

# Hypoxia and Anoxia

By Dr. Robert Diaz

## Summary

Over the last 50 to 75 years, due primarily to human modifications of terrestrial landscapes, low dissolved oxygen (hypoxia and anoxia) has become a serious problem in coastal areas around the globe (Diaz and Rosenberg 2008). It is a problem of large (Baltic Sea, Karlson et al. 2002) and small (Pepper Creek, Tyler et al. 2009) systems. There is also growing evidence that global warming is negatively affecting the dissolved oxygen content of the oceans and that naturally occurring oceanic oxygen minimum zones are expanding into shallower water (Keeling and Garcia 2002, Helly and Levin 2004). The interaction of physical and biological processes that lead to the formation of low dissolved oxygen is complex with a broad range of system-dependent responses (Boesch 2002, Cloern 2001, Breitburg et al. 2009). Hypoxia and anoxia pose a serious threat to estuarine and coastal ecosystem function and the ability of these systems to sustain high value fisheries (Caddy 1993, Baird et al. 2004, Turner et al. 2008). Other recent reviews and summaries that provided good introductions to how hypoxia and anoxia came to be such a large and serious problem are: Gray et al. 2002, Galloway et al. 2008, Rabalais and Gilbert 2008, and Levin et al. 2009.

At the organism level, there are a variety of behavioral and physiological strategies employed to survive hypoxia (Diaz and Rosenberg 1995, Richards et al. 2009). There are also similarities and differences in responses of ecosystems to natural and human-induced low dissolved oxygen (Levin et al. 2009, Vaquer-Sunyer and Duarte 2008). The interplay and synergy of multiple stressors in shaping an ecosystem's response to hypoxia are also important (Mee 1992, Rabalais and Turner 2001, Breitburg 2002).

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### **Web Resources**

To view global distribution and basic data from low dissolved oxygen areas go to Google Earth 5, Ocean Database, Condition of the Seas.

<http://www.gulfhypoxia.net/overview/>

[http://oceanservice.noaa.gov/products/pubs\\_hypox.html](http://oceanservice.noaa.gov/products/pubs_hypox.html)

[http://www.cop.noaa.gov/stressors/pollution/current/noaa\\_hyp\\_1pg.html](http://www.cop.noaa.gov/stressors/pollution/current/noaa_hyp_1pg.html)



## Image Gallery



Portable dissolved oxygen meter (photo credit: L. Hamdan)



Free sulfur in the water column with eel grass in the background from the Island of Fynen, Denmark.  
Photo credit: Nana Rask, County

Dead fish on the shores of Mariager Fjord after an anoxic event depleted water column oxygen. (photo credit: County of Aarhus, Denmark)

