Pacific ocean perch − *Sebastes alutus*

Overall Vulnerability Rank = Moderate

Biological Sensitivity = High

Climate Exposure = Moderate

Sensitivity Data Quality = 75% of scores ≥ 2

Exposure Data Quality = 56% of scores ≥ 2

	Sebastes alutus	Expert Scores	Data Quality	Expert Scores Plots (Portion by Category)
Sensitivity attributes	Habitat Specificity	1.9	2.5	
	Prey Specificity	1.9	2.2	
	Adult Mobility	2.4	2.1	
	Dispersal of Early Life Stages	1.6	1.8	
	Early Life History Survival and Settlement Requirements	2.6	1.5	
	Complexity in Reproductive Strategy	2.3	1.8	
	Spawning Cycle	3.8	2.2	
	Sensitivity to Temperature	3.2	2.5	
	Sensitivity to Ocean Acidification	2.1	2.4	
	Population Growth Rate	3.6	2.9	
	Stock Size/Status	1.1	3.0	
	Other Stressors	1.1	2.8	
	Sensitivity Score	High		
Exposure factors	Sea Surface Temperature	2.0	2.0	
	Sea Surface Temperature (variance)	1.9	2.0	
	Bottom Temperature	2.2	2.0	
	Bottom Temperature (variance)	2.8	2.0	
	Salinity	1.3	2.0	
	Salinity (variance)	2.6	2.0	
	Ocean Acidification	4.0	2.0	
	Ocean Acidification (variance)	1.4	2.0	
	Phytoplankton Biomass	1.1	1.2	
	Phytoplankton Biomass (variance)	1.2	1.2	
	Plankton Bloom Timing	1.7	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	1.9	1.0	
	Mixed Layer Depth (variance)	2.4	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	
	Exposure Score	Moderate		
	Overall Vulnerability Rank	Moderate		

Low
Moderate
High
Very High

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Pacific ocean perch (*Sebastes alutus*)

Overall Climate Vulnerability Rank: **Moderate**. (87% certainty from bootstrap analysis).

Climate Exposure: **Moderate**. The climate exposure ranking primarily reflected bottom temperature variance (average score of 2.8), ocean acidification (4.0), and salinity variance (2.6), whereas the remaining 15 exposure factors had scores less than 2.5.

Biological Sensitivity: **High**. Spawning cycle (3.8) and population growth rate (3.7) were ranked as "very high" sensitivity, and temperature (3.2) was ranked as "high" sensitivity.

Potential for distribution change: **High** (99% 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 neutral effect on Pacific ocean perch, with 67% certainty in expert scores. Most scores were relatively evenly split between the "neutral" and "high" categories (6 and 7 respectively), with three scores in the "positive" category. Because Pacific ocean perch reside in deep habitats (200-300m) on the eastern Bering Sea slope, they occupy a relatively narrow range of temperatures. POP have a limited period of parturition, and climate change could potentially affect the environmental conditions into which larvae are released. However, there is little direct evidence of the effect of climate change on Pacific ocean perch productivity and distribution, which contributes to the "neutral" ranking.

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: Pacific ocean perch have highly variable recruitment, but specific environmental factors affecting recruitment have not been identified. 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: Pacific ocean perch is a long-lived, benthic rockfish species that occurs on the continental slope from central Baja California to the eastern Bering Sea and Aleutian Islands, and west to Japan (Love et al. 2002). Juveniles reside in a pelagic phase for an unknown period of time after metamorphosis from the larval stage, and ages 1-3 probably live in rocky inshore areas. Juvenile Pacific ocean perch (POP) 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 POP is a mostly demersal species that occupies flat, pebbled substrate along the continental slope at depths between 150 - 300 m during the summer, and potentially deeper depths in the fall and winter (Hoff 2013, von Szalay et al. 2011, Gunderson 1971).

POP are primarily planktivores. Small juvenile POP eat mostly calanoid copepods, whereas the prey of larger juveniles is mostly euphausids. Adult POP consume mostly euphausiids, with fish (primarily myctophids) and calanoid copepods also contributing to the diet (Yang 2003).

POP have a complex reproduction strategy involving courtship, mating, and internal fertilization and embryonic development (Love et al. 2002). In Washington and British Columbia, mating of rockfish occurs in the fall in deeper waters on the continental slope than those occupied in the summer, and fish may be less dispersed in the fall to spring than in the summer (Gunderson 1971). POP parturition (the release their larvae) occurs in highly variable oceanic conditions, and the variable timing between food availability and parturition likely accounts for some of the variability in early survival and recruitment success (Love et al. 2002). Parturition in the Aleutian Islands occurs in late winter - early spring (March - May). Parturition in the Aleutian Islands occurs in late winter - early spring (March - May) (TenBrink and Spencer 2013). Little information exists on the duration of the planktonic larval stage, but based on other rockfish species POP are thought to settle to the benthic environment within 3 – 6 months of parturition (Love et al. 2002). The distance that planktonic larvae travel is also unknown, but analyses of genetic spatial stock structure indicate that POP have relatively small lifetime dispersal rates (70 - 400 km), which may suggest that larvae that are transported farther than this distance may not produce offspring that are reproductively successful (Palof et al. 2011).

POP in the Bering Sea/Aleutian Islands are estimated to have a relatively low natural mortality rate (instantaneous rate of 0.06 yr^{-1}), consistent with an observed maximum age in the region of 104 years. POP approach their asymptotic size at a relatively rapid rate, with the von Bertalanffy *K* parameter estimated at 0.14. The age at 50% maturity is estimated at 9.1 years (Spencer and Ianelli 2016).

POP are managed as a single stock across the eastern Bering Sea and Aleutian Islands ecosystems, with the majority of the stock occurring the Aleutian Islands. The stock has increased substantially since the early 1980s. Based on the 2016 stock assessment, the stock is not overfished or subjected to overfishing (Spencer and Ianelli 2016).

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