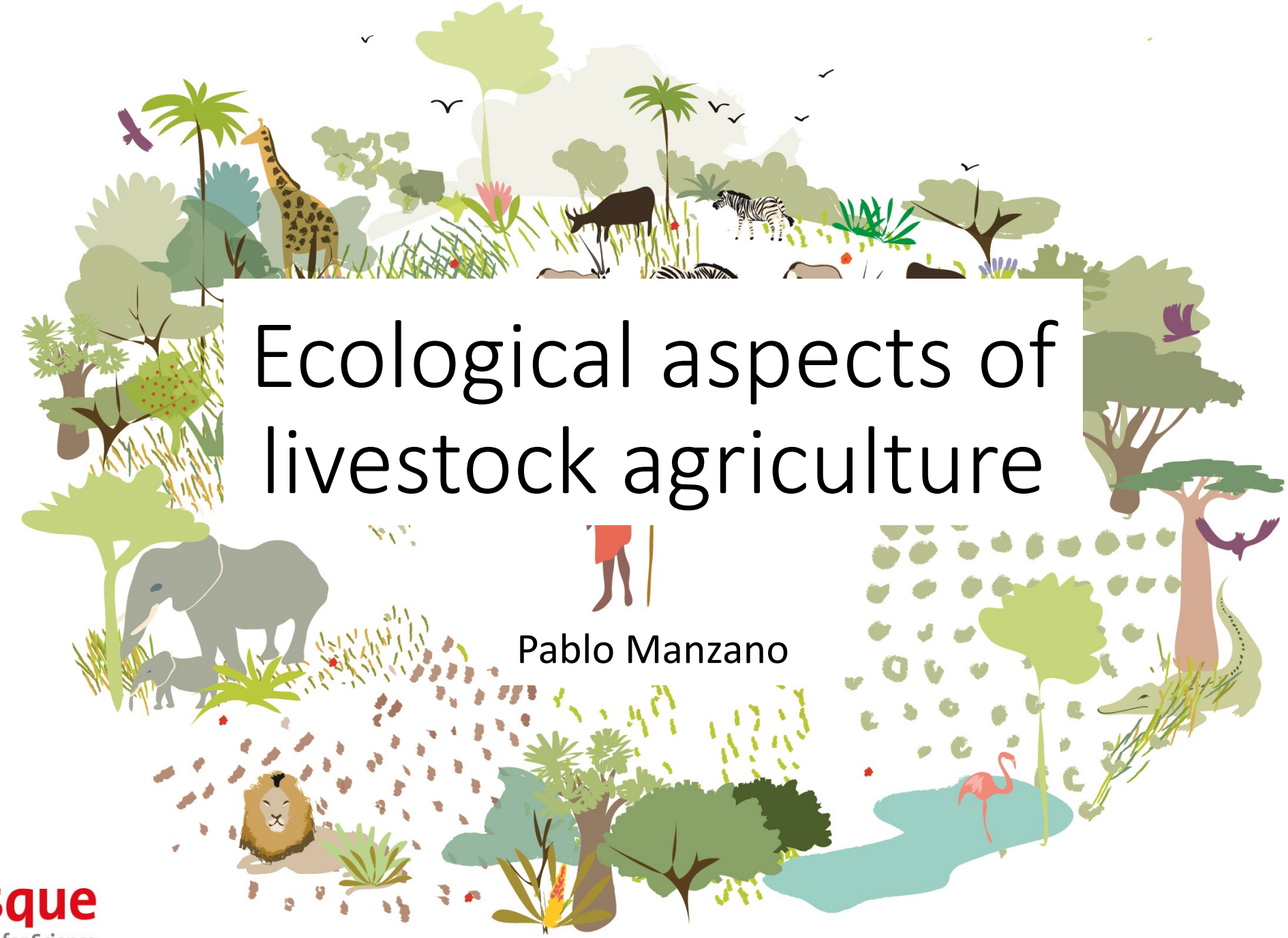

Ecological aspects of livestock agriculture

Pablo Manzano

bc³
BASQUE CENTRE FOR CLIMATE CHANGE
Klima Aldaketa Ikergai
Sustainability, that's it!

HELSINGIN YLIOPISTO
HELSINGFORS UNIVERSITET
UNIVERSITY OF HELSINKI

GCC lab
Global Change and Conservation

ikerbasque
Basque Foundation for Science

HELSUS
HELSINKI INSTITUTE OF SUSTAINABILITY SCIENCE

Current Biology

CellPress

Review

The role of large wild animals in climate change mitigation and adaptation

Yadvinder Malhi[1,*], Tonya Lander[2], Elizabeth le Roux[1,3], Nicola Stevens[1], Marc Macias-Fauria[4], Lisa Wedding[4], Cécile Girardin[1], Jeppe Ågård Kristensen[1,3], Christopher J. Sandom[5,6], Tom D. Evans[7], Jens-Christian Svenning[3], and Susan Canney[8]

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[3]Center for Biodiversity Dynamics in a Changing World (BIOCHANGE) and Section for Ecoinformatics and Biodiversity, Department of Biology, Aarhus University, Ny Munkegade 114, DK-8000 Aarhus C, Denmark
[4]School of Geography and the Environment, University of Oxford, Oxford OX1 3QY, UK
[5]Life Sciences, University of Sussex, Brighton BN1 9QG, UK
[6]Sussex Sustainability Research Programme, University of Sussex, Brighton BN1 9QG, UK
[7]Wildlife Conservation Society, Global Conservation Program, Bronx, New York, NY 10460, USA
[8]Department of Zoology, University of Oxford, Oxford OX1 3SZ, UK
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https://doi.org/10.1016/j.cub.2022.01.041

What ecosystems are we talking about?

