Caribbean spiny lobster

Panulirus argus

Florida

Pots

December 19, 2018

Seafood Watch Consulting Researcher

Disclaimer
Seafood Watch strives to have all Seafood Reports reviewed for accuracy and completeness by external scientists with expertise in ecology, fisheries science and aquaculture. Scientific review, however, does not constitute an endorsement of the Seafood Watch program or its recommendations on the part of the reviewing scientists. Seafood Watch is solely responsible for the conclusions reached in this report.

Seafood Watch Standard used in this assessment: Standard for Fisheries vF3
## Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>About Seafood Watch</td>
<td>3</td>
</tr>
<tr>
<td>Guiding Principles</td>
<td>4</td>
</tr>
<tr>
<td>Summary</td>
<td>5</td>
</tr>
<tr>
<td>Final Seafood Recommendations</td>
<td>6</td>
</tr>
<tr>
<td>Introduction</td>
<td>7</td>
</tr>
<tr>
<td>Assessment</td>
<td>10</td>
</tr>
<tr>
<td>Criterion 1: Impacts on the Species Under Assessment</td>
<td>10</td>
</tr>
<tr>
<td>Criterion 2: Impacts on Other Species</td>
<td>16</td>
</tr>
<tr>
<td>Criterion 3: Management Effectiveness</td>
<td>22</td>
</tr>
<tr>
<td>Criterion 4: Impacts on the Habitat and Ecosystem</td>
<td>30</td>
</tr>
<tr>
<td>Acknowledgements</td>
<td>36</td>
</tr>
<tr>
<td>References</td>
<td>37</td>
</tr>
<tr>
<td>Appendix A: Extra By Catch Species</td>
<td>46</td>
</tr>
<tr>
<td>Appendix B: A</td>
<td>54</td>
</tr>
<tr>
<td>Appendix C: B</td>
<td>55</td>
</tr>
</tbody>
</table>
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 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

The Caribbean spiny lobster (*Panulirus argus*) is fished with traps in and around Florida in both state and federal waters.

They tend to mature fairly quickly (between 1 and 2 years at the earliest) and the minimum harvest size tends to be before most lobsters reach the age of maturity. The lifespan is estimated at 20 years, but most lobsters are harvested before age 3. Mature spiny lobsters spawn at least once, but older lobsters typically spawn three times per year. Females at minimum harvest size can produce around 300,000 eggs per clutch, but females just one year older and large likely produce three clutches of 680,000 eggs. Larvae from these eggs can disperse widely leaving Florida and US waters and likewise arriving in Florida from distant locations in the Caribbean.

The Caribbean spiny lobster stock is not assessed regularly: stock assessments were conducted in 2005 and 2010. The last assessment, in 2010, was rejected by the Stock Assessment Council due to lack of confidence in the reference points. This is mainly because of lack of data regarding the recruitment levels as populations come from the Caribbean. The Florida fishery seems to be experiencing steady landing rates. However, the stock status of Caribbean spiny lobster is essentially unknown. Fishing mortality follows a similar pattern to that of stock abundance, but is also essentially unknown due to recruitment dependence of lobster fished in other Caribbean and Central American countries. The impact of the fishery on spiny lobster in Florida is deemed a "moderate" conservation concern.

Traps have relatively low bycatch rates: the most common non-targeted species caught in the lobster fisheries include white grunts (*Haemulon plumieri*) and stone crabs (*Menippe* spp.). Various other finfish and invertebrates, such as grouper, hogfish, snapper, hermit crabs, arrow crabs, and spider crabs comprise no more than 5% of the catch. White grunts and stone crabs are assessed under Criterion 2, but have low inherent vulnerability and are not overfished or undergoing overfishing. Discard rates are estimated at 8% to 15%. This includes captured invertebrates, which are most often returned to the water alive, but does not include the bait used. In the Florida lobster fishery, live, undersized (and sometimes legal sized) lobster are used as an attractant for other lobsters in lieu of baiting the traps.

Management of the spiny lobster fishery in Florida has been effective at maintaining a relatively stable population over time. Lobster populations are protected using an annual catch limit, minimum sizes, closed areas, and specific seasons to protect breeding females; an allowable number of sub-legal sized lobsters are used as attractants, gear restrictions, licenses, and trap limits. However, management is undermined as the stock status is unknown. Therefore, it is unknown if management is effective at maintaining the stock. Enforcement of existing regulations has increased in recent years and results in punishments for illegal fishing and poaching. Overall, the spiny lobster fishery is scored as yellow.

The commercial spiny lobster fishery in Florida is almost entirely trap based (a small amount are caught via commercial diving and fishing using bully nets; however, this is not considered within the scope of this report). Traps result in some damage to the benthic habitat, but both state and federal waters off the coast of Florida maintain networks of various representative habitats protected from fishing, particularly where sensitive corals are found. To mitigate this impact, 60 are areas closed for the specific reason of protecting Acropora coral species. The ecosystem impacts from the trap fishery are a "moderate" conservation concern.
Final Seafood Recommendations

<table>
<thead>
<tr>
<th>SPECIES/FISHERY</th>
<th>CRITERION 1: IMPACTS ON THE SPECIES</th>
<th>CRITERION 2: IMPACTS ON OTHER SPECIES</th>
<th>CRITERION 3: MANAGEMENT EFFECTIVENESS</th>
<th>CRITERION 4: HABITAT AND ECOSYSTEM</th>
<th>OVERALL RECOMMENDATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caribbean spiny lobster</td>
<td>Yellow (2.644)</td>
<td>Yellow (2.236)</td>
<td>Yellow (3.000)</td>
<td>Yellow (3.000)</td>
<td>Good Alternative (2.700)</td>
</tr>
<tr>
<td>Florida Caribbean Sea, Pots, United States of America</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Summary

Spiny lobsters caught in waters around Florida are considered a "good alternative." There is some uncertainty regarding the status of the stock and the impact on other species; however, an effective management system is in place and there are no major concerns with this fishery.

Scoring Guide

Scores range from zero to five where zero indicates very poor performance and five indicates the fishing operations have no significant impact.

Final Score = geometric mean of the four Scores (Criterion 1, Criterion 2, Criterion 3, Criterion 4).

- **Best Choice/Green** = Final Score >3.2, and no Red Criteria, and no Critical scores
- **Good Alternative/Yellow** = Final score >2.2-3.2, and neither Harvest Strategy (Factor 3.1) nor Bycatch Management Strategy (Factor 3.2) are Very High Concern2, and no more than one Red Criterion, and no Critical scores
- **Avoid/Red** = Final Score ≤2.2, or either Harvest Strategy (Factor 3.1) or Bycatch Management Strategy (Factor 3.2) is Very High Concern or two or more Red Criteria, or one or more Critical scores.

---

2 Because effective management is an essential component of sustainable fisheries, Seafood Watch issues an Avoid recommendation for any fishery scored as a Very High Concern for either factor under Management (Criterion 3).
Introduction

Scope of the analysis and ensuing recommendation

The spiny lobster is a commercially fished marine invertebrate. Several distinct species of spiny lobster are located in various areas of the world and supporting commercial fisheries. This report will provide information and recommendations for the Caribbean spiny lobster (*Panulirus argus*) fished with traps in and around Florida, in both state and federal waters.

Species Overview

Figure 1 Distribution of *P*.argus. Source: (FAO 2018b).

The spiny lobster, of the genus *Panulirus*, contains 24 different species occurring worldwide in tropical and subtropical waters (Giraldes and Smyth 2016). 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 found in their greatest biomass at depths from 0 to 50 meters (m) (Giraldes and Smyth 2016). Juvenile lobsters usually spend their first few years in nearshore surf grass beds, clumps of red macroalgae, and other areas with hard bottom substrate, while adults favor rocky substrates, reefs, and areas that provide protection (Bertelsen et al. 2009) (GMFMC and SAFMC 2011). Spiny lobsters tend to be nocturnal (Butler and Kintzing 2016), living in shelters during the day. How lobsters migrate is under debate: some studies show that spiny lobsters migrate among depths, depending upon the season, generally moving into deeper water in winter months (Holthuis 1991).

*The Caribbean spiny lobster is found and fished along the coast of Florida, within the Gulf of Mexico, the*
Caribbean Sea, and along the coast of South America through Brazil (Holthuis 1991). It should be noted the Caribbean spiny lobster was recently divided into two genetically distinct species in the Caribbean Sea and along the Brazilian coast. The species found along the Brazilian coast is *Panulirus meripurpuratus* (Giraldes and Smyth 2016).

This report covers the Caribbean spiny lobster trap fishery in and around the state of Florida, which represents nearly 95% of commercial landings. The state of Florida also allows diving and the use of bully nets to commercially harvest spiny lobster, which represents 2.4% and 3% of total landings, respectively (GMFMC 2017a). Thus, these methods are not analyzed in this report.

Management councils encompass the federal economic exclusive zones of the states: North Carolina, South Carolina, Georgia, Texas, Louisiana, Mississippi, and Alabama; however, these fisheries capture relatively few landings compared to Florida (GMFMC 2017a), and are not considered within the scope of this report. The fishing area of Florida ranges over ~13,000 km² but 95% of commercially caught lobsters were in the Florida Keys and South Florida. Lobster traps are rarely used outside this area (FAO 2015).

In Florida state waters, the Caribbean spiny lobster fishery is managed by the Florida Fish and Wildlife Conservation Commission (FFWCC). Spiny lobster is regulated under a fishery management plan (FMP) through the Gulf of Mexico and South Atlantic Fishery Management Councils (GMFMC and SAFMC) (GMFMC and SAFMC 2012). FFWCC is the lead management agency for spiny lobster and management is similar in both state and federal fisheries, and the management applied is similar in both state and federal fisheries.

**Production Statistics**

Landings from the Caribbean spiny lobster in the United States have varied over time, but have been increasing recently up to 2453 metric tonnes (MT) in 2016 (Figure 2).

![Figure 2 US landings of the Caribbean spiny lobster (1950 - 2016). Source: NMFS Commercial landings](image-url)
The 66-year trends in US catches likely reflect both fishing effort and recruitment fluctuations from outside the US Exclusive Economic Zone (EEZ) (SAFMC 2016a). The spiny lobster fishery expanded after 1950 and became fully capitalized by the 1980s. Between the late 60s and mid-1970s, landings in Florida started to include some catches from the Bahamas. It is likely the variations in landings between 2,000 and 4,000 MT from 1978 to 2000, also occurred prior to 1978, and the highest landing reported in the 1970s cannot be attributed to Florida alone. Landings from 1975 to 1999 were at a dynamic equilibrium (with a mean of ~2800 MT). Since 2000, landings have declined by ~30% to a new dynamic equilibrium (with a mean of ~2000 MT), due to unknown causes (but factors may include the PaV1 virus, climate change, and overfishing of spawning stocks in the Caribbean) (FAO 2015).

