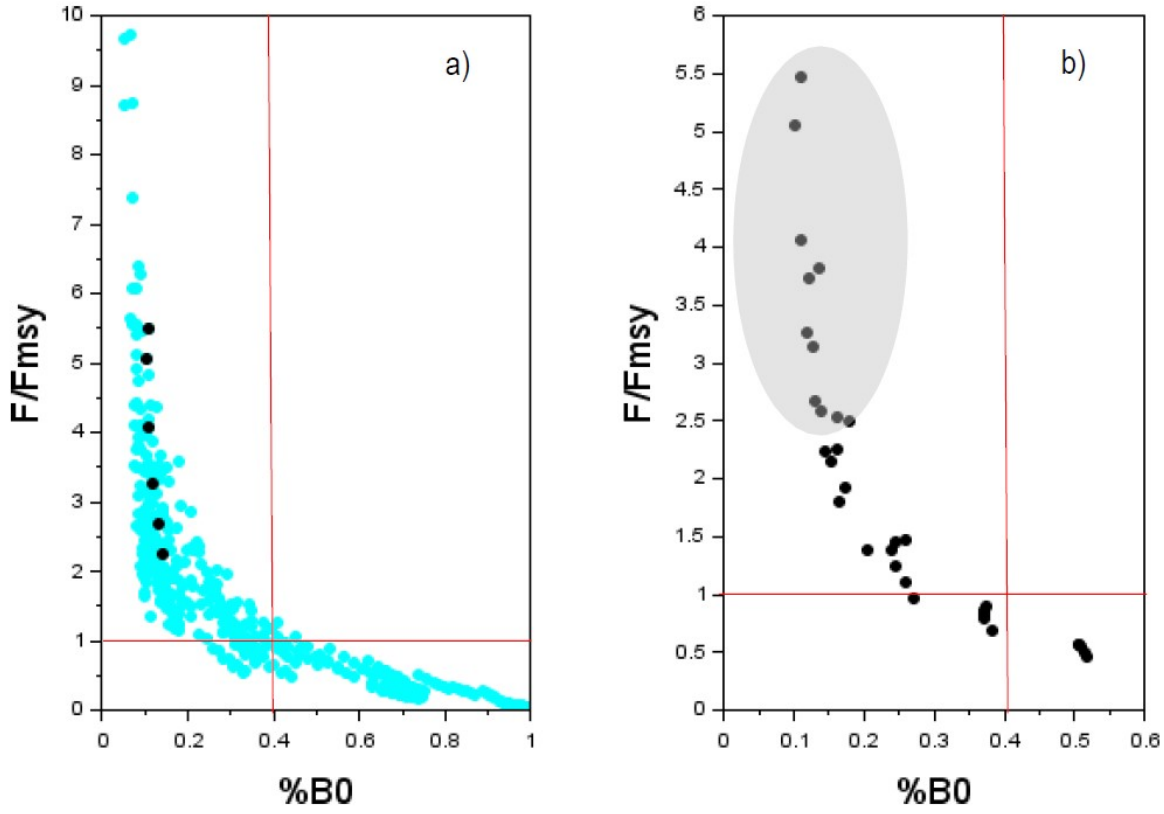


Figure 3: Kobe diagrams of lobster exploitation history. a) B:F ratio for all scenario years for which the final depletion level was assumed to be less than 20%. b) B:F ratio for the year 2020 and all scenarios considered. The area of the most plausible scenarios is highlighted in gray. The red lines represent the reference values. Source: (Canales and Ibarra 2021).

Factor 1.2 - Fishing Mortality

Southwest Atlantic | Pots | Brazil

High Concern

The most recent stock assessment for Caribbean spiny lobster (*P. argus*) in Brazil was conducted in 2021 and deemed that overfishing is occurring (Canales and Ibarra 2021). Fishing mortality was estimated to be 1.5 or 1.6 times the reference value of $F_{40\%}$, depending on which model was used (Canales and Ibarra 2021). Because fishing mortality is near double that of the reference value of $F_{40\%}$, Seafood Watch deems fishing mortality a high concern.

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**
Southwest Atlantic | Pots | Brazil	1.732	0.750: >= 100%	Red (1.299)

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.

SOUTHWEST ATLANTIC | POTS | BRAZIL			
SUB SCORE: 1.732	DISCARD RATE: 0.750	**SCORE: 1.299**	
SPECIES	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Caribbean spiny lobster	1.000: High Concern	1.000: High Concern	Red (1.000)
Brazilian guitarfish	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Grouper (unspecified)	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Snappers	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Corals and other biogenic habitats	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Finfish	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Benthic inverts	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)

Retained and bycatch species that are analyzed in this assessment have been chosen based on whether they represent 5% or more of the spiny lobster catch, or because of their conservation status (e.g., endangered, threatened, overfished), or for their susceptibility to traps (when data are lacking). In this region, the Southwest Atlantic, the vulnerable taxa are benthic invertebrates, corals, and finfish.

There is a lack of bycatch data available for Brazilian fisheries, although the 4th SCC/CGPL meeting stated that red and green lobster likely represent 95% of total catches in the trap fleet (SEAP/MDICT/ MMA 2017). The most recent study assessing bycatch in this fishery was conducted by CeDePesca in 2016 (CeDePesca 2016). This study was based on a single day of fishing, so it was not representative of the entire fishery. In 2020, CeDePesca noted that lobster traps can be associated with other species, namely finfish, that are known to be a common bycatch species (CeDePesca 2020). There is a high incidence of illegal gears used in the fishery; therefore, the available bycatch data may not reflect the true outcome. In the absence of bycatch data, the Seafood Watch Unknown Bycatch Matrix was used to determine species that are at risk in trap fisheries in the Southwest Atlantic region. Bycatch data from a regional bycatch

study in Cearà (the state that catches the majority of Brazilian spiny lobster) (Santana et al. 2015) have been used to determine additional potential bycatch species. Also, a study from 1996 showed that bycatch is quite diverse and includes fish, nontarget lobster species, crabs, and mollusks (Ivo et al. 1996) in (Cruz et al. 2013b).

For the trap fishery in Brazil, guitarfish, grouper, and snapper limit the score for Criterion 2 because of their high vulnerability, unknown stock status, and high potential to interact with this gear type.

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

Factor 2.1 - Abundance

Southwest Atlantic | Pots | Brazil

Moderate Concern

The status of the populations of benthic invertebrates caught by the spiny lobster fishery is of moderate conservation concern because of the unknown factors surrounding this bycatch group. Some invertebrates, such as crabs and seashells, have been identified in a bycatch study based in Cearà State (Santana et al. 2015); however, the specific species have not been identified. Seafood Watch scores the vulnerability of benthic invertebrates a moderate concern.

Factor 2.2 - Fishing Mortality

Southwest Atlantic | Pots | Brazil

Low Concern

Fishing mortality of benthic invertebrates is unknown; therefore, the Unknown Bycatch Matrix scores fishing mortality a low concern.

Brazilian guitarfish

Factor 2.1 - Abundance

Southwest Atlantic | Pots | Brazil

High Concern

The spiny lobster trap fishery is known to interact with guitarfish (*Rhinobatos* spp.) in Ceará State (Santana et al. 2015); however, species-specific data have not been collected on guitarfish species. The International Union for the Conservation of Nature (IUCN) considers the Brazilian guitarfish to be "Critically Endangered" (Pollom et al. 2020), and populations are either unknown or declining. Because some guitarfish species that interact with the spiny lobster fishery are known to be endangered, threatened, or protected (ETP) species, Seafood Watch scores abundance a high concern.

Factor 2.2 - Fishing Mortality

Southwest Atlantic | Pots | Brazil

Moderate Concern

Fishing mortality of guitarfish in the Brazilian spiny lobster fishery is unknown. Therefore, Seafood Watch deems fishing mortality a moderate concern.

