# An Unexpected Side Effect To Ocean Acidity - Whales Will Call 70 Percent Farther

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As more and more greenhouse gases are released into the atmosphere and the oceans warm, their chemistry also changes — seawater becomes more acidic as carbon dioxide from the atmosphere dissolves.

According to a paper to be published this week by marine chemists at the Monterey Bay Aquarium Research Institute, these changes in ocean temperature and chemistry will have an unexpected side effect— sounds will travel farther underwater.

Estimates by the Intergovernmental Panel on Climate Change (IPCC) suggest that the chemistry of seawater could change by 0.3 pH units by 2050. In the October 1, 2008 issue of Geophysical Research Letters, Keith Hester and coauthors calculate that this change in ocean acidity would allow sounds to travel up to 70 percent farther underwater. This will increase the amount of background noise in the oceans and could affect the behavior of marine mammals.

Ocean chemists have known for decades that the absorption of sound in seawater changes with the chemistry of the water itself. As sound moves through seawater, it causes groups of atoms to vibrate, absorbing sounds at specific frequencies. This involves a variety of chemical interactions that are not completely understood. However the overall effect is strongly controlled by the acidity of the seawater. The bottom line is the more acidic the seawater, the less low- and mid-frequency sound it absorbs.

Thus, as the oceans become more acidic, sounds will travel farther underwater. According to Hester's calculations, such a change in chemistry will have the greatest effect on sounds below about 3,000 cycles per second (two and one half octaves above "middle C" on a piano).

This range of sounds includes most of the "low frequency" sounds used by marine mammals in finding food and mates. It also includes many of the underwater sounds generated by industrial and military activity, as well as by boats and ships. Such human-generated underwater noise has increased dramatically over the last 50 years, as human activities in the ocean have increased.

The MBARI researchers say that sound already may be traveling 10 percent farther in the oceans than it did a few hundred years ago. However, they predict that by 2050, under conservative projections of ocean acidification, sounds could travel as much as 70 percent farther in some ocean areas (particularly in the Atlantic Ocean). This could dramatically improve the ability of marine mammals to communicate over long distances. It could also increase the amount of background noise that they have to live with.

There are no long-term records of sound absorption over large ocean areas. However, the researchers cite a study off the coast of California showed an increase in ocean noise between 1960 and 2000 that was not directly attributable to known factors such as ocean winds or ships.

Hester says their research shows how human activities are affecting the Earth in far-reaching and unexpected ways. As they put it in their paper, "The waters in the upper ocean are now undergoing an extraordinary transition in their fundamental chemical state at a rate not seen on Earth for millions of years, and the effects are being felt not only in biological impacts but also on basic geophysical properties, including ocean acoustics."

Ocean acidification—background information

Over the last century, cars, power plants, and a variety of human activities have released hundreds of billions of tons of carbon dioxide ($CO_2$) into the Earth's atmosphere. In analyzing the effects of this planet-wide chemistry

experiment, scientists discovered that about half of this CO2 has been absorbed by the world's oceans. In the last five or ten years, chemical oceanographers say that adding carbon dioxide to the oceans has caused them to be more acidic, just as adding carbon dioxide to water causes the resulting soda water to become more acidic.

Chemists measure acidity using pH units, with a scale that runs from 0 (the most acidic) to 14 (the least acidic, or most basic). Neutral tap water, for example, has a pH of about 7. For comparison, lemon juice has a pH of about 2 and the acid in your car battery might have a pH of 0.8. Seawater, on the other hand, is usually slightly basic, with a pH of about 8.1.

Some marine chemists estimate that the pH of the world's oceans has already dropped by about 0.1 pH units since the beginning of the industrial revolution, about 250 years ago. They further estimate that the pH of the ocean may drop by another 0.2 pH units (to 7.9) by the year 2050. This may not seem like much of a change, but it could have significant impacts on corals and other marine organisms whose body chemistry is adapted to millions of years of relatively constant chemical conditions.

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Article: K. C. Hester, E. T. Peltzer, W. J. Kirkwood, and P. G. Brewer, Unanticipated consequences of ocean acidification: A noisier ocean at lower pH. 2008. Geophysical Research Letters, Vol. 35 #31 (October 1, 2008).