Tanner crab − *Chionoecetes bairdi*

Overall Vulnerability Rank = Moderate

Biological Sensitivity = High

Climate Exposure = Moderate

Sensitivity Data Quality = 92% of scores ≥ 2

Exposure Data Quality = 56% of scores ≥ 2

	Chionoecetes bairdi	Expert Scores	Data Quality	Expert Scores Plots (Portion by Category)
Sensitivity attributes	Habitat Specificity	1.3	3.0	
	Prey Specificity	1.1	2.7	
	Adult Mobility	1.9	2.7	
	Dispersal of Early Life Stages	1.1	3.0	
	Early Life History Survival and Settlement Requirements	2.5	2.7	
	Complexity in Reproductive Strategy	2.4	3.0	
	Spawning Cycle	3.8	2.7	
	Sensitivity to Temperature	2.2	2.7	
	Sensitivity to Ocean Acidification	3.6	3.0	
	Population Growth Rate	3.1	2.3	
	Stock Size/Status	1.1	3.0	
	Other Stressors	1.2	1.7	
	Sensitivity Score	High		
Exposure factors	Sea Surface Temperature	2.0	2.5	
	Sea Surface Temperature (variance)	1.5	2.5	
	Bottom Temperature	2.0	3.0	
	Bottom Temperature (variance)	2.1	3.0	
	Salinity	1.1	2.0	
	Salinity (variance)	2.6	2.0	
	Ocean Acidification	4.0	3.0	
	Ocean Acidification (variance)	1.5	3.0	
	Phytoplankton Biomass	1.3	1.2	
	Phytoplankton Biomass (variance)	1.2	1.2	
	Plankton Bloom Timing	1.5	1.0	
	Plankton Bloom Timing (variance)	2.2	1.0	
	Large Zooplankton Biomass	1.2	1.0	
	Large Zooplanton Biomass (variance)	1.4	1.0	
	Mixed Layer Depth	1.6	1.0	
	Mixed Layer Depth (variance)	2.3	1.0	
	Currents	1.3	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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Tanner crab (*Chionoecetes bairdi*)

Overall Climate Vulnerability Rank: **Moderate**. (79% certainty from bootstrap analysis).

Climate Exposure: **Moderate**. Exposure to ocean acidification (4.0) was ranked as “very high”, and exposure to variability in salinity (2.6) was ranked as “moderate”.

Biological Sensitivity: **High**. Spawning cycle (3.8) and sensitivity to ocean acidification were ranked as “very high”, and population growth rate (3.1) was ranked as “high” sensitivity.

Potential for distribution change: **High** (98% certainty from bootstrap analysis). Dispersal of early life stages and habitat specificity indicated very high potential for distribution change, and adult mobility 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 tanner crab, with 54% certainty in expert scores.

Data Quality: 92% 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: Tanner crab have highly variable recruitment, but specific environmental factors affecting recruitment have not been identified. Variability in the size and extent of the “cold pool” affects the distribution of crab on the continental shelf because Tanner crab are generally excluded from the area occupied by the cold pool due to thermal tolerances (Somerton, 1981).

Results from laboratory experiments suggest that the impact of ocean acidification is life-stagespecific (Long et al., 2013; Long et al., 2016; Swiney et al., 2016). Long et al. (2016) and Swiney et al. (2016) found that, although direct effects of increased ocean acidification on embryos and larvae were small, oocyte development was sensitive to increased acidification and thus embryos from mature females exposed to elevated acidification levels exhibited altered morphology and reduced hatching success while subsequent larvae exhibited morphological and metabolic rate changes due to carryover effects. Long et al. (2013) found that growth and survival rates of juvenile Tanner crab decreased with increased ocean acidification. Additionally, Meseck et al. (2016) found that increased acidification impacted hemocyte physiology, suggesting that the accompanying energetic costs would divert energy from reproduction and other physiological processes. Using a demographic model, Punt et al. (2016) found that fishery catch could be expected to decrease by > 50% in 20 years if natural mortality rates were affected by ocean acidification.

Life History Synopsis: The unit stock in the eastern Bering Sea is defined across the geographic range of the eastern Bering Sea continental shelf, and managed as a single unit. Tanner crab are common in the southern half of Bristol Bay, around the Pribilof Islands, and along the shelf break, although smaller males (<125 mm carapace width (CW)) and ovigerous and immature females of all sizes are distributed broadly from southern Bristol Bay northwest to St. Matthew Island (Rugolo and Turnock, 2011). The distributions of snow (*C. opilio*) and Tanner crab overlap on the shelf from approximately 56° to 60°N, and in this area, the two species hybridize (Karinen and Hoopes 1971).

Tanner crab females brood eggs for about a year before releasing larvae into the water column in the spring, typically between February and May (Swiney, 2008). The larvae spend several months in the plankton before settlement to the benthos (Incze et al., 1982). Following settlement, growth proceeds through a series of molts—up to 11 for females and 17 for males—prior to ending in a terminal molt after which individuals do not grow further in size (Donaldson et al., 1981; Tamone et al., 2007). Males and females exhibit similar growth patterns up to ~60 mm CW, after which female molt increments decrease relative to similarly-sized males. So-called "primiparous" females undergoing their terminal molt at 5-7 years old mate with (generally larger) males for the first time in a soft-shell condition, after which they extrude their first egg clutch. Subsequently, "multiparous" females can mate with males in their hardshell condition or fertilize eggs using stored sperm from previous mating (Donaldson et al., 1981; Swiney et al., 2008). Eggs of primiparous females are extruded approximately three months prior to those of multiparous females, but eclosion is synchronized because the eggs of primiparous females undergo a longer period of developmental diapause than those of multiparous females (Swiney et al., 2008).

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