Monterey Bay Aquarium Seafood Watch®

Atlantic surfclam, Northern quahog, Ocean quahog, Softshell clam

Spisula solidissima, Mercenaria mercenaria, Arctica islandica, Mya arenaria

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United States

Clam dredge, Rakes

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Kristen Hislop, Consulting Researcher

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 is for Atlantic surfclam, ocean quahog, Northern quahog, and softshell clam that are caught with hydraulic clam dredge, hand rake, hoe, and shovel in the U.S. Atlantic. We assess Atlantic surfclam and ocean quahog by catch method (hydraulic clam dredge) and assess northern quahog and softshell clam by state. (Northern quahog: Massachusetts, North Carolina, New York, and Rhode Island. Softshell clam: Maine and Massachusetts.)

Atlantic surfclam and ocean quahog are managed together in the same hydraulic clam dredge fishery by the Mid-Atlantic Fisheries Management Council (MAFMC). The Northeast Fisheries Science Center (NEFSC) conducts rigorous stock assessments for both of these clam species every 3 years. According to the stock assessment performed in 2009, both Atlantic surfclam and ocean quahog are not overfished and overfishing is not occurring. Northern quahog is currently being managed using catch per unit effort (CPUE) data and spatial management. No scientific stock assessments have been conducted recently for northern quahog; therefore, the status of biomass and fishing mortality for northern quahog is unknown. Softshell clam is managed by local municipalities in partnership with the state in both Maine and Massachusetts. In Maine, some of the clam beds under local jurisdiction are surveyed for softshell abundance, and biomass estimates are determined on a flat-by-flat basis upon the request of local governments. This information for specific clam flats cannot be scaled to provide a representation of the softshell clam stocks along the entire Atlantic Coast. Massachusetts does not conduct stock assessments for softshell clams.

None of the fisheries reviewed in this report has interactions with bycatch, and none has impacts on non-target species, or discards. Atlantic surfclam and ocean quahog are caught using hydraulic clam dredges. The hand-harvest gears used to land northern quahog and softshell clam include rakes, hoes, and shovels. Hand-harvest methods are believed to result in negligible bycatch because hand harvesting allows fishers to be highly selective of the species they harvest.

The hydraulic clam dredge fishery for Atlantic surfclam and ocean quahog conducts regular stock assessments and closely follows scientific advice. In addition, management is responsive to changes in stock status and management needs. Stock assessments are not conducted for northern quahogs, but CPUE is monitored and these states have stabilized their landings. Management of softshell clam stocks is delegated to local municipalities, while state-level governments provide technical assistance and recommendations to local decision-makers. No statewide stock assessments on softshell clams are performed. This decentralized regulation system and the lack of a statewide stock assessment make it infeasible to determine whether local jurisdictions follow scientific advice or to determine their track record in maintaining stock abundance.

Hydraulic clam dredges have a high level of contact and disturbance of the benthic habitat and cause high levels of disturbance. The surfclam and ocean quahog fisheries have minimal mitigation for habitat impacts. Rakes, hoes, and shovels may impact intertidal and subtidal habitats, depending upon how much the habitat is subjected to disturbance from wave, tidal, or current action.

The hydraulic clam dredge Atlantic surfclam and ocean quahog fisheries are rated “yellow” or “Good Alternative.” The Massachusetts, North Carolina, New York, and Rhode Island northern quahog fisheries and the Massachusetts and Maine softshell clam fisheries are rated “green” or “Best Choice.”

Table of Conservation Concerns and Overall Recommendations

Stock / Fishery	Impacts on the Stock	Impacts on other Spp.	Management	Habitat and Ecosystem	Overall Recommendation
Atlantic surfclam United States Atlantic - Clam dredge (Hydraulic)	Green (4.47)	Green (5.00)	Green (5.00)	Red (1.94)	**Good Alternative (3.836)**
Northern quahog Massachusetts Atlantic - Rakes (wild)	Yellow (2.64)	Green (5.00)	Yellow (3.00)	Yellow (3.12)	**Best Choice (3.336)**
Northern quahog North Carolina North Atlantic - Rakes (wild)	Yellow (2.64)	Green (5.00)	Yellow (3.00)	Yellow (3.12)	**Best Choice (3.336)**
Northern quahog Rhode Island North Atlantic - Rakes (wild)	Yellow (2.64)	Green (5.00)	Yellow (3.00)	Yellow (3.12)	**Best Choice (3.336)**
Softshell clam Massachusetts North Atlantic - Rakes (wild)	Yellow (2.64)	Green (5.00)	Yellow (3.00)	Yellow (3.12)	**Best Choice (3.336)**
Softshell clam Maine North Atlantic - Rakes (wild)	Yellow (2.64)	Green (5.00)	Yellow (3.00)	Yellow (3.12)	**Best Choice (3.336)**
Ocean quahog United States North Atlantic - Clam dredge (Hydraulic)	Green (5.00)	Green (5.00)	Green (5.00)	Red (1.94)	**Good Alternative (3.945)**
Northern quahog New York North Atlantic - Rakes (wild)	Yellow (2.64)	Green (5.00)	Yellow (3.00)	Yellow (3.12)	**Best Choice (3.336)**

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 contains information on four wild-caught clam species: Atlantic surfclams (*Spisula solidissima*), northern quahogs (*Mercenaria mercenaria*), ocean quahogs (*Arctica islandica*), and softshell clams (*Mya arenaria*). Gears evaluated in this report include hydraulic clam dredges for Atlantic surfclams and ocean quahogs, and hand rakes, shovels, and hoes for northern quahogs and softshell clams. Farmed clams are not evaluated in this report. Although the distribution of some of these species includes regions outside of the United States, this report covers only fisheries within the United States.

The species and their distribution are listed below (see Figure 1):

Atlantic surfclams (*Spisula solidissima*) range from the Gulf of St. Lawrence to Cape Hatteras in the Atlantic. Atlantic surfclams were assessed under the management of the Mid-Atlantic Fisheries Management Council (MAFMC 2010).

Ocean quahogs (*Arctica islandica)* occur on both the east and west sides of the North Atlantic along the continental shelf. Along the North American coast, ocean quahogs are found from Newfoundland to Cape Hatteras. Ocean quahogs were assessed under the management of the Mid-Atlantic Fisheries Management Council (Cargnelli et al. 1999A).

Northern quahogs (*Mercenaria mercenaria*) are found on the Atlantic Coast from the Gulf of St. Lawrence to Florida. This species is also found in the Gulf of Mexico as far south as the Yucatan Peninsula (Eversole 1987). This report focuses only on the Atlantic Coast fishery in the states of Massachusetts, New York, Rhode Island, and North Carolina.

Softshell clams (*Mya arenaria*) have a worldwide distribution. They are presumed to be native to the Atlantic Coast and range from the subarctic to Cape Hatteras and less commonly to South Carolina. Softshell clams have been introduced and successfully established in Europe (Maximovich and Guerassimova 2003) and the Pacific Coast from Alaska to San Francisco (Abraham and Dillon 1986). This report covers the softshell clam fishery in the states of Maine and Massachusetts.

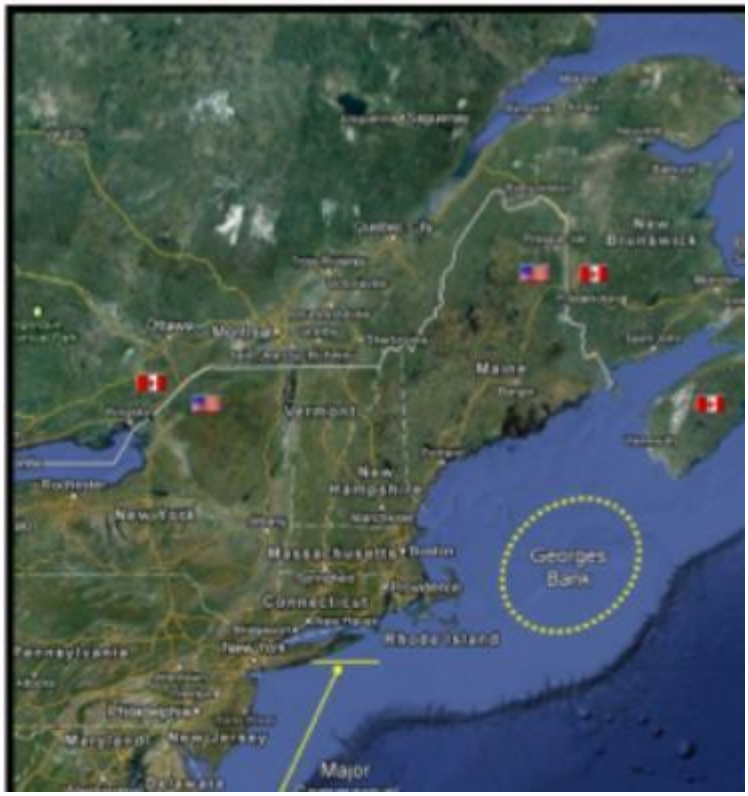

Figure 1. Distribution of Atlantic surfclam and other North Atlantic clam species discussed in this report (figure from trophyrigs.com).

Overview of the species and management bodies

Atlantic surfclam (Spisula solidissima)

Atlantic surfclam and ocean quahog are managed as a group by the Mid-Atlantic Fisheries Management Council under an individual transferable quota (ITQ) program (MAFMC 2010). Vessels that dredge for Atlantic surfclam also dredge for ocean quahogs, which occur farther offshore; however, these two species are not landed in the same fishing trips. Hydraulic clam dredges were used to land 96% of the Atlantic surfclam catch in 2010 (NMFS 2012). The majority of clams have historically been caught off the coast of New Jersey (NMFS 2012). The coast-wide value of the Atlantic surfclam fishery was $29,614,951 in 2014 (NMFS 2015). The highest commercial landings occurred between 1973 and 1975 in this fishery, averaging 40,100 metric tons (MT) annually; this fishery quickly declined after this to a historic low of 15,800 MT in 1979 (Cargnelli et al. 1999). Figure 2 shows Atlantic surfclam landings from 2003 to 2013 (NMFS 2015).

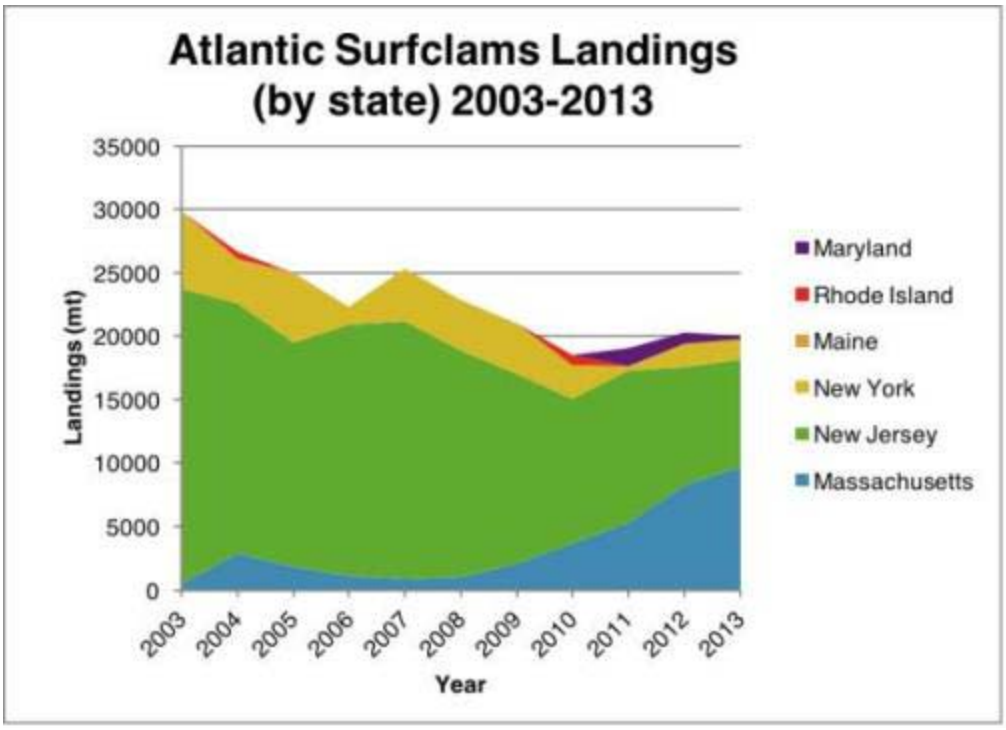

Figure 2. Atlantic surfclam landings by state (NMFS 2015).

The average annual landing for 2004–2013 is 22,088 MT (NMFS 2015). Landings off the coast of New Jersey have been declining (NMFS 2015), and CPUE has consistently declined by 10% per year from 2000 to 2009 (MAFMC 2010). However, the decline in landings is believed to be due to environmental factors rather than fishing pressure (MAFMC 2010). Evidence suggests that the Atlantic surfclam stock is shifting to the north (MAFMC 2010). The Georges Bank area had 5% of the surfclam biomass in 1986, but had 48% in 2009. The Delmarva Peninsula had 55% of the biomass in 1986 but in 2009 had only 5% (MAFMC 2010). There is additional evidence that Atlantic surfclams are adapting to warmer water temperature by shifting into deeper water (Weinberg 2005).

