

# Atlantic Halibut – *Hippoglossus hippoglossus*

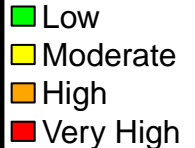
Overall Vulnerability Rank = High ■

Biological Sensitivity = High ■

Climate Exposure = High ■

Data Quality = 83% of scores  $\geq 2$

<i>Hippoglossus hippoglossus</i>		Expert Scores	Data Quality	Expert Scores Plots (Portion by Category)
Sensitivity attributes	Stock Status	4.0	3.0	
	Other Stressors	1.9	1.5	
	Population Growth Rate	3.9	2.5	
	Spawning Cycle	2.0	2.5	
	Complexity in Reproduction	1.4	2.4	
	Early Life History Requirements	2.1	1.6	
	Sensitivity to Ocean Acidification	1.5	2.0	
	Prey Specialization	1.0	3.0	
	Habitat Specialization	1.2	2.8	
	Sensitivity to Temperature	2.1	3.0	
	Adult Mobility	1.9	2.3	
	Dispersal & Early Life History	1.3	2.2	
	<b>Sensitivity Score</b>	<b>High</b>		
	Exposure variables	Sea Surface Temperature	3.9	3.0
Variability in Sea Surface Temperature		1.0	3.0	
Salinity		1.1	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	
<b>Exposure Score</b>		<b>High</b>		
<b>Overall Vulnerability Rank</b>		<b>High</b>		



## **Atlantic Halibut (*Hippoglossus hippoglossus*)**

Overall Climate Vulnerability Rank: **High** (100% 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 Atlantic Halibut use marine habitats.

Biological Sensitivity: **High**. Two sensitivity attributes scored above 3.0: Stock Status (4.0) and Population Growth Rate (3.9). Atlantic Halibut are overfished but overfishing is not occurring (Blaylock and Legault, 2012). Atlantic Halibut are slow-growing, late maturing (6-8 years) and long-lived (50 years, Cargnelli et al., 1999).

Distributional Vulnerability Rank: **High** (100% certainty from bootstrap analysis). Atlantic Halibut are habitat generalists, highly mobile and have dispersive early life stages.

Directional Effect in the Northeast U.S. Shelf: The effect of climate change on Atlantic Halibut on the Northeast U.S. Shelf is very likely to be negative (>95% certainty in expert scores). Atlantic Halibut is a cold water species and warming could cause distribution shifts out of the region. Productivity may also be negatively affected by warming and ocean acidification.

Data Quality: 83% of the data quality scores were 2 or greater indicate that data quality is moderate.

Climate Effects on Abundance and Distribution: Atlantic Halibut growth is sensitive to temperature and optimal temperature for growth decreased with increasing fish size (Björnsson and Tryggvadóttir, 1996). Long-term exposure to CO<sub>2</sub>-acidified seawater also reduced growth. Thus, with changing climatic conditions, Atlantic Halibut growth and population productivity would be expected to decrease in the Northeast U.S. Shelf Ecosystem. Nye et al. (2009) found Atlantic Halibut distributions shifting northward in recent years.

Life History Synopsis: Atlantic Halibut is a long-lived, slow-growing, benthic, marine, flatfish species found on both sides of the Atlantic Ocean, and ranges from Labrador to Long Island, New York, in the western Atlantic (Cargnelli et al., 1999; Klein-MacPhee, 2002). Sexual dimorphism in the species results in larger, older females (Cargnelli et al., 1999). Males mature at approximately 6 years old and females at approximately 7-8 years old (Sigourney et al., 2006). Spawning occurs on offshore banks and the shelf slope in late winter – spring (although some individuals spawn into summer; Cargnelli et al., 1999; Klein-MacPhee, 2002). Atlantic Halibut are annual, group-synchronous, batch spawners over hard sand, clay, or gravel bottom in 4-7 °C water (Cargnelli et al., 1999; Klein-MacPhee, 2002). Eggs are large and, most likely, bathy-pelagic (50-200 m), but sink with development to near the sea floor (Klein-MacPhee, 2002). Eggs incubate for 2 to 3 weeks, but the timing is temperature dependent (Cargnelli et al., 1999). Larvae are pelagic and prefer salinities of 30-34 (Cargnelli et al., 1999). Larvae are rare, resulting in limited information about larval duration, but development is slow. Atlantic Halibut larvae may stay in the water column for up to a year before fully metamorphosing and settling to the bottom (Cargnelli et al., 1999; Klein-MacPhee, 2002). Juvenile Atlantic Halibut mature in two phases. Early juveniles settle to nursery grounds with sandy substrate at 20-60 m depth (Cargnelli et al., 1999; Klein-MacPhee, 2002). At 3-4 years old, Atlantic Halibut emigrates out of the nursery and begins a dispersive phase, migrating longer distances than adults and occasionally moving among regions (Cargnelli et al., 1999; Klein-MacPhee, 2002). Adult Atlantic Halibut are widely dispersed on the shelf (25-700 m) in sand, gravel or clay substrates (Cargnelli et al., 1999; Klein-MacPhee, 2002). Atlantic Halibut move inshore from deep

winter habitat in the spring, probably in response to food availability and regulated by the presence of suitably cool temperatures (Klein-MacPhee, 2002). Diet changes ontogenetically; fish <30 cm eat mainly invertebrates such as annelids and crustaceans (Cargnelli et al., 1999; Klein-MacPhee, 2002). The ratio of invertebrates to bony fish declines until halibut >80 cm eat fish almost exclusively (Cargnelli et al., 1999; Klein-MacPhee, 2002). Greenland Shark, seals, Monkfish (Goosefish), and Spiny Dogfish are common predators of halibut (Cargnelli et al., 1999; Klein-MacPhee, 2002). Atlantic Halibut was heavily fished resulting in a depleted stock prior to 1900 and have yet to recover (Cargnelli et al., 1999). There is evidence of two genetic stocks: Gulf of St. Lawrence and Scotian Shelf, and there is no longer a breeding population in the Gulf of Maine (Klein-MacPhee, 2002). Atlantic Halibut are managed under the New England Fisheries Management Council Northeast Multispecies Fishery Management Plan, and based on the most recent stock assessments, are overfished, but not undergoing overfishing (Blaylock and Legault, 2012).

#### Literature Cited:

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