- Bond

Journal of Vegetation Science 16: 261-266, 2005

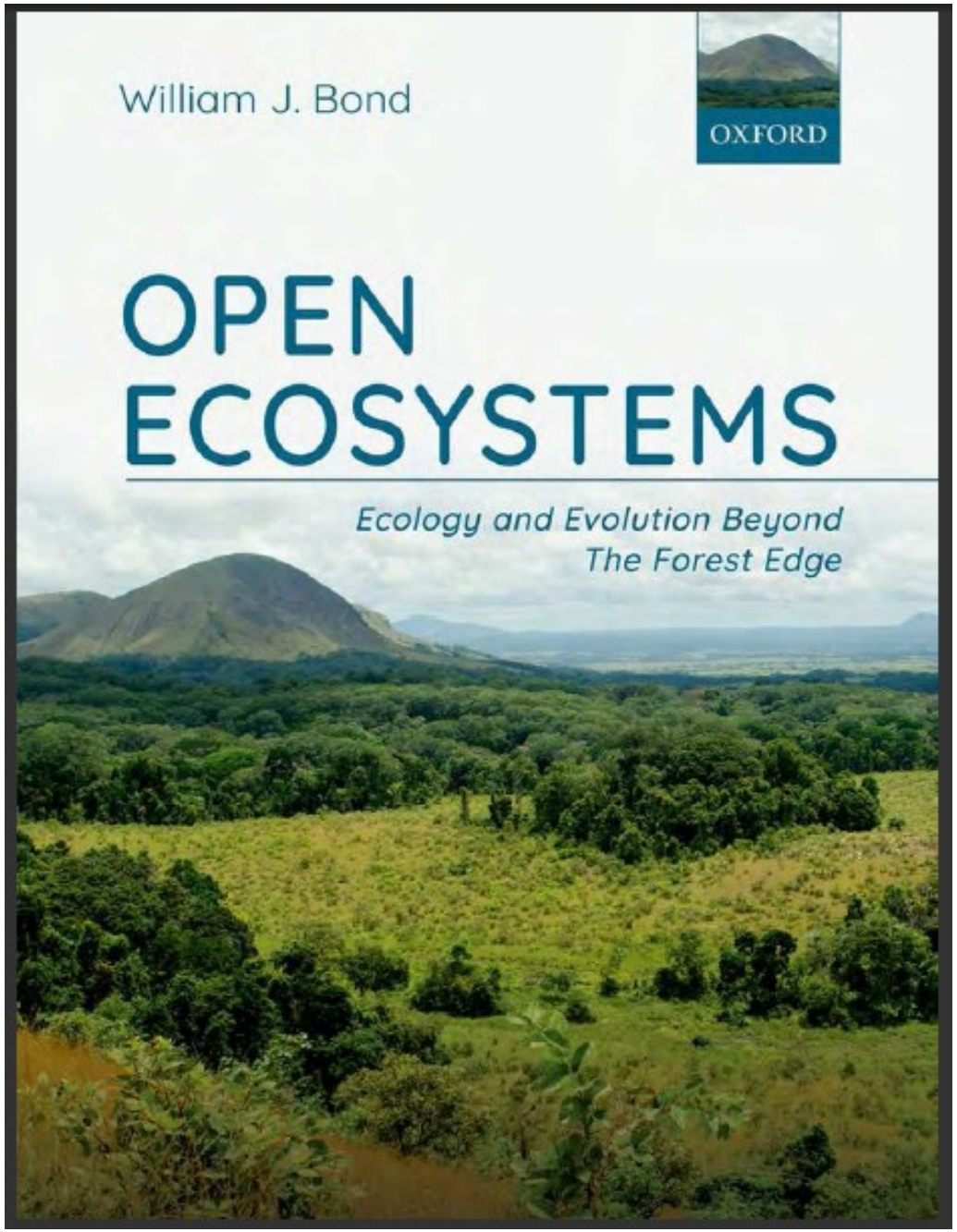
INVITED PERSPECTIVE

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.



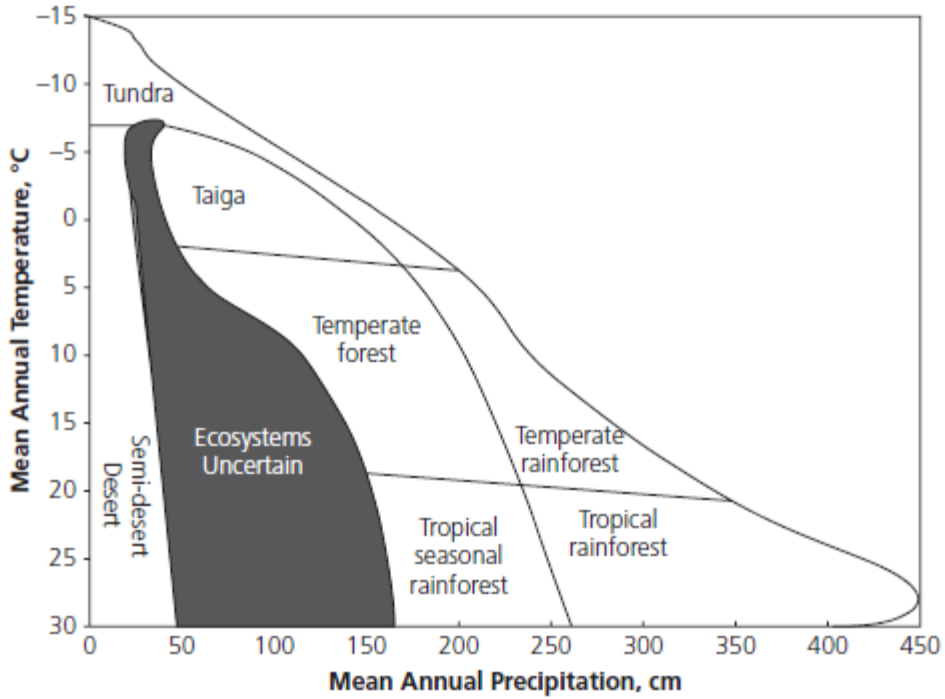


Figure 2.2 Whittaker's climate envelopes for major world vegetation formations. The shaded area is the climate envelope where ecosystems are uncertain and 'either grassland, or one of the types dominated by woody plants, may form the prevailing vegetation in different areas' (redrawn from Whittaker 1975,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

