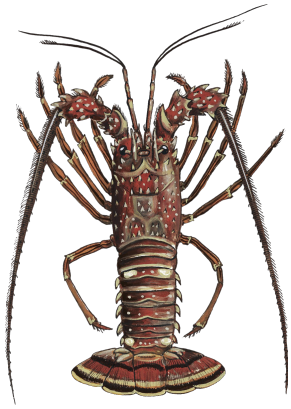
Monterey Bay Aquarium

Seafood Watch®

Caribbean spiny lobster

Panulirus argus



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Nicaragua

Pots, Diving

December 19, 2018

Seafood Watch Consulting Researcher

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

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About Seafood Watch

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

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

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

Guiding Principles

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

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

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

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

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

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

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

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

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

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

Summary

This report provides information and recommendations for the Caribbean spiny lobster (*Panulirus argus*) fished in the waters of Nicaragua with traps and free and assisted diving.

The Caribbean spiny lobster is moderately vulnerable to fishing pressure. They tend to mature quickly (between 2 to 3 years), compared to their life span of around 20 years in the Caribbean. Recently matured spiny lobsters tend to spawn once a year; older lobsters can spawn multiple times per year and females produce up to 2.5 million eggs, which can disperse widely. Regular stock assessments for Caribbean spiny lobster are rare. There is little definitive information about abundance, though estimates suggest that Nicaraguan spiny lobster fisheries are fully-fished and potentially undergoing overfishing. Therefore, Caribbean spiny lobster in Nicaragua are ranked red.

The most common non-target species caught in the Caribbean, the spiny lobster trap fishery includes various finfish and crab species. The total discard rate for lobster fisheries is generally between 8% and 15%, but discards include many invertebrates (which are generally returned alive) and finfish including lionfish. It is unlikely any one species comprises more than 5% of the catch. Some species of concern are caught in the fisheries, such as grouper species, though their capture is at low levels. The impact on other species is ranked red for Nicaraguan traps.

Similarly, the free-dive and hand-harvest fisheries do not capture large numbers of non-targeted species. Thus, the Caribbean spiny lobster fishery is extremely selective and results in very little incidental catch. Since the use of non-trap methods of fishing for lobster is growing, this offers reduced bycatch issues in many of the countries, although fishers often retain conch, sea cucumber, grouper, and snapper. The impact on other species is ranked red for the dive fishery.

Management of spiny lobster has not been effective at maintaining a stable, abundant population. There is a lack of readily available, current information about stock abundance and fishing mortality. The Caribbean spiny lobster regional management body, OSPESCA, and Nicaragua's management agency INPESCA mandates a suite of management measures including a minimum legal size, a closed season, and the type and number of fishing gears to control fishing effort. However, there are difficulties in enforcing the regulations, leading to high incidences of Illegal, Unregulated and Unreported (IUU) fishing, and there is a lack of effective stakeholder inclusion in place. Overall, the management of the spiny lobster fisheries in Nicaragua are ranked red.

The spiny lobster fisheries in Nicaragua use traps or divers to catch lobsters. Traps result in some damage to the benthic habitat, but there are regulations to protect some portions of habitat in reserves. The ecosystem impacts from the trap-based fisheries are considered "moderate." Overall, the dive fishery is ranked green and the pot fishery is ranked yellow.

The spiny lobster trap fishery in Nicaragua is engaged in a Fishery Improvement Project (FIP). 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	CRITERION 1: IMPACTS ON THE SPECIES	CRITERION 2: IMPACTS ON OTHER SPECIES	CRITERION 3: MANAGEMENT EFFECTIVENESS	CRITERION 4: HABITAT AND ECOSYSTEM	OVERALL RECOMMENDATION
Caribbean spiny lobster Nicaragua Caribbean Sea, Diving, Nicaragua	Red (1.526)	Red (1.000)	Red (2.000)	Green (3.464)	**Avoid (1.803)**
Caribbean spiny lobster Nicaragua Caribbean Sea, Pots, Nicaragua	Red (1.526)	Red (1.299)	Red (2.000)	Yellow (2.449)	**Avoid (1.765)**

Summary

Spiny lobsters from Nicaragua, caught with pots or by diving, receive a recommendation of "avoid" based on a risk of overfishing, impact on non-target species such as vulnerable snapper and grouper, and concerns over the enforcement of regulations.

Eco-Certification Information

The Caribbean spiny lobster fishery in Nicaragua is engaged in a Fishery Improvement Project (FIP). Engagement in a FIP does not affect the Seafood Watch score because we base our assessments on the current situation. Monterey Bay Aquarium is a member organization of the Conservation Alliance for Seafood Solutions. The Alliance has outlined guidelines for credible Fishery Improvement Projects. As such, Seafood Watch will support procurement from fisheries engaged in a FIP, provided it can be verified by a third party that the FIP meets the Alliance guidelines. It is not the responsibility of Monterey Bay Aquarium to verify the credibility or progress of a FIP, or to promote the fisheries engaged in improvement projects.

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 Concern[2], 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

This report provides information and recommendations for the Caribbean spiny lobster (*P. argus*) fished in the waters of Nicaragua with traps and by free diving or SCUBA diving with the use of *casitas* (shelters placed on the seabed to attract lobsters).

Acronyms

BICU	Bluefields Indian & Caribbean University		
BRP	Biological Reference Point		
CAPENIC	Camera de La Pesca or the Chamber of Fisheries of Nicaragua	IUCN	International Union for Conservation of Nature
CBA	Biologically Acceptable Quota	IUU	Illegal, Unreported and Unregulated
CGAC	Annual Global Catch Rate	MARENA	Ministry of Environment and Natural Resources
CL	Carapace Length	MARPLESCA	Manejo Regional de la Pesqueria de la Langosta Espinosa del Caribe
CLME	Caribbean Large Marine Ecosystem Project	MIFIC	Ministry of Industry and Commerce
CPUE	Catch Per Unit Effort	MLS or TML	Minimum Landing Size
CRFM	Caribbean Regional Fishery Mechanism	MSY	Maximum Sustainable Yield
DGTA	General Directorate of Aquatic Transport	NGO	Non-Governmental Organization
EEZ	Exclusive Economic Zone	NOAA	National Oceanographic and Atmospheric Administration
ETP	Endangered, Threatened and Protected species	OSPESCA	Organization of the Fisheries and Aquaculture Sector of the Central American
FAB	Fishery Advisory Board	PSA	Productivity-Susceptibility Analysis
FIP	Fishery Improvement Project	PSMA	Port State Measures Agreement
FAO	Food and Agriculture Organization	SAM	Size-At-Maturity
FENICPESCA	Federation of Small-Scale Fishers	SICA	Central American Integration System
HCR	Harvest Control Rules	TRP	Target Reference Point
INPESCA	Nicaraguan Institute of Fisheries and Aquaculture	VMS	Vessel Monitoring System
		WECAFC	Western Central Atlantic Fishery Commission

Species Overview

Figure 1 Distribution of P.argus. Source: (FAO 2017).

The spiny lobster, of the genus *Panulirus,* contains 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 upon the species (Holthuis 1991). Juvenile spiny lobsters may spend their first few years in nearshore surfgrass or algal beds; adults favor rocky substrates and reefs, which provide greater protection (GMFMC and SAFMC 2011). Spiny lobsters tend to be nocturnal and live in shelters during the day. It is debated how lobsters migrate: some studies show that spiny lobsters migrate among depths, depending upon the season, and generally move deeper in winter months (Holthuis 1991).

Several different species of spiny lobster support commercial fisheries worldwide. As such, a variety of management bodies regulate the fisheries. There is a regional management agreement for spiny lobster in Central America established by the Organización del Sector Pesquero y Acuícola del Itsmo Centroamericano Agreement OSP-02-09 (OSPESCA) (FAO 2015a), which mandate management measures for Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, the Dominican Republic and Panama. The agreement is essentially in accord with the regulations of each country (FAO 2015a). The Nicaragua stock is likely shared and exports larvae to other countries including Honduras, Colombia, and Jamaica (CLME 2017a); however, Colombia and Jamaica are not part of OSPESCA and there is a possibility that the stock is shared with countries outside of the OSPESCA system.

The Nicaraguan spiny lobster fishery is a mix of both the industrial fishery and the artisanal fishery, and lobsters are caught using traps (hereafter referred to as pots) and by diving (FAO 2015a). Nicaragua has established ministerial agreements that define fishing quotas, minimum sizes, closed seasons, licensing, pot requirements (such as limiting the number permitted per boat), lobsters must be fully intact, and a prohibition on berried females and molting lobsters ((FAO/WCAFC 2001) (FAO 2003) (FAO 2015a)).

There have been concerns about Illegal, Unreported and Unregulated (IUU) fishing and the retention of undersized and female lobsters (INPESCA 2016). In the past, management regulations have not been adequately enforced, but this has been improving; for example, in 2014, Nicaragua implemented a surveillance and enforcement plan to ensure that monitoring, control, and surveillance activities are enforced on a regular basis (Esquivel 2015) and monitoring activities are recorded (MRAG Americas 2015c).

Production Statistics

Spiny lobsters are fished throughout the Caribbean and along the Central and South American coastlines. The main producers of the *P.argus* in the Americas are as follows:

Table 1. Largest producers of *P.argus*. Landings measured in tonnes in 2014. Source (FAO 2016a).

Land Area	Production (tonnes)	Gears
Brazil	6787	Traps and gillnets (level of gill net use is unknown and is illegal)
Bahamas	6569	Casitas, traps.
Nicaragua	4724	Traps, free and assisted diving
Cuba	4621	Casitas (62%), cages (26%), traps (14%)
Honduras	4502	Traps (30%) and SCUBA diving with hooks (70%)
Dominican Republic	2454	Traps, free and assisted diving
USA	1735	Commercial: Traps, SCUBA, bully net. Recreational: No traps, SCUBA, free divers, bully net
Belize	650	Traps, casitas, and free-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. Average production over the last decade is fluctuating between 31,000 and 38,000 MT (FAO 2016a). The combined western Atlantic landings of the species were ~34,574 MT in 2014 (FAO 2017) (Figure 2). The catch production from Nicaragua is ~3000 to 4000 MT (FAO 2016a).

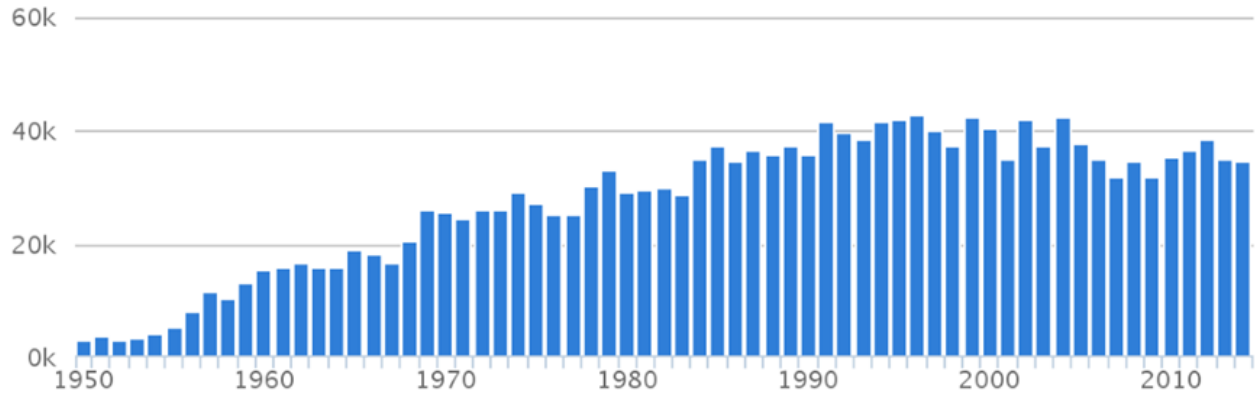

Figure 2 Global capture production. Data from FAO 2014. Source: (FAO 2017).

Spiny lobsters, throughout their range, are caught using a variety of gears (Table 1). The amount of landings from each gear is unknown for some countries or contains high amounts of uncertainty due to the level of data capture and IUU fishing in these regions (Winterbottom et al. 2012).

Importance to the US/North American market.

The United States imports spiny lobster, including the Caribbean spiny lobster, from several countries in the Caribbean and Central and South America (NMFS 2018). The major producers are Bahamas, Belize, Brazil, Honduras, and Nicaragua. Of the total spiny lobster imports to the United States in 2015, ~38% is from Nicaragua, 29% from Honduras, 21% from the Bahamas, and 7% is from Brazil (NMFS 2018) (Figure 3 and 5).

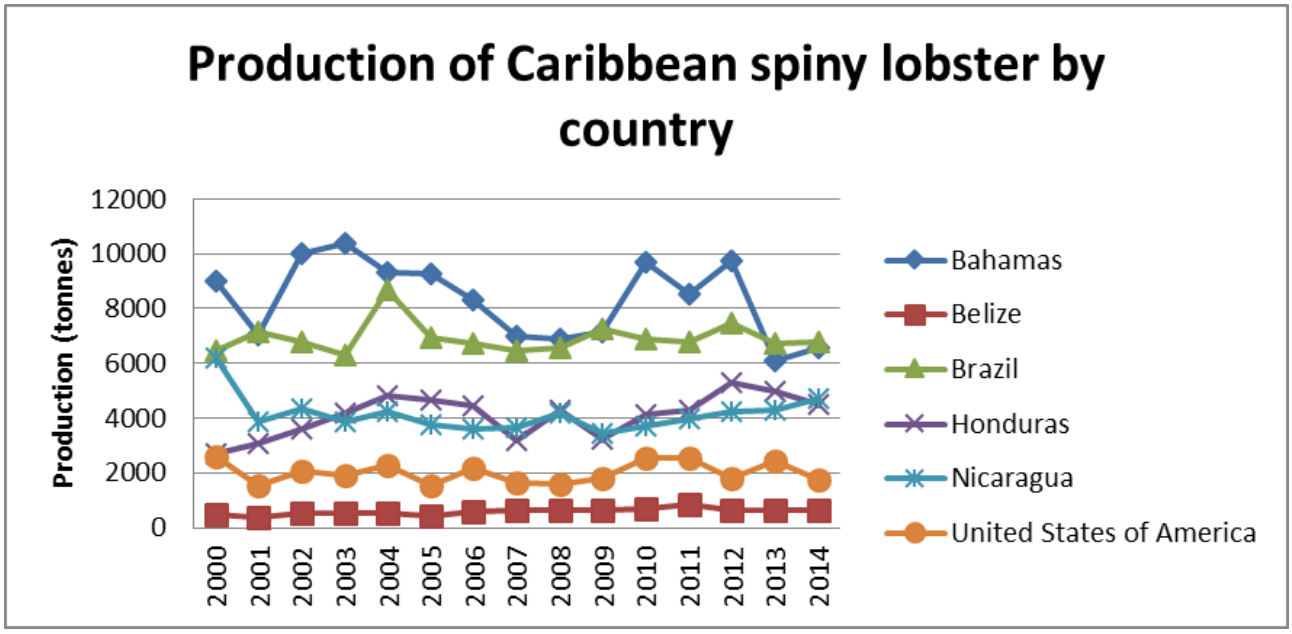

Figure 3 Capture production statistics for Caribbean spiny lobster from 1990 to 2014 in various countries. Figure compiled from (FAO 2016a).