The past several years have made commercial clamming for Atlantic surfclams less profitable (MAFMC 2010). Major users of clam meats have decreased their purchases from the industry and stopped advertising clam products (MAFMC 2010). Imported clam meat from Canada and Vietnam have contributed to an oversupply of clams in the marketplace, and harvesting costs have increased due to rising fuel and insurance costs (MAFMC 2010). By 2008, 22% of the industrial fleet had left the fishery (MAFMC 2010). The percent of surfclams harvested, in comparison to the allowable quota, has been decreasing since 2007. The average percent of allowable quota caught since 2003 has been 86% (MAFMC 2010).

The majority of Atlantic surfclams are caught in the United States with a smaller amount caught on the east coast of Canada (FAO 1999). The U.S. consumes roughly 25,650 MT of Atlantic surfclam. A very small portion (about 1,350 MT) of the surfclam catch is exported (FAO 1999).

Ocean quahog (*Arctica islandica*)

Ocean quahogs and Atlantic surfclams are managed as a group by the Mid-Atlantic Fisheries Management Council under an ITQ program (MAFMC 2010). Over 99% of ocean quahogs were landed with hydraulic clam dredges in 2010 (NMFS 2012). Many of the same vessels that dredge for Atlantic surfclams also dredge for ocean quahogs farther offshore (MAFMC 2010). Ocean quahogs had a coast-wide value of $11,052,078 in 2014 (NMFS 2015). There is a separate small fishery in Maine for the live market, which commands higher prices. U.S. landings peaked at 21,870 MT in 1993 (NMFS 2012). The average coast-wide landing from 2004–2013 was 11,860 MT (NMFS 2015). Figure 3 shows ocean quahog landings from 2000 to 2010 (NMFS 2012A).

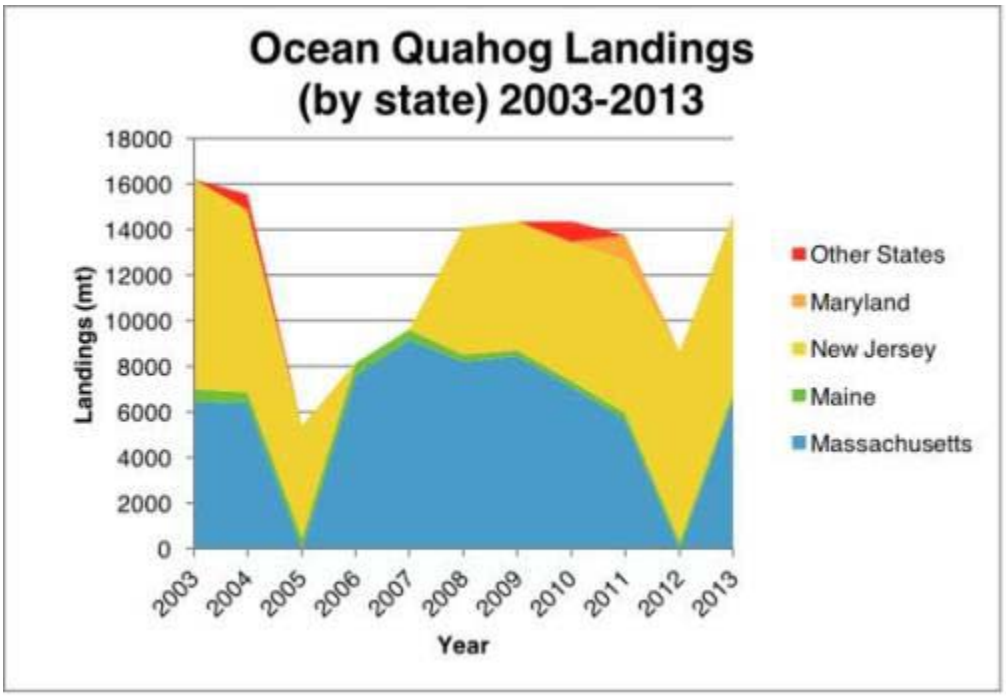

Figure 3. Ocean quahog landings by state (NMFS 2015).

The ocean quahog population is a relatively unproductive stock; managers are treating the stock as if it is being fished down from its virgin state toward the maximum sustainable yield reference point (MAFMC 2010). Based on surveys and CPUE data, the ocean quahog stock has declined the most in the southern regions; today, 84% of the stock occurs in the northern regions (in comparison to 67% of the stock in 1978) (MAFMC 2010). The Georges Banks region now contains 45% of total biomass; this area has been closed to fishing since 1990 because of the presence of paralytic shellfish poisoning (MAFMC 2010). In April 2012, the MAFMC recommended opening the area known as Cultivator Shoals on the Georges Bank as soon as possible, because a new dockside testing protocol has been approved to monitor and test all landings to ensure they are safe for human consumption (MAFMC 2012) (NMFS 2012). Like the Atlantic surfclam fishery, the ocean quahog fishery has gone through consolidation; four

large vessels account for 50% of the quahog catch, and the number of vessels participating in the fishery dropped from 29 in 2004 to 15 in 2009 (MAFMC 2010).

The ocean quahog fishery off the coast of Maine peaked with landings of 129,000 bushels in 2002, then declined before rebounding in 2006 (MAFMC 2010). Ocean quahogs landed in Maine are small compared to those landed offshore, and are marketed in the fresh and half-shell market at relatively high prices (MAFMC 2010). The ocean quahog fishery was worth $1,720,848 in 2010 in Maine (NMFS 2012). The Maine fishery's fishing mortality is more than double that of ocean quahogs dredged from all other regions; however, only 55.6% of the quota of 100,000 bushels was landed in 2009 (MAFMC 2010). Aggressive price cutting by one seller and rising fuel prices have contributed to consolidation of the Maine ocean quahog fishery, and a decrease in landings (MAFMC 2010).

Hard clam (*Mercenaria mercenaria*)

Northern quahogs occur in mostly shallow, estuarine environments, but may be found in deeper water; they have a wide range of temperature and salinity tolerances. Adequate water circulation is essential for successful growth and recruitment of northern quahogs; water movement moves food, maintains water quality, and removes waste (NCDMF 2008). Northern quahogs are managed at the state level; the states covered in this report are Massachusetts, New York, North Carolina, and Rhode Island. In 2013, 10.4% of the northern quahog landings occurred in Massachusetts, 28.6% in New York, 5.1% in North Carolina, and 12.1% in Rhode Island (NMFS 2015).The majority of clams (42%) are landed with uncoded gear or methods (NMFS 2012). The major reported gear used to land northern quahogs is rakes, making up 38% of northern quahogs landed in 2010 (NMFS 2012). From 2005–2009, northern quahogs were the fourth most valuable fishery in New York (NMFS 2012). Since the mid-1980s, landings in this fishery have been slowly decreasing (NMFS 2012). Figure 4 shows northern quahog landings (NMFS 2015).

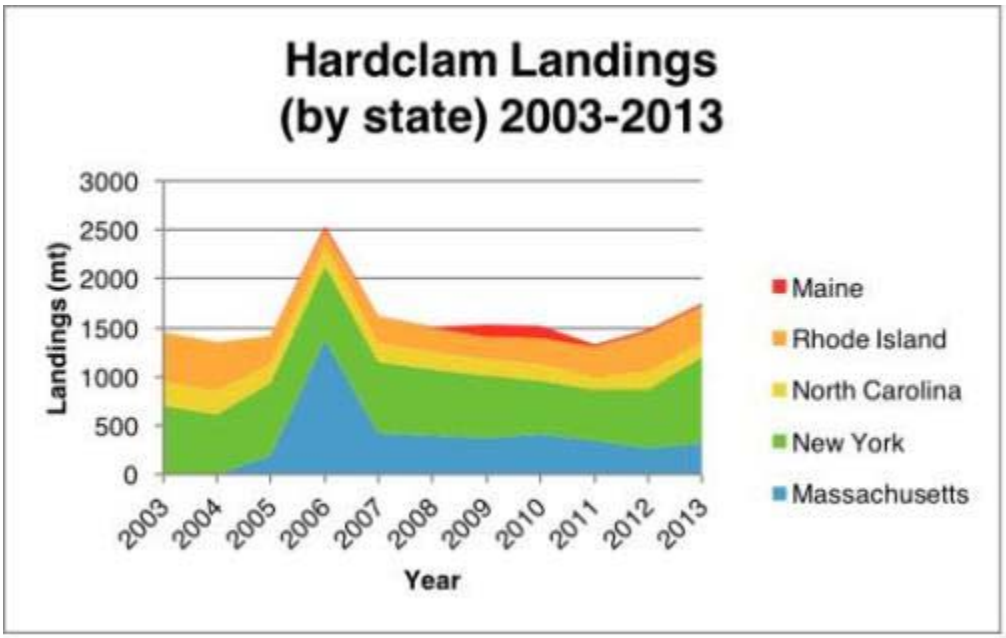

Figure 4. Northern quahog landings by state (NMFS 2015).

According to the landings data from the northern quahog and quahog datasets, this species' highest recorded landings were at 9,435 MT in 1950. Since then, landings have steadily declined, with a faster decline happening in the early 2000s (NMFS 2012). Prior to peak levels in 1970, northern quahogs harvested from the Great South Bay in New York provided more than half the nation's annual catch; there followed a collapse that the fishery has not yet recovered from (TNC 2015). In New York, northern quahog management occurs entirely within state waters. Generally, states manage northern quahogs using gear and spatial restrictions, fishing seasons, and size limits. Declines in landings are in response to a combination of factors: more restrictive water quality regulations, reduced daily possession limits per individual, fewer active participants in the fishery, and reduced prices for northern quahogs (Erkan 2012). In addition, in Rhode Island and other states, recreational shellfishing effort can be substantial. When combined with commercial harvest, easily accessible areas may experience localized depletions in clams (Erkan, 2012). Northern quahogs' distribution runs from Prince Edward Island to the Yucatan Peninsula; however, the areas that produce the highest densities of northern quahogs are between Cape Cod and New Jersey.

Softshell clam (Mya arenaria)

Softshell clams occur in intertidal zones, coastal ponds, and estuaries. Softshell clams are native to the U.S. East Coast, Japan, and Korea, but have spread extensively through human activity and are now found in Europe and the West Coast of the United States (Global Invasive Species Database 2012). Softshell clams burrow 8–14 inches into mud, sand, and gravel intertidal areas, and are harvested from Labrador to North Carolina (Maine Sea Grant 2012). Softshell clam shells are fragile and easily broken, leading to various hand-harvest methods (Maine Sea Grant 2012). Since softshell clams occur in intertidal zones and estuaries, they are managed by each state or local jurisdiction. U.S. landings of softshell clams peaked in 1969 at 6,115 MT. From 1969 to 1996, landings declined, to a low of 967 MT in 1996. After 1996, landings steadily increased, except for another low in 2009 of 830 MT. Landings increased again in 2010 to 1,940 MT (NMFS 2012). The value of softshell clams has increased over time, making them a valuable fishery. The majority of softshell clams, roughly 50% each year, are landed in Maine. Softshell clams are the second most valuable fishery in Maine at $1,720,848 in 2010 (NMFS 2012). Maine has one of the oldest municipal shellfish management programs in the country. Municipal shellfish management started in Maine in the 1820s and has been jointly managed with the state since the 1880s (Nault 2012). Figure 5 shows softshell clam landings from 2000 to 2010 (NMFS 2012).

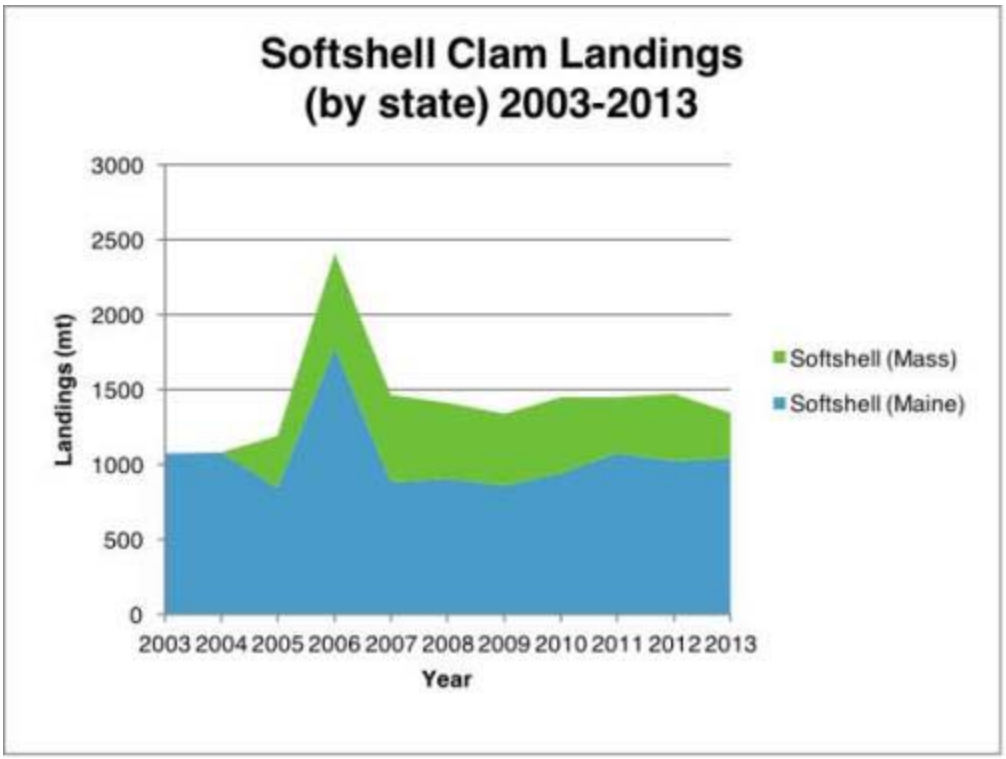

Figure 5. Softshell clam landings by state (NMFS 2015).