Florida is responsible for nearly all the Caribbean spiny lobster landings in the United States. The United States imports spiny lobster from countries around the world, including the Caribbean spiny lobster from several countries in the Caribbean, Central, and South American (NMFS Commercial landings).

**Importance to the US/North American market.**

Spiny lobsters are fished throughout the Caribbean and Mexico and imported in large numbers to the United States. Global capture production has varied widely with a minimum of ~3,000 MT in 1950 and a maximum of 42,000 MT in 1995; the trade of Caribbean spiny lobster is worth ~USD 900 million annually (FAO 2015). Production over the last decade has fluctuated between 31,720 in 2009 to the highest reported production in 2016 at 39,326 MT (FAO 2018a). US commercial landings in 2016 were 2,453 MT, which represents ~6% of western Atlantic landings (NMFS Commercial landings). In the same year, the US reported imports of products named "LOBSTER ROCK CARIBBEAN SPINY FROZEN," "LOBSTER ROCK NSPF FROZEN," or "LOBSTER ROCK NSPF LIVE/FRESH/DRIED/SALTED/BRINE" representing ~122,000 MT in 2016 (NMFS Import data). However, this figure is likely an underestimate, since Caribbean spiny lobster can also be recorded under other categories such as "rock lobster."

**Common and market names.**

Spiny lobsters, in general, are also known as rock lobsters. Although known as spiny lobster, there are other less commonly used nomenclatures. The Caribbean spiny lobster is also known as Bermuda spiny lobster, common spiny lobster, crawfish, crayfish, Florida (spiny) lobster, West Indian langouste, and West Indian spiny lobster (Holthuis 1991) (FishWatch 2017).

**Primary product forms**

The Caribbean spiny lobster is marketed whole and sold live, cooked, and/or frozen. Tails are sold fresh and frozen.
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

<table>
<thead>
<tr>
<th>CARIBBEAN SPINY LOBSTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Region</td>
</tr>
<tr>
<td>Florida/Caribbean Sea</td>
</tr>
</tbody>
</table>

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

**FLORIDA/CARIBBEAN SEA, POTS, UNITED STATES OF AMERICA**

**Moderate Concern**

The abundance of Florida spiny lobster is uncertain. The last stock assessment was conducted in 2010, but was rejected because the Council had "no confidence in the reference points" (GMFMC 2017a). The last approved stock assessment for spiny lobster was in 2005, which concluded that the state of the stock with respect to reference points was unknown (SEDAR 2005).

In the absence of full and accepted stock assessments, a data-limited assessment method has been used. The only data-limited indicator available is length frequency data. These data are not indicative of any trend in length between sampling locations and time (pers. comm., Matthews 2017).

Spiny lobsters have a medium vulnerability but there is only one data-limited indicator (which received a positive outcome). In the absence of a second data-limited indicator, Seafood Watch deems abundance as a "moderate" concern.

**Justification:**

The stock status is unknown due to a lack of data on the biological characteristics of spiny lobster, environmental factors, and lack of data on the Caribbean-wide population (Buesa 2018) (SEDAR 2010). Studies suggest that there are strong upstream connections with Mesoamerica and South America (Kough et al. 2013). However, there is increasing evidence to support the view of a weak, yet detectable genetic structure in the Caribbean. The Florida spiny lobster stock is most strongly associated with the northern Caribbean basin (which includes Florida, the Bahamas, and the northern Cuban coast (Truelove et al. 2017). However, oceanographic models indicate that only ~30% of the modeled larvae from Florida settled back into Florida waters (Kough et al. 2013), and that postlarvae derived from international sources was more important in Florida spiny lobster populations. Annual variance in recruitment is likely, which may be due to upstream effects such as the abundance of spawning stock and oceanographic variability (Kough et al. 2013). Therefore, the US Florida stock cannot be assessed in isolation (GMFMC 2017a) (SEDAR 2010) (FFWCC 2016a). To determine the stock status, a greater understanding of the Caribbean-wide spiny lobster stock, spawning biomass and population-wide dynamics is required (Buesa 2018).

While some reviews have shown, at time of study, that lobsters were "abundant" in certain areas (Maxwell et al. 2009) (SEDAR 2005), stock assessments for spiny lobster in the Southeastern United States have shown a decreasing biomass (Figure 3) (SEDAR 2010). There are also reports that local Florida spawning stock biomass, estimated from an age-structured sequential population analysis, has decreased since 1988.
The stock assessments do not agree with results of direct age structure studies from landings data. These suggest that in the main fishing area, 84% of the landings are from the age-1 age class and few lobsters survive to age-3 (Matthews et al. 2009). Older lobsters are found in marine protected areas (Maxwell et al. 2013) or in the Dry Tortugas area (which experiences lower fishing pressure) (Matthews et al. 2009). More data are required to understand how age structure and fishing effort relate with catch rates in the fishery (FAO 2015a).

Figure 3 Biomass of Caribbean spiny lobster in southeastern US. Figure from (SEDAR 2010)

Preliminary data for a second data-limited indicator has been analysed in recent months. Preliminary analysis of recruitment of postlarval spiny lobsters to Florida suggests that recruitment varies annually but has a decreasing trend. However, these data are not used to score this criteria, since they are currently undergoing a full analysis. The results of these data are likely to be published in mid 2019 (pers. comm., Matthews 2018).

The PSA scores vulnerability as 2.889, therefore Florida spiny lobster is deemed to have a medium vulnerability score.

<table>
<thead>
<tr>
<th>ATTRIBUTE</th>
<th>RESULT</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Productivity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average age at maturity</td>
<td>2 to 3 years (Ehrhardt 2005)</td>
<td>1</td>
</tr>
<tr>
<td>Average maximum age</td>
<td>20 years (Maxwell et al. 2007)</td>
<td>2</td>
</tr>
<tr>
<td>Fecundity</td>
<td>Between 147,000 and 1,952,000 at 72 to 141 mm CL respectively in Florida Keys (Bertelsen and Matthews 2002)</td>
<td>1</td>
</tr>
<tr>
<td>Reproductive Strategy</td>
<td>Brooder</td>
<td>2</td>
</tr>
<tr>
<td>Trophic level</td>
<td>3 (Behringer and Butler 2006b)</td>
<td>2</td>
</tr>
<tr>
<td>Density Dependence</td>
<td>No density dependence suggested, but unknown (Behringer and Butler 2006a) (Gutzler et al. 2015)</td>
<td>2</td>
</tr>
</tbody>
</table>
### Quality of Habitat

Habitat has been moderately altered by non-fishing impacts: extensive hydro-engineering in the Everglades has been reported to cause degradation of marine habitats used by the spiny lobster (Phillips). Coastal development has increased nutrient and sediment run-off, thus impacting seagrasses and coral reefs (Phillips). Seagrasses—which act as important nursery grounds for spiny lobsters—have declined due to a number of anthropogenic activities such as dredging and nutrient loading (Lirman et al. 2019).

### Susceptibility Attribute

<table>
<thead>
<tr>
<th>Areal Overlap</th>
<th>&gt;30% of the species concentration is fished, considering all fisheries.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical Overlap</td>
<td>High degree of overlap between fishing depths and depth range of species</td>
</tr>
<tr>
<td>Selectivity of fishery</td>
<td>Sublegal-sized lobsters (&lt;3 inches CL) are retained as bait in traps. Research utilizing experimental traps and direct observation of fishermen's traps indicated fishing mortality (F due to confinement in traps) of 0.079. Attractant mortality represents an estimated 869,000 dead lobsters/year (FFWCC 2016b). The average weight for sub-legal sized lobsters is 0.3kg (Buesa 2018), this equates to around 260,700 kg dead attractants/year. Since 2,453,000 kg of Caribbean spiny lobster were landed into the US in 2016 (NMFS Commercial landings), dead attractants represent around 11% of total commercial lobster landings. Ghost fishing, lost traps that continue to catch lobster, account for 637,622 lobsters annually (Butler and Matthews 2015) or 272,000 kg of dead lobster (Butler et al. 2015). Since 2,453,000 kg of Caribbean spiny lobster were landed into the US in 2016 (NMFS Commercial landings), ghost fishing accounts for 11% of the total lobster commercial landings. Therefore, lobster mortality due to the use of attractants as bait, combined with mortality due to ghost fishing equates to around 22% of the lobster commercial landings.</td>
</tr>
<tr>
<td>Post-capture mortality</td>
<td>Retained species</td>
</tr>
</tbody>
</table>

\[
P = 1.71429 \\
P^2 = 2.9388 \\
S = (((3 \times 3 \times 2 \times 3) -1)/ 40) + 1 \\
S = (54-1)/40)+1 \\
S = (53/40)+1 \\
S = 2.325 \\
S^2 = 5.405625 \\
\diamondsuit = \sqrt{(P^2 + S^2)}
\]
Factor 1.2 - Fishing Mortality

**FLORIDA/CARIBBEAN SEA, POTS, UNITED STATES OF AMERICA**

**Moderate Concern**

The latest review of the spiny lobster stock assessment for the southeastern US concluded that fishing mortality is unknown (SEDAR 2010), since the reference points were rejected by the Council due to a lack of data regarding the stock (GMFMC 2017a).

Due to increased exploitation, the lobster fishery is considered overcapitalized (because there are more traps active in the fishery than recommended to maintain current harvest levels). Therefore, a primary goal of spiny lobster management is to reduce the number of traps in the fishery (Buesa 2018). The local size structure is severely truncated in the Florida Keys—where the majority of fishing occurs—and the FFWCC suggest that a “substantial percentage of current legal-size lobsters are removed by the fishery each year” (pers. comm., FFWCC 14 November 2018).

The stock is not deemed to be undergoing overfishing using proxy reference points (NMFS 2017c). However, studies suggest that the Florida spiny lobster fishery is highly dependent on recruits from elsewhere in the Caribbean (Kough et al. 2013), where most fisheries are believed to be undergoing overfishing (Ehrhardt et al. 2018).

