



Historia evolutiva y futuro de los ecosistemas abiertos

LIFE Connect Ricotí Final Congress

Pablo Manzano

Basque Centre for Climate Change – BC3



¿Qué concepto tenemos de la naturaleza?



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3.0

El origen del mito

- Raíces culturales: el Paraíso y el Jardín del Edén

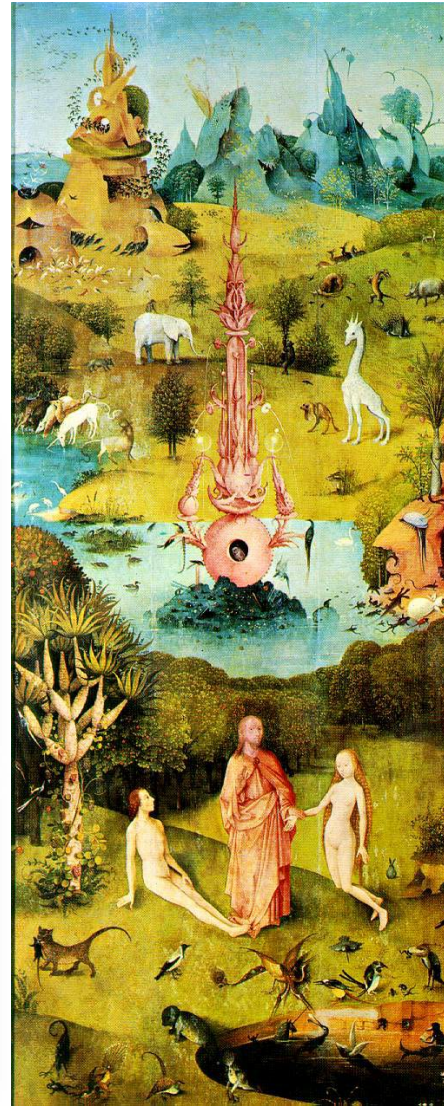


Comparative Studies in Society and History > Volume 48 Issue 1

Cultivating Wilderness: Environmentalism and Legacies of Early Christian Asceticism

Published online by Cambridge University Press: 14 March 2006

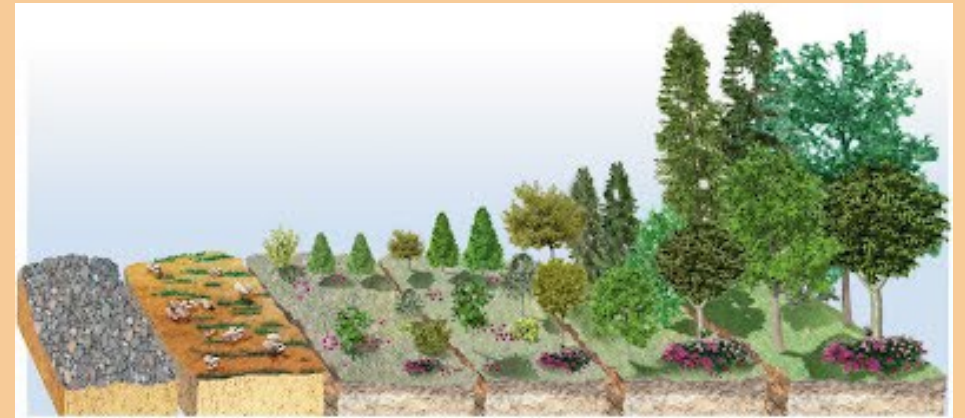
Judith Adler



- Sucesión ecológica
(Humboldt,
1805)



- (F.E. Clements,
1916)



Reconsiderar la naturaleza “intacta” de los ecosistemas silvestres



etimologias.dechile.net/?intacto

Etimología de INTACTO

INTACTO

del latín *intactus*, formado del prefijo privativo *IN-* y de *tactus*, participio del verbo *tango*, *tangere* (tocar). En latín, *intactus* significa no tocado, sin heridas, nuevo, etc. Por lo tanto lo intacto, es lo que no se ha tocado y, en sentido figurado, lo puro, sin mezcla.

= naturaleza “sin tocar”

- Si las perturbaciones son naturales, el ecosistema natural no está “sin tocar”. Necesita ser “tocado” = **perturbado** para ser natural.

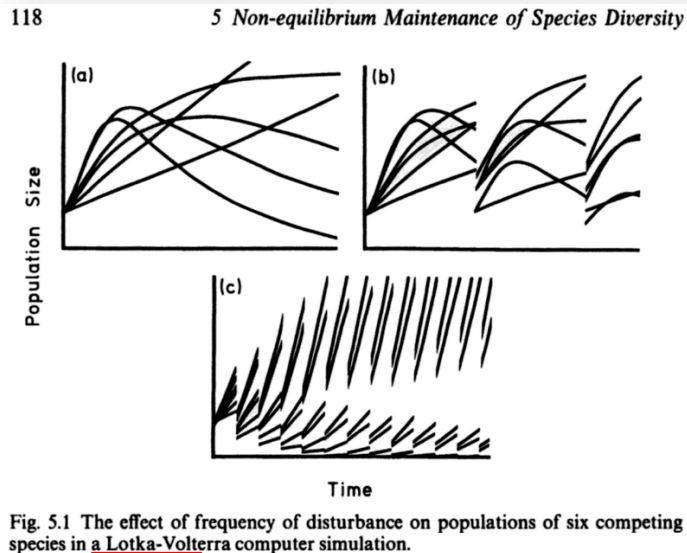
⇒ Distinguir perturbaciones positivas de las negativas

Importancia de las perturbaciones:

Biodiversidad y función ecológica

Perturbaciones

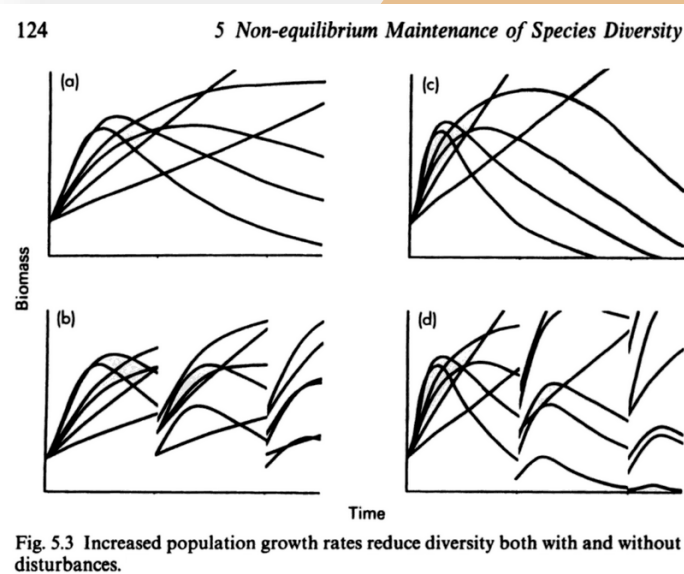
S



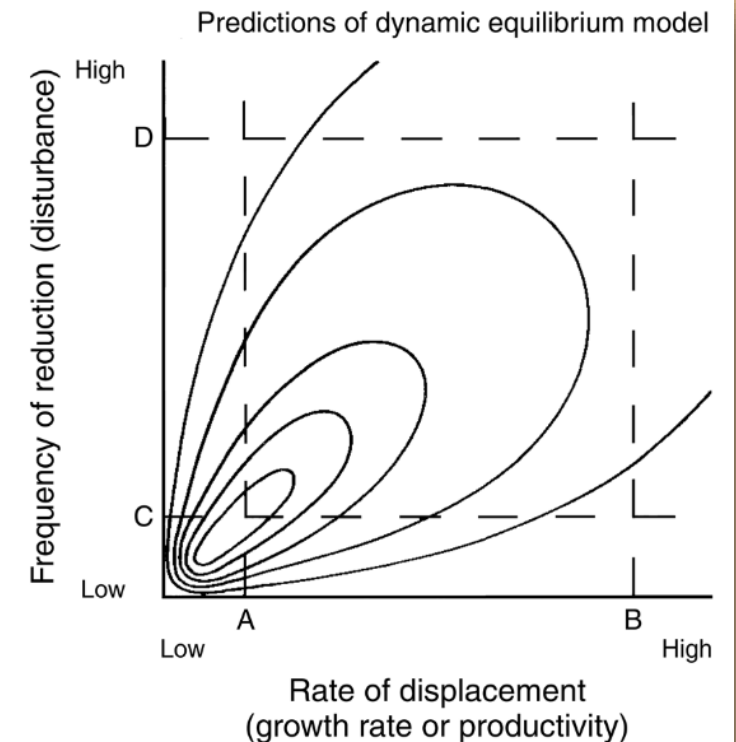
Huston 1979 <https://doi.org/10.1086/283366>,

Huston 1994 <https://www.researchgate.net/publication/201998434>

Productividad



Interacción



Huston 1994: Fig. 5.10

Reciclado de la materia

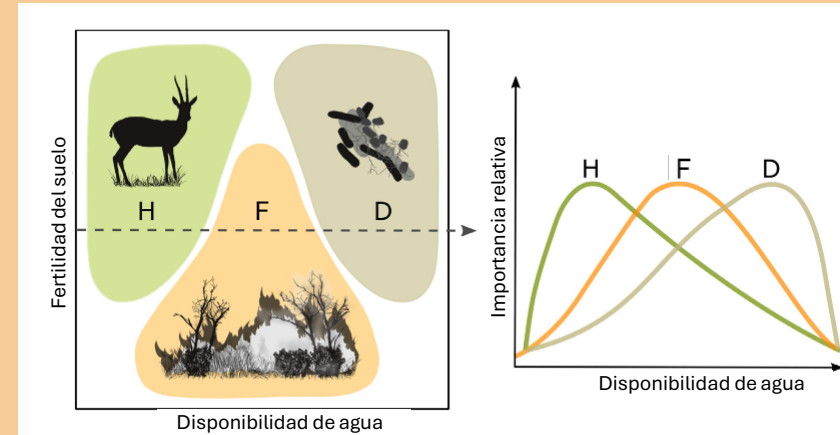
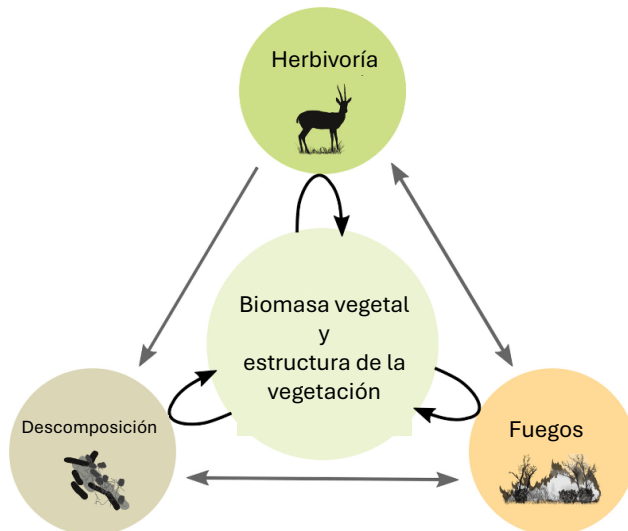
Trends in Ecology & Evolution

CellPress
REVIEWS

Opinion

On the Three Major Recycling Pathways in Terrestrial Ecosystems

Juli G. Pausas ^{1,*,@} and William J. Bond ^{2,3}



Cómo se traduce en el paisaje global

Journal of Vegetation Science 16: 261-266, 2005
© IAVS; Opulus Press Uppsala.

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INVITED PERSPECTIVE

- Bond

Large parts of the world are brown or black: A different view on the 'Green World' hypothesis

Bond, William J.

*Botany Department, University of Cape Town, Private
Bag, Rondebosch, 7701, South Africa;
Fax +27 216504041; E-mail bond@botzoo.uct.ac.za*

Abstract. Climate sets the limits to plant growth but does climate determine the global distribution of major biomes? I suggest methods for evaluating whether vegetation is largely climate or consumer-controlled, focusing on large mammal herbivores and fire as influential consumers. Large parts of the world appear not to be at equilibrium with climate. Consumer-controlled ecosystems are ancient and diverse. Their distinctive ecology warrants special attention.



