Beyond forest carbon

The preservation of forests, both on land and in mangrove swamps, has received much attention in the move to protect biological carbon stores. Less conspicuous communities of organisms deserve some scrutiny, too.

Deforestation and land-use change currently account for up to one fifth of anthropogenic greenhouse gas emissions. The current destruction of mangrove forests alone — which comprise just 0.7% of tropical forest area — has been estimated to account for up to one tenth of carbon emissions from deforestation globally[1]. As such, the protection of terrestrial organic matter through schemes such as the United Nations' REDD programme[2] (Reducing Emissions from Deforestation and Forest Degradation) is recognised as an important approach to tackling climate change. But two studies on pages 459 and 505 of this issue suggest that we must look beyond forest ecosystems if we are to make any headway in the preservation of biogenic carbon stores.

Communities of lichens, cyanobacteria, mosses and algae — collectively known as cryptogamic covers — are the focus of a meta-analysis of previously published data that looks at their spatial extent and associated fluxes of carbon and nitrogen[3]. Cryptogams coat terrestrial surfaces around the globe, and turn out to play a pivotal role in the terrestrial cycling of both carbon and nitrogen. Specifically, they take up approximately 3.9 Pg of carbon per year, equivalent to 7% of the carbon sequestered by land plants annually. More startling than this, each year these communities appear to convert 49 Tg of atmospheric molecular nitrogen — which is abundant but of no use to most plants — to a biologically usable form. This makes cryptogams responsible for almost half of the land-based biological fixation of atmospheric nitrogen. This latter effect may prove significant for biological carbon sequestration too, because plant growth is often limited by the availability of fixed nitrogen[4].

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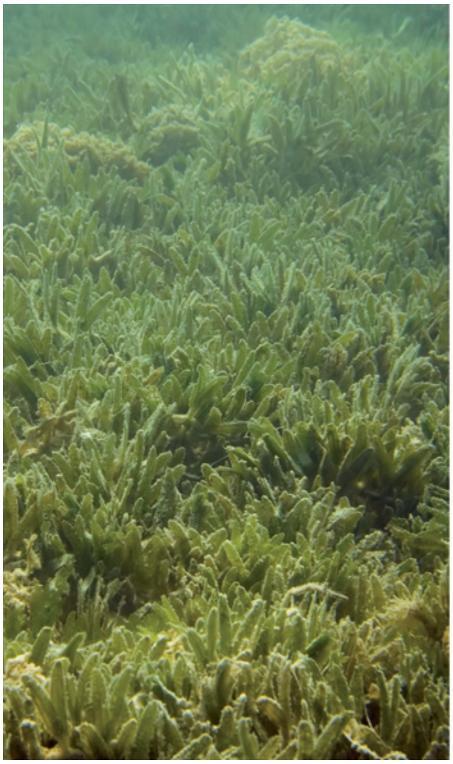

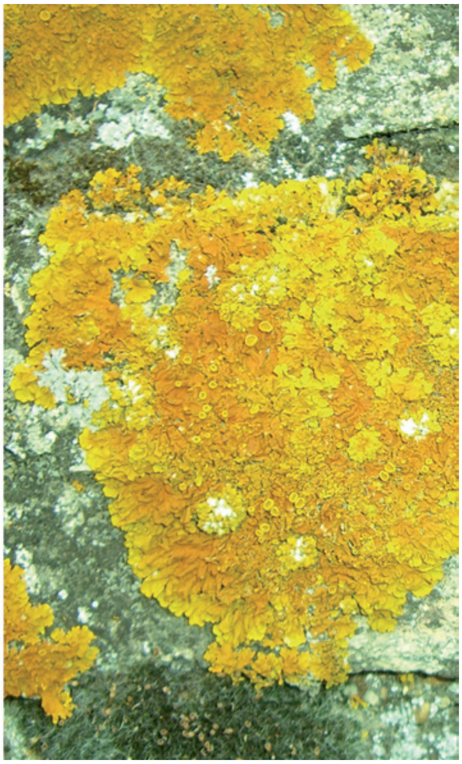

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A second compilation, this time of published and unpublished data on organic carbon, focuses on seagrass meadows and their underlying soils[5]. The study suggests that these submerged communities — found in shallow coastal waters across the globe — constitute a globally significant biospheric carbon stock. Seagrass meadows are estimated to store up to 19.9 Pg of organic carbon globally, equivalent to the amount of carbon stored in the world's tidal marshes and mangrove forests combined. Most of the carbon resides in the underlying soils, which harbour, on average, twice as much carbon per hectare as terrestrial forest soils. Interestingly — particularly in terms of the climatic implications of carbon sequestration — these carbon stocks can persist for thousands of years. Low levels of oxygen in marine sediments lead to very slow turn-over times for carbon.

Coastal communities such as mangroves, salt marshes and seagrass meadows had been recognised as a valuable carbon store that is — from a climate perspective — worthy of preservation[6]. But the specific capacity of seagrass meadows to store carbon was uncertain.

Urban development at the seaside, dredging of the sea floor and the deterioration of coastal water quality have all led to a rapid loss of seagrass ecosystems, at a rate of around 1.5% of seagrass biomass per year. The carbon tied up in the soils beneath these meadows is therefore at risk of release into the atmosphere[5].

Global climate is inextricably linked to the biological uptake and transformation of carbon. That cryptogamic coatings and seagrass meadows have only now been found to play such a significant role in the global carbon cycle should spur further efforts to look more closely at hitherto neglected ecosystems. Communities that are susceptible to anthropogenic perturbations and climate change should be at the top of the list for both future research and conservation efforts. ❐

References

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