Marine reserves help mitigate against climate change, say scientists

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An international team of scientists has concluded that "highly protected" marine reserves can help mitigate the effects of climate change and suggests that these areas be expanded and better managed throughout the world.

Globally, coastal nations have committed to protecting 10 percent of their waters by 2020, but thus far only 3.5 percent of the ocean has been set aside for protection - and less than half of that (1.6 percent) is strongly protected from exploitation. Some scientists have argued that as much as 30 percent of the ocean should be set aside as reserves to safeguard marine ecosystems in the long-term.

Results of the study, which evaluated 145 peer-reviewed studies on the impact of marine reserves, is being published this week in *Proceedings of the National Academy of Sciences*.

"Marine reserves cannot halt or completely offset the growing impacts of climate change," said Oregon State University's Jane Lubchenco, former National Oceanic and Atmospheric Administration (NOAA) Administrator and co-author on the study. "But they can make marine ecosystems more resilient to changes and, in some cases, help slow down the rate of climate change.

"Protecting a portion of our oceans and coastal wetlands will help sequester carbon, limit the consequences of poor management, protect habitats and biodiversity that are key to healthy oceans of the future, and buffer coastal populations from extreme events," Lubchenco said. "Marine reserves are climate reserves."

The scientists say marine reserves can help protect ecosystems - and people - from five impacts of climate change that already are taking place: ocean acidification, rising sea levels, an increase in the severity of storms, shifts in the distribution of species, and decreased ocean productivity and availability of oxygen.

Lead author Callum Roberts, from the University of York, said that many studies already have shown that marine reserves can protect wildlife and support productive fisheries. The goal of this peer-reviewed literature-study was to see whether the benefits of marine reserves could ameliorate or slow the impacts of climate change.

"It was soon quite clear that they can offer the ocean ecosystem and people critical resilience benefits to rapid climate change," Roberts said.

The benefits are greatest, the authors say, in large, long-established and well-managed reserves that have full protection from fishing and mineral extraction, and isolation from other damaging human activities.

The study notes that ocean surface waters have become on average 26 percent more acidic since pre-industrial times, and by the year 2100 under a "business-as-usual" scenario they will be 150 percent more acidic. The authors say coastal

wetlands - including mangroves, seagrasses and salt marshes - have demonstrated a capacity for reducing local carbon dioxide concentrations because many contain plants with high rates of photosynthesis.

"Unfortunately," Lubchenco said, "these ecosystems are some of the most threatened coastal areas and have experienced substantial reductions in the past several decades. Wetland protection should be seen as a key element in achieving greater resilience for coast communities."

Coastal wetlands, along with coral and oyster reefs, kelp forests and mud flats, can help ameliorate impacts of rising sea levels and storm surge. The average global sea level has risen about seven inches since 1900, and is expected to increase nearly three feet by the year 2100, threatening many low-lying cities and nations. The dense vegetation in coastal wetlands can also provide protection against severe storms, which are increasing in intensity in many parts of the world.

Climate change already is having a major impact on the abundance and distribution of marine species. Phytoplankton communities are changing in response to warming, acidification and stratifying oceans, and upper trophic level species are being affected, threatening global food security. Climate change interacts with and exacerbates other stressors like overfishing and pollution, the researchers say.

Reducing some stressors can increase the resilience of species and ecosystems to impacts of other stressors.

"We have seen how marine reserves can be a haven for some species that are under duress from over-fishing or habitat loss, and as a 'stepping-stone' for other species that are recolonizing or moving into new areas," Lubchenco said. "Reserves also promote genetic diversity and provide protection for older fish and other marine organisms. In short, reserves are one of the most powerful tools in our adaptation toolbox. Reserves enhance the resilience of marine ecosystems, and thus our resilience."

Lubchenco, who recently completed a two-year term as the first U.S. Science Envoy for the Ocean, has been involved in research at Oregon State on the interactions between people and marine ecosystems. She has led pioneering studies on coastal hypoxia (so-called "dead zones") and innovative ways to achieve sustainable fishing and other uses of the ocean.

The authors point out that effectiveness of marine reserves is often challenged by lack of staff, equipment and funding; inconsistent management; lack of communication with industry and local communities; and concerns about displacing fishing activities. But, they point out, these challenges can be resolved. Their findings that reserves enhance the resilience of marine ecosystems suggests that reserves may offer the best hope to adapt to a changing climate.

"Marine reserves will not halt, change or stop many of the threats associated with climate change affecting communities within their boundaries," they write. "We contend, however, that existing and emerging evidence suggests that (marine reserves) can serve as a powerful tool to help ameliorate some problems resulting from climate change, slow the development of others, and improve the outlook for continued ecosystem functioning and delivery of ecosystem services."

More information: Callum M. Roberts el al., "Marine reserves can mitigate and promote adaptation to climate change," *PNAS* (2017). www.pnas.org/cgi/doi/10.1073/pnas.1701262114

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