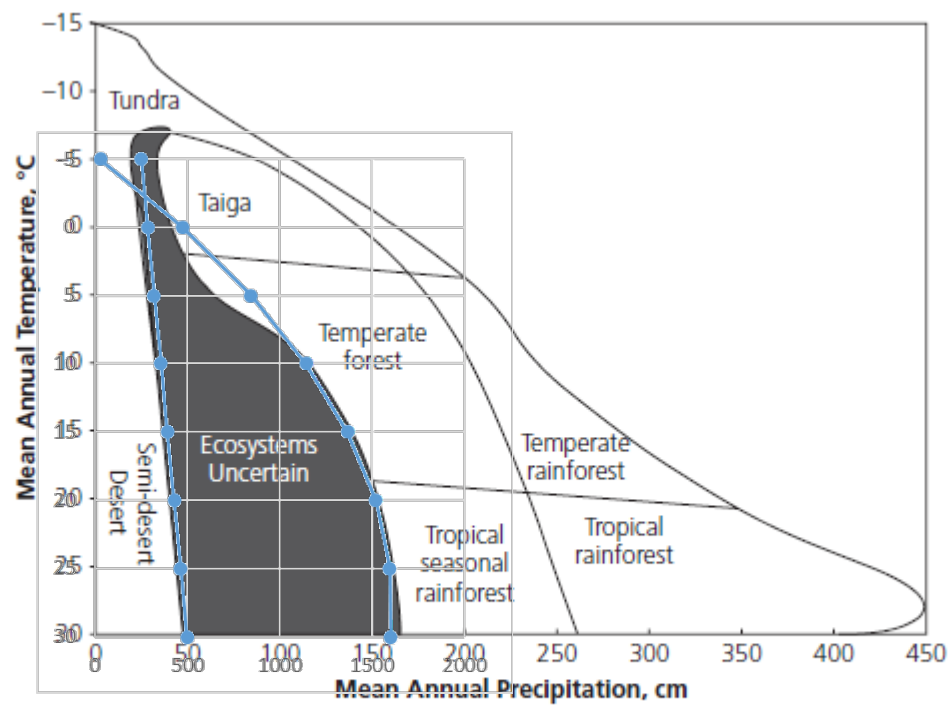
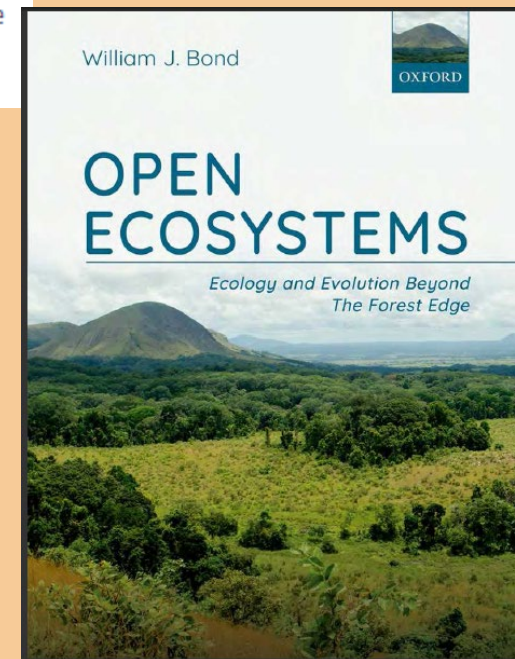
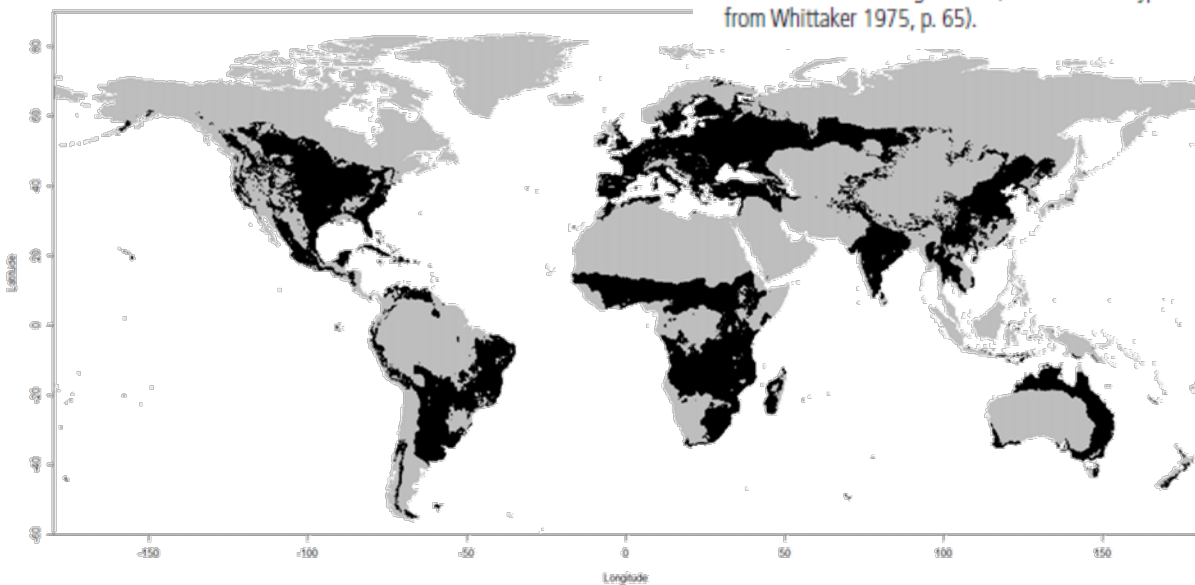


Figure 2.2 Whittaker's climate envelopes for major world vegetation formations. The shaded area is the climate envelope where ecosystems are uncertain and 'either grassland, or one of the types dominated by woody plants, may form the prevailing vegetation in different areas' (redrawn from Whittaker 1975, p. 65).



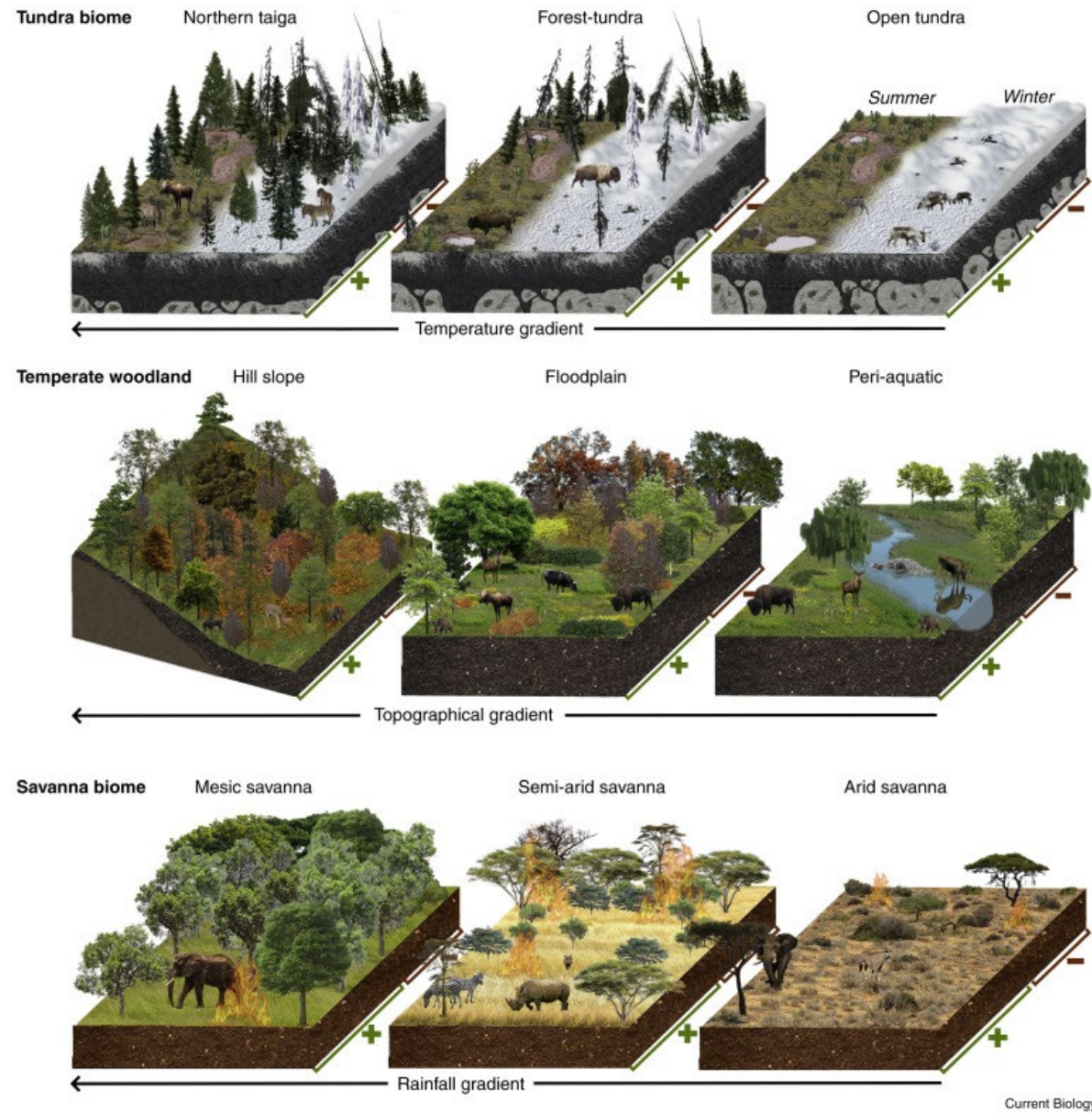




Image source

https://www.elespanol.com/eldigitalcastillalamancha/region/ciudad-real/20211208/plan-sostenibilidad-turistica-impulsa-recursos-parque-cabaneros/633186830_0.html



