

The Ocean, Acidification & the Healing Sea

In the Humanities, in Science, and in Collaboration

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Teaching About the Power of the Sea: The Humanities Perspective

“The cure for anything is salt water—tears, sweat, or the sea.”
—Isak Dinesen [Karen Blixen]

What does it mean in terms of people’s lives?

How do we think about the sea?

What place of importance does the sea hold for us culturally?

Personal connections:

- My grandfather was a fisherman in Greece; my father often went on distant fishing trips with him, as far as Egypt.
- I grew up on an island, surrounded by the Aegean Sea; plentiful fish as food and endless recreation and enjoyment at the beaches. The sea was always in our range of vision.
- During World War 2, when there was no food, my grandmother would use sea water to cook to cook wild greens, for optimal nourishment. In my culture, the sea is viewed as medicinal.



www.inlovewiththemed.com%2Frhodes-greece-get-acquainted-with-the-island-of-helios

In social history and culture, the sea is

Much-prescribed cure for neurasthenia, a broad category of illness to do with emotions, possibly alluding to neuroses and depression— by mid 1700s, doctors were “recommending trips to the seaside for almost any condition”

The site of spas and hospitals. “Mermaids at Brighton by W Heath (1805-1840). Fashionable women flock to take the ‘sea cure’ at Brighton, with its bathing machines scattered along the seafront. “



Wellcome Collection, Creative Commons. <https://brewminate.com/medical-treatment-and-the-english-seaside-in-the-18th-century>

- **In literature across the ages, the sea is**

A positive force that cleanses the soul and gives the spirit reprieve from hardships of everyday life

An all-encompassing symbol of humanity and the universe

A mystical force whose power is endless

A healing place

“Being by the Sea is good for you”



<https://greekcitytimes.com/2020/08/10/fact-being-by-the-sea-is-good-for-your-health/>

But the sea can also be dangerous when it teaches the limits of our human powers

Novels-- The Old Man and the Sea [battle with a fish] Moby Dick [battle with a whale] Lord Jim [sea captain]

Poem– Arnold, “Dover Beach” (1851, about the Industrial Revolution)

The Sea of Faith

Was once, too, at the full, and round earth's shore

Lay like the folds of a bright girdle furled.

But now I only hear

Its melancholy, long, withdrawing roar,

Retreating, to the breath

Of the night-wind, down the vast edges drear

And naked shingles of the world.



In art in general, the sea is always symbolic, often speaking of the human condition

In Science

The sea is infinitely important to health and well-being

What is the current state of the oceans?

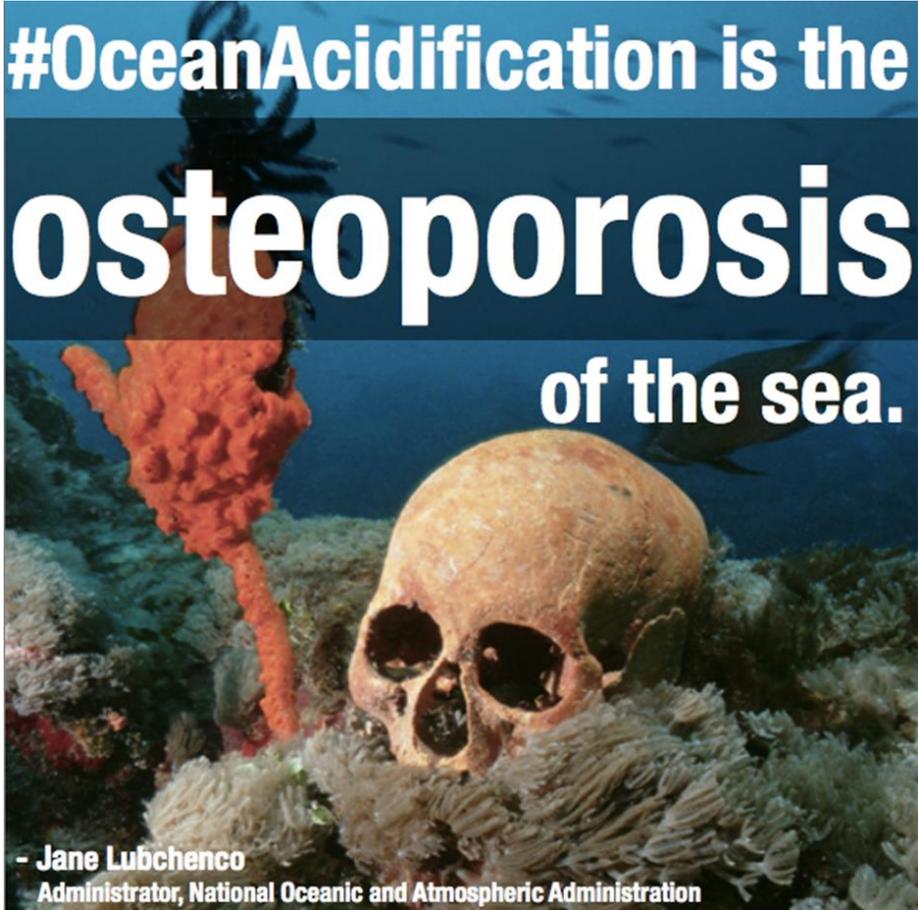
What concrete evidence do we have?

