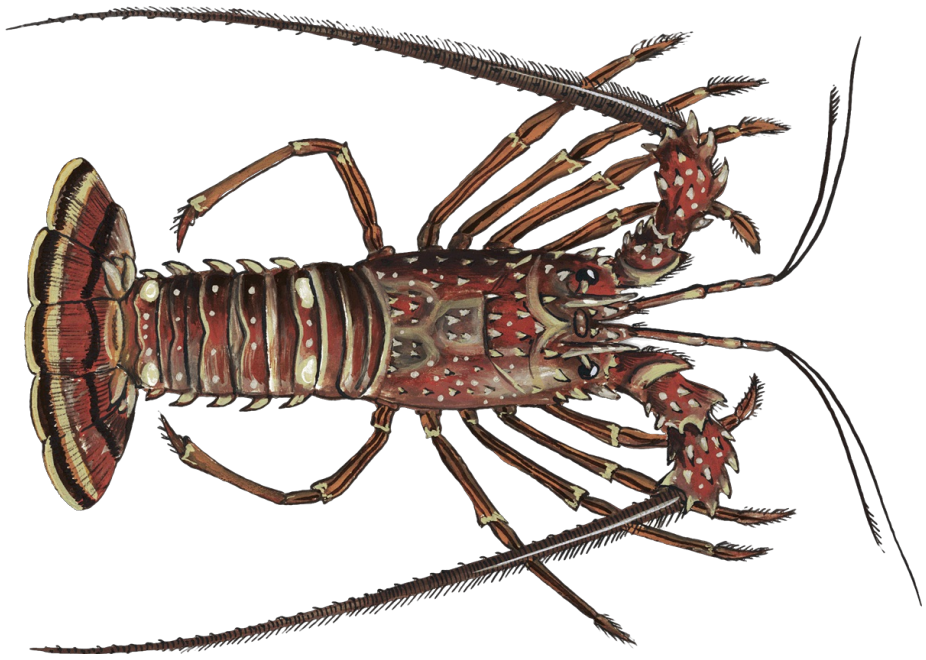
Monterey Bay Aquarium
Seafood Watch

Environmental sustainability assessment of wild-caught caribbean spiny lobster from Florida caught using pots



Species:	Caribbean spiny lobster *(Panulirus argus)*
Location:	Florida
Gear:	Pots
Type:	Wild Caught
Author:	Seafood Watch
Published:	January 9, 2023
Report ID:	27954

Assessed using Seafood Watch Fisheries Standard v3

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About Seafood Watch

Monterey Bay Aquarium's Seafood Watch program evaluates the environmental sustainability of wild-caught and farmed seafood commonly found in the United States marketplace. Seafood Watch defines sustainable seafood as originating from sources, whether wild-caught or farmed, which can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems. The program's goals are to raise awareness of important ocean conservation issues and empower seafood consumers and businesses to make choices for healthy oceans.

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

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

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

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

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

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

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

Guiding Principles

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

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

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

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

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

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

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

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

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

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

Summary

The Caribbean spiny lobster (*Panulirus argus*) is fished with traps in and around Florida in both state and federal waters. It tends to mature fairly quickly (between 1 and 2 years at the earliest) and the minimum harvest size tends to be before most lobsters reach 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 1 year older and large can likely produce three clutches of 680,000 eggs. Larvae from these eggs can disperse widely, leaving Florida and U.S. 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 because of a lack of confidence in the reference points. This is mainly because of a lack of data regarding the recruitment levels, because populations come from the Caribbean. The Florida fishery seems to be experiencing steady landing rates. But, 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 nontargeted species caught in the lobster fisheries include white grunt (*Haemulon plumieri*i) and stone crabs (*Menippe* spp.). Various other finfish and invertebrates, such as grouper, hogfish, snapper, hermit crab, arrow crab, and spider crab compose no more than 5% of the catch. White grunt 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, lobsters that are live or undersized (and sometimes, legal-sized) 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 sublegal-sized lobsters are used as attractants; and there are gear restrictions, licenses, and trap limits. But, management is undermined because 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 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 of these habitats are areas closed specifically to protect *Acropora* coral species. The ecosystem impacts from the trap fishery are a moderate conservation concern.

Final Seafood Recommendations

SPECIES | FISHERY	C 1 TARGET SPECIES	C 2 OTHER SPECIES	C 3 MANAGEMENT	C 4 HABITAT	OVERALL	VOLUME (MT) YEAR
Caribbean spiny lobster | Gulf of Mexico, Western Central Atlantic | Pots | United States | Florida	2.644	2.236	3.000	3.000	**Good Alternative (2.701)**	Unknown

Summary

Spiny lobster caught in waters around Florida is 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,* comprises 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 surfgrass 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 on 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, in the Caribbean Sea, and along the coast of South America through Brazil (Holthuis 1991). It should be noted that 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; these methods represent 2.4% and 3% of total landings, respectively (GMFMC 2017a). Thus, these methods are not analyzed in this report.

Management councils encompass the federal exclusive economic zones (EEZ) 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 approximately 13,000 km^2 but 95% of commercially caught lobsters were landed 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 the management applied is similar in both state and federal fisheries.

Production Statistics

The 66 years of trends in U.S. catches likely reflect both fishing effort as well as recruitment fluctuations from outside the U.S. Exclusive Economic Zone (EEZ) (SAFMC 2016a). The spiny lobster fishery expanded after 1950 and became fully capitalized by the 1980s. Between the late 1960s and mid-1970s, landings in Florida started to include some catches from the Bahamas. It is likely that the variations in landings of 2,000 to 4,000 mt from 1978 to 2000 also occurred before 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 ≈2,800 mt). Since 2000, landings have declined by ≈30% to a new dynamic equilibrium (with a mean of ≈2,000 mt) because of unknown causes (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 America, and South America (NMFS Commercial landings). Caribbean spiny lobster landings in Florida totaled 1,865.08 mt in 2019, which was 23.6% lower than the previous 5-year average (2014–2018) (FFWCC 2020). Specific to the commercial trap fishery, 1,453.35 mt of lobster were landed in Florida in the 2020–21 fishing season (FFWCC 2021).