Production Statistics

The species covered in this report are primarily fished in the United States, with a lesser amount caught in Canada. European fisheries for ocean quahog and northern quahog exist, but catches are low.

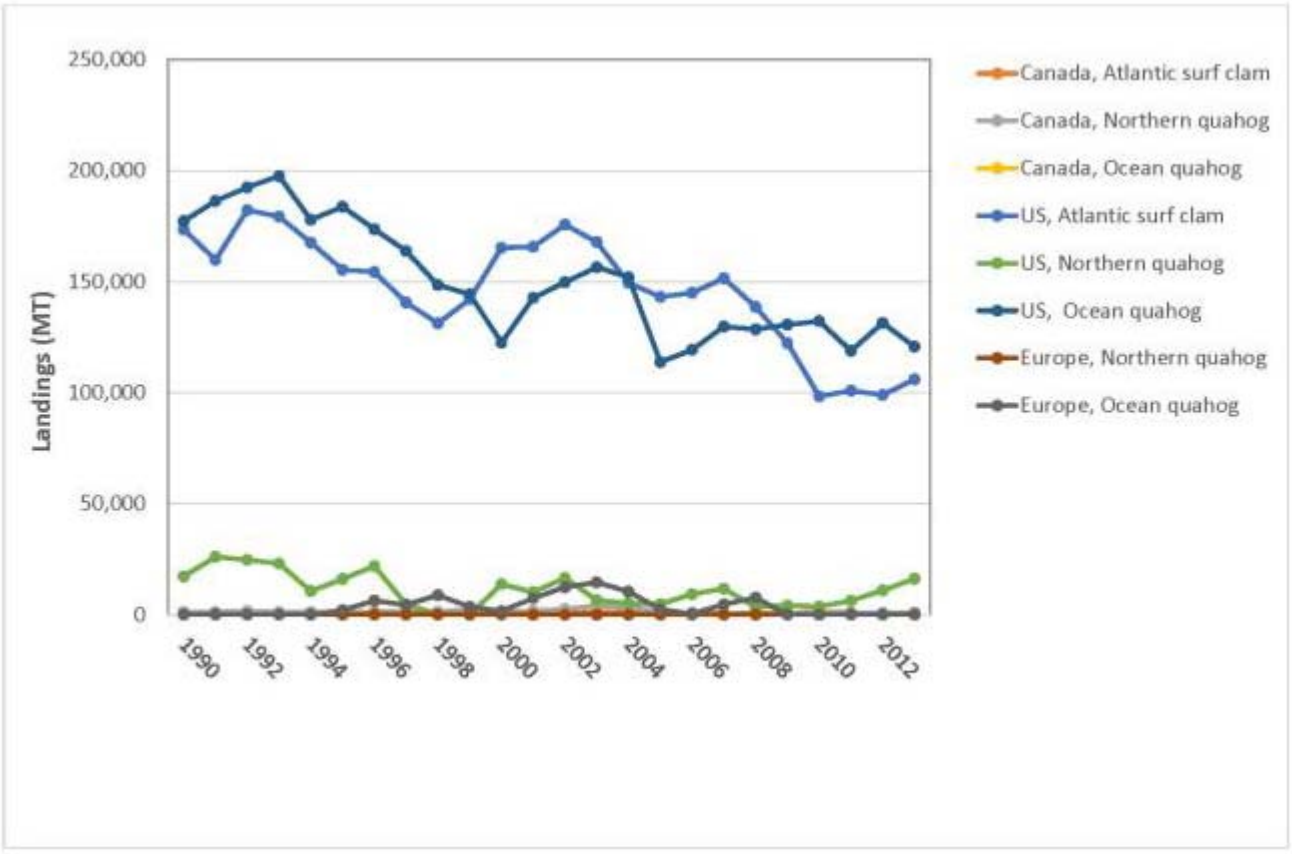

Figure 6. Species specific production in MT.

Importance to the U.S./North American market

Available import/export records for "clam" do not provide a species-level breakdown of data. Therefore, the following data are for all clams and not specific to the fisheries in this report. In 2014, clam imports totaled 23,192,398 kg with a total value of $71,620,032. China was the largest exporter to the United States, with a total of 13,728,704 kg. The next largest exporter was Canada (2,613,928 kg), followed by Thailand (1,517,431 kg), and Indonesia (938,251 kg) (Figure 7). In 2014, the U.S. exported 7,929,918 kg of clam valued at $83,598,901. The largest importer was Vietnam (3,417,966 kg), followed by China (2,206,523 kg), Japan (1,066,817), and Canada (911,936 kg) (NMFS 2015b).

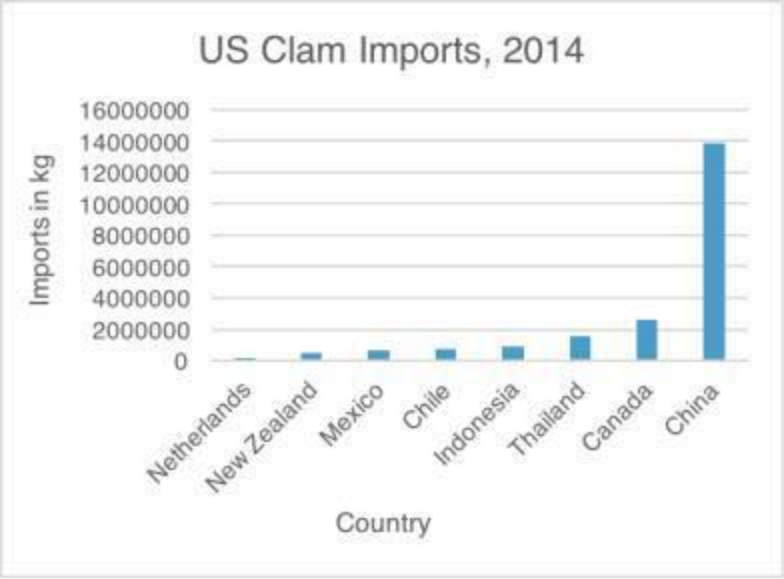

Figure 7. US clam imports

Common and market names

The common name for *Spisula solidissima* is Atlantic surfclam. The market name for Atlantic surfclam is surfclam, and vernacular names include hen clam, bar clam, and sea clam (FDA 2015).

The common name for *Arctica islandica* is ocean quahog. The market name is northern quahog and vernacular names include quahog, black clam, and northern quahog (FDA 2015).

The common name for *Mercenaria mercenaria* is northern quahog. Market names include northern quahog and quahog, and vernacular names include hardshell and littleneck (FDA 2015). This species is referred to differently, based on size. The smallest are called littleneck clams, slightly larger clams are called topnecks, medium large clams are called cherrystones, and the largest clams are called chowders.

The common name for *Mya arenaria* is softshell clam. Market names include clam and softshell, and vernacular names include steamer or maninose clam (FDA 2015).

Primary product forms

Atlantic surfclams are generally sold as fried clam strips. They are also used chopped and used for chowders and other products (Cargnelli et al. 1999). Ocean quahogs within the Maine fishery are sold to the live and half-shell market; ocean quahogs caught elsewhere are processed and then sold chopped, frozen, canned, and in value-added products such as chowders, bisques, and sauces. Northern quahogs are often served raw on the half-shell (littlenecks), baked, or used in dishes such as clam chowder or clam sauces (cherrystone and chowder clams) (NYSDEC 2012). Softshell clams are commonly served steamed or fried.

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

ATLANTIC SURFCLAM				
Region / Method	**Inherent Vulnerability**	**Stock Status**	**Fishing Mortality**	**Subscore**
United States Atlantic Clam dredge (Hydraulic)	2.00:Medium	4.00:Low Concern	5.00:Very Low Concern	**Green (4.472)**

NORTHERN QUAHOG				
Region / Method	**Inherent Vulnerability**	**Stock Status**	**Fishing Mortality**	**Subscore**
Massachusetts Atlantic Rakes (wild)	3.00:Low	3.00:Moderate Concern	2.33:Moderate Concern	**Yellow (2.644)**
New York North Atlantic Rakes (wild)	3.00:Low	3.00:Moderate Concern	2.33:Moderate Concern	**Yellow (2.644)**
North Carolina North Atlantic Rakes (wild)	3.00:Low	3.00:Moderate Concern	2.33:Moderate Concern	**Yellow (2.644)**
Rhode Island North Atlantic Rakes (wild)	3.00:Low	3.00:Moderate Concern	2.33:Moderate Concern	**Yellow (2.644)**

OCEAN QUAHOG				
Region / Method	**Inherent Vulnerability**	**Stock Status**	**Fishing Mortality**	**Subscore**
United States North Atlantic Clam dredge (Hydraulic)	1.00:High	5.00:Very Low Concern	5.00:Very Low Concern	**Green (5.000)**

SOFTSHELL CLAM				
Region / Method	**Inherent Vulnerability**	**Stock Status**	**Fishing Mortality**	**Subscore**
Maine North Atlantic Rakes (wild)	2.00:Medium	3.00:Moderate Concern	2.33:Moderate Concern	**Yellow (2.644)**
Massachusetts North Atlantic Rakes (wild)	2.00:Medium	3.00:Moderate Concern	2.33:Moderate Concern	**Yellow (2.644)**

Criterion 1 Assessment

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.

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.

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.*

ATLANTIC SURFCLAM

Factor 1.1 - Inherent Vulnerability

United States Atlantic, Clam dredge (Hydraulic)

Medium

All the clams considered in this report are broadcast spawners. Broadcast spawners release their eggs and sperm into the water column where fertilization occurs. For broadcast spawning to lead to successful reproduction, high densities of individuals of the same species are required (Bishop and Powers 2003). Since clams are not very mobile, Allee effects are likely when population densities are low. In this report, the “density dependence factor” defaulted to Allee effects being likely, with a score of 1, even when there was not a specific literature source describing Allee effects for the species (Bishop and Powers 2003). The SFW inherent vulnerability score is 2 for Atlantic surfclam, corresponding to

"medium" inherent vulnerability.

Rationale:

Factor	Atlantic surfclams	Score	Source
Average Age of Maturity	Ranges from 3 months to 4 years	3	Cargnelli et al. (1999)
Average Maximum Age	31	1	Cargnelli et al. (1999)
Reproductive Strategy	Broadcast Spawner	3	Cargnelli et al. (1999)
Density Dependence	Depensatory dynamics at low population sizes (Allee effects) demonstrated or likely	1	Bishop and Powers (2003)
Score (mean factor of scores):		2	

Table 1. Inherent vulnerability of Atlantic surfclam.

Factor 1.2 - Stock Status

United States Atlantic, Clam dredge (Hydraulic)

Low Concern

Estimated biomass for the Atlantic surfclam during 2011 was 1,060 thousand MT, which is above the management target of 486 thousand MT of meats. Therefore, the stock is not considered to be overfished (NEFSC 2013). The 2015 NMFS second quarter stock status report lists B/B_{MSY} as 1.09, so the stock is not overfished (NMFS 2015c). Though not overfished, the stocks have been in decline in some areas, most significantly in the southern portion of the fishery and in inshore state waters (O'Dwyer 2015), likely due to environmental factors. There is evidence that surfclam range is shifting northward (MAFMC 2010).

Figure 7 shows the Atlantic surfclam biomass estimate through 2011 from the 2013 benchmark assessment (the most recent assessment) (NEFSC 2013).

Abundance scores as "low" concern because Atlantic surfclam stocks are not overfished, but there is evidence of decline in some areas.