Origin of open ecosystems

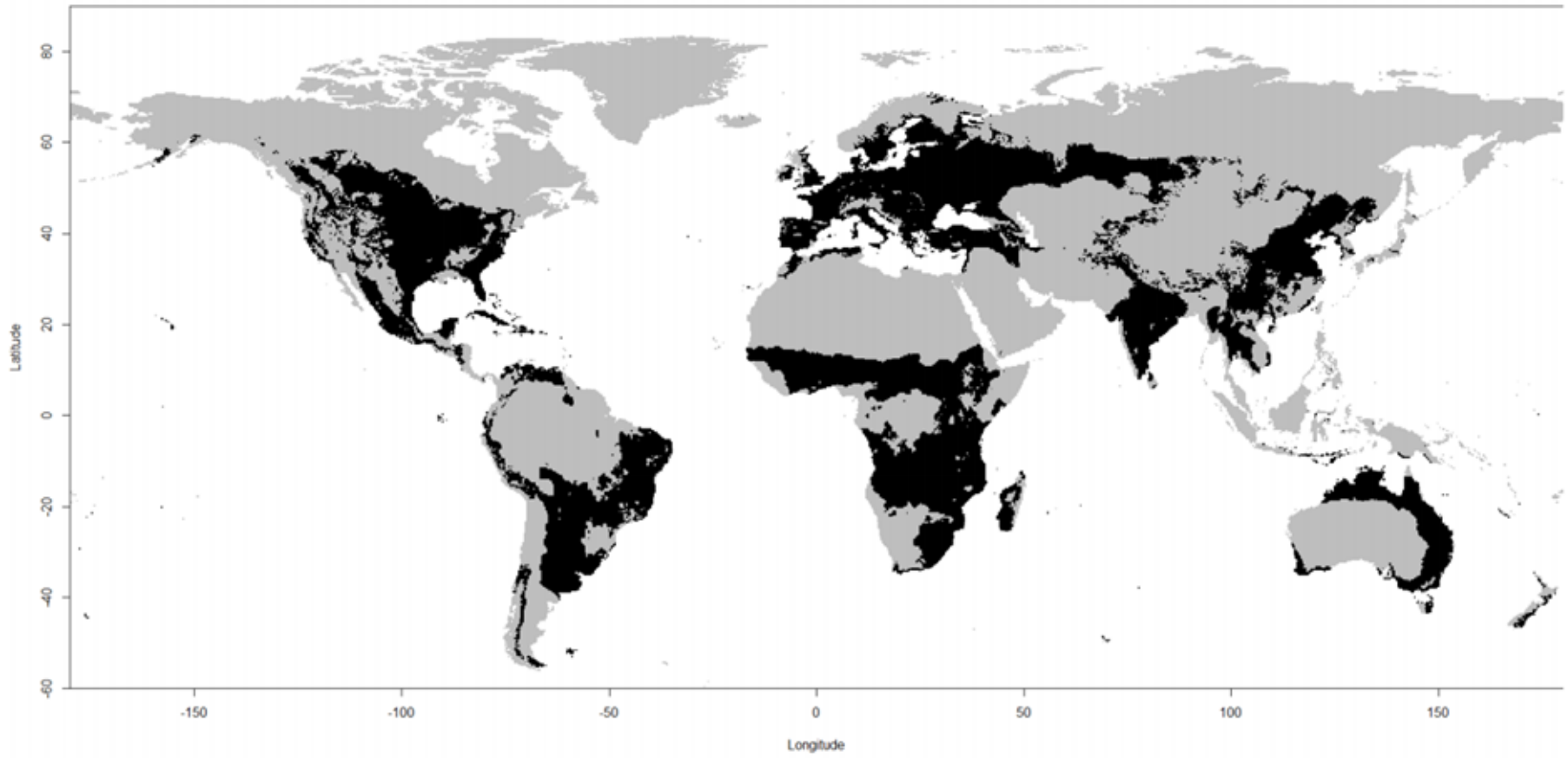


Image source
https://www.elespanol.com/eldigitalcastillalamancha/region/ciudad-real/20211208/plan-sostenibilidad-turistica-impulsa-recursos-parque-cabaneros/633186830_0.html

Image source
Pablo Manzano, own work

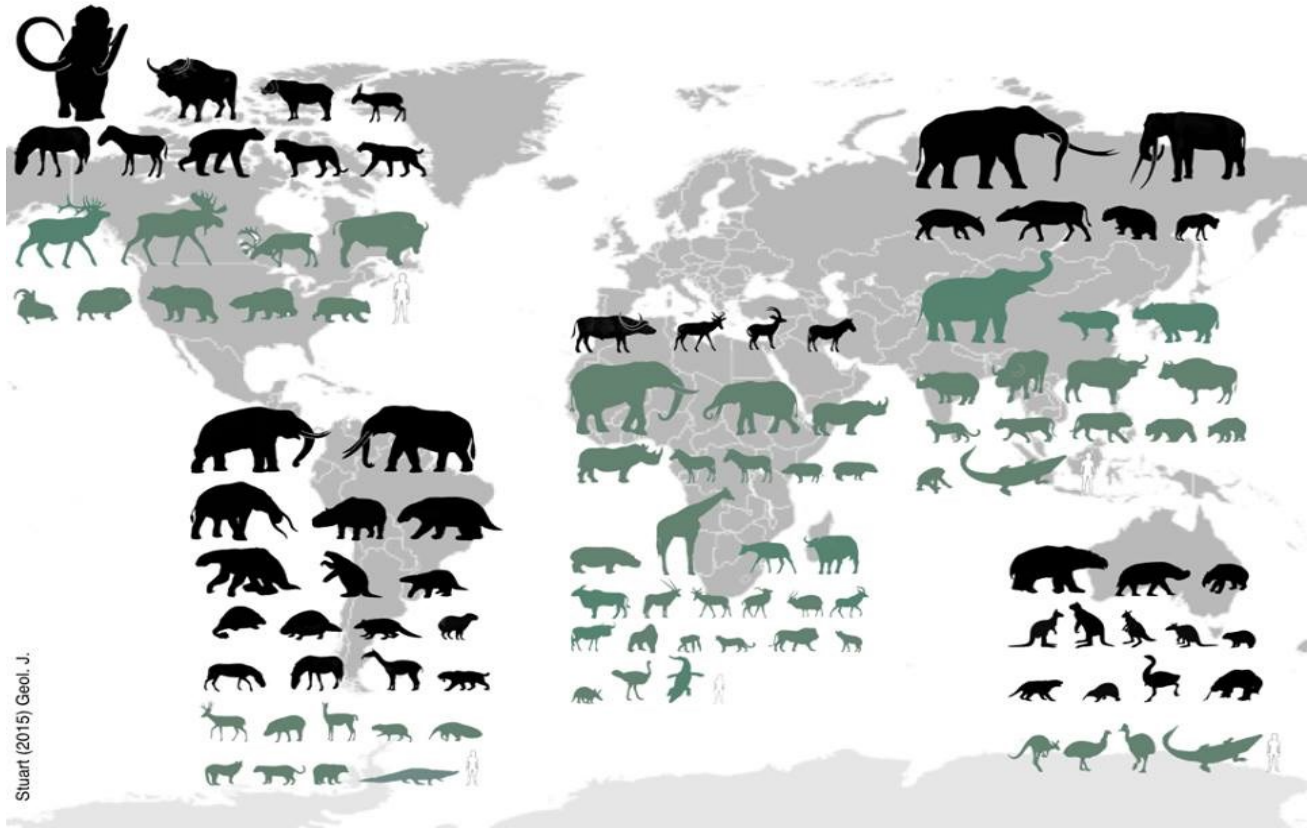
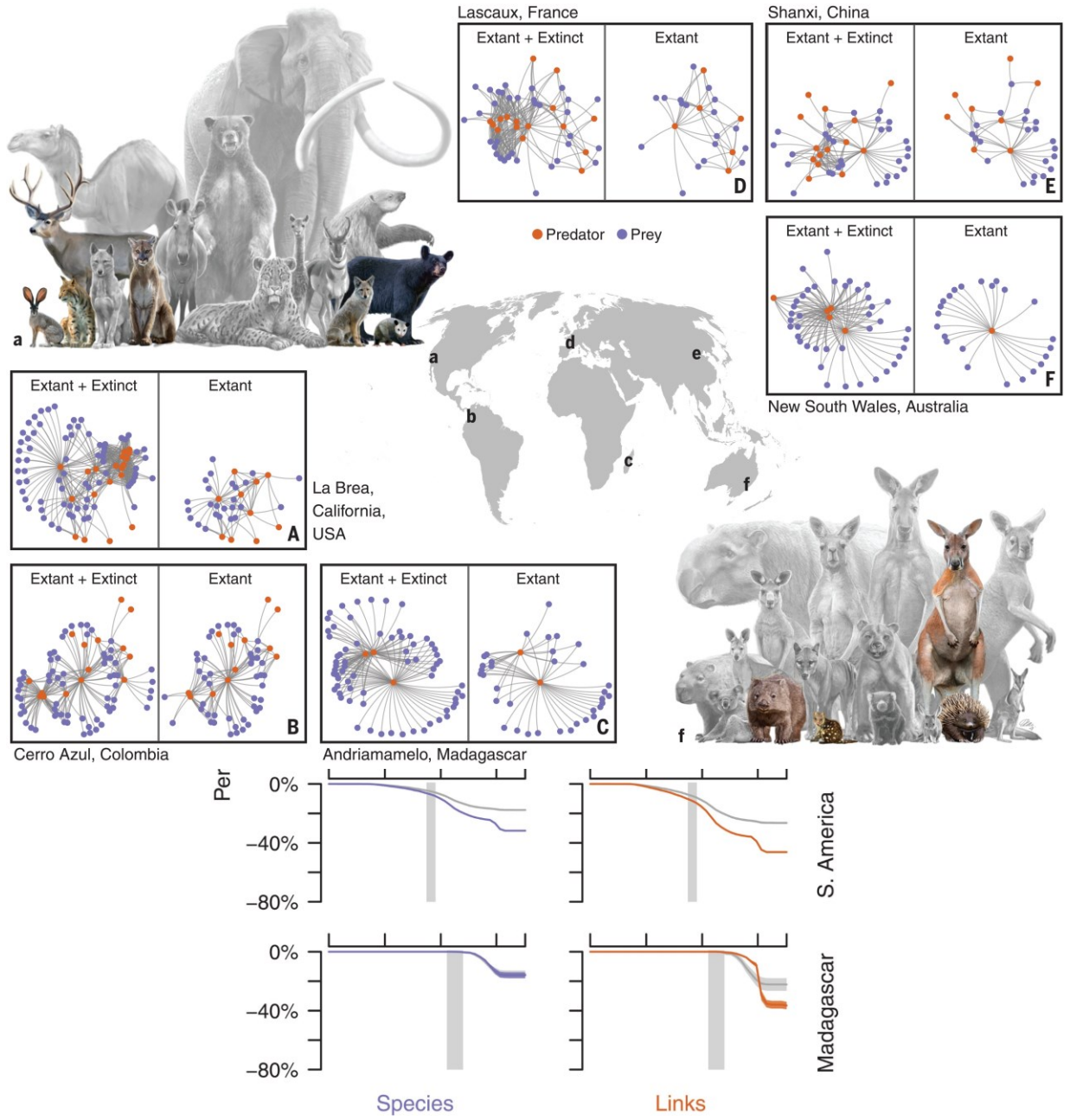