Importance to the US/North American market.

The United States imports spiny lobster, including the Caribbean spiny lobster, from several countries in the Caribbean, Central America, and South America. There is a lack of species-specific import data because Caribbean spiny lobster imports can be named "Lobster Rock Caribbean Spiny," "Lobster Rock NSPF Frozen," or terms to that effect. 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 approximately USD 900 million annually (FAO 2015). Production over the last decade has fluctuated between 31,720 mt in 2009 to the highest reported production of 39,326 mt in 2016 (FAO 2018a). In

2020, 1,620.505 mt of Caribbean spiny lobster were landed in the U.S. and was valued at more than $25 million (NOAA 2022).

Common and market names.

Spiny lobster is also known as rock 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

CARIBBEAN SPINY LOBSTER			
REGION / METHOD	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Gulf of Mexico, Western Central Atlantic | Pots | United States | Florida	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

Criterion 1 Assessments

SCORING GUIDELINES

Factor 1.1 - Abundance

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

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

abundance level, OR abundance is unknown and the species is not highly vulnerable.

- *1 (High Concern) — Population is considered overfished/depleted, a species of concern, threatened or endangered, OR abundance is unknown and species is highly vulnerable.*

Factor 1.2 - Fishing Mortality

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

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

Caribbean spiny lobster

Factor 1.1 - Abundance

Gulf of Mexico, Western Central Atlantic | Pots | United States | Florida

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, so it is unknown if the stock is overfished (SEDAR 2005)(FFWCC 2020)(NMFS 2021).

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, FFWCC, 2017).

Spiny lobster has 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 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 a lack of data on the Caribbean-wide population (Buesa 2018)(SEDAR 2010)(FFWCC 2020)(NMFS 2021). Studies suggest that there are strong upstream connections with Mesoamerica and South America (Kough et al. 2013). But, 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). But, 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 were 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 U.S. Florida stock cannot be assessed in isolation (GMFMC 2017a)(SEDAR 2010)(FFWCC 2016a). To determine the stock status, a greater understanding is required of the Caribbean-wide spiny lobster stock, spawning biomass, and population-wide dynamics (Buesa 2018).

Although some reviews have shown at the 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 2) (SEDAR 2010). There are also reports that local Florida spawning stock biomass, estimated from an age-structured sequential population analysis, has decreased since 1988 (Ehrhardt and Fitchett 2010). The stock assessments do not agree with the 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 class and that few lobsters survive to the

age-3 class (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).

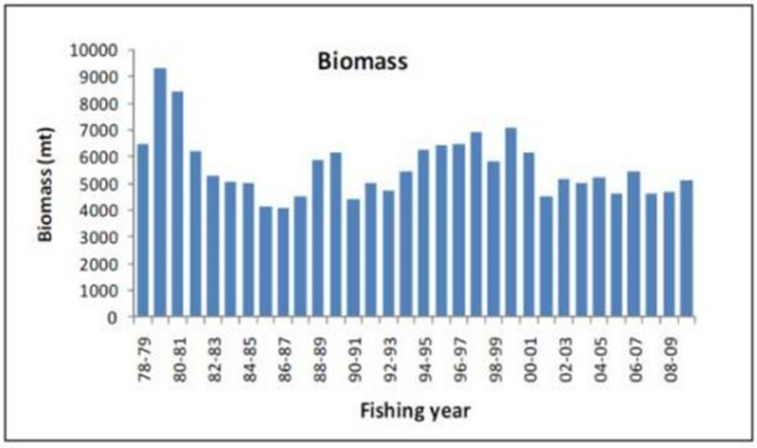

Figure 2. Biomass of Caribbean spiny lobster in the southeastern U.S. Figure from (SEDAR 2010).

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

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

Attribute	Result	Score
Productivity Attribute		
Average age at maturity	2 to 3 years (Ehrhardt 2005)	1
Average maximum age	20 years (Maxwell et al. 2007)	2
Fecundity	Between 147,000 and 1,952,000 at 72 to 141 mm CL, respectively, in Florida Keys (Bertelsen and Matthews 2002)	1
Reproductive strategy	Brooder	2
Trophic level	3 (Behringer and Butler 2006b)	2
Density dependence	No density dependence suggested, but unknown (Behringer and Butler 2006a)(Gutzler et al. 2015)	2

Quality of habitat	Habitat has been moderately altered by nonfishing 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 runoff, thus affecting seagrasses and coral reefs (Phillips). Seagrasses, which act as important nursery grounds for spiny lobster, have declined due to a number of anthropogenic activities, such as dredging and nutrient loading (Lirman et al. 2019).	2
Susceptibility Attribute		
Areal overlap	>30% of the species concentration is fished, considering all fisheries.	3
Vertical overlap	High degree of overlap between fishing depths and depth range of species.	3
Selectivity of fishery	Sublegal-sized lobsters (<3 inches CL) are retained as bait in traps. Research utilizing experimental traps and direct observation of fishers' traps indicated a 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 sublegal-sized lobsters is 0.3 kg (Buesa 2018), which equates to around 260,700 kg dead attractants/year. Because 2,453,000 kg of Caribbean spiny lobster were landed in the U.S. 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). Because 2,453,000 kg of Caribbean spiny lobster were landed in the U.S. in 2016 (NMFS Commercial landings), ghost fishing accounts for 11% of the total lobster commercial landings. Therefore, lobster mortality from the use of attractants as bait, combined with mortality due to ghost fishing, equate to around 22% of the lobster commercial landings.	2
Post-capture mortality	Retained species	3

$P = 1.71429$

$P^2 = 2.9388$

$S = [(3 * 3 * 2 * 3) - 1] \div 40 + 1$

$S = (54 - 1) \div 40 + 1$

$S = 53 \div 40 + 1$

$S = 2.325$

$S^2 = 5.406$

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

$V = \sqrt{2.9388 + 5.406}$

$V = \sqrt{8.344}$

$V = 2.889$

Factor 1.2 - Fishing Mortality

Gulf of Mexico, Western Central Atlantic | Pots | United States | Florida

Moderate Concern

The latest review of the spiny lobster stock assessment for the southeastern U.S. concluded that fishing mortality is unknown (SEDAR 2010), because the reference points were rejected by the Council due to a lack of data regarding the stock (GMFMC 2017a)(FFWCC 2020).