Rationale:

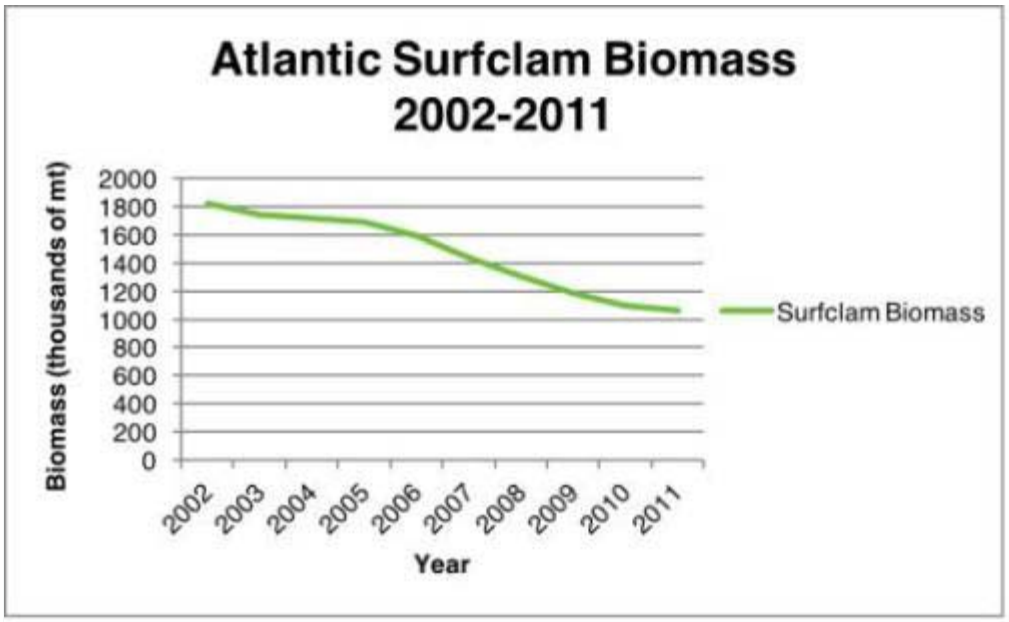

Figure 8. Atlantic surfclam biomass (NEFSC 2013)

Factor 1.3 - Fishing Mortality

United States Atlantic, Clam dredge (Hydraulic)

Very Low Concern

The Atlantic surfclam fishing mortality during 2011 was 0.027, which is below the management threshold of 0.15. Therefore, overfishing is not occurring (NEFSC 2013). We note that population declines exceed fishing mortality rates, so it is likely that there are environmental factors contributing to surfclam population declines in the region (O'Dwyer 2015) (MAFMC 2010). Atlantic surfclam fishing mortality scores as "very low" concern.

Rationale:
We note that fishing had been off limits in Georges Bank, but limited harvest now occurs in this area (O'Dwyer 2015).

NORTHERN QUAHOG

Factor 1.1 - Inherent Vulnerability

Massachusetts Atlantic, Rakes (wild)

New York North Atlantic, Rakes (wild)

North Carolina North Atlantic, Rakes (wild)

Rhode Island North Atlantic, Rakes (wild)

Low

Northern quahog has an overall vulnerability score of 2.5 and is considered to have low vulnerability to fishing pressure.

Rationale:

Factor	Hard Clam	Score	Source
Average Age of Maturity	1-3 years	3	Eversole 1987, Baker et al. 2008
Average Maximum Age	8 (may live up to 40 years with no harvesting or predatory pressure)	3	Hill 2004
Reproductive Strategy	Broadcast Spawner	3	Hill 2004
Density Dependence	Depensatory dynamics at low population sizes (Allee effects) demonstrated or likely	1	Eversole 1987
Score (mean factor of scores):		2.5	

Table 2. Inherent vulnerability of northern quahogs

Factor 1.2 - Stock Status

Massachusetts Atlantic, Rakes (wild)

Moderate Concern

Key relevant information: Most states do not have biomass estimates or target reference points for the northern quahog stock. What is known about northern quahogs in specific states includes the following:

Massachusetts

Massachusetts contracts a NMFS survey vessel to perform a spring trawl survey of marine resources out to 3 nautical miles. Very few northern quahogs were caught in this survey (Massachusetts 2011). However, higher densities of northern quahog occur in the intertidal areas, which cannot be covered by trawl surveys (Eversole 1987). These areas are managed by local governments, which may or may not perform stock assessments as part of their management activities (Wellfleet 2012).

This sub-criterion scores as “moderate” concern because there is no evidence to suggest that the stock is either above or below reference points; abundance is unknown and stock inherent vulnerability is low (as scored in Factor 1.1).

North Carolina North Atlantic, Rakes (wild)

Moderate Concern

Most states do not have biomass estimates or target reference points for the northern quahog stock. What is known about northern quahogs in specific states includes the following:

North Carolina

The status of the stock in North Carolina is currently listed as unknown because there is limited data to assess the population (NCDMF 2008). North Carolina is currently working to restart population surveys to better understand the status of the northern quahog stock (NCDMF 2008).

This sub-criterion scores as “moderate” concern because there is no evidence to suggest that the stock is either above or below reference points; abundance is unknown and stock inherent vulnerability is low (as scored in Factor 1.1).

Rhode Island North Atlantic, Rakes (wild)

Moderate Concern

Most states do not have biomass estimates or target reference points for the northern quahog stock. What is known about northern quahogs in specific states includes the following:

Rhode Island

Rhode Island conducts some trawl surveys in Narragansett Bay. From these surveys, the number of northern quahogs in the bay declined from 1997 to 2003 and then gradually increased until 2009. However, minimal survey work was conducted from 2010 to 2011, leading to unknown biomass. Surveys were restarted in 2012, so biomass estimates may be available in the future. There is no mention of a biomass reference point in the Rhode Island fishery management plan for 2012 (Rhode Island 2012).

This sub-criterion scores as “moderate” concern because there is no evidence to suggest that the stock is either above or below reference points; abundance is unknown and stock inherent vulnerability is low (as scored in Factor 1.1).

New York North Atlantic, Rakes (wild)

Moderate Concern

Most states do not have biomass estimates or target reference points for the northern quahog stock. What is known about northern quahogs in specific states includes the following:

New York
The status of the northern quahog stock is currently unknown. New York currently does not have a statewide estimate of biomass or a fishery management plan for northern quahog (O'Dwyer 2015). In 1999, the Northern quahog Initiative was launched by Sea Grant New York to address the decline of northern quahog in the South Shore Estuary area. Decline in abundance of northern quahog was attributed to overfishing. Despite reduced fishing efforts in the 1990s, the northern quahog population continued to decline. Potential contributing factors included the occurrance of brown tide blooms, reduced reproductive success associated with density and food quality, and predation (Bricelj 2009).

This sub-criterion scores as "moderate" concern because there is no evidence to suggest that the stock is either above or below reference points; abundance is unknown and stock inherent vulnerability is low (as scored in Factor 1.1).

Factor 1.3 - Fishing Mortality

Massachusetts Atlantic, Rakes (wild)

Moderate Concern

Overall, the fishing mortality for northern quahog is unknown. Specifics for states include the following:

Massachusetts

Massachusetts manages its northern quahog resource in partnership with local municipalities and therefore does not have a statewide fishing mortality estimate (MDMF 2012).

Fishing mortality is unknown for this fishery, scoring as "moderate" concern.

North Carolina North Atlantic, Rakes (wild)

Moderate Concern

Overall, the fishing mortality for northern quahog is unknown. Specifics for states include the following:

North Carolina

The fishing mortality in North Carolina is unknown. North Carolina is unable to determine how much mortality of northern quahog is caused by the commercial fishery, and how much is caused by the recreational fishery, due to a lack of information on the recreational northern quahog fishery. The state is also unable to quantify the fishing mortality for its commercial northern quahog fishery until it has access to additional data, including fishing pressure and mortality from the recreational fishery (NCDMF 2008).

Fishing mortality is unknown for this fishery, scoring as “moderate” concern.

Rhode Island North Atlantic, Rakes (wild)

Moderate Concern

Overall, the fishing mortality for northern quahog is unknown. Specifics for states include the following:

Rhode Island

No current fishing mortality estimate of northern quahog is available for Rhode Island due to a lack of current clam surveys and biomass data (Rhode Island 2012).

Fishing mortality is unknown for this fishery, scoring as “moderate” concern.

New York North Atlantic, Rakes (wild)

Moderate Concern

Overall, the fishing mortality for northern quahogs is unknown. Specifics for states include the following:

New York

New York does not have a current fishing mortality estimate for northern quahog due to lack of a statewide survey and biomass data (O’Dwyer 2015). Shellfish in the bays fall under township jurisdictions and some areas have conducted surveys (O’Dwyer 2015) (NYSDEC 2015a). Data is limited and insufficient to determine mortality statewide.

Fishing mortality is unknown for this fishery, scoring as “moderate” concern.

OCEAN QUAHOG

Factor 1.1 - Inherent Vulnerability

United States North Atlantic, Clam dredge (Hydraulic)

High

Ocean quahog has an overall vulnerability score of 1.75 and is considered to have “high” vulnerability to fishing pressure.

Rationale:

Factor	Ocean quahog	Score	Source
Average Age of Maturity	13.1 (males) 12.5 (females)	2	Cargnelli et al. (1999A)
Average Maximum Age	114 years (Maximum age:225)	1	Kilada, Campana, and Roddick (2007)
Reproductive Strategy	Broadcast spawner	3	Cargnelli et al. (1999A)
Density Dependence	Depensatory dynamics at low population sizes (Allee effects) demonstrated or likely	1	Bishop and Powers (2003)
Score (mean factor of scores):		1.75	

Table 3. Inherent vulnerability of ocean quahog

Factor 1.2 - Stock Status

United States North Atlantic, Clam dredge (Hydraulic)

Very Low Concern

Fishable biomass during 2011 was 2,960 thousand MT (Figure 9), well above the biomass target of 1,730 thousand MT and biomass threshold of 1,390 thousand MT. The most recent assesment (2013) found that B/B_{MSY} (or B/B_{MSY} proxy) was 1.71 (NMFS 2015b). Therefore, the ocean quahog stock is not considered to be overfished (Chute et al. 2013) and scores as “very low” concern.

Rationale:

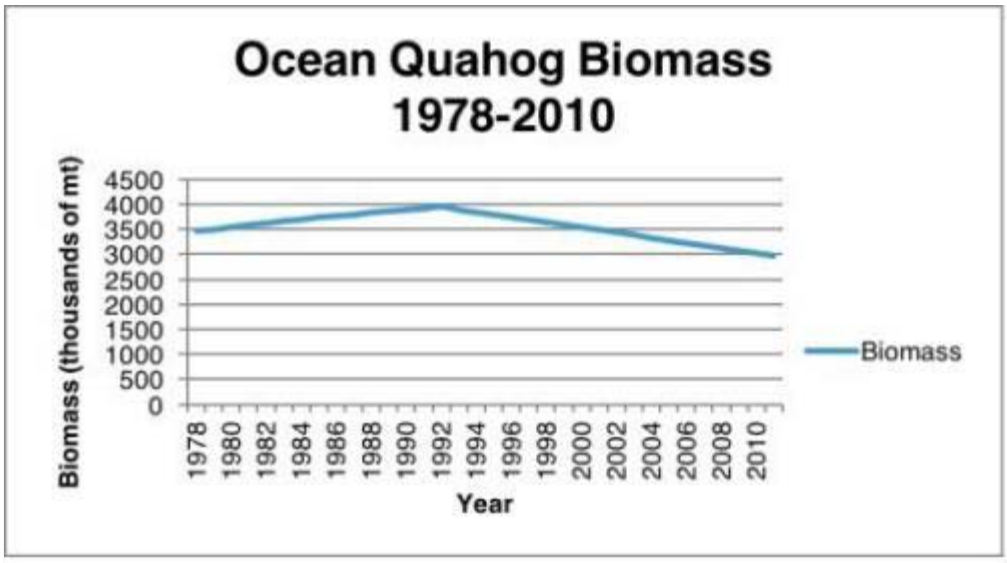

Figure 9. Ocean quahog biomass (Chute et al. 2013)

Factor 1.3 - Fishing Mortality

United States North Atlantic, Clam dredge (Hydraulic)

Very Low Concern

Estimated fishing mortality for the ocean quahog fishery in the U.S. EEZ during 2011 was $0.010y^{-1}$, which is below the current threshold of $0.022y^{-1}$. Fishing mortality is Maine is not included in this and its estimated fishing mortality during 2011 was $0.023y^{-1}$. Although this is above the threshold, the biomass of ocean quahog in Maine represents a small fraction of the fishery (<1% of the stock). Overfishing is determined by the stock as a whole. Therefore, fishing mortality of the entire stock is below the current threshold and overfishing is not occurring (Chute et al. 2013), warranting a score of “very low” concern.

Rationale:
Mean annual recruitment to the ocean quahog stock is small, less than 1% per year, and there is evidence that recruitment occurs in pulses (MAFMC 2010). Currently the fishery is managed on the belief that fishers are fishing down virgin biomass to the management level (MAFMC 2010).

SOFTSHELL CLAM

Factor 1.1 - Inherent Vulnerability

Maine North Atlantic, Rakes (wild)

Massachusetts North Atlantic, Rakes (wild)

Medium

Softshell clam has an overall vulnerability score of 2 and is considered to have medium vulnerability to fishing pressure.

