Red Deepsea crab

Chaceon quinquedens

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U.S. Atlantic
Trap

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Disclaimer

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About Seafood Watch®

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

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

Parties interested in capture fisheries, aquaculture practices and the sustainability of ocean ecosystems are welcome to use Seafood Reports in any way they find useful. For more information about Seafood Watch® and Seafood Reports, please contact the Seafood Watch® program at Monterey Bay Aquarium by calling 1-877-229-9990.

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.

Based on this principle, Seafood Watch had developed four sustainability **criteria** for evaluating wild-catch fisheries for consumers and businesses. These criteria are:

- How does fishing affect the species under assessment?
- How does the fishing affect other, target and non-target species?
- How effective is the fishery's management?
- How does the fishing affect habitats and the stability of the ecosystem?

Each criterion includes:

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

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

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

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

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

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

Summary

This report includes recommendations for Red Deepsea crab (*Chaceon quinquedens*), a large-bodied benthic crustacean caught exclusively by trap. The fishery occurs at a depth of 200–1,800 m along the continental shelf and slopes of the Western Atlantic, ranging from Cape Hatteras Light, North Carolina northward to the U.S.–Canada border.

Red deepsea crabs have medium inherent vulnerability to fishing pressure. They are slow growing, like most deepsea organisms, but reach a maximum size of about 180 mm carapace width (CW) and may live for 25 years or more. Red crabs are sexually mature around 75 mm CW, and in their lifetime, females produce as many as 270,000 eggs, which are brooded under the abdominal flap for up to 9 months.

There is low conservation concern because the red crab stock is not indicated to be in an overfished state according to the biomass reference point, which is above biomass at maximum sustainable yield (B_{MSY}), and according to the fishing mortality reference point, which appears to be below fishing mortality at maximum sustainable yield (F_{MSY}).

Bycatch rates for finfish and invertebrates are near zero for the red crab fishery. The few species that are caught as bycatch are minor species, and comprise approximately 0.001% of total red crab landings. The majority of discards are undersized male red crabs and female red crabs, but discard mortality is estimated to be minimal, at 5%. The red crab fishery is considered a Category II fishery under the Marine Mammal Protection Act (MMPA), which means that occasional incidental interactions and serious injury of whales may occur. However, given the limited overlap of right whales (endangered), humpback whales, and sei whales (endangered) with the area and depth where red crab gear occurs, as well as other factors, interaction with protected species is rare and has not been observed in the fishery's history.

The New England Fishery Management Council (NEFMC), in partnership with the National Marine Fisheries Service (NMFS), the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Department of Commerce, oversees the management of the Atlantic red deepsea crab fishery. It is a well-managed fishery, regulated by having a hard total allowable limit (TAL) of 1,775 mt (until 2016), measures to control the landing of female crabs, and measures to increase the mean size of the crabs harvested over time.

Red deepsea crabs are exclusively fished with trap gear, which is considered to have a low impact on benthic habitats. Specifically, there is no direct information to determine if any adverse affects on essential fish habitat are occurring in the red crab fishery. But several management measures, such as trap limits, controlled access, and a prohibition on non-trap gear, are intended to serve multiple purposes (resource conservation, effort control, etc.), which provide direct benefits to the habitat. Additionally, there is little conservation concern regarding the effects of red crab removal on ecosystem functioning, because they do not constitute a major prey item for any species and have few competitive

interactions with other fishery resources, negligible bycatch of other species, and minimal to no effect on the physical habitat.

Table of Conservation Concerns and Overall Recommendations

Stock / Fishery	Impacts on the Stock	Impacts on other Spp.	Management	Habitat and Ecosystem	Overall Recommendation
Atlantic deep sea red crab United States Atlantic - Trap	Yellow (3.05)	Yellow (2.24)	Green (3.46)	Yellow (3.00)	**Good Alternative (2.902)**

Scoring Guide

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

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

- **Best Choice/Green** = Final Score >3.2, **and** no Red Criteria, **and** no Critical scores
- **Good Alternative/Yellow** = Final score >2.2-3.2, **and** neither Harvest Strategy (Factor 3.1) nor Bycatch Management Strategy (Factor 3.2) are Very High Concern[2], **and** no more than one Red Criterion, **and** no Critical scores
- **Avoid/Red** = Final Score <=2.2, **or** either Harvest Strategy (Factor 3.1) or Bycatch Management Strategy (Factor 3.2) is Very High Concern **or** two or more Red Criteria, **or** one or more Critical scores.

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

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Introduction

Scope of the analysis and ensuing recommendation

This report includes recommendations for Atlantic red deepsea crab (*Chaceon quinquedens*) caught exclusively by trap. The fishery occurs along the continental shelf and slopes of the Western Atlantic, ranging from Cape Hatteras Light, North Carolina northward to the U.S.–Canada border.

Overview of the species and management bodies

Red deepsea crabs are large-bodied brachyuran crabs (family Geryonidae) dwelling on mud, sand, and hard bottom along the continental shelf and slope of the Western Atlantic. Red crabs are generally found at depths of 200–1,800 m and at water temperatures of 5–8°C (Wigley, Theroux, Murray 1975). They have a patchy distribution throughout the Gulf of Mexico and northward to Emerald Bay, Nova Scotia (Haefner 1977) (Serchuk and Wigley 1982), although fishing occurs primarily off Southern New England. Despite the paucity of information on red crab life history, it is thought that male red crabs need 5–6 years to attain commercial size and at least 15 years (18–20 molts) to reach a maximum size of about 180 mm carapace width (CW), while female red crabs grow only to a maximum size of about 136 mm CW (Haefner 1977) (Steimle, Zetlin, Chang 2001). Mating occurs when the larger male crab forms a protective “cage” around the female and carries her for as long as 2 or 3 weeks until she molts and becomes ready to copulate (Elner, R. W., S. Koshio, and G. V. Hurley 1987). Egg brooding takes place under the female’s abdominal flap for up to 9 months (Erdman et al. 1991). Once the larvae hatch, they remain in the plankton for 23–125 days (Kelly, Sulkin, and Van Heukelem 1982), ultimately settling near the base of the continental slope (Roff, Fanning and Stasko 1986). Young crabs then move up the slope as they mature. Male and juvenile crabs are commonly found in deeper water than females.