Because of 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 suggests that a "substantial percentage of current legal-size lobsters are removed by the fishery each year" (pers. comm., FFWCC November 14, 2018).

The stock is deemed to not be undergoing overfishing, using proxy reference points (NMFS 2017c)(NMFS 2021). But, 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: 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 Factor 1.1 for calculations). Attractant mortality has been accounted for in the last stock assessment (SEDAR 2010); however, this assessment is more than 5 years old. Mortality caused by ghost fishing has not been included in the stock assessment, thus increasing uncertainty in the overfishing status in the Florida spiny lobster fishery.

Because F is unknown relative to F_{MSY} but is not considered to be undergoing overfishing using proxy reference points, Seafood Watch deems fishing mortality 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 the fishing seasons 2007–08 to 2009–10, 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 because of the age of the assessment. The Integrated Catch-at-Age (ICA) model suggests that fishing mortality was likely underestimated in the 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 (Figure 3). 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) as a result of low catch rates (FFWCC 2016a). Landings have been increasing, with fluctuations between 2008 and 2015 (FFWCC 2016a). Spiny lobster landings in Florida totaled 4,111,805 lbs in 2019, which was 23.6% lower than the previous 5-year average (2014–18) (FFWCC 2020). Specific to the commercial trap fishery, approximately 3,204,092 lb of lobster were landed in Florida in the 2020–21 fishing season (FFWCC 2021). But, trends in landings are not recommended as an appropriate indicator of the stock of fishing mortality, because they likely reflect market conditions and recruitment fluctuations from outside the U.S. exclusive economic zone (EEZ) {SAFMC, 2016a}.

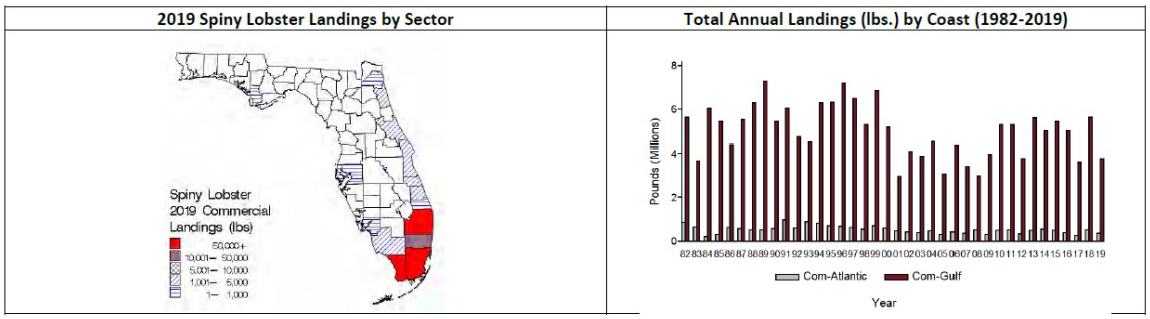

Figure 3. Total annual landings in Florida, by coast. Figure from (FFWCC 2020).

Postcapture 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 Factor 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 Crtitical

Guiding principles

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

Criterion 2 Summary

Criterion 2 score(s) overview

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

CARIBBEAN SPINY LOBSTER			
REGION / METHOD	**SUB SCORE**	**DISCARD RATE/LANDINGS**	**SCORE**
Gulf of Mexico, Western Central Atlantic | Pots | United States | Florida	2.236	1.000: < 100%	Yellow (2.236)

Criterion 2 main assessed species/stocks table(s)

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

GULF OF MEXICO, WESTERN CENTRAL ATLANTIC | POTS | UNITED STATES | FLORIDA			
SUB SCORE: 2.236	DISCARD RATE: 1.000	**SCORE: 2.236**	
SPECIES	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Bottlenose dolphin	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Caribbean spiny lobster	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Florida stone crab	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
White grunt	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Red lionfish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

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. The most common nontargeted 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 May 25, 2018). In recent bycatch studies, the most common fish observed in traps were white grunt (*Haemulon plumieri*, 43% of finfish bycatch), saucereye porgie (*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 because of 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); lionfish can be retained in the fishery (NMFS 2018a). Other bycatch species include 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 2022 Marine Mammal Protection Act (MMPA) List of Fisheries (NOAA 2022b). Therefore, it is unlikely that the fishery will jeopardize marine mammal stocks (NOAA 2022b). 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 2022b). Therefore, bottlenose dolphin has 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 turtle, green turtle, hawksbill turtle, leatherback turtle, or Kemp's ridley turtle. *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 of the spiny lobster fishery with sei and sperm whales, interactions are unlikely because the fishery operates in much shallower waters (pers. comm., J. Powell July 20, 2018), while the North Atlantic right whale "occur[s] within areas encompassed by the spiny lobster fishery" (GMFMC 2018a). North Atlantic right whale may be found from Florida to North Carolina, from November 1 through April 30 (SAFMC 2016b), while spiny lobster trap gear is permitted from August 6 to March 31 (GMFMC 2017a). But, the majority of the spiny lobster fishery operates much farther south than the North Atlantic right whale habitat. Around 90% of spiny lobster landings occur in the Florida Keys (FAO 2015), whereas the southerly tip of the critical habitat for right whale is just south of Cape Canaveral, Florida (NMFS 2017b). In addition, the risk of impact on North Atlantic right whale is not considered sufficient to include the species on the List of Fisheries 2017 (NOAA 2018a). Therefore, North Atlantic right whale is not considered further in this assessment.