Image source
Pablo Manzano, own work



Fricke et al. 2022 https://doi. org/10.1126/science.abn4012

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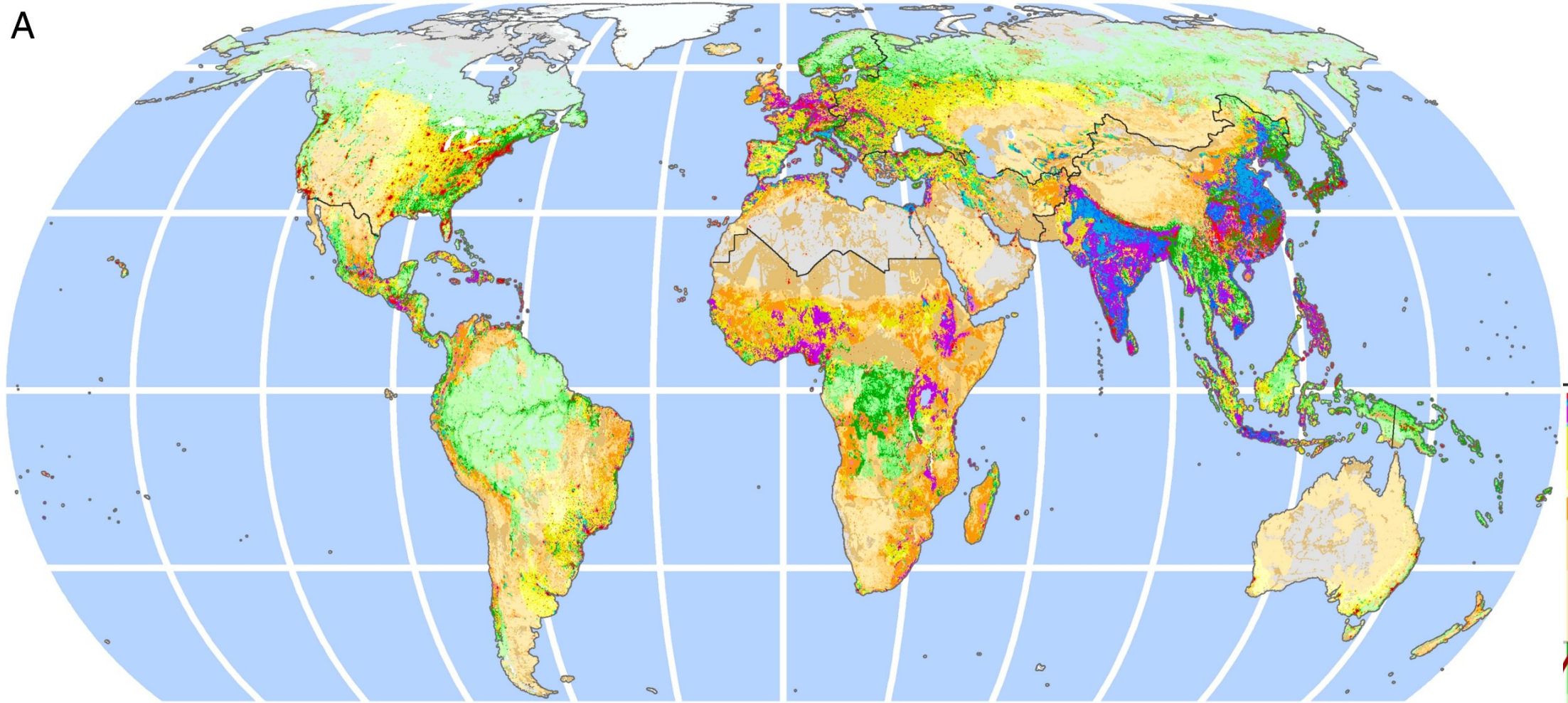


Intensive

Dense Settlements
- Urban
- Mixed settlements

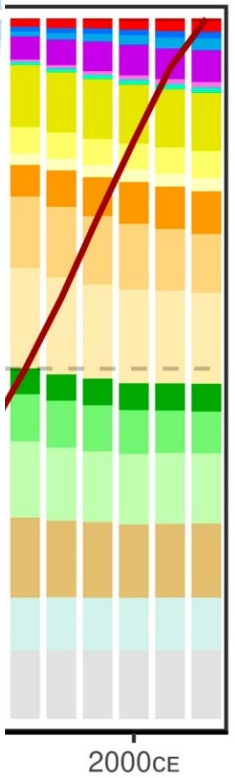
Villages
- Rice villages
- Irrigated villages
- Rainfed villages
- Pastoral villages

Croplands
- Residential irrigated croplands
- Residential rainfed croplands
- Populated croplands
- Remote croplands