In addition to harvesting, there are two sources of mortality in the spiny lobster fishery, including mortality caused by ghost fishing and when sublegal lobsters are used as attractants as bait in lobster traps. Their mortality represents a further 22% of lobsters landed in the fishery (See Criteria 1.1. for calculations). Attractant mortality has been accounted for in the last stock assessment (SEDAR 2010); however, this assessment is over five years old. Mortality caused by ghost fishing has not been included in the stock assessment, increasing uncertainty in the overfishing status in the Florida spiny lobster fishery.

Since F is unknown relative to F_{MSY} but is not considered to be undergoing overfishing using proxy reference points, Seafood Watch deems fishing mortality as a “moderate” concern.

**Justification:**

The reference points used to determine exploitation levels were suggested by the SEDAR reports as a Maximum Fishing Mortality Threshold (MFMT) proxy, using a static spawning potential ratio at F_{SPR20%} ((SEDAR 2005) (SEDAR 2010)) (GMFMC 2017a). The most recent calculated value for the fishing rate was for fishing seasons 2007–2008 to 2009–2010, at 0.21/year (SEDAR 2010) and the fishing mortality rate at F_{SPR20%} was 0.45/year (FAO 2015a). Therefore, overfishing did not take place in these fishing seasons, but there is uncertainty regarding the current rate of fishing due to the age of the assessment. The Integrated Catch-at-Age (ICA) model suggests that fishing mortality was likely underestimated in years leading up to the 2010 assessment (SEDAR 2010) (FAO 2015a).

Atlantic coast landings peaked at nearly 1.0 million lb in 1991, but since 2000, landings have averaged 0.4 million lb. Landings in the Gulf coast generally decreased between 1989 and 1993, but then increased...
markedly thereafter, averaging 6.2 million lb (1994 to 2000). Low landings have been experienced during and after hurricanes (e.g., Hurricane Andrew in 1992 and Hurricane George in 1998) due to low catch rates (FFWCC 2016a). Landings have been increasing with fluctuations between 2008 and 2015) (FFWCC 2016a). Total commercial landings of spiny lobster in 2015 were 8% higher than the average landings over the previous five years (2010 to 2014) and 6% higher than the historical average landings (1982 to 2014) (FFWCC 2016a). However, trends in landings are not recommended as an appropriate indicator of the stock of fishing mortality as they likely reflect market conditions and recruitment fluctuations from outside the US EEZ (SAFMC, 2016a).

Post-capture mortality due to ghost fishing has been estimated at 637,622 lobsters per year (Butler and Matthews 2015), which represents around 10% (Butler et al. 2018) to 11% (see calculation in Criteria 1.1 Justification) of landed lobsters.
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 Critical

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.

<table>
<thead>
<tr>
<th>CARIBBEAN SPINY LOBSTER - FLORIDA/CARIBBEAN SEA - POTS - UNITED STATES OF AMERICA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subscore: 2.236</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Species</th>
<th>Abundance</th>
<th>Fishing Mortality</th>
<th>Subscore</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottlenose dolphin</td>
<td>1.00:High Concern</td>
<td>5.00:Low Concern</td>
<td>Yellow (2.236)</td>
</tr>
<tr>
<td>Florida stone crab</td>
<td>2.33:Moderate Concern</td>
<td>3.00:Moderate Concern</td>
<td>Yellow (2.644)</td>
</tr>
<tr>
<td>White grunt</td>
<td>2.33:Moderate Concern</td>
<td>3.00:Moderate Concern</td>
<td>Yellow (2.644)</td>
</tr>
<tr>
<td>Red lionfish</td>
<td>5.00:Very Low Concern</td>
<td>5.00:Low Concern</td>
<td>Green (5.000)</td>
</tr>
</tbody>
</table>

Studies suggest low levels of bycatch and bycatch mortality of finfish in the commercial trap fishery in both wooden and plastic traps (GMFMC 2017a) (Shester and Micheli 2011).

Bycatch species are not expected to exceed 5% of the lobster catch. Though the most common non-targeted species caught in the lobster fisheries include stone crabs (~84% of invertebrate bycatch) and finfish. A restricted amount of stone crabs can also be legally retained (pers. comm., FFWCC 25 May 2018). In recent bycatch studies, the most common fish observed in traps were white grunts (Haemulon plumieri, 43% of finfish bycatch), saucereye porgies (Calamus calamus, 12% of finfish bycatch), scrawled cowfish (Acanthostracion quadriornis, 7% of finfish bycatch), and yellowtail snapper (Ocyurus chrysurus, 6% of finfish bycatch) (Butler...
and Matthews 2015). Little is known about finfish bycatch populations due to the lack of formal stock assessments (GMFMC 2017a). Lionfish populations have been increasing throughout the Caribbean and their populations have increased in Florida spiny lobster bycatch (Akins et al. 2012) (NMFS 2018a) and lionfish can be retained in the fishery (NMFS 2018a). Other bycatch includes spider crab, snapper, and grouper, but these represent less than 5% of bycatch (GMFMC 2011b). Other bycatch species make up less than 5% of the catch and are not considered species of concern.

The Florida spiny lobster trap/pot fishery is classified as a Category III fishery in the 2017 Marine Mammal Protection Act (MMPA) List of Fisheries (82 FR 3655, 12 January 2017). Therefore, it is unlikely that the fishery will jeopardize marine mammal stocks (NOAA 2018a). The National Marine Fisheries Service (NMFS) has recently added the Florida Keys stock of bottlenose dolphin to the list of stocks incidentally killed or injured in the Category III Florida spiny lobster trap/pot fishery based on one capture in 2013 (NOAA 2018a). Therefore, bottlenose dolphins have been considered in this report.

Turtles are entangled occasionally in trap lines; a biological opinion on those interactions found that the spiny lobster fishery has no population level effect on loggerhead, green, hawksbill, leatherback, or Kemp's ridley sea turtles. Acropora species and the smalltooth sawfish (Pristis pectinata) are also known to interact with the spiny lobster fishery, although the biological opinion also deems that the spiny lobster fishery is unlikely to jeopardize the continued existence of these species (NMFS 2009). Thus, turtles, Acropora and smalltooth sawfish are not considered further in this assessment.

Despite some geographical overlap between the spiny lobster fishery and sei and sperm whales, interactions are unlikely as the fishery operates in much shallower waters (pers. comm., J. Powell 20 July 2018), while the North Atlantic right whale "occur within areas encompassed by the spiny lobster fishery" (GMFMC 2018a). NARW may be found from Florida to North Carolina, from 1 November through 30 April (SAFMC 2016b), while spiny lobster trap gear is permitted from 6 August to 31 March (GMFMC 2017a). However, the majority of the spiny lobster fishery operates much further south than the NARW habitat. Around 90% of spiny lobster landings occur in the Florida Keys (FAO 2015) while the southerly tip of the critical habitat for right whale is just south of south of Cape Canaveral, Florida (NMFS 2017b). Additionally, the impact on NARW are not considered to be a sufficient enough risk to include it on the List of Fisheries 2017 (NOAA 2018a). Therefore, NARW are not considered further in this assessment.

For the trap fishery in Florida, the Bottlenose dolphin limits the score for Criterion 2 due to their high vulnerability and unknown stock status.

**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)
BOTTLENOSE DOLPHIN

Factor 2.1 - Abundance

FLORIDA / CARIBBEAN SEA, POTS, UNITED STATES OF AMERICA

High Concern

The Florida spiny lobster fishery has been selected as a category III species for injuring or killing five bottlenose dolphin stocks detailed in the table below (NOAA 2018a). They are not considered as endangered or threatened, though the Western North Atlantic Central Florida Coastal stock is deemed "depleted" (NOAA 2017a).

The Florida Bay stock is considered to be most at-risk (pers. comm., J. Powell 20 July 2018) because they are a resident population (Waring et al. 2014) which overlaps with the lobster trap/pot. However, the status of this stock relative to the optimum sustainable population (OSP) is unknown and there are insufficient data to determine the population trends for this stock (Waring et al. 2014).

Most of the stocks have unknown populations with unknown trends (Table 1). Marine mammals are assumed to be a highly vulnerability species and therefore, Seafood Watch deems abundance as a "high" concern.

Justification:

Table 1. Stock status of common bottlenose dolphins which interact with Florida spiny lobster fishery.

<table>
<thead>
<tr>
<th>STOCK</th>
<th>STRATEGIC STOCK</th>
<th>MIN. POPULATION ESTIMATE</th>
<th>TREND KNOWN?</th>
<th>OSP KNOWN?</th>
<th>SOURCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biscayne Bay estuarine</td>
<td>Yes</td>
<td>Unknown</td>
<td>No</td>
<td>No</td>
<td>*1, *5</td>
</tr>
<tr>
<td>Central FL coastal</td>
<td>Yes</td>
<td>2,851</td>
<td>No</td>
<td>No</td>
<td>*2, *5</td>
</tr>
<tr>
<td>Eastern GMX coastal</td>
<td>No</td>
<td>11,110</td>
<td>No</td>
<td>No</td>
<td>*3, *5</td>
</tr>
<tr>
<td>FL Bay estuarine</td>
<td>No</td>
<td>Unknown but abundance of 514</td>
<td>No</td>
<td>No</td>
<td>*4, *1</td>
</tr>
<tr>
<td>Florida Keys</td>
<td>Not available</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source

1) (Waring et al. 2014)
2) (Waring et al. 2016)
3) (Waring et al. 2016)
4) (Litz et al. 2008)
5) (NMFS 2017a).
Florida Bay and Biscayne Bay stocks

In the Florida Bay estuarine and Biscayne Bay estuarine stock, the Potential Biological Removal (PBR) is undetermined (Table 2). Therefore fishing mortality is unknown relative to PBR. The Florida Bay stock is considered to be most at-risk (pers. comm., J. Powell 20 July 2018), but level of fishing effort in the pot/trap fishery in this area, is considered low (Waring et al. 2014). There were no documented human-caused mortalities in the last stock assessment report based on 2007 to 2011 data (Waring et al. 2014), but there was one reported entanglement in 2013 (Hayes et al. 2018a). The Biscayne Bay estuarine stock is listed as a strategic stock (Table 2).

Central Florida Coastal and Eastern Gulf of Mexico stocks

The Central Florida coastal stock's annual pot/trap fishery-caused mortality and total annual fishery-related mortality/serious injury are <1% of PBR (Table 2). In the Gulf of Mexico eastern coastal stock, annual pot/trap fishery-caused mortality is <1% of PBR and total fishing mortality is below the PBR (Table 2).