How does this reality figure in the bigger scheme of things?

What kind of importance can we assign to the oceans' health?

Science tells us that our oceans are not as healthy as they need to be



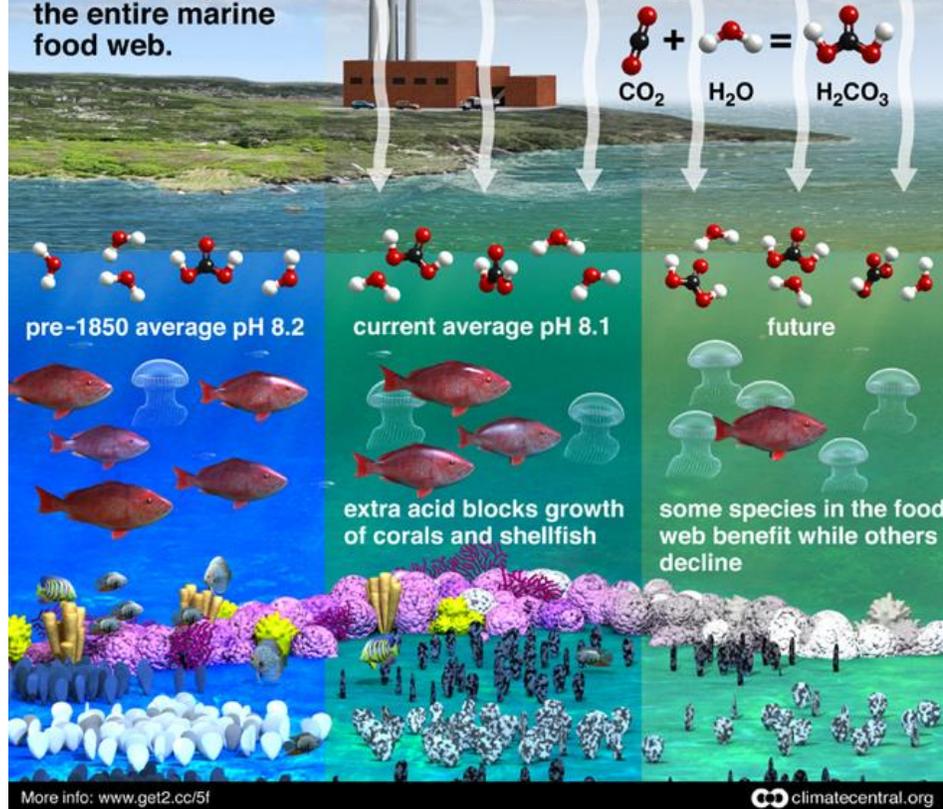


**#OceanAcidification is the
osteoporosis
of the sea.**

**- Jane Lubchenco
Administrator, National Oceanic and Atmospheric Administration**

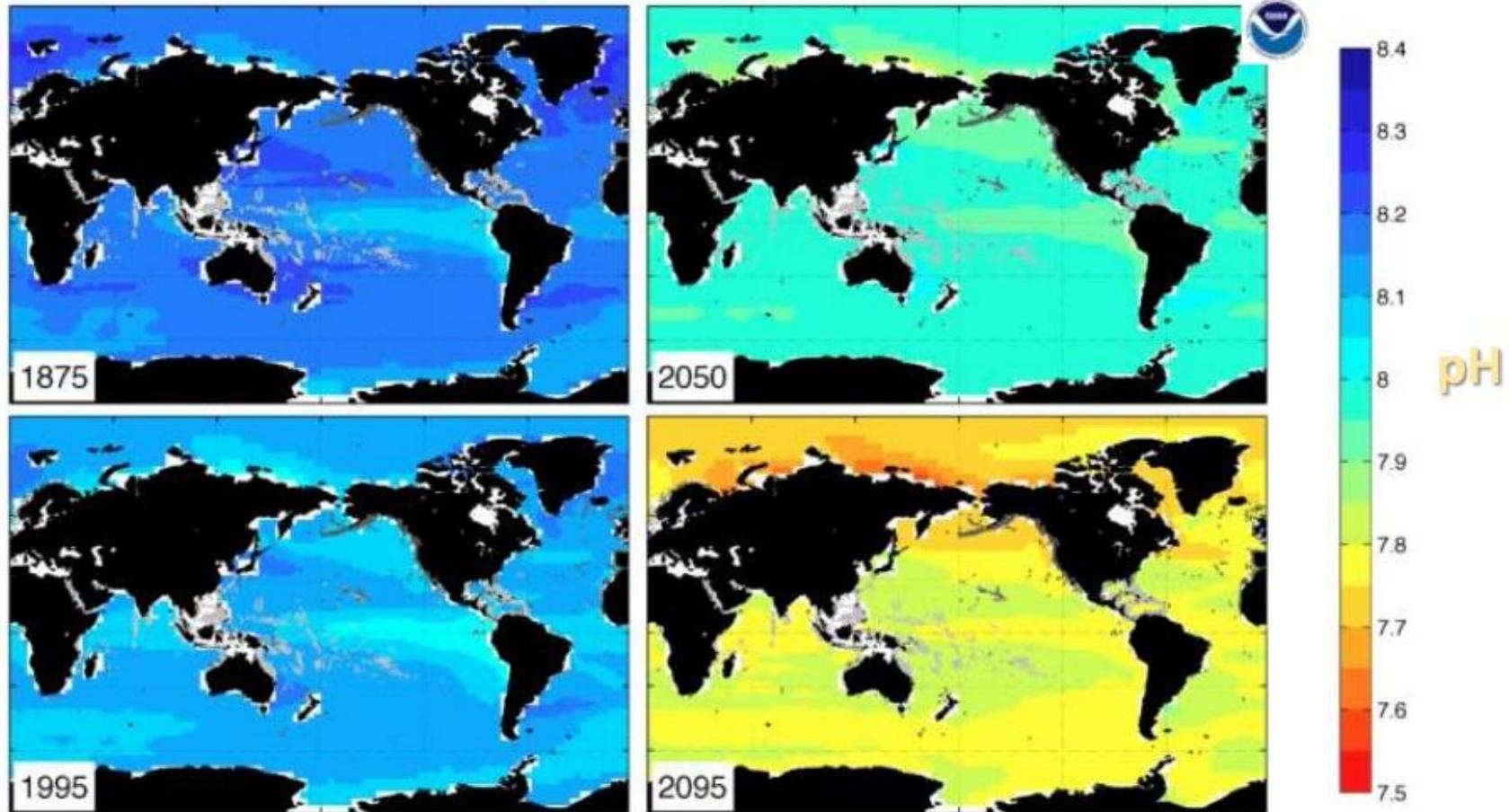
Carbon dioxide dissolves in the ocean to make carbonic acid. The amount of acid has increased over the past 150 years.

These changes in ocean chemistry can disrupt the entire marine food web.



pH distribution in surface waters

from the NCAR CCSM3 model projections using the IPCC A2 CO₂ Emission Scenarios



What is the difference between pH and acidity?

- pH is the scale on which acidity is measured, and so it describes how much acid is in a liquid.
 - A pH of 7 is neutral
- The amount of hydrogen ions in a liquid determines how acidic the liquid is.
 - A pH less than 7 is acidic
 - A pH greater than 7 is basic.



CO₂



• Direct effects

Ocean Acidification may reduce growth rates of juvenile fish, increasing the risk of predation.