Rangelands
- Residential rangelands
- Populated rangelands
- Remote rangelands

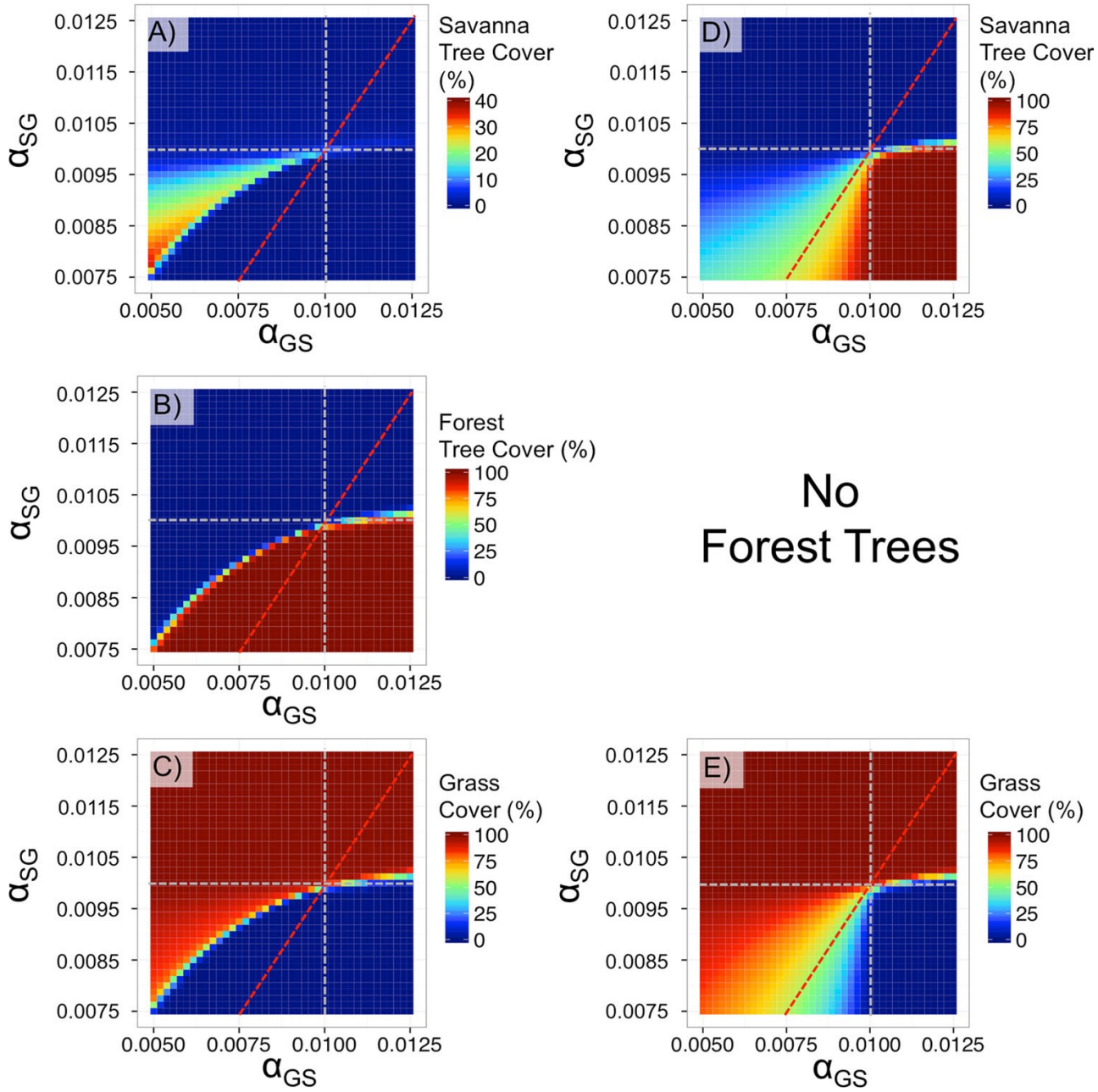
Cultured
- Residential woodlands
- Populated woodlands
- Remote woodlands
- Inhabited drylands

Wildlands
- Wild woodlands
- Wild drylands
- Ice, uninhabited



Ellis et al. 2021 https://doi. org/10.1073/pnas.2023483118

Images' source Pablo Manzano, own work



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

- Management by indigenous peoples

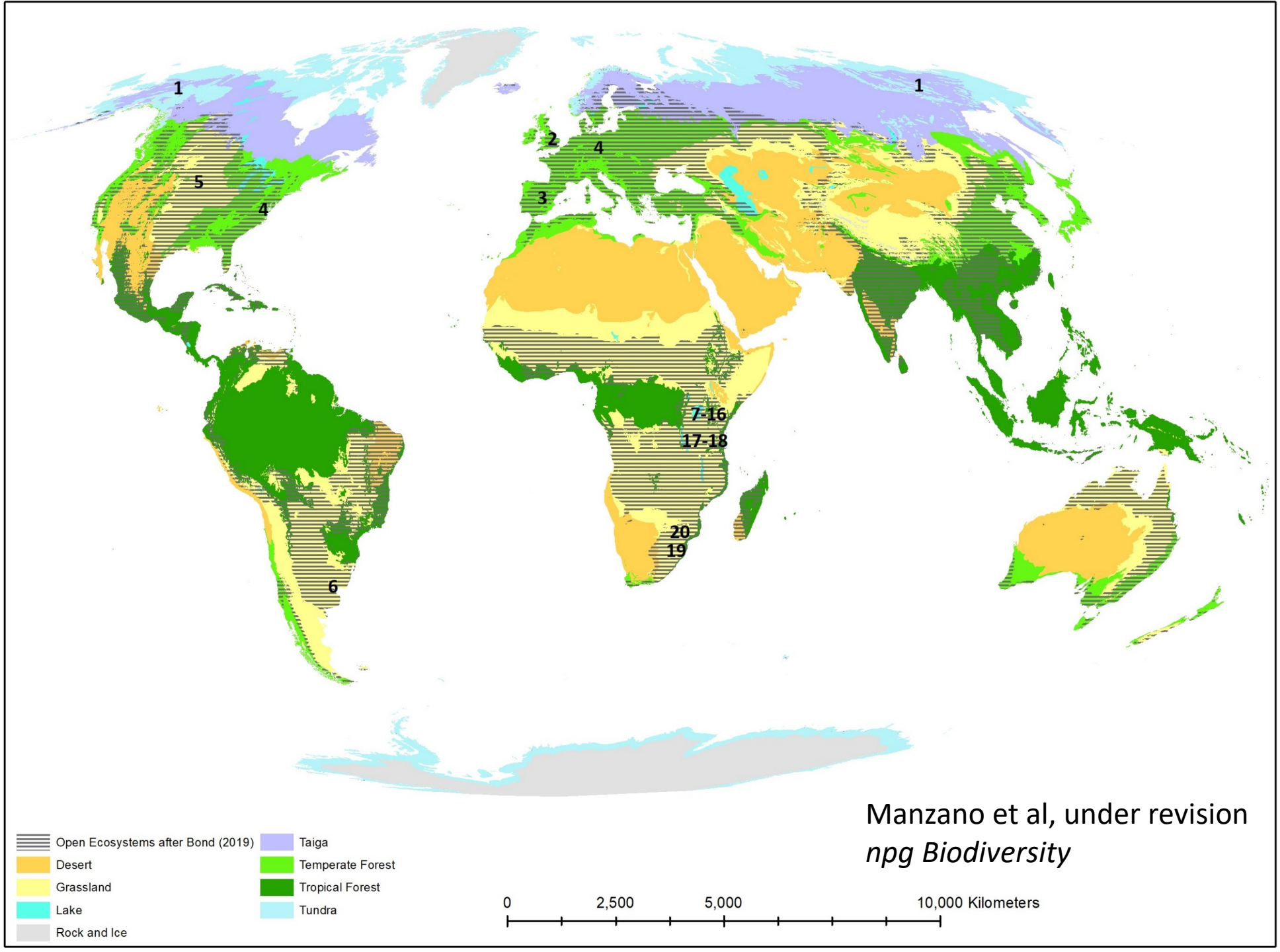
  - Hunter-gatherers

  - Pastoralists

  ⇒ All with the aim of creating pasture!