Corals and other biogenic habitats

Factor 2.1 - Abundance

Southwest Atlantic | Pots | Brazil

High Concern

Many corals are considered ETP species in Brazil; these include critically endangered species such as the staghorn coral, *Acropora cervicornis* (Aronson et al. 2008). Corals and other biogenic habitats are assumed to have a high vulnerability, so they are deemed a high concern.

Factor 2.2 - Fishing Mortality

Southwest Atlantic | Pots | Brazil

Low Concern

Fishing mortality of corals and other biogenic habitats is unknown; therefore, the Unknown Bycatch Matrix scores fishing mortality a low concern.

Finfish

Factor 2.1 - Abundance

Southwest Atlantic | Pots | Brazil

High Concern

The status of the populations of finfish caught by the spiny lobster fishery is of moderate conservation concern, because of the unknown factors surrounding this bycatch group. Some finfish have been identified in a bycatch study based in Cearà (the state with the highest production and export of spiny lobster) (Santana et al. 2015). Finfish such as white grunt (which forms one of the main bycatch species in Cearà) (Santana et al. 2015) have no stock assessment or data-limited indicators to assess the abundance of the stock. But, some ETP species can be caught, such as some species of parrotfish (*Sparisoma* spp.) (Santana et al. 2015).

There is a lack of information regarding the abundance of finfish; however, some ETP species may be caught. Therefore, Seafood Watch scores abundance of finfish a high concern.

Justification:

Greenback parrotfish is endemic to Brazil. There are no current abundance estimates nationally for the species, although there have been previous assessments for specific reef locations (Salz 2015). The IUCN considers the species "Endangered" with a declining population (Padovani-Ferreira et al. 2012). Because the species is considered to be endangered, Seafood Watch deems its abundance a high concern.

Factor 2.2 - Fishing Mortality

Southwest Atlantic | Pots | Brazil

Low Concern
The Unknown Bycatch Matrix deems that fishing mortality of unknown finfish, when caught with traps, is scored a low concern.

Grouper (unspecified)

Factor 2.1 - Abundance

Southwest Atlantic | Pots | Brazil

High Concern
Groupers are known to interact with Brazilian trap fisheries (Santana et al. 2015), although this is not recorded to the species level. Because of their high vulnerability, Seafood Watch considers abundance of groupers a high concern.

Factor 2.2 - Fishing Mortality

Southwest Atlantic | Pots | Brazil

Moderate Concern
There are no data available on the fishing mortality of groupers in the spiny lobster fishery; therefore, Seafood Watch deems fishing mortality a moderate concern.

Snappers

Factor 2.1 - Abundance

Southwest Atlantic | Pots | Brazil

High Concern
Snapper species are caught in Brazilian trap fisheries and mainly include lane snapper and mutton snapper (Santana et al. 2015). But, there are no full, recent, and nationwide stock assessments for these species, and many snapper remain data-limited species. Some snapper species are considered to be ETP: *L. analis*, *L. synagris*, and *L. chrysurus* are being overexploited and have a low resilience (Begossi et al. 2012). Also, some snapper fisheries (e.g., red snapper) show signs of being overfished and are overexploited (Dias 2013). Because some species are in areas considered to be overfished and overexploited in the region, Seafood Watch deems their abundance a high concern.

Factor 2.2 - Fishing Mortality

Southwest Atlantic | Pots | Brazil

Moderate Concern

There are no data available about snapper species caught, although available data show that they represent less than 5% of total catch in traps. Because fishing mortality is unknown, Seafood Watch deems fishing mortality a moderate concern.

Factor 2.3 - Discard Rate/Landings

Southwest Atlantic | Pots | Brazil

>= 100%

Discards

A recent study shows that there are very low or no discards as bycatch in Brazilian spiny lobster fisheries, because bycatch is either retained to be sold, used as bait, or consumed onboard (Cruz et al. 2013b). In lieu of discard estimates, total discard rates given in Shester and Micheli (2011) for spiny lobster trap fisheries are presented as 15%, although this study refers to the California spiny lobster (*P. interruptus*) fishery, where traps are considered to be selective. Conversely, in Brazil, baited traps are not considered selective (Santana et al. 2015).

Bait

There are no quantitative figures estimating bait use in Brazil. But, a study that included interviews with Brazilian fishers showed that 42% reported using sea catfish, 11% used piramutaba catfish heads (*Brachyplatystoma vaillantii*), 6% used unidentified small fish, 4% used unidentified fish heads, 2% used ray, and 2% used shrimp heads. In addition, fishers reported using nonseafood-related products, including bacon (18%), coconut shells (9%), and cow hooves (6%) (Santana et al. 2015). Furthermore, the 3-year FIP audit report stated that, according to stakeholder interviews, the majority of bait presently used is either leather or coconut (Borges 2022).

In the absence of estimates of bait use in Brazil, estimates from other spiny lobster fisheries have been considered. Studies from other lobster fisheries globally have shown that the volumes of bait regularly exceed the volume of the target species landed {Harnish and Willison 2009}{Waddington and Meeuwig 2009}(SCS 2011). Bait use is generally quite high in lobster fisheries (for one season in the Punta Abreojos and Bahia Tortugas cooperatives in Mexico, bait use was equal to approximately 4,500 to 5,000 t, while landings fluctuated around 1,500 t (SCS 2011); therefore bait use is equal to over 300% of landings).

With no accurate information available from the Caribbean spiny lobster fishery, the ratio of pounds of bait used to pounds of lobster landed is assumed to be greater than 100%. Therefore, bait plus discards is scored as greater than or equal to 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
Southwest Atlantic | Pots | Brazil	Critical	Ineffective	Ineffective	Ineffective	Moderately Effective	**Black (0.000)**

Criterion 3 Assessment

SCORING GUIDELINES

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

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

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

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

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

Factor 3.1 - Management Strategy And Implementation

Southwest Atlantic | Pots | Brazil

Critical

Management of the spiny lobster fisheries in Brazil is undergoing significant challenges, including illegal fishing, a poor stock status, and a lack of fishery-independent data to accurately assess the stock. The main organizations involved in the management of the fishery include CedePesca, IBAMA, the Marine Laboratory (LABOMAR), the CGPL, and various ministries (CedePesca 2018a). The lack of effective management has been attributed to national political instability and frequent changes to the governmental institutions managing the stock (CedePesca 2017a)(Borges 2022).

Measures have been implemented in the Brazil spiny lobster fishery, but have often been deemed inadequate due to their low compliance rates and weak enforcement (Borges 2022)(Andrade 2015). For example, although traps are the only legal way to fish spiny lobster (FAO 2015a), an estimated 85% of the total Brazilian catch is harvested illegally: lobster continues to be caught via bottom gillnets or via diving with "hookah" or scuba (Buesa 2018)(FAO 2015a). In addition, the Ceará region, which harvests a large proportion of Brazil's total landings, is deemed an "open access" fishery (Santana et al. 2015). The 2017 stock assessment considers that there are no effective management measures other than the seasonal closure (CedePesca 2017a).

A Management Plan was published for the Brazil spiny lobster fishery in 2017 (Dias Neto 2017). The Plan has stated that the management appears to having a positive impact on the recovery of the spiny lobster (Aragao and Cintra 2018)(Dias Neto 2017), and this is attributed to the prohibition of the use of nets, the extension of the seasonal closure, and the requirement for the United States to import lobsters above the minimum size (Dias Neto 2017). But, the Plan also stated that the recovery of spiny lobsters has been limited, because fishing effort is well above that advised by the SCC and that measures "were not properly implemented" (Dias Neto 2017). In addition, the Plan stated that the lack of data collected in the fishery has precluded an appropriate evaluation of the effectiveness of management in place (Dias Neto 2017). Therefore, the Management Plan has recommended a further review, with urgent improvement, to ensure stock survival (Dias Neto 2017).

