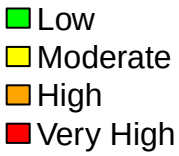
Bluefish − *Pomatomus saltatrix*

Overall Vulnerability Rank = Low

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

	Pomatomus saltatrix	Expert Scores	Data Quality	Expert Scores Plots (Portion by Category)
Sensitivity attributes	Stock Status	2.0	3.0	
	Other Stressors	2.2	2.4	
	Population Growth Rate	1.9	2.8	
	Spawning Cycle	2.0	3.0	
	Complexity in Reproduction	1.7	2.6	
	Early Life History Requirements	2.7	2.7	
	Sensitivity to Ocean Acidification	1.2	2.4	
	Prey Specialization	1.1	3.0	
	Habitat Specialization	1.9	3.0	
	Sensitivity to Temperature	1.1	3.0	
	Adult Mobility	1.1	2.8	
	Dispersal & Early Life History	1.4	2.7	
	Sensitivity Score	Low		
Exposure variables	Sea Surface Temperature	4.0	3.0	
	Variability in Sea Surface Temperature	1.0	3.0	
	Salinity	2.5	3.0	
	Variability Salinity	1.2	3.0	
	Air Temperature	2.1	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	1.5	1.5	
	Exposure Score	High		
Overall Vulnerability Rank		Low		



Bluefish (*Pomatomus saltatrix*)

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

Climate Exposure: **High**. Two exposure factors contributed to this score: Ocean Surface Temperature (4.0) and Ocean Acidification (4.0). Exposure to ocean surface temperature and ocean acidification occurs during all life stages.

Biological Sensitivity: **Low**. Only one sensitivity attribute scored above 2.5: Early Life History Requirements (2.7). Bluefish spawn in waters of defined temperatures and spawning shifts from south to north to south through the seasonal cycle (Wuenschel et al., 2012).

Distributional Vulnerability Rank: **High** (81% certainty from bootstrap analysis). Three of the attributes indicated vulnerability to distribution shift. Bluefish are pelagic and habitat generalists. They are highly mobile and make large seasonal migrations, and larvae disperse over large areas.

Directional Effect in the Northeast U.S. Shelf: The effect of climate change on Bluefish on the Northeast U.S. Shelf is very likely to be positive (>95% certainty in expert scores). As warming continues more habitat in the Northeast U.S. is expected to become available and seasonal movements and spawning may extend into the Gulf of Maine. The effect of ocean acidification over the next 30 years is likely to be minimal.

Data Quality: 92% of the data quality scores were 2 or greater.

Climate Effects on Abundance and Distribution: Few studies examined the effect of climate factors on the population productivity of Bluefish. Changes in distribution, however, have been documented. In the Mediterranean, changes in Bluefish distribution have been linked to warming waters, and changes in spawning locations have been identified (Sabatés et al., 2012). Along the Northeast U.S. Shelf, changes in distribution have not be documented, but an extension of the spawning season into the early fall has been observed (Walsh et al., 2015).

Life History Synopsis**:** Bluefish is a migratory, coastal, warm-temperate species found from Nova Scotia to Argentina, but rare from southern Florida to northern South America (Shepherd and Packer, 2006). Adults reach maturity by age 2 (Shepherd and Packer, 2006). There is most likely one spawning stock with two or three peaks in spawning. Spawning begins in late spring south of Cape Hatteras, North Carolina, with a peak in March-May near the continental shelf edge (Hare and Cowen, 1996). A second peak on the continental shelf of the Mid-Atlantic region occurs from June - August (Shepherd and Packer, 2006). There is also evidence of a small, third peak in fall off the southeast US coast in September to January (McBride et al., 1993). Pelagic eggs hatch within 2 days at 18-22 ^{o}C (Shepherd and Packer, 2006). Larvae are pelagic and associated with the upper 15 m of the water column and concentrated just below the surface (Shepherd and Packer, 2006). The spring-spawned cohort occurs near the Gulf Stream and is probably advected north in the current (Hare and Cowen, 1996); the summer-spawned cohort occurs in the mid-Atlantic region (Shepherd and Packer, 2006). Larvae prey on copepods (Shepherd and Packer, 2006). After 2-4 weeks, larvae transition into pelagic juveniles, remain associated with the surface waters, and spend spring and summer offshore (Shepherd and Packer, 2006). Pelagic juveniles begin including fish in their diet at 30 mm and are almost exclusively piscivorous by 40 mm (Shepherd and Packer, 2006). When the water temperature rises above 13-15 ^{o}C, pelagic juveniles actively move into estuaries and coastal nurseries (Shepherd and Packer, 2006). The northern

transport of eggs and larvae and the cross-shelf migration of juveniles are aided by oceanographic features such as the Gulf Stream, wind-driven surface flow, warm-core ring streamers, and Gulf Stream filaments (Shepherd and Packer, 2006). Juvenile Bluefish use soft substrates and occasionally grass, algae, or oyster beds in estuaries, bays, and coastal areas as nurseries. The spring-spawned cohort recruits to estuarine habitats in the mid-Atlantic in late May to mid-June or 2-3 months after spawning (Shepherd and Packer, 2006). Individuals from the summer-spawned cohort enter estuaries or stay in coastal nursery areas in mid to late August, or 1-2 months after spawning (Shepherd and Packer, 2006). Young Bluefish are prey to oceanic birds and rarely cannibalism (Shepherd and Packer, 2006). Both cohorts leave mid-Atlantic estuaries and coastal areas in October to overwinter in warmer waters south of Cape Hatteras, North Carolina (Shepherd and Packer, 2006). Adult Bluefish move north into the mid-Atlantic region during spring and summer (Shepherd and Packer, 2006). Bluefish prefer oceanic salinities and warmer temperatures of the open-ocean, large-embayment, and estuarine systems, and travel in schools of similarly sized individuals (Shepherd and Packer, 2006). Late juveniles and adults eat locally abundant fish and benthic invertebrates, targeting schooling species such as squids, clupeids, and Butterfish while offshore (Shepherd and Packer, 2006). Sharks, tunas, and billfishes are the only predators large and fast enough to prey on adult Bluefish (Shepherd and Packer, 2006). Bluefish is jointly managed by the Atlantic States Marine Fisheries Commission and the Mid-Atlantic Fishery Management Council as a single stock (ASMFC, 2012). The stock has rebuilt over the last 20 years and is neither overfished nor experiencing overfishing (ASMFC, 2012; NEFSC, 2012).

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