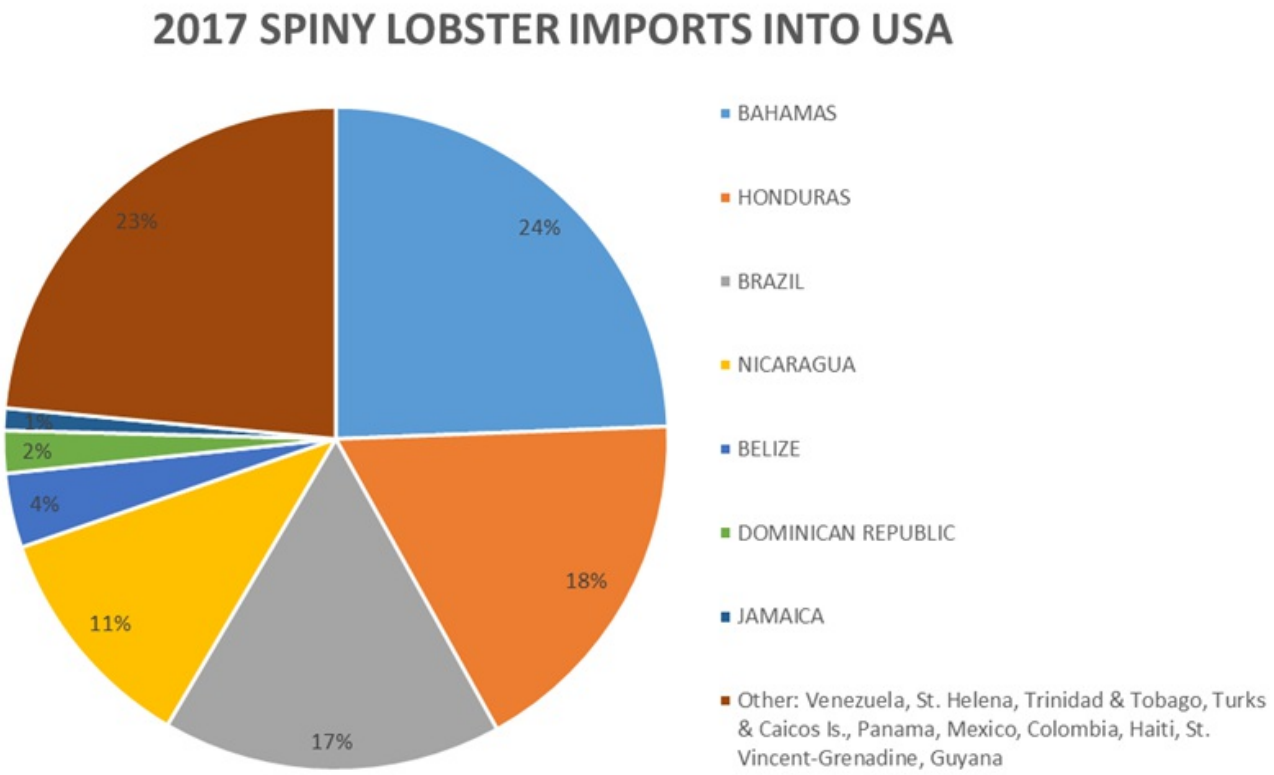

Figure 4 2017 Caribbean spiny lobster imports into USA. 'Other' includes: Mexico, Colombia, Ecuador, Antigua and Barbuda. Source: (NMFS 2018a).

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 lobsters are sold as fresh or frozen either in the form of raw tails, meat, or whole, either blanched or fully cooked (Fishchoice 2015).

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**
Nicaragua/Caribbean Sea | Diving | Nicaragua	2.33: Moderate Concern	1.00: High Concern	Red (1.526)
Nicaragua/Caribbean Sea | Pots | Nicaragua	2.33: Moderate Concern	1.00: High Concern	Red (1.526)

There have been few spiny lobster stock assessments across the Caribbean. The stock found in Nicaragua is part of the Nicaragua-Honduras stock {MRAG Americas 2015c}. The stock status is considered "fully exploited" by the Nicaraguan Institute of Fisheries and Aquaculture (INPESCA) and the biomass is relatively stable; however, the fishery may be undergoing overfishing {MRAG Americas 2015c}.

Reference points have been developed for the stock, although these are not publicly available and there is uncertainty and disagreement in the stock status; therefore, we consider stock status to be unclear. In the absence of a full stock assessment with reference points, data-limited indicators are required to estimate abundance and fishing mortality, which are associated with higher uncertainty {MRAG Americas 2015c}. The uncertainty is further exacerbated by the high rates of IUU fishing within the region {MRAG Americas 2015c}. A recent preliminary assessment showed that the stock is in good condition, with increasing recruitment, and that fishing mortality is around the target reference point (TRP) {CLME 2017a}. Nonetheless, the fishing mortality estimate from the preliminary assessment is still above estimated natural mortality and there are still considerable uncertainties that are not considered in the Honduras stock assessment, e.g., the "high incidence of illegal fishing activities" {Hervas 2016a}. Therefore, CLME (2017a)

recommends that fishing pressure is further reduced {CLME 2017a}.

Spiny lobsters mature rather quickly (between 2 to 3 years at ~70 to 80 mm in length), compared to their maximum life span estimated at 20 to 30 years {Ehrhardt 2005a}. Mature spiny lobsters spawn once a year and females produce between 500,000 to 2 million eggs {Seudeal 2013}, which can disperse widely. The Caribbean spiny lobster fishery can be a very selective when prosecuted by divers. However, the fishery captures juvenile lobster {Briones-Fourzán and Lozano-Álvarez 2015} {MRAG Americas 2015c}, which has increased their susceptibility to fishing in Nicaragua.

Criterion 1 Assessment

SCORING GUIDELINES

Factor 1.1 - Abundance

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

- *5 (Very Low Concern) — Strong evidence exists that the population is above an appropriate target abundance level (given the species' ecological role), or near virgin biomass.*
- *3.67 (Low Concern) — Population may be below target abundance level, but is at least 75% of the target level, OR data-limited assessments suggest population is healthy and species is not highly vulnerable.*
- *2.33 (Moderate Concern) — Population is not overfished but may be below 75% of the target abundance level, OR abundance is unknown and the species is not highly vulnerable.*
- *1 (High Concern) — Population is considered overfished/depleted, a species of concern, threatened or endangered, OR abundance is unknown and species is highly vulnerable.*

Factor 1.2 - Fishing Mortality

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

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

CARIBBEAN SPINY LOBSTER

Factor 1.1 - Abundance

NICARAGUA/CARIBBEAN SEA, DIVING, NICARAGUA
NICARAGUA/CARIBBEAN SEA, POTS, NICARAGUA

Moderate Concern

The stock status is considered to be "fully-exploited" by the management agency (INPESCA). Biomass reference points have been developed but are not publicly available. In the absence of these reference points, data-limited indicators have been used to assess the abundance. Data-limited indicators show that the biomass and the number of recruits are generally stable and increasing (Figures 5 and 6) (MRAG Americas 2015c) (INPESCA 2016).

Since the Productivity-Susceptibility Analysis (PSA) has shown that spiny lobsters have a "high" vulnerability (see justification), but data-limited indicators suggest that the population is stable or increasing, Seafood Watch deems abundance as a “moderate" concern.

Justification:

Current data show that biomass and the number of recruits have generally increased since the datasets began, with positive trends over the past three fishing seasons (Figures 5 and 6) (INPESCA 2016).

There is some uncertainty and disagreement in the stock status, making the stock status unclear, and precluding the determination of the stock status (MRAG Americas 2015c). Current assessments do not adequately address uncertainties such as effort estimates from all fleets, IUU fishing estimates, and over-harvesting of undersized lobsters (MRAG Americas 2015c). Current stock assessments do not account for stock connectivity: there is recent research into spiny lobster genetics showing that high connectivity exists among Caribbean spiny lobster stocks (Truelove et al. 2015a). The Nicaragua stock is part of the Nicaragua-Honduras stock (MRAG Americas 2015c) and there are uncertainties over the abundance of lobsters in Honduran waters (WWF 2015a).

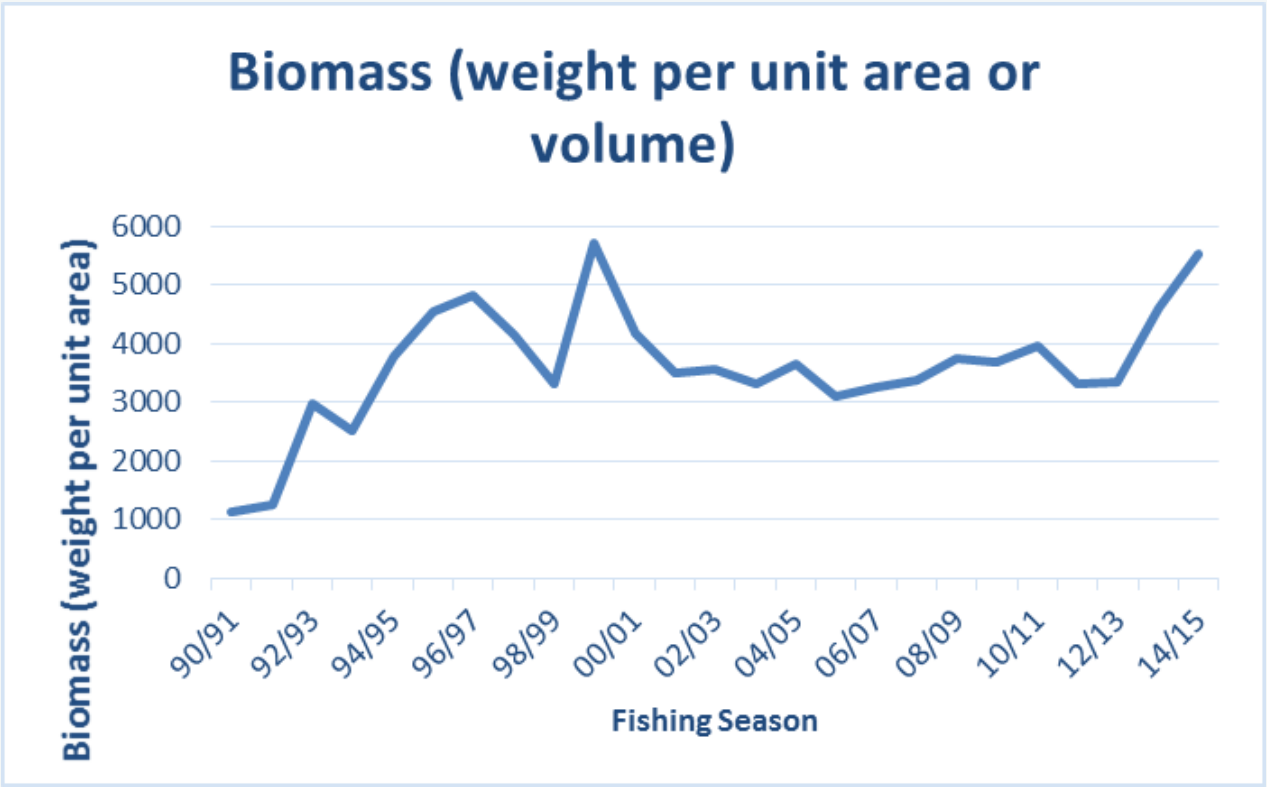

Figure 5 Change in spiny lobster biomass from fishing season 1990-1991 to 2014-2015. Source: Table 1 in (INPESCA 2016)

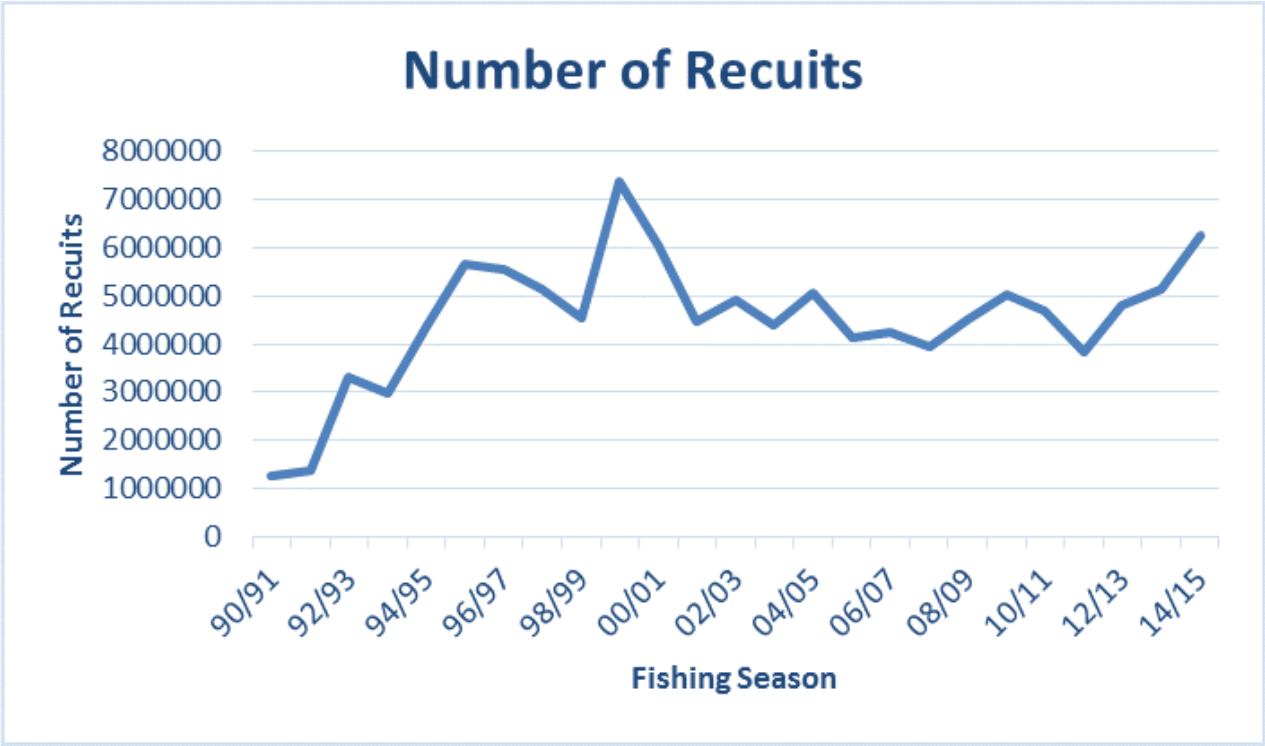

Figure 6 Change in spiny lobster number of recruits from fishing season 1990-1991 to 2014-2015. Source: Table 1 in (INPESCA 2016).

Productivity-Susceptibility Analysis:

PSA score = 3.45525. For this reason, the species is deemed to have "high" vulnerability (detailed scoring of each attribute is shown below).

Productivity Attribute	**Relevant Information**	**Score (1 = low risk, 2 = medium risk, 3 = high risk)**
Average age at maturity	2–3 Years (Ehrhardt 2005a)	1
Average maximum age	20 years (Maxwell et al. 2007a)	2
Fecundity	300,000 to 2.5 million eggs (Bertelsen and Matthews 2001)	1
Reproductive strategy	Brooder	2
Trophic level	2.98 (Vidal and Basurto 2003)	2
Density dependence (invertebrates only)	No density dependence suggested, but unknown (Behringer and Butler 2006)	2
Quality of habitat	Habitat has been moderately altered by non-fishing impacts*	2

*Although there is very little information species specifically relating to the quality of benthic habitat in the Caribbean Nicaragua (Durante et al. 2018), "habitat degradation is a severe problem across the CLME + region," where CLME is the Caribbean Large Marine Ecosystem Project. The degradation is associated

with anthropogenic activities including: "tourism, industry, agriculture, fisheries, shipping, real estate development and housing, and land reclamation" (Debels et al. 2017). The degradation discussed in literature has mainly focused on the scale of coral cover loss in the region, e.g., in (Jackson et al. 2014) and (Kramer et al. 2014).

