Giant grenadier − *Albatrossia pectoralis*

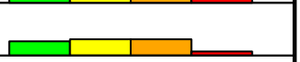
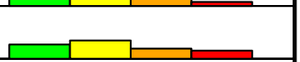
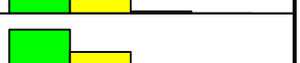
Overall Vulnerability Rank = Low

Biological Sensitivity = Low

Climate Exposure = Moderate

Sensitivity Data Quality = 8% of scores ≥ 2

Exposure Data Quality = 33% of scores ≥ 2

	Albatrossia pectoralis	Expert Scores	Data Quality	Expert Scores Plots (Portion by Category)
Sensitivity attributes	Habitat Specificity	1.8	1.6	
	Prey Specificity	2.1	1.2	
	Adult Mobility	2.2	1.0	
	Dispersal of Early Life Stages	2.2	0.8	
	Early Life History Survival and Settlement Requirements	2.0	1.0	
	Complexity in Reproductive Strategy	2.2	1.2	
	Spawning Cycle	1.8	1.2	
	Sensitivity to Temperature	1.7	1.6	
	Sensitivity to Ocean Acidification	2.0	1.8	
	Population Growth Rate	2.6	2.0	
	Stock Size/Status	1.4	1.8	
	Other Stressors	1.3	1.4	
	Sensitivity Score	Low		
Exposure factors	Sea Surface Temperature	NA	NA	
	Sea Surface Temperature (variance)	NA	NA	
	Bottom Temperature	2.1	3.0	
	Bottom Temperature (variance)	2.7	3.0	
	Salinity	NA	NA	
	Salinity (variance)	NA	NA	
	Ocean Acidification	4.0	3.0	
	Ocean Acidification (variance)	1.3	3.0	
	Phytoplankton Biomass	1.2	1.2	
	Phytoplankton Biomass (variance)	1.1	1.2	
	Plankton Bloom Timing	1.6	1.0	
	Plankton Bloom Timing (variance)	2.3	1.0	
	Large Zooplankton Biomass	1.1	1.0	
	Large Zooplanton Biomass (variance)	1.5	1.0	
	Mixed Layer Depth	1.7	1.0	
	Mixed Layer Depth (variance)	2.1	1.0	
	Currents	NA	NA	
	Currents (variance)	NA	NA	
	Air Temperature	NA	NA	
	Air Temperature (variance)	NA	NA	
	Precipitation	NA	NA	
	Precipitation (variance)	NA	NA	
	Sea Surface Height	NA	NA	
	Sea Surface Height (variance)	NA	NA	
	Exposure Score	Moderate		
	Overall Vulnerability Rank	Low		

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Giant grenadier (*Albatrossia pectoralis*)

Overall Climate Vulnerability Rank: **Low**. (85% certainty from bootstrap analysis).

Climate Exposure: **Moderate**. Exposure to ocean acidification (4.0) was ranked as "very high", and exposure to variability in bottom temperature (2.7) was ranked as "moderate".

Biological Sensitivity: **Low**. Population growth rate (2.6) was ranked as "moderate" sensitivity, and all other sensitivity attributes were ranked as "low" sensitivity.

Potential for distribution change: **Moderate** (72% certainty from bootstrap analysis). Habitat specificity indicated high potential for distribution change, and adult mobility and dispersal of early life stages indicated moderate potential for distribution change.

Directional Effect in the Eastern Bering Sea: Projected climate change in the eastern Bering Sea is expected to have a neutral effect on giant grenadier, with 78% certainty in expert scores.

Data Quality: 8% of the sensitivity attributes, and 33% of the exposure factors, had average data quality scores of 2 or greater (indicating at least "moderate" data quality).

Climate Effects on Abundance and Distribution: Giant grenadier are one of the most abundant species on the slope in the Eastern Bering Sea and adult fish reside at depths greater than 300 m, where the temperature is stable. There is no information on the recruitment of giant grenadier. Very few larvae have been caught in any surveys in Alaska. It is assumed that giant grenadier are pelagic for a portion of their lives, but there is no data on their whereabouts before they settle to the continental slope. Because of this lack of life history information, there is no information on the effects of climate on abundance and distribution.

Life History Synopsis: Giant grenadier range from Baja California, Mexico around the arc of the North Pacific Ocean to Japan, including the Bering Sea and the Sea of Okhotsk (Mecklenburg et al. 2002). On the Bering Sea slope, giant grenadier are by far the most abundant species caught in trawl surveys, in numbers and weight. They are especially abundant in waters >400 m depth and have been caught in longline gear in the western Gulf of Alaska in depths at depths down to 1,600 m (Clausen and Rodgveller 2013). Adults are found in close association with the bottom, as evidenced by their large catches in bottom trawls and on bottom longlines. Very few small, young fish are caught in surveys and so juveniles are thought to be pelagic. Nearly all of giant grenadier caught in surveys at depths <800 m are female (98-99% in the eastern Bering Sea; Clausen 2008) and males become more abundant at deeper depths (Clausen and Rodgveller 2013).

In the Aleutian Islands, the diet comprised mostly squid and myctophids (Yang 2003), whereas in the Gulf of Alaska, squid and pasiphaeid shrimp are the dominant prey (Yang et al. 2006).

Giant grenadier are long-lived and late to mature. The best estimate of the female age-at-50%-maturity, which was obtained from studies in the Gulf of Alaska, is 23 years (Rodgveller et al. 2010). The time of spawning is thought to be protracted and may even extend throughout the year (Rodgveller et al. 2010). The natural mortality estimate, calculated using Hoenig's (1983) longevity equation with a maximum age of 58, is 0.078. It is probable that fish older than 58

exist because fish larger than those that have been aged are caught on longline surveys. An older maximum age would result in a decrease in *M*.

A final rule was issued on 4/6/15 to add grenadiers as an Ecosystem Component to both Fishery Management Plans FMP) (GOA and BSAI) under Amendments 100/91. There is no definition of overfishing for an Ecosystem Component, therefore, these values are not used for management or for determining if overfishing is occurring. As an Ecosystem Component, a stock assessment is not required and there is no ABC or OFL. In 2014 the SSC and Plan Teams agreed that an abbreviated assessment be produced every other year for both regions to monitor catch and biomass (Rodgveller and Hulson 2016).

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Hoenig, J. M. 1983. Empirical use of longevity data to estimate mortality rates. Fish. Bull. 82(1): 898-902.

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