Dissolved oxygen in coastal waters

Levels of dissolved oxygen are declining in ocean waters off the coast of southern California.

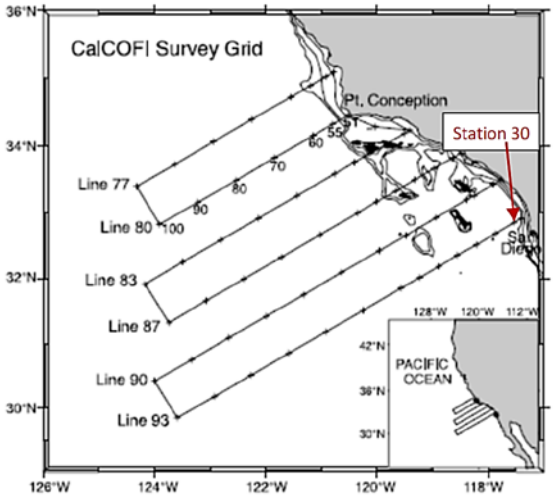
Dissolved oxygen concentrations have been declining in ocean waters off the California coast. Oxygen is vital to the growth and survival of organisms in marine environments, as it is on land. Declining oxygen concentrations can lead to complex changes in marine ecosystems. These changes can exacerbate the impacts of warming ocean temperatures, acidifying waters, and pollution on species abundance and diversity, and ultimately the food web.

Climate change is a large contributor to the loss of oxygen in sea water. Globally, warming ocean temperatures are driving this process. Warmer water holds less oxygen, reduces oxygen mixing between depths, and increases oxygen consumption by organisms. For California, regional circulation of the North Pacific Ocean and chemical pollution from agriculture and waste water discharge also influence dissolved oxygen concentrations.

What does the indicator show?

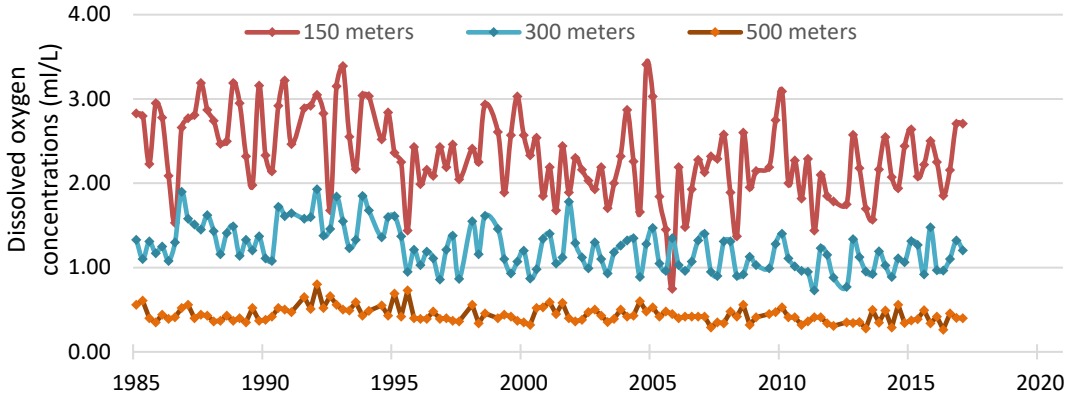
The graph below shows measurements of dissolved oxygen taken at the "Line 93, Station 30" survey location offshore of San Diego (see map). Since 1985, dissolved oxygen concentrations at this location have declined at three depths. Significant low oxygen events are notable. This location is where the California Undercurrent, which transports water from the equator northward along the western continental slope of North America, has a large influence on oxygen content. Throughout the south coast survey region, dissolved oxygen levels to at least 500 meter depths have declined (not shown).

San Diego offshore monitoring station



Source: Bograd et al. 2008

Dissolved oxygen concentrations at three water depths off the San Diego Coast



Note: Values shown are quarterly averages of oxygen concentrations measured at this location.

Source: California Cooperative Oceanic Fisheries Investigations 2017

Why is this indicator important?

Dissolved oxygen is essential for marine life. Since species thrive within specified oxygen conditions, oxygen levels determine the distribution of marine organisms. As levels of dissolved oxygen decline, the depth and extent of low oxygen zones are changing. Expansion of low oxygen zones may constrict favorable habitat for certain species while broadening it for others. For example, changes in the extent of oxygen-deficient zones may have influenced the northward expansion of the Humboldt squid's range over the last decade from Baja California to southeast Alaska. This species thrives in low-oxygen condtions.

The Humboldt squid (Dosidicus gigas) thrives in low oxygen environments and has recently expanded its territory.

Species vulnerable to low oxygen or "hypoxic" conditions can be severely impacted by declining oxygen levels. Episodic hypoxic events have led to fish and crustacean die-offs. Hypoxic conditions can also make it difficult for species to find food, avoid predators, grow and reproduce. This can have widespread impacts on the distribution and abundance of marine life including commercially important species.

Along California's coast is a zone of very low oxygen concentrations (the *Oxygen Minimim Zone*) located at depths from 600 to 1100 meters. This zone is expanding both upwards towards the ocean surface and horizontally– a change that is consistent with expansion of low oxygen zones elsewhere around the world.

Since 1950, more than 500 coastal sites worldwide have reported low or depleted oxygen concentrations. Fewer than 10 percent of these sites were known to be hypoxic before then.