In 1973, a small experimental fishery for male red crabs was established in response to the declining offshore lobster fishery and to fisheries development efforts (Rathjen 1974) toward better harvesting, processing, and marketing of red crab (Serchuk 1977). Before the initial targeted survey for red crabs (Wigley et al. 1975), fishery catches were small and inconsistent. Reported landings since 1982 (excluding 1994, when there was no targeted red crab fishing) varied from a low of 466 mt in 1996 to a high of 4,000 mt in 2001. The number of boats participating in the fishery has varied from 3 to 22, with 3 (out of 4 total) currently operating (as of 2013). Since the fishery’s inception, red crab landings have been inconsistent due to market demand, which fluctuates with the supplies of alternative crab products (New England Fishery Management Council 2013). In 2002, the red deepsea crab Fishery Management Plan was implemented, making it a limited-access fishery. Landings were stable at around 2,000 mt until regulation changed in 2011, lowering the total allowable limit (TAL) to 1,775 mt. A small percentage of annual landings are bycatch from the offshore lobster fishery. The red crab fishery is managed by the New England Fishery Management Council (NEFMC), in partnership with the National Marine Fisheries Service (NMFS), the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Department of Commerce.

Production Statistics

The United States is the exclusive producer of red deepsea crab (the Canadian fishery is no longer operating). All red crabs are processed in New England and sold throughout the U.S.

Importance to the U.S./North American market

From 2002 (when the FMP was implemented) to 2010, Red deepsea crab landings remained stable at around 2,000 mt per year. In September 2011, the TAL was lowered from 2,889 mt to 1,775 mt; since then, landings have hovered slightly below the TAL. Landings in 2012 were 1,180 mt, and total landings in 2013, as of 14 August, were 365 mt and not expected to reach the annual quota due to limited market availability (Scientific Certification Systems, Inc 2013).

The red crab fishery is small, with only 3 out of 4 vessels currently operating, but ex-vessel revenues are estimated to be about $4–5 million per year (Scientific Certification Systems, Inc 2013).

Approximately 150,000–200,000 lbs per year of red crab are sold to companies in Asia (pers. comm., Jon Williams, October 22, 2014).

Common and market names

Red Deepsea crab is also known as red crab and Atlantic red deepsea crab.

Primary product forms

Red crab is sold fresh in New England and the Mid-Atlantic as far south as Virginia. Red crab is also sold frozen (cooked or raw) and as frozen clusters, leg meat, body meat, cocktail claw fingers, and snap-and-eat claws for food service throughout the U.S. The Atlantic Red Crab Company is presently developing live markets that represent 200,000 lbs. per year (pers. comm., Jon Williams, October 22, 2014).

Assessment

This section assesses the sustainability of the fishery(s) relative to the Seafood Watch Criteria for Fisheries, available at http://www.seafoodwatch.org.

Criterion 1: Stock for which you want a recommendation

This criterion evaluates the impact of fishing mortality on the species, given its current abundance. The inherent vulnerability to fishing rating influences how abundance is scored, when abundance is unknown. 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.

Criterion 1 Summary

RED DEEPSEA CRAB				
Region / Method	**Inherent Vulnerability**	**Stock Status**	**Fishing Mortality**	**Subscore**
United States Atlantic Trap	2.00:Medium	4.00:Low Concern	2.33:Moderate Concern	**Yellow (3.053)**

Criterion 1 Assessment

RED DEEPSEA CRAB

Factor 1.1 - Inherent Vulnerability

Scoring Guidelines

- *Low—The FishBase vulnerability score for species is 0-35, OR species exhibits life history characteristics that make it resilient to fishing, (e.g., early maturing (*
- *Medium—The FishBase vulnerability score for species is 36-55, OR species exhibits life history characteristics that make it neither particularly vulnerable nor resilient to fishing, (e.g., moderate age at sexual maturity (5-15 years), moderate maximum age (10-25 years), moderate maximum size, and middle of food chain).*

- *High—The FishBase vulnerability score for species is 56-100, OR species exhibits life history characteristics that make is particularly vulnerable to fishing, (e.g., long-lived (>25 years), late maturing (>15 years), low reproduction rate, large body size, and top-predator).*
  Note: The FishBase vulnerability scores is an index of the inherent vulnerability of marine fishes to fishing based on life history parameters: maximum length, age at first maturity, longevity, growth rate, natural mortality rate, fecundity, spatial behaviors (e.g., schooling, aggregating for breeding, or consistently returning to the same sites for feeding or reproduction) and geographic range.

United States Atlantic, Trap

Medium

Red deepsea crab has a medium inherent vulnerability (score of 2) due to its moderate age at sexual maturity, reproductive strategy, and moderate lifespan (see Table 1).

Rationale:

Table 1. Life-history characteristics for Atlantic red deepsea crab.

Life history attribute	Score	Rationale	Source
Average age at maturity	2	9 years	Van Heukeleum et al.1983
Average maximum age	2	25 years	Melville-Smith 1989, Chute 2006
Fecundity	N/A	160,000-270,000 eggs per lifetime produced by females	Weinberg et al. 2003
Reproductive strategy	2	Fertilized eggs are brooded by females, larvae spend several months in water column	Weinberg et al. 2003
Density dependence	2	No depensatory or compensatory dynamics demonstrated or likely	Syuhada 2014
Total score	**2**	**Moderate vulnerability**	

Factor 1.2 - Stock Status

Scoring Guidelines

- *5 (Very Low Concern)—Strong evidence exists that the population is above target abundance level (e.g., biomass at maximum sustainable yield, BMSY) or near virgin biomass.*
- *4 (Low Concern)—Population may be below target abundance level, but it is considered not overfished*
- *3 (Moderate Concern) —Abundance level is unknown and the species has a low or medium inherent vulnerability to fishing.*
- *2 (High Concern)—Population is overfished, depleted, or a species of concern, OR abundance is unknown and the species has a high inherent vulnerability to fishing.*
- *1 (Very High Concern)—Population is listed as threatened or endangered.*

United States Atlantic, Trap

Low Concern

Biomass at maximum sustainable yield (B/B_{MSY}) in the northern and southern areas combined (for 2012) was 1.50 (B = 9,470 mt, B_{MSY} = 6,316 mt) (Syuhada 2014). There is some uncertainty in abundance due to these values not being corroborated by the most recent quantitative stock assessment (the values are unknown), so this factor is rated "low" concern.

Syuhada's research was a quantitative stock assessment based on data supplied by NOAA and NMFS. This research was peer reviewed by a Ph.D. committee, but has not yet been published in a peer-reviewed journal. The complete NOAA NMFS stock assessment was in 2006 (NEFSC 2006), and in 2010, there was an NMFS Data Poor Stock Assessment Working Group (DPSWG). Syuhada's research followed recommendations made in the previous assessments, and provided a more complete and current analysis. The results of Syuhada (2014) have not been corroborated by NMFS, but will likely be used in the next NMFS assessment (pers. comm., Joseph DeAlteris, December 18, 2014). Because there is uncertainty in the results, this leads to a score of "low" concern rather than very low concern.