Rationale:

Factor	Softshell Clam	Score	Source
Average Age of Maturity	5 years	2	Abraham and Dillon 1986
Average Maximum Age	10-12 years in the Atlantic, 16 in the white sea	2	Abraham and Dillon 1986, Maximovich and Guerassimova 2003
Reproductive Strategy	Broadcast spawner	3	Abraham and Dillon 1986
Density Dependence	Depensatory dynamics at low population sizes (Allee effects) demonstrated or likely	1	Bishop and Powers (2003)
Score (mean factor of scores):		2	

Table 4: Inherent vulnerability of softshell clam

Factor 1.2 - Stock Status

Maine North Atlantic, Rakes (wild)

Moderate Concern

Due to the lack of information or reference points from states with the majority of the softshell clam stock, the stock status is unknown.

This sub-criterion scores as “moderate” concern because there is no evidence to suggest that the stock is either above or below reference points; abundance is unknown and stock inherent vulnerability is medium (as scored in Factor 1.1).

Rationale:
Little is known about the softshell clam stock status. Information available in the states covered in this report includes the following:

Maine

Maine manages its softshell clam resource in partnership with local municipalities. Some of these local municipalities conduct stock surveys for clam beds of interest (Nault 2012). In Maine, landings and effort are tracked on a monthly basis; this approximation of CPUE has been slowly increasing, which indicates healthy stock status, but scientific stock assessments are not performed on a statewide level (Nault 2012).

Massachusetts North Atlantic, Rakes (wild)

Moderate Concern

Due to the lack of information or reference points from states with the majority of the softshell clam stock, the stock status is unknown.

This sub-criterion scores as “moderate” concern because there is no evidence to suggest that the stock is either above or below reference points; abundance is unknown and stock inherent vulnerability is medium (as scored in Factor 1.1).

Rationale:
Very little is known about the softshell clam stock status. Information available in the states covered in this report includes the following:

Massachusetts

Massachusetts manages its softshell clam resource in partnership with local municipalities. It is unknown if these municipalities conduct stock assessments for softshell clam (MDMF 2012).

Factor 1.3 - Fishing Mortality

Maine North Atlantic, Rakes (wild)

Massachusetts North Atlantic, Rakes (wild)

Moderate Concern

Fishing mortality for softshell clam is deemed unknown, due to the lack of information needed to determine fishing mortality. No statewide stock assessments exist for softshell clam, and CPUE data are not collected on a statewide level (Nault 2012), (MDMF 2012). In Maine and Massachusetts, some municipalities may conduct stock assessments or track CPUE, but these data sources cannot be scaled up to determine the fishing mortality at the state level.

Fishing mortality is unknown for this fishery, scoring as “moderate” concern.

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 ghostfishing. 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 surfclam: United States Atlantic, Clam dredge (Hydraulic)

Subscore:: 5.000 **Discard Rate: 1.00** **C2 Rate: 5.000**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
ATLANTIC SURFCLAM	Medium	4.00: Low Concern	5.00: Very Low Concern	**4.472**

Northern quahog: Massachusetts Atlantic, Rakes (wild)

Subscore:: 5.000 **Discard Rate: 1.00** **C2 Rate: 5.000**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
NORTHERN QUAHOG	Low	3.00: Moderate Concern	2.33: Moderate Concern	**2.644**

Northern quahog: New York North Atlantic, Rakes (wild)

Subscore:: 5.000 **Discard Rate: 1.00** **C2 Rate: 5.000**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
NORTHERN QUAHOG	Low	3.00: Moderate	2.33: Moderate	**2.644**

		Concern	Concern	

Northern quahog: North Carolina North Atlantic, Rakes (wild)

Subscore:: 5.000 **Discard Rate: 1.00** **C2 Rate: 5.000**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
NORTHERN QUAHOG	Low	3.00: Moderate Concern	2.33: Moderate Concern	**2.644**

Northern quahog: Rhode Island North Atlantic, Rakes (wild)

Subscore:: 5.000 **Discard Rate: 1.00** **C2 Rate: 5.000**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
NORTHERN QUAHOG	Low	3.00: Moderate Concern	2.33: Moderate Concern	**2.644**

Ocean quahog: United States North Atlantic, Clam dredge (Hydraulic)

Subscore:: 5.000 **Discard Rate: 1.00** **C2 Rate: 5.000**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
OCEAN QUAHOG	High	5.00: Very Low Concern	5.00: Very Low Concern	**5.000**

Softshell clam: Maine North Atlantic, Rakes (wild)

Subscore:: 5.000 **Discard Rate: 1.00** **C2 Rate: 5.000**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
SOFTSHELL CLAM	Medium	3.00: Moderate Concern	2.33: Moderate Concern	**2.644**

Softshell clam: Massachusetts North Atlantic, Rakes (wild)

Subscore:: 5.000 **Discard Rate: 1.00** **C2 Rate: 5.000**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
SOFTSHELL CLAM	Medium	3.00:	2.33:	**2.644**

		Moderate Concern	Moderate Concern	

Criterion 2 Assessment

Factor 2.4 - Discard Rate

Maine/North Atlantic, Rakes (wild)

Massachusetts/Atlantic, Rakes (wild)

Massachusetts/North Atlantic, Rakes (wild)

North Carolina/North Atlantic, Rakes (wild)

Rhode Island/North Atlantic, Rakes (wild)

United States/Atlantic, Clam dredge (Hydraulic)

United States/North Atlantic, Clam dredge (Hydraulic)

<20%

Research dredge surveys done by the Northeast Fisheries Science Center resulted in a catch of over 90% ocean quahog and Atlantic surfclam, and 1% scallops (Wallace and Hoff 2004).

Factor 2.4 - Discard Rate

New York/North Atlantic, Rakes (wild)

<20%

Research dredge surveys done by the Northeast Fisheries Science Center resulted in a catch of over 90% ocean quahog and Atlantic surfclam, and 1% scallops (Wallace and Hoff 2004).

Northern quahog and softshell clam are caught using gears for various types of hand harvest (NMFS 2012). The gears used for hand harvest in these fisheries include shovels, rakes, and tongs (NMFS 2012). Hand harvesting these clam species allows fishers to be highly selective about their catch, and to return unwanted species alive to their habitat, resulting in negligible bycatch (pers. comm., Bruce Kauffman).

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
Maine North Atlantic Rakes (wild)	3.000	All Species Retained	Yellow(3.000)
Massachusetts Atlantic Rakes (wild)	3.000	All Species Retained	Yellow(3.000)
Massachusetts North Atlantic Rakes (wild)	3.000	All Species Retained	Yellow(3.000)
New York North Atlantic Rakes (wild)	3.000	All Species Retained	Yellow(3.000)
North Carolina North Atlantic Rakes (wild)	3.000	All Species Retained	Yellow(3.000)
Rhode Island North Atlantic Rakes (wild)	3.000	All Species Retained	Yellow(3.000)
United States Atlantic Clam dredge (Hydraulic)	5.000	All Species Retained	Green(5.000)
United States North Atlantic Clam dredge (Hydraulic)	5.000	All Species Retained	Green(5.000)

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**
Maine North Atlantic Rakes (wild)	Moderately Effective	N/A	Moderately Effective	Moderately Effective	Highly Effective	Highly Effective	Highly Effective
Massachusetts Atlantic Rakes (wild)	Moderately Effective	N/A	Moderately Effective	Moderately Effective	Highly Effective	Moderately Effective	Highly Effective
Massachusetts North Atlantic Rakes (wild)	Moderately Effective	N/A	Moderately Effective	Moderately Effective	Highly Effective	Moderately Effective	Highly Effective
New York North Atlantic Rakes (wild)	Moderately Effective	N/A	Moderately Effective	Moderately Effective	Highly Effective	Moderately Effective	Highly Effective
North Carolina North Atlantic Rakes (wild)	Moderately Effective	N/A	Moderately Effective	Moderately Effective	Highly Effective	Moderately Effective	Highly Effective
Rhode Island North Atlantic Rakes (wild)	Moderately Effective	N/A	Moderately Effective	Highly Effective	Highly Effective	Highly Effective	Highly Effective
United States Atlantic Clam dredge (Hydraulic)	Highly Effective	N/A	Highly Effective	Highly Effective	Highly Effective	Highly Effective	Highly Effective
United States North Atlantic Clam dredge (Hydraulic)	Highly Effective	N/A	Highly Effective	Highly Effective	Highly Effective	Highly Effective	Highly Effective

Overview by Region:

Mid-Atlantic Fisheries Management Council: Atlantic surfclam and Ocean quahog: Very Low concern

Atlantic surfclam and ocean quahog are managed by the Mid-Atlantic Fisheries Management Council. The management of these species is considered to be excellent. Stock surveys and assessments for these species are performed every 3 years, and management nearly always follows scientific advice for setting total allowable catch (TAC) and overfishing levels for the fishery (MAFMC 2010). Management has also been shown to change the regulations, such as replacing time and effort restrictions with an individual transferable quota system (ITQS) when the existing regulations were not effective (MAFMC 2010). Measurements enacted by management have maintained the stock, and the management process is transparent and allows input from stakeholders.

Massachusetts: Northern quahog: Moderate concern

Massachusetts manages its northern quahog resource in partnership with local municipalities (MDMF 2012). The only statewide regulation regarding northern quahog is a minimum size limit of 1 inch thickness (MDMF 2012). The permits offered for clam digging are managed by local governments. Local governments generally manage their clam resource using spatial management, licensing fees, and gear restrictions (Nault 2012). The state of Massachusetts does conduct offshore trawl surveys, and the northern quahogs that are caught are counted. However, these surveys occur in areas that are not good northern quahog habitat, thus the surveys may be of limited utility for local jurisdictions (Massachusetts 2011). No species of concern occur in this fishery and local fishery management objectives are appropriate.

Massachusetts: Softshell Clam: Moderate concern

Massachusetts manages its softshell clam resource in partnership with local jurisdictions (MDMF 2012). The only statewide regulation is a minimum size limit of 2 inches (MDMF 2012). The local government controls which clam beds may be harvested and when licenses are available for harvesting (Nault 2012). No stock assessments are done on a state level for this species (MDMF 2012). Since management occurs on a local level, it is unknown how well local jurisdictions incorporate scientific information and recommendations, and the track record of management is unknown (MDMF 2012). Softshell clam landings experienced a steep decline from the mid-1980s to the mid-1990s across the Atlantic Coast, and although the management of softshell clams is appropriate for managing fishing pressure, additional threats to the fishery have emerged due to poor water quality and habitat degradation that could benefit from additional management actions. The decline in water quality has led to extensive red tide shellfish closures for Massachusetts, which has created a control on clam harvest (Erkan 2012). Some additional actions have been taken in the form of restoration projects (Shields 2009).

New York: Northern quahog: Moderate concern

New York manages its northern quahog resource in partnership with local municipalities (O'Dwyer 2015). The state does not have a biomass estimate, stock assessment, or a fishery management plan for

northern quahogs (O'Dwyer 2015). Some towns and groups have conducted surveys in the Great South Bay area, and statewide management has discussed management plans for surveys, though this has not yet been acted on (O'Dwyer 2015). Statewide regulation includes harvest limits by size and number as well as gear restrictions (NYSDEC 2015). Because of the limited data to determine the status of the northern quahog stock statewide, New York's northern quahog management is of moderate concern.

Rhode Island: Northern quahog: Moderate concern

Rhode Island's northern quahog management is moderately effective. Total northern quahog landings along the Atlantic Coast have been declining since 1990, but Rhode Island has stabilized its landings (NMFS 2012), although biomass is unknown. Rhode Island manages its northern quahog resource by implementing possession limits, fishing licenses, and seasons (Rhode Island 2012). Rhode Island has an exit/entry ratio of 2:1 for a commercial northern quahog license; however, the number of participants in the fishery is believed to be driven by industry economics, rather than by the management of northern quahogs (Rhode Island 2012). External factors, such as the growth of northern quahog aquaculture, have made the harvest of wild clams less profitable, so fishing effort for northern quahogs has been low (Eagan 2012). Spatial management of northern quahogs is also used in several ways: pollution closures and management areas limit where clams can be harvested; clams are harvested spatially in a rotational manner, allowing areas to recover after harvest; and clam relays transport northern quahogs to specific spatial areas to ensure successful growth and reproduction (Rhode Island 2012). The management areas allow for 3 bushels per day of catch, while other areas allow for 12 (Erkan 2012). One of the objectives of the fishery's management is to engage in adaptive management of northern quahogs to allow a quick response to unanticipated changes in the resource (Rhode Island 2012).

North Carolina: Northern quahog: Moderate concern

Northern quahog is managed at the state level (NCDMF 2008). The fishery is managed with appropriate strategies and goals, and landings have remained stable for the past 10 years. However, increased fishing pressure, habitat degradation, and poor water quality are believed to be affecting the fishery, but the lack of fishery-independent data on northern quahog biomass makes determining the status of the fishery impossible (North Carolina Division of Marine Fisheries 2012). North Carolina is working to restart its biomass surveys for northern quahog to gain fishery-independent biomass data (NCDMF 2008). North Carolina's most recent northern quahog management plan called for improving northern quahog habitat and water quality (NCDMF 2008). North Carolina manages fishing pressure through spatial restrictions, gear restrictions, clam relays, and fishing seasons (NCDMF 2008).

