

Blueback Herring – *Alosa aestivalis*

Overall Vulnerability Rank = Very High ■

Biological Sensitivity = High ■

Climate Exposure = Very High ■

Data Quality = 88% of scores ≥ 2

<i>Alosa aestivalis</i>		Expert Scores	Data Quality	Expert Scores Plots (Portion by Category)	
Sensitivity attributes	Stock Status	2.7	1.2		
	Other Stressors	2.7	2.0		
	Population Growth Rate	2.3	2.0		
	Spawning Cycle	3.5	2.8		
	Complexity in Reproduction	3.2	3.0		
	Early Life History Requirements	3.3	2.5		
	Sensitivity to Ocean Acidification	1.5	2.2		
	Prey Specialization	1.8	3.0		
	Habitat Specialization	2.3	3.0		
	Sensitivity to Temperature	1.8	3.0		
	Adult Mobility	1.3	2.8		
	Dispersal & Early Life History	3.2	2.6		
	Sensitivity Score		High		
	Exposure variables	Sea Surface Temperature	4.0	3.0	
Variability in Sea Surface Temperature		1.0	3.0		
Salinity		1.8	3.0		
Variability Salinity		1.2	3.0		
Air Temperature		4.0	3.0		
Variability Air Temperature		1.0	3.0		
Precipitation		1.3	3.0		
Variability in Precipitation		1.4	3.0		
Ocean Acidification		4.0	2.0		
Variability in Ocean Acidification		1.0	2.2		
Currents		2.0	1.0		
Sea Level Rise		2.6	1.5		
Exposure Score		Very High			
Overall Vulnerability Rank		Very High			

Blueback Herring (*Alosa aestivalis*)

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

Climate Exposure: **Very High.** Three exposure factors contributed to this score: Ocean Surface Temperature (4.0), Ocean Acidification (4.0) and Air Temperature (4.0). Blueback Herring are anadromous, spawning in freshwater, developing in freshwater and estuarine habitats, feeding as adults in marine habitats.

Biological Sensitivity: **High.** Four sensitivity attributes scored above 3.0: Spawning Cycle (3.5), Early Life History Requirements (3.3), Complexity in Reproduction (3.2), and Dispersal and Early Life History. Blueback Herring spawning time varies latitudinally and is linked to spring warming. Eggs and larvae inhabit freshwaters and then juveniles move to estuarine and ocean waters. Dispersal of eggs and larvae is limited.

Distributional Vulnerability Rank: **Medium** (73% certainty from bootstrap analysis). Blueback Herring have a relatively high degree of spawning site fidelity, limiting the ability of the species to shift distribution. However, migrations occur over a wide range (from Northeast U.S. Shelf to Florida) providing more opportunity for straying from natal spawning sites.

Directional Effect in the Northeast U.S. Shelf: The effect of climate change on Blueback Herring is estimated to be neutral, but this estimate has a high degree of uncertainty (<66% certainty in expert scores). Blueback Herring is distributed to Florida, so northward range shifts will likely move Blueback Herring into the Northeast U.S. Shelf. However, changes in rivers from increased precipitation and warming may cause decreases in productivity particularly in the southern portion of the Northeast U.S. shelf. The magnitude of these contrasting effects is unknown. The effect of ocean acidification over the next 30 years is likely to be minimal.

Data Quality: 88% of the data quality scores were 2 or greater indicate that data quality is moderate.

Climate Effects on Abundance and Distribution: Blueback Herring productivity and distribution are susceptible to climate change. Tommasi et al. (2015) indicated that recruitment was affected by stream temperatures and river flow, both of which will be impacted by climate change. However, the effects of the environment on recruitment were less for Blueback Herring compared to Alewife. A number of other components of Alewife physiology and ecology are affected by temperature (Loesch and Lund, 1977) and other climate factors such as changes in streamflow and sea-level rise may also affect Alewife (NMFS, 2012). Lynch et al. (2014) developed projections of the change in the distribution of thermal habitat. However, natal homing is an important element in Blueback Herring life history, thus the marine distribution may be changing faster than the spawning distribution.

Life History Synopsis: Blueback Herring is an anadromous, schooling, coastal pelagic species found in the northwest Atlantic from Cape Breton, Nova Scotia, to the St. Johns River, Florida (Munroe, 2002). Adults reach maturity between ages 3-6 years and females live longer than males (Munroe, 2002). The timing of the spawning season is determined by temperature (peaking when temperatures are 21-25°C), but generally occurs in spring through summer (Munroe, 2002). Blueback Herring make extensive migrations to return to natal streams and prefer areas with swiftly moving fresh or brackish water for spawning (Munroe, 2002). Eggs and sperm are broadcast over the substrate (Munroe, 2002). Eggs scatter to the bottom and adhere to twigs, gravel, or aquatic vegetation till they harden (Munroe, 2002). Spent adults

leave shortly after spawning to return to the sea, but approximately a third of the population is repeat spawners (Munroe, 2002). This proportion of repeat spawners may be decreasing in recent years for many rivers (NMFS, 2013). Once the eggs harden, they become pelagic or semi-pelagic (Munroe, 2002). Incubation takes 3-4 days and yolk absorption takes another 3-4 days post hatch (Munroe, 2002). During this first week, the eggs and early larvae are passively transported downstream to nursery areas with slower moving water (Munroe, 2002). First feeding larvae consume rotifers with increasing consumption of cladocerans as they grow (Munroe, 2002). Transformation to the juvenile stage is usually complete within a month (Munroe, 2002). Eggs, larvae, and juveniles can tolerate salinities of 28, so juvenile nursery habitat occurs in both freshwater and semi-brackish waters (Munroe, 2002; NMFS, 2013). The diet of juveniles mostly contains copepods and cladocerans from the water column, but occasional benthic prey is also consumed (Munroe, 2002). Many predators consume juvenile Blueback Herring, including: American Eel, Yellow Perch, White Perch, turtles, snakes, birds, and mink (Munroe, 2002). Adult herring occur north of 40 degrees in water <13 °C during summer and fall and between 40-43 degrees during winter (Munroe, 2002). During spring, the distribution expands to include the continental shelf from Cape Hatteras, North Carolina, to Nova Scotia as the Blueback Herring return to natal streams for spawning (Munroe, 2002). Adult and juvenile Blueback Herring make diel migrations to the upper water column at night and down in the water column during the day (Munroe, 2002). There are also landlocked populations in freshwater lakes that are likely the result of stocking and dams blocking the juvenile egress. These populations are genetically distinct from the anadromous population (NMFS, 2013). Adult herring are planktivorous and primarily consume ctenophores, calanoid copepods, amphipods, mysids, pelagic shrimps, and small fishes at sea (Munroe, 2002). During the spawning migration up river, herring consume planktonic organisms and terrestrial insects (Munroe, 2002). Blueback Herring are preyed upon by a variety of predators such as Spiny Dogfish, American Eel, Atlantic Cod, Silver Hake, White Hake, Atlantic Halibut, Bluefish, Weakfish, Striped Bass, seals, gulls, and terns (Munroe, 2002). River herring, which includes Alewife, was once an important fishery, but most stocks are either depleted or of unknown status due to a lack of time-series data (ASMFC, 2012). A 2011 petition to have river herring listed as endangered was determined to be unwarranted at the time of review (NMFS, 2013).

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