Susceptibility Attribute	**Relevant Information**	**Score (1 = low risk, 2 = medium risk, 3 = high risk)**
Areal overlap (Considers all fisheries)	>30% of the species concentration is fished, considering all fisheries.	3
Vertical overlap (Considers all fisheries)	High degree of overlap between fishing depths and depth range of species	3
Selectivity of fishery (Specific to fishery under assessment)	Species is targeted or is incidentally encountered, AND attributes of the fishery, in combination with the species' biology or behavior, increase its susceptibility to the gear, since nets are sometimes used to catch spiny lobster and undersized individuals can be caught (INPESCA 2016).	3
Post-capture mortality (Specific to fishery under assessment)	Retained species	3

P= ((1+2+1+2+2+2+2)/7) = 1.714285714

P^2 = 2.93877551

S = (((3 * 3 * 3 * 3) − 1)/40) + 1

S = ((81-1)/40)+1

S = 3

S^2 = 9

V = √ (P^2 + S^2)

V = √ (2.93877551 + 9) = √11.9387755

PSA score = 3.45525 = High Vulnerability

Factor 1.2 - Fishing Mortality

NICARAGUA/CARIBBEAN SEA, DIVING, NICARAGUA
NICARAGUA/CARIBBEAN SEA, POTS, NICARAGUA

High Concern

Since information regarding fishing mortality is unable to be separated for the trap fishery and diving fishery (MRAG Americas 2015c), both gears have been discussed together.

Fishing mortality in the fishing season 2014–2015 was 0.39, which is lower than the fishing mortality reference point F0.1 (1.10) (INPESCA 2016). However, it is uncertain whether the reference point is appropriate (see justification), the stock assessment is not publicly available and it is not possible to ascertain whether the reference point is sufficiently precautionary to prevent overfishing. Current fishing mortality (0.39) is greater than natural mortality (0.35) (INPESCA 2016) and some sources show that the fishery is undergoing overfishing (MRAG Americas 2015c), particularly where the stock is jointly assessed with Honduras (which is deemed overfished) (MRAG Americas 2015c).

As part of a recent regional meeting, a preliminary stock assessment was conducted for the Nicaraguan and Honduran stock, which calculated F = 0.4. These analyses have not yet been completed or published, and the assessment recognizes shortcomings, such as "artisanal fisheries data collection must be improved and the calculation of the morphometric relationships updated"(CLME 2017a). Therefore, preliminary models show that F is around the TRP (CLME 2017a); nonetheless, there is much uncertainty within this assessment and it has not been finalized.

Since there is conflicting information on the state of fishing mortality (the stock assessment suggests that fishing mortality is below the reference point, however, is greater than natural mortality, and there is evidence showing that the fishery is undergoing overfishing. Therefore, Seafood Watch deems fishing mortality as a "high" concern.

Justification:

Although the current fishing mortality rate is believed to be lower than the fishing mortality reference point, there are concerns for both the stock assessment, conflicting data trends, and a lack of appropriate data sources. These concerns are discussed below.

Concerns for the stock assessment

It is debated how conservative F0.1 is as a reference point: although it has been considered as a conservative reference point for fishing mortality (Gongora 2010), it has also been argued that F0.1 is often not set at a level that is conservative enough because it does not adequately account for uncertainty, increasing the risk of recruitment overfishing (Hilborn and Walters 1992) (Walters and Maguire 1996). Since the stock assessment is not publicly available, it is unknown whether the reference point sufficiently accounts for, and quantifies, uncertainty.

Conflicting data trends

Landings of spiny lobster in Nicaragua have fluctuated over time, but they have increased in the past five years (INPESCA 2016), peaking in 2015 (Figures 7 and 8). Reported landings were 1464 MT during the 2014–2015 season and 2,027 MT in 2015 (INPESCA 2016). Annual catch from both the dive and trap fisheries combined, is approximately 445 MT of tails (WWF 2016a). Nominal fishing effort has also increased over the past five years (INPESCA 2016). Annual fishing quotas are in place but are regularly exceeded (Monnereau and Pollnac 2012).

Previous assessments have shown declines in the mean length of individuals harvested, which can indicate overfishing (Valle-Esquivel 2011). However, INPESCA (2016) found that sizes have increased in the last five years (INPESCA 2016).

There are high mortality rates in the fishery, particularly among undersized lobster (MRAG Americas 2015c). Studies have shown large numbers of undersized individuals being caught, and often illegally landed and sold locally (Butler et al. 2011).

Lack of appropriate data sources

There are an inadequate amount of data available to fully assess fishing mortality: there is currently no publicly-available method used to standardize the effort in the industrial and artisanal fleets and much of the data from the artisanal fleet are missing (INPESCA 2016). This is largely from the diving component and is not considered in the recent assessment (INPESCA 2016).

Reportedly, there are high levels of IUU fishing in the fishery, which increases uncertainty in landings data: Monnereau (2016) found that when interviewing fishers, 39% of fishers fish for undersized lobster and 33% catch berried females (Monnereau 2016). INPESCA's Fisheries Investigation Board reported that on industrial lobster trap and dive vessels, between 10 and 20% of the catch is illegal lobster (INPESCA 2016). Environmental variability does not appear to be considered in reference points: Hurricane Felix was expected to cause production losses of 88.6%, causing "devastating" effects to surface and submarine ecosystems, habitats, and on the spiny lobster's biological cycle. This led to the disappearance of spiny lobster from the fishery for over six months, leaving around 66% of the stock as undersized lobsters (MRAG Americas 2014).

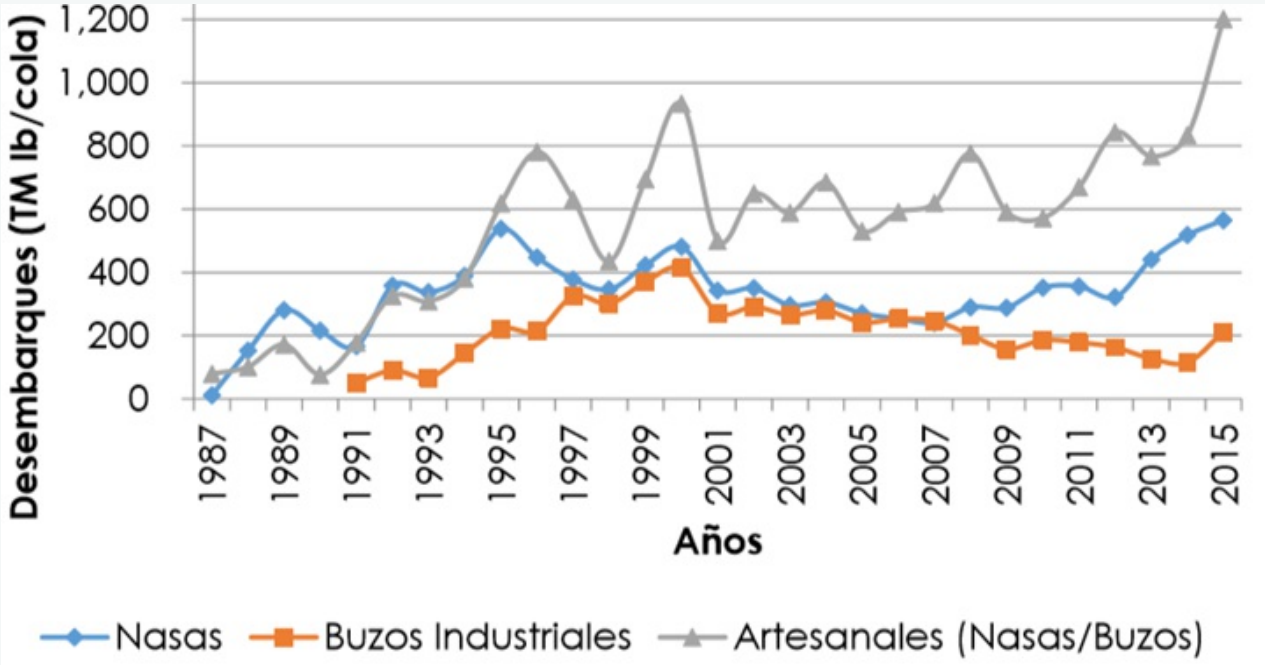

Figure 7 Total landings of lobster tails in the Caribbean of Nicaragua by type of fleet (lbs/tail). Source: (INPESCA 2016)

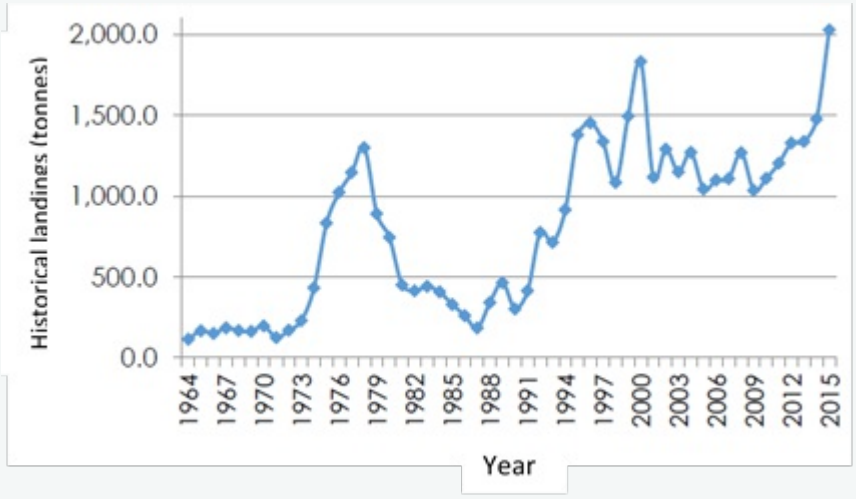

Figure 8 Historical lobster landings of Nicaragua (tonnes). Source: Figure 5 in (INPESCA 2016).

Criterion 2: Impacts on Other Species

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

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

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

Guiding Principles

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

Criterion 2 Summary

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

CARIBBEAN SPINY LOBSTER - NICARAGUA/CARIBBEAN SEA - DIVING - NICARAGUA					
Subscore:	**1.000**	**Discard Rate:**	**1.00**	**C2 Rate:**	**1.000**
Species	**Abundance**	**Fishing Mortality**	**Subscore**		
Sea cucumber	1.00:High Concern	1.00:High Concern	Red (1.000)		
Grouper (unspecified)	1.00:High Concern	3.00:Moderate Concern	Red (1.732)		
Queen conch	1.00:High Concern	3.00:Moderate Concern	Red (1.732)		
Snappers	1.00:High Concern	5.00:Low Concern	Yellow (2.236)		
Benthic inverts	2.33:Moderate Concern	3.00:Moderate Concern	Yellow (2.644)		

CARIBBEAN SPINY LOBSTER - NICARAGUA/CARIBBEAN SEA - POTS - NICARAGUA					
Subscore:	**1.732**	**Discard Rate:**	**0.75**	**C2 Rate:**	**1.299**
Species	**Abundance**	**Fishing Mortality**	**Subscore**		
Grouper (unspecified)	1.00:High Concern	3.00:Moderate Concern	Red (1.732)		
Snappers	1.00:High Concern	5.00:Low Concern	Yellow (2.236)		

Yellowtail snapper	2.33:Moderate Concern	3.00:Moderate Concern	Yellow (2.644)
Benthic inverts	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Red lionfish	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)

Species considered in Criteria 2 are either those that are "Endangered," "Threatened" or "Protected" (ETP) species (using International Union for Conservation of Nature (IUCN) data), the species represented >5% of the catch (using data from bycatch studies) or is retained in the fishery.

The data sources used to determine the species assessed in Criteria 2 are from scientific cruises, observer information and logbooks (INPESCA 2016).

In trap fisheries, bycatch species that exceeded 5% of the catch include yellowtail snapper *Ocyurus chrysurus*, several species of grouper *Epinephelus spp.* (INPESCA 2016) and crabs (WWF 2016b). Another study found that bycatch consisted of hermit crabs (*Petrocirus diogenes)* and lionfish (*Pterois volitans)* (Hervas 2017): these species were deemed unlikely to be retained, though there is insufficient evidence to prove this. No ETP species were recorded from studies in trap fisheries (WWF 2015b).

In dive fisheries, retained species can include mollusks, crabs, finfish, the queen conch (*Lobatus gigas*), sea cucumber (*Isostichopus badionotus*), Caribbean king crab (*Mithrax spinosissimus*), snapper (*Lutjanus spp.*), and grouper (*Epinephelus spp.*) (INPESCA 2016), although not all of these are recorded to species level. Most of these species are not considered to be at risk, though some grouper species are of concern in Nicaragua, e.g., Poey's grouper/yellowedge grouper (*Hyporthodus flavolimbatus*) (Ferreira and Peres 2008) and Nassau grouper (*Epinephelus striatusand*) (Cornish and Eklund 2003). Some snapper, including Cubera, are also on the endangered list for the area (Lindeman et al. 2016). Since there is a possibility that endangered species of grouper and snapper are caught in the spiny lobster fishery, they have been assessed here.

For the trap fishery in Nicaragua, grouper and snapper limit the score for Criterion 2 due to their high vulnerability and unknown stock status, and the lack of species-specific monitoring of their catch.

For the dive fishery in Nicaragua, sea cucumber limit the score for Criterion 2 due to their high vulnerability and high exploitation rates (particularly of immature individuals).

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)

GROUPER (UNSPECIFIED)

Factor 2.1 - Abundance

NICARAGUA / CARIBBEAN SEA, DIVING, NICARAGUA
NICARAGUA / CARIBBEAN SEA, POTS, NICARAGUA

High Concern

Groupers are caught in the Nicaraguan spiny lobster dive fishery (INPESCA 2016) and in the trap fishery (Hervas 2017), but they are often not identified at the species level. A number of grouper species are classed as endangered in Nicaragua, including Nassau Grouper (Cornish and Eklund 2003).

There is a possibility that endangered grouper species are caught in the spiny lobster fishery. Other unknown grouper species are caught with unknown stock status, and grouper are assumed to have high vulnerabilities. Seafood Watch considers abundance to be a "high" conservation concern.

Factor 2.2 - Fishing Mortality

NICARAGUA / CARIBBEAN SEA, DIVING, NICARAGUA

Moderate Concern

There is a lack of data on the impact of the spiny lobster fisheries on individual grouper species. Groupers can be retained in the dive fishery (INPESCA 2016) but catch data are not available; therefore, fishing mortality is unknown.

Fishing mortality is unknown relative to reference points; therefore, Seafood Watch deems fishing mortality a "moderate" concern.

NICARAGUA / CARIBBEAN SEA, POTS, NICARAGUA

Moderate Concern

There is a lack of data on the impact of the spiny lobster fisheries on individual grouper species. Current available data show that collectively, groupers represent no more than 5% of the total catch in traps, though they can be retained (INPESCA 2016).

Fishing mortality is unknown relative to reference points; therefore, Seafood Watch deems fishing mortality a "moderate" concern.

Factor 2.3 - Modifying Factor: Discards and Bait Use

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

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

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

NICARAGUA / CARIBBEAN SEA, DIVING, NICARAGUA

< 100%

The freedive and hand-harvest fisheries do not result in large numbers of non-targeted species. As a result, the Caribbean spiny lobster fishery is extremely selective and results in very little incidental catch.

Diving requires no bait use and is a very selective fishing method; therefore, it receives a factor score of 1.

NICARAGUA / CARIBBEAN SEA, POTS, NICARAGUA

≥ 100%

There are no specific data on discarding from the Nicaraguan fishery; therefore, a similar fishery has been used as a proxy. Total discard rates given by Shester and Micheli (2011) for Mexican spiny lobster trap fisheries are presented as 15% (Shester and Micheli 2011). This figure includes the invertebrates that are most often returned to the water alive. Bait use in Nicaragua normally consists of cowhide (López 2010) (Monnereau 2016).

Since discards plus bait use is likely to represent less than 100% of total landings, Seafood Watch scores discards and bait use as 1.

SEA CUCUMBER

Factor 2.1 - Abundance

NICARAGUA / CARIBBEAN SEA, DIVING, NICARAGUA

High Concern

Three primary sea cucumber species are harvested in Nicaraguan waters (*Isostichopus badionotus*, *Holothuria mexicana, Hotithuria floridiana*) (La Gaceta 2017a). *I. badionotus* is known to be retained in the dive fishery (INPESCA 2016). *I. badionotus* is not an ETP species (Toral-Granda et al. 2013a) and there are no data-limited indicators to determine its abundance. *H. mexicana* are not not considered an ETP species either (Toral-Granda et al. 2013b), but there is no known ETP status for *Hotithuria floridiana.* Very little data are available for either species. However, a recent source has stated that "the sea cucumber resources are severely depleted" (Rogers et al. 2017a).