Image source

Pablo Manzano, own work

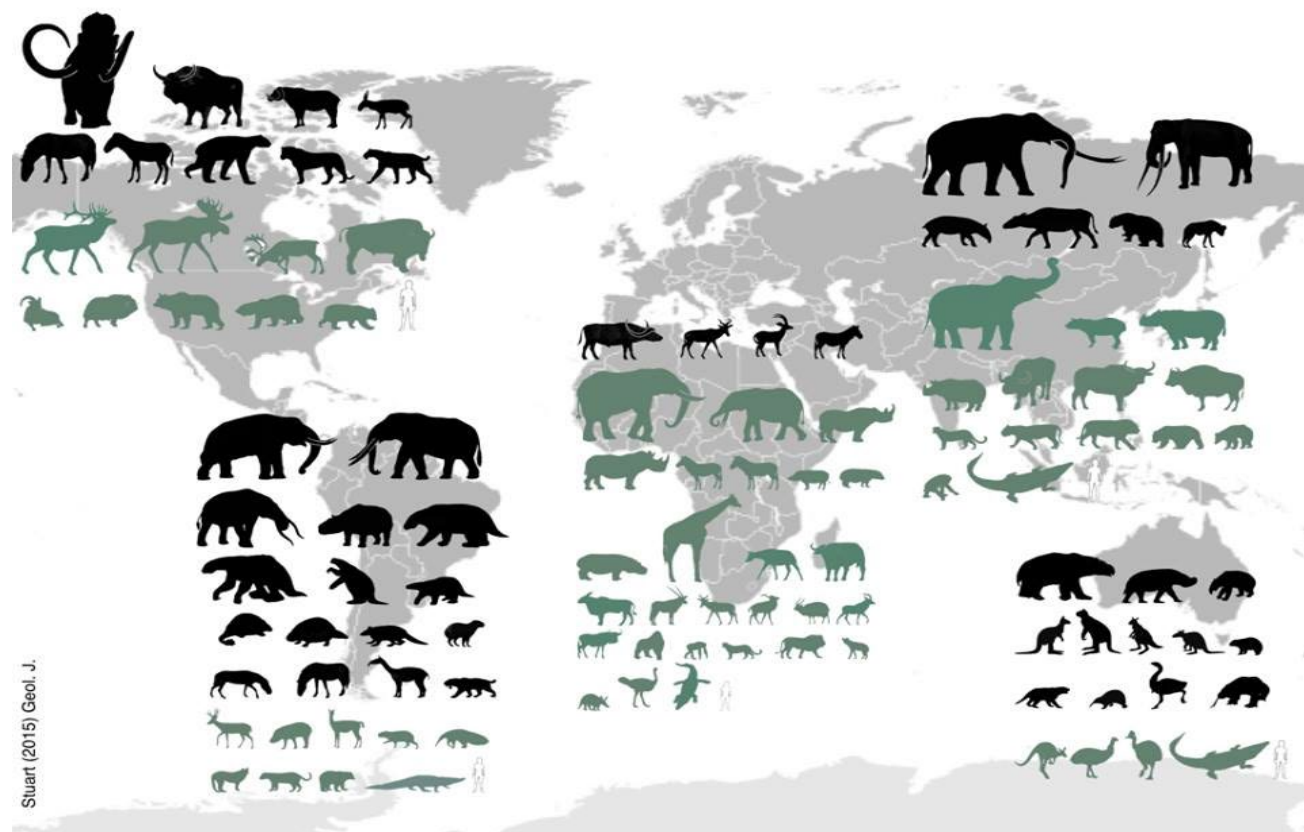


Image source
Pablo Manzano, own work

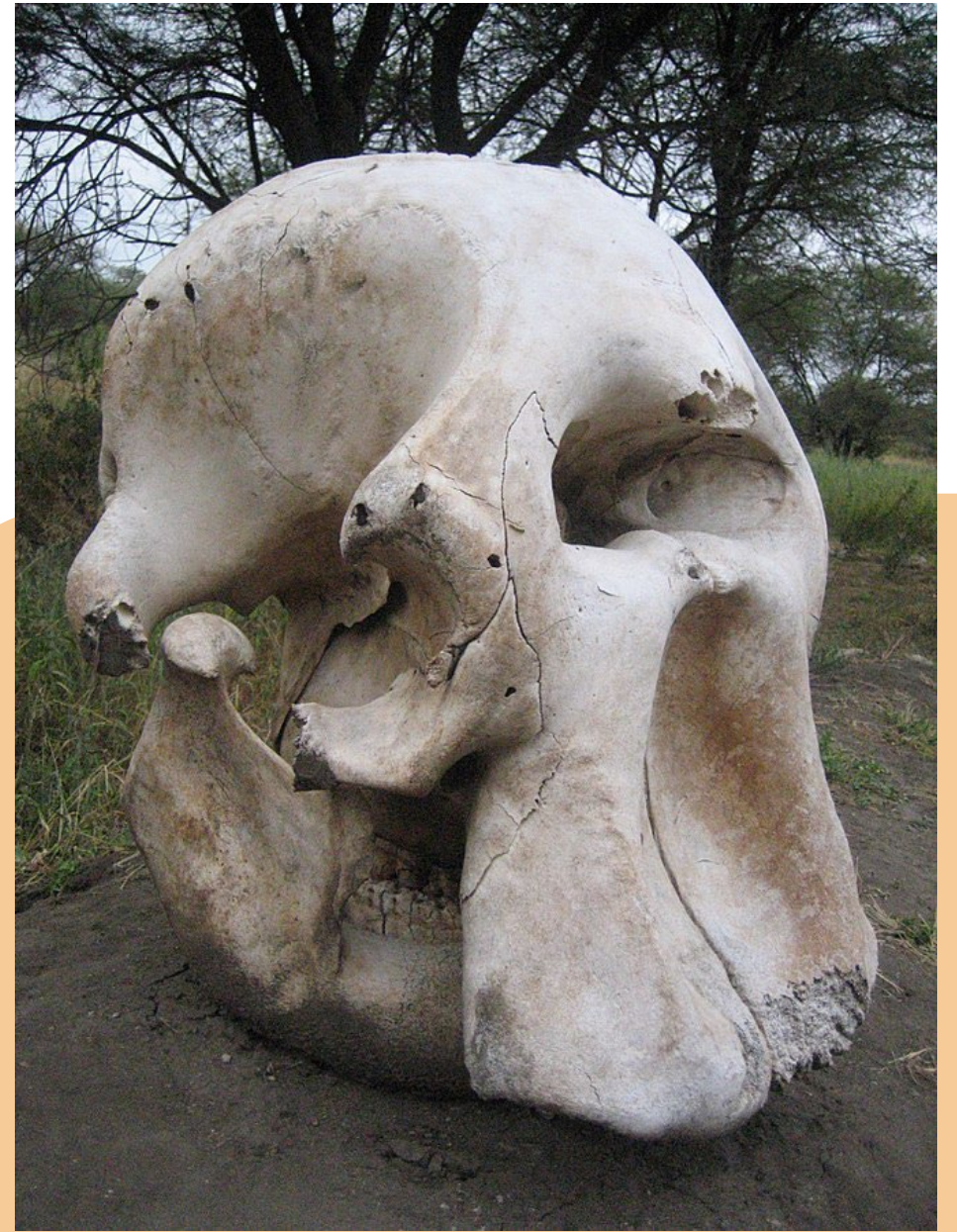
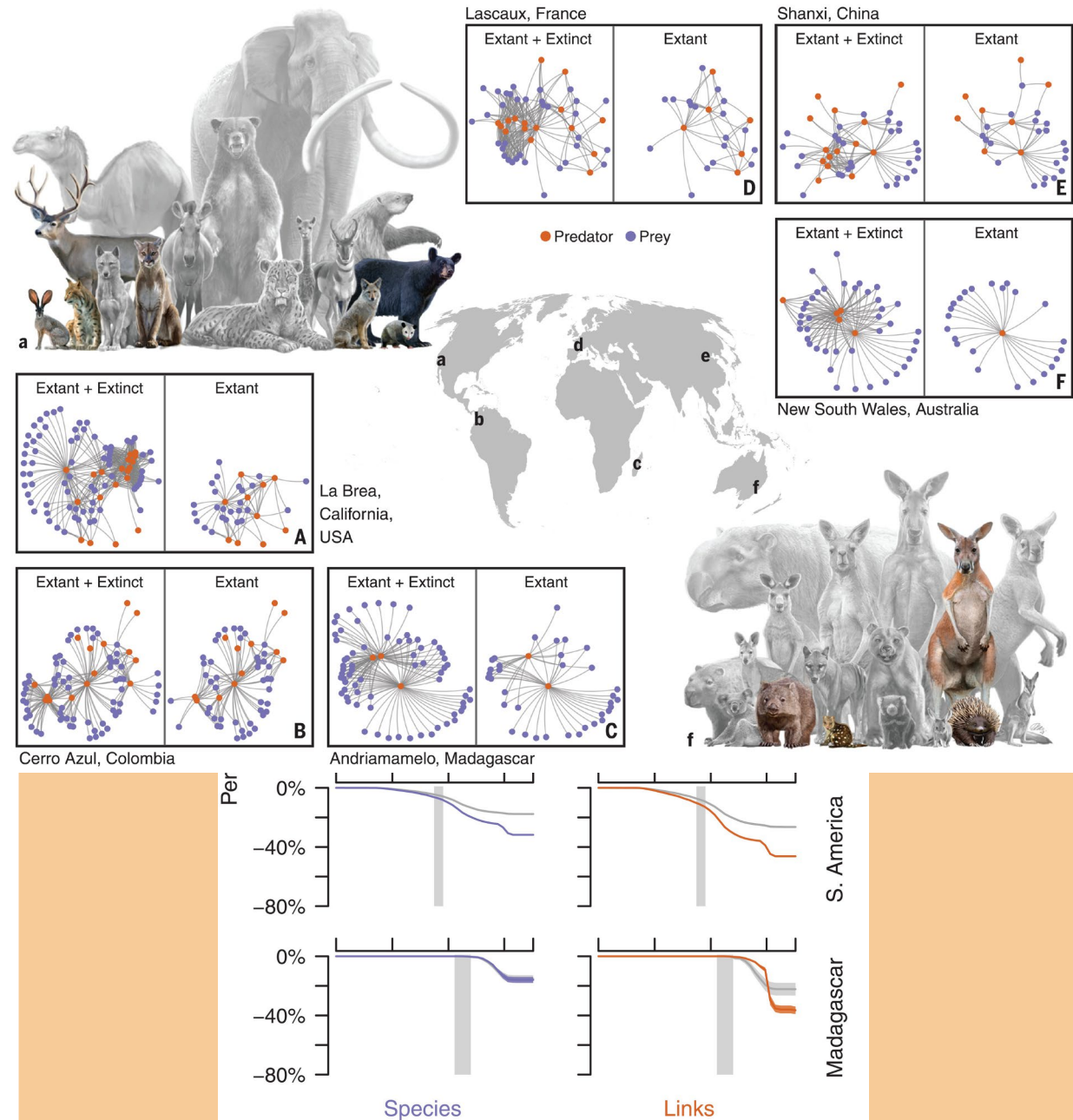
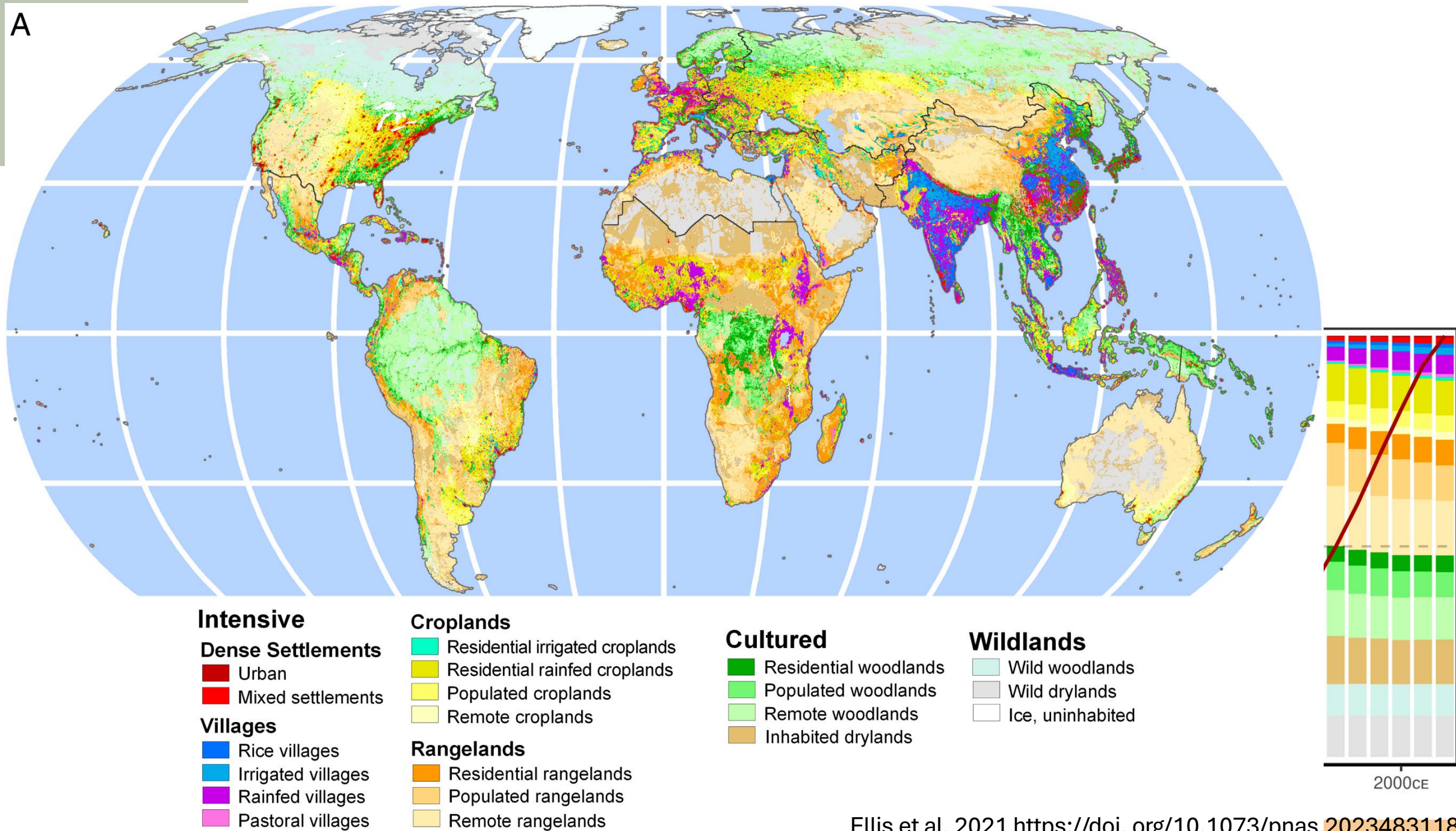
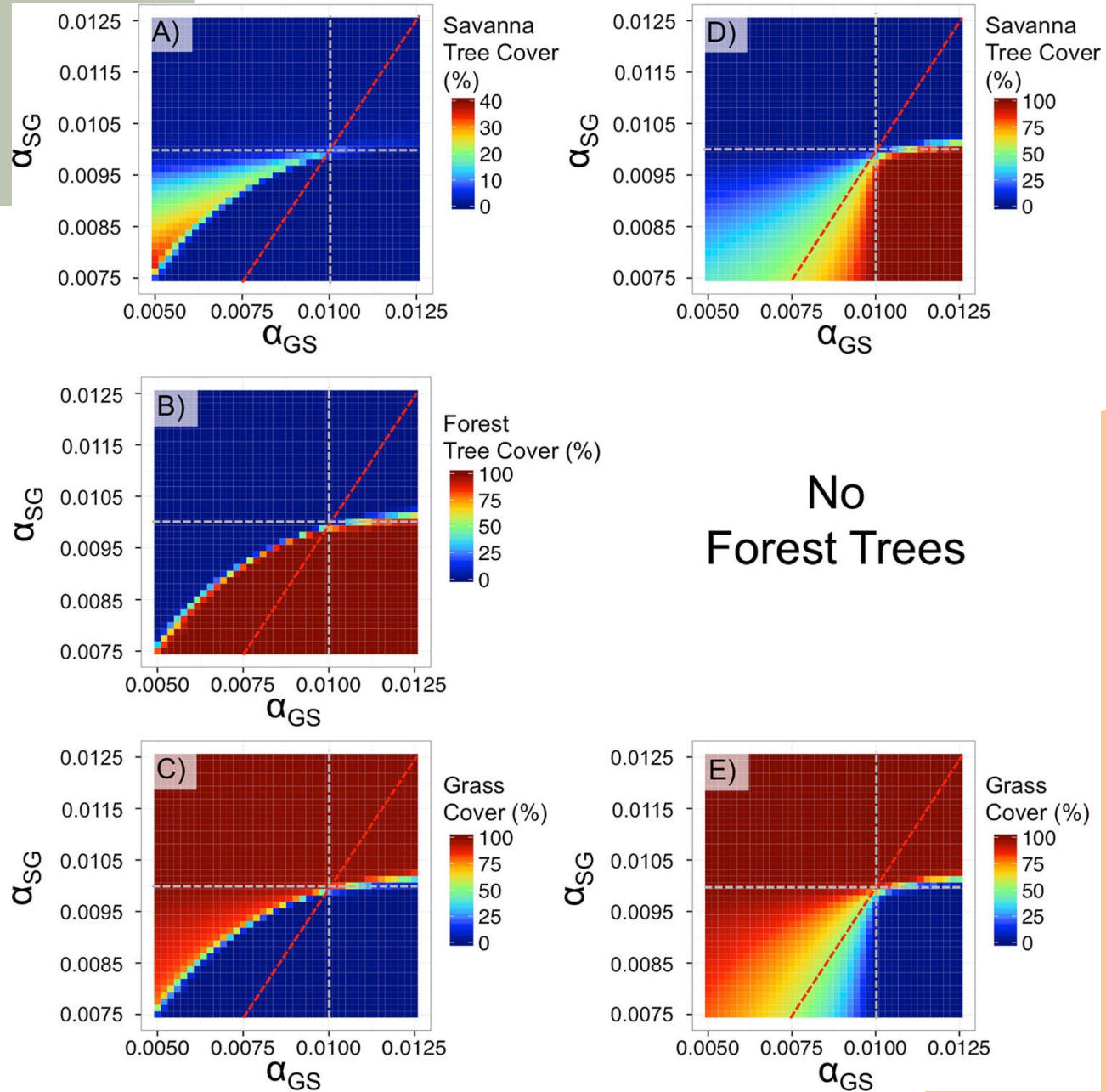


