Oceans II ▪ By Thomas E. Lovejoy

Rising acidity threatens marine life

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The problems of acid rain and acid lakes, which came to public attention in the 1980s, have been addressed to a considerable degree. Today we face a far more profound challenge: increasingly acid oceans.

It is little known outside of scientific circles that a fundamental change has already taken place in the chemistry of the two thirds of the earth's surface occupied by oceans. The change, of 0.1 of a pH unit, sounds trivial when expressed in the logarithmic scale that science uses, but it translates to the upper layers of the oceans already being 30 percent more acid than in preindustrial times.

The change is being causes by increased atmospheric levels of greenhouse gases, in particular carbon dioxide. In addition to forcing climate change, more carbon dioxide combines with water and produces carbonic acid.

The consequences for marine ecosystems are only beginning to be understood but are bound to be far-reaching. Ocean acidification will affect the tens of thousands of species that build skeletons of calcium carbonate, including mollusks, corals and many other organisms known only to specialists that play important roles in marine ecosystems.

Coral reefs are icons of the sea. In many ways they are the most spectacular of marine ecosystems, and are of considerable importance to the nations that have them. They are already under serious stress: In addition to the effects of silt from deforestation and other human factors, they are suffering from elevated water temperatures, triggered by global warming, that cause the coral organisms to evict their symbiotic algal partners. Now they must also cope with increasing acidity.

One reason there are not higher levels of carbon dioxide in the atmosphere (and even more global warming) is that the oceans absorb a significant amount of carbon dioxide. Some of the gas has been converted to calcium carbonate by astronomical numbers of tiny calcifying organisms, whose skeletons sink to the bottom of the oceans, eventually becoming limestone. Ocean acidification will weaken this helpful process of sequestering carbon as calcium carbonate, and diminish both the amount of oxygen those organisms generate and their contribution to marine food chains.

As carbon dioxide levels in the atmosphere increase further, so will ocean acidity. With time the acidity will spread from surface waters deeper into the oceans. With current trends, the oceans will double in acidity from pre-industrial levels by the end of the century. The portions of the oceans supersaturated with calcium carbonate ("shell friendly" in the scientist Scott Doney's words) will shrink; in the rest, living organisms will be vulnerable to having their shells literally dissolve. That will affect their survival. Change will ripple through marine ecosystems.

So what can we do beyond fretting about the impacts and implications? In the acid rain era, one attempt to address the symptoms rather than the cause was to add limestone to lakes. Oceans are simply too big for such an approach and, in any case, much of the limestone is already in the oceans.

The only answer really is to stabilize greenhouse gas levels as rapidly as possible. The oceans are, after all, where life began, and they are telling us something hugely important. Were an annual physical to reveal analogous changes in human body chemistry, it would be cause for emergency action.

Thomas E. Lovejoy is president of the Heinz Center for Science, Economics and the Environment and co-editor of two books on climate change and the natural world.