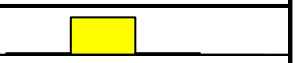
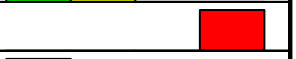
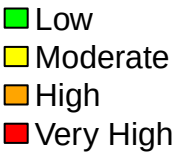
Atlantic Surfclam − *Spisula solidissima*

Overall Vulnerability Rank = High

Biological Sensitivity = High
Climate Exposure = High
Data Quality = 92% of scores ≥ 2

Spisula solidissima		Expert Scores	Data Quality	Expert Scores Plots (Portion by Category)
Sensitivity attributes	Stock Status	2.0	3.0	
	Other Stressors	2.0	2.4	
	Population Growth Rate	2.3	2.2	
	Spawning Cycle	2.3	2.8	
	Complexity in Reproduction	1.5	2.8	
	Early Life History Requirements	1.8	2.2	
	Sensitivity to Ocean Acidification	3.7	2.4	
	Prey Specialization	1.8	3.0	
	Habitat Specialization	1.2	3.0	
	Sensitivity to Temperature	1.9	3.0	
	Adult Mobility	3.8	3.0	
	Dispersal & Early Life History	2.0	2.8	
	Sensitivity Score	High		
Exposure variables	Sea Surface Temperature	3.9	3.0	
	Variability in Sea Surface Temperature	1.0	3.0	
	Salinity	2.1	3.0	
	Variability Salinity	1.2	3.0	
	Air Temperature	1.9	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	1.1	1.5	
	Exposure Score	High		
Overall Vulnerability Rank		High		



Atlantic Surfclam (*Spisula solidissima*)

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

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

Biological Sensitivity: **High**. Two sensitivity attributes scored above 3.0: Sensitivity to Ocean Acidification (3.7) and Adult Mobility (3.8). Atlantic Surfclams form calcium carbonate shell and adults are sessile.

Distributional Vulnerability Rank: **High** (67% certainty from bootstrap analysis).

Directional Effect in the Northeast U.S. Shelf: The effect of climate change on Atlantic Surfclam 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 Atlantic Surfclam. Warming may also further reduce habitat, which will reduce productivity and cause distributions to shift northwards and into deeper waters.

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

Climate Effects on Abundance and Distribution: Distribution of Atlantic Surfclams are affected by increasing temperature; mortality is higher at higher temperatures (Naráez et al., 2015) resulting in a shift in the distribution of the population (Weinberg, 2005). A southern congener (Raveneli's Surfclam) has been identified genetically from the Northeast U.S. Shelf suggesting a range expansion in recent decades. Fertilization success was not affected by a wide-range of temperature nor pH conditions (Clotteau and Dubé, 1993). While fertilization may not be affected, embryonic and larval development of molluscs in general are negatively impacted by ocean acidification (Gazeau et al., 2013).

Life History Synopsis**:** Atlantic Surfclam is a marine bivalve species that occurs from the Gulf of St. Lawrence to Cape Hatteras, North Carolina (Cargnelli et al., 1999). Size and age at maturity varies by region and ranges from 3 months after settlement and 5 mm off the coast of New Jersey to 4 years and 80-95 mm off Prince Edward Island, Canada (Cargnelli et al., 1999). Spawning occurs in summer and early fall in warm water, starting earlier inshore than offshore (Cargnelli et al., 1999). Gametes are broadcast into the water column. Surfclam eggs hatch into trochophore larvae within 1-2 days of fertilization (Cargnelli et al., 1999). The shell first appears on veliger larvae in 1-3 days, and after approximately 18 days, larvae develop into the pediveliger stage, which have a foot and can swim and burrow (Cargnelli et al., 1999). Larvae cannot survive high temperature and prefer higher salinities (Cargnelli et al., 1999). Settlement occurs approximately 3-4 weeks after fertilization. Juveniles and adults occur in coastal waters up to 66 m and do not tolerate low DO (Cargnelli et al., 1999). Offshore surfclams grow larger than individuals inshore (Cargnelli et al., 1999). Atlantic Surfclam is susceptible to a variety of parasites and predators. Parasites include *Sphenophyra dosinae*, *Myocheres major*, *Echeneribothrium* spp., *Paranisakiopsis pectinis*, *Urosporidium spisuli*. A number of species prey on recently settled Atlantic Surfclam including naticid snails, sea stars, Lady Crab, Jonah Crab, Horseshoe Crab, Haddock, Atlantic Cod, and Sevenspine Bay Shrimp (Cargnelli et al., 1999). Surfclams are planktivorous siphon feeders (Cargnelli et al., 1999). The Mid-Atlantic Fishery Management Council manages Atlantic Surfclams through the Atlantic Surfclam and Ocean Quahog Fishery Management Plan and the stock is neither overfished nor is overfishing occurring (NEFSC, 2013).

Literature Cited:

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