Image source. Ryan Junell from Oakland - Flickr
https://commons.wikimedia.org/wiki/File:Elephant_skull_at_Serengeti_National_Park.jpg



A





Ratajczak et al 2017 Ecosystems
DOI: 10.1007/s10021-017-0110-7

Diversidad de sabanas



Trabajo propio



Cathedral mopane forest - South Luangwa Valley.jpg
Nyika_miombo.jpg

(a) Hierba inflamable



Low	←	Leaf moisture content	→	High
High	←	C : N and C : P ratios	→	Low
Aerated	←	Canopy architecture	→	Dense
High	←	Tannins & volatile oils	→	Low

Hierba palatable



(b) Crecimiento vertical

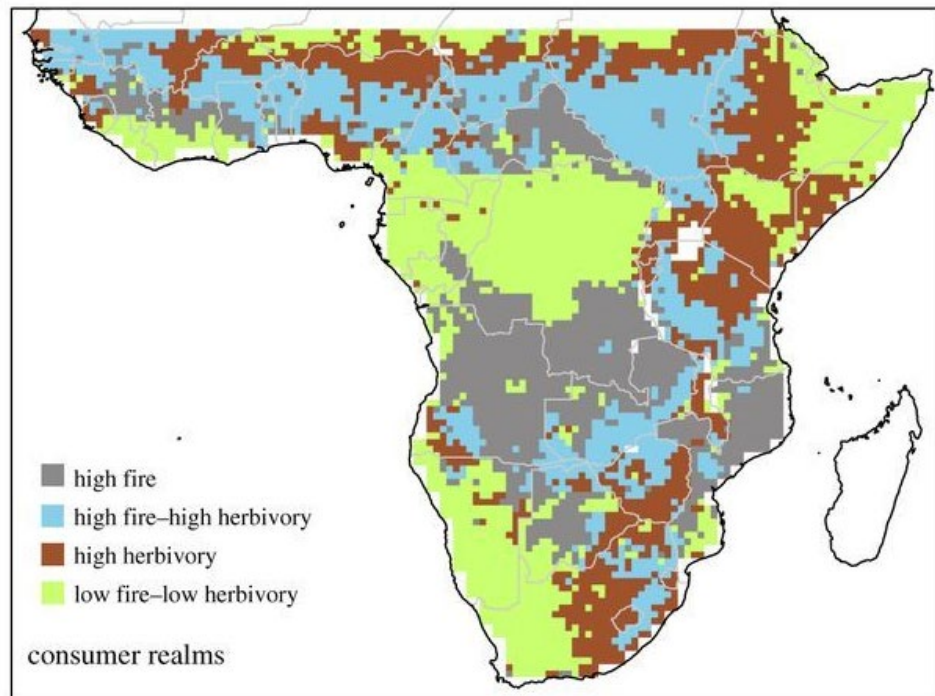


Vertical	←	Culm angle	→	Horizontal
Intravaginal	←	Branching	→	Extravaginal
Basal	←	Tillering	→	Distal
Short	←	Rhizomes	→	Long

Crecimiento horizontal

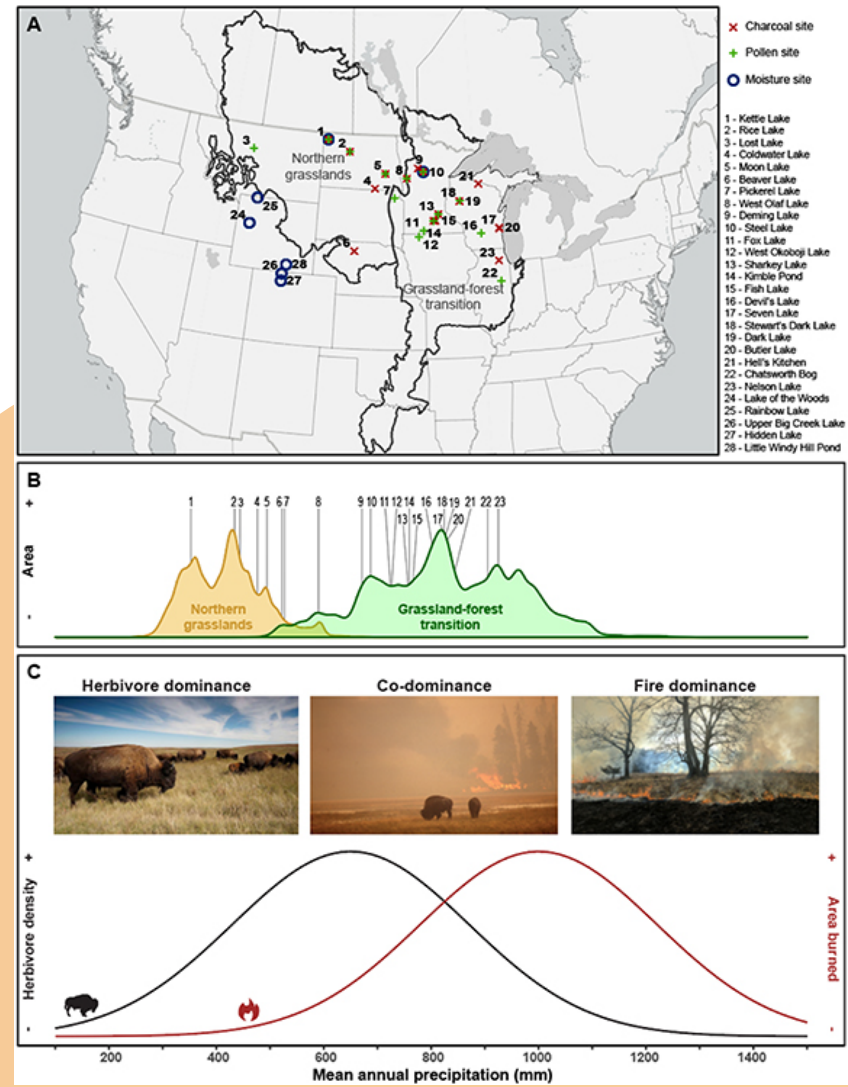


(d)



Archibald & Hempson 2016

<https://doi.org/10.1098/rstb.2015.0309>

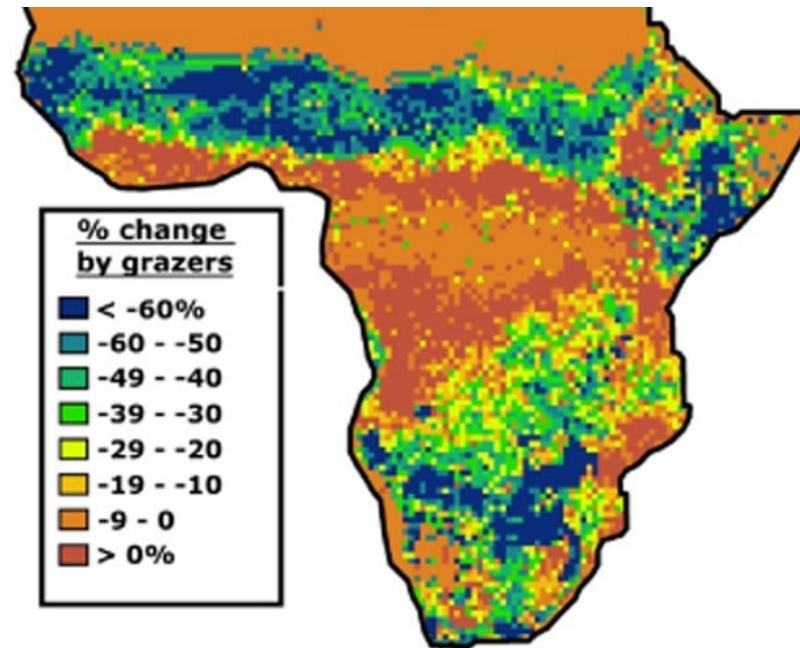


Wendt et al 2023 <https://doi.org/10.1088/1748-9326/ad0ad0>

¿La herbivoría cambia la disponibilidad del combustible? Sí: evidencia a escala continental

El área quemada se reduce hasta un 60% si a un DGVM se añaden herbívoros (niveles históricos, no de hanado actual)

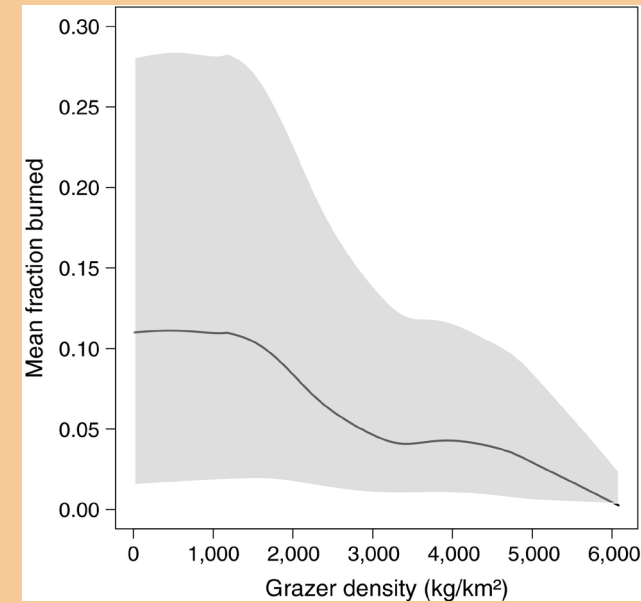
Pachzelt et al 2015 <https://doi.org/10.1111/geb.12313>



