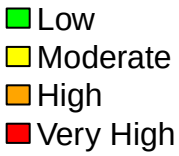
Red Drum − *Sciaenops ocellatus*

Overall Vulnerability Rank = High

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

	Sciaenops ocellatus	Expert Scores	Data Quality	Expert Scores Plots (Portion by Category)
Sensitivity attributes	Stock Status	2.1	1.6	
	Other Stressors	2.4	2.8	
	Population Growth Rate	2.9	3.0	
	Spawning Cycle	2.6	3.0	
	Complexity in Reproduction	1.5	2.8	
	Early Life History Requirements	2.8	2.5	
	Sensitivity to Ocean Acidification	1.8	3.0	
	Prey Specialization	1.4	3.0	
	Habitat Specialization	2.0	3.0	
	Sensitivity to Temperature	1.5	2.8	
	Adult Mobility	1.6	2.6	
	Dispersal & Early Life History	2.2	2.6	
	Sensitivity Score	Moderate		
Exposure variables	Sea Surface Temperature	4.0	3.0	
	Variability in Sea Surface Temperature	1.0	3.0	
	Salinity	2.8	3.0	
	Variability Salinity	1.2	3.0	
	Air Temperature	4.0	3.0	
	Variability Air Temperature	1.0	3.0	
	Precipitation	1.2	3.0	
	Variability in Precipitation	1.3	3.0	
	Ocean Acidification	4.0	2.0	
	Variability in Ocean Acidification	1.0	2.2	
	Currents	2.0	1.0	
	Sea Level Rise	3.3	1.5	
	Exposure Score	Very High		
Overall Vulnerability Rank		High		



Red Drum (*Sciaenops ocellatus*)

Overall Climate Vulnerability Rank: **High** (48% 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). Exposure to all three factors occur during all life stages. Red Drum spend most of their life cycle in coastal waters.

Biological Sensitivity: **Moderate**. Three sensitivity attributes scored above 2.5: Population Growth Rate (2.9), Spawning Cycle (2.6), and Early Life History Requirements (2.8). Red Drum are long-lived and relatively slow growing for a sciaenid. They spawn in late-summer and early-autumn in coastal areas including inlets. Early Life Stages remain in coastal areas and are rarely observed in shelf waters. Juveniles use structured habitats in coastal and estuarine waters.

Distributional Vulnerability Rank: **Moderate** (42% certainty from bootstrap analysis). Only one attribute indicated vulnerability to distribution shift. Red Drum are capable of moving long distances and make seasonal migrations in colder portions of their range.

Directional Effect in the Northeast U.S. Shelf: The effect of climate change on Red Drum on the Northeast U.S. Shelf is estimated to be positive, but this estimate is uncertain (<66% certainty in expert scores). Overwinter mortality may be an important component of the population dynamics and warming winters would increase recruitment. The species is more common in the south and thus there is the expectation that as warming occurs more areas on the Northeast U.S. shelf will be thermally suitable. 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.

Climate Effects on Abundance and Distribution: The productivity of Red Drum is likely related to climate. In laboratory experiments, Anderson and Scharf (2012) indicated that severe winters may cause high mortality of young-of-year Red Drum independent of body size, whereas smaller young-of-the-year are more susceptible to mortality during moderate winters. The over-winter mortality hypothesis for Red Drum is very similar to that for Atlantic Croaker (Hare and Able, 2007). Rooker et al. (1998) found that predation on young-of-the-year Red Drum was lower in vegetated compared to non-vegetated habitats suggesting potential susceptibility to sea-level rise and loss of vegetated habitats in estuaries and coastal areas. Little work has been done examining potential climate effects on Red Drum distribution.