Many of the recent management measures and elements (see Justification) regarding harvest strategy and assessment have not been tested and their efficacy remains unknown (Borges 2022). The lack of adequate management and enforcement has resulted in high fishing mortality rates, above those that are scientifically recommended (Canales and Ibarra 2021)(CedePesca 2017a) (CedePesca 2018a). Since 2011, fishing mortality has improved slightly, attributed to market behavior. Current fishing mortality levels will not permit the reproductive biomass to considerably exceed the limit reference point (LRP) (Canales and Ibarra 2021)(CedePesca 2017a). Therefore, fishing mortality reductions are required to protect the stock.

Because a high proportion of spiny lobster landings in Brazil are caught using illegal fishing methods (85%) and management is not effective in rebuilding populations, the management strategy and evaluation is deemed critical.

Justification:
A Management Plan was implemented in the Brazil spiny lobster fishery in 2017, with the objective "to promote the recovery and maintenance of the sustainable use of lobsters in Brazil, considering the bioecological, social, economic, and related aspects of sustainability with environmental education and legal aspects, in a short, medium and long term vision" (Dias Neto 2017). Although there have been some improvements in the stock, the stock is still at quite low levels (see Criterion 1). The Management Plan has therefore recommended further catch reductions and improvements in the objectives (Dias Neto 2017).

Major political changes have occurred in the fishery in recent years that have delayed the progress of the management of the fishery. Fisheries were managed by the Ministry of Fisheries (MPA) until 2015, when it was replaced by the Secretariat of Fisheries within the Ministry of Agriculture, Livestock, and Food. In turn, this Secretariat was replaced in early 2017 by the Secretariat of Fisheries and Aquaculture to the Ministry of Industry, Development, and Commerce (MDIC). But, the Secretariat was granted ministry status by late 2017. Also, the government of Ceará State is defunct, as of 2016 (CedePesca 2018a).

In October of 2019, the Ministry of Agriculture, Livestock, and Food published the Normative Instruction Nº 54, which took effect in January 2020 (MAPA 2019). This Normative Instruction requires harvesters and dealers to deliver only whole lobsters to processing plants (with a 5% tolerance of tails). In addition, no commercialization or transport within the domestic market is allowed between February and April, and the fishing season is now established between May 1 and October 31 (MAPA 2019).

The Brazilian presidency published Decree 10.544 in November of 2020, which detailed the Sectorial Plan for Marine Resources (which went into effect on January 1, 2021) (Atos do Poder Executivo 2020). The Plan consists of 17 goals for sustainable development of fisheries and aquaculture including, but not limited to, the restructuring of the vessel tracking program, strengthening recovery plans, updating and reviewing regulatory guidelines, and fighting illegal, unreported, and unregulated fishing.

The federal government published Ordinance SAP/MAPA Nº 221 on June 8, 2021, which established the rules for management, transport, processing, monitoring, storage, and market of Caribbean spiny lobster (MAPA and SAP 2021). This Ordinance further establishes a mandatory delivery regulation of whole lobsters to processing plants in 2022 and requires lobsters to be delivered alive in 2023. It further emphasized that the sale of lobsters to the local market from February 1 to April 30 is prohibited.

On June 29, 2021, Decree Nº 10.736 was published and established the Internal Regulations of the National Collaborative Network for the Sustainable Management of Fisheries Resources—Rede Pesca Brazil (Rede Nacional Colaborativa para a Gestão Sustentável dos Recursos Pesqueiros—Rede Pesca Brasil) (Atos do Poder Executivo 2021). This network includes a technical working group and 10 permanent management committees, 1 of which is the Permanent Committee for Fisheries Management and the Sustainable Use of Lobsters. On January 24, 2022, Ordinance SAP/MAPA No.

554 was published and further established the Internal Regulations of the National Collaborative Network for the Sustainable Management of Fisheries Resources (Rede Pesca Brasil) (MAPA and SAP 2022a).

On February 23, 2022, the SAP/MAPA published a public notice of call No. 3. The purpose of this call was to fill vacancies in the Permanent Management Committees by selecting persons from the societal institutions involved within the fishing industry (MAPA and SAP 2022b). In April 2022, the list of approved and classified institutions was published and established the Permanent Management Committee members (MAPA and SAP 2022c). But to date, no meeting has been called with said committees, so the groups are not yet operational.

Management measures in place are often considered inadequate or have low compliance rates (Borges 2022). For example, although size-at-maturity (CL50%) for male *P. argus* is estimated at 92.2 (± 2.53 SE) mm CL (carapace length), the minimum legal size (MLS) is 75 mm CL (Neves et al. 2016), rendering the MLS too small. The MLS has been deemed to be insufficient in protecting stock numbers (Giraldes et al. 2015). The undersized proportion of the catch is expected to represent the majority (>50%) of the catch (Santana et al. 2015).

According to the FIP 3-year audit report, issues related to illegal fishing (namely illegal gears) are still widespread (Borges 2022). Currently, there is no regulation or method in place to ensure that companies are not buying illegally caught lobsters. Therefore, there is a need for improved traceability mechanisms to be established in the fishery. In addition, there is no rebuilding strategy for the stock, and the Brazilian National Fisheries Policy does not contain explicit objectives or goals to establish a rebuilding strategy (Borges 2022).

Factor 3.2 - Bycatch Strategy

Southwest Atlantic | Pots | Brazil

Ineffective

There is a lack of information available about the impacts of the spiny lobster fishery on other species. The most recent study assessing bycatch in this fishery was conducted by CeDePesca in 2016 (CeDePesca 2016). This study was based on a single day of fishing, so it was not representative of the entire fishery. In 2020, CeDePesca noted that lobster traps can be associated with other species, namely finfish (CeDePesca 2020). Stakeholder interviews show that bycatch in the fishery has been associated with fish, whelks, octopus, and occasionally turtles (Borges 2022). Available data show that Brazilian spiny lobster baited trap fisheries are nonselective (Santana et al. 2015) and catch a range of species: snappers and grunts represent the greatest proportion of bycatch (≈60%), and bycatch can include ETP species such as guitarfish (Santana et al. 2015) (Pollom et al. 2020). Bait is reported to include a variety of species, including various ray species (Santana et al. 2015). It is unknown whether the catch of ETP represents over 5% of the catch because there are no national data available. Discard rates are unknown throughout the Brazil spiny lobster fishery.

There are significant issues with ghost fishing in Brazilian fisheries (Adelir-Alves et al. 2016). Traps were shown to represent a small proportion of ghost fishing gears (2%) (Adelir-Alves et al. 2016), although abandoned gears were found to interact with a variety of ETP species (Adelir-Alves et al. 2016). Currently, there are no alternative measures to reduce bycatch or ghost fishing, and there is little information and great uncertainty regarding interactions with ETP species (Borges 2022). Management is considered inadequate at mitigating the impacts of ghost fishing in the marine environment (Adelir-Alves et al. 2016).

In the Brazil spiny lobster fishery, management has been informal and few measures are implemented to reduce the impact of fishing on reefs (Salz 2015). Management measures implemented to reduce the impact of the lobster fishery on bycatch species include requiring a minimum mesh size in traps of 5 cm between knots and prohibiting the harvesting of lobsters using nontrap gear, such as nets (FAO 2015a) (which were associated with entangling a large variety of marine organisms) (Adelir-Alves et al. 2016). Since 2014, the Ministry of Fisheries and Aquaculture has mandated that annual licenses can only be granted after vessel inspections prove that traps are the only fishing gear onboard (CedePesca 2018a). Around 300 marine protected ares (MPA) have been implemented, including one of the largest MPAs in the world, but few aim to protect marine habitats (Araújo and Bernard 2016). The effectiveness of these measures may be severely undermined by the high level of illegal fishing (>85% (Andrade 2015)). There is no requirement for spatial monitoring and control of the fishing vessels, leading to a higher likelihood of illegal fishing in protected areas (Borges 2022). Although some information exists regarding the impact of the gear on habitat, there are no vessel monitoring systems (VMS) or observer coverage onboard, so it is difficult to know if the area-based fishing limits are being followed (Borges 2022) (CeDePesca 2020).