The Florida spiny lobster fishery is categorized as a Category III fishery. The Central Florida coastal and eastern Gulf of Mexico stocks are automatically scored a "low" concern, since the percent of PBR taken by fishery is very low (<1%). The fishing mortality relative to PBR of the Florida Bay and Biscayne Bay stocks is unknown; therefore, a more conservative score is required. However, the most recent stock assessment suggested that there were no recorded interactions with the lobster trap fishery between 2007 and 2011 (Waring et al. 2014); therefore, Seafood Watch deems fishing mortality as "low" concern.

Justification:

Justification

Table 2. Fishing mortality of common bottlenose dolphins relative to PBR.

<table>
<thead>
<tr>
<th>STOCK</th>
<th>TOTAL ENTANGLEMENTS</th>
<th>TOTAL ANNUAL FISHING MORTALITY</th>
<th>PBR</th>
<th>SOURCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biscayne Bay Estuarine</td>
<td>None (2007 to 2011)</td>
<td>Unknown</td>
<td>Unknown</td>
<td>*1</td>
</tr>
<tr>
<td>Central FL coastal</td>
<td>1 (2009 to 2013)</td>
<td>0.2</td>
<td>29</td>
<td>*2</td>
</tr>
<tr>
<td>Eastern GMX coastal</td>
<td>5 (2009 and 2013)</td>
<td>1.6</td>
<td>111</td>
<td>*2, *3</td>
</tr>
<tr>
<td>FL Bay estuarine</td>
<td>1 (in 2013)</td>
<td>Unknown</td>
<td>Unknown</td>
<td>*1 *4</td>
</tr>
<tr>
<td>Florida Keys</td>
<td>Not available</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sources

1) (Waring et al. 2014)
2) (Waring et al. 2016)
3) (NMFS 2017a)
4) (Hayes et al. 2018a)
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.

<table>
<thead>
<tr>
<th>RATIO OF BAIT + DISCARDS/LANDINGS</th>
<th>FACTOR 2.3 SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;100%</td>
<td>1</td>
</tr>
<tr>
<td>&gt;=100</td>
<td>0.75</td>
</tr>
</tbody>
</table>

FLORIDA / CARIBBEAN SEA, POTS, UNITED STATES OF AMERICA

< 100%

Discards

There is little information about the total discard rate in the Caribbean spiny lobster fishery. Total discard rates given in Shester and Micheli (2011) for spiny lobster trap fisheries are presented as 15%. Although this study refers to the California spiny lobster (P. interruptus) fishery, rather than the Caribbean spiny lobster in Florida, it is possible the rates are quite similar. Matthews et al. (2005) noted that the number of fish that died in traps during observations over one season was quite small (Matthews et al. 2005).

Studies determining discard impacts in the Floridian fishery have also determined that confinement of lobsters in traps also may result in a 10% mortality rate (Matthews 2001). This figure may increase due to sub-lethal effects caused by confinement (including slowed growth rates, weight loss, and molting where lobsters do not increase in size (Wilson et al. 2014) (Matthews 2001).

Bait

Studies from other global lobster fisheries have shown that the volume of bait used regularly exceeds the volume of the target species landed (Harnish and Willison 2009) (Waddington and Meeuwig 2009), but that is not the case in the Florida lobster fishery. The Florida fishery permits the use of undersized lobsters (or “shorts”) or attractants in traps (GMFMC and SAFMC 2011). Attractant mortality represents an estimated 869,000 dead lobsters/year (FFWCC 2016b). The average weight for sub-legal sized lobsters is estimated at 0.3kg (Buesa 2018), this equates to around 260,700 kg dead attractants/year. Since 2,453,000 kg of Caribbean spiny lobster were landed into the US in 2016 (NMFS Commercial landings), dead attractants represent around 11% of total lobster catch.

Alternatively, strips of salted cowhide and fish heads are used as bait (Buesa 2018). Studies have shown that traps baited with short lobsters catch more lobster than traps baited with any other method (Heatwole et al. 1988).

Discard and bait rates represent 15 and 11%, respectively and therefore, equate to less than 100% of lobsters landed. Therefore, a score of 1 is provided.
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

<table>
<thead>
<tr>
<th>Fishery</th>
<th>Management Strategy</th>
<th>Bycatch Strategy</th>
<th>Research and Monitoring</th>
<th>Enforcement</th>
<th>Stakeholder Inclusion</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fishery 1: Florida / Caribbean Sea</td>
<td>Moderately Effective</td>
<td>Moderately Effective</td>
<td>Moderately Effective</td>
<td>Moderately Effective</td>
<td>Highly Effective</td>
<td>Yellow (3.000)</td>
</tr>
</tbody>
</table>

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 managers 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.

FLORIDA / CARIBBEAN SEA, POTS, UNITED STATES OF AMERICA

Moderately Effective
Since the 1800s, there has been a commercial spiny lobster trap fishery along the Florida coast. Regulations and laws regulating the spiny lobster in the state of Florida have been in place since the early 1900s, namely minimum size limits, a closed season, and the prohibition of taking berried females (Buesa 2018). The lobster fishery takes place in state and federal waters. It is managed by the Florida state agency (Florida Fish and Wildlife Conservation Commission) and federal councils (SAFMC and GMFMC) through a FMP in the South Atlantic and the Gulf of Mexico Management Council regions since 1982 (GMFMC and SAFMC 1982). The FMP has been amended 12 times over the years (GMFMC 2017a). In 1992, Florida adopted regulations instituting the Lobster Trap Certificate Program to reduce the number of traps in the fishery (Matthews and Williams 2000). FMP Amendment 10 (2011) established a combined recreational and commercial fishery Annual Catch Limit (ACL) of 10.46 million lb whole weight and an Annual Catch Target (ACT) for the combined recreational and commercial fishery of 6.59 million lb (GMFMC 2017a). The amendment also modified regulations regarding the use of undersized lobsters as bait (Federal Register 2011). Amendment 11, implemented in April 2012, closed 60 specific areas to protect Acropora coral species. Amendment 12 was implemented in 2014 and consolidated the existing federal dealer permits and increased the frequency of federal dealer reporting from a monthly to weekly basis. More recently, modifications to Amendment 4 respecified the OFL and ABC by using a longer time series of landings data (GMFMC 2017a).

The federal fishery is managed through a series of input and output controls (Florida state regulations and the federal FMP are typically in line with one another) and include gear management measures (such as trap limits, marking requirements) and harvest regulations (such as ACLs and minimum sizes; see Justification for a full list of measures). In recent seasons, the ACT and ACL have been breached. To be more precautionary, the Gulf Council’s Scientific and Statistical Committees (SSC) now use mean long-term landings to determine the OFL values (10.46 million lb) (GMFMC 2017a).

There is a lack of evidence to prove that the management strategy is being implemented successfully. The most recent stock assessment was rejected by the Review Panel and current reference points are not deemed suitable for the stock. The stock is not believed to be undergoing overfishing and landings have been stable in recent years (GMFMC 2017a). However, a large proportion of recruitment to the US spiny lobster fishery comes from outside the US EEZ. US catches probably have little, if any, effect on the productivity or sustainability of the biomass in US waters (SAFMC 2016a). This makes it difficult to determine if the management within the US EEZ is effective at managing the stock.

Lobster and stone crab seasons have some overlap and stone crabs are caught and retained in the spiny lobster fishery (pers. comm., FFWCC 25 May 2018). Stone crab are subject to management through the FFWCC, which includes the limited fishing grounds outside state waters (FFWCC 2011a) (FFWCC 2016c).

There is lack of evidence to show that management is effective at managing the stock. The stock status is unknown and reference points contain important data gaps. In lieu of a recent stock assessment, many measures have been implemented to ensure the stock's survival: the fishery has experienced stable landings, though landings trends are likely driven by market-based fluctuations. Therefore, Seafood Watch deems Management Strategy and Evaluation as "moderately effective."

**Justification:**

The full list of management measures consist of the following gear and harvest regulations (the following information is available from (FishWatch 2017) unless otherwise stated):

**Gear management measures**

- trap limits (FAO 2015a)
- commercial fishermen are limited to harvesting 250 lobsters per day when diving or using nets, but there
is no daily possession or bag limit when using traps  
- there is a prohibition on using spears, hooks, piercing devices, explosives, or poisons to harvest spiny lobster (SAFMC 2018a)  
- vessel and gear identification requirements: traps/pots must be tagged, and traps, buoys, and vessels marked with their permit numbers  
- permit restrictions  
- traps must adhere to requirements (based on materials, size, and degradable escape panels (on plastic traps)  
- traps must have certificates (availability of which is reduced periodically by the FFWCC through the trap reduction program) (FFWCC 2018a)  
- abandoned traps or buoys are the permit owner’s responsibility

### Harvest Regulations

- minimum size (3 inches carapace length and with tails 5.5 inches in length or longer)  
- 4-month closed season (1 April through 5 August off Florida and the Gulf states) during the months of greatest reproductive activity  
- prohibition on the take of egg-bearing females and a ban on tailing (FishWatch 2017)  
- licenses  
- location-dependent bag limits for commercial and recreational fishermen  
- There is an annual catch limit of 10.46 million lb that applies to both commercial and recreational fisheries in both state and federal waters of the Gulf and South Atlantic. When this ACL is exceeded, management measures are implemented to curtail further harvesting (GMFMC 2017a).  
- All fishermen are prohibited from harvesting spiny lobsters in selected federal and Florida marine-protected areas, particularly in sensitive coral reefs off the Florida Keys (GMFMC 2017).

Management in the past has adjusted regulations in response to various cues (decline in landings, assessment results, and/or other impacts). Spiny lobster fishing has been occurring in and around Florida since the 1800s, but the landings began to rise dramatically following the Second World War until about 1975 when the Bahamian waters were closed to foreign fishermen (NMFS 2012a) (Hunt 2000). Since 1975, lobster landings have fluctuated without a distinct trend (with the exception of lower harvests tending to occur in El Niño years (Hunt 2000).

The Lobster Trap Certificate Program was enacted in 1992, and though the program did not result in a decline in landings by the 1998/1999 fishing season (Matthews and Williams 2000), the relatively stable lower landings in the 2000s may be a reflection of the program. Since the addition of the ACL in 2012, landings have remained relatively stable in the past five years (GMFMC 2017a).

The ACT was exceeded in the 2014/2015 season and both the ACL and ACT were exceeded in the 2015/2016 season; the 2015 Review Panel concluded that the ACL and ACT is not suitable for managing spiny lobster compared to other implemented effort controls (traps limits, gear restrictions, limited entry, seasonal closures, and spatial closures). However, NMFS have stated that the stock does not qualify to be exempt from ACLs and AMs (GMFMC 2017a). Therefore, the 2016 Review Panel, recommended that the ACL should be increased and be based on a longer-time series of landings (since 1991), since it reflects the dynamics of the fishery more accurately (GMFMC 2017a).

