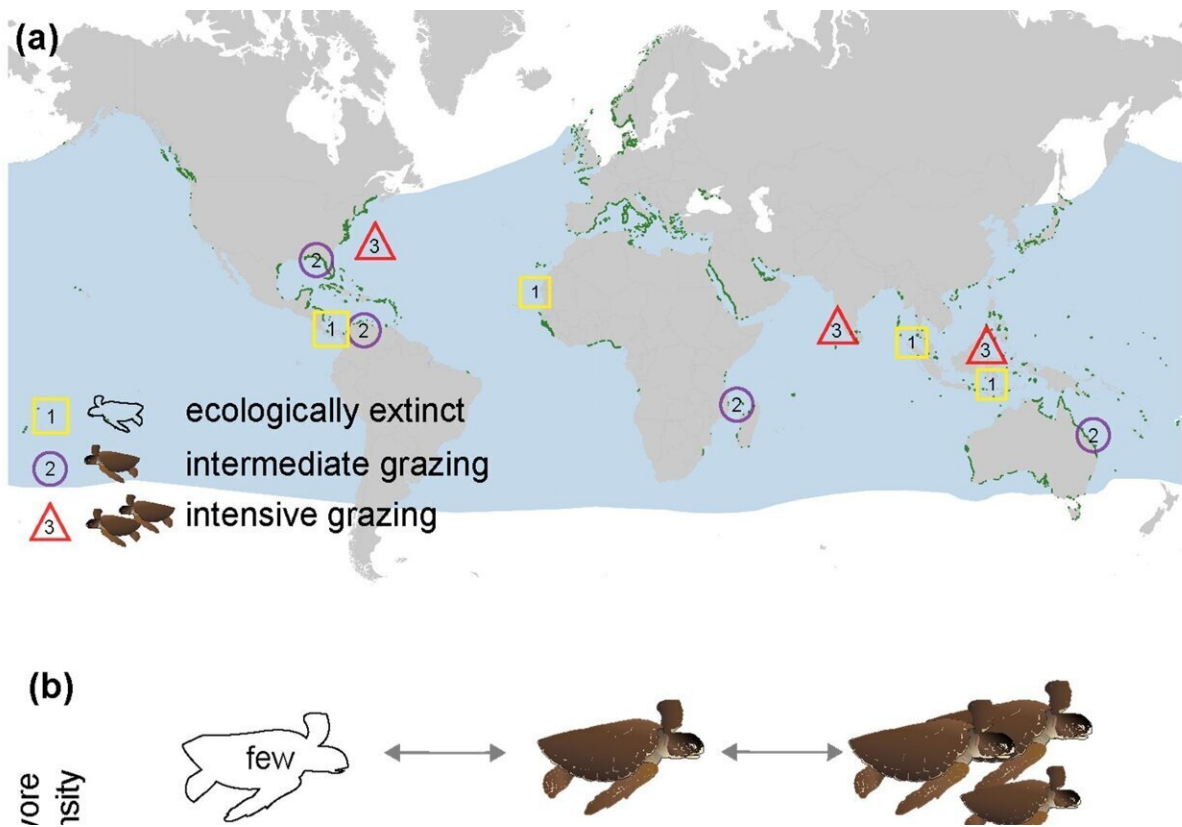


# Sea turtles are returning, but what are the effects on coastal ecosystems?

November 4 2022

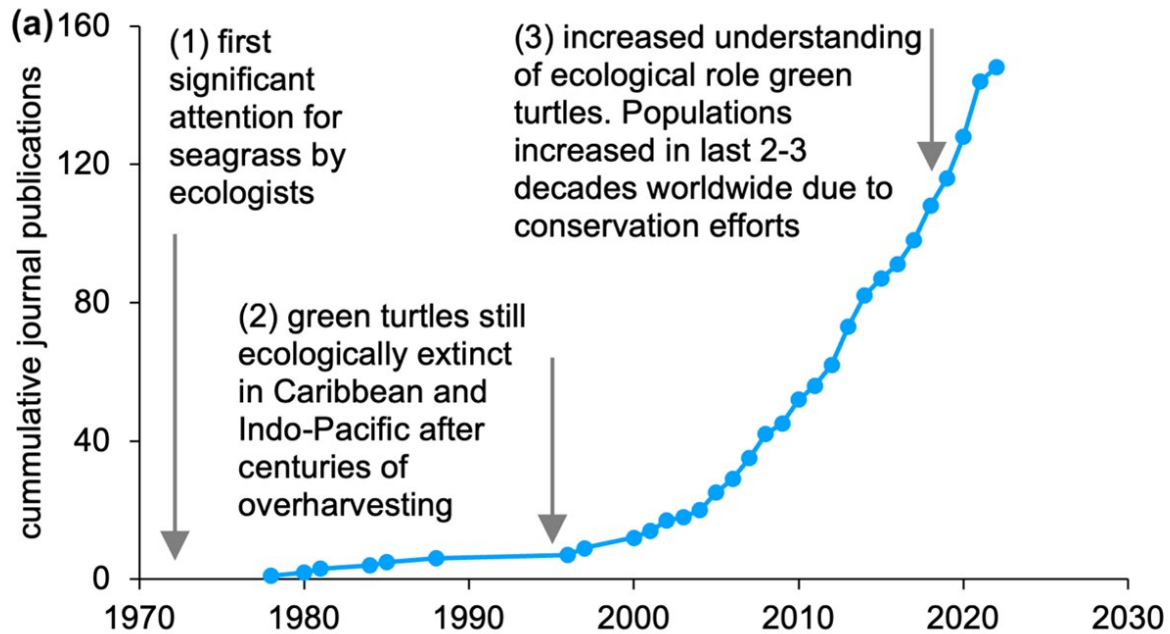


Three scenarios of megaherbivore grazing intensity can be observed in tropical seagrass ecosystems with green turtles as megaherbivores worldwide (Fig a). The turtle's ecological role is rapidly unfolding in numerous foraging areas where populations are recovering through conservation after centuries of decline, with an increase in recorded overgrazing episodes. In field experiments, researchers assessed the effects of simulated grazing intensity scenarios on ecosystem functions and multifunctionality (Fig b) in a tropical Caribbean seagrass ecosystem over an 18-month period. Credit: Wageningen University

Sea turtles have been overharvested in the past, resulting in their endangered population status. But over the last two decades, their populations have recovered in certain areas around the world, and their ecological role is unfolding. The seagrass meadows they feed on are returning to their naturally grazed state as a result. Some are even becoming overgrazed. How does the return of the sea turtle affect the functioning of coastal ecosystems?

A research team analyzed the seagrass ecosystem value (such as coastal protection and carbon storage) along a turtle grazing area from low to high. In experiments, they determined the impact of recovering [sea turtle populations](#) on ecosystem functioning. The team, led by Wageningen University, with colleagues from the Netherlands and the Dutch Caribbean, recently published their findings in *Global Change Biology*.

Seagrass meadows provide us with a range of goods and services. For example, they provide a habitat and food for many commercially important fish species. They also help protect the coast by stabilizing sediment, and reducing wave energy. With the return of the large herbivore—the sea turtle—it is important to quantify their impact on the [ecosystem services](#) a seagrass meadow can provide. Often these services are measured separately, but in the new study, the most essential services have been assessed together to assess the ecosystem's multifunctionality.



The number of publications on seagrass and green turtle grazing in peer-reviewed journals is accelerating over time (Web of Science, Scopus, Google Scholar 1960-2022, SI text 1), mirroring the recovery of green turtle populations. Credit: Wageningen University

## Combining ecosystem services in one index

"Our approach to measuring different ecosystem functions simultaneously and combining these in one ecosystem-multifunctionality-index is new for [marine habitats](#) and led to striking results," says Marjolijn Christianen, lead investigator of the study.

"We found that medium turtle grazing pressure increased carbon storage and nutrient cycling in [seagrass meadows](#). On the other hand, fish biomass and other services were higher in meadows without turtle grazing. More importantly, we found a simultaneous collapse of all these services under severe turtle grazing pressure."