For the trap fishery in Florida, the bottlenose dolphin limits the score for Criterion 2 due to the species' 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)

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

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

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

Bottlenose dolphin

Factor 2.1 - Abundance

Gulf of Mexico, Western Central Atlantic | Pots | United States | Florida

High Concern

The Florida spiny lobster fishery has been selected as a Category III fishery for injuring or killing five bottlenose dolphin stocks, as detailed in Table 1 (NOAA 2022b). Bottlenose dolphin is not considered endangered or threatened, although the Western North Atlantic Central Florida Coastal stock is deemed "Depleted" (NOAA 2018b).

The Florida Bay stock is considered to be the most at-risk (pers. comm., J. Powell July 20 2018) because it is a resident population (Waring et al. 2014) that overlaps with the lobster trap/pot fishery. But, 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 vulnerable species, so Seafood Watch deems abundance a high concern.

Justification:

Table 1. Stock status of common bottlenose dolphin that interact with the Florida spiny lobster fishery.

Stock	Strategic stock	Min. population estimate	Trend known?	OSP known?	Source
Biscayne Bay estuarine	Yes	Unknown	No	No	(Waring et al. 2014)(NOAA 2022b)
Central FL coastal	Yes	913	Yes; decline	No	(NOAA 2018b)(NOAA 2022b)
Eastern GMX coastal	No	14,199	No	No	(NOAA 2022b)(NOAA 2022c)
FL Bay estuarine	No	Unknown but abundance of 514	No	No	(Litz et al. 2008)(Waring et al. 2014)
Florida Keys	Yes	Unknown	No	No	(NOAA 2022d)

Factor 2.2 - Fishing Mortality

Gulf of Mexico, Western Central Atlantic | Pots | United States | Florida

Low Concern

Florida Bay, Florida Keys, and Biscayne Bay stocks

In the Florida Bay estuarine, the Florida Keys, and Biscayne Bay estuarine stocks, 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 the most at-risk (pers. comm., J. Powell July 20,

2018), but the 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 and Florida Keys stock are listed as strategic stocks (see Table 1 in Factor 2.1).

Central Florida Coastal and Eastern Gulf of Mexico Coastal stocks

There were no documented mortalities or serious injuries in the trap/pot gear from 2011–15 in the Central Florida coastal stock (NOAA 2018b). The mean annual fishery-related mortality/serious injuries are ≈4% of PBR, and all of those were related to the hook-and-line (rod and reel) fishery (Table 2). In the eastern Gulf of Mexico coastal stock, annual pot/trap fishery-caused mortality is <1% of PBR and total fishing mortality is below the PBR (Table 2) (NOAA 2022c).

The Florida spiny lobster fishery is categorized as a Category III fishery. The Central Florida coastal and eastern Gulf of Mexico coastal stocks are automatically scored a low concern, because the percentage of PBR taken by the fishery is quite low (0% and <1%, respectively). The fishing mortality relative to PBR is unknown for each of the Florida Bay, Florida Keys, and Biscayne Bay stocks; therefore, a more conservative score is required. But, the most recent stock assessments suggested that there were no recorded interactions with the lobster trap fishery between 2007 and 2011 for the Biscayne Bay and Florida Bay estuarine stocks, and only one interaction with the Florida Keys stock from 2015 to 2019 (Waring et al. 2014)(NOAA 2022d); therefore, Seafood Watch deems fishing mortality a low concern.

Justification:
Table 2. Fishing mortality of common bottlenose dolphin relative to PBR.

Stock	Total entanglements	Total annual fishing mortality	PBR	Source
Biscayne Bay Estuarine	None (2007 to 2011)	Unknown	Unknown	(Waring et al. 2014)
Central FL coastal	0 (2011 to 2015)	0.4	9.1	(NOAA 2018b)
Eastern GMX coastal	1 (2015 and 2019)	1.2	114	(NOAA 2022c)
FL Bay estuarine	0 (2007 to 2011)	Unknown	Unknown	(Waring et al. 2014)(Hayes et al. 2018a)
Florida Keys	1 (2015 and 2019)	Unknown	Unknown	(NOAA 2022d)

Florida stone crab

Factor 2.1 - Abundance

Gulf of Mexico, Western Central Atlantic | Pots | United States | Florida

Moderate Concern

There are no biological reference points to determine the overfished status of stone crab. Because there is no recent stock assessment for the species, a productivity-susceptibility analysis (PSA) and data-limited indicators have been used to score the stock. The stock assessment is between 5 and 10

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 has been decreasing (FFWCC 2017a). Because 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 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). Table 3 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 2020).

	ATLANTIC	GULF
YOY	Stone crabs were extremely rare and therefore it is difficult to deduce trends.	Abundances were low through 2005 and then increased through 2011, followed by a steady decline though 2018, and an increase in 2019.
POST-YOY	Abundances increased from 1999 to a peak in 2003, followed by a decrease through 2010, with peaks in 2011, 2014, 2015, and 2019.	Abundances were variable with a peak in 2008, followed by a decline through 2016, and a modest increasing trend in 2017–19.

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. Because females mature at a smaller size than males and their claws are proportionally smaller than male crab claws, female crabs are expected to spawn once or more before reaching the minimum 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.

Attribute	Result	Score
Productivity Attribute		
Average age at maturity	2 years (Fluech 2012)	1
Average maximum age	7 to 9 years (Fluech 2012)	1

Fecundity	>1 million/season (Fluech 2012)	1
Reproductive strategy	Brooder (Fluech 2012)	2
Trophic level	high TL predator ≈3 (NOAA 2011a)	2
Density dependence	No density dependence suggested, unknown	2
Quality of habitat	Habitat has been moderately altered by nonfishing 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 runoff, thus affecting seagrasses and coral reefs (Phillips). Seagrasses, which act as important nursery grounds for spiny lobster, have declined due to a number of anthropogenic activities such as dredging and nutrient loading (Lirman et al. 2019).	2
Susceptibility Attribute		
Areal Overlap	Unknown; default	3
Vertical Overlap	Unknown; default	3
Selectivity of fishery	Species is targeted or is incidentally encountered AND is not likely to escape the gear, BUT conditions under "high risk" do not apply.	2
Post-capture mortality	Retained species (pers. comm., FFWCC May 25, 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). But, larger males are targeted (Gerhart and Bert 2008), which have higher rates of mortality than smaller males. The larger, clawed male mortality rate is significantly higher than that for smaller males, because their claws are much larger relative to their body size (FFWCC 2016c). In addition, they are at their prime mating size, thereby limiting reproductive potential.	3

