# Whaling and fishing for the largest species has altered carbon sequestering in oceans

September 6 2010

(PhysOrg.com) -- Decades of whaling and fishing for the largest species have altered the ability of oceans to store and sequester carbon, according to a team of marine researchers from the University of Maine, the University of British Columbia and the Gulf of Maine Research Institute (GMRI).

An individual whale contains a huge amount of carbon, an amount only exceeded by the largest trees, says Andrew Pershing, a research scientist with a joint appointment at UMaine and GMRI who led the team. A century of whaling equates to burning more than 70 million acres of temperate forest or 28,000 SUVs driving for 100 years, he says.

“We tend to think of carbon storage in peat bogs, trees and grasslands, not in animals,” Pershing says. “By removing whales, sharks and large fish, we’ve reduced the amount of carbon stored in these populations.”

Conserving larger marine vertebrate species and the largest individuals in the species should be a top conservation priority, according to the researchers, whose findings on the impact of whaling on the ocean carbon cycle were published last week (week of Aug. 30) by the international Public Library of Science (PLoS).

Carbon credits could provide additional incentive to rebuild fish and whale populations, Pershing says.

Ocean iron fertilization is the most widely discussed idea for sequestering carbon in the ocean. But calculations by Pershing and the other researchers — Line Christensen at the University of British Columbia; Nicholas Record and Peter Stetson from UMaine and GMRI; and Graham Sherwood from GMRI — suggest that rebuilding whale and large fish populations would be even more efficient means of storing carbon.

“The big surprise was in our calculations comparing carbon exported by sinking whale carcasses to the carbon exported by iron fertilization,” says Pershing, whose research was supported by NASA and the National Science Foundation. “If we had all the whales we used to have, they would remove the same amount of carbon in a year as 200 of the most efficient iron fertilization events. What that tells me is that we can get significant carbon savings by conserving resources in the ocean, protecting whales, larger fish and sharks.”

Dead, sinking phytoplankton cells are the primary means of removing carbon from the ocean’s euphotic zone near the surface. Marine vertebrates play a much smaller role in the movement and storage of inorganic and organic carbon in the ocean ecosystem. However, their contributions cannot be underestimated, considering the inherent metabolic efficiency of the large animals.

A blue whale has a biomass of 90 tons, with 9 tons of carbon stored in its tissues. Only a large tree has more carbon, Pershing says.

Compared to phytoplankton that have life spans measured in days, whales and large fish live for decades. Carbon accumulated in their bodies is sequestered — out of the atmosphere — for the life of the animal. Because of their potential to store carbon for years, marine vertebrates such as whales are comparable to trees.

And because of their size and few predators, whales and other big marine vertebrates can efficiently export carbon from the surface waters to the deep sea. Those that die natural deaths transport their carbon to the ocean depths, away from the atmosphere.

To study the consequences of removing these large animals on the ocean's ability to store carbon, the researchers looked at populations of whale species, reconstructing their pre-whaling and modern abundances. Those species include blue whales in the Southern Ocean, whose numbers have been reduced by more than 99 percent.

The researchers estimate that 100 years of whaling removed 23 million tons of carbon from marine ecosystems. Populations of large baleen whales now store only 15 percent of the carbon they had before whaling.

In those ecosystems heavily impacted by whaling, the populations of smaller species increased. But such a shift toward smaller animals could decrease the total community biomass by 30 percent or more, according to the researchers. The larger animals require less food per unit mass, more efficiently storing carbon than smaller animals.

Compared to smaller animals, bigger species require less food (carbon) per day to support each gram of tissue. The same amount of food can support a greater tonnage of whales than penguins, Pershing says.

"In many ways bigger is better," Pershing says. "Larger organisms are more efficient, requiring less food per unit in their bodies."

Provided by The University of Maine