

In addition, the main threats most of these charismatic species face have been mapped and identified (5). Despite these advantages, many marine megafauna species continue to decline.

Recently, 14 key countries agreed to sustainably manage the totality of the oceans under their national jurisdictions by 2025 (6), and the United Nations proclaimed this as a Decade of Ocean Science for Sustainable Development (7). To meet these goals, we must increase the number and size of highly protected marine protected areas within an integrated ocean management approach (8). Moreover, direct catch (including shark finning but excluding non-endangered bony fishes, cephalopods, and aboriginal subsistence) must be substantially reduced. To reduce bycatch, fishing should be restricted to selective or traditional gear and the use of nets in industrial-based fisheries should be minimized (9, 10). To avoid the generation of marine litter and prevent litter from entering the marine environment, single-use plastics should be prohibited (11). International laws should be revised to promote responsible, inclusive, and community-based tourism and to promote adequate surveillance in the high seas (12). These feasible and efficient mitigation measures are in line with the unprecedented level of commitment and responsibility that the world's leaders have declared.

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REFERENCES AND NOTES

- C. Pimiento *et al.*, *Sci. Adv.* **6**, eaay7650 (2020).
- R. Chami, T. Cosimano, C. Fullenkamp, S. Oztosun, *Finance Dev.* **56**, 34 (2019).
- IUCN 2021, The IUCN Red List of Threatened Species, Version 2021-1; <https://www.iucnredlist.org>.
- B. Lascelles *et al.*, *Aquat. Conserv.* **24**, 111 (2014).
- R. L. Lewison *et al.*, *Proc. Natl. Acad. Sci. U.S.A.* **111**, 5271 (2014).
- High Level Panel for a Sustainable Ocean Economy, "Towards a sustainable ocean economy" (2020); <https://oceanpanel.org/>.
- UN Decade of Ocean Science for Sustainable Development, "The ocean decade" (2021); www.oceandecade.org/.
- E. Sala *et al.*, *Nature* **592**, 397 (2021).

- J. E. Cinner *et al.*, *Science* **368**, 307 (2020).
- J. Senko *et al.*, *Anim. Conserv.* **17**, 5 (2014).
- C. M. Duarte *et al.*, *Nature* **580**, 39 (2020).
- R. R. Helm *et al.*, *Science* **372**, 1048 (2021).

COMPETING INTERESTS

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Savannas are vital but overlooked carbon sinks

On the second day of the 2021 United Nations Climate Change Conference (COP26), 130 nations announced a decision to halt global deforestation by 2030 (1). This is a welcome move and a political success, but ecologically it falls short. The plan needs to be expanded to include savannas, which cover an area of 20 million km²—more than the 17 million km² covered by tropical forests (2)—and are potentially more important carbon sinks than forests.

In the course of a year, each hectare of the Serengeti plains in Tanzania removes between 5000 and 20,000 kg of carbon dioxide (3) from the atmosphere, enough in total to offset every airline flight to East Africa and all the emissions produced in the region (4, 5). The repeated grazing of wildebeests, zebras, and a variety of insects (6) stimulates vegetative growth multiple times within a year (7, 8), which considerably increases the volume of carbon dioxide absorbed from the atmosphere. Wildlife feces and carcasses enrich the store of carbon and nitrogen in the soil.

The Serengeti and other tropical and temperate savannas, which store carbon in the soil rather than in the biomass of trees (4), can capture at least as much carbon as tropical forests if managed correctly (9, 10). They are as threatened as tropical forests by agriculture expansion and land clearing. Like tropical forests, they are crucially in need of protection (11, 12); excessive grazing and fires are diminishing the abundance of wild herbivores and thus their potential to store carbon (8, 10). Substantial amounts of biodiversity, as well as many pastoralist peoples, depend on savannas. They also generate employment and foreign currency through tourism (5).

The parties to United Nations Framework Convention on Climate Change must be bolder in their approach to climate change. Declared goals must include both forests and savannas.

Moreover, target dates should be set as soon as possible. Even 2025 may be too late to save the vulnerable forest and savanna ecosystems that provide the only fully scalable natural solution to remove carbon dioxide from the atmosphere.

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REFERENCES AND NOTES

- "Glasgow leaders' declaration on forests and land use" (2021); <https://ukcop26.org/glasgow-leaders-declaration-on-forests-and-land-use/>.
- P. Elias, C. May-Tobin, in *The Root of the Problem: What's Driving Tropical Deforestation Today*, D. Boucher *et al.*, Eds. (Union of Concerned Scientists, 2011), pp. 1–12.
- R. M. Holdo *et al.*, *PLOS Biol.* **7**, e1000210 (2009).
- O. J. Schmitz, *Ecosystems* **17**, 344 (2014).
- A. Dobson, *Philos. Trans. R. Soc. B Biol. Sci.* **364**, 1665 (2009).
- S. J. McNaughton, *Ecol. Mono.* **55**, 259 (1985).
- S. J. McNaughton, *Am. Natural.* **113**, 691 (1979).
- M. E. Ritchie, J. F. Penner, *Ecol. Evol.* **10**, 5302 (2020).
- J. Grace *et al.*, *J. Biogeogr.* **33**, 387 (2006).
- T. H. Tear *et al.*, *One Earth* **12**, 1776 (2021).
- C. L. Parr, *Trends Ecol. Evol.* **29**, 205 (2014).
- N. Ramankutty *et al.*, *Glob. Biogeochem. Cyc.* **22**, 10.1029/2007GB002952 (2008).

10.1126/science.abn4482