Yellowtail Flounder − *Limanda ferruginea*

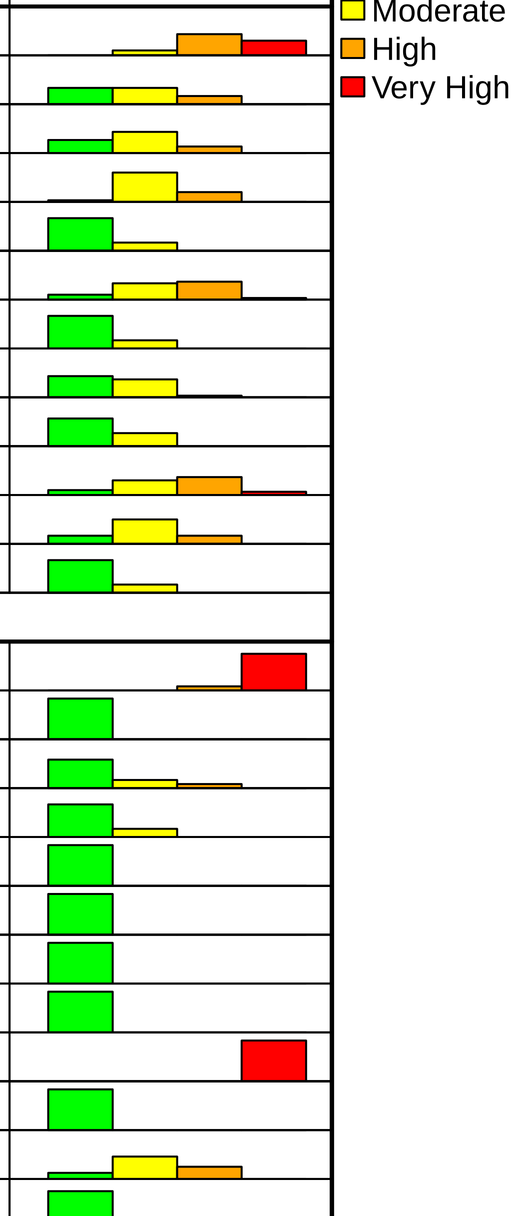
Overall Vulnerability Rank = Low

Biological Sensitivity = Low

Climate Exposure = High

Data Quality = 88% of scores ≥ 2

	Limanda ferruginea	Expert Scores	Data Quality	Expert Scores Plots (Portion by Category)
Sensitivity attributes	Stock Status	3.2	2.6	
	Other Stressors	1.8	1.8	
	Population Growth Rate	1.8	2.8	
	Spawning Cycle	2.2	3.0	
	Complexity in Reproduction	1.2	2.4	
	Early Life History Requirements	2.4	2.6	
	Sensitivity to Ocean Acidification	1.2	2.2	
	Prey Specialization	1.5	2.8	
	Habitat Specialization	1.3	3.0	
	Sensitivity to Temperature	2.5	2.8	
	Adult Mobility	2.0	2.8	
	Dispersal & Early Life History	1.2	3.0	
	Sensitivity Score	Low		
Exposure variables	Sea Surface Temperature	3.9	3.0	
	Variability in Sea Surface Temperature	1.0	3.0	
	Salinity	1.4	3.0	
	Variability Salinity	1.2	3.0	
	Air Temperature	1.0	3.0	
	Variability Air Temperature	1.0	3.0	
	Precipitation	1.0	3.0	
	Variability in Precipitation	1.0	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		Low		



Yellowtail Flounder (*Limanda ferruginea*)

Overall Climate Vulnerability Rank: **Low** (41% certainty from bootstrap analysis).

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

Biological Sensitivity: **Low**. Only one sensitivity attributes scored above 2.5: Stock Status (3.2). One attribute above 2.5 is scored as a Low sensitivity.

Distributional Vulnerability Rank: **High** (100% certainty from bootstrap analysis). Yellowtail Flounder are habitat generalists, moderately mobile and have dispersive early life stages (Johnson et al., 1999).

