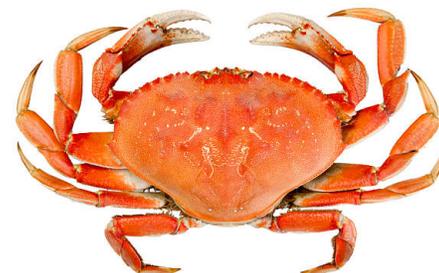


## What is Ocean Acidification?

1. Annually, around 25% of human-caused carbon dioxide emissions is absorbed by the ocean, making the ocean's chemistry more acidic.
  - Le Quéré, C, Andrew RM, and et al. (2016), Global Carbon Budget 2016, Earth System Science Data, DOI:10.5194/essd-8-605-2016. <https://www.earth-syst-sci-data.net/8/605/2016/>
2. This decrease in ocean pH over time is called ocean acidification and it makes it harder for calcifying animals like Dungeness crab to thrive.
  - <http://www.whoi.edu/website/OCB-OA/FAQs>



## How will Ocean Acidification Affect Dungeness Crab?

3. Dungeness crabs are an abundant and valuable species throughout national marine sanctuaries along the west coast of the United States.
  - <http://www.dfw.state.or.us/mrp/shellfish/crab/lifehistory.asp>
  - <http://wdfw.wa.gov/fishing/commercial/crab/>
  - <http://www.adfg.alaska.gov/index.cfm?adfg=dungenesscrab.main>
  - <https://www.wildlife.ca.gov/conservation/marine/invertebrates/crabs>
  - <https://www.nwfsc.noaa.gov/research/divisions/cb/ecosystem/marineecology/ocean-acidification.cfm>
  - <http://westcoastsoah.org/wp-content/uploads/2016/04/OAH-Panel-Key-Findings-Recommendations-and-Actions-4.4.16-FINAL.pdf>

## Life Cycle of the Dungeness Crab

4. Molting from one stage to the next and carrying fertilized eggs require a lot of energy, as does dealing with stress from global ocean change.
  - <http://www.whoi.edu/website/OCB-OA/FAQs>
  - <http://www.dfw.state.or.us/mrp/shellfish/crab/lifehistory.asp>

## NOAA Research Shows Crabs are Vulnerable

5. In lab studies, exposure to lower pH seawater decreases Dungeness crab larval development rates and survival.
  - Miller JJ, Maher M, Bahaboy E, Friedman CS, McElhany P (2016) Exposure to low pH reduces survival and delays development in early life stages of Dungeness crab (*Cancer magister*). Marine Biology 163:118

6. NOAA studies show with less prey available for Dungeness crab, complex modeling projects a decline in Dungeness crab biomass and loss in economic revenue in the next 50 years due to ocean acidification

- Marshall KN, Kaplan I, Hodgson E, Hermann A, Busch DS, McElhany P, Essington TE, Harvey CJ, Fulton, EA (2017) Risks of ocean acidification in the California Current food web and fisheries: ecosystem model projections. *Global Change Biology* 23:1525-1539

### **Dungeness Crab are Important to People**

7. NOAA supports research to understand the impacts of ocean acidification.
  - Global Ocean Acidification Observing Network. (2017). [Interactive map of global ocean acidification monitoring sites September 5, 2017]. GOA-ON Data Portal. <http://portal.goa-on.org/Explorer>
8. The jobs and livelihood of many fishermen, restaurant workers, and seafood retailers depend on healthy Dungeness crab.
  - Drummond B and Steele S (2015) High Hopes: The future of Dungeness crab. Nature Conservancy. <https://vimeo.com/140025969>
  - <https://www.nwfsc.noaa.gov/news/features/ocean-acidification-west-coast-dungeness-crab-fishery/index.cfm>
9. The US Dungeness crab fishery is valued at \$220 million annually.
  - <https://www.nwfsc.noaa.gov/news/features/ocean-acidification-west-coast-dungeness-crab-fishery/index.cfm>
10. Tribal Dungeness crab fisheries are culturally important to many Native Americans, providing food, income, and communal activity.
  - [http://old.seattletimes.com/html/outdoors/2002049590\\_nwwdungeness30.html](http://old.seattletimes.com/html/outdoors/2002049590_nwwdungeness30.html)
  - <https://indiancountrymedianetwork.com/culture/health-wellness/geoducks-crabs-and-sea-slugs-for-food-and-profit/>

### **NOAA's West Coast National Marine Sanctuaries are:**

- <https://sanctuaries.noaa.gov/science/sentinel-site-program/climate-change-ocean-acidification.html>
- <https://sanctuaries.noaa.gov/science/sentinel-site-program/olympic-coast/climate-change-ocean-acidification.html>
- <https://sanctuaries.noaa.gov/news/apr16/ocean-acidification.html>

### **How Can You Help?**

- <https://climateinterpreter.org/content/humans-can-take-action-slow-process-ocean-acidification>

- 
- <http://sanctuaries.noaa.gov/involved/>