Rationale:
The red crab stock remains healthy because the current biomass is above target abundance level (B/B_{MSY} > 1). Although there have been two stock assessments conducted during the four decades since the fishery was started (NEFSC 2006) (Serchuk 1977), as well as a report from the DPSWG in 2010, the management measures such as maximum sustainable yield (MSY) and biomass at maximum sustainable yield (B_{MSY}) have been uncertain. But Syuhada (2014) used a biomass dynamic model to estimate the biological reference points, including MSY and other properties (fishing mortality at maximum sustainable yield, F_{MSY}; and B_{MSY}) for the red crab stock. His work shows an improvement in stock biomass over the years, and with the ratio above one, it indicates that these areas are not overfished (see Figure 2a, b).

In his dissertation, Syuhada (2014) separated the red crab population in the northwest Atlantic into two sub-stocks (with Hudson Canyon as a bio-geographic barrier dividing the population along the upper continental slope off New England [north] and the mid-Atlantic [south]) to differentiate the effects of

fishing on the older mature fishery in the north and east (which has been more heavily fished) from the newer fishery in the south. For this report, we have classified the red deepsea crab fishery as a single stock because it is managed as a single stock, but also due to the negligible differences between the two regions with respect to biomass/abundance, fishing mortality, discard rate, and bycatch. But any differences between north and south are noted, so all information is taken into account.

Syuhada (2014) found that the estimated density (biomass) of red crabs in the southern area is almost twice the density in the northern area, resulting in higher values of catch per unit effort (CPUE) in the southern areas than the northern areas. Yet mean abundance (number) of crabs is much higher in the northern region (an average of 70 crabs/trap in each survey) than in the southern region (an average of 53 crabs/trap in each survey) (Syuhada 2014).

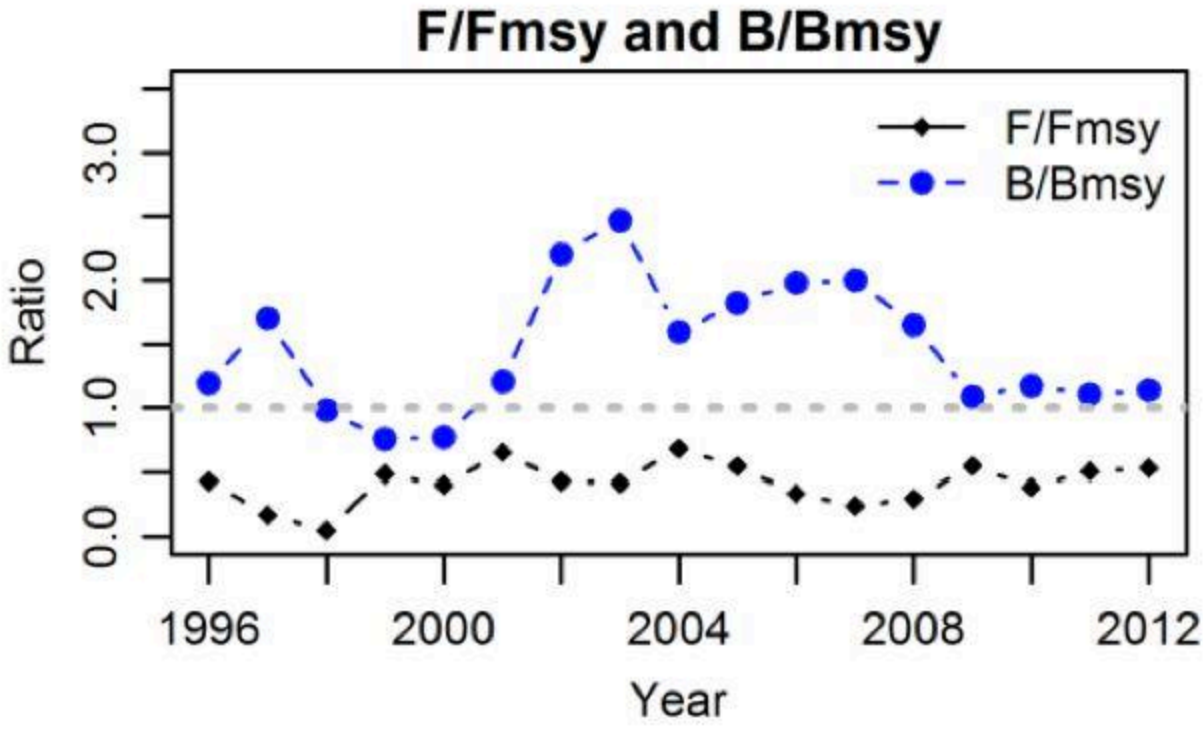

Figure 2a. Biomass dynamic model output for B/B_{MSY} and F/F_{MSY} from the northern portion of the red crab stock (Syuhada 2014).