Since the PSA (see justification) deems the species to have a high vulnerability, Seafood Watch deems abundance a "high" concern**.**

Justification:

Productivity-Susceptibility Analysis

PSA score = 3.60555. For this reason, the species is deemed to have high vulnerability (detailed scoring of each attribute is shown below).

PRODUCTIVITY ATTRIBUTE	PRODUCTIVITY	SOURCE	SCORE
Average maximum age	<10 years	(Poot-Salazar et al. 2014)	2
Fecundity	>20,000	(Zacarias-Soto et al. 2013)	2
Reproductive strategy	Broadcast spawner	(Purcell 2010)	1
Density Dependence	Potential Allee effects	(Uthicke et al. 2010) (Hernandez-Flores 2015)	3
Quality of Habitat	Habitat has been moderately altered by non-fishing impacts*	See discussion below	2

*Although there is very little information species specifically relating to the quality of benthic habitat in the Caribbean Nicaragua (Durante et al. 2018), "habitat degradation is a severe problem across the CLME+" region. The degradation is associated with anthropogenic activities including: "tourism, industry, agriculture, fisheries, shipping, real estate development and housing, and land reclamation" (Debels et al. 2017). The degradation discussed in literature has mainly focused on the scale of coral cover loss in the region, e.g., in (Jackson et al. 2014) and (Kramer et al. 2014).

SUSCEPTIBILITY ATTRIBUTE	SUSCEPTIBILITY	SCORE
Areal overlap	Unknown	3
Vertical overlap	Unknown	3
Selectivity of fishery (harvesting of individuals below the size-at-maturity (SAM) (Rogers et al. 2017a))	Unknown	3
Post-capture mortality	Unknown	3

$P = ((2+2+1+3+2) /5) = 2$

$P^2 = 4$

$S = (((3 * 3 * 3 * 3) - 1)/40) + 1$

$S = ((81-1)/40)+1$

$S= 3$

$S^2 = 9$

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

$V = \sqrt{(4 + 9)} = \sqrt{13}$

PSA score = 3.60555 = High Vulnerability

Factor 2.2 - Fishing Mortality

NICARAGUA / CARIBBEAN SEA, DIVING, NICARAGUA

High Concern

The number of sea cucumbers retained in the spiny lobster dive fishery is unknown, though landings for the species have vastly increased over the past decade (Figure 9). There is known exploitation of undersized individuals and "immature sea cucumbers now represent a growing and alarming proportion of the catches" (Rogers et al. 2017a). There are also reports of illegal catches (Rogers et al. 2017a) and exploitation is high (Toral-Granda et al. 2013b) (Rogers et al. 2017a).

Since fishing mortality is unknown relative to reference points, but overfishing is likely occuring, Seafood Watch deems fishing mortality a "high" concern.

Justification:

Figure 9 Sea cucumber landings 2006-2015. Source: (INPESCA 2015a)

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

NICARAGUA / CARIBBEAN SEA, DIVING, NICARAGUA

< 100%

The freedive and hand-harvest fisheries do not result in large numbers of non-targeted species. As a result, the Caribbean spiny lobster fishery is extremely selective and results in very little incidental catch.

Diving requires no bait use and is a very selective fishing method; therefore, it receives a factor score of 1.

Criterion 3: Management Effectiveness

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

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

The Criterion 3 rating is determined as follows:

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

Rating is Critical if Management Strategy and Implementation is Critical.

GUIDING PRINCIPLE

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

Criterion 3 Summary

Fishery	Management Strategy	Bycatch Strategy	Research and Monitoring	Enforcement	Stakeholder Inclusion	Score
Fishery 1: Nicaragua / Caribbean Sea | Diving | Nicaragua	Moderately Effective	Highly Effective	Moderately Effective	Moderately Effective	Ineffective	Red (2.000)
Fishery 2: Nicaragua / Caribbean Sea | Pots | Nicaragua	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Ineffective	Red (2.000)

The main issues encountered in the Nicaraguan spiny lobster fishery are the scale of IUU fishing, the size of the artisanal fleet (which is difficult to monitor and enforce management measures as the fleet is widely dispersed in Nicaraguan waters {INPESCA 2016}), and ghost fishing.

A history of overfished lobster populations in Nicaragua has been partly due to the lack of readily available, current data about stock abundance and fishing mortality. This has improved over the last five years with the implementation of a fishery improvement project (FIP) that has been implementing management measures and research programs to reduce the impact of the fishery on the ecosystem {MRAG Americas 2015c}.

The management of Nicaraguan fisheries have improved over recent years. However, in 2009, OSPESCA formed agreements for the following countries under the Central American Integration System (SICA): Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, the Dominican Republic and Panama. The "Regional Regulation of Caribbean Lobster Fishing (*P. argus*)," OSP-02-09 requires that all countries implement a fishery management plan and laws including minimum tail weights, a minimum closed season from 1 March to 30 June, escape gaps in lobster traps, trap limits, and prohibit sale of lobster tail meat without a shell {FAO 2015a}. Other measures that are implemented in Nicaragua include minimum size limits, and prohibition on retaining berried females and molting lobsters {MRAG Americas 2015c} (Table 2). However, some of these management measures are not effective at managing the stock, e.g., Minimum Legal Size (MLS) often does not reflect the average SAM of lobsters, which risks growth-overfishing {IOCARIBE 2007} {Van Gerwen 2013}.

Though monitoring has improved in recent years, major data gaps exist on basic information such as fishing mortality. For example, the artisanal fleet is largely unmonitored and there are little data available from logbooks. Data gaps limit the effectiveness of management measures.

The Caribbean region suffers from widespread issues with illegal fishing (particularly by breaching regulations such as fishing outside closed seasons, catching undersized lobster, berried females, or fishing without a license or permit). Enforcement remains weak as illegal fishing continues {FAO 2015a}. As a result, management measures are often considered unsuitable or ineffective at conserving the stock {Andrade 2015}.

Criterion 3 Assessment

Factor 3.1 - Management Strategy and Implementation

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

NICARAGUA / CARIBBEAN SEA, DIVING, NICARAGUA
NICARAGUA / CARIBBEAN SEA, POTS, NICARAGUA

Moderately Effective

Nicaraguan spiny lobster fisheries are managed regionally by the Organization for the Fishing and Aquaculture Sector of the Central American Isthmus (OSPESCA) and nationally by the Nicaraguan Institute of Fisheries and Aquaculture (INPESCA). These organizations manage the fishery through a Harvest Control Rule (HCR), which includes a suite of management measures including quotas (calculated annually), size limits, prohibitions on retaining berried and molting lobsters, trap requirements, seasonal closures, and effort limits (license requirements and permits) (Table 2).

Some of the management measures are considered unsuitable to conserve the stock: for example the size limit is smaller than the average SAM for males (Van Gerwen 2013). The success of management measures is undermined by illegal and unreported fishing. MRAG Americas (2015c) states that the "majority of the IUU catch is undetected and cannot be quantified" (MRAG Americas 2015c). Information is particularly lacking for the artisanal sector, the catch of juvenile lobsters and berried females and the number of illegal incursions of foreign vessels. Estimates of illegal fishing generally range between 10 to 20% (Table 2) (Gutierrez-Garcia 2016a), and 18% was estimated to be unreported in 2013 (MRAG Americas 2015c).

Stock assessments are carried out regularly; however, there is concern for both the accuracy of reference points and the data used in stock assessments. Reference points do not reflect important factors effecting

fishing mortality, such as the genetic link between the Honduran-Nicaraguan stock, environmental variability, uncertainty such as the incidence of illegal fishing and data-gaps from the artisanal fleet. Quotas are based on the result of these stock assessments, and therefore may not be precautionary enough to sustain the fishery. Although the stock is currently concluded to be fully-exploited, studies show that the stock is likely undergoing overfishing (MRAG Americas 2015c).

Some species are retained in the dive (crabs, finfish, the queen conch, sea cucumber, Caribbean king crab, snapper, grouper (INPESCA 2016), and trap fishery (lionfish). There is currently no recovery plan in the fishery. Conch are managed under a management plan (FAO 2016c). There are minimum size restrictions for the three primary sea cucumber species (La Gaceta 2017a); however, there is concern over "illegal fishing" and harvesting of "undersized individuals" and "immature sea cucumbers now represent a growing and alarming proportion of the catches" (Rogers et al. 2017a). However, the proportion of illegal sea cucumber catches taken by the spiny lobster fishery is unknown. Lionfish may be retained in the trap fishery but they are non-native and invasive (Johnston et al. 2017); therefore, the impact of the trap fishery on lionfish is of low concern (Criteria 2).

There is a suite of management measures to protect the stock, but there is a high level of illegal fishing. Nonetheless, the level of illegal fishing does not appear to be high enough to score the management strategy as “ineffective.” Management effectiveness is unknown but reference points are unclear and do not account for uncertainty. Therefore, Seafood Watch deems the management strategy as "moderately effective."

Justification:

The Nicaraguan spiny lobster fishery is deemed “fully exploited” with a stable (MRAG Americas 2015c) or increasing biomass (WWF 2016b). There is conflicting advice on the level of fishing mortality, which is either below the reference point (WWF 2016b) or showing that overfishing is occurring (MRAG Americas 2015c). Therefore, the HCR is currently unsuccessful in preventing overfishing and are currently not meeting its objectives (MRAG Americas 2015c).

Management is reactive to changes in the stock status since it changes quotas annually (MRAG Americas 2015c). The quota is an Annual Global Catch Rate (CGAC), based on Biologically Acceptable Quota (CBA), and calculated annually based on size-composition (Gutierrez-Garcia 2016b). However, there are concerns over the stock assessment and how it reacts to uncertainty.

The Nicaraguan spiny lobster stock assessment is not publicly available. The stock assessment contains reference points: the limit reference point for biomass is defined as B_{MSY} and the TRP for fishing mortality is F0.10 (which was calculated in 2001)**.** It is debated how conservative F0.1 is as a reference point, since it does not adequately account for uncertainty, increasing the risk of recruitment overfishing (Hilborn and Walters 1992) (Walters and Maguire 1996). The method used to calculate Biological Reference Points (BRPs) has not been clearly documented (MRAG Americas 2015c). The reference points contain uncertainty—mainly attributable to the lack of data from the artisanal sector (MRAG Americas 2015c)—and there is no method to standardize effort between artisanal and industrial fleets (MRAG Americas 2015b)). There is a lack of consideration for the Honduran spiny lobster stock (which is genetically linked to the Nicaraguan stock (MRAG Americas 2015c) (Hervas 2017) and there is a high level of illegal and unreported fishing (MRAG Americas 2015c) and a lack of data from the artisanal fleet (CLME 2017a).

It has been recommended that a cross-state stock assessment committee be set up between Honduras and Nicaragua under the regional framework of OSPESCA to account for the genetic link between the two stocks (pers. comm., WWF 2017). A preliminary model that was produced for the Nicaraguan and Honduran stock, (which includes biological and fishing data for years 2010 to 2015), concludes that fishing pressure should be reduced (CLME 2017a). The closed season has been attributed to reducing fishing pressure, positively effecting recruitment (CLME 2017a). Thus, management addresses some scientific recommendations.

However, there are many uncertainties about fishing effort and catch, which undermine the understanding of the state of the stock and management measures (CLME 2017a).

Alternative sources of mortality to fishing mortality have been identified, e.g., hurricanes (MRAG Americas 2014), but are not measured (MRAG Americas 2015c). Growth estimates, mortality, and recruitment parameters have recently been calculated and incorporated into models (Gutierrez-Garcia 2016b).

Since the HCR is underpinned by a single reference point for fishing mortality and there are significant issues in the stock assessment process, the effectiveness of HCRs is debated. The HCR does not advise a sustainable level of exploitation level in relation to abundance. There is a need for increased precaution particularly for stronger reductions in quota to react to potential declines in biomass (MRAG Americas 2015c).

Technical guidelines are used to distribute quotas nationally among industrial and artisanal sectors (MRAG Americas 2014), though quotas are not distributed equally (MRAG Americas 2015b). There is conflicting information about quota usage: MRAG (2013) states that if the spiny lobster quota is exceeded, the fishery is closed (MRAG Americas 2013). However, Monnereau and Pollnac (2012) state that annual fishing quotas are in place but are regularly exceeded (Monnereau and Pollnac 2012). Nicaragua has recently been implementing temporary closures based on information about the status of the stock. Seasonal closures have been implemented since 2012 and are being monitored (MRAG Americas 2013) (INPESCA 2015b). However, the enforcement of pot removal is low: although there is a 2500 pot limit per vessel, many vessels often contain up to 6000 pots (Fanning et al. 2011). Therefore, it is unlikely that all pots are removed from the fishery during the closure. The MLS (76 mm CL) (Table 2) is smaller than the SAM at (CL50%) for male *P. argus* (92.2 (± 2.53SE) mm CL), rendering the MLS too small for a sustainable fishery (Van Gerwen 2013). A lack of government funds is a barrier to improved research and enforcement, subsequently impacting the suitability and implementation of management measures (MRAG Americas 2015c).

Due to the high connectivity of spiny lobster stocks throughout the Caribbean, suitable management is required throughout the region to ensure that the whole stock is maintained (Truelove et al. 2015a) (Truelove et al. 2015b). There have been recent improvements in transboundary management throughout Caribbean countries: the CLME strategy has been implementing management in the spiny lobster fisheries, throughout the Caribbean region, to account for this high connectivity (CLME 2013). To account for some of this connectivity, OSPESCA has implemented a suite of management measures under regulation OSP-02-09 for seven countries, including Nicaragua (FAO 2015a).

There are retained species in both the trap and dive fishery. Conch and sea cucumber are retained species in the dive fishery (INPESCA 2016). Management measures have been implemented Caribbean-wide to prevent the harvest and spreading of lionfish, and more studies are being conducted to determine the specific impacts of lionfish in Nicaragua (MRAG Americas 2015c). However, there is no formal fishery management plan for lionfish in Nicaragua. In order to reduce the impact of the spiny lobster fishery on other species, seasonal closures have been implemented since 2012; they are monitored (MRAG Americas 2013) (INPESCA 2015b), but are compromised by illegal fishing (Ehrhardt et al. 2011). The illegal sized lobster fishery yields around USD 6 million annually which, if left to reach MLS, would have been worth USD 11.7 million more, annually (Ehrhardt 2006) (Monnereau 2016), and (if implemented and enforced effectively) is likely to improve total landings in the long term (Gutierrez-Garcia 2016a).

Divers use kayaks that are deployed from a mothership and will catch lobsters as deep as 50 m (Valle-Esquivel 2011). As a result, divers have been killed from the bends and other diving-related accidents (CEJIL 2015). Since 2013, Law 613 Protection and Safety has been implemented to protect divers (INPESCA 2016).

