

Climate Change-Induced Stress on California Least Tern San Francisco Bay National Wildlife Refuge Complex August, 2017

Summary

Below we provide a quick summary of climate impacts for California least tern as a starting point and references for further reading. We recommend reviewing the most recent literature when making conservation decisions. Please also see "[Climate and Hydrology Projections for the San Francisco Bay NWR Complex](#)" for background information about the anticipated rates, extent, and level of certainty for future physical changes for the region.

Climate variation influences bird populations both in their breeding and non-breeding areas by affecting important demographic processes such as breeding success and survival. Increased frequency and intensity of storms, heat exposure, and ocean acidification could negatively impact California least tern feeding and breeding in the San Francisco Bay Area.

(Gardali et al. 2012) determined vulnerability and climate priority rankings for 358 bird taxa in California. Species ranked as Climate Priority 3 (low priority) are those with vulnerability scores ≥ 30 and < 40 , ≥ 40 and < 45 are ranked as Climate Priority 2 (moderate priority), and ≥ 45 are ranked as Climate Priority 1 (high priority). California least tern was the only seabird listed as a Climate Priority 1.

Increased Temperatures, Extreme Heat

Large scale direct mortality of least tern (*Sterna albifrons*) chicks has been documented (Overstreet and Rehak 1982). In 1980, nearly all of several hundred chicks of the least tern chicks within a narrow beach nesting area about 900 m long in eastern Gulfport, Mississippi, died, during a heatwave (25 June to 1 July) (Overstreet and Rehak 1982). Necropsies and lab tests confirmed that deaths were caused by heat stroke (Overstreet and Rehak 1982). Recorded Means of daily maximum, average, and minimum air temperatures for those 7 days were 35.5, 30.3, and 25.1 C, and daily high recorded humidity levels ranged from 72 to 98%, averaging 85.6% (Overstreet and Rehak 1982).

Changing Ocean Conditions and Prey Availability

California least terns (CALT) typically forage over short distances in calm, narrow estuaries or large bays, and occasionally in the open ocean. Changing ocean conditions

including; changes in sea surface temperatures, El Niño, ocean acidification, and upwelling will directly and indirectly affect prey quality and availability. The CALT's diet consists exclusively of fish, and multiple studies have linked CALT breeding productivity to diet (Elliot, Hurt, and Sudeman 2007; Robinette et al. 2015). Northern anchovies and juvenile rockfish are thought to be indicators of a high quality diet (Elliot, Hurt, and Sudeman 2007; Robinette et al. 2015) . Diets high in larval fish and Pacific saury may indicate poor quality diet (Coomber 2013).

How changing ocean conditions will affect fish species, and in turn CALT, is an area of active research. For example, Robinette et al. (2013) found that the occurrence of anchovies in CALT diet to be correlated with the Pacific Decadal Oscillation while the occurrence of rockfish to be correlated with local sea surface temperature. We recommend that decision makers consult the most current literature when making decisions because this area of research is evolving so rapidly.

Please also refer to the Sea Surface Temperatures, El Niño, Ocean Acidification, and Changes in Upwelling sections of the [Breeding Seabirds Climate Summary](#) for information about potential impacts from those climate factors.

References

- Coomber, Caitlin. 2013. "Sea Grant California Study: Seabird Chick Survival Linked to Diet." <https://caseagrant.ucsd.edu/news/study-seabird-chick-survival-linked-to-diet>.
- Elliot, Heidi K., Rachel Hurt, and William Sudeman. 2007. "Breeding Biology and Status of the California Least Tern *Sterna Antillarum Browni* at Alameda Point, San Francisco Bay, California." *Waterbirds* 30 (3): 133–42. doi:10.1675/063.034.0201.
- Gardali, Thomas, Nathaniel E. Seavy, Ryan T. DiGaudio, and Lyann A. Comrack. 2012. "A Climate Change Vulnerability Assessment of California's at-Risk Birds." *PLoS ONE* 7 (3). doi:10.1371/journal.pone.0029507.
- Overstreet, RM, and Edward Rehak. 1982. "Heat-Stroke in Nesting Least Tern Chicks from Gulfport, Mississippi, during June 1980." *Avian Diseases* 26 (4): 918–23. <http://www.jstor.org/stable/10.2307/1589880>.
- Robinette, Dan P, Julie Howar, Meredith L Elliott, Dan P Robinette, Julie Howar, Meredith L Elliott, and Jaime Jahncke. 2015. "Use of Estuarine, Intertidal, and Subtidal Habitats by Seabirds Within the MLPA South Coast Study Region." *Report to the California Ocean Science Trust and California Sea Grant*.