In Amendment 4, the Council recommended that a landings-based estimate (using an OFL) is more appropriate for the MFMT, rather than using the fishing mortality proxy $F_{20}$. Therefore, the Gulf Council’s SSC required that landings should determine the OFL based on mean landings of the most recent 10 years. The ABC was set at the mean of the most recent 10 years’ landings. This time-series length was chosen to reflect the most recent circumstances within the fishery (GMFMC 2017a). To further incorporate scientific uncertainty
and the precautionary approach into the reference points (OFL), a larger buffer has been set between the OFL and ABC. If there are two consecutive years of low landings (below 5.3 million lb), a review panel must reconvene to discuss contingency measures (GMFMC 2017a).

Not all sources of mortality have been incorporated into stock assessments. In addition to harvesting, there are two sources of mortality in the spiny lobster fishery (mortality caused by ghost fishing and when sublegal lobsters are used as attractants and bait in lobster traps), which represent around 22% of lobsters landed in the fishery (See Criteria 1.1. for calculations). Attractant mortality has been accounted for in the total fishing mortality estimate in the stock assessment (SEDAR 2010). However, lobster mortality caused by ghost fishing has not been included in the fishing mortality estimates in the 2010 stock assessment. While this adds further uncertainty to the stock assessment, the Caribbean-wide stock still has an important influence on the Florida spiny lobster fishery (Kough et al. 2013).

The Trap Reduction Program will likely further reduce fishing impact: the program aims to reduce the number of trap certificates from to 470,244 (2016/2017 season) to 400,000 (NMFS 2018a) by removing 10% of traps under each certificate when they are transferred outside the owner’s immediate family (McCawley 2016). However, reduction rates are slow and effort estimates suggest that fewer than 150,000 to 250,000 traps should be used in the fishery (FAO 2015a). Concurrently, there has been an increase in the number of federal spiny lobster permits provided, while the number of federal lobster tailing-only permits has declined (where “tailing-only” means spiny lobsters are separated, and tails are retained) (GMFMC 2017a).

**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.

**FLORIDA / CARIBBEAN SEA, POTS, UNITED STATES OF AMERICA**

**Moderately Effective**

Traps are very selective: the main bycatch in the Florida spiny lobster fishery are juvenile spiny lobster, followed by stone crabs (further discussion of their management is available in Criteria 3.1 since they are retained species). Non-target species make up a relatively small proportion of catches; comprising no more than 5% of the catch, they include include various finfish and invertebrates, such as grunts, grouper, hogfish, snapper, hermit crabs, arrow crabs, and spider crabs (GMFMC 2017a). The spiny lobster fishery is not a leading cause of a high level of mortality for any species of concern: the 2009 Biological Opinion declared that the species most at risk to the fishery were Acropora corals, smalltooth sawfish, and Atlantic turtles. The impact from the lobster fishery does not reduce the likelihood of survival and recovery of their populations (NMFS 2009) (GMFMC 2017a). The spiny lobster fishery is a Category III fishery under the MMPA, since there is a remote likelihood of mortalities or serious injuries to marine mammals. The Category III listing includes several stocks of the common bottlenose dolphin; however, due to their low likelihood of capture and low level of fishing mortality relative to the PBR, they have received a "low" concern for fishing mortality in Criteria 2.

A suite of measures has been implemented in the FMP to reduce the risk of the spiny lobster fishery on bycatch and ETP species. These generally include gear restrictions, gear identification requirements, a permit program, trap limits, area closures, and prohibitions on capturing or harming species listed on the ESA (see justification for further details). Observer programs are not in place due to the fishery's Category III designation. Instead, the National Oceanographic Atmospheric Administration (NOAA) conducts a mandatory Trip Interview Program (TIP) in Florida for all commercial fishermen (pers. comm., T. Matthews 2017).
There are significant issues with ghost traps in the Florida spiny lobster fishery, causing an estimated mortality of 637,622 lobsters annually (Butler and Matthews 2015), equating to approximately 11% of the total lobster catch. Abandoned traps or buoys are the responsibility of the owner (GMFMC 2017a). Traps must have certificates (availability of which is reduced periodically by the FFWCC through the trap reduction program) (FFWCC 2018a). To mitigate the impact of ghost fishing, plastic lobster traps are required to have a degradable escape panel (on plastic traps) (FFWCC 2017c), and there are requirements for trap materials and sizes. However, derelict traps can continue to fish for over one year (Butler and Matthews 2015). The State of Florida runs two programs dedicated to removing lost and abandoned traps from state waters and has the authority to expand those programs into federal waters (FishWatch 2017). Nonetheless, the efficacy is limited as only 10% of traps are removed annually (Buesa 2018).

Lobster traps are a very selective fishing gear. Management is effective at reducing the impact on bycatch and endangered, threatened and protected (ETP) species. Although programs have been initiated to reduce the risk of ghost fishing, they are relatively new, and more time is required for them to be effective. Therefore, Seafood Watch deems Bycatch Strategy as a "moderately effective."

**Justification:**

Several ETP species potentially interact with the spiny lobster fishery, explored in more depth below. Studies from 1997 to 2009 recorded that trap/pot gear accounted for 18.2% of fishery gear stranding interactions with common bottlenose dolphins, Florida manatees, and sea turtles in Florida (Adimey et al. 2014). NMFS published a final rule in 2016 (81 FR 42268), which listed the Nassau grouper as threatened under the Endangered Species Act (ESA) and the spiny lobster fishery may impact the Nassau grouper off southern Florida, as both the species overlap (GMFMC 2017a). NARW "occur within areas encompassed by the spiny lobster fishery" (GMFMC 2018a). They may be found from Florida to North Carolina, from November 1 through April 30 (SAFMC 2016 cited in (SAFMC 2016b)), while spiny lobster trap gear is permitted from August 6th to March 31st (GMFMC 2017a). Nonetheless, the interaction between NARW and the spiny lobster fishery may be underestimated, since studies using passive acoustic monitoring found that NARWs may be present as far south as North Carolina waters throughout the year (NMFS 2018a). However, the impact on NARW are not considered to be a sufficient enough risk to include it on the List of Fisheries 2017.

To further reduce the risk on bycatch and ETP species, the FMP mandates gear restrictions, gear identification requirements (tagged and marked traps, buoys, and vessels must show their permit numbers), a permit program, and trap limits (GMFMC 2017a). Traps in this fishery are typically deployed singly, rather than in strings, which may result in fewer concerns regarding entanglement in ropes (GMFMC 2017a). However, there has been an increase in trap trawls in the fishery and the impact of this has not been studied (pers. comm., J. Powell 20 July 2018). Trap line in the water is also reduced as Florida State waters require that "no more than 15 feet of any buoy line attached to a buoy used to mark a spiny lobster trap or trotline shall float on the surface of the water" (FFWCC 2018c). There are also area closures with designated critical habitat for species that overlap the fishery (Acropora corals, Northwest Atlantic [NWA] loggerhead sea turtles, and North Atlantic right whale [NARW]) (GMFMC 2017a). NOAA has increased the level of protection for certain species at risk in the area: in 2016, NMFS published a final rule (81 FR 20058) listing 11 DPSs of green sea turtles; the North Atlantic and South Atlantic DPSs of green sea turtles that could occur in the action area are listed as threatened. It is illegal to take (to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct) (16 U.S.C. 1532[19]) species protected under the ESA).

There are measures designed to reduce discards and protect habitat: spiny lobster trap fishing has been prohibited in 60 closed areas due to their high benthic conservation value and high coral density. In 2014, NMFS published a final rule to list 22 coral species under the ESA (79 FR 53851), five of which occur in the Gulf and South Atlantic. In Southern Florida (where a relatively high amount of fishing takes place), there are seven MPAs which prohibit harvesting spiny lobster to protect coral (GMFMC 2017a).
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.

**FLORIDA / CARIBBEAN SEA, POTS, UNITED STATES OF AMERICA**

**Moderately Effective**

Stock assessments are irregular. The latest Florida spiny lobster stock assessment was rejected by the SEDAR review panel due to lack of accurate data to determine the Caribbean-wide stock status. The assessment used fishery-dependent (landings, CPUE, etc.) data research regarding genetic stocks (SEDAR 2010). Some sources of mortality were considered, but many are not quantified and uncertainty remains. More data are required on the Caribbean-wide stock to assess the Florida spiny lobster effectively. The Caribbean-wide assessment is expected to be published in 2019 (SEDAR 2018a). The stock, bycatch, and ghost fishing are monitored using a variety of fishery-dependent and independent techniques.

Since a variety of data-monitoring methods are used in the fishery, though data are lacking (specifically on the stock status, and some sources of fishing mortality) and the Caribbean-wide stock requires assessment to fully understand the stock status, Seafood Watch deems scientific research and monitoring as "moderately effective."

**Justification:**

The spiny lobster fishery is assessed through SEDAR, which is a “process developed by the Southeast Fisheries Science Center and the South Atlantic Fishery Management Council, to improve the quality and reliability of stock assessments and to ensure a robust and independent peer review of stock assessment products” (SEDAR 2005).

In 2003, SEDAR expanded to include all three southeast councils (South Atlantic, Gulf of Mexico, and Caribbean) and to review assessments developed through the Atlantic and Gulf States Marine Fisheries Commissions and state agencies. In the stock assessment process, two statistical assessment models (the Integrated Catch-at-Age (ICA) model and a modified DeLury model) were used to determine mortality rates and biomass (SEDAR 2010). Despite the rigorous scientific review and application of the models, stock assessments have been unable to determine the current biomass of Florida spiny lobster because the stock relies on larvae from the Caribbean-wide stock, which has an unknown biomass (GMFMC 2017a). More data are required on the Caribbean-wide stock to assess the Florida spiny lobster effectively (e.g., spiny lobster self-recruitment and productivity (SAFMC 2016a)).

Within the stock assessments, many sources of mortality are considered (including recreational fishing and use as bait); however, sources of mortality have not been quantified, such as PaV1 lobster virus on juvenile lobster recruitment, the Deepwater Horizon oil spill, and hurricanes (GMFMC 2017a). Other sources of mortality have been identified and managed, but these are not factored into the proxy reference points for the fishery (SEDAR 2010). It is unknown if ACLs are determined using these data sources.

