

# Impacts of Ocean Acidification on California Living Marine Resources

Ocean acidification is already impacting important species and ecosystems in California. Visualizing these impacts can aid state resource managers in understanding what's at stake as oceans acidify.



## Benthic Invertebrates

SPECIES COMMON NAME	RESPONSE TO OCEAN ACIDIFICATION					ECOSYSTEM ROLE	ECONOMIC IMPORTANCE
	Calcification	Growth	Reproduction	Survival	Behavior		
California Mussel	↓	↓	U	↓	U	■	R
Dungeness Crab	U	NE	M	↓	U	▲ ●	C, R
Ochre Sea Star	↓	↓	U	U	U	▲	
Olympia Oyster	↓	↓	U	↓	U	■	C, R
Pacific Oyster	↓	↓	U	↓	U		C
Purple Sea Urchin	M	↓	M	M	U	■ ●	C, R
Red Sea Urchin	U	↓	↓	↓	U	■ ●	C, R
Red Abalone	U	↓	↓	M	U	●	R



## Pelagics

SPECIES COMMON NAME	RESPONSE TO OCEAN ACIDIFICATION					ECOSYSTEM ROLE	ECONOMIC IMPORTANCE
	Calcification	Growth	Reproduction	Survival	Behavior		
Krill (CA spp)	U	M	U	M	U	●	
Market Squid	↑	U	↓	↓	U	▲ ●	C
Pteropod (CA spp)	↓	U	↓	↓	I	●	



## Finfish

SPECIES COMMON NAME	Activity	RESPONSE TO OCEAN ACIDIFICATION				ECOSYSTEM ROLE	ECONOMIC IMPORTANCE
		Growth	Reproduction	Survival	Behavior		
Cabezon	U	NE	U	NE	U		C, R
Blue Rockfish	NE	NE	U	NE	NE	▲	C, R
Copper Rockfish	↓	NE	U	NE	I	▲	C, R
Gopher Rockfish	↓	NE	↓	NE	I	▲	C, R



## Submerged Aquatic Vegetation

SPECIES COMMON NAME	Photosynthesis	RESPONSE TO OCEAN ACIDIFICATION			ECOSYSTEM ROLE	ECONOMIC IMPORTANCE
		Growth	Reproduction	Survival		
Eelgrass	↑	M	↑	U	■	
Giant Kelp	NE	M	M	NE	■	C, R

### KEY

- ↑ Increase
- ↓ Decrease
- M Mixed Results (Increased, Decreased, No Effect)
- NE No Effect
- U Unknown (Not Studied)
- I Impacted
- ▲ Predator
- Engineer
- Food Web Link
- C Commerical
- R Recreational

### Resident California species whose responses to ocean acidification have not been studied:

- California Spiny Lobster\*
- Pacific/Ocean Pink Shrimp\*
- California Spot Prawn
- Brown/Pacific/California Rock Crab
- Red Rock Crab
- Warty Sea Cucumber
- Giant Red Sea Cucumber
- Giant Keyhole Limpet
- Purple Hinged Rock Scallop\*
- Pacific Geoduck\*
- Lingcod
- California Sheephead
- Chinook Salmon
- Steelhead (Coastal Rainbow Trout)
- Coho Salmon\*
- California Halibut
- Pacific Jack Mackerel
- Pacific Herring
- Night Smelt
- Shiner Surfperch
- California Grunion\*

\* Indicates work in progress.  
NOTE: This is not an exhaustive list.

FURTHER INFORMATION  
<http://bit.ly/OAimpacts>

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REFERENCES  
<http://bit.ly/OAReferences>



## About this Document

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**OCEAN ACIDIFICATION (OA)** is a change in seawater chemistry associated with a decrease in pH, caused primarily by the ocean absorbing carbon dioxide emissions. This complex process has the potential to significantly change the chemistry of the world's oceans, negatively impacting living marine resources along the California coast and the State's ocean-based economy valued at approximately \$45 billion annually.<sup>1</sup>

Over the past 10 years, California has responded to the threat of OA by investing in science that can help the state anticipate, mitigate, and adapt to the significant ocean chemistry changes ahead. In addition, the State's political leaders are recognizing the need to identify and protect vulnerable locations and species in California through legislation and policy action:

- **The 2018 State of California Ocean Acidification Action Plan** includes actions to prepare for the full range of risks and impacts, and build resilience of affected communities, industries and interests.
- **Assembly Bill No. 2139** calls for the development of a comprehensive inventory of areas in California vulnerable to OA.

Ongoing research, monitoring, and modeling efforts are beginning to illuminate chemical, ecological, and social OA "hotspots" throughout the state. To support this ongoing work, Ocean Science Trust, working closely with state partners and scientific experts, developed this visualization. This data compilation was created by synthesizing results from peer reviewed articles and engaging scientific experts working on OA. The species included represent a diverse subset of species considered as ocean climate indicators, commercially, recreationally, and/or ecologically important. This product is a first step in sharing what we know with living marine resource managers about which ocean species may be most vulnerable to OA, and identifies critical gaps in knowledge where the potential effects of OA are still unknown. We hope it will inform decisions to reduce OA risk to important California fishery resources.

While there is still much to learn, this synthesis is a critical first step in helping the State build resilient California fisheries and ecosystems.

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**Learn more about OA in CA:**  
<http://www.oceansciencetrust.org/projects/oaactionplan>

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1. Eastern Research Group, Inc (2016) The national significance of California's ocean economy. NOAA. <https://coast.noaa.gov/data/digitalcoast/pdf/california-ocean-economy.pdf>.