Directional Effect in the Northeast U.S. Shelf: The effect of climate change on Yellowtail Flounder on the Northeast U.S. Shelf is very likely to be negative (>95% certainty in expert scores). Recruitment of the southern stock has decreased and this has been linked to warming. The species has also shifted northward in recent years as temperatures have warmed. Decreasing productivity and northward shifts will lead to negative consequences for Yellowtail Flounder in the coming years.

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

Climate Effects on Abundance and Distribution: Yellowtail Flounder recruitment success has been linked to ocean temperatures (Sissenwine, 1974) and more specifically to the volume of the cold pool, an area of winter water on the bottom of the Mid-Atlantic Bight during summer (Sullivan et al., 2005). Continued warming in the Mid-Atlantic will likely reduce population productivity further. The distribution of Yellowtail Flounder is related to temperature (Murawski, 1993) and the population has shifted northward in recent years (Nye et al., 2009). These study indicate a clear negative effect of climate change on Yellowtail Flounder in the Northeast U.S. Shelf ecosystem.

Life History Synopsis**:** Yellowtail Flounder are a benthic marine flatfish found from the Gulf of St. Lawrence, Labrador, and Newfoundland to the Chesapeake Bay (Johnson et al., 1999; Klein-MacPhee, 2002). Like many flatfish, yellowtail is sexually dimorphic, with larger, older females (Klein-MacPhee, 2002). Yellowtail grow faster and matures earlier than most other western Atlantic flatfish, with most females mature by their third year (Johnson et al., 1999; NEFSC, 2008). Spawning occurs from mid-February to July along the continental shelf, beginning in the southern part of the range and quickly expanding northward (Klein-MacPhee, 2002). Females batch spawn over the course of a month, depositing eggs on the bottom for fertilization (Klein-MacPhee, 2002; NESFC, 2012b). After fertilization, eggs float near the surface, and hatch into pelagic larvae after about a week (Johnson et al., 1999). Larvae occur near the surface at night and down to 20 m during the day, with larger larvae making longer migrations (Klein-MacPhee, 2002). Most larvae are collected inside the 100 m isobath in 5-17 °C water (Johnson et al., 1999). Atlantic Mackerel eat larval yellowtail, especially when copepod nauplii abundances are low (Klein-MacPhee, 2002). After approximately 2-3 months as pelagic larvae (Johnson et al., 1999; NEFSC, 2012b), 11-16 mm fish settle to mid-shelf bottom habitats, using temperature (4-8 °C) and depth (41-70 m) to determine suitable habitat (Johnson et al., 1999; Klein-MacPhee, 2002). Juvenile abundance is higher in the mid-Atlantic cold pool, initially settling in shallower water, but moving to deeper water during the months after settlement (Klein-MacPhee, 2002). Juveniles eat small benthic invertebrates such as polychaetes (Johnson et al., 1999). Adults prefer offshore sand or mixed sand and mud substrate in cool to intermediate temperature, high salinity water (Klein-MacPhee, 2002), but are also found in some rivers, bays, and harbors (Johnson et al., 1999). There are three distinct stocks in United States waters, with little mixing among regions, except for short migrations east in spring and summer, west in fall and winter by Southern New England and Georges Bank stocks (Johnson et al., 1999; Klein-MacPhee, 2002). Amphipods and polychaetes are the main prey of Yellowtail Flounder, with occasional consumption of other benthic invertebrates and small fish (Johnson et al., 1999; Klein-MacPhee, 2002). Predators include Spiny Dogfish, Atlantic Cod, several skate species, and several other benthic piscivores (Johnson et al., 1999; Klein-MacPhee, 2002). Yellowtail Flounder has been exploited since the 1930's, with wide swings in abundance since the 1970's (Johnson et al., 1999). The New England Fishery Management Council manages the species as three stocks under the Northeast Multispecies Fishery Management Plan: Cape Cod-Gulf of Maine, Georges Bank, and Southern New England-Mid Atlantic (NESFC, 2008). The Cape Cod-Gulf of Maine and Georges Bank stocks are overfished and overfishing is occurring (NEFSC, 2008; NEFSC, 2012a). The Southern New England-Mid Atlantic stock is considered rebuilt , although biomass stock status is uncertain , but not experiencing overfishing (NEFSC, 2012b).

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