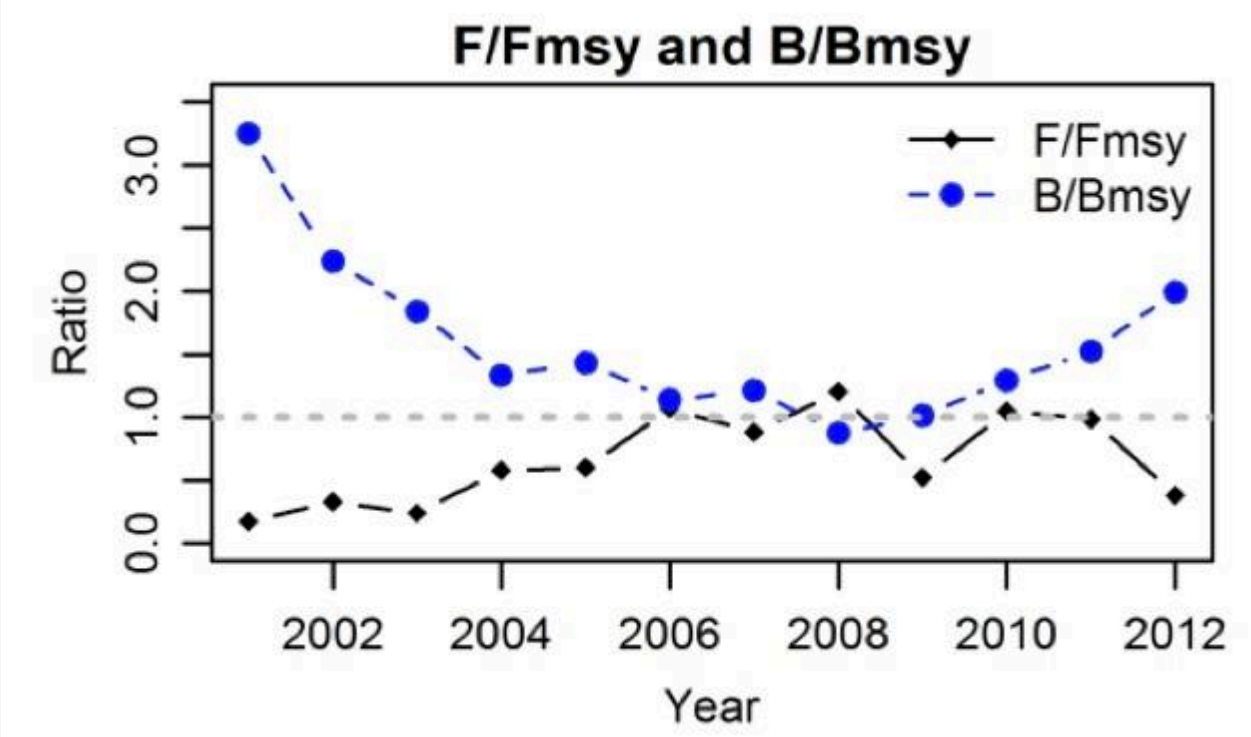

Figure 2b. Biomass dynamic model output for B/B_{MSY} and F/F_{MSY} from southern portion of the red crab stock (Syuhada 2014).

Factor 1.3 - Fishing Mortality

Scoring Guidelines

- *5 (Very Low Concern)—Highly likely that fishing mortality is below a sustainable level (e.g., below fishing mortality at maximum sustainable yield, FMSY), OR fishery does not target species and its contribution to the mortality of species is negligible (≤ 5% of a sustainable level of fishing mortality).*
- *3.67 (Low Concern)—Probable (>50%) chance that fishing mortality is at or below a sustainable level, but some uncertainty exists, OR fishery does not target species and does not adversely affect species, but its contribution to mortality is not negligible, OR fishing mortality is unknown, but the population is healthy and the species has a low susceptibility to the fishery (low chance of being caught).*
- *2.33 (Moderate Concern)—Fishing mortality is fluctuating around sustainable levels, OR fishing mortality is unknown and species has a moderate-high susceptibility to the fishery and, if species is depleted, reasonable management is in place.*
- *1 (High Concern)—Overfishing is occurring, but management is in place to curtail overfishing, OR fishing mortality is unknown, species is depleted, and no management is in place.*

- *0 (Critical)—Overfishing is known to be occurring and no reasonable management is in place to curtail overfishing.*

United States Atlantic, Trap

Moderate Concern

Fishing mortality at maximum sustainable yield (F/F_{MSY}) in the northern and southern areas combined (for 2012) was 0.54 (F = 0.30, F_{MSY} = 0.552) (Syuhada 2014). But Syuhada's research, which followed recommendations made in previous assessments and provided a more complete and current analysis, has not yet been published in a peer-reviewed journal or corroborated by the most recent quantitative stock assessment (the values are unknown), so this factor is rated "moderate" concern.

Rationale:
NMFS data indicate that landings have been reasonably stable at approximately 2,000 mt since 2002, when the red crab Fishery Management Plan (FMP) was implemented (NFSC 2006). At that time, F_{MSY} was determined to be unknown due to lack of information on growth, recruitment, and natural mortality. But Syuhada (2014) used a biomass dynamic model to estimate F_{MSY} for the red crab stock. The current fishing mortality is likely below a sustainable level ($F/F_{MSY} < 1$), indicating that overfishing did not occur in 2012 (see Figure 2a, b), although the model indicates a higher fishing mortality than the previous stock assessment estimate did (NFSC 2006).

Criterion 2: Impacts on Other Species

All main retained and bycatch species in the fishery are evaluated in the same way as the species under assessment were evaluated in Criterion 1. 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. To determine the final Criterion 2 score, the score for the lowest scoring retained/bycatch species is multiplied by the discard rate score (ranges from 0-1), which evaluates the amount of non-retained catch (discards) and bait use relative to the retained catch. The Criterion 2 rating is determined as follows:

- *Score >3.2=Green or Low Concern*
- *Score >2.2 and <=3.2=Yellow or Moderate Concern*
- *Score <=2.2=Red or High Concern*
  Rating is Critical if Factor 2.3 (Fishing Mortality) is Critical.

Criterion 2 Summary

Atlantic deep sea red crab: United States Atlantic, Trap				
Subscore:: **2.236**	**Discard Rate:** **1.00**		**C2 Rate:** **2.236**	
Species	**Inherent Vulnerability**	**Stock Status**	**Fishing Mortality**	**Subscore**
MAMMALS	High	1.00: Very High Concern	5.00: Very Low Concern	**2.236**
ATLANTIC DEEP SEA RED CRAB	Medium	4.00: Low Concern	2.33: Moderate Concern	**3.053**

Of the 0.001% of bycatch that Tallack (2007) and Syuhada (2014) observed (golden crab (*Chaceon fenneri*), Jonah crab (*Cancer borealis*), unidentified whelk spp., ocean pout (*Macrozoarces americanus*), and wrymouth (*Cryptacanthodes maculatus*)), all are “minor species” (MSC Guidelines, Section 7.3), and biological-based limits are not available for most of them.

There have been no documented interactions between the red crab fishery and endangered, threatened, and protected (ETP) species, based on observer coverage. Additionally, there is ongoing monitoring with at-sea observers to ensure that the red crab fishery continues to have no impact on ETP species (Scientific Certification Systems, Inc. 2009). Specifically, the current red crab fishery uses fixed trap gear that is slightly larger than traditional lobster traps. The configuration of the gear is very similar to the offshore sector of the American lobster fishery, but is limited to the narrow shelf edge habitat of Northeast and Mid-Atlantic waters (Section 8.7; NEFMC 2002). The common method of red crab fishing is to set traps for a short soak time (<24 hours) to reduce the amount of crab mortality in the traps. The

red crab fishery is considered a Category II fishery under the Marine Mammal Protection Act (MMPA), which means that occasional incidental interactions and serious injury may occur. But interaction with protected species is rare, given 1) the limited overlap of right whales, humpback whales, and sei whales with the area where red crab gear occurs; 2) the depth at which red crab gear is set; 3) the small scale of the fleet/low concentration of gear in the action area; 4) the existing Atlantic Large Whale Take Reduction Plan (ALWTRP) measures for trap gear; and 5) the management measures that restrict the number of traps a vessel may use (NMFS Biological Opinion 2002) (Atlantic Red deepsea Crab FMP Specifications for Fishing Years 2014-2016). The May 2013 Biological Opinion reviewed the impacts of the red crab fishery and determined that the exemption to the sinking groundline requirement for gear at depths greater than 280 fathoms is unlikely to have an adverse impact on entanglement risks for right, humpback, fin, and sei whales (Atlantic Deep Sea Red Crab FMP Specifications for Fishing Years 2014-2016). Dr. William McLellan, a scientist from the ALWTRP who conducts necropsies of whales investigated in the mid-Atlantic, corroborated this information and has found no direct link to gear interactions from the red deepsea crab fishery. Jon Williams, owner and CEO of The Atlantic Red Crab Company, also mentioned that the fishery currently has only 16 buoy/endlines between Cape Hatteras, NC and the Canadian line, and that, in the event of migrating whales, the company follows the endline regulations (pers. comm., September 14, 2014).