Because there are limited bycatch data available to show that the impacts of the spiny lobster trap fishery are low, traps are nonselective and catch ETP species, and management is deemed ineffective at managing ghost fishing, Seafood Watch deems the bycatch strategy ineffective.

Factor 3.3 - Scientific Research And Monitoring

Southwest Atlantic | Pots | Brazil

Ineffective

Stock assessments have been produced regularly over recent years by CeDePesca and through the Rural Federal University of Pernambuco (UFRPE) and IBAMA (Andrade 2015)(CedePesca 2017a)(Canales and Ibarra 2021).

The Brazil spiny lobster stock is data-limited. There is a lack of monitoring programs in the Brazil spiny lobster fishery, and information on total landings statistics, fleet composition, and the number of boats in the fishery are not available {Aragão 2014}. Assessments rely on fishery-dependent data with considerable sources of uncertainty. The stock is currently overfished and undergoing overfishing (Canales and Ibarra 2021). The most recent stock assessment is not peer-reviewed and does not account for the major sources of uncertainty (Borges 2022). In addition,

the time series are often short and intermittent (FAO 2015a) and certain data sets are reported to be unusable because of their level of bias (Andrade 2015). Most of the data are collected on a regional basis (including monthly catch and effort data, length composition of the catches, and commercial categories). Fewer data are collected on a nationwide scale (nationwide data include total exports and exports per commercial category) (CedePesca 2017a).

There have been some increases in data collection, particularly regarding size and weight data. Currently, data collection and monitoring via logbooks consists of total catches by length to enable stock assessments to be conducted (Borges 2022). Until 2015, stock assessments were conducted using import data from the U.S. National Oceanographic Atmospheric Administration (NOAA), but since then, assessments have been based on export data, which are provided by SINDFRIO (an exporters association) and centralized through Brazilian foreign trade data. But, stock assessments still rely on fishery-dependent data (CedePesca 2017a)(Canales and Ibarra 2021) and the summary of the 4th SCC/CGPL meeting concluded that new information on exploitation of the lobster resources are "inexistent or insufficient" (SEAP/MDICT/ MMA 2017).

There are little data collected related to bycatch, discards, and ETP species. Limited studies have researched the impact of the trap fisheries in certain regions (such as those conducted in Ceará) (Santana et al. 2015). There is no robust information regarding monitoring of illegal fishing (Borges 2022). Great uncertainty regarding bycatch and ETP species interactions still exist within the fishery. There is no required video monitoring or observer coverage in the fishery. Also, monitoring of ghost fishing is nonexistent (Borges 2022).

Because minimal data are collected to assess the stock, the data sets host many uncertainties, and there are few appropriate management measures used, Seafood Watch deems scientific research and monitoring ineffective.

Justification:
The most recent stock assessment in 2021 consisted of landings data from 1955 to 2020 and length data from 2004 to 2020 (Canales and Ibarra 2021). The CedePesca (2017a) assessment's data was based on export data provided by SINDFRIO (an exporter organization) to estimate the stock status, whereas Andrade (2015) used catch and CPUE data obtained from Brazilian governmental organizations. The CPUE and effort data used in Andrade (2015) were only available for certain time periods (between 1965 and 1997 and isolated data between 2002 and 2004). Size composition data that were available for the years 1970 to 1993 could not be used because they contained too much bias (Andrade 2015). The high incidence of illegal fishing activities (>85% of the catch is illegally harvested) was accounted for in the Andrade (2015) assessment by estimates based on exported tonnage from a 1993 report. The illegal activities do not appear to be estimated or reflected in the recent stock assessments (CedePesca 2017a)(Canales and Ibarra 2021).

There are a number of uncertainties in stock assessments (which were discussed in Andrade (2015)):

- Effort and CPUE data were only available from 1965 to 1997 and intermittent data between 2002 and 2004.

- Catch data are derived from export data, and limited catch rate data originate only from trap data as opposed to other harvesting methods (e.g., gillnets), because these harvesting methods are illegal.
- Catch data are not indicative of the whole catch: because catch and effort data are derived from export data, the catch that enters the Brazilian domestic market is not recorded and reflected in stock assessments (Andrade 2015).
- Red spiny lobster stocks are not distinguished in stock assessments (on the Brazilian continental shelf, there are two red spiny lobsters: one in shallow waters [<50 m] and one in deeper waters [50–100 m]).

Data collection and monitoring have been slowly improving throughout the FIP. In March 2014, exporters started collecting annual export data per commercial size category to CeDePesca and IBAMA-Ceará (CedePesca 2018a). IBAMA-Ceará began working with Ceará State's municipalities and federal institutes to improve data collection (CedePesca 2018a). In addition, the Permanent Committee for Lobster Management intends to implement a monitoring system to collect landings data in 2018 (CedePesca 2018a) and a quota system in 2019, which will help monitor catches (CedePesca 2018a). But to date, there is still little information regarding scientific research of the fishery, and monitoring is not adequate because it does not represent the entire fishery (e.g., low sample sizes, localized and outdated studies, and great uncertainty) and no comprehensive studies have been conducted (Borges 2022).

Factor 3.4 - Enforcement Of Management Regulations

Southwest Atlantic | Pots | Brazil

Ineffective

A variety of government institutions aim to enforce regulations in the spiny lobster fishery. The most recent regulation was passed in June 2021 (Ordinance SAP/MAPA Nº 221) and requires satellite tracking with regular emission of a signal for all motorized vessels that are equal to or greater than 10 meters length, by 2022 (MAPA and SAP 2021). In addition, all vessels are required to complete and deliver onboard maps for each fishing cruise carried out by said vessel (MAPA and SAP 2021). But, instability in government departments and a lack of funding have resulted in ineffective enforcement of regulations.

There are substantial concerns regarding illegal fishing, particularly associated with the use of illegal fishing gears (Andrade 2015), harvesting of undersized lobsters (Cruz et al. 2013)(Dias Neto 2017), and traps often having smaller mesh sizes than those mandated by the Brazilian government (FAO 2015a). Although Buesa (2018) stated that the only measure that appears to be enforced is the seasonal closure (Buesa 2018), Dias Neto (2017) has stated that there is a disregard for the seasonal closures in the fishery (Dias Neto 2017). There are few enforcement programs in place and there is weak compliance of existing management measures (CedePesca 2018a). The 4th SCC/CGPL meeting concluded that the current management and monitoring process is "ineffective," current governance is "extremely fragile," and institutions are inoperative, because of either regular structural changes or staff turnover (SEAP/MDICT/ MMA 2017). According to the FIP 3-year audit, although certain regulations, sanctions, and mechanisms do

exist within the national government, they are not effective and there is no evidence that they are being applied (Borges 2022). It is known that fishers generally do not comply with management measures; thus, there is evidence of noncompliance (Borges 2022). There have been increasing efforts to increase regulations around the sales and purchase of lobster; the consequences of breaching these violations is communicated throughout the supply chain (Tribuna Do Norte 2013).

There have been recent improvements in enforcement activities, but enforcement and surveillance are still believed to be inadequate and compliance is known to be poor. Therefore, Seafood Watch deems enforcement of management regulations ineffective.

