

## University of Groningen

### Savannas are vital but overlooked carbon sinks

Dobson, Andy; Hopcraft, Grant; Mduma, Simon; Ogutu, Joseph O.; Fryxell, John; Anderson, T. Michael; Archibald, Sally; Lehmann, Caroline; Poole, Joyce; Caro, Tim

*Published in:*  
 Science

*DOI:*  
[10.1126/science.abn4482](https://doi.org/10.1126/science.abn4482)

**IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.**

*Document Version*  
 Publisher's PDF, also known as Version of record

*Publication date:*  
 2022

[Link to publication in University of Groningen/UMCG research database](#)

*Citation for published version (APA):*

Dobson, A., Hopcraft, G., Mduma, S., Ogutu, J. O., Fryxell, J., Anderson, T. M., Archibald, S., Lehmann, C., Poole, J., Caro, T., Holt, R. D., Berger, J., Rubenstein, D. I., Kahumbu, P., Chidumayo, E. N., Milner-Gulland, E. J., Schluter, D., Otto, S., Balmford, A., ... Sinclair, A. R. E. (2022). Savannas are vital but overlooked carbon sinks. *Science*, 375(6579), 392. <https://doi.org/10.1126/science.abn4482>

#### Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

#### Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

*Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.*

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.

Filipe Alves<sup>1\*</sup>, Massimiliano Rosso<sup>2</sup>, Songhai Li<sup>3,4,5</sup>, Douglas P. Nowacek<sup>6</sup>

<sup>1</sup>Marine and Environmental Sciences Centre (MARE), Agência Regional para o Desenvolvimento da Investigação, Tecnologia e Inovação, Madeira, Portugal. <sup>2</sup>Centro Internazionale in Monitoraggio Ambientale (CIMA) Research Foundation, 17100 Savona, Italy. <sup>3</sup>Marine Mammal and Marine Bioacoustics Laboratory, Institute of Deep-sea Science and Engineering, Chinese Academy of Sciences, Sanya 572000, China. <sup>4</sup>Center for Ocean Mega-Science, Chinese Academy of Sciences, Qingdao 266071, China. <sup>5</sup>Function Laboratory for Marine Fisheries Science and Food Production Processes, Qingdao National Laboratory for Marine Science and Technology, Qingdao 266237, China. <sup>6</sup>Nicholas School of the Environment and Pratt School of Engineering, Duke University Marine Laboratory, Beaufort, NC 28516, USA.

\*Corresponding author.

Email: filipe.alves@mare-centre.pt

#### REFERENCES AND NOTES

- C. Pimiento *et al.*, *Sci. Adv.* **6**, eaay7650 (2020).
- R. Chami, T. Cosimano, C. Fullenkamp, S. Ozotson, *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/](http://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

S.L. receives funding from the National Natural Science Foundation of China (41422604), "One Belt and One Road" Science and Technology Cooperation Special Program of the International Partnership Program of the Chinese Academy of Sciences (183446KYSB20200016).

10.1126/science.abn6022

## 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 km<sup>2</sup>—more than the 17 million km<sup>2</sup> 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 500 and 2000 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.

Andy Dobson<sup>1\*</sup>, Grant Hopcraft<sup>2</sup>, Simon Mduma<sup>3</sup>, Joseph O. Ogutu<sup>4</sup>, John Fryxell<sup>5</sup>, T. Michael Anderson<sup>6</sup>, Sally Archibald<sup>7</sup>, Caroline Lehmann<sup>8,9</sup>, Joyce Poole<sup>10</sup>, Tim Caro<sup>11</sup>, Monique Bergerhoff Mulder<sup>12</sup>, Robert D. Holt<sup>13</sup>, Joel Berger<sup>14</sup>, Daniel I. Rubenstein<sup>1</sup>, Paula Kahumbu<sup>15</sup>, Emmanuel N. Chidumayo<sup>16</sup>, E. J. Milner-Gulland<sup>17</sup>, Dolph Schluter<sup>18</sup>, Sarah Otto<sup>18</sup>, Andrew Balmford<sup>19</sup>, David Wilcove<sup>1</sup>, Stuart Pimm<sup>20</sup>, Joseph W. Veldman<sup>21</sup>, Han Olff<sup>22</sup>, Reed Noss<sup>23</sup>, Ricardo Holdo<sup>24</sup>, Colin Beale<sup>25</sup>, Gareth Hempson<sup>7</sup>, Yustina Kiwango<sup>26</sup>, David Lindenmayer<sup>27</sup>, William Bond<sup>28</sup>, Mark Ritchie<sup>29</sup>, Anthony R. E. Sinclair<sup>18</sup>

<sup>1</sup>Department of Ecology and Evolutionary Biology, Princeton University, Princeton, NJ 08544, USA.

