Ocean Acidification

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(Note: While most of the information in this article will not change with time, the part about Alaska is no longer being maintained as of late 2014)

Carbon dioxide (CO_2) is the major polluting byproduct of the combustion of fossil fuels such as **coal**. In the atmosphere, it acts as a greenhouse gas, trapping heat and causing global climate change. However, this released CO_2 is also absorbed by the oceans, causing them to become more acidic. In recent years there has been an explosion of research focused on the effects of carbon dioxide levels on the chemistry of the world's oceans. This has been referred to as "the other CO_2 issue" and **can only be alleviated by a reduction of man-made carbon dioxide emissions** .

Oceans are a critical part of the Earth's **carbon cycle** , acting as a carbon "sink" that sponges up CO_2 from the atmosphere. They are estimated to have **absorbed up to 35% of the total man-made carbon dioxide emissions** , and have slowed down the process of climate change. However, this absorption of hundreds of billions of tons of CO_2 has the potential to harm marine life by changing the chemistry of the oceans.

Shells upon shells

A few barnacles on this whelk shell

Effects on Marine Life

When carbon dioxide is taken up by seawater, some of it is converted to **carbonic acid** (H_2CO_3) which has resulted in a **30% increase in ocean acidity** since the Industrial Revolution. The **acidification of the oceans** reduces the availability of **calcium carbonate** which is the crucial building block used for the shells of numerous organisms. These include not only **corals and edible shellfish such as clams, crabs, and oysters** but also various planktonic species which form the base of many marine food chains. If these species decline, so will the species that eat them.

Ocean acidification is a new and growing area of research. Possible proposed outcomes range from **increased rates of algal photosynthesis** to the **collapse of entire ecosystems** . Some impacts are most likely already occurring. Laboratory experiments have demonstrated that current and near-future levels of CO_2 in seawater have a damaging effect on many marine organisms (see Further Reading below). For example a **recent study** found that near-future projected levels of CO_2 had serious detrimental effects on the growth of ecologically and economically important shellfish species such as bay scallops, oysters, and clams. **Other work** has focused on the direct impacts to fish behavior. In contrast **a study** released in December 2009 found that while some species suffer under conditions of increased acidity, others may prosper. While particular outcomes are unknown, this large-scale change in ocean chemistry will most probably change the make-up of ocean ecosystems if CO_2 levels continue to rise.

Effects on Climate Change

In addition, the **rate at which the oceans are able to absorb CO_2 is decreasing** . As we continue to release CO_2 into the atmosphere, a lower percentage of that CO_2 will be sequestered in the ocean - more of

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it will stay in the atmosphere. More CO_2 in the atmosphere means more climate change. Man-made carbon dioxide emissions are **projected to continue** at high levels for some time, even using optimistic models. Under the "business-as-usual" scenario it is expected that by 2100 the oceans will be **300% more acidic then in pre-industrial times** and this would represent a **level of acidity not seen in the past 300 million years** . In addition, increasing acidity **may inhibit the growth** of the phytoplankton that normally serve to remove a significant portion of CO_2 from the atmosphere.

Ocean Acidification in Alaska

Surf is up

Waves break along the Gulf of Alaska's Lost Coast.

The very same elements that make Alaskan fisheries so productive, namely cold and shallow water, also allow them to absorb more carbon dioxide than the rest of the oceans. A **2009 study** led by a researcher from the University of Alaska in Fairbanks, has demonstrated that waters in the Gulf of Alaska are much more acidic than expected based on measurements in other oceans, and this matches similar findings in the Bering and Chukchi Seas. Increasingly acid waters will weaken crab and clam shells, potentially stressing their populations or increasing predation. Shellfish fisheries will be directly impacted, as will **subsistence harvesting**. And while fish such as salmon, halibut, and pollock are not directly affected by increasing acidity, their food supply will be. The tiny pteropod that makes up more than 50% of the pink salmon's diet has been shown to be susceptible to carbon dioxide levels and the survey of Alaska waters described above found that some places are already too acidic for this organism to form adequate shells.

The **Alaska Center for Climate Assessment and Policy (ACCAP)** has recently **released a video** describing ocean acidification and possible impacts in Alaska. In September 2010, the University of Alaska Fairbanks (UAF) ramped up research into ocean acidification with the creation of **a new research center** dedicated to the topic. In summer 2012 this center released **a report** documenting the changes in Alaskan marine resources due to ocean acidification. There are currently **three measuring buoys operating in the state** , one near Resurrection Bay, another west of Bristol Bay, and the most recent in the Beaufort Sea. The UAF research center recently received funding for additional buoys at Kodiak, the Bering Sea, and in the Southeast. Communities in Alaska are **"not panicked" but "concerned and curious"** about the impact of ocean acidification in the state. Recent efforts **are also focusing** on Kachemak Bay. In 2012 the state legislature approved funding for a new network of monitoring buoys, **the first of which** was scheduled to go into place in February 2013. Other monitoring efforts **ramped up** in the spring of 2014.

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