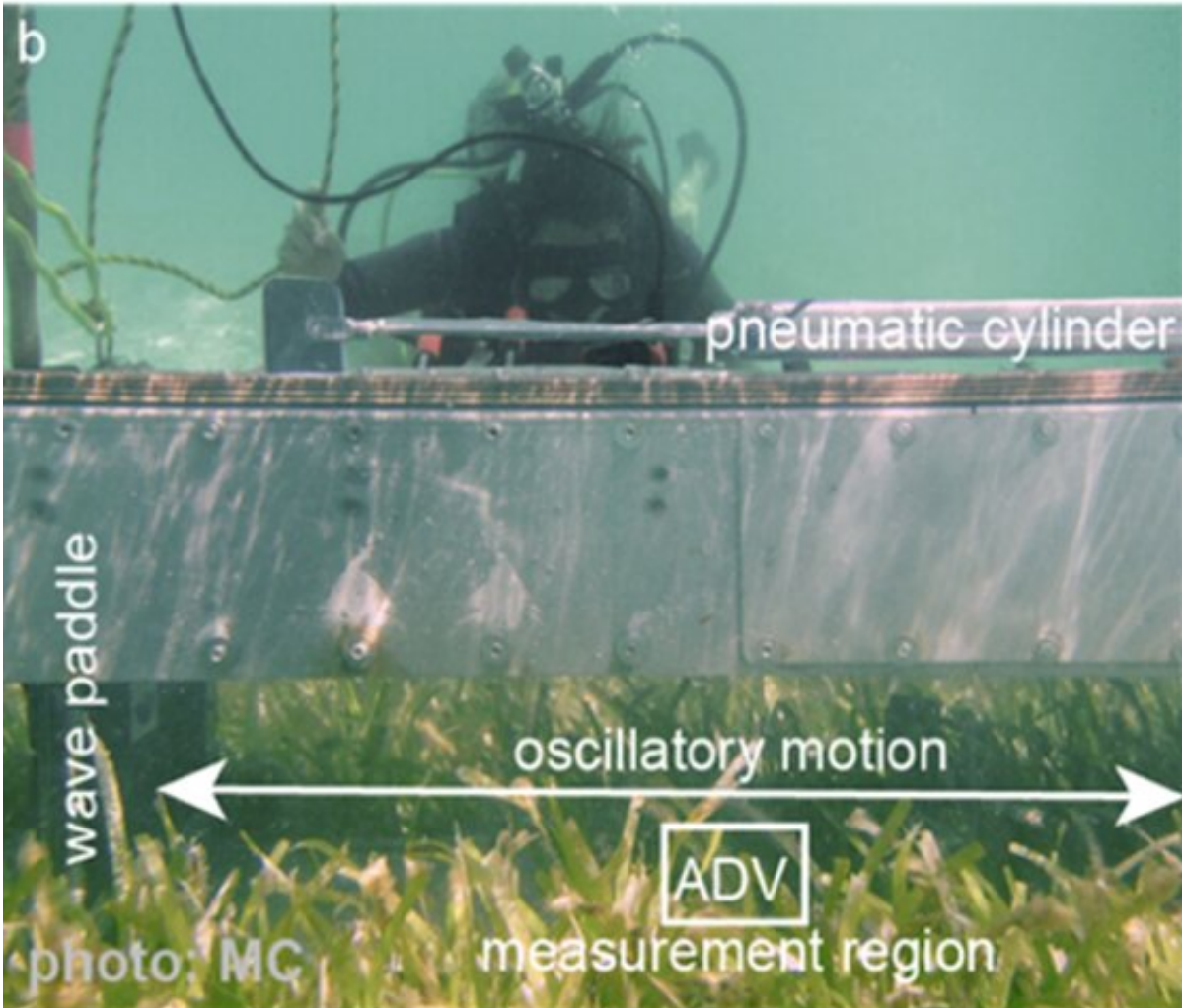
Based on these results, the authors argue that the successful return of the sea turtle should be accompanied by the protection of their habitat, seagrass meadows, as well as their predators, who can influence turtle grazing behavior through fear effects. "Based on recent insights from studies in the Bahamas, the resulting spatial variation in grazing pressure can probably prevent habitat collapse," says Fee Smulders, co-author of the study.

"By taking an integrative ecosystem approach to management, we can maintain high ecosystem multifunctionality, as well as balanced [ecosystems](#) that can sustain natural densities of charismatic [sea turtles](#)," says Christianen.





Cages were used to keep turtles from grazing the seagrass to mimic the no-grazing scenario. Credit: Wageningen University



Innovative underwater field flumes, developed by co-authors from the Royal Netherlands Institute of Sea Research (James et al. 2020), were used to measure sediment stability, one of the ecosystem functions that were measured. Credit: Wageningen University

### **Pristine seagrass meadows**

Green sea turtles are considered the megaherbivores of the ocean. Since their populations have been decimated, scientists have become accustomed to studying and experiencing ungrazed seagrass meadows. These lush seagrass meadows dominated by sturdy species are considered healthy, in "pristine" condition, and very valuable. But with the return of the green sea turtle in many [coastal areas](#) in the past decades—due to successful conservation—many seagrass meadows have been transformed into grazed seascapes.

[An earlier paper](#) published in *Nature Ecology and Evolution* by Wageningen researchers discussed how we must reconsider our view of a pristine seagrass meadow, which likely consists of a mosaic of (heavily) grazed patches and ungrazed patches with high plant species diversity and higher biodiversity in general.

This mosaic seascape may be more natural, even though the ecosystem value may be slightly lower than ungrazed meadows. Now that the different grazing scenarios (high turtle abundance, low abundance, sometimes hyper-abundant) coincide in all three ocean basins where turtles are found, the outcomes of these new studies are even more globally relevant and urgent. The findings can also be used to predict ecosystem impacts of future shifts.

**More information:** Marjolijn J. A. Christianen et al, Seagrass ecosystem multifunctionality under the rise of a flagship marine megaherbivore, *Global Change Biology* (2022). [DOI: 10.1111/gcb.16464](https://doi.org/10.1111/gcb.16464)

Provided by Wageningen University

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