Justification:
There are several sources of illegal fishing in the Brazil spiny lobster fishery. "The vast majority of vessels" fish with prohibited fishing methods (where the dive method accounts for an estimated 84.1% of the production) (Dias Neto 2017) (Figure 4). Breaches in fishing gear legislation occur mainly because fishing with "pots remains economically unviable in many areas," particularly where there has been a decline in abundance of lobster (SEAP/MDICT/ MMA 2017). Marambais (a net used to catch lobster) are widely used in the State of Ceará and are used in shallow waters where juvenile lobsters are found (SEAP/MDICT/ MMA 2017). The Management Plan stated that sublegal lobsters represent from 6.4% to 63.4% of the *P. argus* catch and from 11.9% to 27.5% of the *P. laevicauda* catch (Dias Neto 2017).

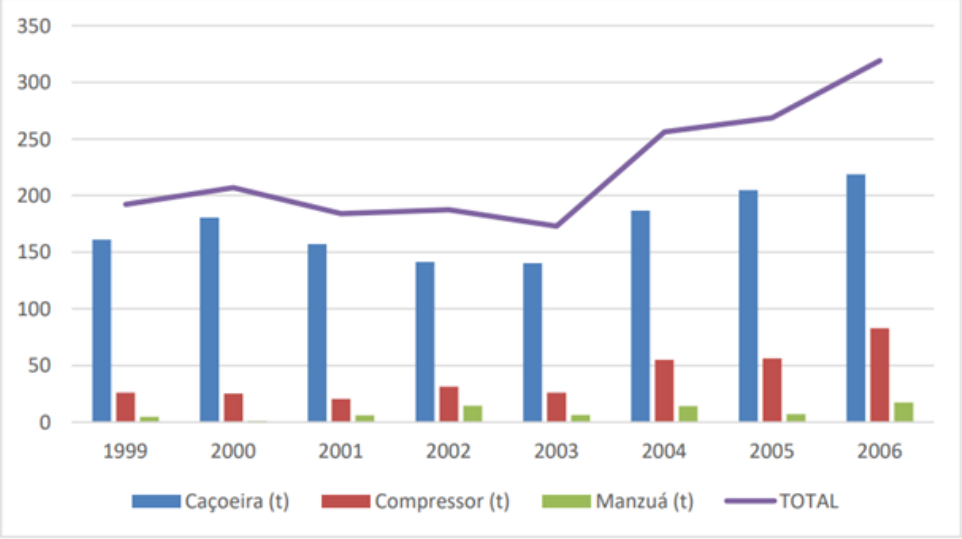


Figura 1. Produção de lagostas pelos principais métodos de pesca empregados no

Figure 4: Lobster production by the main fishing methods employed in the State of Pernambuco between 1999 and 2006. Source: (SEAP/MDICT/ MMA 2017).

In late 2013, the federal government implemented a Program to Combat Illegal Fishing through the government institutions for Fisheries, Environment, Defense, Justice, the Navy, and the Federal Police (CedePesca 2018a). IBAMA enforces minimum legal size limits and seasonal closures via

environmental agents AU Islanders and regional police such as CIPPA-Porto Seguro. The Brazilian navy also supports vessel inspections to seize any illegal stock, but these enforcement patrols vary regionally (IBAMA 2015a). Since 2014, the Federal Public Ministry and Ministry of Labor required that licenses be only issued after inspections have proved that lobster fishing vessels comply with requirements (CedePesca 2018a). It is unknown if this has been successful, but it is unlikely that vessels are compliant because European inspections in September 2016 raised concerns "on the quality and characteristics of fishing vessels" in Brazil (Mereghetti 2018).

Violations may result in fines and imprisonment. Throughout the closed season, retailers (including restaurants, bars, fishmongers, fish distribution companies, and other companies selling lobsters) must provide inventory statements by deadlines. If inventory statements are not provided, retailers are subject to fines and/or jail sentences. IBAMA reports that the sale of lobsters or spawning fish during the closed season is prohibited. Therefore, consumers must also respect these laws. During the closed season, lobsters are not allowed to be captured, transported, stored, processed, and marketed without additional IBAMA documentation/authorization (Tribuna Do Norte 2013)**.**

The enforcement progress of the FIP has been inhibited by funding: in 2013, IBAMA-CE was assured funding for enforcement; however, the funding had not been provided later. Furthermore, IBAMA suffered budget cuts from the federal government, which led to reduced enforcement activities for the lobster fishery (CedePesca 2018a)(Borges 2022). Since the implementation of the U.S. Seafood Import Monitoring Program (SIMP) in December 2016, the United States is increasing its ability to detect seafood caught through illegal methods. The new U.S. laws require that imports provide data on the name and flag state of the harvesting vessel and evidence of authorization to fish (NOAA 2016). Similarly, Brazil cannot currently export seafood to the European Union, after the country introduced a self-imposed ban on January 3, 2018 (Mereghetti 2017).

Factor 3.5 - Stakeholder Inclusion

Southwest Atlantic | Pots | Brazil

Moderately Effective

Because of political turmoil, Brazilian government agencies have changed frequently, thus inhibiting stakeholder inclusion and effective decision-making (CedePesca 2018a). Working groups have been created to encourage stakeholder participation in the spiny lobster fishery, although some of these groups have been unpredictable. For example, the 2011 MCS pre-assessment found that the CGPL (which enables decision-making for the lobster fishery) had not been effective since 2004, and was considered slow to respond and lacked transparency (CedePesca 2018a). In recent years, the CGPL appears to have increased activity, engaging a variety of stakeholders through regular meetings, but the 4th SCC/CGPL meeting stated that there was inappropriate representation in the CGPL (SEAP/MDICT/ MMA 2017). In 2017, the CGPL's Scientific Subcommittee (SCC) was reconvened and management measures were agreed to at stakeholder meetings (CedePesca 2018a). Most recently on June 29, 2021, Decree Nº 10.736 was published, which established the Internal Regulations of the National Collaborative Network for the

Sustainable Management of Fisheries Resources—Rede Pesca Brazil (Rede Nacional Colaborativa para a Gestão Sustentável dos Recursos Pesqueiros—Rede Pesca Brasil) (Atos do Poder Executivo 2021). This network includes a technical working group and 10 permanent management committees, 1 of which is the Permanent Committee for Fisheries Management and the Sustainable Use of Lobsters. IBAMA created the Technical Spiny Lobster Working Group in 2002. Its mission is to discuss, evaluate, and propose management measures for the lobster fishery. The working group considers the views of a variety of stakeholders including fishers, political groups, industry, processing plants, scientists, managers, and enforcement organizations (FAO 2003). But, it is unknown if this working group is still active.

Stakeholders can request some information regarding the fishery's management and performance, and the requests are generally met (Borges 2022). The Permanent Management Committees seem to be working, because measures discussed in the past have been adopted (e.g., SAP/MAPA Nº 221) (MAPA and SAP 2021)(Borges 2022). Given that there is opportunity for a variety of key stakeholders to be involved in the decision-making process, but there is a lack of transparency preventing stakeholders from addressing conflicts, Seafood Watch deems stakeholder inclusion moderately 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
Southwest Atlantic | Pots | Brazil	Score: 2	Score: 0	Moderate Concern	**Yellow (2.449)**

Spiny lobster is generally found on rocky substrates and reefs, or wherever protection and shelter can be found (Holthuis 1991). Thus, traps are deployed in a variety of habitats including rocky reefs. The impact of traps on coral reefs has not been quantified. The vulnerability of habitats where fishing takes place has currently not been determined, and the impacts of the various fishing methods must be determined (Valle-Esquivel 2011). A consequence spatial analysis (CSA) was carried out in 2020 to assess the risk of the fishery's impact on habitats, with data obtained through a scientific literature review (CeDePesca 2020). The literature review found that the habitat associated with the fishery is described as "habitat with fine, medium and biogenic substrates; with sediments such as: silt, fine sands, coarse sands, gravel, and calcareous algae (biogenic); with flat geomorphology, simple surface structure, with large/upright community biota" (CeDePesca 2020). But, this study only used data obtained from various previously published papers, so it is not fully representative of the Brazilian fishery.

