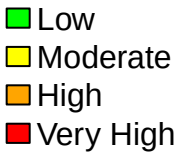
Atlantic Sturgeon − *Acipenser oxyrinchus*

Overall Vulnerability Rank = Very High

Biological Sensitivity = High
Climate Exposure = Very High
Data Quality = 88% of scores ≥ 2

	Acipenser oxyrinchus	Expert Scores	Data Quality	Expert Scores Plots (Portion by Category)
Sensitivity attributes	Stock Status	3.5	1.8	
	Other Stressors	2.9	2.6	
	Population Growth Rate	3.9	2.4	
	Spawning Cycle	2.6	2.8	
	Complexity in Reproduction	2.8	2.4	
	Early Life History Requirements	2.2	2.2	
	Sensitivity to Ocean Acidification	1.6	2.0	
	Prey Specialization	1.4	3.0	
	Habitat Specialization	3.1	3.0	
	Sensitivity to Temperature	1.7	2.8	
	Adult Mobility	1.2	2.9	
	Dispersal & Early Life History	3.0	3.0	
	Sensitivity Score	High		
Exposure variables	Sea Surface Temperature	4.0	3.0	
	Variability in Sea Surface Temperature	1.0	3.0	
	Salinity	2.1	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	2.7	1.5	
	Exposure Score	Very High		
	Overall Vulnerability Rank	Very High		



Atlantic Sturgeon (*Acipenser oxyrhynchus*)

Overall Climate Vulnerability Rank: **Very High** (99% 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). Atlantic Sturgeon are anadromous, spawning in freshwater, developing in freshwater and estuarine habitats, and feeding as adults in freshwater, estuarine, and marine habitats.

Biological Sensitivity: **High**. Four sensitivity attributes scored above 3.0: Population Growth Rate (3.9), Stock Status (3.5), Habitat Specialization (3.1), and Dispersal and Early Life History (3.0). Shortnose Sturgeon was listed as Endangered under the Endangered Species Act in 2009 (ASSRT, 2010) and are long-lived and slow growing (Musick, 2002). Spawning occurs in specific habitats in the spring and individuals spawn every 1-5 years. Eggs are benthic and relatively large, hatched larvae are relatively well-developed, and larval dispersal is minimal.

Distributional Vulnerability Rank: **Low** (100% certainty from bootstrap analysis). Atlantic Sturgeon are relatively invulnerable to distribution shifts. Spawning occurs in freshwater (Able and Fahay, 2010) and genetic studies indicate a high level of separation between river system (Grunwald et al., 2008). Adults do move into marine habitats (10-50 m) for feeding creating the possibility for movement among river systems (Stein et al., 2004). Climate projections based on a habitat model of a con-specific European Atlantic Sturgeon (*Acipenser sturio).*

Directional Effect in the Northeast U.S. Shelf: The effect of climate change on Atlantic Sturgeon is estimated to be negative, but this estimate has a high degree of uncertainty (<66% certainty in expert scores). Most climate factors have the potential to decrease productivity (sea level rise; reduced dissolved oxygen, increased temperatures). However, understanding the magnitude and interaction of different effects is difficult. 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: Numerous studies indicate that Atlantic Sturgeon will be impacted by climate change. Secor and Gunderson (1998) found that juvenile metabolism and survival were impacted by increasing hypoxia in combination with increasing temperature. Niklitschek and Secor (2005) used a multivariable bioenergetics and survival model to generate spatially explicit maps of potential production in the Chesapeake Bay; a 1^{o}C temperature increase reduced productivity by 65% (Niklitschek and Secor, 2005). Habitat models coupled with global climate models for the cogener, European Atlantic Sturgeon (*Acipenser sturio*) indicate strong climate effects throughout the range, especially in the southern portions (Lassalle et al., 2010).

Life History Synopsis**:** Atlantic Sturgeon is a long-lived, anadromous species found from Labrador to northern Florida associated with most large river estuarine systems and surrounding coastal waters (Able and Fahay, 2010). Males reach maturity at 9-24 years, and females mature at 10-30 years, maturing at younger ages in the warm south than the cool north (Musick, 2002; Able and Fahay, 2010). Older, larger females produce substantially more eggs than younger females (Able and Fahay, 2010). Individuals do not spawn every year, with 1-5 years between spawning events (Able and Fahay, 2010). Spawning occurs during winter-spring in the south and spring-summer in northern areas after returning

to natal rivers (Able and Fahay, 2010). Spawning occurs in freshwater with a strong current, at least 3 m deep, and over rubble bottom (Able and Fahay, 2010). Eggs are darkly pigmented, demersal, and adhere to structure and vegetation (Able and Fahay, 2010). Eggs hatch within a week of spawning, and early larvae are large, photonegative, and hide in crevices of nearby structure (Musick, 2002; Able and Fahay, 2010). Larvae rely on yolk for 6-12 days, and remain in freshwater near the spawning site for at least a few months; larvae do not tolerate even low salinities (Able and Fahay, 2010; ASMFC, 2012). At sizes between 31.5 mm and 136 mm, late larvae and early juveniles become photopositive and migrate downstream to nursery areas, slowly becoming more tolerant of saline water (Musick, 2002; Able and Fahay, 2010; ASMFC, 2012). Juveniles remain in freshwater and estuaries for several years before heading to sea (Able and Fahay, 2010; ASMFC, 2012). Once juveniles have left the estuary, they mature to adulthood in coastal waters and may make seasonal along-shelf migrations south in fall and winter, then north in spring and summer (Musick, 2002). Juvenile Atlantic Sturgeon consume aquatic insects, amphipods, isopods, molluscs, polychaete and oligochaete worms in fresh and brackish waters and may cease feeding during summer (Able and Fahay, 2010). Adult Atlantic Sturgeon are found in coastal and estuarine waters during fall and winter (Able and Fahay, 2010). Spawning adults migrate to freshwater in spring when water temperatures rise; however, a small portion of the population may migrate to spawning areas during the previous fall (Able and Fahay, 2010). Males arrive at spawning sites and stay in the river or lower estuary till fall before migrating, but females migrate out of spawning areas after 4-6 weeks (Able and Fahay, 2010). Atlantic Sturgeon are opportunistic benthivores, consuming insect larvae, polychaetes, isopods, decapod crustaceans, amphipods, gastropods, bivalves, and small fishes (Musick, 2002; Able and Fahay, 2010). Little is know about predators of the Atlantic Sturgeon. The Atlantic States Marine Fisheries Commission manages the species and has placed a moratorium on fishing until 2038 (ASMFC, 2006). In 2012 the Gulf of Maine population was listed as a threatened species and the remaining four Atlantic populations were listed as endangered under the Endangered Species Act (NMFS, 2012a, b).

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