$P = 1.5$

$P^2 = 2.25$

$S = [(3 \times 3 \times 2 \times 3) - 1] \div 40 + 1$

$S = (54 - 1) \div 40 + 1$

$S = 53 \div 40 + 1$

$S = 2.325$

$S^2 = 5.406$

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

$V = \sqrt{2.25 + 5.406}$

$V = \sqrt{7.656}$

$V = 2.767$

Factor 2.2 - Fishing Mortality

Gulf of Mexico, Western Central Atlantic | Pots | United States | Florida

Factor 2.2 - Fishing Mortality

Gulf of Mexico, Western Central Atlantic | Pots | United States | Florida

Moderate Concern

The last stock assessment for stone crab was published in 2011 and generally showed that the stock is undergoing overfishing (Muller et al. 2011)(FFWCC 2017a). The assessment concluded that stone crab is the target of a highly overcapitalized trap fishery (where the number of traps is excessive and the 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). Although the stock assessment is between 5 and 10 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 crab is not expected to exceed 5% of bycatch in the spiny lobster catch, and in recent ghost-fishing studies, nonlobster invertebrates were observed in fewer than 10% of trap observations (Butler and Matthews 2015). But, stone crab claws are retained in the spiny lobster fishery (and the rest of the clawed crab is discarded into the water). The mortality rates of the clawed crabs is highly dependent on the method in which they are harvested (see Justification). When stone crabs are declawed, their mortality ranges from 25% to 71% when one claw is removed, and from 14% to 80% when both claws are removed (Duermit et 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 (Duermit et al. 2015)(Muller et al. 2011): Duermit et al. (2017) showed that only 3% of legal-sized crabs caught in the study had regenerated claws (Duermit et al. 2017).

Although the mortality rate of stone crab can be high, catch rates of stone crab 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 a moderate concern.

Justification:

Two models were used to estimate fishing mortality: the surplus production model and the DeLury model. In the surplus production model, over 50% of model runs suggest that overfishing may be occurring (F_{2009}/F_{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 be fully 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 that catch potential has reached an upper limit. Between 1986 and 1987 through 2004–05, there have been no observed declines in recruitment (FFWCC 2020).

The stock assessment mentions that there is a lack of data regarding fishing mortality in the recreational fishery, thus increasing uncertainty in the total fishing mortality estimates (Muller et al. 2011). Also, the stock assessment is between 5 and 10 years old (Muller et al. 2011). Another assessment was expected to be published in 2019.

Although discard mortality rates vary 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 (Duermit et al. 2015). Depending on the size of the crab and when in the intermolt cycle the crab is declawed, it can take 1 to 2 years for a crab to regenerate a claw to legal size (Muller et al. 2011). It is legal to remove both claws of legal-sized crabs; however, fishery managers do not encourage this practice because 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 the handling times and temperature (Duermit et al. 2015).

Red lionfish

Factor 2.1 - Abundance

Gulf of Mexico, Western Central Atlantic | Pots | United States | Florida

Very Low Concern

Because lionfish is a nonnative species (Akins et al. 2012), Seafood Watch deems it a very low conservation concern.

Factor 2.2 - Fishing Mortality

Gulf of Mexico, Western Central Atlantic | Pots | United States | Florida

Low Concern

Because lionfish is a nonnative species (Akins et al. 2012), Seafood Watch deems it a low conservation concern.

White grunt

Factor 2.1 - Abundance

Gulf of Mexico, Western Central Atlantic | Pots | United States | Florida

Moderate Concern

There is no recent or local stock assessment for white grunt; however, the International Union for the Conservation of Nature (IUCN) classifies white grunt as "Least Concern" (Lindeman et al. 2016). According to the Seafood Watch Fisheries Standard, white grunt receives a score of moderate concern for fisheries abundance because of its IUCN "Least Concern" status.

Factor 2.2 - Fishing Mortality

Gulf of Mexico, Western Central Atlantic | Pots | United States | Florida

Moderate Concern

Because fishing mortality is unknown relative to reference points, fishing mortality is deemed a moderate concern.

Factor 2.3 - Discard Rate/Landings

Gulf of Mexico, Western Central Atlantic | Pots | United States | Florida

< 100%
Discards

There is little information about the total discard rate in the Caribbean spiny lobster fishery. Total discard rates 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 that 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 because of sublethal 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 sublegal-sized lobsters is estimated at 0.3 kg (Buesa 2018), which equates to around 260,700 kg dead attractants/year. Because 1,620,505 kg of Caribbean spiny lobster were landed in the U.S. in 2020 (NOAA 2022), dead attractants represent around 16% 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 16%, respectively, and 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.

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

Criterion 3 Summary

FISHERY	MANAGEMENT STRATEGY	BYCATCH STRATEGY	RESEARCH AND MONITORING	ENFORCEMENT	INCLUSION	SCORE
Gulf of Mexico, Western Central Atlantic | Pots | United States | Florida	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Highly effective	**Yellow (3.000)**

Criterion 3 Assessment

SCORING GUIDELINES

Factor 3.1 - Management Strategy and Implementation

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

Factor 3.2 - Bycatch Strategy

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

Factor 3.3 - Scientific Research and Monitoring

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

Factor 3.4 - Enforcement of Management Regulations

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

Factor 3.5 - Stakeholder Inclusion

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

Factor 3.1 - Management Strategy And Implementation

Gulf of Mexico, Western Central Atlantic | Pots | United States | Florida

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 fishery management plan (FMP) in the South Atlantic and the Gulf of Mexico Management Council regions since 1982 (GMFMC and SAFMC 1982). The FMP has been amended 13 times over the years (GMFMC 2017a)(NOAA 2019). 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. In 2017, modifications to Amendment 4 prespecified the OFL and ABC by using a longer time series of landings data (GMFMC 2017a). Recently, Amendment 13 was added to the FMP in 2019 (NOAA 2019). The section of the amendment that pertains to the trap fishery includes a change in the commercial trap soak start time. Specifically, traps may now be baited and placed in the water beginning on the Saturday immediately following the recreational mini-season, but cannot be pulled for harvest until after the season opens (NOAA 2019).