Maine: Softshell Clam: Moderate concern

Maine manages softshell clams in partnership with local municipalities. The local government manages its clam beds and Maine provides technical assistance, analysis, and recommendations to local governments regarding their clams stocks (Nault 2012). The only statewide regulations regarding commercial softshell harvest are a minimum size limit of 2 inches and a gear restriction of rakes only (Maine 2012). The state previously required clam surveys from local governments, but this was

infeasible due to lack of resources (Nault 2012). Shellfishing closures occur on a variety of clam beds due to pollution and human health concerns. Although these closures are not done with fisheries management in mind, they do protect the clam stock (Maine 2012). Local governments often manage their clams on a flat-by-flat basis, and may choose if and when to perform clam surveys on their clam beds (Nault 2012). Many are active in planting clam seed as part of their license requirement or town regulation. In addition, many towns implement licensing control and open or close clam beds to harvest (Nault 2012). A number of areas in Maine are not ideal for clam habitat due to water quality concerns and physical characteristics; clams in these areas never reach the 2-inch legal size limit. Maine helps local jurisdictions determine areas of poor habitat for softshell clams and transplant clams to better habitat where growth will occur (Nault 2012). The state monitors the number of licenses by month as a proxy to determine fishing effort (Nault 2012). Overall, the number of licenses issued has increased considerably; however, the trend in landings (and CPUE) has shown a slow, steady increase (Nault 2012). Emerging threats to softshell clams in Maine include changing land uses affecting water quality, but restoration projects have started work to improve water quality and to re-open closed clam beds for shellfishing (Casco Bay Estuary Partnership 2012). The decline in water quality has led to extensive closures in the clam fishery, which has controlled clam harvest in Maine (Erkan 2012).

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.

Maine North Atlantic, Rakes (wild)

Moderately Effective

Maine manages its softshell clam resource in partnership with local governments. The state provides technical expertise and recommendations to local governments regarding their softshell clam resource (Nault 2012). Local governments manage clams on a bed-by-bed basis; landings data provide evidence that some effective measures are in place, but it is difficult to determine the extent of management effectiveness due to the lack of statewide estimates.

Massachusetts Atlantic, Rakes (wild)

Massachusetts North Atlantic, Rakes (wild)

Moderately Effective

Massachusetts manages its northern quahog resource in partnership with local municipalities (MDMF

2012). The only statewide regulation regarding northern quahog is a minimum size limit of 1 inch thickness (MDMF 2012). The permits offered for clam digging are managed (Nault 2012). The state of Massachusetts does conduct offshore trawl surveys, and the northern quahogs that are caught are counted. However, these surveys occur in areas that are not good northern quahog habitat, thus the surveys may be of limited utility for local jurisdictions (Massachusetts 2011). No species of concern occur in this fishery, and local fishery management objectives are appropriate.

Massachusetts manages its softshell clam resource in partnership with local jurisdictions (MDMF 2012). The only statewide regulation is a minimum size limit of 2 inches (MDMF 2012). The local government controls which clam beds may be harvested and when licenses are available for harvesting (Nault 2012). No stock assessments are done on a state level for this species (MDMF 2012). Since management occurs on a local level, it is unknown how well local jurisdictions incorporate scientific information and recommendations, and the track record of management is unknown (MDMF 2012). Softshell clam landings experienced a steep decline from the mid-1980s to the mid-1990s across the Atlantic Coast, and although the management of softshell clams is appropriate for managing fishing pressure, additional threats to the fishery have emerged due to poor water quality and habitat degradation that could benefit from additional management actions. The decline in water quality has led to extensive red tide shellfish closures for Massachusetts, which has created a control on clam harvest (Erkan 2012). Some additional actions have been taken in the form of restoration projects (Shields 2009).

Management strategy and implementation scores as “moderately effective” for this gear type because even though there is some effective management in place, there is a need for increased precaution.

New York North Atlantic, Rakes (wild)

Moderately Effective

New York manages its northern quahog resource in partnership with local municipalities (O’Dwyer 2015). Statewide regulation includes harvest limits by size and number as well as gear restrictions. The minimum harvest size for northern quahog is 1 inch thickness. The recreational harvest limit is 100 clams per day and commercial harvest is unrestricted. No recreational permit is required in state lands. A New York State Digger Permit is required for commerical harvest (NYSDEC 2015a). Some towns and groups have conducted surveys in the Great South Bay area, and statewide management has discussed management plans for surveys, though this has not yet been acted on (O’Dwyer 2015). Additionally, some townships have begun to develop spawner sanctuaries, which are designed to increase densities to help spawning success and are off limits to harvesting (O’Dwyer 2015). New York does not have a statewide stock assessment or a fishery management plan. Thus, it is unknown if harvest restrictions are appropriate. Therefore, New York’s management stratgey and implementation is considered moderately effective.

Management strategy and implementation scores as “moderately effective” because even though there is some effective management in place, there is a need for increased precaution.

North Carolina North Atlantic, Rakes (wild)

Moderately Effective

North Carolina has an appropriate strategy and goals for managing its northern quahog fishery. The goal of northern quahog fishery management is to “manage northern quahogs stocks in a manner that achieves sustainable harvest and protects its ecological value” (p. 21 (NCDMF 2008)). The northern quahog fishery has been managed through harvest and size limits as well as through season and area restrictions, and a relay program in which clams are moved from polluted areas and placed on leases for depuration (removing impurities) (NCDMF 2008). In addition, the management program is re-assessed and modified as data become available. The management strategy and goals are appropriate for this fishery, and landings have remained relatively stable for the past 10 years; however, stock assessments are needed to ensure the long-term health of the fishery.

Management strategy and implementation scores as “moderately effective” because while there is some effective management in place, there is a need for increased precaution.

Rhode Island North Atlantic, Rakes (wild)

Moderately Effective

Rhode Island’s northern quahog management includes yearly statewide stock surveys and licensing to control effort. There is evidence through CPUE and landings data that the strategy is being implemented successfully due to maintained stock abundance ((Rhode Island 2012) and (NMFS 2012)). However, stocks assessments are needed to ensure the long-term health of the fishery.

Management strategy and implementation scores as "moderately effective" because even though there is some effective management in place, there is a need for increased precaution.

United States Atlantic, Clam dredge (Hydraulic)

United States North Atlantic, Clam dredge (Hydraulic)

Highly Effective

This fishery has a highly appropriate management strategy and goals, and biomass surveys show that the strategy is being implemented successfully (MAFMC 2010), warranting a score of “highly effective”

for harvest management strategy and implementation. After using a complex system of time and effort restrictions, the Mid-Atlantic Fisheries Management Council implemented an ITQ system for the Atlantic surfclam and ocean quahog fisheries in 1988 (MAFMC 2010). The fisheries council also provided more appropriate ITQ management measures for the Maine ocean quahog fishery (MAFMC 2010). The council has shown a willingness to consider and implement changes based on new scientific information as it becomes available, such as implementing a new overfishing definition for ocean quahogs in 1999. The changes made to the management of Atlantic surfclam and ocean quahog have led to lower fishing effort and fewer instances of exceeding set catch limits (MAFMC 2010).

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.

Maine North Atlantic, Rakes (wild)

N/A

No stocks of concern occur in this Maine fishery. Local municipalities may perform clam relays and close spatial areas if they are concerned about local depletions of softshell clams. Since no stocks of concern exist in this fishery, Seafood Watch deems the recovery of stocks of concern to be not applicable.

Massachusetts Atlantic, Rakes (wild)

Massachusetts North Atlantic, Rakes (wild)

N/A

No stocks of concern occur in this fishery in Massachusetts; therefore, Seafood Watch deems the recovery of stocks of concern to be not applicable.

New York North Atlantic, Rakes (wild)

N/A

No stocks of concern occur in this fishery in New York; therefore, Seafood Watch deems the recovery of

stocks of concern to be not applicable.

North Carolina North Atlantic, Rakes (wild)

N/A

There are no stocks of concern in this fishery. Since no stocks of concern exist in this fishery, Seafood Watch deems the recovery of stocks of concern to be not applicable.

Rhode Island North Atlantic, Rakes (wild)

N/A

No designated stocks of concern exist in Rhode Island. Rhode Island has experience localized depletions, which are being managed with the Shellfish Management Areas, spawner sanctuaries, and northern quahog relays. These groups transfer wild northern quahogs into the two areas previously mentioned (pers. comm., Dennis Erkan, 2012). With these efforts, success is probable, and the landings in Rhode Island have been stable over the past 10 years (NMFS 2012). Since no stocks of concern exist in this fishery, Seafood Watch deems the recovery of stocks of concern to be not applicable.

United States Atlantic, Clam dredge (Hydraulic)

United States North Atlantic, Clam dredge (Hydraulic)

N/A

There are no stocks of concern in this fishery. Ocean quahog is very long lived and slow growing, and the management of the fishery takes this into account when determining biomass estimates and setting catch limits. Since no stocks of concern exist in this fishery, Seafood Watch deems the recovery of stocks of concern to be not applicable. (MAFMC 2010).

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.

Maine North Atlantic, Rakes (wild)

Moderately Effective

Maine tracks the number of softshell clam harvest permits per month as a proxy for fishing effort, and local governments may perform clam surveys and plant seed clams to replenish stocks (Nault 2012). About a decade ago, the state required all coastal towns to survey one-third of their intertidal clam resources annually. This effort was labor-intensive and rarely helped to develop conservation plans for shellfish resources on a local level because few people were surveying large expanses of intertidal habitat, so the survey requirement was removed (Nault 2012). Some data related to stock abundance and health are collected, but may be insufficient to maintain stock abundance.

Some data related to stock abundance and health are collected, but may be insufficient to maintain stock abundance, warranting a score of “moderately effective” for scientific research and monitoring.

Massachusetts Atlantic, Rakes (wild)

Massachusetts North Atlantic, Rakes (wild)

Moderately Effective

Northern quahog: The decision to manage using stock assessments is left to local municipalities, which may or may not collect data related to stock abundance (Wellfleet 2012). Softshell Clam: The decision to perform some kind of biomass assessment is done on the local level in Massachusetts; there is no statewide stock assessment. However, landings data are collected by the state (MDMF 2012).

Scientific research and monitoring scores as “moderately effective” for hard and soft clams in Massachusetts because even though some stock abundance and health data are collected, it is insufficient to determine the status of clam stocks or guarantee the long term maintenance of these stocks.

New York North Atlantic, Rakes (wild)

Moderately Effective

New York does not have biomass estimates or a fishery management plan for northern quahog. Some of the local juristictions have conducted surveys on northern quahog, mostly in the Great South Bay area (O’Dwyer 2015). In 1999, the Northern quahog Initiative was launched by New York Sea Grant to improve science-based understanding of factors that control the northern quahog population. The sharp decline in abundance of northern quahog in the South Shore Estuary area in the late 1970s and 1980s was attributed to overfishing. Despite reduced fishing efforts in the 1990s due to low abundance, the

northern quahog population continued to decline. Potential contributing factors included the occurrance of brown tide blooms, reduced reproductive success associated with density and food quality, and predation (Bricelj 2009). In 2005, New York completed a comprehensive wildlife conservation study that acts as the guiding document for management of species. (At the time this Seafood Watch report was written, this study was being revised and a public comment draft had been released.) Northern quahog was listed as a high-priority species of greatest conservation need. The goals set forth for management of mollusks (including northern quahog) include continued research into the efficacy and optimal placement of reef sites and spawner sanctuaries, as well as continued work with local governments to manage the resource (NYSDEC 2005). Although New York set forth goals to improve its management of northern quahogs, it currently lacks a fishery management plan and has limited data to determine the status of the northern quahog stock statewide. Therefore, Seafood Watch ranks scientific research and monitoring for this fishery to be “moderately effective.”

North Carolina North Atlantic, Rakes (wild)

Moderately Effective

North Carolina is working to restart its biomass surveys for northern quahog. Currently, a monitoring program is underway in Core Sound to provide baseline data on northern quahog abundance and to gather environmental parameters (NCDMF 2008). A fishery-dependent monitoring program started in 1999 to collect data at the trip level on gear type, catch composition, and size distribution of northern quahogs by market grade. These fishery-dependent data are currently being used to manage the fishery (NCDMF 2008). Although some data are collected related to stock abundance and health, it is insufficient to maintain the stock, warranting a score of “moderately effective” for scientific research and monitoring.