Criterion 2 Assessment

MAMMALS

Factor 2.1 - Inherent Vulnerability

Scoring Guidelines (same as Factor 1.1 above)

United States Atlantic, Trap

High

Since the mammals included are North American right whales, humpback whales, fin whales, blue whales, sei whales, and sperm whales, this factor is rated “high” concern (SFW 2015).

Factor 2.2 - Stock Status

Scoring Guidelines (same as Factor 1.2 above)

United States Atlantic, Trap

Very High Concern

Because whales are critically endangered and may get caught in the pot warp gear that runs from the traps to the buoy at the surface and/or in the groundline that connects the traps together along the

ocean floor, this factor is rated “very high” concern.

Factor 2.3 - Fishing Mortality

Scoring Guidelines (same as Factor 1.3 above)

United States Atlantic, Trap

Very Low Concern

The red deepsea crab fishery is considered a Category II fishery by NMFS, meaning that there is risk of occasional interactions resulting in mortality or serious injury of marine mammals, specifically humpback whales or fin whales (NMFS 2014a). This risk is identified through analogy to similar gear types in the region. Observer data demonstrate that there are no known interactions between marine mammals and the red deepsea crab fishery. The NEFMC has concluded that the red crab fishery, combined with implementation of the RPAs contained in the recent Biological Opinion for the American Lobster fishery (the red crab fishery uses fixed trap gear that is slightly larger than traditional lobster traps), will affect but not likely jeopardize the existence of right whales, humpback whales, fin whales, blue whales, sei whales, or sperm whales (NEFMC 2002). Also, the scale of the fishery is much smaller than other pot/trap fisheries in the region. Accounting for the small scale of the fishery and the absence of known interactions with marine mammals, Seafood Watch considers the fishery a “very low” concern.

Rationale:
The “no jeopardy” assessment was based on an understanding that the Red Crab FMP will maintain satisfactory control over expanding effort in a fishery that is restricted by the distribution of these species to the fringe of their range. In addition, the red crab fishing gear will continue to be subject to regulations under the Atlantic Large Whale Take Reduction Plan (ALWTRP) to meet the further reduction in entanglement threat mandated in the Biological Opinion for the American Lobster FMP, to remove the likelihood of jeopardy in the red crab fishery (Scientific Certification Systems, Inc 2009). Based on observer coverage, there have been no documented interactions between the red crab fishery and ETP species to date, and there is ongoing monitoring to ensure that there continues to be no impact.

Factor 2.4 - Discard Rate

United States Atlantic, Trap

< 20%

Presently, the red crab fishery averages 11 lbs of red crab per pound of bait fished, or approximately

236,495.8 lbs of bait per landings/year. Total landings for 2012 were 2,601,454 lbs, and total discards for 2012 were 130,073 lbs, so the overall discard rate is 14.1%.

Rationale

The majority of discards are undersized male red crabs and female red crabs. Less than 0.001% of catches are bycatch (Tallack 2007). Discard mortality is estimated to be minimal, at 5% (Tallack 2007) (Syuhada 2014).

Criterion 3: Management effectiveness

Management is separated into management of retained species (harvest strategy) and management of non-retained species (bycatch strategy).

The final score for this criterion is the geometric mean of the two scores. 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 or either the Harvest Strategy (Factor 3.1) or Bycatch Management Strategy (Factor 3.2) is Very High Concern = Red or High Concern*
  Rating is Critical if either or both of Harvest Strategy (Factor 3.1) and Bycatch Management Strategy (Factor 3.2) ratings are Critical.

Criterion 3 Summary

Region / Method	Management of Retained Species	Management of Non-Retained Species	Overall Recommendation
United States Atlantic Trap	4.000	3.000	Green(3.464)

Factor 3.1: Harvest Strategy

Scoring Guidelines

Seven subfactors are evaluated: Management Strategy, Recovery of Species of Concern, Scientific Research/Monitoring, Following of Scientific Advice, Enforcement of Regulations, Management Track Record, and Inclusion of Stakeholders. Each is rated as 'ineffective,' 'moderately effective,' or 'highly effective.'

- *5 (Very Low Concern)—Rated as 'highly effective' for all seven subfactors considered.*
- *4 (Low Concern)—Management Strategy and Recovery of Species of Concern rated 'highly effective' and all other subfactors rated at least 'moderately effective.'*
- *3 (Moderate Concern)—All subfactors rated at least 'moderately effective.'*
- *2 (High Concern)—At minimum, meets standards for 'moderately effective' for Management Strategy and Recovery of Species of Concern, but at least one other subfactor rated 'ineffective.'*
- *1 (Very High Concern)—Management exists, but Management Strategy and/or Recovery of Species of Concern rated 'ineffective.'*

- *0 (Critical)—No management exists when there is a clear need for management (i.e., fishery catches threatened, endangered, or high concern species), OR there is a high level of Illegal, unregulated, and unreported fishing occurring.*

Factor 3.1 Summary

Factor 3.1: Management of fishing impacts on retained species							
Region / Method	**Strategy**	**Recovery**	**Research**	**Advice**	**Enforce**	**Track**	**Inclusion**
United States Atlantic Trap	Highly Effective	N/A	Moderately Effective	Highly Effective	Highly Effective	Highly Effective	Highly Effective

Subfactor 3.1.1 – 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? To achieve a highly effective rating, there must be appropriate management goals, and evidence that the measures in place have been successful at maintaining/rebuilding species.

United States Atlantic, Trap

Highly Effective

Since the red crab fishery has an appropriate strategy and goals, and there is evidence that the strategy is being implemented successfully, this factor is rated “highly effective.”