Biome	Area (billions ha)	Vegetation	Soil	TOTAL	ratio (t C/ha)	aerial t C per ha	soil t C per ha
Trop forest	1,76	212	216	428	243,18	120,45	122,73
Temp forest	1,04	59	100	159	152,88	56,73	96,15
Bor forest	1,37	88	471	559	**408,03**	64,23	343,80
Trop savanna	2,25	66	264	330	146,67	29,33	117,33
Temp grassl	1,25	9	295	304	243,20	7,20	236,00
Deserts & semid	4,55	8	191	199	43,74	1,76	41,98
Tundra	0,95	6	121	127	133,68	6,32	127,37
Wetlands	0,35	15	225	240	685,71	42,86	642,86
Croplands	1,6	3	128	131	81,88	1,88	80,00
TOTAL	15,12	466	2011	2477	163,82		

IPCC. 2000. IPCC Special Report. Climate Land Use, Land-Use Change, and Forestry. Summary for Policymakers. WMO, UNEP. ISBN: 92-9169-114-3.
archive.ipcc.ch/pdf/special-reports/spm/srl-en.pdf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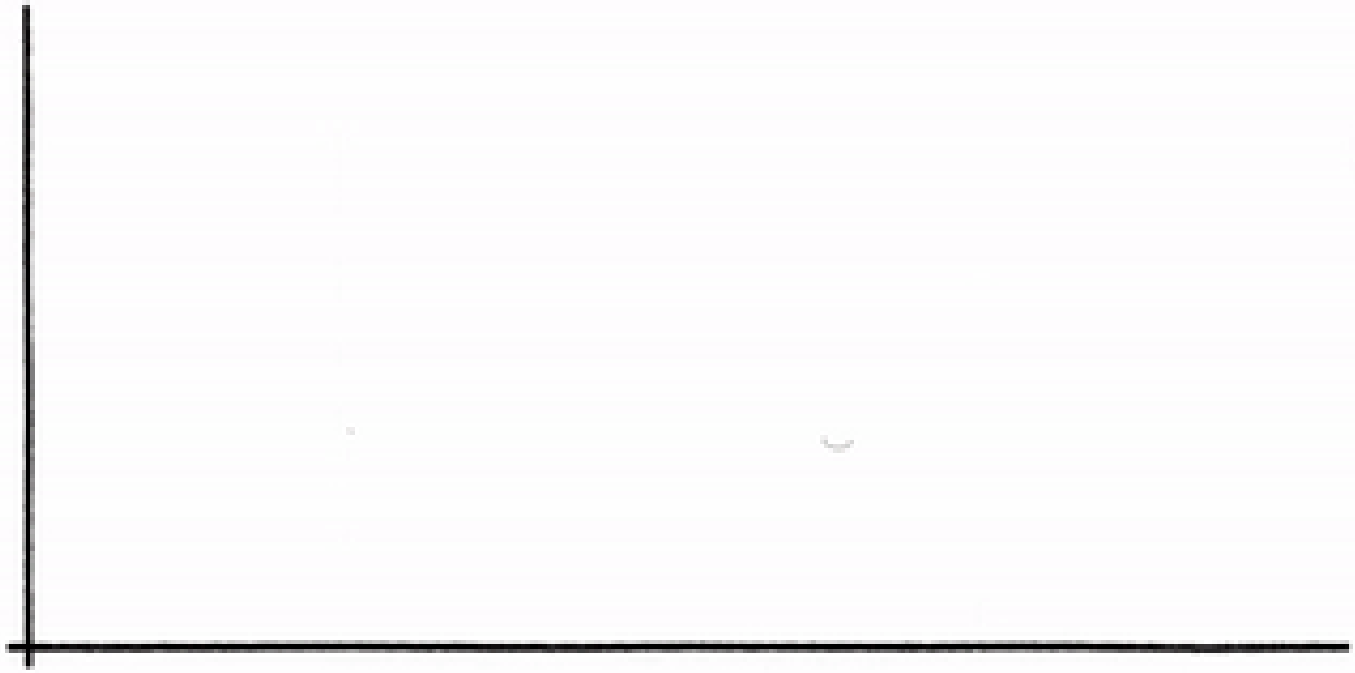
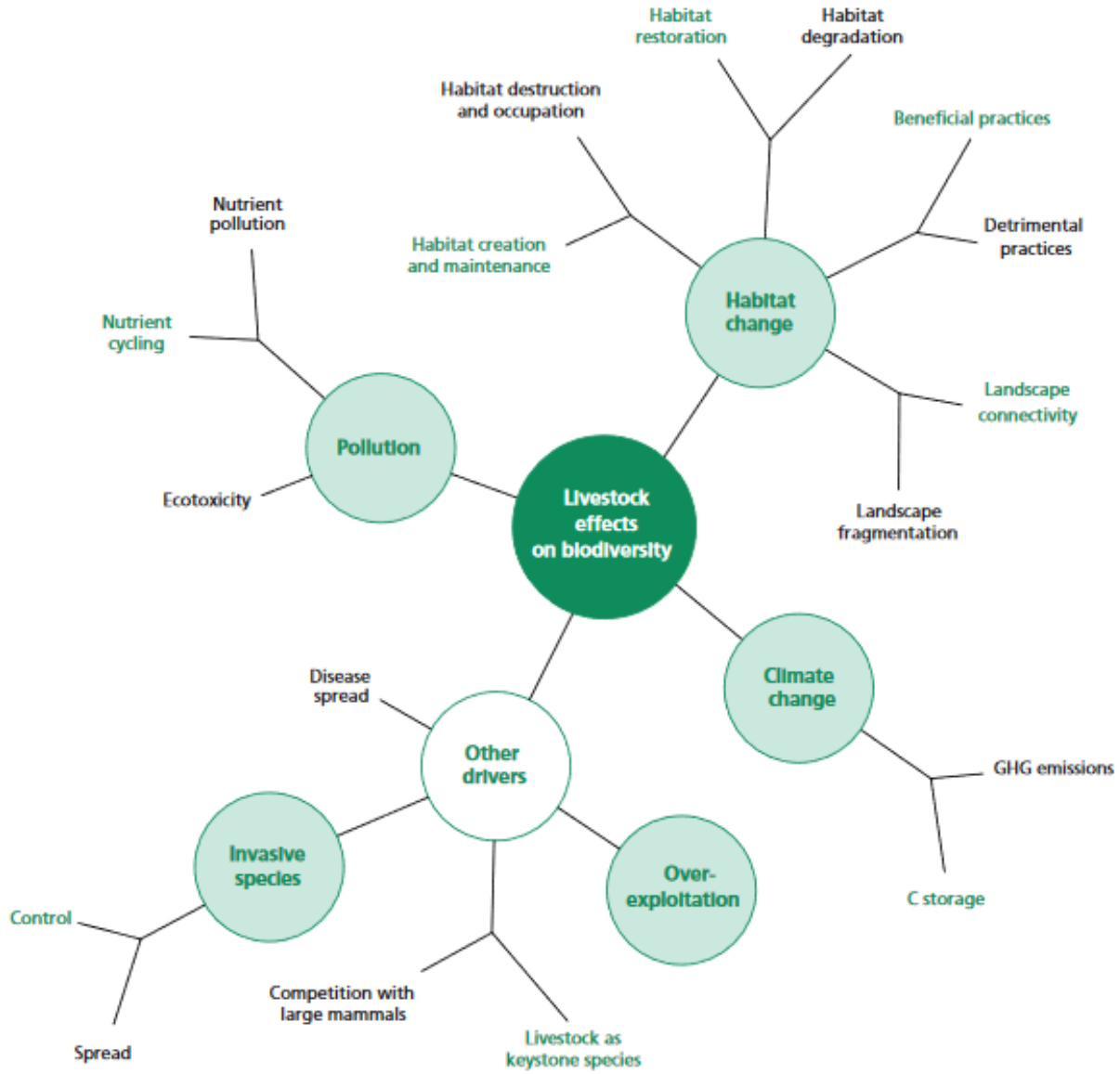
7-16
17-18
20
19
6
Open Ecosystems after Bond (2019)
Desert
Grassland
Lake
Rock and Ice
Taiga
Temperate Forest
Tropical Forest
Tundra
0
2,500
5,000
10,000 Kilometers
Manzano et al, under revision
npg Biodiversity