Table 2. Management measures in Nicaragua

	MANAGEMENT MEASURES
Gov. body	INPESCA
Multi/ single species	Single-species
Industrial/ Artisanal	60% artisanal; 40% commercial (Dept. Of INPESCA Fishery Statistics, 2016) (INPESCA 2016).
Fleet size	Industrial: 91 vessels (75 trap, 16 diving vessels) (40.7% of landings). Artisanal: 750 (FAO 2015a) 59.3 % of landings (INPESCA 2016).
Fishing Method	Traps, free and assisted diving (FAO 2015a)
Quota	Yes, calculated annually (FAO 2015a)
Size limit (tail weight (ounce))	5 (FAO 2015a)
Size limit (length)	76 mm CL and tail is 140 mm (FAO 2015a)
Closed season	1 March to 30 June (FAO 2015a)
Closed season length	4 months (FAO 2015a)
Berried females prohibition	Yes (FAO 2017b)
Molting lobsters prohibition	Yes (FAO 2017b)
Other handling laws	Cannot harvest filet or diced tail meat and lobster must carry intact spermatophores. Inventory of stock three days after start of closed season (FAO 2015a)
SCUBA prohibition	No
Licenses Limit	Yes (since 2009) (FAO 2015a)
Escape gap in traps	Yes (INPESCA 2016)

Gear regulations	Traps must be removed from the water before season closure. Limit of 2500 traps/vessel (FAO 2015a)
Other	Industrial fleets are not permitted to fish within 25 miles of the cays and islands (FAO 2015a). The number of fishers, type of vessel, and fishing gear in both industrial and artisanal sectors is regulated and all supply chain members must be registered (INPESCA 2016).
Level of Illegal fishing	Estimates of illegal fishing vary. One study, which involved interviews with fishermen, concluded that the illegal catch represented between 10 to 20% of the total lobster catch. Another study, which involved reporting of illegal lobster at restaurants, suggested that illegal lobster represents between 13 to 31%, but generally, the illegal catch represents 14.5% of the total catch (Gutierrez-Garcia 2016a). Monnereau (2016) found that during interviews with fishers, 39% of fishers fish for undersized lobster and 33% catch berried females (Monnereau 2016). However, evidence suggests that 90% of lobsters sold to processing plants from trap and dive fisheries are of a legal size (MRAG Americas 2014). Additionally, the unreported catch is expected to represent around 18%. Also, some of the catch is consumed by fishers when on fishing trips (Hervas 2017).

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.

NICARAGUA / CARIBBEAN SEA, DIVING, NICARAGUA

Highly Effective

The common capture methods with hooks and/or diving with the use of casitas result in minimal incidental catch. The non-lobster component of the catch is retained and are discussed in factor 3.1. Nicaragua has signed international and regional agreements to protect ETP species. Fisheries and environmental laws (under the Ministry of Industry and Commerce (MIFIC) and the Ministry of Environment and Natural Resources (MARENA) require that marine mammals, turtles, and other species described in CITES are sufficiently protected (Ehrhardt et al. 2011).

Since there is relatively no bycatch in the fishery, Seafood Watch deems the bycatch strategy as "highly effective."

NICARAGUA / CARIBBEAN SEA, POTS, NICARAGUA

Moderately Effective

Management measures to reduce the impact of the lobster fishery on bycatch and ETP species include marine reserves, escape vents, and removal of all pots from the water prior to season closures (Table 2). Studies are

currently being conducted to determine whether ETP species are caught and retained in the fishery, though generally, bycatch is thought to represent a small proportion of the catch. Nicaragua has signed international and regional agreements to protect ETP species. Fisheries and environmental laws (under MIFIC and MARENA) require that marine mammals, turtles, and other species described in CITES are sufficiently protected (Ehrhardt et al. 2011).

Lionfish are an invasive species (Johnston et al. 2017). There is no management plan for reducing their population increase in Nicaraguan waters. More studies are being conducted to determine the specific impacts of lionfish in Nicaragua (INPESCA 2015c).

Nicaragua spiny lobster fishers remove pots three days before the end of the season; by calculating the number of pots returned they determine the potential number of pots left in the water annually (INPESCA 2015c). Although Nicaragua mandates 2,500 pots per licence, the industrial fleet may carry up to 4000 to 5,000 traps per licence; hence, the number of traps estimated to be in the water at the end of the season may be much lower than the actual number (Monnereau 2016).

Bycatch in the Nicaraguan spiny lobster pot fishery is low, reducing the bycatch management required. More information is required on the catch and discard survival of ETP species. There is some protection to prevent the capture of bycatch species. The impacts of ghost fishing are expected to be large and likely continue throughout the closed season, but there are measures being taken to better understand and reduce this problem. Therefore, Seafood Watch deems the bycatch strategy as "moderately effective."

Justification:

In Nicaragua's 2015 fishing season, 159,697 pots were removed from the artisanal and industrial fishery. A recorded 30,022 live lobsters were returned to the sea (INPESCA 2015c). If an average legal-sized lobster in Florida weighs ~0.52 kg (Matthews 2001), then 15,611 kg were returned to the sea, which represents less than 1% of 2014 landings (1,780 MT).

Abandoned pots (ghost pots) can continuously capture and harm animals and damage marine ecosystems. Butler and Matthews (2015) proposed that 637,622 lobsters are killed each year by ghost pots (Butler and Mathews 2015). Ghost pots also destroy or damage protected corals, benthic habitats, and 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). High wind speeds can cause pots to travel further, increasing their footprint over a greater expanse of benthic environments. In Florida, fishermen report that pot loss in seasons without tropical cyclones averaged 2 to 5%, whereas when winter storms/tropical cyclones occur this rises to 19 to 65%. As climate change is expected to increase storm intensification and frequency, particularly in vulnerable areas such as the Caribbean, pot loss is expected to increase. Therefore, by continuing pot fisheries at such a large scale and intensity, the impact that pots deliver, particularly in sensitive coral habitats, is likely to worsen (Uhrin 2016). Additionally, the time it takes for a pot to decay is dependent on the materials and depth it is at (Butler and Mathews 2015). However, the Nicaraguan fishery use wooden pots (Monnereau 2016), which can remain in tact for around one to two years (Butler and Mathews 2015).

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.

NICARAGUA / CARIBBEAN SEA, DIVING, NICARAGUA
NICARAGUA / CARIBBEAN SEA, POTS, NICARAGUA

Moderately Effective

INPESCA collects fishery-independent data (distribution, abundance, and population structure using biological and CPUE data) (MRAG Americas 2014) and fishery-dependent data (landings, industrial effort, and sales data) (MRAG Americas 2015c). Recent progress has been made as the industrial sector now records catches of retained, discarded and ETP species on catch forms and fishing logbooks (MRAG Americas 2014).

Stock assessments are not publicly available but are conducted regularly. Stock assessments lack robustness: data on fishing effort and yields are only recently available for the artisanal part of the fleet (Hervas 2017) (which represent an estimated 62% of the total landings (CLME 2017a), but mostly for the industrial portion of the fishery (MRAG Americas 2015c). Monitoring has improved in the artisanal fleets with the recent 2016 Census (Hervas 2017) but the data are yet to be analysed and published (CLME 2017a). Landings data are currently collected for both fleets, but fleet specific data are unavailable (Fishery Progress 2018a). Temporary closures of the industrial and artisanal fisheries are closely monitored at the regional level ((MRAG Americas 2013) (INPESCA 2015b)). The stock assessment is peer-reviewed by Centro de Investigaciones Pesqueras y Acuícolas (CIPA), OSPESCA, and experts (MRAG Americas 2015c).

There is a lack of data regarding illegal and unreported fishing and "the majority of the IUU catch is undetected and cannot be quantified" (MRAG Americas 2015c). However, monitoring of illegal and unreported fishing is improving: INPESCA published a new methodology to monitor and estimate illegal fishing in 2016 and they monitor restaurants for the sale of illegal lobsters (Gutierrez-Garcia 2016a).

INPESCA record the amount of traps, which are deployed each fishing season and brought back at the end of the season. Therefore, the number of ghost traps is monitored and this has been studied (INPESCA 2015c), where INPESCA has calculated the number of pots left in the water by recording the number of pots at the beginning and end of the season.

Both fishery dependent and independent data are collected to create regular stock assessments; the fishery lacks data from the artisanal sector, bycatch data (through methods such as at-sea observer studies), and illegal fishing data, though there have been recent improvements in data collection. Therefore, Seafood Watch deems Scientific Research and Monitoring as "moderately effective."

Justification:

Catch composition is recorded in landing forms and there have been some on-board observer programs that have also recorded catch composition. It has been recommended that more data be captured under the monthly lobster catch and sale forms and INPESCA monitoring forms (MRAG Americas 2014).

A number of issues prevent the accurate and reliable capture of data: these include lack of manpower, funding, training, suitable equipment, cooperation with fishers, size of fleet, illiteracy rates (especially in artisanal fleets (WWF 2015b)), and transportation to, or communication with, remote locations (Winterbottom et al. 2012). To improve data collection, the Manejo Regional de la Pesqueria de la Langosta Espinosa del Caribe (MARPLESCA) plan stated in a recent Food and Agriculture Organizaton (FAO) meeting, that they aimed to collect information on catch and fishing effort, biological data, vessel licensing data, fleet size, and details about the vessels and Vessel Monitoring System (VMS) data (FAO 2016b).

Nicaragua has implemented a fishery data collection system since 1970, with the most reliable information collected since 1990, publishing results monthly. Data are captured using landing forms, and onboard observer

programs have occasionally measured bycatch and catch composition (WWF 2015b). Bycatch is monitored particularly in the industrial sector using catch forms and captain's logbooks (Esquivel 2015). Improvements in the collection of bycatch information in the artisanal sector have been delayed because of high levels of illiteracy (WWF 2015b). INPESCA communicates with and regularly reports queen conch exports and landings to both CITES and the FAO (Navarro 2014).

Bluefields Indian & Caribbean University (BICU) is currently working with INPESCA to determine the impact of lionfish on lobster in Nicaragua. The impact of fishing on marine habitats and ecosystems are not yet determined, though impacts have been studied in other Caribbean regions (INPESCA 2015c).

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.

NICARAGUA / CARIBBEAN SEA, DIVING, NICARAGUA
NICARAGUA / CARIBBEAN SEA, POTS, NICARAGUA

Moderately Effective

Organizations participating in fishery enforcement include INPESCA, MARENA, The Navy, The Police, the General Directorate of Aquatic Transport (DGTA) and the regional governments (MRAG Americas 2014). In 2014, INPESCA implemented a surveillance and enforcement plan to ensure that monitoring, control, and surveillance activities are conducted on a regular basis (Esquivel 2015) and monitoring activities are recorded (MRAG Americas 2015c). All industrial vessels are required to have VMS and those that violate the requirement face penalties (INPESCA 2016).

There is a lack of data regarding illegal and unreported fishing and the "the majority of the IUU catch is undetected and cannot be quantified." However, around 90% of lobsters sold by trap and dive fisheries to processing plants are of a legal size (MRAG Americas 2014). Table 2 shows that illegal and unreported estimates vary but are typically between 10 to 20%. More stringent control on fishing licenses and/or a quota system should be implemented to limit catch and effort (MRAG Americas 2015c). However, the CLME project recognizes that enforcement a prohibition of SCUBA diving would be a major issue in Nicaragua and Honduras (FAO 2015b).

INPESCA, coast guard, local villages, and the regional government enforce the closed season by patrolling their respective areas and destroying any traps found ((INPESCA 2015c) (Monnereau 2016)). Traps are required to be removed from the water three days before the end of the fishing season and INPESCA retrieves remaining traps. Enforcement officers found 2,864 lb of lobster during the fishery closure in 56 outlets (INPESCA 2015c).

Although enforcement has been suggested to be in place, there are concerns about the effectiveness and level of enforcement, particularly regarding enforcing trap limits, recalling traps for seasonal closures, capture of undersized lobsters and escape gaps implemented into traps (Table 31.1 (Jameson et al. 2019)).

Enforcement strategies are in place and improved in recent years, but their efficacy is unknown. There is no comprehensive estimate of illegal and unreported fishing, though illegal catches are estimated to range between 10 to 20% (Table 2). There is a monitoring and enforcement strategy to reduce the risk of ghost fishing. Therefore, Seafood Watch deems enforcement as "moderately effective."

Justification:

Nicaraguan fisheries are members of the Central American Integration System (SICA) and the Organization of the Fisheries and Aquaculture Sector of the Central American Isthmus (OSPESCA). They work with the Nicaraguan Army and the National Police to implement enforcement procedures. In both Honduras and Nicaragua, processing and exporting plants and fisheries have collaborated recently to standardize producer identification and registration details and lobster transfer regulations. This will enable increased traceability, sanitary standards, and monitoring and enforcement, therefore reducing the likelihood of illegal lobsters entering foreign markets (FAO 2015a).

Until 2014, a lack of government funds for capacity building, monitoring, and enforcement facilitated weak compliance and enforcement efforts. One of the main issues that undermines Nicaraguan enforcement is the lack of fishery inspectors in areas of high densities of lobster fishing, particularly in the offshore and industrial lobster trap and dive boats. These areas allow the illegal sale of lobster to the national and foreign markets. Municipal inspectors are mainly designated to the artisanal fishery. However, OSPESCA are making regional efforts to reduce illegal fishing by training INPESCA inspectors in illegal fishing prevention (pers. comm., WWF 2017) and to implement port controls that align with the Port State Measures Agreement (PSMA) to prevent illegally caught lobster from entering ports (Pew Charitable Trusts 2017).

Illegal and unreported catch estimates vary: previous studies show that annual fishing quotas are in place, but are regularly exceeded (Monnereau and Pollnac 2012). Such illegal fishing can include the number of illegal incursions of foreign vessels (MRAG Americas 2015c). There have been concerns in the past over trap limits being exceeded (Jameson et al. 2019) (Fanning et al. 2011). There is a lack of up-to-date data to show that trap limits are being exceeded; industrial vessels are limited to holding 2500 traps; however, many vessels often contain up to 6000 traps (Fanning et al. 2011). More monitoring on all fleets and greater controls on the artisanal fleet are required to ensure adherence (pers. comm., WWF 2017) since there is currently no enforcement in place to ensure these restrictions are adhered to (Jameson et al. 2019). The impacts of illegal and unreported catches span to biological, social, and economic issues: illegal and unreported catches decrease the accuracy in stock assessments and can decrease the suitability of management measures such as quotas (Monnereau 2016).

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.

NICARAGUA / CARIBBEAN SEA, DIVING, NICARAGUA
NICARAGUA / CARIBBEAN SEA, POTS, NICARAGUA

Ineffective

The Nicaraguan spiny lobster quota is split almost equally between industrial and artisanal sectors. However, stakeholder inclusion is heavily weighted towards the industrial sector (Monnereau 2016). The processing plants possess overwhelming social and economic power amongst stakeholders and are represented by the Camera de La Pesca, or the Chamber of Fisheries of Nicaragua (CAPENIC), along with members of the industrial fishing fleet (Monnereau 2016). CAPENIC advises the government about the fishery (Monnereau 2016).

The small-scale cooperatives (federation of small-scale fishers or FENICPESCA), represents approximately

half of the fishery, but is not well represented in stakeholder groups (Monnereau 2016). Consequently, the small-scale cooperatives, along with Non-Governmental Organizations (NGOs) have little impact on the management of the fishery towards the processors who own much of the industrial fleet. A symptom of this power deficit is the lack of MPAs designated in the area (Monnereau 2016). Table 6.3 in Monnereau (2016) shows that all of the Nicaraguan spiny lobster fleets have a "low" level of participation in decision making (except from the vessel owners in certain fleets).

There is evidence of corruption in INPESCA: as a consequence, the National Oceanographic and Atmospheric Administration (NOAA) has charged an INPESCA employee and a donor has resigned from funding the organization (Monnereau 2016).

Although some stakeholders are considered in decision-making, influence is weighted strongly in favor of one group, processors, and the industrial fleet. Corruption is evident and offers little information regarding the decision-making process; therefore, stakeholder inclusion is deemed “ineffective.”

Justification:

Nicaragua had a fishery advisory board in place since 2004, called the Comisión Nacional de Pesca, but it is not currently operative and decisions are mainly made by CAPENIC, which is comprised of lobster processing plants/exporters. Additionally, in 2015, a multi-sectoral FIP technical management committee was established to monitor the progress of the FIP and to advise the Nicaraguan government on lobster fishing activities (Hervas 2017). The Nicaraguan Government members also visit stakeholders to understand their needs (Monnereau 2016).

There have been improvements in stakeholder inclusion in the fishery, for example fishers and exporters have made progress in standardizing processes (relating to traceability and sanitary standards in the processing and exporter sector, monitoring of lobster products, and reducing the level of IUU throughout the lobster industry) (FAO 2015a). Due to high illiteracy rates, stakeholder inclusion can be difficult among the artisanal sector. Therefore, there has been a recent effort to communicate more with “Piquineras” who are the women that record fishing activities, catch, and sales. As a group, they are considered highly organized and provide a method of communicating information with fishers (MRAG Americas 2015c).