Abandoned traps (ghost traps) continuously capture and harm animals and damage marine ecosystems (Adelir-Alves et al. 2016). There is a lack of information regarding the impact of traps on ghost fishing in Brazil. Minimal management is applied to Brazilian trap fisheries to reduce their impact on the habitat and ecosystem. Fishing with traps is not permitted within 4 miles of the coast, and traps are required to have a minimum mesh size of 5 cm for the netting used in them (FAO 2015a). But, other countries that fish for spiny lobster, such as the United States (in Florida), mandate and enforce degradable wooden panels to reduce the risk of ghost fishing (Briones-Fourzán and Lozano-Álvarez 2015).

The role of the spiny lobster in Brazilian ecosystems is not well-studied and the spiny lobster is currently overfished. Some spatial management is in place to protect spiny lobster and other species; however, less than one-quarter of marine protected areas (MPA) are expected to meet their minimal objectives (Magris et al. 2013), thereby reducing their efficacy.

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

Southwest Atlantic | Pots | Brazil

Score: 2

Spiny lobster is generally found on rocky substrates and reefs, or wherever protection and shelter can be found (Holthuis 1991). A consequence spatial analysis (CSA) was carried out in 2020 to assess the risk of the fishery's impact on habitats, with data obtained through a scientific literature review (CeDePesca 2020). The literature review found that the habitat associated with the fishery is described as "habitat with fine, medium and biogenic substrates; with sediments such as: silt, fine sands, coarse sands, gravel, and calcareous algae (biogenic); with flat geomorphology, simple surface structure, with large/upright community biota"(CeDePesca 2020). But, this study only used data obtained from various previously published papers, so it is not fully representative of the Brazilian fishery. In addtion, a study conducted in 2016 found traps in reef habitats (Adelir-Alves et al. 2016). Because traps can be set on rocky or reef structures, Seafood Watch gives this factor a score of 2.

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

Southwest Atlantic | Pots | Brazil

Score: 0

Brazil has protected approximately 26% of its territorial seas through marine protected areas (MPA) (Marine Conservation Institute 2022). It is not clear if these MPAs protect lobster habitat. Measures are in place, such as seasonal closures to reduce the amount of habitat damage caused by fisheries, and fishing is not permitted within 4 miles of the coast (FAO 2015a). But, there are few measures to limit effort: there are vessel licenses, though no limits on quota; few gear modifications are required, and less than one-quarter of MPAs are expected to meet their minimum objectives (Magris et al. 2013). The lack of enforcement and low compliance rates significantly reduced the potential efficacy of mitigation measures. Ghost fishing gear has been found in fishing exclusion zones (Adelir-Alves et al. 2016), which causes significant impacts to habitats (Adelir-Alves et al. 2016), and over 85% of the stock is estimated to be harvested through illegal methods (Andrade 2015).

Because ≈26% of Brazil's territorial seas have MPAs but it is unclear if the MPAs aim to protect lobster habitat, their effectiveness is perceived to be low, and there are few measures in place to reduce the impact of gears on the habitat, so Brazil receives a score of no mitigation (0).

Justification:

MPAs are the popular tool in Brazil for managing coastal ecosystems and species, particularly through no-take MPAs, because they encourage exploited populations to recover and increase spillover and recruitment (Salz 2015).

Brazil hosts one of the largest MPAs in the world and around 300 MPAs, but few aim to protect marine habitats (Araújo and Bernard 2016). A study that attempted to analyze the efficacy of MPAs in Brazil found that only 23% of ecosystems were meeting minimum objectives (Magris et al. 2013). Abandoned, lost, and discarded gear are found in MPAs, where it is illegal for them to be used (Adelir-Alves et al. 2016).

Factor 4.3 - Ecosystem-based Fisheries Management

Southwest Atlantic | Pots | Brazil

Moderate Concern

Although the fishery is unlikely to have any detrimental impacts on the ecosystem, there are still significant information shortfalls (Borges 2022). Specifically, there are no measures in place to assess the fishery's impact on the ecosystem, the ecological role of spiny lobster has not been well studied, and there is an absence of ecological information for the species (Giraldes et al. 2015)(Borges 2022). Because the impacts of the spiny lobster fishery on the ecosystem are unknown, ecosystem impacts likely include interactions between traps and coral reefs/sensitive ecosystems, the effects of ghost fishing, and the potential harm of invasive species. But, there are spatial management measures in place to protect ecosystems. As of 2022, approximately 26% of Brazil's territorial waters are protected by MPAs, though it is unknown if these are protecting spiny lobster, and less than one-quarter of the MPAs are expected to achieve their minimum objectives (Magris et al. 2013)(Marine Conservation Institute 2022).

Because there is a lack of information regarding the spiny lobster and its ecological role, a lack of policies in place to protect ecosystem functioning—but some spatial management is in place to protect that functioning—and detrimental food web impacts are unlikely, Seafood Watch deems Ecosystem-based Fisheries Management a moderate concern.

Justification:

In other Caribbean coral reef ecosystems, the only identified role that *P. argus* plays is as a prey item for octopus and grouper. Therefore, fishing it at high intensities can reduce the prey availability for top predators (Higgs 2016b).

The overexploitation of spiny lobster likely indirectly affects the ecological role of Brazil's tropical coastal reefs (Giraldes et al. 2015): there are concerns with the removal of detrivores/omnivorous decapods and the impact of their overexploitation on fishes and corals and other benthic organisms (Giraldes et al. 2015). Many species studied in Brazilian waters are already overexploited (Chaves et al. 2013a), and prolonged periods of overexploitation can result in the collapse of ecosystems (Neubauer et al. 2013). The continuous removal of primary and secondary consumers throughout food webs may cause a large-scale ecological imbalance in the coastal reef system and potentially is already affecting trophic relationships {McConkey and O'Farrill 2015}. This is exacerbated by the use of illegal gears, such as gillnets, which can cause irreversible change in the coastal reef ecosystem (Smith et al. 2011) and trophic cascades (Säterberg et al. 2013).

There is limited information regarding ghost fishing as a result of gear lost in the Brazil spiny lobster fishery; however, in the Florida spiny lobster fishery, Butler and Matthews (2015) proposed that 637,622 lobsters are killed each year by ghost traps. Ghost traps also destroy or damage protected corals, benthic habitats, benthic fauna and flora; they disturb sediments, reduce biomass, kill foundation species, entangle marine mammals and turtles, and confine trapped animals, resulting in their injury or mortality {Butler and Mathews 2015}.

Acknowledgements

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.

Seafood Watch would like to thank the consulting researcher and author of this report, Beverly O'Kane, as well as several anonymous reviewers for graciously reviewing this report for scientific accuracy.

References

0d42d0ae-0934-4032-bba5-b1168af8ffb9.

331308 [Accessed September 2, 2016].

Adelir-Alves, Johnatas, Rocha, Gecely Rodrigues Alves, Souza, Thiago Felipe, Pinheiro, Pedro Carlos, & Freire, Kátia de Meirelles Felizola. (2016). Abandoned, lost or otherwise discarded fishing gears in rocky reefs of Southern Brazil. Brazilian Journal of Oceanography, 64(4), 427-434. https://dx.doi.org/10.1590/s1679-87592016124806404

Andrade, H.A., 2015. Stock assessment of the red spiny lobster (Panulirus argus) caught in the tropical southwestern Atlantic. Latin American Journal of Aquatic Research, 43(1), pP.201–214. Available at: http://www.lajar.cl/pdf/imar/v43n1/Articulo_43_1_17.pdf.