Data sources occur from fishery-dependent and independent sources: to collect fishery-dependent data, Florida state has required all commercial fishermen to report landings for each trip using the Marine Fisheries Information System, since 1984. This collates data on catch weight for each species, gear type, amount of gear, trip duration, and fishing location. port sampling collects data on lobsters regarding carapace length, sex, gear type, and trip information (FAO 2015a). The FFWCC monitors Florida’s commercial fishery through the Marine Fisheries Trip Ticket Program. The Program requires all seafood product sales to be reported on a
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.

FLORIDA / CARIBBEAN SEA, POTS, UNITED STATES OF AMERICA

Moderately Effective

The Florida Fish and Wildlife Commission maintain a law enforcement division that is charged with enforcing state and federal fisheries and wildlife laws (FFWCC 2012). The Fishery Management Councils (South Atlantic and Gulf of Mexico) do not have any specific law enforcement authority, but occasionally provide recommendations and guidance regarding law enforcement issues. The NOAA Office for Law Enforcement works closely with the US Coast Guard to enforce federal regulations within the EEZs and has been successful in prosecuting several cases of illegal lobster harvest in Florida (NMFS 2012a).

FMP regulations are enforced through NOAA's Office for Law Enforcement, the United States Coast Guard, and various state authorities. NOAA's law enforcement and state agencies monitor recreational and commercial landings to ensure that the ACL is not breached (GMFMC 2017a). However, in recent seasons, the ACT and ACL have been breached (GMFMC 2017a). IUU has not been measured, but the FFWCC believe that not much
IUU fishing occurs (pers. comm., T. Matthews 2017).

Commercial fishers are required to have permits and follow gear and vessel marking and identification requirements (Federal Register 2011). To aid enforcement activities, vessels and buoys are required to abide by a color code and display their state registration number on the vessel, traps, and buoys (GMFMC 2017a). License holders are required to use an accumulated landings system to monitor the regional quotient, which is the proportion of landings and value out of the total landings and value of that species for that region, and is a relative measure of engagement and reliance).

Enforcement measures are in place to effectively implement measures; however the effectiveness of current enforcement is uncertain. Enforcement is deemed “moderately effective.”

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.

FLORIDA / CARIBBEAN SEA, POTS, UNITED STATES OF AMERICA

Highly Effective

The management of spiny lobster stock in Florida is transparent and includes stakeholder input. Stakeholders are an important part of the fishery management plan process. With every amendment proposed to the FMP, or new rules and regulations proposed in the state of Florida, stakeholder input is heavily sought. A proposed amendment to the FMP (Amendment 11) did not include changes to trap-line markings as a result of stakeholder input, among other factors (NMFS 2012a). A variety of user groups are consulted regularly through public meetings where user groups can address conflicts. Scientific data are collected through fisher-science programs e.g., trap programs. Therefore, Seafood Watch deems Stakeholder Inclusion as “highly effective.”
Criterion 4: Impacts on the Habitat and Ecosystem

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

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

GUIDING PRINCIPLES

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

Rating cannot be Critical for Criterion 4.

Criterion 4 Summary

<table>
<thead>
<tr>
<th>Region / Method</th>
<th>Gear Type and Substrate</th>
<th>Mitigation of Gear Impacts</th>
<th>EBFM</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Florida / Caribbean Sea / Pots / United States of America</td>
<td>3</td>
<td>0</td>
<td>Moderate Concern</td>
<td>Yellow (3.000)</td>
</tr>
</tbody>
</table>

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**

**FLORIDA / CARIBBEAN SEA, POTS, UNITED STATES OF AMERICA**
Spiny lobsters are generally found on rocky substrates and reefs, or wherever protection and shelter can be found (Holthuis 1991). The spiny lobster fishery deploys most (71%) of its traps on seagrass and sand (FFWCC 2017b). Generally, traps are not "placed directly on coral but, rather, close to coral" (GMFMC 2005a). Since traps are deployed predominantly on non-coral habitats, Seafood Watch rated this factor with a score of 3.

**Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts**

**FLORIDA / CARIBBEAN SEA, POTs, UNITED STATES OF AMERICA**

The main mitigation measures adopted in the spiny lobster fishery to reduce impact on the habitat are protected areas. The Florida Keys National Marine Sanctuary (FKNMS) provides ecological reserves and sanctuary preservation areas that are closed to all fishing, and as a result prohibit spiny lobster fishing (NMFS 2009). These include 60 areas that are closed to protect coral (Acropora species), enclosing approximately 5.9 mi² (GMFMC and SAFMC 2012) (Figure 4; Figure 5). The take of spiny lobsters is also prohibited in the Everglades National Park (Florida Keys NMS 2018), Dry Tortugas National Park, the John Pennekamp State Park (Florida Administrative Code 46-24.0065), the Card Sound–Biscayne Bay Sanctuary, and some of the Merritt Island National Wildlife Refuge (University of Florida 2014) (Florida Museum 2018b) (FKNMS 2015).

Florida state waters extend 3 nautical miles (5.6 km) offshore in the Atlantic Ocean and 9 nautical miles (16.7 km) offshore in the Gulf of Mexico, equating to 10,860 mi² (28,126 km²) (Graham et al. 2016). However, the traditional Florida spiny lobster fishing area is approximately 5000 mi² (FAO 2015a).

While it hasn't been possible to attain a precise figure to show the area of representative lobster habitat protected, Table 4 shows that Florida's state waters that protect spiny lobsters represent approximately 2105 mi². Therefore, the proportion of the fishery that is protected is around 19% (2,105/10,860 mi²). The percentage of the Florida EEZ that is closed to fishing that impacts lobster habitat does not meet the 20% boundary required in the Seafood Watch standard. Furthermore, there is concern that ghost traps are likely damaging some of the protected areas in place. For example, Uhrin et al. (2014) estimated that there were an estimated 85,000 ghost traps and over one million non-fishing traps or remnants of traps in the FKNMS. Coral habitats were found to have the greatest density of trap debris in the study area, despite their sensitivity to damage from trap debris (Uhrin et al. 2014). Uhrin et al. (2005) observed significant declines in seagrass density after six weeks when the beds were covered with traps in beds, and that the beds were denuded after six months (Uhrin et al. 2005).

Since less than 20% of representative lobster habitat is protected, no mitigation score is provided for this section.

**Justification:**

Table 4. Sizes of all protected areas in Florida relating to spiny lobster management.

<table>
<thead>
<tr>
<th>PROTECTED AREA</th>
<th>SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Currently, there are several sanctuary preservation areas and ecological reserves within the FKNMS intended to preserve “discrete, biologically important areas that help sustain critical marine species and habitats” (FKNMS 2015). Further, FKNMS regulations prohibit the operation of a vessel in such a manner that will injure coral, as well as anchoring on live coral in water depths less than 40 ft when the bottom can be seen (15CFR 922.163 [i] and [ii]) (NMFS 2009). Final Amendment 11 to the Gulf of Mexico and South Atlantic FMP closed 60 areas to specifically protect Acropora spp. (GMFMC and SAFMC 2012). These area closures have occurred in waters where around 90% of the commercial Florida spiny lobster catch is caught in waters (Butler and Matthews 2015).

Due to the protections placed upon protected species in the Gulf of Mexico and South Atlantic waters (such as closed areas) NMFS have suggested that the spiny lobster fishery is not likely to jeopardize continued existence of any species proposed for listing (GMFMC 2017a).

Florida has also implemented two programs to remove lost and abandoned traps from state waters and potentially (the Spiny Lobster, Stone Crab, and Blue Crab Trap Retrieval Program, where commercial fishermen remove derelict traps during closed seasons, and the Derelict Trap and Trap Debris Removal Program allows volunteers to collect derelict traps and trap debris during open or closed seasons). Together, these programs recover an estimated 10% of the lost traps each year (McCawley 2016). Buoys are marked with a “C” for spiny lobster traps to easily identify traps, attribute ghost fishing to the relevant gear and report them to the permit owner (NOAA 2018a).
Figure 4 Map of Florida Keys National Marine Sanctuary protected areas. From (FKNMS 2015).

Figure 5 Map of Florida Keys area with area closures shown in yellow. Available at: http://portal.gulfcouncil.org/SpinyLobsterManagement.html

Factor 4.3 - Ecosystem-Based Fisheries Management

FLORIDA / CARIBBEAN SEA, POTS, UNITED STATES OF AMERICA

Moderate Concern

The role that spiny lobsters play in reef ecosystems is unknown; hence, the impact of their removal from the ecosystem has not been determined (Higgs 2016). Therefore, suitable management is required throughout the region to ensure that the whole stock is maintained (Truelove et al. 2015b) (Truelove et al. 2015a).
No exceptional species are regularly caught in the spiny lobster fishery. Although sea turtles may occasionally interact with the fishery, the biological opinion (NMFS 2009) prepared by the National Marine Fisheries Service for the continued authorization of spiny lobster fishing in the US South Atlantic and Gulf of Mexico Exclusive Economic Zones found that the impact from the lobster fishery does not reduce the likelihood of survival and recovery of Atlantic sea turtle populations.

Although it is unlikely that the spiny lobster fishery will cause food web cascades in coral reef ecosystems, spiny lobsters are an abundant mid-trophic level predator (Behringer and Butler 2006b) and likely contain a high amount of available energy reserves: spiny lobster are important predators of mollusks, crustaceans, echinoderms, and small fishes (Butler and Dolan 2017). Juvenile lobsters are prey for octopus and a variety of fish species (including snapper and grouper species) (Butler and Dolan 2017).

Spatial protection is used in the fishery to protect designated critical habitat for Acropora corals, NWA loggerhead sea turtles, and the North Atlantic right whale, which overlap with the spiny lobster fishery (GMFMC 2017a). Spiny lobster trap fishing has been prohibited in 60 closed areas due to their high benthic conservation value and high coral density. In 2014, NMFS published a final rule to list 22 coral species under the ESA (79 FR 53851), five of which occur in the Gulf and South Atlantic (GMFMC 2017a).

Since detrimental food web impacts are not likely, but the ecosystem role of lobster is not known and there is a lack of precautionary management to reduce the impact of the fishery on the ecosystem, Seafood Watch deems ecosystem-based fisheries management as a “moderate“ concern.
Acknowledgements

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

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


Buesa, R.J. 2018. The Florida spiny lobster (Panulirus argus) fishery. Available at: https://www.researchgate.net/publication/322525805_The_Florida_spiny_lobster_Panulirus_argus_fishery_RESEARCH_FINAL_REPORT_15_January_2018


FFWCC 2016d. FWC Trap Retrieval Programs. Available at: https://evergladesrestoration.gov/content/bbrrc/minutes/2016_meetings/111616/5_Trap_Retrieval_Programs_6


FKNMS. 2015. Sanctuary Preservation Areas Available at: https://floridakeys.noaa.gov/zones/spas/welcome.html.

