






DATA PAPER

Ecological consequences of large herbivore exclusion in an African savanna: 12 years of data from the UHURU experiment

Jesse M. Alston^{1,2,3}  | Courtney G. Reed^{4,5} | Leo M. Khasoha^{1,2,6} | Bianca R. P. Brown^{4,5} | Gilbert Busienei⁶ | Nathaniel Carlson⁷ | Tyler C. Coverdale^{7,8} | Megan Dudenhoeffer⁹ | Marissa A. Dyck¹⁰ | John Ekeno⁶ | Abdikadir A. Hassan⁶ | Rhianna Hohbein¹¹  | Rhiannon P. Jakopak¹²  | Buas Kimiti⁶ | Samson Kurukura⁶ | Peter Lokeny⁶ | Allison M. Louthan¹³  | Simon Musila¹⁴ | Paul M. Musili¹⁵ | Tosca Tindall¹⁶ | Sarah Weiner⁶ | Tyler R. Kartzinel^{4,5} | Todd M. Palmer¹⁷ | Robert M. Pringle¹⁸  | Jacob R. Goheen^{1,2}

¹Department of Zoology and Physiology, University of Wyoming, Laramie, Wyoming, USA

²Program in Ecology, University of Wyoming, Laramie, Wyoming, USA

³Center for Advanced Systems Understanding (CASUS), Görlitz, Germany

⁴Department of Ecology, Evolution, and Organismal Biology, Brown University, Providence, Rhode Island, USA

⁵Institute at Brown for Environment and Society, Brown University, Providence, Rhode Island, USA

⁶Mpala Research Centre, Nanyuki, Kenya

⁷Department of Ecology and Evolutionary Biology, Cornell University, Ithaca, New York, USA

⁸Department of Organismic and Evolutionary Biology, Harvard University, Cambridge, Massachusetts, USA

⁹Department of Veterinary Sciences, University of Wyoming, Laramie, Wyoming, USA

¹⁰Biological Sciences Department, Ohio University, Athens, Ohio, USA

¹¹Warnell School of Forestry and Natural Resources, University of Georgia, Athens, Georgia, USA

¹²Haub School of Environment and Natural Resources, University of Wyoming, Laramie, Wyoming, USA

¹³Division of Biology, Kansas State University, Manhattan, Kansas, USA

¹⁴Mammalogy Section, Zoology Department, National Museums of Kenya, Nairobi, Kenya

¹⁵Botany Department, National Museums of Kenya, Nairobi, Kenya

¹⁶Institute of Human Sciences, University of Oxford, Oxford, UK

¹⁷Department of Biology, University of Florida, Gainesville, Florida, USA

¹⁸Department of Ecology and Evolutionary Biology, Princeton University, Princeton, New Jersey, USA

Correspondence

Jacob R. Goheen

Email: jgoheen@uwyo.edu

Abstract

Diverse communities of large mammalian herbivores (LMH), once widespread, are now rare. LMH exert strong direct and indirect effects on community structure and ecosystem functions, and measuring these effects is important for testing

Jesse M. Alston and Courtney G. Reed contributed equally to this work.

© 2022 The Authors. Ecology © 2022 The Ecological Society of America.

Funding information

Bundesministerium für Bildung und Forschung; Center for Advanced Systems Understanding; Garden Club of America, Grant/Award Number: Elizabeth Gardner Norweb Scholarship; High Meadows Environmental Institute at Princeton University; Institute at Brown for Environment and Society; National Geographic Society; National Science Foundation, Grant/Award Numbers: DEB-0709880, DEB-1355122, DEB-1547679, DEB-1930763, DEB-1930820, DEB-2018405, IOS-1656527, OISE-0852961; Natural Sciences and Engineering Research Council of Canada; Nature Conservancy; Sächsisches Staatsministerium für Wissenschaft und Kunst; Sherwood Family Foundation; University of British Columbia; University of Florida; University of Wyoming

Handling Editor: William K. Michener

ecological theory and for understanding past, current, and future environmental change. This in turn requires long-term experimental manipulations, owing to the slow and often nonlinear responses of populations and assemblages to LMH removal. Moreover, the effects of particular species or body-size classes within diverse LMH guilds are difficult to pinpoint, and the magnitude and even direction of these effects often depends on environmental context. Since 2008, we have maintained the Ungulate Herbivory Under Rainfall Uncertainty (UHURU) experiment, a series of size-selective LMH exclosures replicated across a rainfall/productivity gradient in a semiarid Kenyan savanna. The goals of the UHURU experiment are to measure the effects of removing successively smaller size classes of LMH (mimicking the process of size-biased extirpation) and to establish how these effects are shaped by spatial and temporal variation in rainfall. The UHURU experiment comprises three LMH-exclusion treatments and an unfenced control, applied to nine randomized blocks of contiguous 1-ha plots ($n = 36$). The fenced treatments are MEGA (exclusion of megaherbivores, elephant and giraffe), MESO (exclusion of herbivores ≥ 40 kg), and TOTAL (exclusion of herbivores ≥ 5 kg). Each block is replicated three times at three sites across the 20-km rainfall gradient, which has fluctuated over the course of the experiment. The first 5 years of data were published previously (*Ecological Archives* E095-064) and have been used in numerous studies. Since that publication, we have (1) continued to collect data following the original protocols, (2) improved the taxonomic resolution and accuracy of plant and small-mammal identifications, and (3) begun collecting several new data sets. Here, we present updated and extended raw data from the first 12 years of the UHURU experiment (2008–2019). Data include daily rainfall data throughout the experiment; annual surveys of understory plant communities; annual censuses of woody-plant communities; annual measurements of individually tagged woody plants; monthly monitoring of flowering and fruiting phenology; every-other-month small-mammal mark-recapture data; and quarterly large-mammal dung surveys. There are no copyright restrictions; notification of when and how data are used is appreciated and users of UHURU data should cite this data paper when using the data.

KEYWORDS

climate change, dik-dik (*Madoqua*), East African savannas, elephants (*Loxodonta africana*), extinction, food webs, grazing and browsing herbivores, impala (*Aepyceros melampus*), long-term ecological field experiments, plant communities, rangeland ecology, species interactions

CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT


Data are available as Supporting Information and are also available in Dryad at: <https://doi.org/10.5061/dryad.1g1jwstxw>.


ORCID

Jesse M. Alston  <https://orcid.org/0000-0001-5309-7625>

Rhianna Hohbein  <https://orcid.org/0000-0003-2935-426X>

Rhiannon P. Jakopak  <https://orcid.org/0000-0002-8873-023X>

Allison M. Louthan  <https://orcid.org/0000-0002-2735-6539>

Robert M. Pringle  <https://orcid.org/0000-0001-7487-5393>

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

How to cite this article: Alston, Jesse M., Courtney G. Reed, Leo M. Khasoha, Bianca R. P. Brown, Gilbert Busienei, Nathaniel Carlson, Tyler C. Coverdale, et al. 2022. "Ecological Consequences of Large Herbivore Exclusion in an African Savanna: 12 years of Data from the UHURU Experiment." *Ecology* 103(4): e3649. <https://doi.org/10.1002/ecy.3649>