Rationale:
The red crab fishery has a well-defined harvest strategy in place, which is implemented through the New England Fishery Management Council. In 2002, a Fishery Management Plan (FMP) was put into effect after years of cooperative effort between the red crab fishers, the National Marine Fisheries Service, and the New England Fishery Management Council (NEFMC 2002). After robust analysis of fishery-dependent resource harvest and economic data, the FMP limited the number of vessels that could harvest red crab, developed trap limits per vessel, and provided a target TAC of 2,889 mt and a days-at-sea (DAS) allocation of 780 fleet days to harvest the TAC (Scientific Certification Systems, Inc 2013). Originally, specification settings were done each year (NEFMC 2004); now there is a 3-year review process in place (see Stock Assessment and Fishery Evaluation (SAFE) Report, and 2005 Fishing Year Specifications). In 2010, an amendment was approved to set a hard total allowable limit (TAL) of 1,775 mt for 2011-2013 (now extended to 2016), eliminate days-at-sea control (DAS) and trip limits, remove the prohibition on landing more than one tote of female red crabs, and grant in-season closure authority to the NMFS Regional Administrator (Scientific Certification Systems, Inc 2013).

Subfactor 3.1.2 – Recovery of Species of Concern

Considerations: When needed, are recovery strategies/management measures in place to rebuild overfished/threatened/ endangered species or to limit fishery's impact on these species and what is their likelihood of success? To achieve a rating of Highly Effective, rebuilding strategies that have a high likelihood of success in an appropriate timeframe must be in place when needed, as well as measures to minimize mortality for any overfished/threatened/endangered species.

United States Atlantic, Trap

N/A

Since there are currently no overfished, depleted, endangered, or threatened species targeted or retained in the red crab fishery, this factor is rated "not applicable."

Subfactor 3.1.3 – Scientific Research and Monitoring

Considerations: How much and what types of data are collected to evaluate the health of the population and the fishery's impact on the species? To achieve a Highly Effective rating, population assessments must be conducted regularly and they must be robust enough to reliably determine the population status.

United States Atlantic, Trap

Moderately Effective

The red crab stock is monitored annually using fishery-dependent data; however, fishery-independent data need to be collected and included in the assessments for highly effective research and monitoring. Therefore, this factor is rated "moderately effective."

Rationale:
Fishery-dependent data are used to monitor stock status because there have been only two comprehensive fishery-independent surveys of red crab since the fishery's inception in the 1970s. The red crab industry supports the collection of fishery-dependent data by an independent observer on several trips annually, which are evenly distributed throughout the fishing year. Since the initial Marine Stewardship Council (MSC) assessment of this fishery in 2009, the fishery has supported several research projects that have provided data to better manage the fishery, such as CPUE data from the traps, lengths of a sample of landed and discarded red crab, weights of other discarded species, and other environmental/habitat data (Scientific Certification Systems, Inc 2013). The red crab industry is committed to working with NMFS or an industry-contracted stock assessment scientist to develop annual stock assessments based on fishery-dependent data, because the industry recognizes that NMFS

has no plans for regular fishery-independent surveys of the red crab resource.

Subfactor 3.1.4 – Management Record of Following Scientific Advice

Considerations: How often (always, sometimes, rarely) do managers of the fishery follow scientific recommendations/advice (e.g. do they set catch limits at recommended levels)? A Highly Effective rating is given if managers nearly always follow scientific advice.

United States Atlantic, Trap

Highly Effective

Since management follows scientific advice, such as by modifying and implementing regulations in response to research findings, this factor is rated "highly effective." For example, the Data Poor Species Workshop and the resulting emergency action to modify the red crab TAC and DAS in 2009 demonstrate the ongoing review of the science relative to the red crab resource and the ability of the management system to respond to new science (Scientific Certification Systems, Inc 2009).

Subfactor 3.1.5 – 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.

United States Atlantic, Trap

Highly Effective

Representatives of the U.S. Coast Guard and the Enforcement Branch of the National Marine Fisheries Service present reports on recent enforcement actions at every meeting of the NEFMC. There have not been any known violations of the red crab FMP, the industry complies with plan provisions, and there is no systematic non-compliance (Scientific Certification Systems, Inc 2009), so this factor is rated "highly effective."

Rationale:
The Magnuson-Stevens Act (MSA) gives authority to the Secretary of Commerce and the Secretary of the department in which the Coast Guard operates to enforce the provisions of the Act. The law also allows them to use the personnel, services, equipment, and facilities of any other federal agency (including all elements of the Department of Defense) and any State agency to carry out these duties. The National Marine Fisheries Service commonly executes Memoranda of Agreement with coastal states to enforce the federal fishery management regulations (Scientific Certification Systems, Inc 2009). The MSA specifies the Federal District Courts as having jurisdiction over cases or controversies arising under

the Act.

Subfactor 3.1.6 – Management Track Record

Considerations: Does management have a history of successfully maintaining populations at sustainable levels or a history of failing to maintain populations at sustainable levels? A Highly Effective rating is given if measures enacted by management have been shown to result in the long-term maintenance of species overtime.

United States Atlantic, Trap

Highly Effective

Based on annual landings data (Scientific Certification Systems, Inc 2013), management of the red crab fishery has resulted in long-term maintenance of average stock abundance and ecosystem integrity, so this factor is rated “highly effective.”

Subfactor 3.1.7 – 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 and includes stakeholder input.

United States Atlantic, Trap

Highly Effective

The red crab fishery management system incorporates, and solicits input from, relevant government agencies and private sector stakeholders, including the red crab fishery participants and individuals and organizations with an interest in the marine environment. Therefore, this factor is rated “highly effective.”

Rationale:
The NEFMC is the main entity of the management system. Council membership includes NOAA/NMFS, the chief fishery administrator for each state within the Council’s jurisdiction, appointed members of the public, and representatives of the U.S. Fish & Wildlife Service, the U.S. Coast Guard, the Atlantic States Marine Fisheries Commission, and the U.S. Department of State (Scientific Certification Systems, Inc 2009).

When the NEFMC approves of a fishery management plan, the Secretary of Commerce reviews the plan and requests input about it from interested parties before deciding to approve, disapprove, or partly approve it. Additionally, the fishery management councils can develop proposed regulations to implement fishery management plans. These regulations are reviewed by the Secretary of Commerce, and include a public comment period of 15–60 days. All comments received on the proposed rule, and the agency's responses to those comments, are included in the final rules (Scientific Certification Systems, Inc 2009).

Bycatch Strategy

Factor 3.2: Management of fishing impacts on bycatch species						
Region / Method	**All Kept**	**Critical**	**Strategy**	**Research**	**Advice**	**Enforce**
United States Atlantic Trap	No	No	Moderately Effective	Moderately Effective	Highly Effective	Moderately Effective

Trap gear is highly selective and incidental bycatch is considered low. There are no known concerns with bycatch in the Atlantic red deepsea crab fishery. There is a risk of interactions with marine mammals in pots and traps used in the crab fishery. Trap gear is officially determined to be of entanglement risk to humpback and fin whales, so NMFS classified the Atlantic red deepsea crab fishery as a Category II fishery (meaning there is occasional incidental mortality and injury of marine mammals associated with this fishery). Though it is difficult to determine the scale of risk associated with the red deepsea crab fishery, Seafood Watch considers there to be some risk due to the use of similar gear and the potential spatial and temporal overlaps between the fisheries and whales. Category II fisheries participants are required to comply with any take reduction plans that are applicable.