Florida Keys National Marine Sanctuary (FKNMS) 2015. 2015 Regulations for Recreational Harvest and Lobster Information for Monroe County, Florida. Available at: http://dpanther.fiu.edu/sobek/content/FI/GO/00/03/11/00001/mc_lobster.pdf


Florida Keys National Marine Sanctuary (NMS). 2018. Regulations for Recreational Harvest & Lobster Information for Monroe County, Florida. Available at: https://nmsfloridakeys.blob.core.windows.net/floridakeys-


National Park Service. 2017a. Biscayne Bay-Card Sound Lobster Sanctuary. Available at:


NOAA. 2011a. ENVIRONMENTAL ASSESSMENT, REGULATORY IMPACT REVIEW, AND REGULATORY FLEXIBILITY ACT ANALYSIS TO REPEAL THE FISHERY MANAGEMENT PLAN FOR THE STONE CRAB FISHERY OF THE GULF OF MEXICO.

NOAA. 2012a. ATLANTIC LARGE WHALE TAKE REDUCTION PLAN MONITORING STRATEGY: Monitoring Effectiveness of and Regulatory Compliance with the Atlantic Large Whale Take Reduction Plan. NOAA Fisheries Service, Northeast Region. Available at: https://www.greateratlantic.fisheries.noaa.gov/protected/whaletrp/docs/5a_alwtrp_monitoring_strategy.pdf


Appendix A: Extra By Catch Species

FLORIDA STONE CRAB

Factor 2.1 - Abundance

FLORIDA / CARIBBEAN SEA, POTS, UNITED STATES OF AMERICA

Moderate Concern

There are no biological reference points to determine the overfished status of stone crabs. Since there is no recent stock assessment for the species, a PSA and data-limited indicators have been used to score the stock.

The stock assessment is between five and ten years old, adding uncertainty to the results of the stock assessment. Fishery-independent surveys show that relative abundance generally has remained stable over time (with fluctuations) or have been decreasing (FFWCC 2017a).

Since the PSA deems vulnerability as “low” and there is some conflicting information about stock status (either showing stable or declining trends), Seafood Watch deems abundance as a “moderate” concern.

Justification:

The most recent assessment of stone crab stocks (Muller et al. 2011) used two models to evaluate the stock status: the surplus production model and the DeLury model. The DeLury model demonstrated that recruitment varies without trend. The last stock assessment for the stone crab fishery concluded that the resource is fished at a maximum level (Muller et al. 2011). Since the most recent assessment, there has been little to no change in the fishery or its population (pers. comm., FFWCC 2017).

Fishery-independent surveys measured abundance using two indicators: young-of-the-year (YOY) and post-YOY throughout two areas, the Atlantic and the Gulf (table 3) (FFWCC 2017a). The table below shows that relative abundance has generally remained stable or has been decreasing.

Table 3. Summary of data collected on young-of-the-year (YOY) and post-YOY stone crab. Source: (FFWCC 2017a).

<table>
<thead>
<tr>
<th>YOY</th>
<th>Atlantic</th>
<th>Gulf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stone crabs were extremely rare and therefore it is difficult to deduce trends.</td>
<td>There were generally high, stable abundances between 2006 to 2015, but declined in 2016, to a 10-year low.</td>
<td></td>
</tr>
<tr>
<td>POST-YOY</td>
<td>Post-YOY has fluctuated over time, with a large peak in 2011 and high levels in 2014 and 2015; however, values have decreased in the 2016 season.</td>
<td>Since 2008, relative abundance has been generally decreasing.</td>
</tr>
</tbody>
</table>

There is some concern relating to the low numbers of large, mature males (Muller et al. 2011). Gerhart and Bert (2008) suggested that few males are likely to have mated before entering the fishery. Since females mature at a smaller size than males, and their claws are proportionally smaller towards male crab claws, female crabs are expected to spawn once or more before reaching the minimal harvest claw size. Male stone crabs have a size-related mating hierarchy, hence few males have mated before they attain legal size (Gerhart and Bert 2008).

The PSA score is 2.23 or a "low" concern.
<table>
<thead>
<tr>
<th>ATTRIBUTE</th>
<th>RESULT</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Productivity Attribute</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average age at maturity</td>
<td>2 Years (Fluech 2012)</td>
<td>1</td>
</tr>
<tr>
<td>Average maximum age</td>
<td>7 to 9 years (Fluech 2012)</td>
<td>1</td>
</tr>
<tr>
<td>Fecundity</td>
<td>&gt;1 million/season (Fluech 2012)</td>
<td>1</td>
</tr>
<tr>
<td>Reproductive strategy</td>
<td>Brooder (Fluech 2012)</td>
<td>2</td>
</tr>
<tr>
<td>Trophic level</td>
<td>high TL predator ~3 (NOAA 2011a)</td>
<td>2</td>
</tr>
<tr>
<td>Density dependence</td>
<td>No density dependence suggested, unknown</td>
<td>2</td>
</tr>
<tr>
<td><strong>Quality of Habitat</strong></td>
<td>Habitat has been moderately altered by non-fishing impacts: extensive hydro-engineering in the Everglades have been reported to cause degradation of marine habitats used by the spiny lobster (Phillips). Coastal development has increased nutrient and sediment run-off, thus impacting seagrasses and coral reefs (Phillips). Seagrasses, which act as important nursery grounds for spiny lobsters, have declined due to a number of anthropogenic activities such as dredging and nutrient loading (Lirman et al. 2019).</td>
<td>2</td>
</tr>
<tr>
<td><strong>Susceptibility Attribute</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Areal Overlap</td>
<td>Unknown; default</td>
<td>3</td>
</tr>
<tr>
<td>Vertical Overlap</td>
<td>Unknown; default</td>
<td>3</td>
</tr>
<tr>
<td>Selectivity of fishery</td>
<td>Species is targeted or is incidentally encountered AND is not likely to escape the gear, BUT conditions under &quot;high risk&quot; do not apply.</td>
<td>2</td>
</tr>
<tr>
<td>Post-capture mortality</td>
<td>Retained species (pers. comm., FFWCC 25 May 2018). Females are not processed/sold and only one claw can be removed (which decreases mortality rates from 46% (where both claws are removed) to 28%. (Davis et al. 1978). However, larger males are targeted (Gerhart and Bert 2008), which have higher rates of mortality than smaller males. Larger, clawed-male mortality rate is significantly higher than that for smaller males, since their claws are much larger in comparison to their body size (FFWCC 2016c). Additionally, they are at their prime mating size, thereby limiting reproductive potential.</td>
<td>3</td>
</tr>
</tbody>
</table>

$$P = 1.5$$

$$P^2 = 2.25$$

$$S = (((3 \times 3 \times 2 \times 3) -1)/ 40) + 1$$
Factor 2.2 - Fishing Mortality

FLORIDA / CARIBBEAN SEA, POTS, UNITED STATES OF AMERICA

**Moderate Concern**

The last stock assessment for stone crabs was published in 2011 and generally showed that the stock is undergoing overfishing (Muller et al. 2011) (FFWCC 2017a). The assessment concluded that stone crabs are the target of a highly over-capitalized trap fishery (where the number of traps is excessive and their stock status "is best indicated by the lack of an increase in landings when the number of traps more than doubled") (Muller et al. 2011). Though the stock assessment is between five and ten years old, low catch-per-trap rates have been recorded, indicating that there are too many traps in the fishery (FFWCC 2017a).

Spiny lobster traps account for less than 10% of stone crab landings (FFWCC 2017a). Stone crabs are not expected to exceed 5% of bycatch in the spiny lobster catch, and in recent ghost fishing studies, non-lobster invertebrates were observed in fewer than 10% of trap observations (Butler and Matthews 2015). However, stone crab claws are retained in the spiny lobster fishery (and the rest of the clawed crab is discarded back into the water). The mortality rates of the clawed crabs is highly dependent on the method in which they are harvested (see Justification for further explanation). When stone crabs are declawed, their mortality ranges between 25 to 71% (when one claw is removed) and 14 to 80% (when both claws are removed) (Duermiot al. 2015). Another study suggests that most stone crabs die when both claws are removed (Gandy et al. 2016). The frequency of clawed crabs re-entering the fishery is uncommon (Duermiot al. 2015) (Muller et al. 2011): Duermiot al. (2017) showed that only 3% of legal-sized crabs caught in the study had regenerated claws (Duermiot al. 2017).

While the mortality rate of stone crabs can be high, catch rates of stone crabs and overall mortality caused by the lobster fishery is assumed to be relatively low compared to that from the direct stone crab fishery; therefore, Seafood Watch deems fishing mortality as a “moderate” concern.

**Justification:**

Two models were used to estimate fishing mortality: the surplus production model and DeLury model. In the surplus production model, over 50% of model runs suggests that overfishing may be occurring (F/F\text{MSY} = 1.11) (Muller et al. 2011). The DeLury model was used to estimate if recruitment has changed over time given the high levels of mortality. The model found that recruitment is variable but without trend. Recruitment in the fishery occurs from two sources: 1) where crabs with their original claws reach minimum size, and 2) where
crabs have new claws that meet the minimum size (i.e., the crab was declawed and grew a new one). Therefore, this method cannot fully be trusted to evaluate fishing mortality (Muller et al. 2011).

The catch-per-trip data series showed declines until the 2007–08 season but subsequently showed increases. The report suggested that the lack of an increase in landings—concurrent with a doubling in the number of traps—indicated catch potential has reached an upper limit. Between 1986 and 1987 through 2004–05, there have been no observed declines in recruitment (FFWCC 2017a).

The stock assessment mentions that there is a lack of data regarding fishing mortality in the recreational fishery, increasing uncertainty in total fishing mortality estimates (Muller et al. 2011). Additionally, the stock assessment is between five and ten years old (Muller et al. 2011). Another assessment is expected to be published in 2019.