Criterion 4: Impacts on the Habitat and Ecosystem

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

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

GUIDING PRINCIPLES

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

Rating cannot be Critical for Criterion 4.

Criterion 4 Summary

Region / Method	Gear Type and Substrate	Mitigation of Gear Impacts	EBFM	Score
Nicaragua / Caribbean Sea / Pots / Nicaragua	2	0	Moderate Concern	Yellow (2.449)
Nicaragua / Caribbean Sea / Diving / Nicaragua	4	0	Moderate Concern	Green (3.464)

Criterion 4 Assessment

SCORING GUIDELINES

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

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

- *5 - Fishing gear does not contact the bottom*
- *4 - Vertical line gear*
- *3 - Gears that contacts the bottom, but is not dragged along the bottom (e.g. gillnet, bottom longline, trap) and is not fished on sensitive habitats. Or bottom seine on resilient mud/sand habitats. Or midwater trawl that is known to contact bottom occasionally. Or purse seine known to commonly contact the bottom.*

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

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

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

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

Factor 4.3 - Ecosystem-Based Fisheries Management

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

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

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

NICARAGUA / CARIBBEAN SEA, DIVING, NICARAGUA

4

In the diving fishery, there is very little or no habitat damage; therefore, a score of 4 is provided to this fishery. When divers are fishing for queen conch—which can be the same method used to catch spiny lobster—the fishery indirectly e□ects the habitat by anchoring boats to the seafloor (CFMC 2014). According to CFMC (2014, p. 113), queen conch harvest "is expected to have little to no adverse direct e□ects on the physical environment in general, including *Acropora* species and their designated critical habitat." Therefore, Seafood Watch scores the habitat e□ects of the fishery as "4."

NICARAGUA / CARIBBEAN SEA, POTS, NICARAGUA

2

Spiny lobsters are generally found on rocky substrates and reefs, or wherever protection and shelter can be found (Holthuis 1991). As such, traps are deployed in a variety of habitats including rocky reefs. There is some impact expected on coral reefs, however, this has not been quantified. The vulnerability of habitats where fishing takes place has currently not been determined, and impacts of the various fishing methods must be determined (Valle-Esquivel 2011). Since the fishery can sometimes place traps on reefs, Seafood Watch scores the physical impact on the habitat as "2."

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

NICARAGUA / CARIBBEAN SEA, DIVING, NICARAGUA

0

The proportion of protected waters in Nicaraguan Caribbean waters is unknown. Nicaragua has only recently implemented a process to establish MPAs in the Caribbean waters of Nicaragua, which has been initiated through NGOs and the Nicaraguan state and lobster industry (Monnereau 2016). Nicaragua prohibits industrial fleets from fishing within 25 miles of the cays and islands (FAO 2015a) thereby protecting coastal habitats. However, this measure may be undermined due to the high level of illegal fishing, which includes documented cases of non-registered vessels in the Nicaraguan Exclusive Economic Zone (EEZ) (Hervas 2017).

There are some mitigation measures in place, though it is not known how effective these policies are; therefore, Seafood Watch deems that no mitigation is in place, which scores 0.

NICARAGUA / CARIBBEAN SEA, POTS, NICARAGUA

0

The proportion of protected waters in Nicaraguan Caribbean waters is unknown. Nicaragua has only recently implemented a process to establish MPAs in the Caribbean waters of Nicaragua, which has been initiated through NGOs and the Nicaraguan state and lobster industry (Monnereau 2016). Nicaragua prohibits industrial fleets from fishing within 25 miles of the cays and islands (FAO 2015a), thereby protecting coastal habitats. Caution must be granted when considering these as effective marine protection: with a lack of resources to effectively enforce regulations and a high level of illegal fishing (MRAG Americas 2015c), the efficacy of their protection is limited.

There are some mitigation measures in place, though it is not known how effective these policies are; therefore, Seafood Watch deems that no mitigation is in place, which scores 0.

Justification:

Though there isn't sufficient habitat management for the trap fishery, there is some management that may indirectly reduce the impact on the habitat, e.g., the fishery is effort managed through licence limits (Table 2).

Factor 4.3 - Ecosystem-Based Fisheries Management

NICARAGUA / CARIBBEAN SEA, DIVING, NICARAGUA
NICARAGUA / CARIBBEAN SEA, POTS, NICARAGUA

Moderate Concern

The ecological role of spiny lobsters has not been studied; therefore, the impact of the spiny lobster fishery on the ecosystem is largely unknown and requires study. Ecosystem impacts may involve interactions between traps and coral reefs/sensitive habitats, the effects of ghost fishing on habitats and other species, and the volume of lobster removed from the ecosystem (Hervas 2017).

No known exceptional species are caught in the spiny lobster fishery. However, there have been no efforts to fully assess the ecological impacts of any of the fisheries, and illegal fishing may undermine current understanding of ETP catches (MRAG Americas 2015c).

There is no formal fishery management plan for lionfish, but multiple management plans are being developed through cooperation and communication among local, state, federal, and international partners to attempt to control lionfish populations and their ecosystem impacts (Tsigourakos 2015).

There are no management measures to mitigate impacts on the marine ecosystem; however, trophic cascades are not considered likely. Therefore Seafood Watch deems ecosystem-based fisheries management as a "moderate" concern.

Justification:

There have been improvements in data collection and stock assessments though recommendations focused on improving management practices and creating regional standardized assessments by national fishery organizations such as OSPESCA, the Caribbean Regional Fishery Mechanism (CRFM), and the Western Central Atlantic Fishery Commission (WECAFC) (FAO 2015c).

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

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References

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.

Behringer, D.C. & Butler, M.J. IV. 2006. Density - dependent population dynamics in juvenile Panulirus argus (Latreille): the impact of artificial density enhancement. Journal of Experimental Marine Biology and Ecology, 334, 84 – 95.

Bertelsen, R. and Matthews, T. 2001. Fecundity dynamics of female spiny lobster (Panulirus argus) in a south Florida fishery and Dry Tortugas National Park lobster sanctuary. Marine and Freshwater Research, 52(8), p.1559.

Briones-Fourzan, P. & Lozano-Alvarez, E., 2015. Lobsters: ocean icons in changing times. ICES Journal of Marine Science: Journal du Conseil, 72(suppl 1), P.i1.1-i6. Available at: http://icesjms.oxfordjournals.org/lookup/doi/10.1093/icesjms/fsv111 [Accessed December 5, 2016].

Butler, C.B and Mathews, T.R. 2015. Effects of ghost fishing lobster traps in the Florida Keys. ICES J. Mar. Sci. ICES Journal of Marine Science, 72, i1 –i6. doi:10.1093/icesjms/fsv111. Available at: http://icesjms.oxfordjournals.org/content/early/2015/01/06/icesjms.fsu238

Butler, M., Cockcroft, A., MacDiarmid, A. & Wahle, R. 2011. Panulirus argus. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.1. http://www.iucnredlist.org/details/summary/169976/0.

Caribbean Large Marine Ecosystem (CLME). 2007. FINAL REPORT OF THE PROJECT CONCEPT/TDA SYNTHESIS WORKSHOP. KINGSTON, JAMAICA.

Caribbean Large Marine Ecosystem Project, 2013. 1 March – 30 June 2013: 4th simultaneous seasonal ban on Caribbean Spiny Lobster fisheries in SICA members countries. Available at: http://clmeproject.org/n10.html [Accessed September 8, 2016].

Castro-Perez, J.M., Arias-Gonzalez, J.E., Acosta-Gonzalez, G., & Defeo, O. 2018. Comparison of catch, CPUE and length distribution of spawning aggregations of mutton snapper (Lutjanus analis) and grey triggerfish (Balistes capriscus) on a Mesoamerican coral reef. Lat. Am. J. Aquat. Res., 46(4). pp. 717-726.

CEJIL. 2015. Miskito Divers (Opario Lemoth Morris y otros). Available at: https://cejil.org/en/miskito-divers-opario-lemoth-morris-y-otros. [Accessed on 12.06.2017]

CFMC. 2014. Comprehensive Amendment to the U.S. Caribbean Fishery Management Plans: Annual Catch Limit Control Rule. Caribbean Fishery Management Council and the Naonal Marine Fisheries Service, Southeast Regional Office. San Juan, Puerto Rico. 214 pp.

Chollett, I., Box, S.J., Mumby, P.J., 2016b. Quantifying the squeezing or stretching of fisheries as they adapt to displacement by marine reserves: Reserve Effects on Fishing Activity. Conserv. Biol. 30, 166–175. doi:10.1111/cobi.12573

Chollett, I., Garavelli, L., O'Farrell, S., Cherubin, L., Matthews, T.R., Mumby, P.J., Box, S.J., 2016a. A Genuine Win-Win: Resolving the "Conserve or Catch" Conflict in Marine Reserve Network Design: Reserve networks for fisheries benefits. Conserv. Lett. doi:10.1111/conl.12318.

CLME 2017a. Final report: Regional Workshop on Harmonization and Validation of Forms and Methodologies for Caribbean Spiny Lobster Stock AssessmentPanama City, Panamá. 27 of November to December 1st 2017.

Cornish, A. & Eklund, A.M. 2003. Epinephelus striatus. The IUCN Red List of Threatened Species 2003: e.T7862A12858266. http://dx.doi.org/10.2305/IUCN.UK.2003.RLTS.T7862A12858266.en.

Debels, P., Fanning, L., Mahon, R,. McConney, P., Walker, L., Bahri, T., Haughton, M., McDonald, K., Perez, M., Singh-Rentone, S., Toro, C., Anrooyi, R.V., Khouri, A.V., Whalley, P., 2017. The CLME+ Strategic Action Programme: An ecosystems approach for assessing and managing the Caribbean sea and North Brazil Shelf Large Marine Ecosystems. Environmental Development 22, 191–205.

Durante, L.M., Cruz, I.C.S., Lotufo, T.M.C..2018. The effect of climate change on the distribution of a tropical zoanthid (Palythoa caribaeorum) and its ecological implications. PeerJ 6:e4777; DOI 10.7717/peerj.4777

Earth's Endangered Creatures (EEC). 2016. Endangered Species Search by Area Selection. Available at: http://www.earthsendangered.com/search-regions3.asP. [Accessed September 20, 2016].

Ehrhardt, N. M. 2005a. Population Dynamic Characteristics and Sustainability Mechanisms in Key Western Central Atlantic Spiny Lobster, Panulirus Argus, Fisheries. Bulletin of Marine Science 76(26): 501- 526.

Ehrhardt, N. 2006. Integrated study of the spiny lobster fishery in the Atlantic coast of Nicaragua with special emphasis on the issue of diving. Danish Agency for International Development (DANIDA) Final Report to the Ministry of Development, Industry, and Commerce. Government of Nicaragua. Managua, Nicaragua. April 2006.

Ehrhardt, N., Puga, R., Butler IV, M., 2009. The Caribbean spiny lobster, Panulirus argus, fisheries.

Ehrhardt, N., R. Puga, and M. Butler, IV. 2011. Implications of the ecosystem approach to fisheries management in large ecosystems: The case of the Caribbean spiny lobster, in Fanning, L., R. Mahon, and P. McConney (eds). Towards Marine Ecosystem-Based Management in the Wider Caribbean. Amsterdam University Press: Amsterdam, NLD.

Esquivel, M.V. 2015. Action Plan for Nicaragua's Caribbean Spiny Lobster Trap Fishery Improvement Project (FIP). MRAG Americas, Inc. Report produced for WWF.

Fanning, L., R. Mahon, and P. McConney (eds). 2011. Towards Marine Ecosystem-Based Management in the Wider Caribbean. Amsterdam University Press: Amsterdam, NLD.

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, 2011. Review of the state of world marine fishery resources. FAO Fisheries and Aquaculture Technical Paper No. 569. Rome, FAO. 2011. 334 pp.

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, 2015b. Report of the seventh session of the Scientific Advisory Group, Panama City, Panama, 7–8 November 2015., Bridgetown, Barbados. Available at: http://www.fao.org/fi/static-media/MeetingDocuments/WECAFC16/Ref3t.pdf.

FAO, 2015c. Western Central Atlantic Fishery Commission (WECAFC) Seventh session of the scientific advisory (SAG) in Panama City, Panama, 7-8 November 2015. Available at: ftp://ftp.fao.org/FI/DOCUMENT/wecafc/7th_sag_2015/4e.pdf [Accessed September 5, 2016].

FAO, 2016a. Fisheries Global Information System (FAO-FIGIS) - Web site. Available at: http://www.fao.org/fishery/topic/18042/en [Accessed September 3, 2016].

FAO, 2016b. Report of the WECAFC–FIRMS Data workshop in Christ Church, Barbados, 19–21 January 2016., Rome. Available at: http://www.fao.org/3/a-i5789e.pdf.

FAO. 2016. Western Central Atlantic Fishery Commission Report of the second meeting of the CFMC/OSPESCA/WECAFC/CRFM working group of queen conch. Panama City, Panama, 18-20 November 2014. FAO Fisheries and Aquaculture Report No. 1097. pp.428

FAO, 2017. Panulirus argus (Latreille, 1804) [WWW Document]. URL http://www.fao.org/fishery/species/3445/en [Accessed November 10, 2016].

FAO. 2017b. The world lobster market, by Graciela Pereira and Helga Josupeit, FAO Consultants. Globefish Research Programme Volume 123. Rome, Italy.

FAO/Western Central Atlantic Fishery Commission (WCAFC). 2001. Report on the FAO/DANIDA/CFRAMP/WECAFC Regional Workshops on the Assessment of the Caribbean Spiny Lobster (Panulirus argus). FAO, Belize City, Belize.

FAO/Western Central Atlantic Fishery Commission (WCAFC). 2006. Report of the fifth Regional Workshop on the Assessment and Management of the Caribbean Spiny Lobster. Mérida, Yucatán, Mexico, 19–29 September 2006. FAO Fisheries Report. FAO.

Ferreira, B.P. and Peres, M.B. 2008. Hyporthodus flavolimbatus. The IUCN Red List of Threatened Species 2008: e.T64400A12775324.

Fishchoice, 2015. Spiny Lobster (Caribbean). Available at: http://www.fishchoice.com/buying-guide/spiny-lobster-caribbean [Accessed August 10, 2016].

Fishery Progress. 2018a. Action 2.2 Development of a monitoring strategy for artisanal fisheries. Available at: https://fisheryprogress.org/node/506/actions-progress#overlay=action/613. [Accessed on 28th November 2018]

Foley, J.R. and Takahashi, M. 2017. Shell Lip Thickness Is the Most Reliable Proxy to Sexual Maturity in Queen Conch (Lobatus gigas) of Port Honduras Marine Reserve, Belize; Informing Management to Reduce the Risk of Growth Over?shing. Front. Mar. Sci. 4:179. doi: 10.3389/fmars.2017.00179

GMFMC & South Atlantic Fishery Management Council (SAFMC), NOAA. 2011. Final Amendment 10 to the Fishery Management Plan for Spiny Lobster in the Gulf of Mexico and South Atlantic Including Final Environmental Impact Statement, Regulatory Impact Review, and Regulatory Flexibility Act Analysis.

Gongora, M. 2010. Assessment of Spiny Lobster (Panulirus argus) of Belize based on fishery-dependent data. United Nations University Fisheries Training Programme, Iceland [final project]. Available at: http://www.unuftp.is/static/fellows/document/mauro09prf.pdf

Gutiérrez-García, R.G., 2016a. Propuesta de plan permanente para el control y la estimación de la captura

ilegal, no declarada y no reglamentada (INDNR) de la Langosta Espinosa del Caribe de Nicaragua or Proposal for a permanent plan for the control and Estimation of illegal, undeclared and non- Regulation (IUU) of the Spiny Lobster of the Caribbean of Nicaragua.