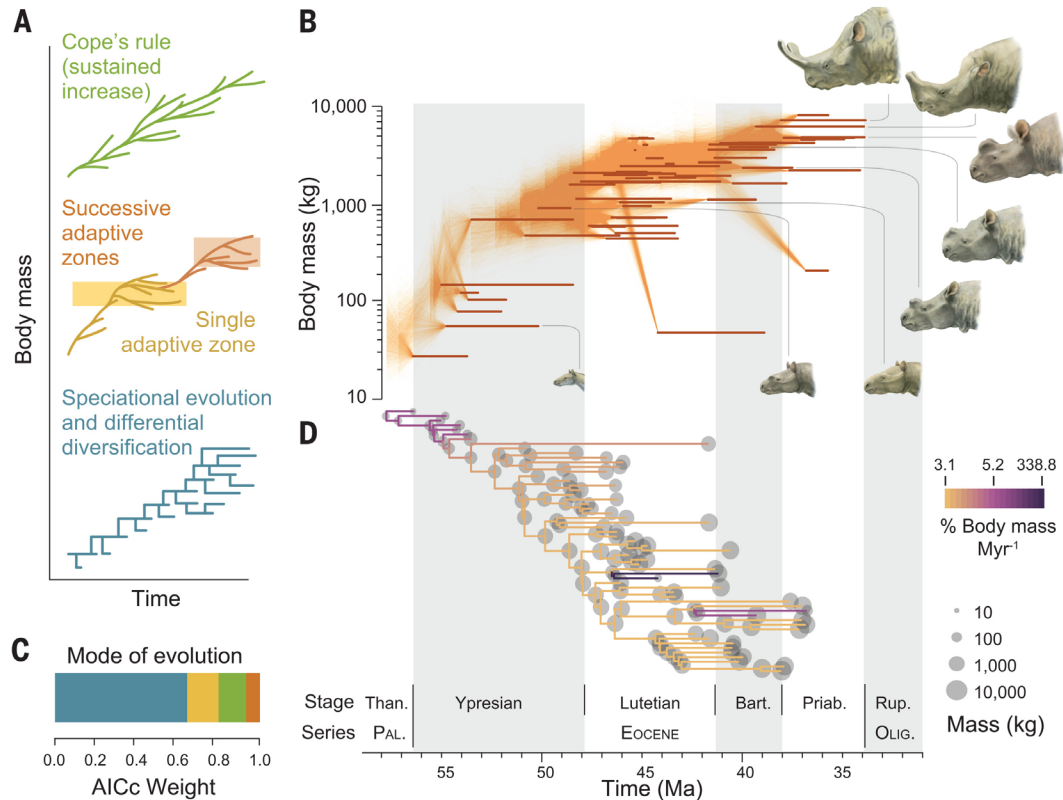
Datos de campo:
relación no lineal

Smit & Archibald 2019

<https://doi.org/10.1111/1365-2664.13312>



Otros paquidermos: rinocerontes



Sanisidro et al. 2023

<https://doi.org/10.1126/science.ade1833>

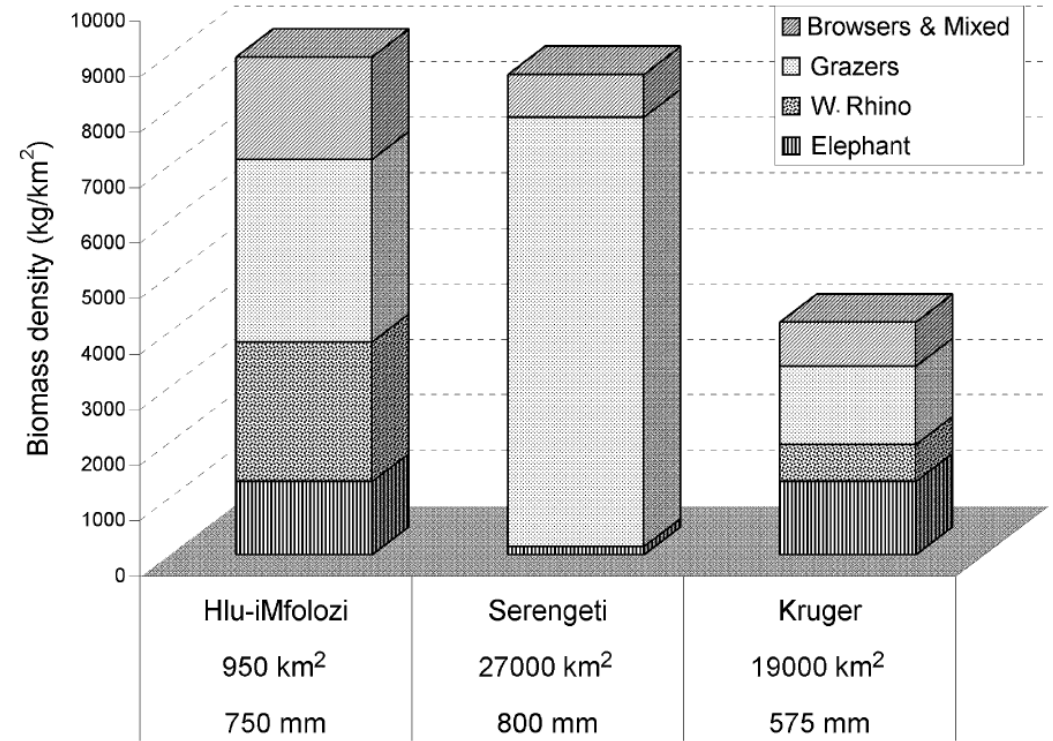
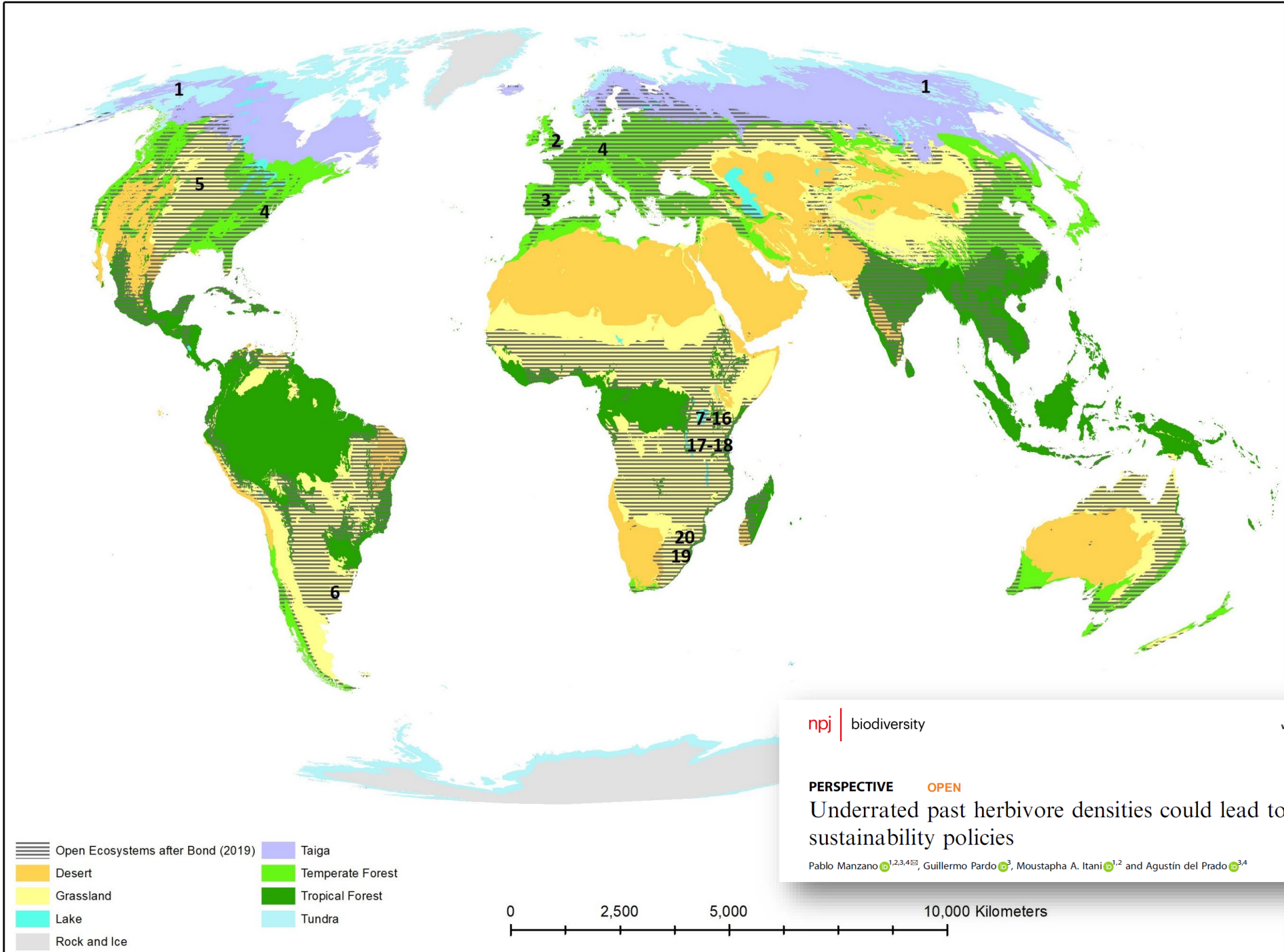


Figure 5.1 Comparative herbivore biomass densities subdivided by dietary categories for Hluhluwe-iMfolozi Park (from mean population totals for 1986–2008 shown in Table 5.2), Serengeti ecosystem (from Mduma and Hopcraft, 1995), and the southern half of Kruger National Park (mean of aerial counts 1980–1993 corrected for undercounting bias except for elephants and rhinos for

Owen-Smith et al 2017

<https://doi.org/10.1017/9781139382793.010>



npj | biodiversity

www.nature.com/npjbiodivers

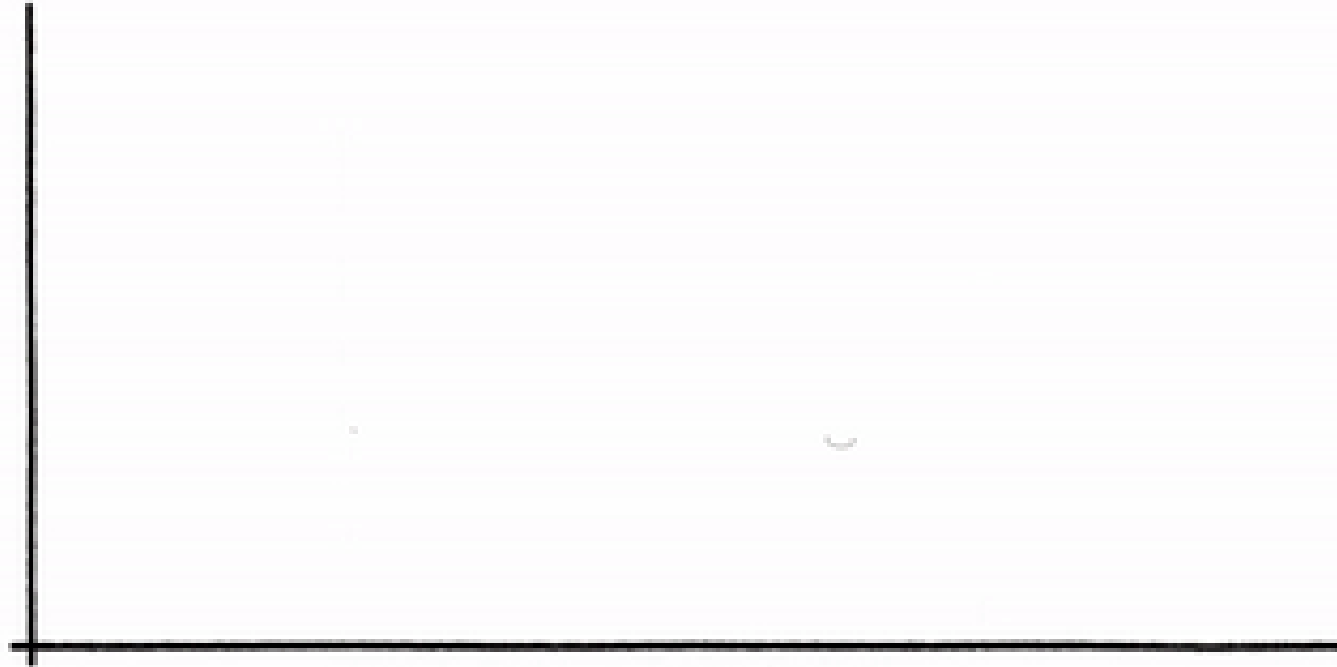
PERSPECTIVE OPEN

[Check for updates](#)

Underrated past herbivore densities could lead to misoriented sustainability policies

Pablo Manzano ^{1,2,3,4}, Guillermo Pardo ³, Moustapha A. Itani ^{1,2} and Agustín del Prado ^{3,4}

https://youtu.be/KYDk5xlQ7_4



Tipos funcionales de herbívoros

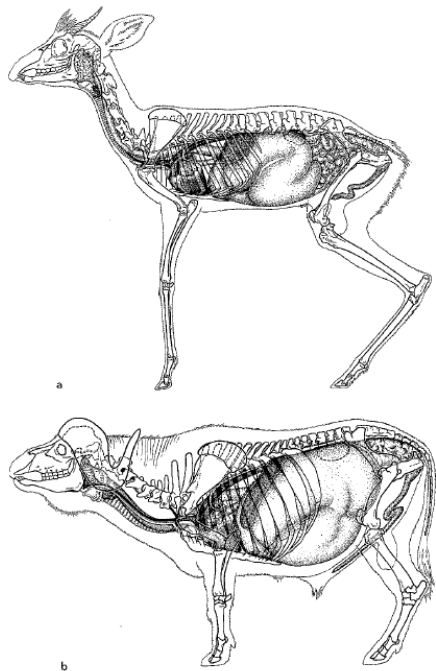
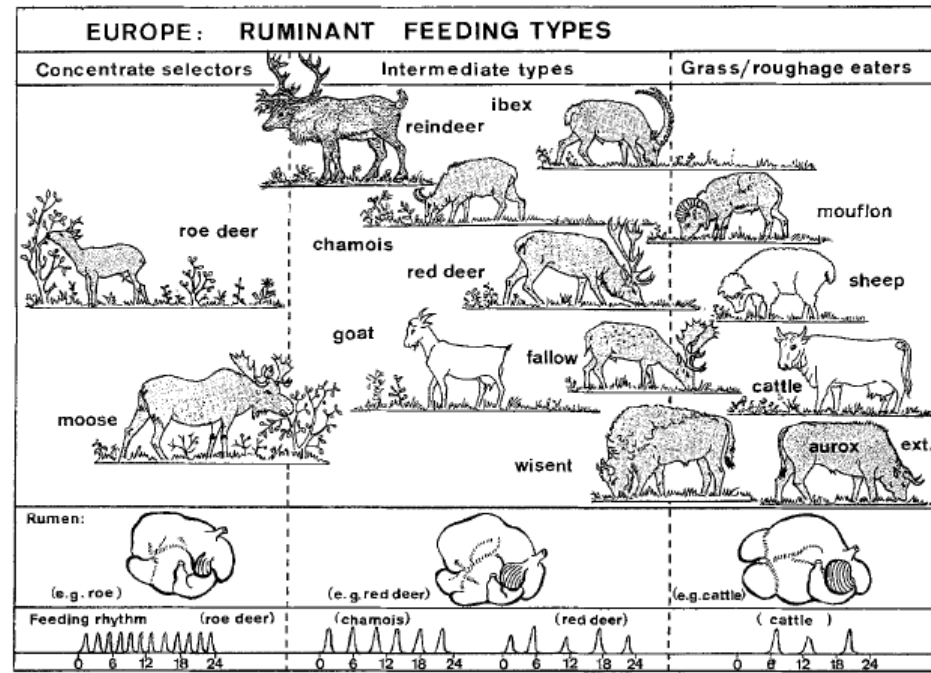


