

MPA NEWS



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How MPAs can help mitigate impacts of climate change via coastal blue carbon, “fish carbon”, and more

When nations gathered in Paris last December to forge a pact on climate change, the agreement's original text made no mention at all of oceans. Not only did this oversight ignore 71% of Earth's surface; it also overlooked the fact that marine ecosystems act as an enormous climate control system.

The seas regulate the concentration of atmospheric CO₂ worldwide by absorbing and storing it in a variety of ways. A healthy, resilient ocean - where there is abundant plant life to convert CO₂ to oxygen, and abundant animal populations to store carbon in their shells, bodies, and wastes - may be key to helping mitigate the impacts of climate change.

Marine protected areas can play a role in fostering that healthy, resilient ocean. To be sure, addressing the enormous threat of global climate change will require much, much more than just MPAs. But MPAs do offer legitimate ways to store carbon and to offset some of the impacts of a changing climate. And practitioners are starting to explore some of these opportunities.

MPAs and coastal blue carbon

There is 50 times more carbon in the ocean than in the atmosphere (<https://oct.to/Zk6>). Most of the ocean carbon - about 98% - is dissolved as organic and inorganic matter in the deep ocean and seafloor sediment. Once carbon is at such depths, it generally remains stored for the long term. The rest of the carbon exists in oceans' surface layers, from where there is regular exchange with the atmosphere. For example, at least half of the oxygen we breathe comes from marine plants, which absorb CO₂ and convert it to O₂ through photosynthesis.

When carbon is absorbed and stored by oceanic plants, it is called blue carbon: the storage removes carbon from the atmosphere for years or decades or longer, thus helping to counter the impact of climate change. Mangrove forests, salt marshes, and seagrass beds are examples. When these habitats grow, they capture and store carbon as living plant material and in the sediment below them. When the habitats are destroyed, however, much of their carbon is released back to the atmosphere and ocean.

"MPAs as a management tool play a very important role for blue carbon ecosystems," says Dorothee Herr, IUCN's coordinator of the International Blue Carbon Initiative, which helps develop management approaches and engage governments on the issue (<http://thebluecarboninitiative.org>). "By protecting these areas, MPAs help reduce and avoid carbon emissions from blue carbon ecosystems. And when the MPAs involve active ecosystem restoration - such as of mangroves, saltmarshes, and seagrasses - they also help increase carbon sequestration."

Herr cites a 2015 paper by Daniela Miteva of Duke University (<https://oct.to/Zku>) that evaluated the effectiveness of protected areas in Indonesia at conserving mangroves and reducing blue carbon emissions. The findings: MPAs reduced mangrove loss by about 140 km² between 2000 and 2010, and avoided blue carbon emissions of approximately 13 million metric tons (CO₂ equivalent).

"The goal of coastal blue carbon efforts is to incentivize better management of these systems using a variety of climate change policies and financial incentives," says Herr. These approaches include the UN's Reducing Emissions from Deforestation and Forest Degradation (REDD+) program, which creates a financial value for the carbon stored in forests, and offers financial incentives for developing nations to foster conservation and enhancement of their forest carbon stocks (<http://www.un-redd.org>). IUCN released a report in January 2016 on using climate finance and other financial mechanisms to support coastal wetland programs and projects: <https://oct.to/ZkL>.

Some MPAs are already assessing how blue carbon can factor in their sites' services and, potentially, finances. In the Dominican Republic, the 550-km² Montecristi National Park hosted blue carbon research conducted by Counterpart International, a US-based NGO. That research, which quantified the amount of carbon stored in the park's mangroves, has served as a cornerstone for the ongoing development of a Blue Carbon NAMA (Nationally Appropriate Mitigation Action) for the Dominican Republic. The NAMA will eventually provide financial mechanisms and incentives for local communities to sustain and expand mangrove coverage in and around protected areas nationwide.

"Most of the Dominican Republic's mangrove resources are located in protected areas," says Paul Guggenheim, Counterpart's country representative. He notes a national ban on clearing of mangroves within protected areas is regularly enforced. The designation of the MPAs has allowed local stakeholders and government agencies to develop a clear institutional and legal framework to conserve the mangroves.

Guggenheim adds, though, that other blue carbon ecosystems such as estuarial wetlands and seagrasses are in both protected and unprotected areas in the Dominican Republic. Thus unprotected areas must also be considered as part of a holistic national strategy. "While MPAs are a valuable tool, complementary national laws and international agreements are also invoked in the country's approach to conserving sources of blue carbon," he says. For example, the national law that created the Ministry of Environmental and Natural Resources repeatedly states the importance of conserving mangrove ecosystems.

In Costa Rica, the 306-km² Térraba-Sierpe National Wetland, which contains roughly 40% of the nation's mangrove area, hosted blue carbon research in 2012. The study was the first-ever ecosystem-level carbon inventory conducted in the Central America/Caribbean region.

Miguel Cifuentes Jara, a scientist with Costa Rica's Tropical Agricultural Research and Higher Education Center (CATIE), led the Térraba-Sierpe research, as well as later studies of other mangroves in Costa Rica, El Salvador, and Panama. "As I've collected more data and shared it with other researchers and decision-makers, interest in blue carbon has increased," he says. "My working group supported the development of a draft blue carbon policy statement for Costa Rica in 2014-2015."

