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Kachemak Bay Research Reserve in Homer, Alaska. Credit: National Ocean Service

The Carbon/Methane Balance Sheet Problem

By Mark Fogarty

Sometimes carbon sequestration is two steps forward and one step back. That certainly seems to be the case when it comes to coastal eco-system carbon sequestration and methane emission.

A multi-author article from Nature Communications, "Methane emissions offset atmospheric carbon dioxide uptake in coastal macroalgae, mixed vegetation and sediment ecosystems," details a definite mixed bag from a study of the Baltic Sea.

Coastal ecosystems take in huge amounts of carbon dioxide from the atmosphere, but researchers are still deciphering how much methane, a far more potent greenhouse gas, they put back into the system.

As reviewed by Ruth Kamnitzer at mongabay.com, the scholarly article sketches a portrait of "coastal carbon sink complexity." Her takeaways are these:

- Coastal ecosystems take in huge amounts of carbon dioxide from the atmosphere, but researchers are still deciphering how much methane, a far more potent greenhouse gas, they put back into the system.

- Researchers studying seaweed and mixed vegetation habitats in the Baltic Sea found they emit methane equivalent to 28% and 35% respectively of the CO2 they absorb.

- The findings highlight more work is needed to understand methane emissions in different coastal areas to get a better accounting of the carbon balance sheet.

"Coastal ecosystems are very good at pulling carbon out of the atmosphere," she writes. "But we also need to look at what they're putting back in."

Kamnitzer notes coastal ecosystems are huge carbon sinks, citing three "blue carbon" areas: mangrove forests, seagrass meadows and salt marshes. (Seaweed is a potential fourth.)

But there's a catch, she feels.

"Marine areas can also give off methane, a far more potent greenhouse gas than carbon dioxide. And most of that marine methane is also coming from coastal areas."

Also, there is no consensus yet on the carbon/methane coastal balance, making this recent Baltic Sea study a valuable potential benchmark.

"Researchers from Stockholm University and the University of Finland found that habitats of bladderwrack seaweed (Fucus vesiculosus) emit methane that's equivalent to 28% of the CO2 that they absorb. In mixed vegetation habitats, they found that methane emission amounted to 35% of the CO2 intake."

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She wrote the study "highlights that concurrent measurements of both gases are needed to make an overall statement about whether these systems are sinks or sources of carbon-based greenhouse gases."

To get a large sample size without having to take constant manual measurements, Kamnitzer writes, "the research team built a unique automated system that took continuous measurements of CO2 and methane in three habitat types common in the Baltic Sea: bladderwrack, mixed vegetation, and bare sediment areas. The system was stationed on a small houseboat in a shallow bay off Askö Island in Sweden.

"The team also took sediment and vegetation samples by hand, wading out from shore or working from a small rowboat. In summer the water was warm, according to leader Roth, but in winter they had to don dry suits and brave the ice-covered waters."

She notes the team was surprised by the large amount of methane coming from bladderwrack stands.

This is one of the first studies looking at methane versus carbon in seaweed habitats, the author notes.

"Even studies on the interplay between different greenhouse gases in blue carbon ecosystems are scant: a review published in Global Biogeochemical Cycles in 2021 found that the high variability of methane and nitrous oxide emissions in blue carbon ecosystems means much more research is needed to understand how these might counterbalance their sink potential."

Seasonal net greenhouse gas balances. Methane is the simplest of saturated hydrocarbons and has a chemical formula of CH4. Methane emissions offset atmospheric carbon dioxide uptake in coastal macroalgae, mixed vegetation and sediment ecosystems, *Nature Communications*, January 2023.