ARAGÃO, J.A.N.; CINTRA, I.A.H. 2018. Avaliação do estoque de lagosta vermelha Panulirus argus na costa brasileira (Stock assessment of the red spiny lobster Panulirus argus in the brazilian coast). Accepted for publication in the "Arquivos de Ciências do Mar", Instituto de Ciências do Mar da Universidade Federal do Ceará, in July this year.

Araújo, J.L., Bernard, E., 2016. Management effectiveness of a large marine protected area in Northeastern Brazil. Ocean Coast. Manag. 130, 43–49. doi:10.1016/j.ocecoaman.2016.05.009.

Aronson, R., Bruckner, A., Moore, J., Precht, B. & E. Weil. 2008. Acropora cervicornis. The IUCN Red List of Threatened Species 2008: e.T133381A3716457. http://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T133381A3716457.en. Downloaded on 29 May 2018.

Atos do Poder Executivo. 2020. Decreto N 10.544, De 16 Novembro de 2020.

Atos do Poder Executivo. 2021. Decreto N 10.736, de 29 de Junho de 2021

Begossi, A., P. Lopes, and R. Silvano. 2012. Co-Management of Reef Fisheries of the Snapper-Grouper Complex in a Human Ecological Context in Brazil. In: G.H. Kruse, H.I. Browman, K.L. Cochrane, D. Evans, G.S. Jamieson, P.A. Livingston, D. Woodby, and C.I. Zhang (eds.), Global Progress in Ecosystem-Based Fisheries Management. Alaska Sea Grant, University of Alaska Fairbanks. doi:

Borges 2022. Brazil red and green lobster - Trap: Three-Year Audit Report.

Briones-Fourzán, P., Lozano-Álvarez, E. 2015. Lobsters: ocean icons in changing times. ICES Journal of Marine Science, 72, suppl_1, pp. i1–i6. Available at: https://doi.org/10.1093/icesjms/fsv111

Buesa, R.J. 2018. Spiny lobsters fisheries in the Western Central Atlantic (RESEARCH FINAL REPORT - 27 January 2018).

Canales and Ibarra. 2021. Evaluación de la población de langosta roja (Panulirus argus) explotada en

costas del noreste de Brasil.

CeDePesca 2016. Complete report of onboard observation of impacts of lobster fishing with creels on other species. Center for Sustainable Fisheries and Development.

CedePesca 2017. Avaliação do estoque da Lagosta Vermelha e Recomendações de Gestão: Relatório Técnico Nº 4 – Fevereiro 2017. Available at: http://cedepesca.net/wp-content/uploads/2017/03/Analise_dados_exportacao_fornecidos_pelo_SINDFRIO_201715096.pdf.

CeDePesca 2020. Spatial and Consequence Analysis. Risk Analysis for Habitat: CSA Method.

CedePesca, 2018. Brazilian Lobster (English). Available at: http://cedepesca.net/promes/shrimp-and-lobster/brazilian-lobster-eng/ [Accessed 08 May, 2018].

Chaves, L.T.C., Pereira, P.H.C., Feitosa, J.L.L., 2013a. Coral reef fish association with macroalgal beds on a tropical reef system in North-eastern Brazil. Mar. Freshw. Res. 64, 1101–1111. http://dx.doi.org/10.1071/MF13054.

Cruz, R. Silva, K.C.A, Cintra, I.H.A,. 2013b. Assessment of wild spiny lobster stocks on the Brazilian continental shelf. Crustaceana. 86 (3). 336 – 356.

Cruz, R., Silva, K.C.A., Neves, S.D.S., Cintra, I.H.A. 2013. Impact of lobster size on catches and prediction of commercial spiny lobster landings in Brazil. Crustaceana, 86, p.1274-1290.

Dias Neto, 2017. Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis. Avaliação da execução do plano de gestão para o uso sustentável de lagostas no Brasil. In English: Brazilian Institute of Environment and Renewable Natural Resources. Evaluation of the implementation of the management plan for the sustainable use of lobsters in Brazil.

Dias, M. C. 2013. Pré-avaliação da pescaria de pargo (Lutjanus purpureus) com armadilhas nas Regiões Norte e Nordeste do Brasil). Prepared for: Netuno Pescados LTDA.

Dias, M. C. 2013. Pré-avaliação da pescaria de pargo (Lutjanus purpureus) com armadilhas nas Regiões Norte e Nordeste do Brasil). Prepared for: Netuno Pescados LTDA.

FAO, 2003. Second workshop on the management of Caribbean spiny lobster fisheries in the WECAFC area in Havana, Cuba, 30 September – 4 October 2002, Rome. Available at: ftp://ftP.fao.org/docrep/fao/006/y4931b/y4931b.pdf.

FAO, 2015a. Report of the first meeting of the OSPESCA/ WECAFC/ CRFM/ CFMC Working Group on Caribbean Spiny Lobster, Panama City, Panama, 21–23 October 2014, Bridgetown, Barbados. Available at: http://www.fao.org/3/a-i4860b.pdf.

FAO, 2018a. Fisheries Global Information System (FAO-FIGIS) - Web site. Available at: http://www.fao.org/fishery/topic/18042/en [Accessed May 8th 2018].

FAO. 2022. Fisheries Global Information System (FAO-FIGIS) - Web site. Available at: https://www.fao.org/fishery/en/topic/18042/en [Accessed Sept 27th 2022].

FishChoice. 2017. Spiny Lobster (Caribbean). Available at: https://fishchoice.com/buying-guide/spiny-lobster-caribbean. [Accessed 14th May 2018]

Giraldes, B.W., Silva, A.Z., Corrêa, F.M., Smyth, D.M., 2015. Artisanal fishing of spiny lobsters with gillnets — A significant anthropic impact on tropical reef ecosystem. Glob. Ecol. Conserv. 4, 572–580. doi:10.1016/j.gecco.2015.10.008

Giraldes, B.W., Silva, A.Z., Corrêa, F.M., Smyth, D.M., 2015. Artisanal fishing of spiny lobsters with gillnets — A significant anthropic impact on tropical reef ecosystem. Glob. Ecol. Conserv. 4, 572–580. https://doi.org/10.1016/j.gecco.2015.10.008

Giraldes, B.W., Smyth, D.M., 2016. Recognizing Panulirus meripurpuratus sp. nov. (Decapoda: Palinuridae) in Brazil—Systematic and biogeographic overview of Panulirus species in the Atlantic Ocean. Zootaxa 4107, 353. https://doi.org/10.11646/zootaxa.4107.3.4

Holthuis, L.B. 1991. FAO species catalogue. Vol. 13. Marine lobsters of the world. An annotated and illustrated catalogue of species of interest to fisheries known to date. FAO Fisheries Synopsis. No. 125, Vol. 13. Rome, FAO. 1991. 292 P. Available at: http://www.fao.org/docrep/009/t0411e/t0411e00.htm

Magris, R.A., Mills, M., Fuentes, M.M.P.B., Pressey, R.L., 2013. Analysis of Progress Towards a Comprehensive System of Marine Protected Areas in Brazil. Nat. Conserv. 11, 81–87. doi:10.4322/natcon.2013.013.

MAPA and SAP. 2021. Portaria SAP/MAPA N 221 de 8 de Junho de 2021.

MAPA and SAP. 2022a. Portaria SAP/MAPA N 554, de 21 de Janerio de 2022.

MAPA and SAP. 2022b. EDITAL DE CHAMAMENTO PÚBLICO Nº 3, DE 23 DE FEVEREIRO DE 2022.

MAPA and SAP. 2022c. INSTITUTIONS APPROVED AND CLASSIFIED TO COMPOSE THE PERMANENT COMMITTEE FOR MANAGEMENT OF FISHERIES AND SUSTAINABLE USE OF aOF TUNA AND RELATED SPECIES - CPG TUNA AND RELATED SPECIES, PRESENTED IN ORDER OF CLASSIFICATION

MAPA. 2019. INSTRUÇÃO NORMATIVA Nº 54, DE 29 DE OUTUBRO DE 2019.