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 and 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 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)(NMFS 2021). But, a large proportion of recruitment to the U.S. spiny lobster fishery comes from outside the U.S. exclusive economic zone (EEZ). U.S. catches probably have little, if any, effect on the productivity or sustainability of the biomass in U.S. waters (SAFMC 2016a). This makes it difficult to determine if the management within the U.S. EEZ is effective at managing the stock.

Lobster and stone crab seasons have some overlap, and stone crab is caught and retained in the spiny lobster fishery (pers. comm., FFWCC May 25, 2018). Stone crab is subject to management through the FFWCC, which includes the limited fishing grounds outside state waters (FFWCC 2022b).

There is a lack of evidence to show that management is effective at managing the impacts of fishing on 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 2022), (FFWCC 2022a), or (SAFMC 2022) unless otherwise stated):

Gear management measures

- Trap limits
- Commercial fishers 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
- 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)

Harvest Regulations

- Minimum size (3 inches carapace length and with tails 5.5 inches long or longer)
- 4-month closed season (April 1 through August 5 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
- Licenses requirement
- Location-dependent bag limits for commercial and recreational fishers
- 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 fishers 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}

- Traps may be baited and placed in the water beginning on the Saturday immediately following the recreational mini-season, but cannot be pulled for harvest until after the season opens (NOAA 2019)

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 after World War II until about 1975, when the Bahamian waters were closed to foreign fishers (NMFS 2012a)(Hunt 2000). Since 1975, lobster landings have fluctuated without a distinct trend (except that lower harvests tend 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 1998–99 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 5 years (GMFMC 2017a).

The ACT was exceeded in the 2014–15 season, and both the ACL and ACT were exceeded in the 2015–16 season; the 2015 Review Panel concluded that the ACL and ACT are not suitable for managing spiny lobster compared to other implemented effort controls (traps limits, gear restrictions, limited entry, seasonal closures, and spatial closures). But, NMFS has 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), because it reflects the dynamics of the fishery more accurately (GMFMC 2017a).

In Amendment 4, the Council recommended that a landings-based estimate (using an overfishing limit, OFL) is more appropriate for the maximum fishing mortality threshold (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 acceptable biological catch (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 (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 Criterion 1, Factor 1.1 for calculations). Attractant mortality has been accounted for in the total fishing mortality estimate in the stock assessment (SEDAR 2010). But, lobster mortality caused by ghost fishing has not been included in the fishing mortality estimates in the 2010 stock assessment. Although 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 470,244 (2016–17 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). But, 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

Gulf of Mexico, Western Central Atlantic | Pots | United States | Florida

Moderately Effective

Traps are highly selective: the main bycatch species in the Florida spiny lobster fishery are juvenile spiny lobster, followed by stone crab (further discussion of its management is available in Factor 3.1 because it is a retained species). Nontarget species make up a relatively small proportion of no more than 5% of the catch. They include include various finfish and invertebrates, such as grunt, grouper, hogfish, snapper, hermit crab, arrow crab, and spider crab (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 from 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, because 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, because of the low likelihood of capture and low level of fishing mortality relative to the potential biological removal (PBR), bottlenose dolphin received a score of low concern for fishing mortality in Criterion 2.

A suite of measures has been implemented in the FMP to reduce the risk of the spiny lobster fishery on bycatch and on endangered, threatened, and protected (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 Endangered Species Act (ESA) (see Justification for further details). Observer programs are not in place as a result of 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), which equals approximately 11% of the total lobster catch. Abandoned traps or buoys are the responsibility of the owner (GMFMC 2017a). Traps must have certificates (the 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 (FFWCC 2017c), and there are requirements for trap materials and sizes. But, derelict traps can continue to fish for over 1

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 because only 10% of traps are removed annually (Buesa 2018).

Lobster traps are a highly selective fishing gear. Management is effective at reducing the impact on bycatch and on 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 moderately effective.

Justification:
Several ETP species potentially interact with the spiny lobster fishery. Studies from 1997 to 2009 recorded that trap/pot gear accounted for 18.2% of fishery gear stranding interactions with common bottlenose dolphin, Florida manatee, and sea turtles in Florida (Adimey et al. 2014). NMFS published a final rule in 2016 (81 FR 42268) that listed the Nassau grouper as "Threatened" under the ESA, and the spiny lobster fishery may affect the Nassau grouper off southern Florida because both species overlap (GMFMC 2017a). North Atlantic right whale "occur[s] within areas encompassed by the spiny lobster fishery" (GMFMC 2018a). It 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 6 to March 31 (GMFMC 2017a). Nonetheless, the interaction between North Atlantic right whale and the spiny lobster fishery may be underestimated, because studies using passive acoustic monitoring found that this whale species may be present as far south as North Carolina waters throughout the year (NMFS 2018a). But, the impact on North Atlantic right whale is not considered to be a sufficient risk to include the species 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). But, there has been an increase in trap trawls in the fishery and the impact of this has not been studied (pers. comm., J. Powell July 20, 2018). The amount of trap line in the water is also reduced because 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 (e.g., *Acropora* corals, Northwest Atlantic loggerhead sea turtle, and North Atlantic right whale) (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 distinct population segments (DPS) of green sea turtle; the North Atlantic and South Atlantic DPSs of green sea turtle 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]) any 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 because of 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),

of which 5 occur in the Gulf and South Atlantic. In Southern Florida (where a relatively high amount of fishing takes place), there are seven marine protected areas (MPA) that prohibit harvesting spiny lobster, to protect coral (GMFMC 2017a).