Subfactor 3.2.1 – Management Strategy and Implementation

Considerations: What type of management strategy/measures are in place to reduce the impacts of the fishery on bycatch species and how successful are these management measures? To achieve a Highly Effective rating, the primary bycatch species must be known and there must be clear goals and measures in place to minimize the impacts on bycatch species (e.g., catch limits, use of proven mitigation measures, etc.).

United States Atlantic, Trap

Moderately Effective

The primary bycatch concerns associated with trap fisheries in the Northwest Atlantic are interactions with marine mammals. Humpback and fin whales are endangered species that are protected under the Endangered Species Act (ESA) and the Marine Mammal Protection Act (MMPA), so management

measures must be in place in order to comply. As mandated by the 1994 amendments to the ESA and MMPA, NMFS developed the Atlantic Large Whale Take Reduction Plan (ALWTRP) to reduce mortality and serious injury to North Atlantic right, humpback, and fin whales in U.S. commercial fisheries, especially gillnet and trap fisheries (ALWTRT 2011). The initial goals of the ALWTRP were to reduce entanglement-related serious injuries and mortalities of right, humpback, and fin whales to zero mortality (10% of PBR), and reduce serious injuries, within 5 years of implementation. The regulations under the ALWTRP consist of a combination of gear modifications and area closures (ALWTRT 2011). Since the implementation of the ALWTRP in 1997, it has undergone several modifications to meet both short-term and long-term goals. These modifications have included gear restrictions and area closures. In 2007, NMFS approved a final rule implementing broad-based gear modification strategies that included expanded weak link and sinking ground line requirements, changes in management boundaries, seasonal restrictions for gear modifications, expanded exempted areas, and changes in regulatory language for clarification and consistency (ALWTRT 2011). Despite the best efforts from ALWTRP and the cooperation and compliance of fishers, the main threats to humpback and fin whales continue to be entanglements in fishing gear and ship strikes (Waring et al. 2014). Between 2007 and 2011, the minimum annual mortality and serious injury rates of humpback whales was 11.95, and for fin whales was 3.7 (Waring et al 2014). Thus, 15 years after the implementation of ALWTRP, the mortality and serious injury rates have been reduced by management measures but have not reached zero mortality. The management strategy and implementation is therefore ranked as “moderately effective.”

Subfactor 3.2.2 – Scientific Research and Monitoring

Considerations: Is bycatch in the fishery recorded/documented and is there adequate monitoring of bycatch to measure fishery’s impact on bycatch species? To achieve a Highly Effective rating, assessments must be conducted to determine the impact of the fishery on species of concern, and an adequate bycatch data collection program must be in place to ensure bycatch management goals are being met.

United States Atlantic, Trap

Moderately Effective

There is little to no data collection on bycatch and discarding in the crab fishery, although traps and pots are considered relatively selective and of low concern. Of greater concern is the possible interaction with large marine mammals. Under the Marine Mammal Protection Act, each fisher taking part in a listed fishery is required to report any incidental encounters with protected species, accommodate observers when requested, and adhere to all relevant take reduction plans (NMFS 2014b). There is currently about 10% observer coverage in red deepsea crab fisheries, although spatial and temporal coverage is unknown (Scientific Certification Systems, Inc 2009) (Scientific Certification Systems, Inc 2013). The two best available indicators of the efficacy of the current ALWTRP regulations are serious injury and mortality, along with the frequency of large whale entanglements that are either observed or

reported (ALWTRT 2011). Based on the requirement to report interactions with protected marine mammals and the low concerns associated with crab gear, Seafood Watch considers research and monitoring of bycatch species to be “moderately effective.”

Rationale:
Due to the lack of comprehensive and reliable data regarding large whale/fishery interactions, monitoring the ALWTRP is challenging. Three of the bigger challenges are 1) large whale entanglements are often not witnessed or documented by observers or fishermen (ALWTRT 2011); 2) even if fishing gear is recovered from an entanglement incident, it is often difficult to identify or attribute to a particular gear type, gear component, fishery, or geographic region (ALWTRT 2011); and 3) typically, the data that are necessary for effective monitoring of the ALWTRP encompass many regulated fisheries spanning a large geographic range along the U.S. East Coast (ALWTRT 2011). Despite these challenges, the ALWTRP continues to develop and modify their monitoring strategies in the hopes that both the short- and long-term goals set forth by the MMPA can be met. One way to measure the effectiveness of the ALWTRP involves comparing the most recent estimated annual serious injury and mortality of right, humpback, and fin whales to their respective PBR and zero mortality rate goal (ZMRG) levels (ALWTRT 2011). This comparison (on an annual basis) is important because it can determine effectiveness of ALWTRP regulations, enforcement, and education/outreach efforts, and it can indicate compliance levels (NOAA 2012). The most recent PBR estimates (July 2014) are 2.7 whales for the Gulf of Maine humpback whale and 5.6 whales for the fin whale (Waring et al. 2014). These estimates indicate that conservation of these species continues to be a priority (ALWTRT 2011).

Subfactor 3.2.3 – Management Record of Following Scientific Advice

Considerations: How often (always, sometimes, rarely) do managers of the fishery follow scientific recommendations/advice (e.g., do they set catch limits at recommended levels)? A Highly Effective rating is given if managers nearly always follow scientific advice.

United States Atlantic, Trap

Highly Effective

There is no indication that scientific advice is not being followed or incorporated in any region, because they have worked to reduce entanglements. Therefore, this factor is rated “highly effective.”

Subfactor 3.2.4 – Enforcement of Management Regulations

Considerations: Is there a monitoring/enforcement system in place to ensure fishermen follow management regulations and what is the level of fishermen’s compliance with regulations? To

achieve a Highly Effective rating, there must be consistent enforcement of regulations and verification of compliance.

United States Atlantic, Trap

Moderately Effective

The level of enforcement of compliance with ALWTRP regulations by the New England fisheries is carried out by the NMFS office of Protected Resources (PRD), NOAA's Office of Law Enforcement (OLE), and marine patrols of each state. The level of enforcement by individual states varies; however, states do enforce fisheries activities, both dockside and within state waters. Additionally, state law enforcement agencies work with the U.S. Coast Guard (USCG) and NMFS in federal waters (NMFS 2011). However, due to the importance of protecting whale populations and the relatively low level of coverage in the emerging crab fisheries, there is need for greater enforcement, so this factor is rated "moderately effective."

