

Rougheye rockfish – *Sebastes aleutianus*

Overall Vulnerability Rank = Moderate ■

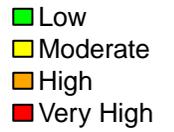
Biological Sensitivity = High ■

Climate Exposure = Moderate ■

Sensitivity Data Quality = 75% of scores ≥ 2

Exposure Data Quality = 56% of scores ≥ 2

<i>Sebastes aleutianus</i>		Expert Scores	Data Quality	Expert Scores Plots (Portion by Category)	
Sensitivity attributes	Habitat Specificity	1.9	2.0		
	Prey Specificity	1.8	2.4		
	Adult Mobility	2.3	2.1		
	Dispersal of Early Life Stages	1.8	1.4		
	Early Life History Survival and Settlement Requirements	2.6	1.5		
	Complexity in Reproductive Strategy	2.3	1.4		
	Spawning Cycle	3.6	2.0		
	Sensitivity to Temperature	3.2	2.4		
	Sensitivity to Ocean Acidification	2.0	2.4		
	Population Growth Rate	3.8	2.8		
	Stock Size/Status	1.9	2.0		
	Other Stressors	1.1	2.8		
	<b>Sensitivity Score</b>		<b>High</b>		
	Exposure factors	Sea Surface Temperature	2.0	2.0	
Sea Surface Temperature (variance)		1.9	2.0		
Bottom Temperature		2.1	2.0		
Bottom Temperature (variance)		2.9	2.0		
Salinity		1.2	2.0		
Salinity (variance)		2.7	2.0		
Ocean Acidification		4.0	2.0		
Ocean Acidification (variance)		1.3	2.0		
Phytoplankton Biomass		1.2	1.2		
Phytoplankton Biomass (variance)		1.2	1.2		
Plankton Bloom Timing		1.7	1.0		
Plankton Bloom Timing (variance)		2.2	1.0		
Large Zooplankton Biomass		1.1	1.0		
Large Zooplankton Biomass (variance)		1.5	1.0		
Mixed Layer Depth		1.9	1.0		
Mixed Layer Depth (variance)		2.3	1.0		
Currents		1.4	2.0		
Currents (variance)		1.7	2.0		
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		
<b>Exposure Score</b>		<b>Moderate</b>			
<b>Overall Vulnerability Rank</b>		<b>Moderate</b>			



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## **Rougheye rockfish (*Sebastes aleutianus*)**

Overall Climate Vulnerability Rank: **Moderate**. (73% 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 (2.9) and variability in salinity (2.7) were ranked as “moderate”.

Biological Sensitivity: **High**. Population growth rate (3.8) and spawning cycle (3.6) were ranked as “very high” sensitivity, and sensitivity to temperature was ranked as “high”.

Potential for distribution change: **High** (93% certainty from bootstrap analysis). Three attributes (dispersal of early life stages, habitat specificity, and sensitivity to temperature) indicated high potential for distribution change.

Directional Effect in the Eastern Bering Sea: Projected climate change in the eastern Bering Sea is expected to have a negative effect on rougheye rockfish, with 61% certainty in expert scores.

Data Quality: 75% of the sensitivity attributes, and 56% 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: Rockfish species in Alaska, including rougheye rockfish, generally have highly variable recruitment, but specific environmental factors affecting recruitment have not been identified. Rockfishes have a complex reproduction strategy involving courtship, mating, and internal fertilization. Changes in temperature could affect reproduction, rates of embryonic development, dates of parturition, and subsequent abundance. The relatively short time series of the eastern Bering Sea slope survey has limited detailed examination of how climate variability affects the stock distribution.

### Life History Synopsis:

Rougheye rockfish are distributed along the continental slope from southern California to the Aleutian Islands and eastern Bering Sea, and west to the Kamchatka Peninsula and Japan (Love et al. 2002). Juveniles reside in a pelagic phase for an unknown period of time after metamorphosis from the larval stage. After settlement to the benthic environment, juveniles reside in depths of 200- 300m. Little is known of the habitat associations of juvenile rougheye rockfish, although juvenile red rockfish are associated with boulders, sponges, and upright coral (Carlson and Haight 1976; Rooper and Boldt 2005; Rooper et al. 2007). Commercial fishing and research survey data indicate that adult rougheye rockfish and blackspotted (*Sebastes melanostictus*) rockfish (a closely related species) are demersal species that occupy sand-mud substrates (300m-500m) with steep slopes and are associated with boulders and corals (Kreiger and Ito 1999; Kreiger and Wing 2002).

In a studies from the Aleutian Islands and the Gulf of Alaska, small rougheye rockfish consumed mostly shrimp, along with a variety of other prey groups including amphipods, euphausiids, and various fish species. Adult rougheye consume mostly myctophids, along with a variety of other prey groups including amphipods, shrimp, euphausiids, and various fish species (Yang 2003; Yang and Nelson 2000). The survival of larvae is thought to be more strongly dependent upon

the availability of suitable prey than on predation pressure. Rockfish are not a major prey item of predators in the Bering Sea and Aleutian Islands (BSAI) area.

Rougheye rockfish have a complex reproduction strategy involving courtship, mating, and internal fertilization and embryonic development. The fecundity is a function of the food available (which itself is an indirect function of temperature via oceanographic conditions) and temperature-dependent metabolic rates. These factors also affect the rate of embryonic development and the date of parturition.

Rougheye rockfish are a long-lived stock with late maturity; the estimated instantaneous natural mortality rate is 0.03 yr<sup>-1</sup>, and the estimated age at 50% maturity is 18.4 years (Spencer et al. 2018). The von Bertalanffy *K* parameter is estimated at 0.06.

Rougheye rockfish are managed within a two-species stock complex that also includes blackspotted rockfish in the BSAI. Population estimates for the portion of the BSAI stock in the EBS management area is not assessed with an age-structured model, but rather a smoothed time series of survey biomass estimates. Therefore, estimates of stock status based on age-structured reference points (i.e., *B*<sub>40%</sub>) are not available for the EBS region. For the entire BSAI area, the blackspotted/rougheye rockfish complex was not overfished or approaching an overfished condition.

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