Factor 3.3 - Scientific Research And Monitoring

Gulf of Mexico, Western Central Atlantic | Pots | United States | Florida

Moderately Effective

Stock assessments are irregular. The latest Florida spiny lobster stock assessment was rejected by the SEDAR review panel because of a lack of accurate data to determine the Caribbean-wide stock status. The assessment used fishery-dependent (e.g., landings, CPUE) 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. A U.S. Caribbean stock assessment was conducted in 2019, but did not include information regarding the Florida stock (SEDAR 2019). Therefore, the 2010 stock assessment is the most up-to-date stock assessment (SEDAR 2010)(SEDAR 2019) (pers. comm. T. Matthews, 2022, FFWCC). The stock, bycatch, and ghost fishing are monitored using a variety of fishery-dependent and -independent techniques.

Because a variety of data-monitoring methods are used in the fishery, but 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 has required all commercial fishers 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 trip ticket at the time of sale (FFWCC 2018b). Fishery-independent data are collected through state and federal agencies and research institutions conduct monitoring studies on spiny lobster populations via trap and dive studies, at various stages of the lobster's life history.

The Florida lobster fishery contains a relatively large recreational component (Table 3.1.1 in (GMFMC 2017a)). The recreational fishery landings are monitored through landings reports and a mail survey (FAO 2015a); however, there are issues with monitoring (GMFMC 2017a) and compliance with record-keeping (FFWCC 2016b).

Studies are conducted to determine bycatch species caught in the fishery, but bycatch is likely low and normally consists of stone crab (GMFMC 2017a), which is managed under the FFWCC (FFWCC 2011a).

There is no at-sea observer study for the Florida spiny lobster fishery because the spiny lobster fishery is a Category III fishery (which means that there is a remote likelihood of mortalities or serious injuries to marine mammals) (NOAA 2018a). In lieu of observer studies, NOAA conducts Trip Interview Programs, where observers conduct interviews with commercial and recreational fishers to help determine catch rates and sizes (Buesa 2018). The Marine Mammal Authorization Program (MMAP) requires all commercial fishing vessel owners or operators to report all "incidental injuries and mortalities of marine mammals that have occurred as a result of commercial fishing operations" to NMFS within 48 hours (NOAA 2012a). The common bottlenose dolphin Florida Bay stock is considered to be the most at-risk among the common bottlenose dolphin stocks listed under the Category III status (pers. comm., J. Powell July 20, 2018) because it is a resident population (Waring et al. 2014) that overlaps with the lobster trap/pot fishery (Waring et al. 2014). It is unknown if these low reported entanglement rates are due to the low numbers of reported strandings (Waring et al. 2014), because strandings may go unreported as a result of the lack of land in the Florida Keys area (pers. comm., J. Powell July 20, 2018), there is no direct observer coverage (NOAA 2018a), or there is an actual low entanglement rate (pers. comm., J. Powell 20 July 2018).

FFWCC monitors ghost fishing, its effects, and trap recovery rates through the two programs (the Spiny Lobster, Stone Crab, and Blue Crab Trap Retrieval Program and the Derelict Trap and Trap Debris Removal Program) (FFWCC 2016d).

Factor 3.4 - Enforcement Of Management Regulations

Gulf of Mexico, Western Central Atlantic | Pots | United States | Florida

Moderately Effective

The Florida Fish and Wildlife Commission maintains 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 U.S. 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). But, in recent seasons, the ACT and ACL have been breached (GMFMC 2017a). Illegal, unreported, and unregulated (IUU) fishing 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 to 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

Gulf of Mexico, Western Central Atlantic | Pots | United States | Florida

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 fishery science programs, e.g., trap programs. Therefore, Seafood Watch deems Stakeholder Inclusion highly effective.

Criterion 4: Impacts on the Habitat and Ecosystem

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

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

Guiding principles

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

Rating cannot be Critical for Criterion 4.

Criterion 4 Summary

FISHERY	FISHING GEAR ON THE SUBSTRATE	MITIGATION OF GEAR IMPACTS	ECOSYSTEM-BASED FISHERIES MGMT	SCORE
Gulf of Mexico, Western Central Atlantic | Pots | United States | Florida	Score: 3	Score: 0	Moderate Concern	**Yellow (3.000)**

Criterion 4 Assessment

SCORING GUIDELINES

Factor 4.1 - Physical Impact of Fishing Gear on the Habitat/Substrate
Goal: The fishery does not adversely impact the physical structure of the ocean habitat, seafloor or associated biological communities.

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

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

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts
Goal: Damage to the seafloor is mitigated through protection of sensitive or vulnerable seafloor habitats, and limits on the spatial footprint of fishing on fishing effort.

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

Factor 4.3 - Ecosystem-Based Fisheries Management
Goal: All stocks are maintained at levels that allow them to fulfill their ecological role and to maintain a functioning ecosystem and food web. Fishing activities should not seriously reduce ecosystem services provided by any retained species or result in harmful changes such as trophic cascades, phase shifts or reduction of genetic diversity. Even non-native species should be considered with respect to ecosystem impacts. If a fishery is managed in order to eradicate a non-native, the potential impacts of that strategy on native species in the ecosystem should be considered and rated below.

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

- *1 — Scientifically demonstrated trophic cascades, alternate stable states or other detrimental food web impact are resulting from this fishery.*

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

Gulf of Mexico, Western Central Atlantic | Pots | United States | Florida

Score: 3

Spiny lobster is 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). Because traps are deployed predominantly on noncoral habitats, Seafood Watch rated this factor with a score of 3.

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

Gulf of Mexico, Western Central Atlantic | Pots | United States | Florida

Score: 0

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, so this prohibits spiny lobster fishing (NMFS 2009). These areas include 60 areas that are closed to protect coral (*Acropora* species), enclosing approximately 5.9 mi^2 (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 mi^2 (28,126 km^2) (Graham et al. 2016). But, the traditional Florida spiny lobster fishing area is approximately 5,000 mi^2 (FAO 2015a).

Although it has not 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 2,105 mi^2. Therefore, the proportion of the fishery that is protected is around 19% (2,105 of 10,860 mi^2). The percentage of the Florida EEZ that is closed to fishing that affects 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 85,000 ghost traps and over one million nonfishing 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 6 weeks when the beds were covered with traps, and that the beds were denuded after 6 months (Uhrin et al. 2005).