Fig. 1a, b. Comparison of ruminant extremes scaled to equal size irrespective of weight: Günther's dik-dik (a), 3-4 kg, early evolved concentrate selector; African buffalo (b), 800-1000 kg, late evolved grass and roughage eater; note relative dimensions of forestomach (from Hofmann 1973, redrawn)



I. AFRICA: RUMINANT FEEDING TYPES

CONCENTRATE SELECTORS	INTERMEDIATE TYPES	GRASS / ROUGHAGE EATERS
Dikdik	Impala	African buffalo
Suni	Klipspringer	Uganda Kob
Grey Duiker	Thomson Gazelle	Bohor Reedbuck
Red Duiker	Grant Gazelle	Waterbuck
Bushbuck	Eland Antelope	Oribi
Giraffe	Steenbok	Gnu
Lesser Kudu		Kongoni
Greater Kudu		Mountain Reedbuck
Gerenuk		Topi
Bongo		Oryx

Elemento que falta



Reemplazo de nichos por pueblos indígenas

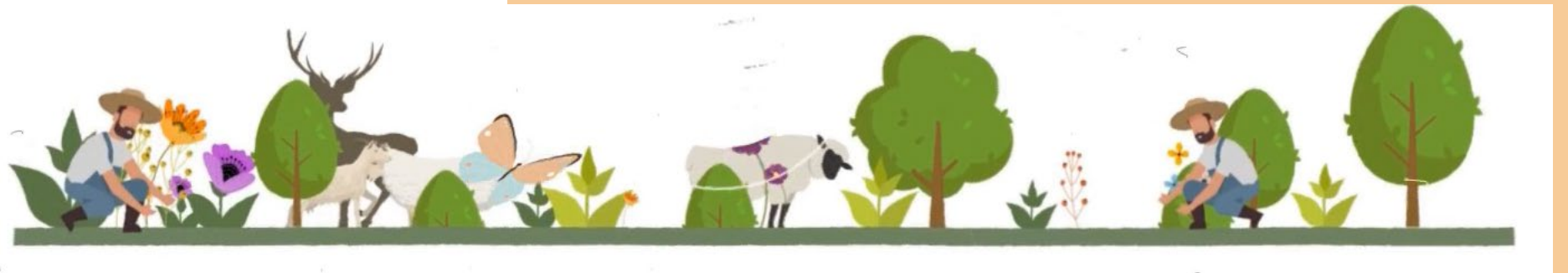
- Cazadores – recolectores

Nikulina et al 2025

<https://doi.org/10.1371/journal.pone.0328218>



- Pastores



⇒ ¡Todos queriendo crear pasto!

Fuente de la imagen:

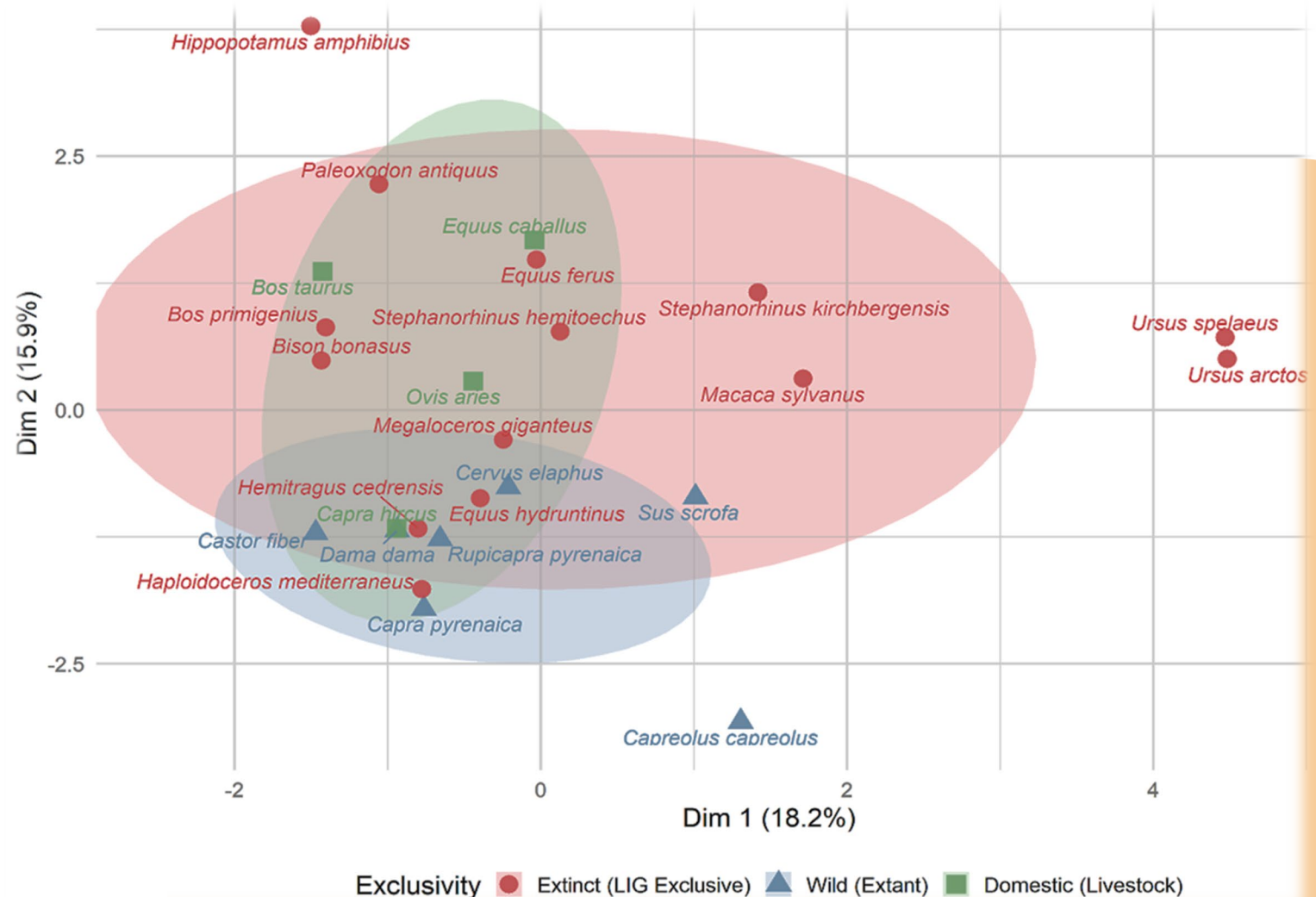
https://youtu.be/KYDk5xlQ7_4

Escenarios de futuro

¿Cómo han evolucionado los nichos?

- Pérdida desde el LIG de desbrozadores/megafauna
⇒ Sustitución por actividades tradicionales
- Pérdida actual de pastadores
- Escenarios exclusivamente de ramoneadores

Serrano-Zulueta et al.
(enviado a Ecosistemas)





Images' source Pablo Manzano, own work



Escenarios de futuro

¿Con qué estamos jugando?

- Los nichos se han conservado
- Nos adentramos en territorio desconocido



Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

Palaeogeography, Palaeoclimatology, Palaeoecology

journal homepage: www.elsevier.com/locate/palaeo

Community-level functional stability in East African herbivores amid major Neogene environmental change

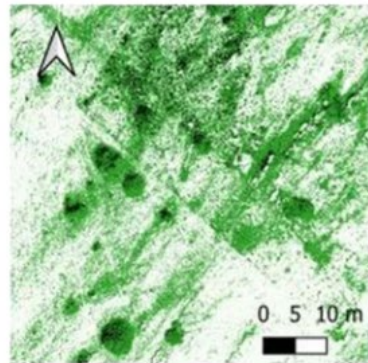
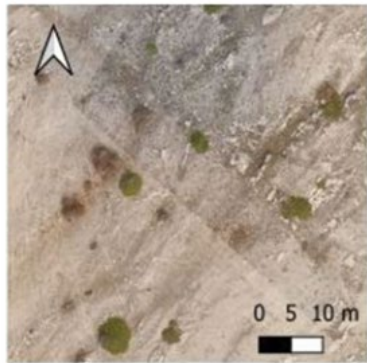
Jeremias Glöggler^{a,b,*}, Jessamy H. Doman^c, Miquel Torrents-Ticó^{d,e}, Juha J. Saarinen^a, Mar Cabeza^{e,f}, Indrė Žliobaitė^{b,a}



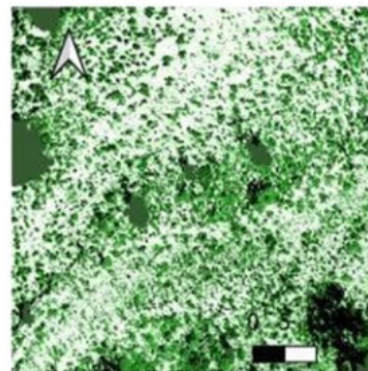
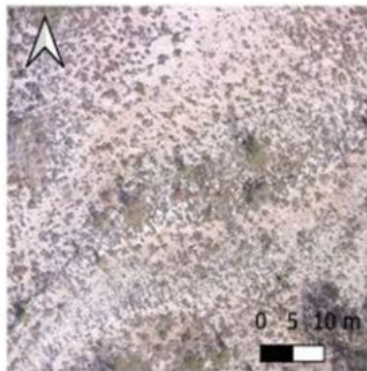
Turkana, hace 4 MA. Australopitecinos compartiendo paisaje con hasta 4 especies diferentes de proboscídeos (*Anancus ultimus*, *Deinotherium bozasi*, *Loxodonta adaurora* y *Loxodonta exoptata*).

Imagen: Julius Csotonyi (<http://csotonyi.com>)

Efectos en paisajes de balance de herbívoros



Livestock + wild ungulates



Wild ungulates



Balanites aegyptiaca



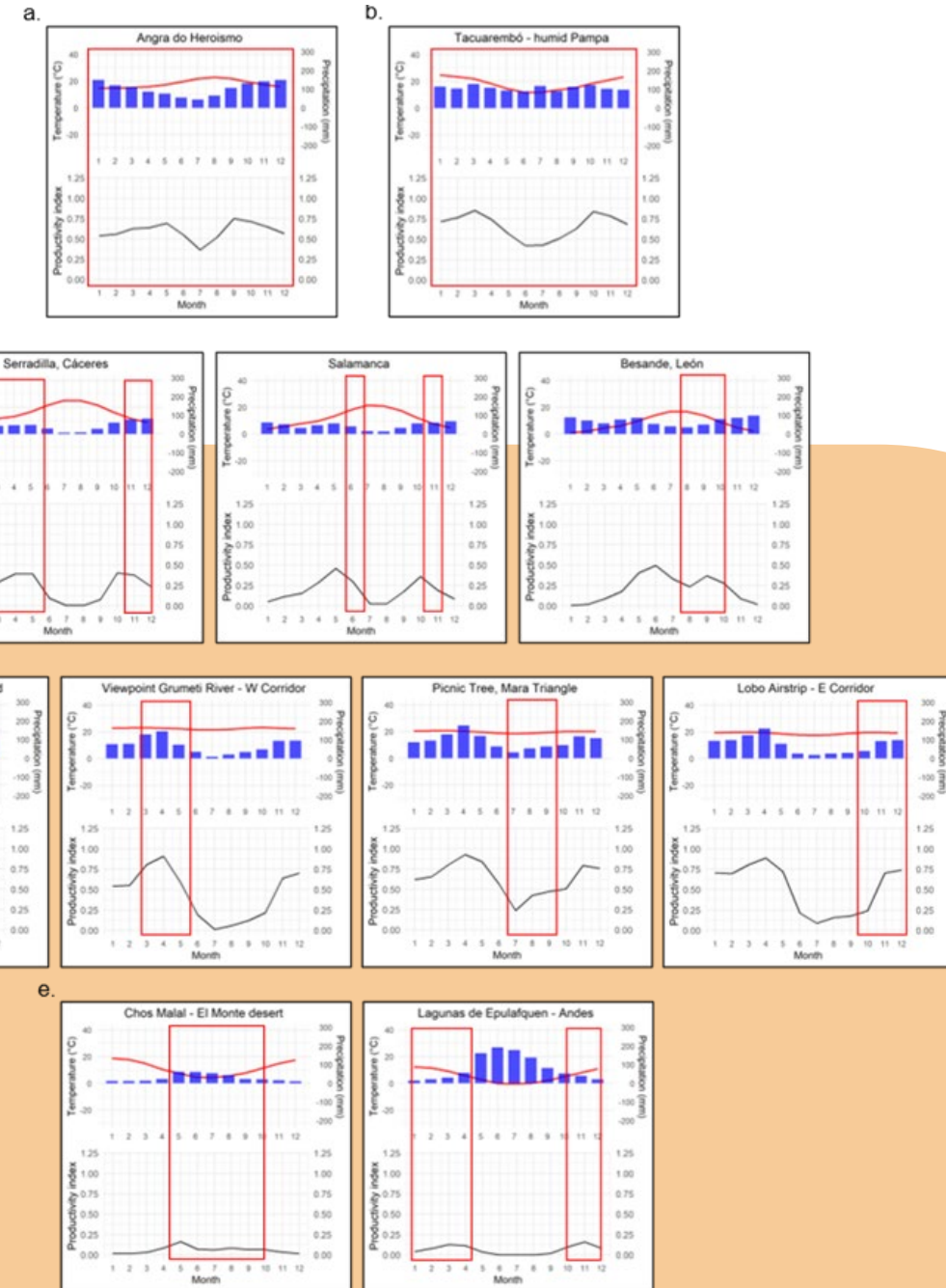
Vachellia tortillis



Vachellia etbaica

(trabajo propio)