• Foodweb effects

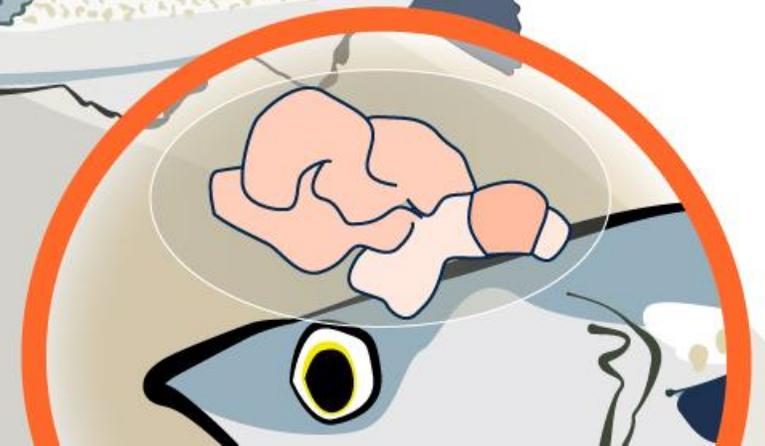
Ocean Acidification may reduce abundance of prey for pollock. In particular pteropods have been shown to be sensitive to Ocean Acidification

• Sensory effects

Ocean Acidification can interfere with sensory signals in the brain causing the fish to not recognize predators or prey. Ultimately

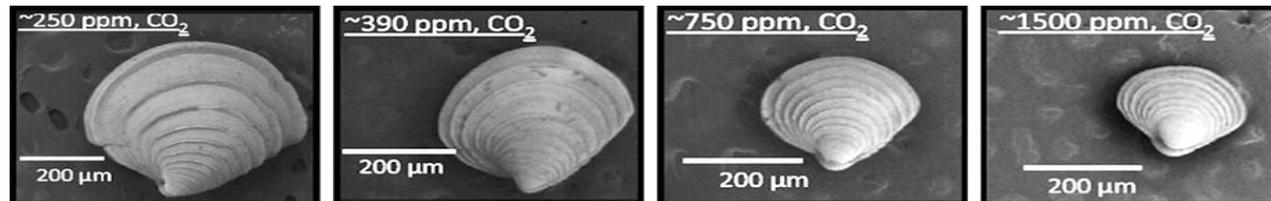
• Cumulative effects

Over time Ocean Acidification may reduce the overall productivity of fish stocks resulting in reduced commercial and subsistence harvest levels.



Some Issues with lower pH

- Calcium carbonate minerals are the building blocks for the skeletons and shells of many marine organisms.
- In areas where most life now congregates in the ocean, the seawater is supersaturated with respect to calcium carbonate minerals. This means there are abundant building blocks for calcifying organisms to build their skeletons and shells.
- However, continued ocean acidification is causing many parts of the ocean to become under-saturated with these minerals, which is likely to **affect the ability of some organisms to produce and maintain their shells.**



Aragonite & Calcite: Two forms of calcium carbonate in marine organisms

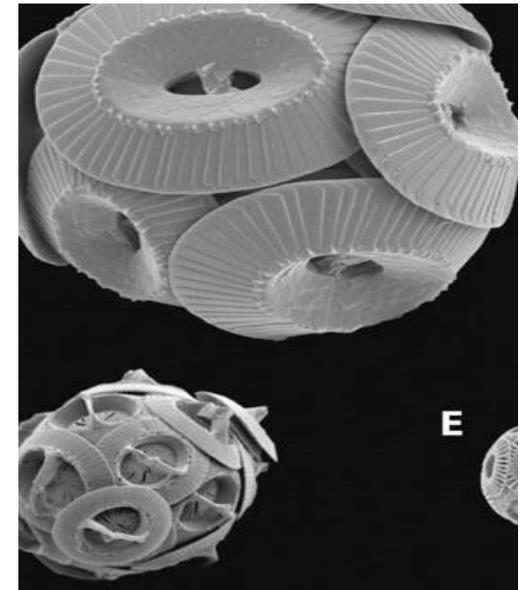
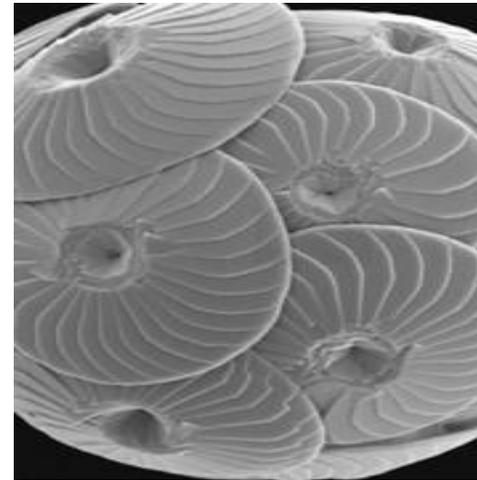
Aragonite

