Butterfish − *Peprilus triacanthus*

Overall Vulnerability Rank = Low

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

	Peprilus triacanthus	Expert Scores	Data Quality	Expert Scores Plots (Portion by Category)
Sensitivity attributes	Stock Status	1.2	2.2	
	Other Stressors	1.4	1.8	
	Population Growth Rate	1.1	2.5	
	Spawning Cycle	2.2	2.8	
	Complexity in Reproduction	1.5	2.4	
	Early Life History Requirements	2.1	2.2	
	Sensitivity to Ocean Acidification	1.4	2.6	
	Prey Specialization	1.6	2.6	
	Habitat Specialization	1.5	2.9	
	Sensitivity to Temperature	1.8	2.8	
	Adult Mobility	1.1	2.6	
	Dispersal & Early Life History	1.4	2.5	
	Sensitivity Score	Low		
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	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		

Low
Moderate
High
Very High

Butterfish (*Peprilus traicanthus*)

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**. All sensitivity scores were below 2.5.

Distributional Vulnerability Rank: **Very High** (52% certainty from bootstrap analysis). Three of the attributes indicated vulnerability to distribution shift: Butterfish are habitat generalists. They are highly mobile and make large seasonal migrations. Spawning occurs across the shelf and larvae are broadly dispersed.

Directional Effect in the Northeast U.S. Shelf: The effect of climate change on Butterfish 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. Recent excursions into the Gulf of Maine have occurred in recent years and this is likely to continue as the ecosystem warms. 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: Several studies indicate that Butterfish distribution is vulnerable to changes in climate. Colton (1972) showed that Butterfish distribution shifted southwards during an extended period of cooling on the Northeast U.S. Shelf (1953-1967) and Collie et al. (2008) found that Butterfish abundance increased in Narragansett Bay during the more recent warming trend (1970-2005). Manderson et al. (2011) developed a habitat model for Butterfish on the Northeast U.S. Shelf, which suggests that, as the Northeast U.S. Shelf warms, more pelagic habitat will become available for Butterfish.

Life History Synopsis**:** Butterfish is a short-lived, pelagic species that occurs from the Gulf of St Lawrence to southern Florida, but is primarily found from Maine to Cape Hatteras, North Carolina (Able and Fahay, 2010). Butterfish mature in 1-2 years (Cross et al., 1999). Spawning begins in late winter (or year round) south of Cape Hatteras, and continues to the north and inshore as water temperatures increase, peaking in spring and summer (Able and Fahay, 2010). Spawning is primarily on the continental shelf, but some spawning in coastal areas and in large estuaries has also been documented (Able and Fahay, 2010). Butterfish are broadcast spawners, and the resultant pelagic eggs incubate for 2-3 days at approximate 18-20^{o}C before hatching (Cross et al., 1999). Larvae are pelagic, become increasingly nektonic with growth and development, and often associate with jellyfish, Sargassum, and floating debris during the late-larval stage (Cross et al., 1999). Larvae develop gradually into pelagic juveniles and then adults (Cross et al., 1999; Able and Fahay, 2010). Juvenile Butterfish are pelagic or nektonic and while often associated with large jellyfish, are also frequently seen swimming freely in loose schools (Cross et al., 1999; Able and Fahay, 2010). The juvenile Butterfish diet consists of abundant plankton including copepods and ctenophores (Able and Fahay, 2010). Juveniles can reach half their adult size in the first year and follow similar migration patterns to adult Butterfish (Cross et al., 1999; Able and Fahay, 2010). Adult and juvenile Butterfish form loose schools and migrate in response to changing temperatures. Butterfish move to offshore areas along the continental shelf edge south of Georges Bank in winter,

then migrate inshore and to the north as temperatures rise above 10 ^{o}C (Cross et al., 1999; Able and Fahay, 2010). During spring and summer, Butterfish can be found across the shelf and into large estuaries (Cross et al., 1999). These cross-shelf migrations are less pronounced south of Cape Hatteras where the temperatures stay mild (Cross et al., 1999; Able and Fahay, 2010). While generally associated with the upper water column, Butterfish can also be found near the bottom, particularly during winter, and are frequently collected over sand, mud, or rock substrates (Cross et al., 1999). Adult Butterfish are planktivores consuming urochordates, mulluscs, crustaceans, jellyfish, polychaetes, small fishes, and ctenophores (Cross et al., 1999; NEFSC, 2014). The predators of Butterfish include Silver Hake, Monkfish (Goosefish), Weakfish, Bluefish, Swordfish, and Hammerhead Sharks (NEFSC, 2014). Butterfish are managed by the Mid-Atlantic Fishery Management Council and are neither overfished nor is overfishing occurring (NEFSC, 2014).

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