Although discard mortality rates varies significantly with the number of claws removed, the size of the wound (produced by claw removal) is considered a more significant factor. The indirect effects of claw removal (including altered feeding abilities) are deemed substantial (Duermitt et al. 2015). Depending upon the size of the crab and when in the intermolt cycle the crab is declawed, it can take one to two years for a crab to regenerate a claw to legal size (Muller et al. 2011). It is legal to remove both claws of legal crabs; however, fishery managers do not encourage this practice as it significantly reduces discard survival rates (FFWCC 2017d). Other factors that may increase mortality rates specifically include being dropped from large heights, but also sex, carapace width, degree of injury, which claw was removed (Kronstadt et al. 2018), and increasing handling times and temperature (Duermitt et al. 2015).

**Factor 2.3 - Discard Rate**

**FLORIDA / CARIBBEAN SEA, POTS, UNITED STATES OF AMERICA**

< 100%

**Discards**

There is little information about the total discard rate in the Caribbean spiny lobster fishery. Total discard rates given in Shester and Micheli (2011) for spiny lobster trap fisheries are presented as 15%. Although this study refers to the California spiny lobster (*P. interruptus*) fishery, rather than the Caribbean spiny lobster in Florida, it is possible the rates are quite similar. Matthews et al. (2005) noted that the number of fish that died in traps during observations over one season was quite small (Matthews et al. 2005).

Studies determining discard impacts in the Floridian fishery have also determined that confinement of lobsters in traps also may result in a 10% mortality rate (Matthews 2001). This figure may increase due to sub-lethal effects caused by confinement (including slowed growth rates, weight loss, and molting where lobsters do not increase in size (Wilson et al. 2014) (Matthews 2001).

**Bait**

Studies from other global lobster fisheries have shown that the volume of bait used regularly exceeds the volume of the target species landed (Harnish and Willison 2009) (Waddington and Meeuwig 2009), but that is not the case in the Florida lobster fishery. The Florida fishery permits the use of undersized lobsters (or “shorts”) or attractants in traps (GMFMC and SAFMC 2011). Attractant mortality represents an estimated 869,000 dead lobsters/year (FFWCC 2016b). The average weight for sub-legal sized lobsters is estimated at 0.3kg (Buesa 2018), this equates to around 260,700 kg dead attractants/year. Since 2,453,000 kg of Caribbean spiny lobster were landed into the US in 2016 (NMFS Commercial landings), dead attractants
represent around 11% of total lobster catch.

Alternatively, strips of salted cowhide and fish heads are used as bait (Buesa 2018). Studies have shown that traps baited with short lobsters catch more lobster than traps baited with any other method (Heatwole et al. 1988).

Discard and bait rates represent 15 and 11%, respectively and therefore, equate to less than 100% of lobsters landed. Therefore, a score of 1 is provided.

**WHITE GRUNT**

**Factor 2.1 - Abundance**

**FLORIDA / CARIBBEAN SEA, POTS, UNITED STATES OF AMERICA**

**Moderate Concern**

There is no recent or local stock assessment for white grunt and the International Union for Conservation of Nature (IUCN) classifies grunt as "Least Concern" (Lindeman et al. 2016).

Since white grunt are not deemed as an endangered, threatened or protected (ETP) species, and the PSA determines their vulnerability as "medium," Seafood Watch scores white grunt as a "moderate" concern.

**Justification:**

The PSA score for white grunt = 2.72. For this reason, the species is deemed as having a "medium" vulnerability.

<table>
<thead>
<tr>
<th>ATTRIBUTE</th>
<th>RESULT</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Productivity Attribute</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average age at maturity</td>
<td>1.5 years (Ault et al. 2005)</td>
<td>1</td>
</tr>
<tr>
<td>Average maximum age</td>
<td>18 years (Murie and Parkyn 2005)</td>
<td>2</td>
</tr>
<tr>
<td>Fecundity</td>
<td>19,873–535,039 (Palazon-Fernandez 2007)</td>
<td>1</td>
</tr>
<tr>
<td>Average maximum size (fish only)</td>
<td>30 cm (IGFA 2011)</td>
<td>2</td>
</tr>
<tr>
<td>Average size at maturity (fish only)</td>
<td>~17 cm (Potts 2000)</td>
<td>1</td>
</tr>
<tr>
<td>Reproductive strategy ]</td>
<td>Broadcast spawner (Froese and Pauly 2016)</td>
<td>1</td>
</tr>
<tr>
<td>Trophic level</td>
<td>3.8 (Froese and Pauly 2016)</td>
<td>3</td>
</tr>
<tr>
<td><strong>Susceptibility Attribute</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Areal Overlap</td>
<td>&gt;30% of the species concentration is fished, considering all fisheries</td>
<td>3</td>
</tr>
<tr>
<td>Vertical overlap</td>
<td>High degree of overlap between fishing depths and depth range of species</td>
<td>3</td>
</tr>
<tr>
<td>Selectivity of fishery</td>
<td>Species is targeted, or is incidentally encountered AND is not likely to escape the gear, BUT conditions under “high risk” do not apply</td>
<td>2</td>
</tr>
<tr>
<td>------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>---</td>
</tr>
<tr>
<td>Post-capture mortality</td>
<td>Retained species, or majority dead when released, or unknown</td>
<td>3</td>
</tr>
</tbody>
</table>

**Factor 2.2 - Fishing Mortality**

**FLORIDA / CARIBBEAN SEA, POTS, UNITED STATES OF AMERICA**

**Moderate Concern**

Since fishing mortality is unknown relative to reference points, fishing mortality is deemed a “moderate” concern.

**Factor 2.3 - Discard Rate**

**FLORIDA / CARIBBEAN SEA, POTS, UNITED STATES OF AMERICA**

< 100%

**Discards**

There is little information about the total discard rate in the Caribbean spiny lobster fishery. Total discard rates given in Shester and Micheli (2011) for spiny lobster trap fisheries are presented as 15%. Although this study refers to the California spiny lobster (*P. interruptus*) fishery, rather than the Caribbean spiny lobster in Florida, it is possible the rates are quite similar. Matthews et al. (2005) noted that the number of fish that died in traps during observations over one season was quite small (Matthews et al. 2005).

Studies determining discard impacts in the Floridian fishery have also determined that confinement of lobsters in traps also may result in a 10% mortality rate (Matthews 2001). This figure may increase due to sub-lethal effects caused by confinement (including slowed growth rates, weight loss, and molting where lobsters do not increase in size (Wilson et al. 2014) (Matthews 2001).

**Bait**

Studies from other global lobster fisheries have shown that the volume of bait used regularly exceeds the volume of the target species landed (Harnish and Willison 2009) (Waddington and Meeuwig 2009), but that is not the case in the Florida lobster fishery. The Florida fishery permits the use of undersized lobsters (or "shorts") or attractants in traps (GMFMC and SAFMC 2011). Attractant mortality represents an estimated 869,000 dead lobsters/year (FFWCC 2016b). The average weight for sub-legal sized lobsters is estimated at 0.3kg (Buesa 2018), this equates to around 260,700 kg dead attractants/year. Since 2,453,000 kg of Caribbean spiny lobster were landed into the US in 2016 (NMFS Commercial landings), dead attractants represent around 11% of total lobster catch.

Alternatively, strips of salted cowhide and fish heads are used as bait (Buesa 2018). Studies have shown that traps baited with short lobsters catch more lobster than traps baited with any other method (Heatwole et al. 1988).

Discard and bait rates represent 15 and 11%, respectively and therefore, equate to less than 100% of lobsters
**RED LIONFISH**

**Factor 2.1 - Abundance**

**FLORIDA / CARIBBEAN SEA, POTS, UNITED STATES OF AMERICA**

**Very Low Concern**

Since lionfish are a non-native species (Akins et al. 2012), Seafood Watch deems them as a "very low" conservation concern.

**Factor 2.2 - Fishing Mortality**

**FLORIDA / CARIBBEAN SEA, POTS, UNITED STATES OF AMERICA**

**Low Concern**

Since lionfish are a non-native species (Akins et al. 2012), Seafood Watch deems them a "low" conservation concern.

**Factor 2.3 - Discard Rate**

**FLORIDA / CARIBBEAN SEA, POTS, UNITED STATES OF AMERICA**

**< 100%**

**Discards**

There is little information about the total discard rate in the Caribbean spiny lobster fishery. Total discard rates given in Shester and Micheli (2011) for spiny lobster trap fisheries are presented as 15%. Although this study refers to the California spiny lobster (*P. interruptus*) fishery, rather than the Caribbean spiny lobster in Florida, it is possible the rates are quite similar. Matthews et al. (2005) noted that the number of fish that died in traps during observations over one season was quite small (Matthews et al. 2005).

Studies determining discard impacts in the Floridian fishery have also determined that confinement of lobsters in traps also may result in a 10% mortality rate (Matthews 2001). This figure may increase due to sub-lethal effects caused by confinement (including slowed growth rates, weight loss, and molting where lobsters do not increase in size (Wilson et al. 2014) (Matthews 2001).

**Bait**

Studies from other global lobster fisheries have shown that the volume of bait used regularly exceeds the volume of the target species landed (Harnish and Willison 2009) (Waddington and Meeuwig 2009), but that is not the case in the Florida lobster fishery. The Florida fishery permits the use of undersized lobsters (or "shorts") or attractants in traps (GMFMC and SAFMC 2011). Attractant mortality represents an estimated 869,000 dead lobsters/year (FFWCC 2016b). The average weight for sub-legal sized lobsters is estimated at 0.3kg (Buesa 2018), this equates to around 260,700 kg dead attractants/year. Since 2,453,000 kg of Caribbean spiny lobster were landed into the US in 2016 (NMFS Commercial landings), dead attractants represent around 11% of total lobster catch.

Alternatively, strips of salted cowhide and fish heads are used as bait (Buesa 2018). Studies have shown that
traps baited with short lobsters catch more lobster than traps baited with any other method (Heatwole et al. 1988).

Discard and bait rates represent 15 and 11%, respectively and therefore, equate to less than 100% of lobsters landed. Therefore, a score of 1 is provided.
Appendix B: A

The Caribbean-wide assessment is expected to be published in March 2019 through SEDAR 57 (SEDAR 2018). The stone crab stock assessment is expected in late 2018, to be published in 2019. Stone crab abundance studies are on-going and the data will be used in the upcoming assessment. (pers. comm., Florida Fish and Wildlife Conservation Commission on 28.09).
Appendix C: B

(Matthews et al. 2001) estimates 0.646 million lobster could be recruited to the fishery if they were not used as bait. This multiplied by 0.52kg (average legal-sized lobster weight) = ~ 335,920 kg lobster. Based on 2015 landings (2690 MT), this represents about 12% of lobster landings.