Life History Synopsis**:** Red Drum is a large, long-lived, oligohaline, coastal and estuarine fish species found historically from Long Island, New York to the western Gulf of Mexico, but rare north of Chesapeake Bay in recent years (Able and Fahay, 2010). Males mature earlier, at 1-3 years, than females, at 3-6 years (ASMFC, 2013). Spawning occurs in near-shore and high-salinity estuarine areas such as along beaches, near the mouths of estuaries, and at the mouth of large embayments during summer-fall as temperatures drop (Able and Fahay, 2010; ASMFC, 2013). Eggs and larvae are pelagic in near-shore and bay-mouth areas, but rarely collected in shelf waters (Able and Fahay, 2010). After about 3 weeks, larvae settle to lower salinity nursery areas of the upper estuary where they transform into the juvenile stage around 10 mm standard length (Able and Fahay, 2010; ASMFC, 2013). Juveniles become increasingly tolerant of freshwater as they grow and can occur in a wide range of salinities from tidal freshwater to coastal marine water. They generally reside in estuarine water over mud, sand, and oyster bars (Able and Fahay, 2010; ASMFC, 2013). Juveniles in the northern population may migrate to

deeper water during winter and move to coastal water incrementally from age 1-3 years (ASMFC, 2013). Juveniles are predators of zooplankton, particularly amphipods and mysids (Able and Fahay, 2010). Adult Red Drum can tolerate a wide range of salinities from freshwater to the high salinities of the Gulf of Mexico, but generally occur in high-salinity surf zones and on natural and artificial reefs and structure (ASMFC, 2013). The northern population (North Carolina to New Jersey) makes seasonal migrations from the North Carolina shelf in winter to estuaries from North Carolina to Chesapeake Bay in late spring to early fall (historically going as far north as Massachusetts; Able and Fahay, 2010; ASMFC, 2013). The southern (South Carolina to Florida) population makes cross-shelf seasonal migrations to deeper shelf water in the winter and estuaries in the summer (ASMFC, 2013). The adult diet becomes increasingly dependent on large crustaceans and small fishes with growth, and the largest Red Drum rely almost exclusively on crustaceans (Able and Fahay, 2010). There are few known predators on adults, but the bottlenose dolphin has been known to eat Red Drum (Able and Fahay, 2010). The population dynamics and habitat use of adults has been poorly studied, making management difficult. The Atlantic States Marine Fisheries Commission manages Red Drum as two Atlantic stocks (northern: New Jersey to North Carolina; southern: South Carolina to Florida). Based on the 2009 stock assessment, neither population is believed to be undergoing overfishing, but stock status could not be reliably determined due to the high degree of uncertainty in the assessment (SEDAR, 2009).

Literature Cited:

Able KW, Fahay MP. Ecology of estuarine fishes: temperate waters of the western North Atlantic. Baltimore: The Johns Hopkins University Press; 2010. 566p.

Anderson DA, Scharf FS. The effect of variable winter severity on size-dependent overwinter mortality caused by acute thermal stress in juvenile red drum (Sciaenops ocellatus). ICES J Mar Sci. 2013; fst041. doi: 10.1093/icesjms/fst041

Atlantic States Marine Fisheries Commission (ASMFC). 2013. Addendum I to Amendment 2 to the Red Drum fishery management plan: habitat needs and concerns. Accessed online (May 2015): http://www.asmfc.org/species/red-drum

Hare JA, Able KW. Mechanistic links between climate and fisheries along the east coast of the United States: explaining population outbursts of Atlantic croaker (Micropogonias undulatus). Fisheries Oceanography, 2007; 16(1): 31-45. doi: 10.1111/j.1365-2419.2006.00407.x

Rooker JR, Holt GJ, Holt SA. Vulnerability of newly settled red drum (Sciaenops ocellatus) to predatory fish: is early-life survival enhanced by seagrass meadows? Mar Biol. 1998; 131(1): 145-151. doi: 10.1007/s002270050305

Southeast Data, Assessment, and Review (SEDAR). 2009. SEDAR 18 Atlantic Red Drum Stock Assessment Report. Accessed online (May 2015): http://sedarweb.org/sedar-18