Gutiérrez-García, R.G., 2016b. DOCUMENTACIÓN DE LAS ACCIONES Y PROCEDIMIENTOS RELACIONADOS CON LA EVALUACIÓN Y SEGUIMIENTO DE LA LANGOSTA Panulirus argus DEL CARIBE DE NICARAGUA.

Harnish, L. and J.H. Martin Willison. 2009. Efficiency of bait usage in the Nova Scotia lobster fishery: a first look. Journal of Cleaner Production 17(3): 345-347.

Heatwole, D.W., J.H. Hunt, and F.S. Kennedy, Jr. 1988. Catch efficiencies of live lobster decoys and other attractants in the Florida spiny lobster fishery. Florida Marine Resources Publication 44. 15 pages.

Hernández-Flores, A. 2015. The Cost of Avoiding Sea Cucumber stock depletion. North American Association of Fisheries Economists NAAFE 2015 Biennial Forum, Ketchikan, Alaska, May 22, 2015.

Hervás, A. 2016. Action Plan for the Honduras Caribbean Spiny Lobster (Panulirus argus) Fishery Improvement Project (FIP): Updated Version.

Hervás, A. 2017. Plan de Acción del Proyecto de Mejoramiento Pesquero (FIP) de la Pesquería de Langosta Espinosa (Panulirus argus) del Caribe de Nicaragua con la modalidad de pesca con nasas or Plan of Action of the Fisheries Improvement (FIP) Spiny Lobster (Panulirus argus) from the Caribbean with the modality of dishing with pots.

Hilborn, R., Walters, C.J. 1992. Quantitative Fisheries Stock Assessment: Choice, Dynamics and Uncertainty. Chapman & Hall, New York, p570

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 IBAMA 2008. Plano de gestão para o uso sustentável de Lagostas no Brasil

INPESCA, 2014. Anuario Pesquero y Acuicola 2013. Instituto Nicaraguense de la Pesca Y Acuicultura, Queen Conch Working Group, Second Meeting. Documents for the November 18-20, 2014 Meeting. Panamá City, Panamá. Available at:
http://www.inpesca.gob.ni/images/ANUARIO%20PESQUERO%20Y%20ACUICOLA%20%20DE%20NICARAGUA%2

INPESCA, 2015a. ANUARIO PESQUERO Y ACUICOLA 2015. Available at:
http://www.inpesca.gob.ni/images/DocumentosSubidos2016/ANUARIO%20PESQUERO%20Y%20ACUICOLA%20D

INPESCA, 2015c. Informe final de la veda de la langosta del mar caribe nicaraguense Panulirus argus, basado en la legislacion nacional y la reglamentacion regional OSP-02-09. Available at:
http://www.inpesca.gob.ni/images/DocumentosSubidos2016/INFORME%20FINAL%20DE%20VEDA%20LANGOST

INPESCA. 2015b. The Final Report of the Ban of the Spiny Lobster, Panulirus argus, in the Caribbean Sea, Nicaragua, Based on the National Legislation Regulations and Regional OSP- 02-09. Report by the Monitoring Directorate of surveillance and Control, INPESCA. Managua, Nicaragua.

INPESCA, 2016. PROPUESTA DE PLAN DE MANEJO PESQUERO (PMP) PARA LA LANGOSTA ESPINOSA (Panulirus argus) DEL CARIBE NICARAGÜENSE.

IOCARIBE. 2007. CLME Full Project Component 4: Spiny Lobster Pilot Project. Available at: https://www.researchgate.net/publication/242137701_CLME_Full_Project_Component_4_Spiny_Lobster_Pilot_Pr

IUCN, 2011. Panulirus argus. Available at: http://www.iucnredlist.org/details/summary/169976/0 [Accessed August 9, 2016].

Jackson, J.B.C., Donovan, M.K., Cramer, K.L., Lam, V.V., (eds). 2014. Status and trends of Caribbean coral reefs: 1970-2012. Global Coral Reef Monitoring Network, IUCN, Gland, Switzerland, 304 pp.

Jameson, S.C., Stevens, K., Bennett, R.C., 2019. Nicaragua: Caribbean Coast, in: World Seas: An Environmental Evaluation. Elsevier, pp. 725–741.

Johnston, M.W., Bernard, A.M., Shivji, M.S. 2017. Forecasting lionfish sources and sinks in the Atlantic: are Gulf of Mexico reef fisheries at risk? Coral Reefs. 36:169–181

Kramer, P., Kramer, P.R., Arias, E, Mcfield, M.D. 2014. 16. STATUS OF CORAL REEFS OF NORTHERN CENTRAL AMERICA: MEXICO, BELIZE, GUATEMALA, HONDURAS, NICARAGUA AND EL SALVADOR.

La Gaceta. 1991. DECLARATION OF THE MARINE BIOLOGICAL RESERVE "CAYOS MISKITOS AND IMMEDIATE COASTAL STRIP" DECREE No. 43-91 of October 1, 1991.

La Gaceta. 2017a. Article 5: Decreto actualizacion de las medidas de ordenamiento para la pesqueria de pepino de mar del litoral Caribe. (Decree update of the ordering measures for the sea cucumber fishery of the Caribbean coast). Number 241. 19th December 2017.

Lazarre, D., 2016. Examining the Lionfish Invasion: How Growth and Recruitment Relates to Connectivity and Controls. University of Miami. Available at: http://scholarlyrepository.miami.edu/oa_dissertations/1721/.

Lindeman, K., Anderson, W., Carpenter, K.E., Claro, R., Cowan, J., Padovani-Ferreira, B., Rocha, L.A., Sedberry, G. & Zapp-Sluis, M. 2016. Lutjanus cyanopterus. The IUCN Red List of Threatened Species 2016: e.T12417A506633.

López, V.P.Z. 2010. Evaluación Socioeconómica de las Comunidades Pesqueras de Langosta en la Mosquitia de Honduras y Nicaragua. Report produced for WWF and USAID. Available at: https://s3-us-west-2.amazonaws.com/sfwart/comments/59600/Informe-SOCMON-Mosquitia_2010.pdf

Matthews, T.R. 2001, Trap induced mortality of the spiny lobster, Panulirus argus, in Florida, USA. Marine Freshwater Research. 52: 1509-1516.

Matthews, T.R. 2001, Trap induced mortality of the spiny lobster, Panulirus argus, in Florida, USA. Marine Freshwater Research. 52:1509-1516. Available at: http://www.publish.csiro.au.stanford.idm.oclc.org/mf/pdf/MF01192

Maxwell, K., Matthews, T., Sheehy, M., Bertelsen, R. and Derby, C. 2007a. Neurolipofuscin Is a Measure of Age in Panulirus argus, the Caribbean Spiny Lobster, in Florida. The Biological Bulletin, 213(1), pp.55-66.

Monnereau, I., 2016. The red gold rush: the impact of governance styles on value chains and the well-being of lobster fishers in the wider Caribbean, Amsterdam. Available at: http://dare.uva.nl/document/2/113103.

Monnereau, I. and R. Pollnac. 2012. Which Fishers are Satisfied in the Caribbean? A Comparative Analysis of Job Satisfaction among Caribbean Lobster Fishers. Social Indicators Research 109:95– 118.

MRAG, 2012. MSC Public Certification Report for Sian Ka'an and Banco Chinchorro Biosphere Reserves Spiny Lobster fishery, St. Petersburg, Florida.

MRAG, 2013. Action plan for Nicaragua's Caribbean spiny lobster trap fishery improvement Project (FIP). Prepared for WWF.

MRAG, 2014. Action Plan for Nicaragua's Caribbean Spiny Lobster Trap Fishery Improvement Project (FIP), Available at: http://seafoodsustainability.org/wp-content/uploads/2015/10/Action_Plan_Nicaragua_Lobster_2014.pdf.

MRAG, 2015b. Description of the procedures used for the control of the annual global capacity (CGAC) and the fishing effort applied to the spiny lobster fishery Panulirus argus OF THE CARIBBEAN OF NICARAGUA, Managua.

MRAG, 2015c. Second Review of the Nicaragua Spiny Lobster Fishery Improvement Project, Managua, Nicaragua.

Navarro, R.A.B. 2014. Informe nacional de Nicaragua. Second meeting of the Queen Conch (Strombus gigas) Working Group. Documents for the November 18-20, 2014 Meeting, Panamá City, Panamá.

NMFS, 2014a. Queen Conch, Strombus gigas (Linnaeus 1758) Status Report. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Report ID236. Silver Spring, MD. 104 pp.

NMFS, 2014b. Sustainable Fisheries review and input on the Draft Queen Conch 12-month Listing Determination. National Marine Fisheries Service, Southeast Regional Office, Sustainable Fisheries Division. St. Petersburg, FL.

NMFS, 2014c. Nassau Grouper, Epinephelus striatus (Bloch 1792)Biological Report. Available at: http://sero.nmfs.noaa.gov/protected_resources/listing_petitions/documents/biological_report.pdf.

NMFS, 2018. Commercial Fisheries Statistics. https://www.st.nmfs.noaa.gov/commercial-fisheries/commercial-landings/index

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.

Pew Charitable Trust. 2017. 8-Country Commitment Shows Central America Is Serious About Ending Illegal Fishing. Available at: http://www.pewtrusts.org/en/research-and-analysis/blogs/compass-points/2017/02/15/8-country-commitment-shows-central-america-is-serious-about-ending-illegal-fishing [Accessed on 3 March 2017].

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

Poot-Salazar, A., Hernandez-Flores, A., Ardisson, P.2014. Use of the SLW index to calculate growth function in the sea cucumber Isostichopus badionotus. Nature, 4 : 5151.

Prada, M.C. and Appeldoorn, R.S. 2014. Regional queen conch fisheries management and conservation plan.

Second Meeting of the CFMC/WECAFC/CITES/OSPESCA/CRFM Working Group on Queen Conch. November 2014. San Juan, Puerto Rico. 43 pp.

Purcell, S.W. 2010. Managing sea cucumber fisheries with an ecosystem approach. Edited/compiled by Lovatelli, A.; M. Vasconcellos and Y. Yimin. FAO Fisheries and Aquaculture Technical Paper. No. 520. Rome, FAO. 2010. 157p

Rogers, A. Hamel, J. and Mercier, A. 2017a. BECHE-DE-MER: Information Bulletin: From life-sustaining to life-threatening: The case of the sea cucumber fishery in Nicaragua. Pacific Community. Issue 37. March 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.

Seudeal, N. 2013. "Panulirus argus", Animal Diversity Web. Available at: http://animaldiversity.org/accounts/Panulirus_argus/. [Accessed September 10, 2016].

Shester, G.G., Micheli, F., 2011. Conservation challenges for small-scale fisheries: Bycatch and habitat impacts of traps and gillnets. Biol. Conserv. 144, 1673–1681. doi:10.1016/j.biocon.2011.02.023.

Sosa-Cordero, E., 2010. Evaluación del recurso langosta Panulirus argus en la plataforma de Honduras y Nicaragua, a partir de datos del programa de observadores colectados en dos temporadas 2007-2008; 2009-2010, México.

Toral-Granda, M.V, Alvarado, J.J., Benavides, M., Paola Ortiz, E., Mercier, A. & Hamel, J.-F. 2013b. Holothuria mexicana (errata version published in 2016). The IUCN Red List of Threatened Species 2013: e.T180492A102419104. http://dx.doi.org/10.2305/IUCN.UK.2013-1.RLTS.T180492A1637654.en. Downloaded on 05 October 2018

Toral-Granda, M.V, Alvarado, J.J., Hamel, J.-F., Mercier, A., Benavides, M. & Paola Ortiz, E. 2013. Isostichopus badionotus (errata version published in 2016). The IUCN Red List of Threatened Species 2013: e.T180519A102420305.

Truelove, N., Ley-Cooper, K., Segura-Garcíab, R. Briones-Fourzánd, P., Lozano-Álvarezd, E., Phillips B.F., Box, S.J., Preziosia, R.F., 2015b. No Genetic analysis reveals temporal population structure in Caribbean spiny lobster (Panulirus argus) within marine protected areas in Mexico. Fisheries Research, 172, pP.44–49. Available at: http://www.sciencedirect.com/science/article/pii/S0165783615001794.

Truelove, N.K., Griffiths, S., Ley-cooper, K., Azueta, J., Majil, I., Box, S.J., Behringer, D.C.,Butler, M.J., Preziosi, R.F., 2015a. Genetic evidence from the spiny lobster fishery supports international cooperation among Central American marine protected areas. Conservation Genetics, 16(2), pP.347–358. Available at: http://link.springer.com/article/10.1007/s10592-014-0662-4.

Tsigourakos, V. 2015. Lionfish Management Workshop at the Gulf and Caribbean Fisheries Institute Meeting November 12th, 2015, Panamá

Uhrin, A.V., 2016. Tropical cyclones, derelict traps, and the future of the Florida Keys commercial spiny lobster fishery. Mar. Policy 69, 84–91. doi:10.1016/j.marpol.2016.04.009

USFWS. 2012. Importing queen conch - What you need to know. U.S. Fish & Wildlife Service, Office of

International Affairs. Arlington, VA.

Uthicke, S., Byrne, M., Conand, C. 2010. Genetic barcoding of commercial Beˆche-de-mer species(Echinodermata: Holothuroidea). Molecular Ecology Resources. 10, 634–646. doi: 10.1111/j.1755-0998.2009.02826.x

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.

van Gerwen, I., 2013. The effects of trap fisheries on the populations of Caribbean spiny lobster and reef fish species at the Saba Bank, Wageningen. Available at: http://www.dcbd.nl/sites/www.dcbd.nl/files/documents/Gerwen 2013Thesis_AFI_ImkeVanGerwen_FEB2014_FINAL.pdf.

Vidal, L. & Basurto, M. 2003. A preliminary trophic model of Bahía de la Ascensión, Quintana Roo, Mexico. Fisheries Centre Research Reports,11, 255 – 264.

Walters, C & Maguire, J.J. 1996. Lessons for stock assessment from the northern cod collapse. Rev. Fish. Biol. Fish. 6, 125-137.

Winterbottom, M., Haughton, M., Mutrie, E. & Grieve, K. 2012. Management of the Spiny Lobster Fishery in CARICOM Countries: Status and Recommendations for Conservation, Puerto Morelos, Mexico. Available at: http://nsgl.gso.uri.edu/flsgp/flsgpw11001/papers/086.pdf.

World Bank, 2015. Marine protected areas (% of territorial waters). Available at: http://data.worldbank.org/indicator/ER.MRN.PTMR.ZS. [Accessed September 8, 2016].

WWF, 2015b. Tracking sheet Nicaraguan Spiny Lobster, Available at: http://seafoodsustainability.org/wp-content/uploads/2015/10/Tracking_Sheet_Nicaragua_Lobster_H2_2015.pdf.

WWF. 2015a. National Fish and Wildlife Foundation WWF Sub award agreement from Smithsonian Institution FINAL PROGRAMMATIC REPORT

WWF, 2016a. Nicaragua Lobster. Available at: http://fisheryimprovementprojects.org/fip/nicaragua-lobster-fishery-improvement-project [Accessed September 8, 2016].

WWF, 2016b. Tercera reunión de revisión del Proyecto de Mejoramiento Pesquero (FIP) de la esquería de la langosta espinosa (Panulirus argus) con nasa de Nicaragua. Or Third review meeting of the Improvement Project Fishery (FIP) of the fishery for Spiny lobster (Panulirus argus) with pots from Nicaragua. 18th November 2016.

Zacarías-Soto, M., Olvera-Novoa, M.A., Pensamiento-Villarauz, S., Sanchez-Tapia, I. 2013. Spawning and Larval Development of the Four-Sided Sea Cucumber, Isostichopus badionotus (Selenka 1867), under Controlled Conditions. World Aquaculture Society 44, 5: 694 - 705.