- Coral reefs, calcareous algae
- Dissolves more easily when carbonate concentrations fall



• Calcite

- Foraminifera, coccolithophorids
- More resistance to ocean acidification



/





Actively swimming pteropod in seawater with low surface CO₂ conditions that preserve the shell with no dissolution



Pteropod showing swimming difficulties and partially dissolved shell after exposure to elevated CO₂ conditions (1600 ppm) for 2 weeks



With Ocean acidification

Calcifying organisms must work harder to produce shells, and as a result –

- Have less energy left to find food, to reproduce or to defend against disease or predators
- Populations of some species may even go extinct

TROPICAL CORAL REEFS

- Corals must grow rapidly to outpace predation by fish and other organisms, and to compete for space with algae and sea grasses.
- Ocean acidification prevents reef building corals from growing fast enough to escape predation and competition, or to repair physical damage sufficiently.
- Slowed growth is not the only impact that ocean acidification could have on coral reefs
 - coral bleaching.



Neurological Effects : changes in ocean chemistry can affect the behavior of non-calcifying organisms as well.

- The ability of certain fish, like pollock, to detect predators is decreased in more acidic waters. Recent studies have shown that decreased pH levels also affect the ability of larval clownfish to locate suitable habitat.
- When subjected to lower pH levels, the larval clownfish lost their chemosensory ability to distinguish between their favored and protective anemone habitat among the reefs and unfavorable habitats like mangroves.
- Additionally, greater acidity impairs their ability to distinguish between the "smell" of their own species and that of predators. These two factors create an increased risk of predation.
- **When these organisms are at risk, the entire food web may also be at risk.**

Polar Ecosystem

CO₂ dissolves more rapidly in cold water, acidifying waters of polar regions faster than in lower altitudes.

Is there any advantage to higher CO₂ levels in our oceans?

- While some species will be harmed by ocean acidification, photosynthetic algae and seagrasses may benefit from higher CO₂ conditions in the ocean, as they require CO₂ to live just like plants on land.



Resources

- <https://www.khanacademy.org/science/biology/biodiversity-and-conservation/threats-to-biodiversity/v/ocean-acidification-and-biodiversity-impacts>
- <https://www.youtube.com/watch?v=6SMWGV-DBnk>
- <https://www.youtube.com/watch?v=8m1X26Auw6Q>
- <https://www.youtube.com/watch?v=dbMomQgl3Fk>
- <https://www.youtube.com/watch?v=GL7qJYKzcsk>

Teaching Resources

- <https://www.pbslearningmedia.org/resource/nvls-sci-acidification/what-is-ocean-acidification/>
- <https://www.biointeractive.org/classroom-resources/ocean-acidification>
- <https://www.coris.noaa.gov/activities/oa/multimedia.html>
- <https://www.climate.gov/teaching/resources/ocean-acidification>
- <https://legacy.aaos.org/alaska-ocean-acidification-network/oa-for-educators/>
- <http://ocean-acidification.net/for-everyone/>

Humanities Resources: Free full-texts available online

- <https://libguides.colostate.edu/English/ELfulltext>
- <https://www.loc.gov/rr/main/alcove9/literature/full-text.html>
- <https://pulitzercenter.org/stories/new-threat-oceans-deep-sea-mining-precious-metals>
- <https://pulitzercenter.org/blog/behind-story-alaska-natives-front-line>
- <http://www.gutenberg.org/ebooks/search/?query=literatures>
- <https://www.yesmagazine.org/issues/> (“What an Ecological Civilization Looks Like” Issue, Feb 2121)