Rol de la movilidad



- De Meyer et al. in prep

Tendencias

Transiciones hacia sistemas ganaderos lineares

- High proportion of grassland in agricultural area, high animal density
- High proportion of grassland in agricultural area, medium animal density
- High proportion of grassland in agricultural area, low animal density
- Low proportion of grassland in agricultural area, high animal density
- Low proportion of grassland in agricultural area, crops and animals
- Low proportion of grassland in agricultural area, high animal density
- Less than 20% of agricultural area in total area

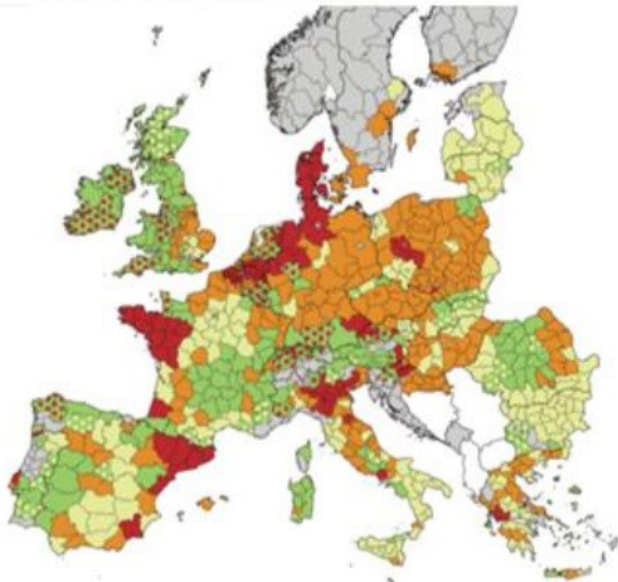


Figure 2: Typology of European livestock production areas
(Source INRA based on Eurostat, 2010)

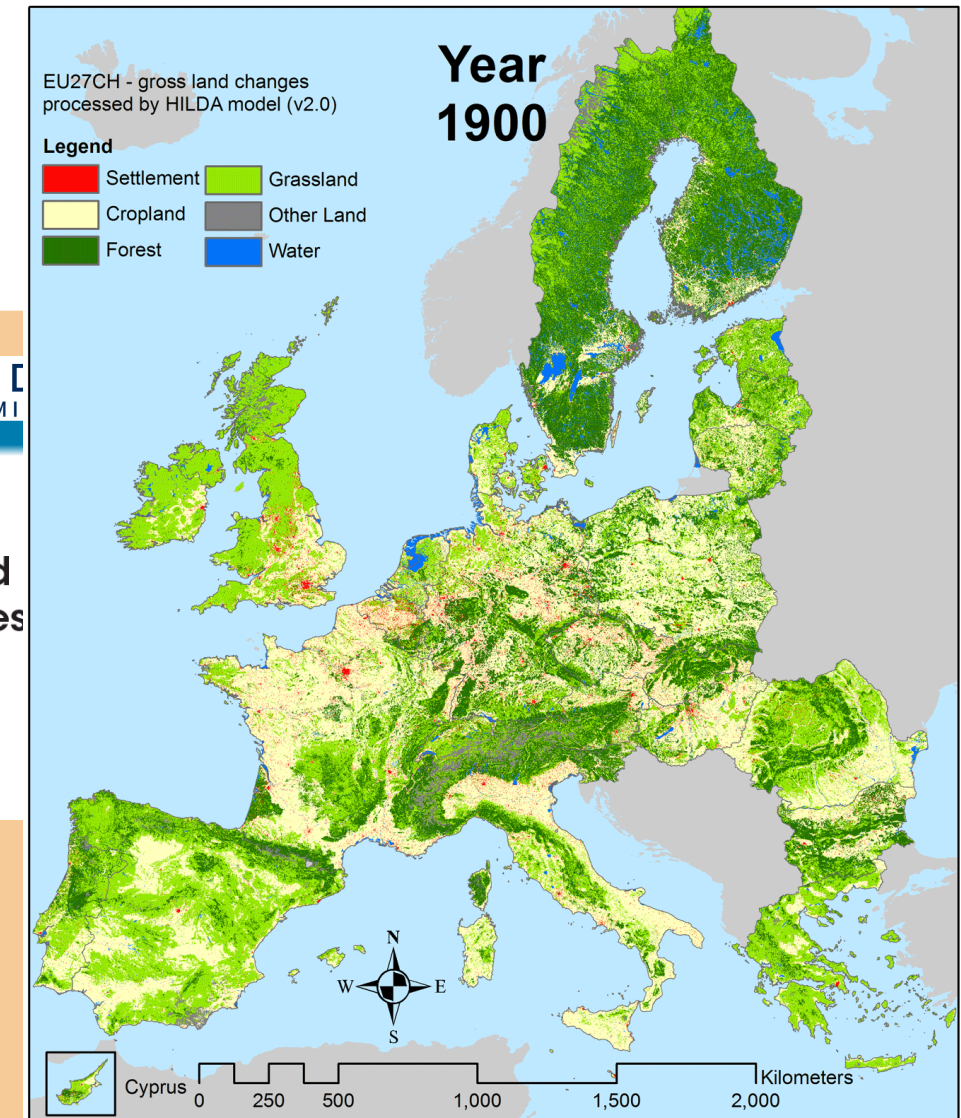
ANIMAL FRONTIERS OXFORD
ACADEMY

Article

Extension but positive outcomes,
mixed but negative: complexity and
challenges in evaluating land use by livestock
systems

Authors: Mariana de Aragão Pereira^{1,2} and Wilhelm Windisch^{3,4}

¹ Institute for Climate Change (BC3), Leioa, Spain
² Basque Foundation of Science, Bilbao, Spain
³ Embrapa, Campo Grande, Brazil
⁴ University of Munich, Chair of Animal Nutrition, Freising, Germany

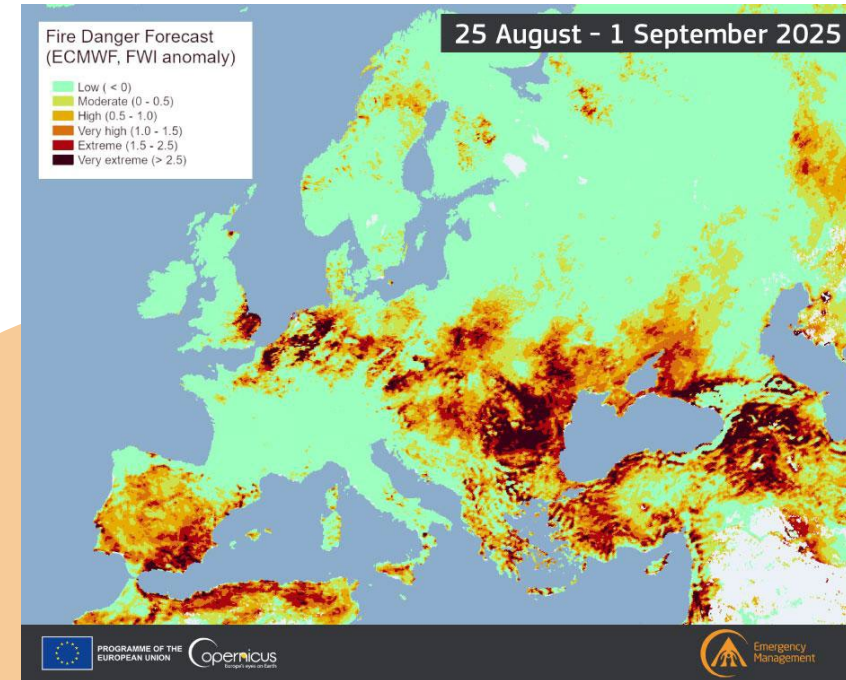
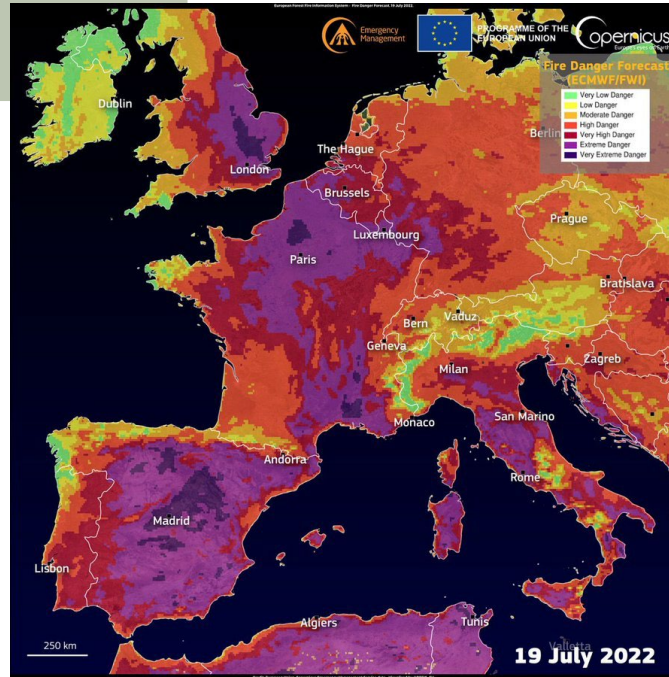


Source: <http://www.geo-informatie.nl/fuchs003/#>

Fuente: ATF Vision Paper – Febrero 2019

http://animaltaskforce.eu/Portals/0/ATF_Vision_Paper_2019.pdf

Consecuencias del colapso



ANIMAL FRONTIERS OXFORD
ACADEMIC

Ecosystem management using livestock:
embracing diversity and respecting ecological
principles 

Logan Thompson, Jason Rowntree, Wilhelm Windisch, Sinéad M Waters,
Laurence Shalloo, Pablo Manzano ✉

Animal Frontiers, Volume 13, Issue 2, April 2023, Pages 28–34, <https://doi.org/10.1093/af/vfac094>