Appendix A: Extra By Catch Species

SNAPPERS

Factor 2.1 - Abundance

NICARAGUA / CARIBBEAN SEA, DIVING, NICARAGUA
NICARAGUA / CARIBBEAN SEA, POTS, NICARAGUA

High Concern

Snappers are retained in Nicaraguan spiny lobster dive fisheries (INPESCA 2016), however, they are not identified to species level. Most of these species are not considered at risk, though some snapper in Nicaragua are endangered including Cubera snapper (*Lutjanus cyanopterus*) (Lindeman et al. 2016).

Since some snappers are assumed to be highly vulnerable, Seafood Watch deems abundance a "high" concern.

Factor 2.2 - Fishing Mortality

NICARAGUA / CARIBBEAN SEA, DIVING, NICARAGUA
NICARAGUA / CARIBBEAN SEA, POTS, NICARAGUA

Low Concern

There are no data available about snapper species caught, though available data show that collectively they make up less than 5% of total catch in traps (INPESCA 2016). In the absence of fishery specific impacts to this group the Unknown Bycatch Matrix has been used, which determines the impact of trap and dive fisheries on finfish is a "low" concern.

Factor 2.3 - Discard Rate

NICARAGUA / CARIBBEAN SEA, DIVING, NICARAGUA

< 100%

The freedive and hand-harvest fisheries do not result in large numbers of non-targeted species. As a result, the Caribbean spiny lobster fishery is extremely selective and results in very little incidental catch.

Diving requires no bait use and is a very selective fishing method; therefore, it receives a factor score of 1.

NICARAGUA / CARIBBEAN SEA, POTS, NICARAGUA

≥ 100%

There are no specific data on discarding from the Nicaraguan fishery; therefore, a similar fishery has been used as a proxy. Total discard rates given by Shester and Micheli (2011) for Mexican spiny lobster trap fisheries are presented as 15% (Shester and Micheli 2011). This figure includes the invertebrates that are most often returned to the water alive. Bait use in Nicaragua normally consists of cowhide (López 2010) (Monnereau 2016).

Since discards plus bait use is likely to represent less than 100% of total landings, Seafood Watch scores discards and bait use as 1.

QUEEN CONCH

Factor 2.1 - Abundance

NICARAGUA / CARIBBEAN SEA, DIVING, NICARAGUA

High Concern

The most recent full stock assessment of queen conch is from 2014. There are no reference points to determine if the stock is healthy, though data-limited indicators suggest conflicting results: although average length has remained stable, other data-limited indicators suggest declines (percentage of mature individuals, lip thickness, and density of adults) (FAO 2016c).

Since the productivity-susceptibility analysis deems conch as "highly vulnerable" and data-limited indicators are showing conflicting results, Seafood Watch deems the abundance of queen conch in Nicaragua a "high" concern.

Justification:

The percentages of juveniles captured has increased from 11% (2009 survey), 34% (2012 survey) to 20% (2013 survey). The percentage of sexually mature individuals (for both sexes) declined from 93 (2009 survey) to 65 (2012 survey) and 85% (2013 survey). Therefore, the percentage of mature conch has declined, although the proportion of juveniles has increased (FAO 2016c).

Abundance estimates increased from a 2004 estimate of 112 individuals/ha to 176 to 267 individuals/ha in 2009 (number of individuals varied in the 2009 survey dependent on month, location, and depth). In the 2009 survey, juvenile densities reached 1,715 individuals/ha (NMFS 2014a) (NMFS 2014b).

Surveys were also conducted in December 2012 and May 2013. Densities of individuals/ha overall declined from 136 individuals/ ha (2009 survey) to 96 individuals/ha (2012 survey) followed by an increase to 119 individuals/ha (2013 survey) (FAO 2016c). Average size/siphonal length remained similar: 228 mm (2009 survey), 232 mm (2012 survey) and 222 mm (2013 survey). Average lip thickness (for both sexes) declined from 19 mm (2009 survey) to 10 mm (2012 survey) and then 15 mm (2013 survey) (FAO 2016c). Therefore, average length has remained stable, although lip thickness has declined.

Lip thickness is considered a more reliable measure of reproductive maturity than shell length (Foley and Takahashi 2017) because once conch is mature, it stops growing, but its lip thickness continues to increase; therefore, it is easier to continue to measure its life-stage and growth (Prada and Appeldoorn 2014). Because of this, lip thickness limits are considered a strong tool to manage juvenile mortality and reduce risk of growth overfishing (Foley and Takahashi 2017).

Productivity-Susceptibility Analysis

PSA score = 3.60555127546. For this reason, the species is deemed "highly vulnerable" (detailed scoring of each attribute is shown below).

Productivity Attribute	Relevant Information	Score (1 = low risk, 2 = medium risk, 3 = high risk)
Average age at maturity	3 1/2 to 4 years (pers. comm., Anonymous 2016)	1
Average maximum age	30 years (NMFS 2014a).	3

Fecundity	1 million eggs (NMFS 2014a)	1
Reproductive strategy	Demersal egg layer	2
Density dependence (invertebrates only)	Density dependence; susceptible to Allee effects (NMFS 2014a)	3
Quality of habitat	Habitat has been moderately altered by non-fishing impacts*	2

*Although there is very little information species specifically relating to the quality of benthic habitat in the Caribbean Nicaragua (Durante et al. 2018), "habitat degradation is a severe problem across the CLME + region", where CLME is the Caribbean Large Marine Ecosystem Project. The degradation is associated with anthropogenic activities including: "tourism, industry, agriculture, fisheries, shipping, real estate development and housing, and land reclamation" (Debels et al. 2017). The degradation discussed in literature has mainly focused on the scale of coral cover loss in the region e.g. in (Jackson et al. 2014) and (Kramer et al. 2014).

Susceptibility Attribute	**Relevant Information**	**Score (1 = low risk, 2 = medium risk, 3 = high risk)**
Areal overlap (Considers all fisheries)	>30% of the species concentration is fished, considering all fisheries.	3
Vertical overlap (Considers all fisheries)	High degree of overlap between fishing depths and depth range of species	3
Selectivity of fishery (Specific to fishery under assessment)	Species is targeted or is incidentally encountered AND Attributes of the fishery, in combination with the species' biology or behavior, increase its susceptibility to the gear. For example illegal fishing takes place on undersized or berried females (MRAG Americas 2013).	3
Post-capture mortality (Specific to fishery under assessment)	Retained species	3

P = ((1+3+1+2+3+2)/6) = 2

$P^2 = 4$

S = (((3 * 3 * 3) − 1)/40) + 1

S = ((81-1)/40)+1

S = 3

$S^2 = 9$

V = √ (P2 + S2)

V = √ (4 + 9) = √13

PSA score = 3.60555127546 = High Vulnerability

Factor 2.2 - Fishing Mortality

NICARAGUA / CARIBBEAN SEA, DIVING, NICARAGUA

Moderate Concern

Nicaragua allows SCUBA and hookah as part of an industrial commercial queen conch fishery. Industrial landings and exports have increased dramatically since 2008 (FAO 2016c). There are no reference points for the stock; therefore, it is unknown whether fishing mortality is at a sustainable level.

Conch are a retained species in the spiny lobster fishery. Spiny lobster fishers (during the spiny lobster season) catch 60% of the total conch catch; the remaining catch takes place when lobster season is closed (NMFS 2014a) (Navarro 2014). However, this is likely to change as the conch season now occurs when the spiny lobster season is closed (FAO 2016c).

Therefore, Seafood Watch deems the mortality of queen conch in Nicaragua as "moderate" concern.

Justification:

Since 2008, landings have increased from 56.47 MT to 603.4 MT (1,330,459 lb) in 2013 (Figures 10 and 11) (NMFS 2014a);(INPESCA 2014). Nearly all the landings are exported (Figure 12)(NMFS 2014a).

DESEMBARQUES Y PRODUCCION REGISTRADA DE LOS RECURSOS PESQUEROS Y ACUICOLAS (en libras)
AMBOS OCEANOS Y AGUAS CONTINENTALES

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Representación porcentual en el 2015
Caracol filete (100% limpio)	271,016	120,129	278,552	490,759	805,741	761,313	1,034,168	1,330,459	1,618,812	1,535,396	1.70

Figure 10 Total queen conch landings from Caribbean Nicaragua in tons of fillet 100% clean. Source: (INPESCA 2015a).

Figure 11 Nicaragua's queen conch (filleted) landings and exports by weight from 2006-2015. Source: (INPESCA 2015a).

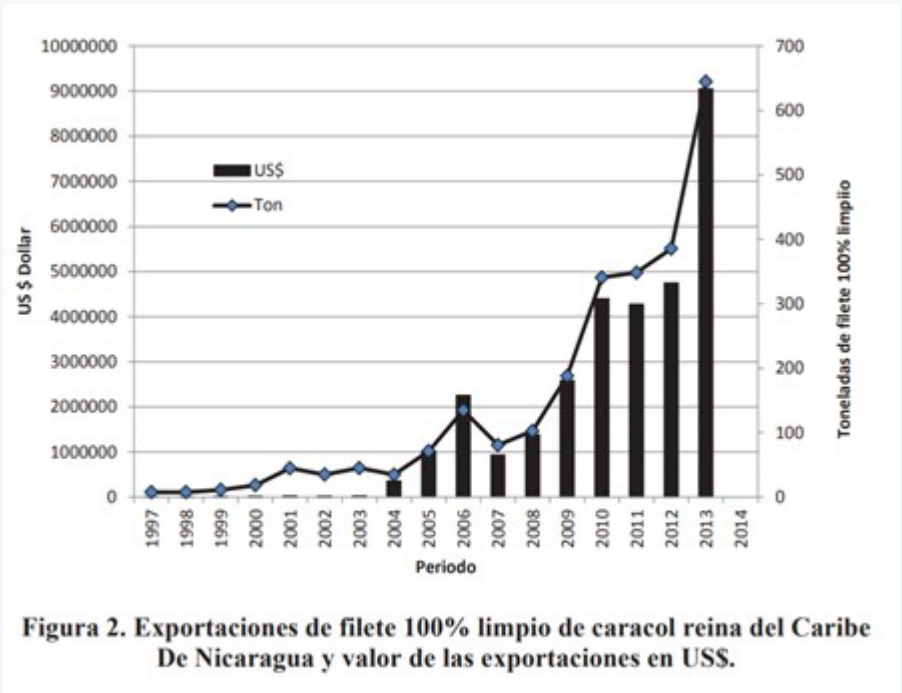

Figure 12 Exports of 100% Clean Queen Conch Fillet from Nicaragua and value of exports in US $. Source (FAO 2016c).

Factor 2.3 - Discard Rate

NICARAGUA / CARIBBEAN SEA, DIVING, NICARAGUA

< 100%

The freedive and hand-harvest fisheries do not result in large numbers of non-targeted species. As a result, the Caribbean spiny lobster fishery is extremely selective and results in very little incidental catch.

Diving requires no bait use and is a very selective fishing method; therefore, it receives a factor score of 1.

BENTHIC INVERTS

Factor 2.1 - Abundance

NICARAGUA / CARIBBEAN SEA, DIVING, NICARAGUA
NICARAGUA / CARIBBEAN SEA, POTS, NICARAGUA

Moderate Concern

There is no information available on the type of crabs caught in the Nicaraguan crab fishery, though it is believed that hermit crabs are caught as bycatch in traps (Hervas 2017). Seafood Watch considers abundance of unknown invertebrates in trap fisheries as a "moderate" concern.

Factor 2.2 - Fishing Mortality

NICARAGUA / CARIBBEAN SEA, DIVING, NICARAGUA

Moderate Concern

Fishing mortality is unknown, since the catch is not recorded at species level. Various crab species are known to be retained in dive fisheries (INPESCA 2016).

Since various crab species are caught and some are retained in the fishery, Seafood Watch deems fishing mortality a "moderate" concern.

NICARAGUA / CARIBBEAN SEA, POTS, NICARAGUA

Low Concern

Fishing mortality is unknown, since the catch is not recorded at species level. Hermit crabs have been reported as a bycatch species in pots (Hervas 2017). It is unclear whether hermit crabs or other invertebrates are retained.

Since various crab species are caught in the fishery, the unknown bycatch matrix deems fishing mortality a "low" concern.

Factor 2.3 - Discard Rate

NICARAGUA / CARIBBEAN SEA, DIVING, NICARAGUA

< 100%

The freedive and hand-harvest fisheries do not result in large numbers of non-targeted species. As a result, the Caribbean spiny lobster fishery is extremely selective and results in very little incidental catch.

Diving requires no bait use and is a very selective fishing method; therefore, it receives a factor score of 1.

NICARAGUA / CARIBBEAN SEA, POTS, NICARAGUA

≥ 100%

There are no specific data on discarding from the Nicaraguan fishery; therefore, a similar fishery has been used as a proxy. Total discard rates given by Shester and Micheli (2011) for Mexican spiny lobster trap fisheries are presented as 15% (Shester and Micheli 2011). This figure includes the invertebrates that are most often returned to the water alive. Bait use in Nicaragua normally consists of cowhide (López 2010) (Monnereau 2016).

Since discards plus bait use is likely to represent less than 100% of total landings, Seafood Watch scores discards and bait use as 1.

RED LIONFISH

Factor 2.1 - Abundance

NICARAGUA / CARIBBEAN SEA, POTS, NICARAGUA

Very Low Concern

Lionfish are an invasive species (Johnston et al. 2017); their population is expanding rapidly in terms of abundance and geographic range due to their biological attributes, adaptiveness to various habitats, and high competitive ability (e.g., due to their venomous spines) (MRAG Americas 2015c). Since lionfish are an invasive species, Seafood Watch scores abundance as a "very low" concern.

Factor 2.2 - Fishing Mortality

NICARAGUA / CARIBBEAN SEA, POTS, NICARAGUA

Low Concern

A stock assessment for lionfish has not yet been conducted; as such, there is no formal metric for fishing mortality. However, lionfish are invasive in the western Atlantic Ocean, Caribbean Sea and Gulf of Mexico (Johnston et al. 2017). Therefore, fishery managers want to reduce their abundance. Because of this, we have rated this factor as "low" concern.

Factor 2.3 - Discard Rate

NICARAGUA / CARIBBEAN SEA, POTS, NICARAGUA

≥ 100%

There are no specific data on discarding from the Nicaraguan fishery; therefore, a similar fishery has been used as a proxy. Total discard rates given by Shester and Micheli (2011) for Mexican spiny lobster trap fisheries are presented as 15% (Shester and Micheli 2011). This figure includes the invertebrates that are most often returned to the water alive. Bait use in Nicaragua normally consists of cowhide (López 2010)

(Monnereau 2016).

Since discards plus bait use is likely to represent less than 100% of total landings, Seafood Watch scores discards and bait use as 1.

YELLOWTAIL SNAPPER

Factor 2.1 - Abundance

NICARAGUA / CARIBBEAN SEA, POTS, NICARAGUA

Moderate Concern

Biomass of yellowtail snapper is unknown; however, they are not considered an ETP species. Since there is no information available regarding their abundance, they are considered an unknown finfish and scored as a "moderate" concern.

Factor 2.2 - Fishing Mortality

NICARAGUA / CARIBBEAN SEA, POTS, NICARAGUA

Moderate Concern

Fishing mortality is unknown relative to reference points. Therefore, Seafood Watch deems fishing mortality a "moderate" concern.

Factor 2.3 - Discard Rate

NICARAGUA / CARIBBEAN SEA, POTS, NICARAGUA

≥ 100%

There are no specific data on discarding from the Nicaraguan fishery; therefore, a similar fishery has been used as a proxy. Total discard rates given by Shester and Micheli (2011) for Mexican spiny lobster trap fisheries are presented as 15% (Shester and Micheli 2011). This figure includes the invertebrates that are most often returned to the water alive. Bait use in Nicaragua normally consists of cowhide (López 2010) (Monnereau 2016).

Since discards plus bait use is likely to represent less than 100% of total landings, Seafood Watch scores discards and bait use as 1.