Rhode Island North Atlantic, Rakes (wild)

Moderately Effective

Rhode Island previously conducted stock biomass assessments in Narragansett Bay on an annual basis since 1993; however, minimal survey work was done from 2010 to 2011 due to vessel age and repair needs (Rhode Island 2012). But the vessel repair work was completed, and biomass surveys restarted in 2012 (Erkan 2012). This survey work allows the Rhode Island Department of Environmental Management to consider both fishery-dependent and independent data in its management decisions. Since some data related to stock abundance and health are collected but may be insufficient (due to gaps in data collection) to maintain the northern quahog stock, Seafood Watch ranks scientific research and monitoring as “moderately effective.”

United States Atlantic, Clam dredge (Hydraulic)

United States North Atlantic, Clam dredge (Hydraulic)

Highly Effective

The management uses an independent, up-to-date, and rigorous scientific stock assessment to determine the health of the Atlantic surfclam and ocean quahog resource (MAFMC 2010). Data collection on clam stock biomass has been sufficient to ensure management goals are appropriate to maintain stocks, as evidenced by long-term maintenance of clam populations, warranting a score of "moderately effective" for scientific research and monitoring.

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.

Maine North Atlantic, Rakes (wild)

Moderately Effective

Although scientific data are collected, which is highly dependent on town jurisdiction, the degree to which each jurisdiction follows scientific advice regarding their clam beds is unknown (Maine 2012A), warranting a score of "moderately effective" for management record of following scientific advice.

Massachusetts Atlantic, Rakes (wild)

Massachusetts North Atlantic, Rakes (wild)

Moderately Effective

Northern quahog: Massachusetts' Division of Marine Fisheries conducts the Resource Assessment Surveys Project, which is mostly focused on finfish, but does include some information on northern quahogs. The Resource Assessment Surveys Project exists because "Resource conservation laws require that the best scientific information be used as the basis for management actions. The Resource Assessment Project's mission is to collect and analyze data to contribute to this process (MDMF 2012A)." How these surveys and other resource assessment resources are used at the local level is unknown (MDMF 2012).

Softshell Clam: Due to the large number of municipalities managing shellfish in Massachusetts, and the inconsistency of information availability, generalizing the use of scientific advice for each local

jurisdiction is infeasible, therefore the use of scientific advice is unknown (MDMF 2012).

Since it is unknown how scientific advice is used to manage hard or softshell clam stocks, Seafood Watch ranks Massachusetts' following of scientific advice as "moderately effective."

New York North Atlantic, Rakes (wild)

Moderately Effective

Limited data is available on the status of the northern quahog fishery in New York. Although some towns conduct surveys, this data does not currently inform statewide management. The state has set forth goals to improve management through continued research and work with local governments to manage the resource. The state has also listed northern quahog as a species of greatest conservation need (NYSDEC 2005). It is unknown when New York will start to improve its management of northern quahog or if the goals currently set forth by local governments are met. Therefore, scientific advice is considered "moderately effective."

North Carolina North Atlantic, Rakes (wild)

Moderately Effective

Management does not have a track record of disregarding scientific advice (NCDMF 2008). Efforts are being made on the state level to have management react faster to changes in northern quahog population levels (NCDMF 2008). The current track record is unknown, warranting a score of "moderately effective" for scientific advice.

Rhode Island North Atlantic, Rakes (wild)

Highly Effective

Management nearly always follows scientific advice, earning a score of "highly effective" for this factor. Rhode Island's management has adapted to the changing abundance and distribution of northern quahog, and made changes to manage the resource more effectively (Rhode Island 2012).

United States Atlantic, Clam dredge (Hydraulic)

United States North Atlantic, Clam dredge (Hydraulic)

Highly Effective

Management nearly always follows scientific advice, earning a score of “highly effective” for this factor. There is evidence that management is conservative in setting the TAC limit (MAFMC 2010).

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.

Maine North Atlantic, Rakes (wild)

Highly Effective

Enforcement is done by the marine patrol and shellfish wardens that work through both state and federal programs and regularly enforce regulations and the use of harvest tags (Maine 2012A). Enforcement scores as “highly effective.”

Massachusetts Atlantic, Rakes (wild)

Massachusetts North Atlantic, Rakes (wild)

Highly Effective

Northern quahog: Regulations are enforced by the local marine police or shellfish constables through regular patrols (MDMF 2012). Regulations are regularly enforced and independently verified by trip-level reporting of landings and other relevant information (MDMF 2012).

Softshell Clam: Enforcement is provided by shellfish constables and environmental police (MDMF 2012A). Landings can be independently verified by shellfish endorsements (permits) for commercial clam diggers and shellfish ID cards (MDMF 2012).

Enforcement scores as “highly effective” for hard and softshell clams in Massachusetts.

New York North Atlantic, Rakes (wild)

Highly Effective

The NYSDEC’s environmental conservation police officers are authorized to enforce state fisheries laws and check recreational and commercial fishers for compliance with state laws (NYSDEC 2015c). New

York must be in compliance with the National Shellfish Sanitation Program (NSSP), which has enforcement requirements. As a deterrent to illegal harvesting, officials patrol harvest areas that are classified as the following: “restricted, conditionally restricted, or prohibited, or conditionally approved or approved when in closed status.” These patrols occur 4–16 times per 30 harvestable days, depending on the risk category (4 days for low risk, 8 for medium, and 12 for high). Risk categories are determined by shellfish productivity, ease of harvest, and difficulty of patrol (NSSP 2013). New York has 66 patrol areas, 11 of which are considered exceptions, either due to lack of resource or because they do not have closures. Another 4 areas are medium risk, 50 areas are low risk, and 1 area, Jamaica Bay, is high risk (O’Dwyer 2015). New York’s robust enforcement strategy is considered “highly effective.”

North Carolina North Atlantic, Rakes (wild)

Highly Effective

Regulations are enforced by North Carolina Marine Patrol through regular patrols (North Carolina Division of Marine Fisheries 2012) and are independently verified through the trip ticket program, warranting a score of “highly effective” for this factor.

Rhode Island North Atlantic, Rakes (wild)

Highly Effective

Enforcement is done by the Bureau of Natural Resources Fish and Wildlife & Law Enforcement and is “highly effective” (Rhode Island 2012). There are multiple patrol officers on patrol boats daily that cover all of Narragansett Bay (Hall 2012).

United States Atlantic, Clam dredge (Hydraulic)

United States North Atlantic, Clam dredge (Hydraulic)

Highly Effective

Regulations are enforced by the National Oceanic and Atmospheric Administration’s Office of Law Enforcement in collaboration with other enforcement offices of coastal states (NOAA Enforcement 2012). Tracking tags, which are allotted through the individual quotas, are attached to cages of landed clams to monitor clam landings and determine if TAC is exceeded (McCay and Brandt 2010). These fisheries also require onboard Vessel Monitoring Systems (VMS), which track vessels’ movements in near real time. Before leaving the dock area, a vessel must submit a declaration of their trip. In addition, New York state has a pilot program in which state vessels that also have federal permits and VMS units

can be tracked as well to make sure they are complying with state regulations. (O'Dwyer 2015)

Regulations are regularly enforced and are verified, which is appropriate for this fishery, warranting a score of "highly effective" for this factor.

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.

Maine North Atlantic, Rakes (wild)

Highly Effective

Although statewide biomass surveys are not available, measures enacted by management have resulted in an increase in landings, albeit a slow increase (Nault 2012), warranting a score of "highly effective" for this factor.

Massachusetts Atlantic, Rakes (wild)

Massachusetts North Atlantic, Rakes (wild)

Moderately Effective

Northern quahog: Due to the large number of municipalities managing shellfish in Massachusetts and the inconsistency of information availability, generalizing the track record of every municipality to the statewide level is infeasible; therefore the track record is unknown and scores as "moderately effective."

Softshell Clam: Due to the large number of municipalities managing shellfish in Massachusetts and the inconsistency of information availability, generalizing the track record of every municipality to the statewide level is infeasible; therefore the track record is unknown and scores as "moderately effective."

New York North Atlantic, Rakes (wild)

Moderately Effective

Although New York has had consistent landings of northern quahog over the last decade, it has listed

northern quahog as a species of greatest conservation need (NYSDEC 2005). Additionally, the status of the stock is uncertain due to a lack of biomass estimates (O'Dwyer 2015). New York's track record is uncertain due to the lack of biomass estimates and fisheries management plan for northern quahogs, so it is considered "moderately effective."

North Carolina North Atlantic, Rakes (wild)

Moderately Effective

The track record of North Carolina's northern quahog management is uncertain because the lack of a stock assessment makes tracking the current biomass of northern quahogs infeasible, warranting a score of "moderately effective" for this factor. Thus, determining whether changes in management have led to sustainable fishing is difficult. Additional stressors such as water quality and habitat degradation are believed to be affecting the fishery, but the lack of a stock assessment hinders the ability to determine the level of impact. However, landings records show constant landings throughout the last 10 years, indicating long-term stock abundance (North Carolina Division of Marine Fisheries 2012).

Rhode Island North Atlantic, Rakes (wild)

Highly Effective

Measures enacted by management maintained stock productivity and ecosystem integrity over time (NMFS 2012), warranting a score of "highly effective" for this factor.

United States Atlantic, Clam dredge (Hydraulic)

United States North Atlantic, Clam dredge (Hydraulic)

Highly Effective

Measures enacted by management have resulted in the long-term maintenance of stock abundance, warranting a score of "highly effective" for this factor.

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.

Maine North Atlantic, Rakes (wild)

Highly Effective

The management process is transparent and local; stakeholders have opportunities to be involved with the management process (Maine 2012). Stakeholder inclusion is considered "highly effective."

Massachusetts Atlantic, Rakes (wild)

Massachusetts North Atlantic, Rakes (wild)

Highly Effective

Northern quahog: Decisions regarding shellfish management are made at public meetings, and public meetings are announced to stakeholders in accordance with Massachusetts General Laws Chapter 39, Section 23B (Wellfleet 2012).

Softshell Clam: The management process is transparent and allows for stakeholder participation through public meetings and public hearing notices (MDMF 2012B).

Since the management process is transparent and includes stakeholder input, stakeholder inclusion is considered "highly effective" for hard and softshell clams.

New York North Atlantic, Rakes (wild)

Highly Effective

The management process is transparent and stakeholders have the opportunity to comment on the state's comprehensive wildlife conservation strategy plan (NYSDEC 2005). The DEC has a Shellfish Advisory Committee, consisting of local town officials and industry members, specifically baymen's groups. The meetings are open to the public and occur multiple times per year (O'Dwyer 2015). Therefore, stakeholder inclusion is considered "highly effective."

North Carolina North Atlantic, Rakes (wild)

Highly Effective

The management process is transparent and includes stakeholder input, scoring “highly effective” for stakeholder inclusion (North Carolina Division of Marine Fisheries 2012).

Rhode Island North Atlantic, Rakes (wild)

Highly Effective

The management process is transparent and includes stakeholder input, scoring “highly effective” for stakeholder inclusion. One of the objectives of the management of northern quahog is to maintain existing social and cultural characteristics of the fishery wherever possible (Rhode Island 2012).

United States Atlantic, Clam dredge (Hydraulic)

United States North Atlantic, Clam dredge (Hydraulic)

Highly Effective

The management process is transparent and includes stakeholder input in accordance with the Administrative Procedures Act, which requires that agencies publish notices of proposed regulations for public review and public comment. Stakeholder inclusion is considered “highly effective.”

Bycatch Strategy

Factor 3.2: Management of fishing impacts on bycatch species						
Region / Method	**All Kept**	**Critical**	**Strategy**	**Research**	**Advice**	**Enforce**
Maine North Atlantic Rakes (wild)	Yes	N/A	N/A	N/A	N/A	N/A
Massachusetts Atlantic Rakes (wild)	Yes	N/A	N/A	N/A	N/A	N/A
Massachusetts North Atlantic Rakes (wild)	Yes	N/A	N/A	N/A	N/A	N/A
New York North Atlantic Rakes (wild)	Yes	N/A	N/A	N/A	N/A	N/A
North Carolina North Atlantic Rakes (wild)	Yes	N/A	N/A	N/A	N/A	N/A
Rhode Island North Atlantic Rakes (wild)	Yes	N/A	N/A	N/A	N/A	N/A
United States Atlantic Clam dredge (Hydraulic)	Yes	N/A	N/A	N/A	N/A	N/A
United States North Atlantic Clam dredge (Hydraulic)	Yes	N/A	N/A	N/A	N/A	N/A

There is no management of impacts on bycatch species, because bycatch is minimal using hydraulic clam dredges and hand-harvest methods. For further discussion of bycatch in this report, see Criterion 2.