Marine Conservation Institute. 2022. Brazil Marine Protection. URL: https://mpatlas.org/countries/BRA

MDICT-ALICEWEB. 2018. Sistema de análise das informações de comércio exterior via internet do Ministério do Desenvolvimento, Indústria e Comércio Exterior. Disponível em: http://aliceweb.desenvolvimento.gov.br/.

Mereghetti, M. 2017. Brazilian government will temporarily halt EU seafood exports. [online] Undercurrent News. Available at: https://www.undercurrentnews.com/2017/12/29/brazilian-government-will-temporarily-halt-eu-seafood-exports/# [Accessed 16 Jan. 2018].

Mereghetti, M. 2018. Brazil seafood export ban to EU leaves Calvo unaffected, but worries country's fish industry. [online] Undercurrent News. Available at: https://www.undercurrentnews.com/2018/01/16/brazil-seafood-export-ban-to-eu-leaves-calvo-unaffected-but-worries-the-countrys-fish-industry/ [Accessed 15 Jan. 2018].

Neubauer, P., Jensen, O.P., Hutchings, J.A., Baum, J.K., 2013. Resilience and Recovery of Overexploited Marine Populations. Science 340, 347–349. https://doi.org/10.1126/science.1230441

Neves, S.S., Gaeta, J. C., Santana, J. V. M., Saraiva, S. Z. R., Cruz, R. 2016. Effect of lobster size variation on catches on the continental shelf off Ceará, Brazil. Arquivos de Ciências do Mar, 48, pp. 57-66. Available at: http://setores.ufc.br/labomar/wp-content/uploads/2017/02/acm-2015-48-2-06.pdf.

NMFS. 2022. COMMERCIAL FISHERIES STATISTICS: Annual Trade Data by Product, Country/Association. Available at: https://www.fisheries.noaa.gov/foss/f?p=215:200:827320844118:Mail:NO::: [Accessed 27th September 2022]

NOAA 2015. FishWatch: Caribbean Spiny Lobster Available at: http://www.fishwatch.gov/profiles/caribbean-spiny-lobster. [Accessed September 10, 2016]

NOAA, 2016. U.S. Seafood Import Monitoring Program - Fact sheet. Accessible at: http://www.iuufishing.noaa.gov/Portals/33/NMFS_SIMP%20FR_%20Fact%20Sheet.pdf.

Padovani-Ferreira, B., Floeter, S., Rocha, L.A., Ferreira, C.E., Francini-Filho, R., Moura, R., Gaspar, A.L. & Feitosa, C. 2012. Scarus trispinosus. The IUCN Red List of Threatened Species 2012: e.T190748A17786694. http://dx.doi.org/10.2305/IUCN.UK.2012.RLTS.T190748A17786694.en. Downloaded on 29 May 2018.

Pollack, D.E. 1995. Evolution of Life-history patterns in three genera of spiny lobsters. Bulletin of Marine Science. 57(2): 516-526.

Pollom et al. 2020. Pseudobatos horkelii. The IUCN Red List of Threatened Species 2020: e.T41064A2951089.

Salz, R. 2015. Greenback Parrotfish (Scarus trispinosus) Status Review Report. Report to National Marine Fisheries Service, Office of Protected Resources. February 2015, 56 pp. Available at: http://www.cio.noaa.gov/services_programs/prplans/pdfs/ID272_Greenback_Parrotfish_Status_Review.pdf.

Santana, J. V. M., Neves, S. D. S., Saraiva, S. Z. R., Adams C. & Cruz R. 2015. Current management and externalities in lobster fisheries exploitation on the continental shelf of Ceará, Brazil. Arq. Ciên. Mar, Fortaleza, 48(2): 5 - 18. Available at: https://www.flseagrant.org/wp-content/uploads/Current-

Management-Strategies-and-Externalities-Lobster-in-Brazil.pdf.

Säterberg, T., Sellman, S., Ebenman, B., 2013. High frequency of functional extinctions in ecological networks. Nature 499, 468–470. http://dx.doi.org/10.1038/nature12277.

SCC/CGPL. 2017. Relatório Técnico-Científico da 4ª Reunião do Subcomitê Científico do Comitê Permanente de Gestão da Pesca de Lagosta (SCC/CGPL). Secretaria de Aquicultura e Pesca (SEAP/MDCTIC) e Ministério do Meio Ambiente (MMA). Fortaleza, 30 a 31 de agosto de 2017.

Scientific Certification Systems (SCS). 2011. Marine Stewardship Council Public Certification Report, Baja California Lobster Fishery, Mexico, MSC Re-Certification, Version 5, 16 June 2011. Available at: http://www.msc.org/track-a-fishery/certified/pacific/mexico-baja-california-red-rocklobster/assessment-downloads-2/30.06.2011_PCR_BajaLobster.pdf.

SEAP/MDICT, MMA.SECRETARIA DA PESCA E AQUICULTURA – SPA/MDICT. MINISTÉRIO DO MEIO AMBIENTE - MMA 2017. Relatório Técnico-Científico da 4ª Reunião do Subcomitê Científico do Comitê Permanente de Gestão da Pesca de Lagosta (SCC/CGPL). Fortaleza, 30 a 31 de agosto de 2017.

Smith, A.D.M., Brown, C.J., Bulman, C.M., Mackinson, S., Marzloff, M., Shannon, L.J., 2011. Impacts of fishing low–trophic level species on marine ecosystems. Science 333(80), 1147– 1151.

TRIBUNA DO NORTE. 2013. IBAMA apreende barco que se preparava para pescar lagostas ilegalmente. Available at: http://www.tribunadonorte.com.br/noticia/ibama-apreende-barco-suspeito-de-pescar-lagosta-em-periodo-ilegal/247311.

Valle-Esquivel, M., 2011. Summary of the Honduras Caribbean Spiny Lobster Marine Stewardship Council (MSC) PreAssessment, Available at: http://seafoodsustainability.org/wp-content/uploads/2015/11/PreAssessment_Summary_Honduras_Lobster_2011.pdf.

Appendix A: Updates to the Brazil Caribbean Spiny Lobster Report

Updates to the December 19, 2018 Brazil Caribbean Spiny Lobster Report were made on October 31, 2022:

Although the following documents have been incorporated into the report, the overall recommendations for Caribbean spiny lobster caught by pots in Brazil remain unchanged and no updates warranted any factor or criterion score change:

- A 2021 Caribbean spiny lobster stock assessment conducted in Brazil
- A 2020 Brazilian guitarfish IUCN assessment
- Various government documents (e.g., Normative Instruction Nº 54, Decree Nº 10.544, Ordinance Nº 221, Decree Nº 10.736, Ordinance Nº 554, and Public Notice Call Nº 3)
- A 2020 habitat risk analysis (Consequence Spatial Analysis)

Appendix B: Rating Review Summary Table

Criteria	Previous Report (2018)	Current Review (2022)
Who conducted the stock assessment?	UFRPE, CeDePesca, Aragao and Cintra	CeDePesca with independent researcher Dr. Cristian M. Canales
When was the stock assessment conducted?	2015; 2017; 2018	2021
Where/what are the catch composition data source(s)?	Independent research studies	Same as previous; no new information found
Who manages the fishery?	CeDePesca, IBAMA, the Marine Laboratory (LABOMAR), the CGPL, and various ministries	Ministry of Agriculture, Livestock and Food (MAPA), as Aquaculture and Fisheries Secretariat (SAP/MAPA)
What is the date of the published management plan?	2017	Same as previous
Are there any amendments?	No	Same as previous