Colapso deseado

nature
sustainability

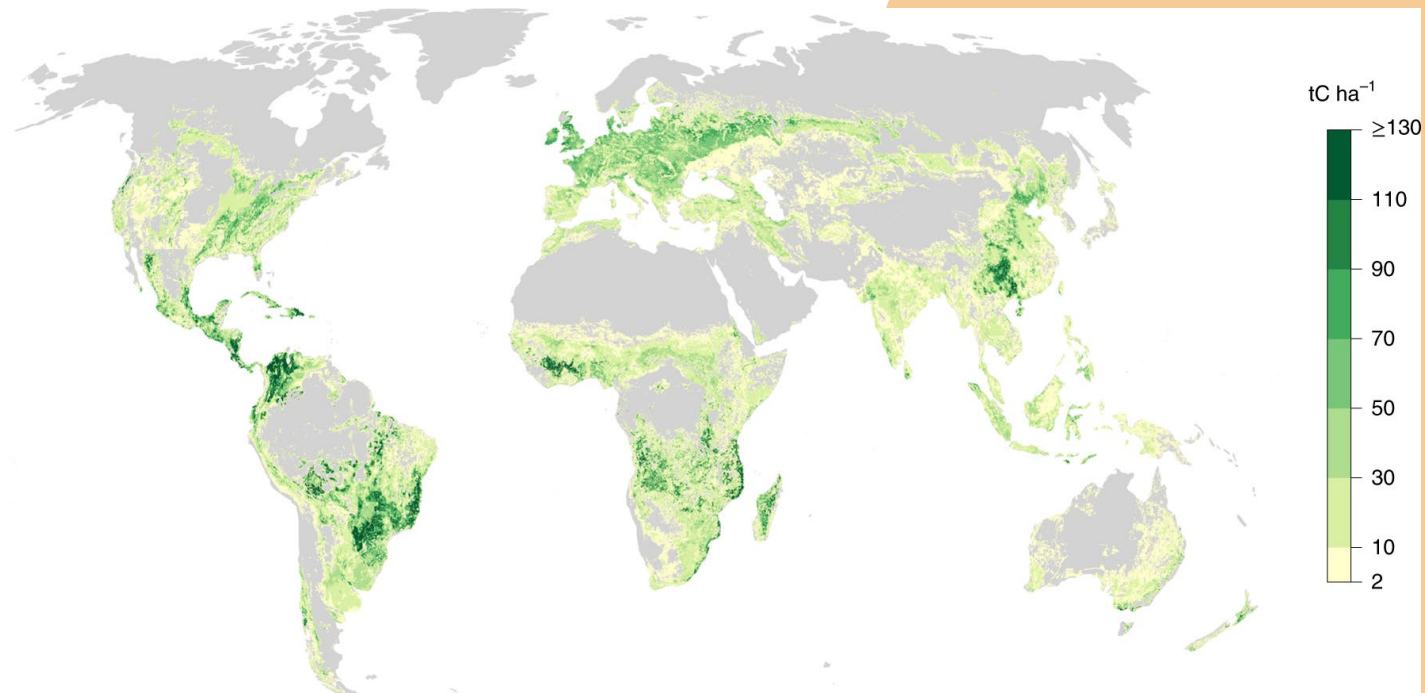
BRIEF COMMUNICATION

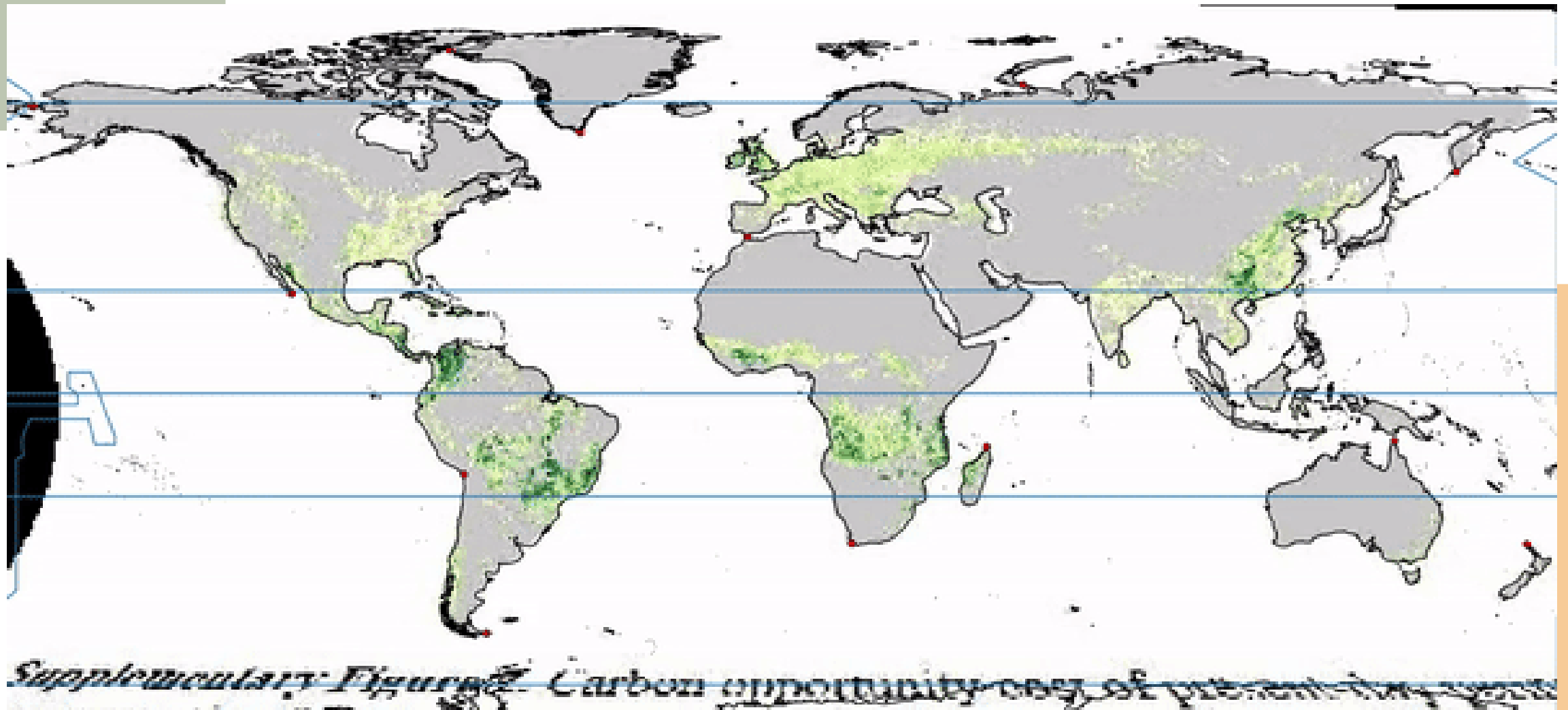
<https://doi.org/10.1038/s41893-020-00603-4>



The carbon opportunity cost of animal-sourced food production on land

Matthew N. Hayek¹✉, Helen Harwatt², William J. Ripple³ and Nathaniel D. Mueller^{4,5}





Ejemplo: “pastos permanentes a bosque”.

¿Quién gana?

Que siga la fiesta

- Petroleras
- Aerolíneas
- Automóvil

shifts in global food production to plant-based diets by 2050 could lead to sequestration of 332–547 GtCO₂, equivalent to 99–163% of the CO₂ emissions budget consistent with a 66% chance of limiting warming to 1.5 °C.

Cumulative CO₂ emissions (anthropogenic emissions minus removal) must remain below 335 GtCO₂ after 2019 to limit warming to 1.5 °C at a 66% likelihood level¹⁴. CO₂ removal from terrestrial vegetation following ELC or VGN dietary shifts would increase permissible CO₂ emissions by 99% (63%–137%) or 163% (107%–222%), respectively. Adding net CO₂ uptake by native ecosystem soil and litter to this total increases the 1.5 °C budget by 139% or 230%, respectively.



Los sistemas circulares son complejos

Particularmente el pastoreo

One Earth



CellPress

Perspective

Toward a holistic understanding of pastoralism

Pablo Manzano,^{1,2,16} Daniel Burgas,^{3,16} Luis Cadahía,^{4,16} Jussi T. Eronen,^{2,5,6} Álvaro Fernández-Llamazares,^{1,2} Slimane Bencherif,⁷ Øystein Holand,⁸ Oula Seitsonen,^{9,10} Bayarma Byambaa,¹¹ Mikael Fortelius,¹² María E. Fernández-Giménez,¹³ Kathleen A. Galvin,^{14,15} Mar Cabeza,^{1,2,17,*} and Nils Chr. Stenseth^{4,*}

¹Global Change and Conservation Lab, Organismal and Evolutionary Biology Research Programme, Faculty of Biological and Environmental Sciences, University of Helsinki, P.O. Box 65, 00014 Helsinki, Finland

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³Department of Biological and Environmental Sciences, University of Jyväskylä, 40014 Jyväskylä, Finland

⁴Centre for Ecological and Evolutionary Synthesis (CEES), Department of Biosciences, University of Oslo, P.O. Box 1066 Blindern, 0316 Oslo, Norway

⁵Ecosystems and Environment Research Programme, Faculty of Biological and Environmental Sciences, University of Helsinki, P.O. Box 65, 00014 Helsinki, Finland

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⁹Archaeology, Faculty of Humanities, University of Oulu, 90570 Oulu, Finland

¹⁰Cultural Heritage Studies, Faculty of Arts, University of Helsinki, 00100 Helsinki, Finland

¹¹Chair of Land Management, Department of Aerospace and Geodesy, Technical University of Munich, 80333 Munich, Germany

¹²Department of Geosciences and Geography, University of Helsinki, 00014 Helsinki, Finland

¹³Department of Forest & Rangeland Stewardship, Colorado State University, Fort Collins, CO 80523, USA

¹⁴Department of Anthropology and Geography, Colorado State University, Fort Collins, CO 80523, USA

¹⁵The Africa Center, Colorado State University, Fort Collins, CO 80523, USA

¹⁶These authors contributed equally

¹⁷Lead contact

*Correspondence: mar.cabeza@helsinki.fi (M.C.), n.c.stenseth@mn.uio.no (N.C.S.)

<https://doi.org/10.1016/j.oneear.2021.04.012>

Journal of Environmental Management 328 (2023) 116966



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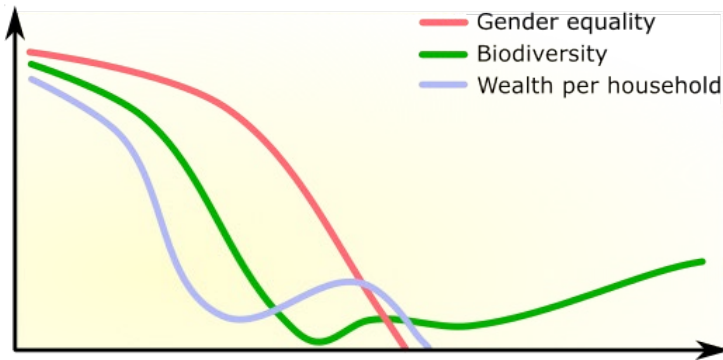
Review

Global principles in local traditional knowledge: A review of forage plant-livestock-herder interactions

Abolfazl Sharifian^{a,b,f,*}, Batdelger Gantuya^{b,c}, Hussein T. Wario^d, Marcin Andrzej Kotowski^e, Hossein Barani^a, Pablo Manzano^{f,g,h,i}, Saverio Krätli^j, Dániel Babai^k, Marianna Biró^b, László Sáfián^l, Jigjidsüren Erdenetsogt^m, Qorban Mohammad Qabelⁿ, Zsolt Molnár^b



Itinerarios de sostenibilidad

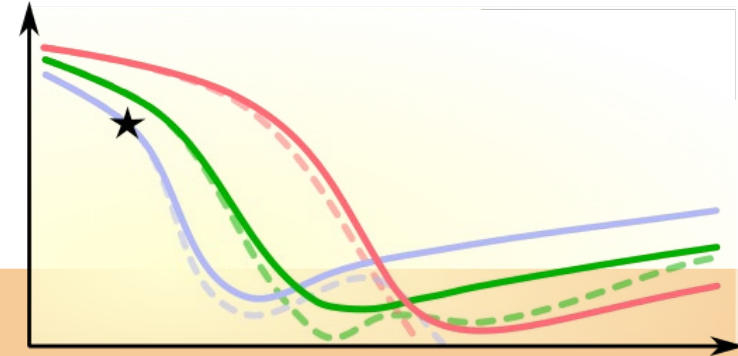


Trayectoria de
colapso

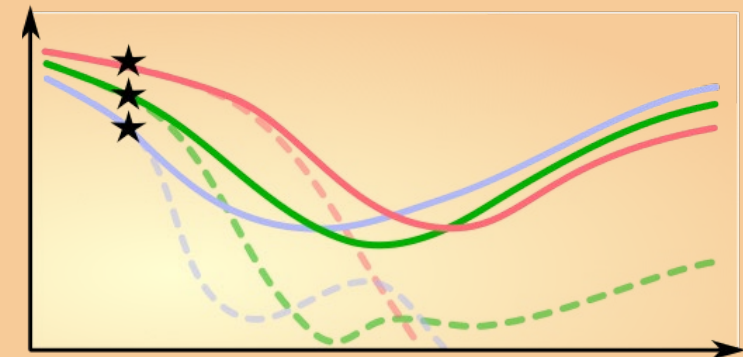
Sectoriales, unidisciplinares

INTERVENCIONES

Holísticas



Pérdidas críticas
Riesgo permanente de colapso



Pérdidas y riesgo de colapso evitados

Qué medir, cómo medir



Social patterns explained through environmental-economic perspectives



Environmental patterns explained through economic perspectives



Economic patterns complemented by environmental perspectives

Challenges for the balanced attribution of livestock's environmental impacts: the art of conveying simple messages around complex realities

Pablo Manzano,^{1,2,3} Jason Rowntree,^{4,5} Logan Thompson,^{6,7} Agustín del Prado,^{1,2,3} Peer Ederer,^{8,9} Wilhelm Windisch,^{10,11} and Michael R.F. Lee^{12,13}

¡Sí, se puede!

The Journal of Latin American and Caribbean Anthropology



Agriculture, Ecosystems and Environment 398 (2026) 110092



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Pastoral governance hierarchies shape vegetation dynamics in Lebanon's high-elevation rangelands

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Governance, Mobility, and Pastureland Ecology. An Eco-Anthropological Study of Three Pastoral Commons in Northeastern Andalusia

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