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.
Maine North Atlantic Rakes (wild)	3.00:Low Concern	0.25:Minimal Mitigation	3.00:Moderate Concern	**Yellow (3.123)**
Massachusetts Atlantic Rakes (wild)	3.00:Low Concern	0.25:Minimal Mitigation	3.00:Moderate Concern	**Yellow (3.123)**
Massachusetts North Atlantic Rakes (wild)	3.00:Low Concern	0.25:Minimal Mitigation	3.00:Moderate Concern	**Yellow (3.123)**
New York North Atlantic Rakes (wild)	3.00:Low Concern	0.25:Minimal Mitigation	3.00:Moderate Concern	**Yellow (3.123)**
North Carolina North Atlantic Rakes (wild)	3.00:Low Concern	0.25:Minimal Mitigation	3.00:Moderate Concern	**Yellow (3.123)**
Rhode Island North Atlantic Rakes (wild)	3.00:Low Concern	0.25:Minimal Mitigation	3.00:Moderate Concern	**Yellow (3.123)**
United States Atlantic Clam dredge (Hydraulic)	1.00:High Concern	0.25:Minimal Mitigation	3.00:Moderate Concern	**Red (1.937)**
United States North Atlantic Clam dredge (Hydraulic)	1.00:High Concern	0.25:Minimal Mitigation	3.00:Moderate Concern	**Red (1.937)**

Hydraulic clam dredges have a high level of contact and disturbance on the benthic habitat. As the dredge is towed along the seafloor, it shoots jets of water into sandy substrate, which makes the capture of clams in the dredge more efficient (Figure 9). The dredge leaves behind a trench in the seafloor and suspends sediments; the sediment disturbance caused by the dredge takes approximately 40 days to recover in habitats that are typically dredged for Atlantic surfclam and ocean quahog (Stevenson et al. 2004). However, the dredge track will act as a trap for empty shells for a year after the dredging occurred (Gilkinson et al. 2003). Since the dredge track accumulates shells, it will be detectable

through sidescan sonograms because the density and composition of sediment within the track is different than the surrounding benthic habitat (Gilkinson et al. 2003). Although hydraulic clam dredges cause high levels of disturbance, the prime habitat for Atlantic surfclam and ocean quahog is high-energy sandy habitat, which is believed to recover quickly from hydraulic clam dredging (MAMFC 2010). In addition, only a small portion, approximately 100 square nautical miles, of potential habitat for clams on the U.S. continental shelf is affected by hydraulic clam dredges, in comparison to the large amounts of this type of habitat available on the Atlantic Coast (MAMFC 2010). Fishing effort for clams is being controlled with an individual transferable quota system but is not being reduced, therefore minimal mitigation for habitat impacts is in place for hydraulic clam dredges (Wallace and Hoff 2005).

Rakes, hoes, and shovels may affect intertidal and subtidal habitats, depending upon how much disturbance the habitat is subject to from wave, tidal, or current action (Brown and Wilson 1997). Rakes, hoes and shovels are used in Maine, Massachusetts, Rhode Island, and North Carolina to land northern quahog and softshell clam. Raked intertidal areas in the United Kingdom have lower species richness than areas that have not been raked, and there is potential for damage to undersized individuals of the fishery's target species (Kaiser et al. 2001). Kaiser et al. also found that the raking impacts persisted in a habitat up to 1 year (Kaiser et al. 2001). Using shovels may also cause impacts to intertidal habitat, especially if the area harvested is not exposed to strong wave or tidal action, which would re-distribute disturbed sediment. However, these fisheries do not have significant bycatch, and they do not capture disproportionately important species to the ecosystem. Overall, the impact to the benthic habitat of these gears is medium.

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.

Maine North Atlantic, Rakes (wild)

Massachusetts Atlantic, Rakes (wild)

Massachusetts North Atlantic, Rakes (wild)

New York North Atlantic, Rakes (wild)

North Carolina North Atlantic, Rakes (wild)

Rhode Island North Atlantic, Rakes (wild)

Low Concern

Rakes, hoes, and shovels can impact the intertidal and subtidal habitats (Brown and Wilson 1997), (Kaiser et al. 2001). A study on habitat impacts of raking mudflats in Maine found that commercial digging can have a negative impact on several intertidal species, although these impacts are likely due to cumulative effects (Brown and Wilson 1997). When digging for clams, if the hole created is not refilled and if the beach is not exposed to high-energy waves and tides, the pile of sediment left on the beach may damage many other types of intertidal species (WDFW 2012).

United States Atlantic, Clam dredge (Hydraulic)

United States North Atlantic, Clam dredge (Hydraulic)

High Concern

A hydraulic clam dredge shoots jets of water into sandy substrate as it is towed along the bottom of the seafloor to “loosen” the clams, which are then caught in the dredge. The dredge leaves behind a trench in the sandy bottom, which is generally the width of the dredge. The hydraulic clam dredges used in the Atlantic surfclam and ocean quahog fishery are typically 12 ft wide and 22 ft long (Stevenson et al. 2004). Their top towing speed is 2.5 knots (Stevenson et al. 2004). The largest area of intensive hydraulic clam dredging activity is located off the central New Jersey coast. No areas containing eelgrass are dredged (Stevenson et al. 2004). Figure 11 shows hydraulic clam dredging intensity from 1995 through 2001.

Hydraulic clam dredging creates steep-sided trenches 8–30 cm deep that begin to deteriorate immediately after they are formed (Stevenson et al. 2004). The dredge also makes sediments in and near the trench fluid and suspends sediments, with silts and clays remaining suspended the longest (Stevenson et al. 2004). Complete recovery of the seafloor topography, sediment grain size, and sediment water content were noted after 40 days in a shallow, sandy environment that was exposed to

winter storms (Stevenson et al. 2004). Additionally, hydraulic clam dredges removed the structures caused by burrows, tubes, and shells on the seafloor. The dredge tracks can also act as traps for empty shells up to 1 year after the dredging occurred, even though the tracks are no longer visible to the naked eye (Gilkinson 2003). After 3 years, the densities of large burrows in the seafloor created by the propeller clam (*Cyrtodaria siliqua*) were reduced by 90% due to the species high mortality when dredging occurs (Gilkinson 2003). In general, hydraulic clam dredging causes an immediate and significant reduction in the total number of infaunal organisms present in the sediment, and sometimes causes a significant decrease in the presence of epifaunal organisms on the surface of the sediment as well (Stevenson et al. 2004). The use of hydraulic clam dredges also provides opportunities for predator species to consume dislodged benthic organisms in and around the trench of the dredge. Predator densities increase after a dredge passes through, returning to normal after 24 hours (Stevenson et al. 2004). In a study on the long-term impacts of dredging on the Georges Bank benthic species, Collie et al. (1997) found that species number and species diversity were significantly larger at undisturbed sites in comparison to dredged sites (Collie et al. 1997). Recovery of biological structure in the benthic environment from dredging impacts can take months to years, depending on the species affected (Hawkins 2006). However, the sediments dredged for Atlantic surfclams and ocean quahogs are frequently disturbed by storms and the area dredged is small in comparison to the available habitat on the Atlantic Coast. Since hydraulic clam dredges have high levels of disturbance of benthic habitat and marine species, Seafood Watch deems hydraulic clam dredges as a “high concern” with respect to habitat impacts.

Rationale:

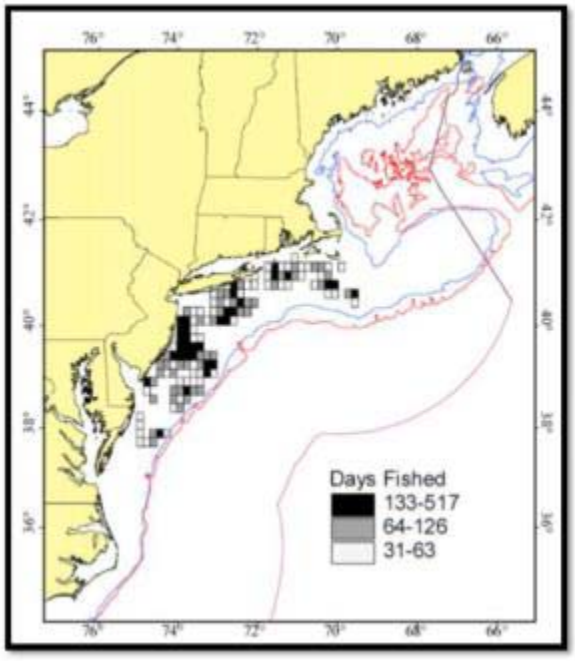

Figure 11. Distribution of Hydraulic Clam Dredging Intensity on the Atlantic Coast from 1995 through 2001 (Stevenson et al. 2004).

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.*

Maine North Atlantic, Rakes (wild)

Minimal Mitigation

Maine (rakes): Spatial areas can be closed to clam raking by the state of Maine if the water quality is so poor it threatens shellfish consumers. Other spatial closures, such as closures for successful recruitment and restrictions to fishing effort, happen on the local level and are unknown. Since fishing effort is being controlled but not reduced, Seafood Watch deems the mitigation for this fishery to be "minimal."

Massachusetts Atlantic, Rakes (wild)

Massachusetts North Atlantic, Rakes (wild)

Minimal Mitigation

Massachusetts (rakes, shovels, hoes): Spatial areas may be closed to clam harvest by the state if they have high levels of pollution or the algae that causes paralytic shellfish poisoning. Spatial closures and effort restrictions for clam raking/digging in Massachusetts are handled at the local level. Since fishing effort is being controlled but not reduced, Seafood Watch deems the mitigation for this fishery to be "minimal."

New York North Atlantic, Rakes (wild)

Minimal Mitigation

New York closes spatial areas in response to marine biotoxins, viruses, and bacteria that make shellfish

hazardous for consumption. Because these closures are not in response to ecosystem impacts or aimed at habitat protection, Seafood Watch ranks New York as having “minimal” mitigation.

North Carolina North Atlantic, Rakes (wild)

Minimal Mitigation

There is “minimal” mitigation for this gear type.

Rhode Island North Atlantic, Rakes (wild)

Minimal Mitigation

Rhode Island (rakes, shovels, hoes): Rhode Island closes areas to northern quahog harvest, protecting the clam stock and the habitat in spawner sanctuaries and management areas (Rhode Island 2012). Rhode Island may also close polluted areas to clam harvest (Rhode Island 2012). Since these measures are not specifically for ecosystem or habitat protection, and these closures are designed to be temporary, Seafood Watch ranks this as “minimal” mitigation.

United States Atlantic, Clam dredge (Hydraulic)

United States North Atlantic, Clam dredge (Hydraulic)

Minimal Mitigation

Fishing effort is controlled, not actively reduced; therefore, Seafood Watch deems fishing gear impacts as minimal for hydraulic clam dredge. A variety of information suggests that the habitat that Atlantic surfclam and ocean quahog occur in is able to recover from dredging disturbance relatively quickly, because it is in a high-energy environment with a great deal of disturbance from waves and currents (Wallace and Hoff 2005). Additionally, only a small portion of the potential habitat available is impacted by hydraulic clam dredges, although areas without dredge impacts are not under protection: they simply are not being fished due to economic or other reasons. Since a small portion of the available habitat is impacted by hydraulic clam dredges and fishing effort is being controlled, but not reduced, Seafood Watch ranks the mitigation of gear impacts as “minimal.” Atlantic surfclam and ocean quahog occur in waters less than 80 ft deep, where storms and currents dominate the natural disturbance regime. The Atlantic surfclam and ocean quahog fishery covers a relatively small area of the available clam habitat on the shelf (less than 400 km^2). Since the fishery covers a small area, the majority of disturbance on the sandy bottom is caused by currents and storms rather than hydraulic clam dredges. The Mid Atlantic Fisheries Management Council believes that any fish habitat impacts would be temporary and minimal. The council evaluated seven alternatives to minimize any potential impacts of the hydraulic clam

dredging and concluded that the “no action” alternative should be maintained and that no management measures were necessary (Wallace and Hoff 2005). In addition, the Georges Bank has been closed since 1990 to hydraulic clam dredging due to the clams there having high concentrations of the toxin that causes paralytic shellfish poisoning (MAFMC 2010). Recent testing of the clams on the Georges Bank has shown that their toxin levels are far below the regulatory threshold requiring closure; however, the public is still concerned about consuming clams from the closed area, so a dockside screening and testing protocol was developed to test all landings from the formerly closed area. With the testing protocol to ensure public safety, there has been a management action to re-open the Georges Bank to hydraulic clam dredging in late August of 2012 (MAFMC 2010). However, this closure was not intended to protect clam habitat from dredge impacts, so it therefore does not attempt to protect a variety of habitats from dredging. Since the Georges Bank is likely to be reopened to hydraulic clam dredging soon, its current closure is not counted as a modifying factor in this report.

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.*

Maine North Atlantic, Rakes (wild)

Massachusetts Atlantic, Rakes (wild)

Massachusetts North Atlantic, Rakes (wild)

New York North Atlantic, Rakes (wild)

North Carolina North Atlantic, Rakes (wild)

Rhode Island North Atlantic, Rakes (wild)

Moderate Concern

Species that are especially important to the ecosystem are not caught in the fisheries assessed in this report. The use of hand harvest to capture clams allows non-target species to be returned to the substrate alive, resulting in negligible bycatch of species that are important for ecosystem functioning. There are no efforts to fully assess the ecological impacts in the fishery.

United States Atlantic, Clam dredge (Hydraulic)

United States North Atlantic, Clam dredge (Hydraulic)

Moderate Concern

There are no exceptional species caught in the hydraulic clam dredge fishery, and scientific assessment and management of ecosystem impacts are not yet underway.

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