Criterion 4: Impacts on the habitat and ecosystem

This Criterion assesses the impact of the fishery on seafloor habitats, and increases that base score if there are measures in place to mitigate any impacts. The fishery's overall impact on the ecosystem and food web and the use of ecosystem-based fisheries management (EBFM) principles is also evaluated. Ecosystem Based Fisheries Management aims to consider the interconnections among species and all natural and human stressors on the environment.

The final score is the geometric mean of the impact of fishing gear on habitat score (plus the mitigation of gear impacts score) and the Ecosystem Based Fishery Management 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 cannot be Critical for Criterion 4.

Criterion 4 Summary

Region / Method	Gear Type and Substrate	Mitigation of Gear Impacts	EBFM	Overall Recomm.
United States Atlantic Trap	3.00:Low Concern	0.00:No Effective Mitigation	3.00:Moderate Concern	**Yellow (3.000)**

Justification of Ranking

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

Scoring Guidelines

- *5 (None)—Fishing gear does not contact the bottom*
- *4 (Very Low)—Vertical line gear*
- *3 (Low)—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. Bottom seine on resilient mud/sand habitats. Midwater trawl that is known to contact bottom occasionally (*
- *2 (Moderate)—Bottom dragging gears (dredge, trawl) fished on resilient mud/sand habitats. Gillnet, trap, or bottom longline fished on sensitive boulder or coral reef habitat. Bottom seine except on mud/sand*
- *1 (High)—Hydraulic clam dredge. Dredge or trawl gear fished on moderately sensitive habitats (e.g., cobble or boulder)*

- *0 (Very High)—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.

United States Atlantic, Trap

Low Concern

Since the red crab fishery has been determined to have no identifiable adverse effects on essential habitats, this factor is rated "low" concern.

Rationale:
The red crab fishery uses pot/trap gear that contacts the bottom (via a vertical line) primarily in soft muddy habitats and in the heads of canyons that dissect the upper edge of the continental slope. Eno et al. (1996) described few direct impacts to benthic habitats associated with the use of traps. A review of the potential impacts to habitat from a variety of fishing gear types found that traps have the potential to adversely affect corals and hard-bottom habitats (Barnette 2001), but there is no direct information to determine if these adverse affects are occurring in the red crab fishery. In general, pots and traps result in minimal impacts to benthic habitats compared to other types of fishing gear.

Factor 4.2 – Mitigation of Gear Impacts

Scoring Guidelines

- *+1 (Strong Mitigation)—Examples include large proportion of habitat protected from fishing (>50%) with gear, fishing intensity low/limited, gear specifically modified to reduce damage to seafloor and modifications shown to be effective at reducing damage, or an effective combination of 'moderate' mitigation measures.*
- *+0.5 (Moderate Mitigation)—20% of habitat protected from fishing with gear or other measures in place to limit fishing effort, fishing intensity, and spatial footprint of damage caused from fishing.*
- *+0.25 (Low Mitigation)—A few measures are in place (e.g., vulnerable habitats protected but other habitats not protected); there are some limits on fishing effort/intensity, but not actively being reduced.*
- *0 (No Mitigation)—No effective measures are in place to limit gear impacts on habitats.*

United States Atlantic, Trap

No Effective Mitigation

The red crab fishery has been determined to have no identifiable adverse effects on EFH, therefore no specific management alternatives for minimizing the adverse effects of fishing are necessary (NEFMC 2002). This factor is rated as “no effective mitigation.”

Rationale:
Several management measures intended to serve multiple purposes (resource conservation, effort control, etc.) also provide direct benefits to the habitat. These measures include trap limits, controlled access, and a prohibition on non-trap gear.

Factor 4.3 – Ecosystem-Based Fisheries Management

Scoring Guidelines

- *5 (Very Low Concern)—Substantial efforts have been made to protect species’ ecological roles and ensure fishing practices do not have negative ecological effects (e.g., large proportion of fishery area is protected with marine reserves, and abundance is maintained at sufficient levels to provide food to predators).*
- *4 (Low Concern)—Studies are underway to assess the ecological role of species and measures are in place to protect the ecological role of any species that plays an exceptionally large role in the ecosystem. Measures are in place to minimize potentially negative ecological effect if hatchery supplementation or fish aggregating devices (FADs) are used.*
- *3 (Moderate Concern)—Fishery does not catch species that play an exceptionally large role in the ecosystem, or if it does, studies are underway to determine how to protect the ecological role of these species, OR negative ecological effects from hatchery supplementation or FADs are possible and management is not place to mitigate these impacts.*
- *2 (High Concern)—Fishery catches species that play an exceptionally large role in the ecosystem and no efforts are being made to incorporate their ecological role into management.*
- *1 (Very High Concern)—Use of hatchery supplementation or fish aggregating devices (FADs) in the fishery is having serious negative ecological or genetic consequences, OR fishery has resulted in trophic cascades or other detrimental impacts to the food web.*

United States Atlantic, Trap

Moderate Concern

Red crab does not appear to play a significant role in trophic interactions as predator or prey (Pauley et al. 1989) or to play a disproportionate role in the ecosystem relative to its biomass, and the fishery is thought to have little impact on the ecosystem. However, since there do not appear to be any efforts to

formally address the impact of red crab and the red crab fishery on the ecosystem, this factor is rated "moderate" concern.

Rationale:
There is little indication that red crab constitutes a major prey item for any species, and there are few records of red crab prey sources (they are most likely opportunistic omnivores) (Steimle, Zetlin, Chang 2001). Additionally, there are few competitive interactions between red crab and any other fishery resources. The primary competitive interactions involve Jonah crab (*Cancer borealis*), American lobster (*Homarus americanus*), and golden crab (*Chaceon fenneri*), but none of these appears significant. There is no information to suggest that red crab is a significant or even minor component of the diets of any marine mammals or endangered species.

Although not yet formally addressed by the management agencies, it can be reasonably assessed that the red crab fishery has little effect on the continental slope ecosystem trophic structure and function, community composition, and biodiversity (Scientific Certification Systems, Inc 2009). The fishery has negligible bycatch of other species, and red crab females and undersized males that are captured and discarded have a high survival rate. Moreover, the fishery has a minimal effect on the physical habitat because the traps only affect a relatively small area. The direct removal of the targeted resource is the only real effect of the fishery on the ecosystem, and because the annual removals of red crabs represent a small fraction of the overall biomass, the impact of these removals on ecosystem trophic structure and function, community composition, and biodiversity is minimal (Scientific Certification Systems, Inc 2009).

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

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