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

Justification:
Currently, there are several sanctuary preservation areas and ecological reserves within the FKNMS that are 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 (Butler and Matthews 2015).

Because of the safeguards placed upon protected species in the Gulf of Mexico and South Atlantic waters (such as closed areas), NMFS has suggested that the spiny lobster fishery is not likely to jeopardize the 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 (the Spiny Lobster, Stone Crab, and Blue Crab Trap Retrieval Program, where commercial fishers remove derelict traps during closed seasons, and the Derelict Trap and Trap Debris Removal Program, which 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).

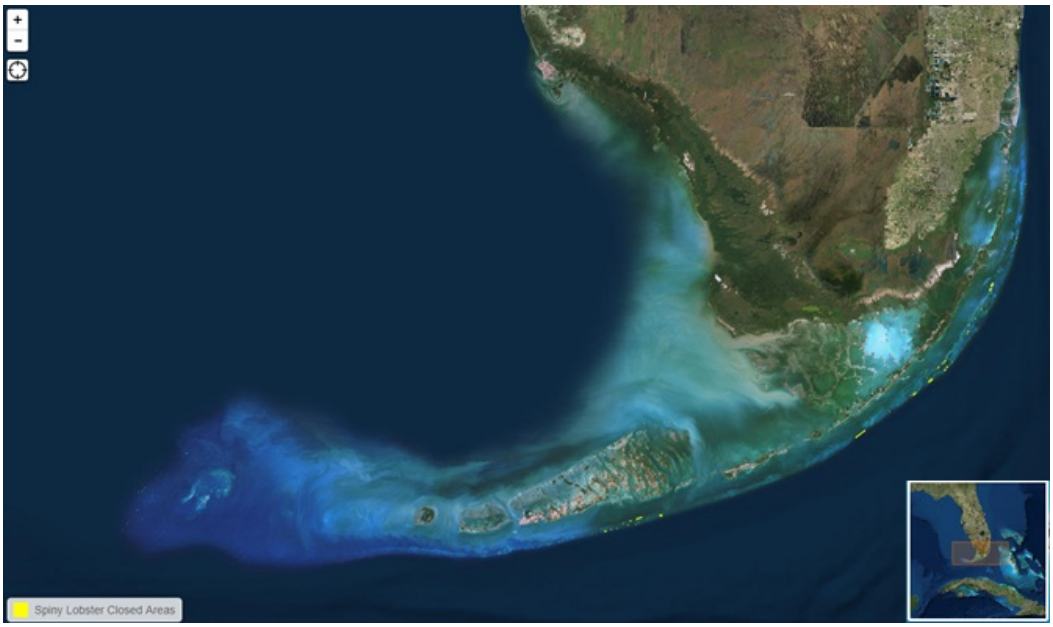

Figure 5. Map of Florida Keys area with area closures shown in yellow. Available at: http://portal.gulfcouncil.org/SpinyLobsterManagement.html

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

Protected Area	Size
Florida Keys National Marine Sanctuary (FKNMS)	190.53 mi^2 (pers. comm., NOAA November 16, 2018).
Merritt Island National Wildlife Refuge	Approximately 22% of the waters have been closed to fishing (Johnson et al. 1999), the refuge is 140,000 acres or 218 mi^2, therefore around 48 mi^2 are closed to fishing (U.S. Department of the Interior Fish and Wildlife Service 2008)
Florida Bay in the Everglades National Park	1,100 mi^2 (Florida Museum 2018a)
Spiny Lobster Sanctuary Biscayne Bay Florida	270 mi^2 (National Park Service 2017a)
John Pennekamp Coral Reef State Park	99 mi^2 (State of Florida Department of Environmental Protection 2018)
Dry Tortugas	260 mi^2 (National Park Service 2017b)
Others including artificial habitats and the waters of and around the City of Layton (FKNMS 2015)	
Total = 191 + 48 + 1,100 + 270 + 236 + 260 = 2,105 mi^2	

Factor 4.3 - Ecosystem-based Fisheries Management

Gulf of Mexico, Western Central Atlantic | Pots | United States | Florida

Moderate Concern

The role that spiny lobsters plays in reef ecosystems is unknown; hence, the impact of its 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 U.S. 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 lobster is an abundant mid-trophic-level predator (Behringer and Butler 2006b) and likely contains a high amount of available energy reserves: spiny lobster is an important predator 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, Northwest Atlantic loggerhead sea turtle, 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 because of 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), of which 5 occur in the Gulf and South Atlantic (GMFMC 2017a).

Because 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 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.

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Appendix A: Updates to the Florida Caribbean Spiny Lobster Report

Updates to the December 19, 2018 Florida Caribbean Spiny Lobster Report were made on November 1, 2022:

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

- 2018 Final Amendment 13 to the Fishery Management Plan for Spiny Lobster in the Gulf of Mexico and the South Atlantic
- 2022 Marine Mammal Protection Act (MMPA) List of Fisheries (Common bottlenose dolphin)
    - 2018 Western North Atlantic Central Florida Coastal Stock Assessment
    - 2022 Gulf of Mexico Eastern Coastal Stock Assessment
    - 2022 Florida Keys Stock Assessment
- 2020 Florida Fish and Wildlife Conservation Commission Status and Trends Report

Appendix B: Rating Review Summary Table

Criteria	Previous Report (2018)	Current Review (2022)
Who conducted the stock assessment?	SEDAR	Same as previous
When was the stock assessment conducted?	2005 (approved); 2010 (rejected)	Same as previous
Where/what are the catch composition data source(s)?	MMPA LOF; pers. comm.; third-party studies	Same as previous
Who manages the fishery?	The Florida Fish and Wildlife Conservation Commission (FFWCC), SAFMC, and GMFMC	Same as previous
What is the date of the published management plan?	1982	Same as previous
Are there any amendments?	12 amendments	Yes—Regulatory amendment 13 (2019)