He notes that because Costa Rica's forestry law is so stringent - no land use change from forest to other uses is allowed, inside or outside protected areas - it is difficult to say whether protected area status is essential for blue carbon in Costa Rica ("...although it may very well be essential elsewhere in Central America," he says). Costa Rica's net balance of forest cover is positive. That being said, blue carbon could eventually be good for Térraba-Sierpe's management: there is an independent initiative underway, promoted by Germany's international development organization, to develop a blue carbon-based financial mechanism for the park and other MPAs in Costa Rica (<https://oct.to/Zkz>).

There is no "one size fits all" blue carbon solution or mechanism suitable for every country or project, says IUCN's Herr. It is up to countries, with the help of IUCN and others, to assess what type of blue carbon policy and financial incentives best fit their national circumstances, taking into account the coastal management policies and practices - including MPAs - that are in place already. "Blue carbon cannot happen in isolation to the conservation and management efforts already happening on the ground," she says.

The emerging science of "fish carbon"

A 2014 report by GRID-Arendal and Blue Climate Solutions added a new term to the field of climate change mitigation: fish carbon. The report *Fish Carbon: Exploring Marine Vertebrate Carbon Services* (<http://www.grida.no/publications/fish-carbon/>) - looked beyond the blue carbon of coastal areas. It highlighted the direct relevance of marine vertebrates, including fish and marine mammals in the open ocean, to climate change mitigation via an array of natural mechanisms. It also stressed the importance of conserving marine vertebrates in order to protect their mitigation services.

The report, which aimed to stimulate further work on the topic, outlined eight mechanisms for fish carbon:

1. **Trophic Cascade Carbon:** Food web dynamics help maintain the carbon storage and sequestration function of coastal marine ecosystems (e.g., how a kelp forest is maintained by herbivory and predation).
2. **Biomixing Carbon:** Turbulence and drag, associated with the movement of marine vertebrates, causes enhanced mixing of nutrient rich water from deeper in the water column toward the

surface, where it enhances primary production by phytoplankton and thus the uptake of dissolved CO₂.

3. **Bony Fish Carbonate:** Bony fish excrete metabolized carbon as calcium carbonate (CaCO₃) enhancing oceanic alkalinity, potentially providing a buffer against ocean acidification.
4. **Whale Pump:** Nutrients from the fecal material of whales stimulate enhanced primary production by phytoplankton, and thus uptake of dissolved CO₂.
5. **Twilight Zone Carbon:** Mesopelagic fish feed in the upper ocean layers during the night and transport consumed organic carbon to deeper waters during daylight hours, where it is released as fecal pellets.
6. **Biomass Carbon:** Marine vertebrates accumulate and store carbon in the ocean as biomass throughout their natural lifetimes, with larger individuals storing proportionally greater amounts over prolonged timescales.
7. **Deadfall Carbon:** The carcasses of large pelagic marine vertebrates sink through the water column, exporting carbon to the ocean floor where it becomes incorporated into the benthic food web and is sometimes buried in sediments (a net carbon sink).
8. **Marine Vertebrate Mediated Carbon:** Marine vertebrates consume and repackage organic carbon through marine food webs, which is transported to deep waters by rapidly sinking fecal material.

"Although in very early stages, the science suggests that the contribution of marine vertebrates to carbon capture and storage may be significant," says Angela Martin, co-author of the report with Steven Lutz. "This would potentially allow for protection of marine biodiversity for carbon services, using the precautionary principle."

It is not hard to see the potential links between fish carbon mechanisms and the protection that can be provided for vertebrates by MPAs. Lutz says MPAs will be a very important management option for conserving, restoring, and enhancing fish carbon services. "MPAs and fish carbon could benefit each other if the financial and intrinsic value of fish carbon can be harnessed to support and inform sustainable management policies such as MPAs," he says.

It may take some time to get there: quantification of any one species's contribution to carbon capture and storage, and net carbon impacts, remains to be done. Martin and Lutz say the scientific community and policy-makers are not yet ready to make the leap to action on fish carbon. "In this vein, we have developed a number of targeted research projects, including one that will consider the spectrum of specifically whale carbon services in the Cook Islands, which can be used to inform MPA management there," says Lutz. They are currently seeking funding for these projects.

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Box: Protecting healthy wetlands as a defense against extreme weather events

Coastal wetlands can be an important source of blue carbon, as described in the adjacent article. But that's not the only role they can play in helping to mitigate climate change. Mangrove forests in particular protect upland areas against flooding and erosion, as caused by sea level rise and storms. With extreme weather events expected to become more frequent due to climate change, and with sea levels already increasing, healthy mangrove ecosystems will grow ever more important to coastal communities.

For resources on how mangroves reduce wind swell and waves and reduce storm surge along coasts, go to <http://coastalresilience.org/our-work/habitats>

Box: More resources on climate change and the relevance of MPAs

"Protection of our oceans must go hand-in-hand with the fight against climate change", editorial by Tommy Remengesau, Jr., President of Palau

<https://oct.to/ZkD>

The Blue Carbon Initiative

<http://thebluecarboninitiative.org>

Blue Carbon Portal

<http://bluecarbonportal.org>

GEF Blue Forests Project

<http://www.gefblueforests.com/>

CAKE (Climate Adaptation Knowledge Exchange)

<http://cakex.org>

Coastal Blue Carbon manual: methods for assessing carbon stocks and emissions factors in mangroves, tidal salt marshes, and seagrass meadows

<https://oct.to/ZkR>

Paris Climate Agreement

http://unfccc.int/files/home/application/pdf/paris_agreement.pdf

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