<sup>2</sup>Glasgow University, Glasgow, UK. <sup>3</sup>Tanzania Wildlife Research Institute, Arusha, Tanzania.

<sup>4</sup>University of Hohenheim, Stuttgart, Germany.

<sup>5</sup>University of Guelph, Guelph, ON N1G 2W1, Canada. <sup>6</sup>Wake Forest University, Winston-Salem, NC 27109, USA. <sup>7</sup>University of the Witwatersrand, Braamfontein, Johannesburg, 2000, South Africa.

<sup>8</sup>Tropical Diversity, Royal Botanical Gardens, Edinburgh EH35LR, UK. <sup>9</sup>School of GeoSciences, University of Edinburgh, Edinburgh EH93FF, UK.

<sup>10</sup>ElephantVoices, San Francisco, CA 94111, USA. <sup>11</sup>University of Bristol, Bristol BS8 1TH, UK. <sup>12</sup>Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany. <sup>13</sup>University of Florida, Gainesville, FL 32611, USA. <sup>14</sup>Colorado State University, and Wildlife Conservation Society, Fort Collins, CO 80523, USA. <sup>15</sup>Wildlife Direct, Karen 00502, Nairobi, Kenya. <sup>16</sup>Zambian National University, Lusaka, Zambia. <sup>17</sup>Department of Zoology, Oxford University, Oxford OX1 3SZ, UK. <sup>18</sup>University of British Columbia, Vancouver, BC V6T 1Z4, Canada. <sup>19</sup>Cambridge University, Cambridge CB2 3EJ, UK. <sup>20</sup>Duke University, Durham, NC 27708, USA.

<sup>21</sup>Department of Ecology and Conservation Biology, Texas A&M University, College Station, TX 77843, USA. <sup>22</sup>University of Groningen, 9712 CP Groningen, Netherlands. <sup>23</sup>Florida Institute for Conservation Science, Oviedo, FL 32766, USA. <sup>24</sup>University of Athens, Athens, GA 30602, USA. <sup>25</sup>University of York, Heslington, York YO10 5DD, UK. <sup>26</sup>Tanzania National Parks, Arusha, Tanzania. <sup>27</sup>Australian National University, Canberra, ACT 0200, Australia. <sup>28</sup>University of Cape Town, Rondebosch, Cape Town, 7700, South Africa. <sup>29</sup>Syracuse University, Syracuse, NY 13244, USA.

\*Corresponding author.

Email: dobber@princeton.edu

Downloaded from <https://www.science.org> at Bibliotek der Rijksuniversiteit on February 04, 2022

10.1126/science.abn6022

10.1126/science.abn6022

10.1126/science.abn6022

10.1126/science.abn6022

10.1126/science.abn6022

10.1126/science.abn6022

10.1126/science.abn6022

10.1126/science.abn6022

10.1126/science.abn6022

10.1126/science.abn6022

10.1126/science.abn6022

10.1126/science.abn6022

10.1126/science.abn6022

10.1126/science.abn6022

10.1126/science.abn6022

10.1126/science.abn6022

10.1126/science.abn6022

10.1126/science.abn6022

10.1126/science.abn6022

10.1126/science.abn6022

10.1126/science.abn6022

## Savannas are vital but overlooked carbon sinks

Andy DobsonGrant HopcraftSimon MdumaJoseph O. OgutuJohn FryxellT. Michael AndersonSally ArchibaldCaroline LehmannJoyce PooleTim CaroMonique Borgerhoff MulderRobert D. HoltJoel BergerDaniel I. RubensteinPaula KahumbuEmmanuel N. ChidumayoE. J. Milner-GullandDolph SchluterSarah OttoAndrew BalmfordDavid WilcoveStuart PimmJoseph W. VeldmanHan OlffReed NossRicardo HoldoColin BealeGareth HempsonYustina KiwangoDavid LindenmayerWilliam BondMark RitchieAnthony R. E. Sinclair

*Science*, 375 (6579), • DOI: 10.1126/science.abn4482

### View the article online

<https://www.science.org/doi/10.1126/science.abn4482>

### Permissions

<https://www.science.org/help/reprints-and-permissions>

Use of think article is subject to the [Terms of service](#)

---

*Science* (ISSN 1095-9203) is published by the American Association for the Advancement of Science, 1200 New York Avenue NW, Washington, DC 20005. The title *Science* is a registered trademark of AAAS.

Copyright © 2022 The Authors, some rights reserved; exclusive licensee American Association for the Advancement of Science. No claim to original U.S. Government Works