Caribbean seagrasses provide services worth $255B annually, including vast carbon storage, study shows

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Discussions of valuable but threatened ocean ecosystems often focus on coral reefs or coastal mangrove forests. Seagrass meadows get a lot less

attention, even though they provide wide-ranging services to society and store lots of climate-warming carbon.

But the findings of a new University of Michigan-led study show that seagrass ecosystems deserve to be at the forefront of the global conservation agenda, according to the authors. It's the first study to put a dollar value on the many services—from storm protection to fish habitat to carbon storage—provided by seagrasses across the Caribbean, and the numbers are impressive.

Using newly available satellite data, the researchers estimate that the Caribbean holds up to half the world's seagrass meadows by surface area , and it contains about one-third of the carbon stored in seagrasses worldwide.

They calculated that Caribbean seagrasses provide about $255 billion in services to society annually, including $88.3 billion in carbon storage.

In the Bahamas alone, the ecosystem services provided by seagrasses are valued at more than 15 times the country's 2020 gross domestic product, according to the study published online June 21 in the journal *Biology Letters.*

"Our study is the first to show that seagrass beds in the Caribbean are of global importance in their areal extent, in the amount of carbon they store, and in the value of the economic services they provide to society," said study lead author Bridget Shayka, a doctoral student in the U-M Department of Ecology and Evolutionary Biology.

"The findings underscore the importance of conserving and protecting these highly threatened and globally important ecosystems, which are critical allies in the fight against climate change."

One way to prioritize seagrass conservation would be to include those verdant undersea meadows in global carbon markets through projects that minimize loss, increase areal extent or restore degraded beds.

The idea of selling "blue carbon" offset credits, which monetize carbon stored in coastal and marine ecosystems, is gaining traction for several reasons.

For one, many island nations that have already been impacted by climate change—through increasingly intense hurricanes or rising sea levels, for example—have large areas of valuable coastal ecosystems that store carbon and that provide other services to society.

Blue carbon (the name refers specifically to carbon stored in coastal and open-ocean ecosystems while "green carbon" refers more broadly to carbon stored in all natural ecosystems) offset credits could be a way for wealthier countries to compensate for their contribution to human-caused climate change while at the same time benefiting the economies of impacted countries and helping to conserve coastal ecosystems, which are among the most impaired in the world.

Threats to seagrass meadows include coastal development, chemical pollution, recreation, shipping and climate change.

"Because seagrass ecosystems are both highly important for carbon storage and sequestration, and are highly degraded globally, they represent an important burgeoning market for blue carbon," said marine ecologist and study senior author Jacob Allgeier, an associate professor in the U-M Department of Ecology and Evolutionary Biology.

"Yet, to date, a fundamental impediment to both evaluating seagrass and promoting it in the blue carbon market has been the lack of thorough seagrass distribution data."

For their study, the U-M-led team used newly available seagrass distribution data collected by the PlanetScope constellation of small DOVE satellites. They classified Caribbean seagrass ecosystems as either sparse or dense and estimated the amount of carbon in plants and sediments using data from Thalassia testudinum, the dominant seagrass species in the region.

The researchers then calculated a conservative economic value for the total ecosystem services provided by seagrasses in the Caribbean and for the stored carbon, using previously published estimates for the value of services including food production, nursery habitat for fishes and invertebrates, recreation and carbon storage.

Grouper, queen conch and lobster are among the commercially harvested animals that rely on Caribbean seagrass. Green sea turtles, tiger sharks and manatees also depend on it.

To estimate the dollar value of the carbon stored in Caribbean seagrass beds, the researchers used $18 per metric ton of carbon dioxide equivalents, borrowed from California's cap and trade program.

In addition to Caribbean-wide estimates, the researchers calculated values for individual countries in the region:

- The Bahamas has the largest share of Caribbean seagrass (61%), providing total ecosystem services valued at $156 billion annually, including $54 billion in carbon storage.

- Cuba ranks second in areal seagrass coverage (33% of the Caribbean total), with a value of $84.6 billion per year for all ecosystem services, including $29.3 billion for carbon storage.

- The dollar value of the carbon in seagrasses around Cuba is

equivalent to 27% of the country's 2020 GDP.

"Importantly, the degradation of seagrass beds often leads to erosion and sediment resuspension, which can create a positive feedback of increased seagrass loss and the release of C stored in sediments," the authors wrote. "Blue carbon finance thus represents a potential mechanism by which the global community can invest in conserving and protecting these vital ecosystems."

More than 60 species of seagrasses grow in shallow coastal waters around the world. They evolved from land plants that recolonized the oceans 70 to 100 million years ago.

In a separate paper accepted for publication in the journal *Proceedings of the Royal Society*, Allgeier and colleagues show that the construction of artificial reefs in the Caribbean can help protect seagrass ecosystems from human impacts, including nutrient pollution and overfishing.

Seagrasses use photosynthesis to pull carbon dioxide from the atmosphere, then store the carbon in plant tissues. The seagrasses are quickly inundated by sediments, slowing decomposition. As a result, more than 90% of the carbon stored in seagrass beds is in the top meter of sediment.

Caribbean seagrasses and associated sediments store an estimated 1.3 billion metric tons of carbon, according to the new study. That's a big number, but it's just 1.09% of the carbon contained in above- and below-ground woody biomass in the Amazon, and just 1.12% of the carbon in the biomass and soils of the world's temperate forests, according to the new study.

More information: Bridget F. Shayka et al, The natural capital of seagrass beds in the Caribbean: evaluating their ecosystem services and

blue carbon trade potential, *Biology Letters* (2023). DOI: 10.1098/rsbl.2023.0075

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