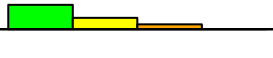
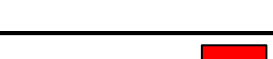
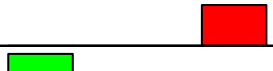
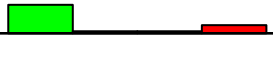
Ocean Quahog − *Arctica islandica*

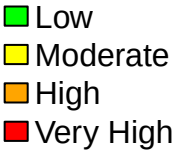
Overall Vulnerability Rank = Very High

Biological Sensitivity = Very High

Climate Exposure = High

Data Quality = 92% of scores ≥ 2

	Arctica islandica	Expert Scores	Data Quality	Expert Scores Plots (Portion by Category)
Sensitivity attributes	Stock Status	1.2	2.4	
	Other Stressors	1.6	2.6	
	Population Growth Rate	3.9	2.8	
	Spawning Cycle	1.8	2.8	
	Complexity in Reproduction	1.5	2.4	
	Early Life History Requirements	2.0	2.2	
	Sensitivity to Ocean Acidification	3.9	2.6	
	Prey Specialization	1.4	3.0	
	Habitat Specialization	1.8	3.0	
	Sensitivity to Temperature	2.4	2.8	
	Adult Mobility	3.9	2.6	
	Dispersal & Early Life History	1.9	2.8	
	Sensitivity Score	Very High		
Exposure variables	Sea Surface Temperature	3.9	3.0	
	Variability in Sea Surface Temperature	1.0	3.0	
	Salinity	1.9	3.0	
	Variability Salinity	1.2	3.0	
	Air Temperature	2.0	3.0	
	Variability Air Temperature	1.0	3.0	
	Precipitation	1.1	3.0	
	Variability in Precipitation	1.1	3.0	
	Ocean Acidification	4.0	2.0	
	Variability in Ocean Acidification	1.0	2.2	
	Currents	2.1	1.0	
	Sea Level Rise	1.8	1.5	
	Exposure Score	High		
	Overall Vulnerability Rank	Very High		



Ocean Quahog (*Arctica islandica*)

Overall Climate Vulnerability Rank: **Very High** (100% certainty from bootstrap analysis).

Climate Exposure: **High**. Two exposure factors contributed to this score: Ocean Surface Temperature (3.9) and Ocean Acidification (4.0). All life stages of Ocean Quahog use marine habitats.

Biological Sensitivity: **Very High**. Three sensitivity attributes scored above 3.5: Population Growth Rate (3.9), Sensitivity to Ocean Acidification (3.9), and Adult Mobility (3.9). Ocean Quahog are slow growing, sessile, and have a calcium carbonate shell.

Distributional Vulnerability Rank: **High** (71% certainty from bootstrap analysis).

Directional Effect in the Northeast U.S. Shelf: The effect of climate change on Ocean Quahog on the Northeast U.S. Shelf is very likely to be negative (>95% certainty in expert scores). Ocean acidification will likely negatively impact molluscs, including Ocean Quahog. Warming will likely reduce growth, which will affect productivity. Warming may also decrease the available habitat resulting in shifts in distribution.

Data Quality: 92% of the data quality scores were 2 or greater indicate that data quality is moderate.

Climate Effects on Abundance and Distribution: Growth of Ocean Quahog slows at higher temperatures (Hiebenthal et al., 2013) and since the species is long-lived, shell growth increments are used as a proxy for ocean temperatures (e.g., Wanamaler et al., 2009). Experiments suggest minimal effect of decreasing aragonite saturation (Hiebenthal et al., 2013) and increasing CO_2 levels (Stemmer et al., 2013) on growth. Thus increased warming, not ocean acidification, is likely to have the greatest impact on Ocean Quahog resulting from climate change.

Life History Synopsis**:** Ocean Quahog is a cold-water, long-lived, bivalve found on the continental shelf from Newfoundland to Cape Hatteras, North Carolina (Cargnelli et al., 1999). The mean age of maturity for this slow-growing species is 9-19 years, and they can live for over 200 years (Cargnelli et al., 1999; NEFSC, 2009). Ocean Quahog broadcast spawn over a protracted season from spring to fall (Cargnelli et al., 1999). Planktonic eggs mature into free-swimming trochophore larvae, which mature into shelled and swimming veliger larvae (Cargnelli et al., 1999). The final larval stage, the pediveliger stage, swims, but also has a foot for burrowing (Cargnelli et al., 1999). Temperature influences growth rates, with an optimal range from 13-15 ^{o}C (Cargnelli et al., 1999). Larvae consume phytoplankton (Cargnelli et al., 1999). Metamorphosis to the benthic juvenile stage occurs between 175-200 µm, and juvenile clams grow relatively quickly (Cargnelli et al., 1999). Juveniles occur in offshore sandy substrates, typically between 45-75 m depths in saline waters (Cargnelli et al., 1999). Adult quahogs occur in dense beds over level bottom just below the surface sediments in medium to fine grain sand (Cargnelli et al., 1999). Temperature regulates the cross-shelf distribution of the clam, with 6-16^{o} C optimal, and temperatures above 16^{o} C limit distribution (Cargnelli et al., 1999). The clams usually occur at depths between 25-61 m, and can survive anoxic conditions (Cargnelli et al., 1999). Adults and juveniles pump water from just above the substrate surface through their siphon and filter suspended phytoplankton, alternating between feeding and digestion periods (Cargnelli et al., 1999). Rock Crabs, sea stars, crustaceans, Longhorn Sculpin, Ocean Pout, Haddock, and Atlantic Cod are common predators (Cargnelli et al., 1999). The Mid-Atlantic Fishery Management Council manages Ocean Quahog through the Ocean Quahog and

Atlantic Surfclam Fishery Management Plan. The species is not overfished and overfishing is not occurring, but the population is in decline (NEFSC, 2009).

Literature Cited:

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