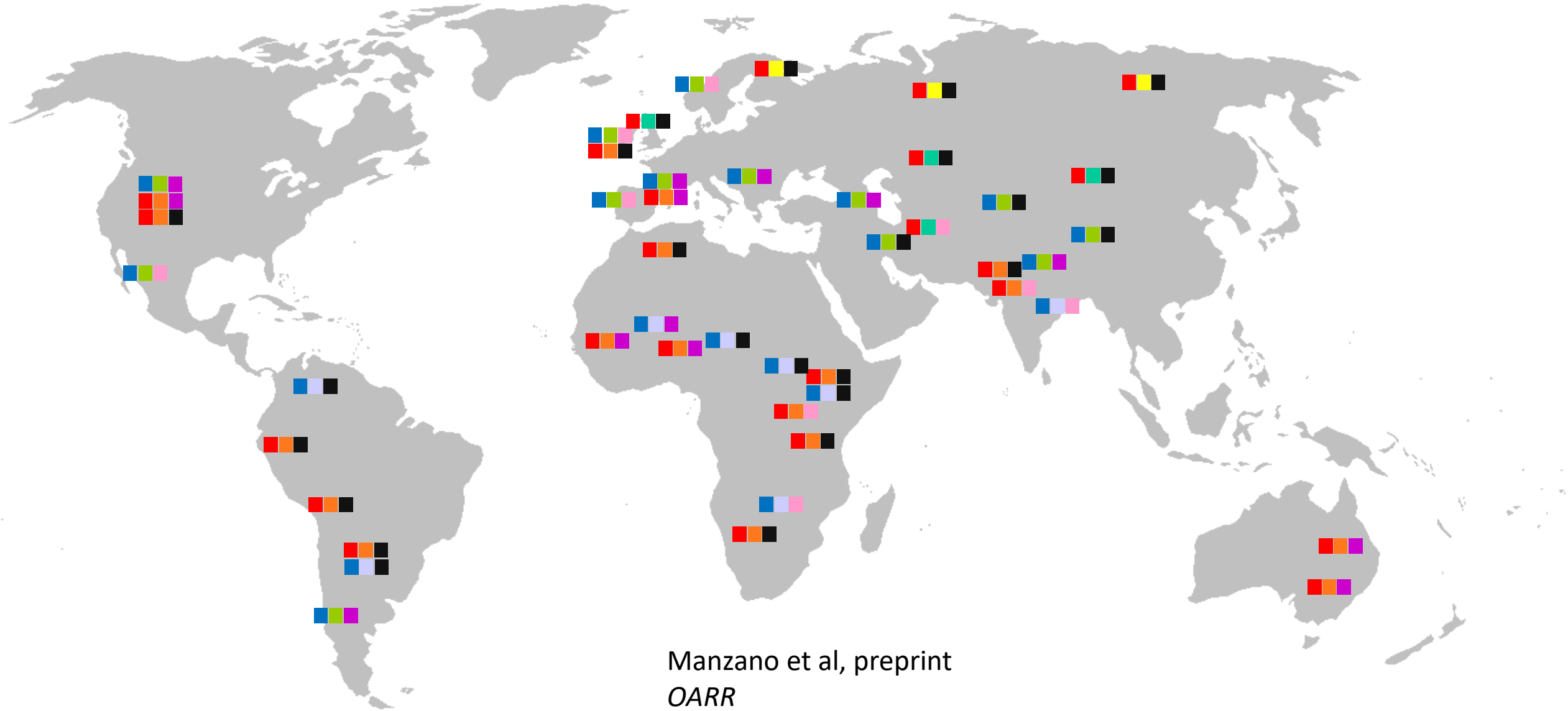
https://youtu.be/KYDk5xlQ7_4



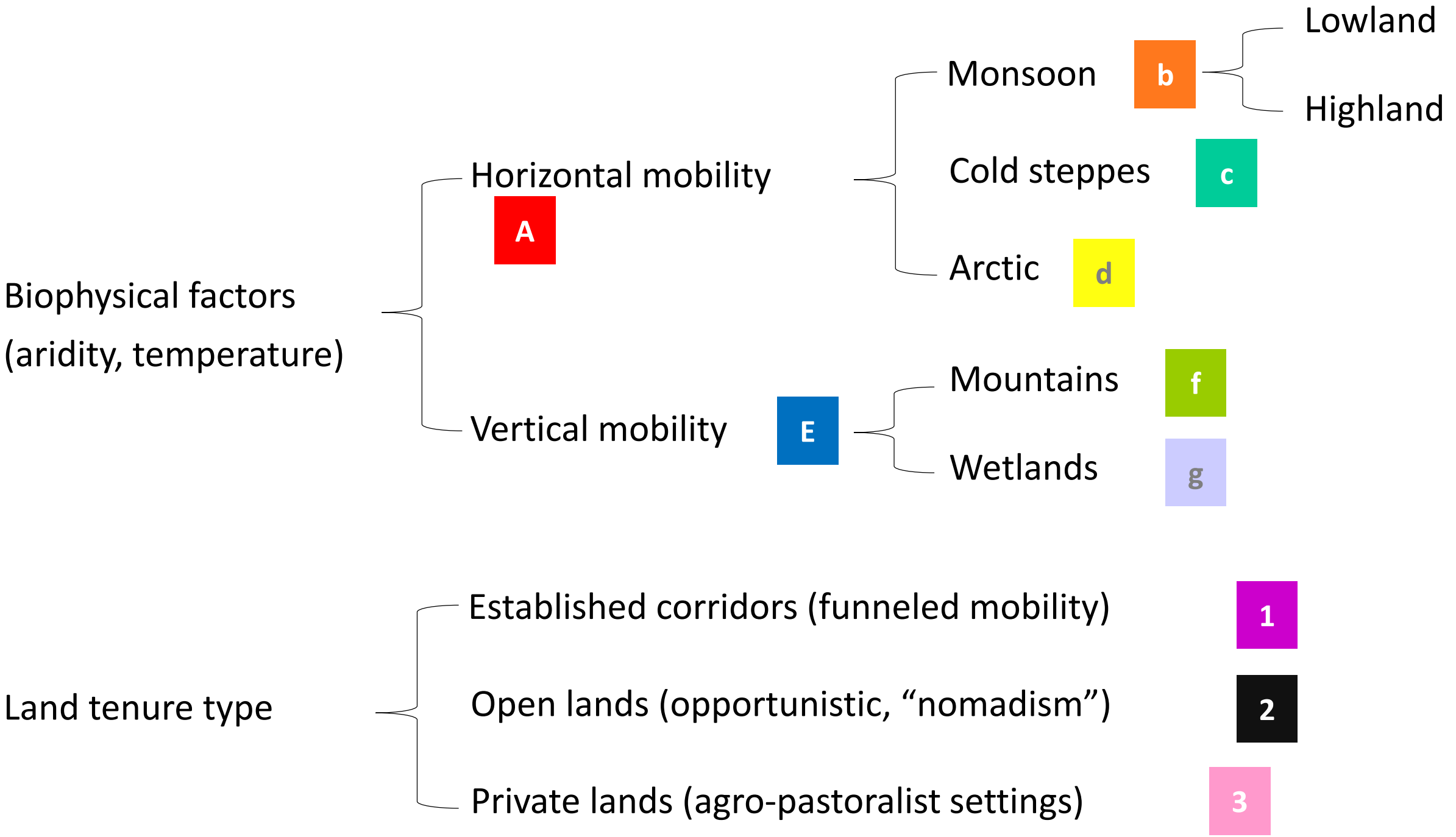


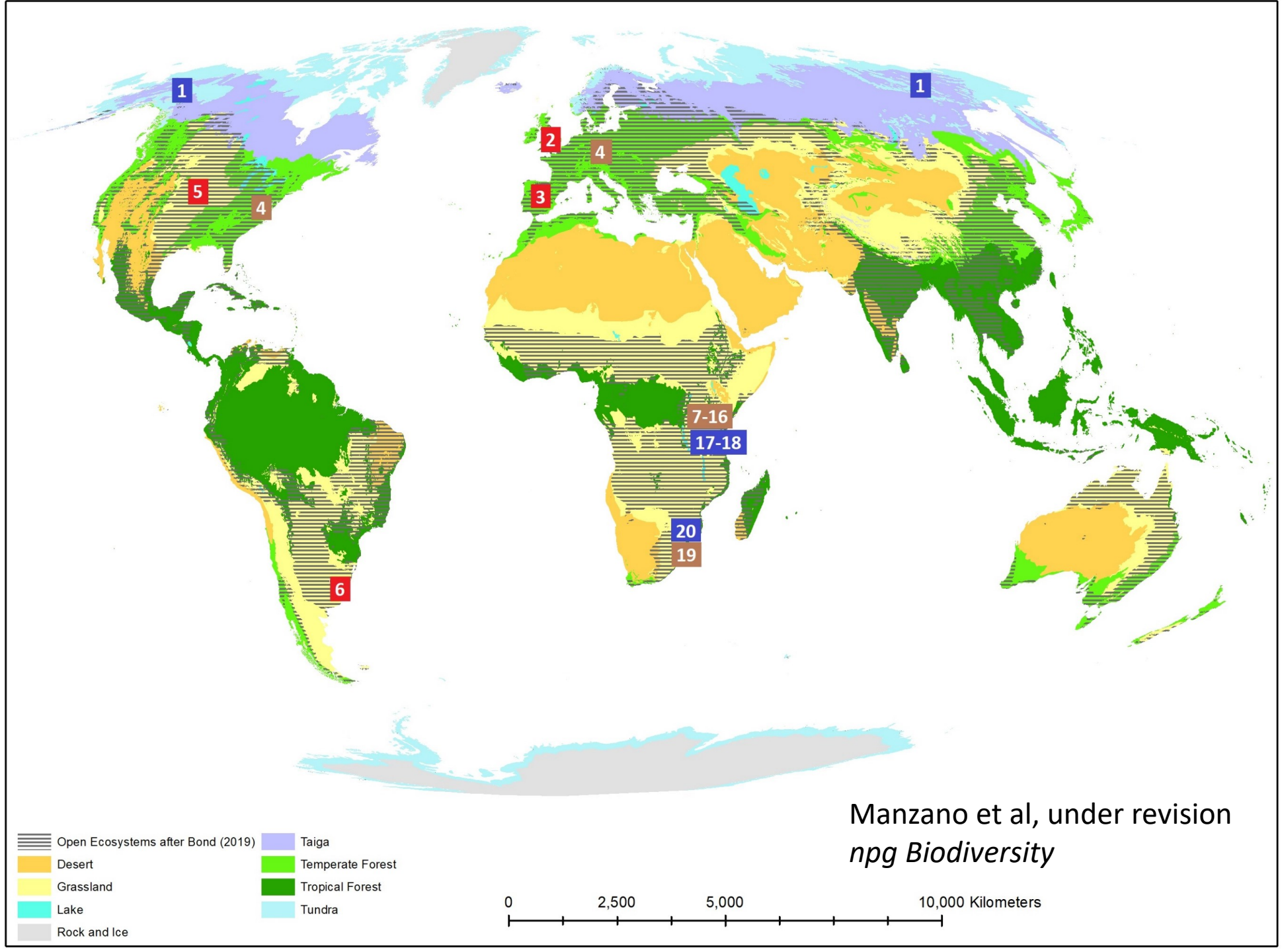
Teillard et al 2016 https://www.fao.org/3/av151e/av151e.pdf#page=34

Types of mobile pastoralism



Manzano et al, preprint
OARR


Biophysical factors
(aridity, temperature)
Horizontal mobility
A
Monsoon
b
Lowland
Highland
Cold steppes
c
Arctic
d
Vertical mobility
E
Mountains
f
Wetlands
g
Land tenure type
Established corridors (funneled mobility)
1
Open lands (opportunistic, “nomadism”)
2
Private lands (agro-pastoralist settings)
3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Open Ecosystems after Bond (2019)
Desert
Grassland
Lake
Rock and Ice
Taiga
Temperate Forest
Tropical Forest
Tundra
0
2,500
5,000
10,000 Kilometers
Manzano et al, under revision
npg Biodiversity

PeerJ

Herbivore corridors sustain genetic footprint in plant populations: a case for Spanish drove roads

Alfredo García-Fernández[1], Pablo Manzano[2,3,4], Javier Seoane[3], Francisco M. Azcárate[3], Jose M. Iriondo[1] and Begoña Peco[3]

[1] Área de Biodiversidad y Conservación, Universidad Rey Juan Carlos, Móstoles, Madrid, Spain
[2] Commission on Ecosystem Management, International Union for Conservation of Nature, Nairobi, Kenya
[3] Terrestrial Ecology Group—Departamento de Ecología, Centro de Investigación en Biodiversidad y Cambio Global (CIBC), Universidad Autónoma de Madrid, Madrid, Spain
[4] HELSUS, Faculty of Biological and Environmental Sciences, University of Helsinki, Helsinki, Finland

One Earth

Gold Standard for the Global Goals | 1 ton of CO_2 offset

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] Bayarmaa 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,*]

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[7]Faculty of Nature and Life Sciences, Department of Agronomic and Veterinary Sciences, University of Djelfa, P.O. Box 3117, 17000 Djelfa, Algeria
[8]Faculty of Biosciences, Norwegian University of Life Sciences, 1430 Ås, Norway
[9]Archaeology, Faculty of Humanities, University of Oulu, 90570 Oulu, Finland
[10]Cultural Heritage Studies, Faculty of Arts, University of Helsinki, 00100 Helsinki, Finland
[11]Chair of Land Management, Department of Aerospace and Geodesy, Technical University of Munich, 80333 Munich, Germany
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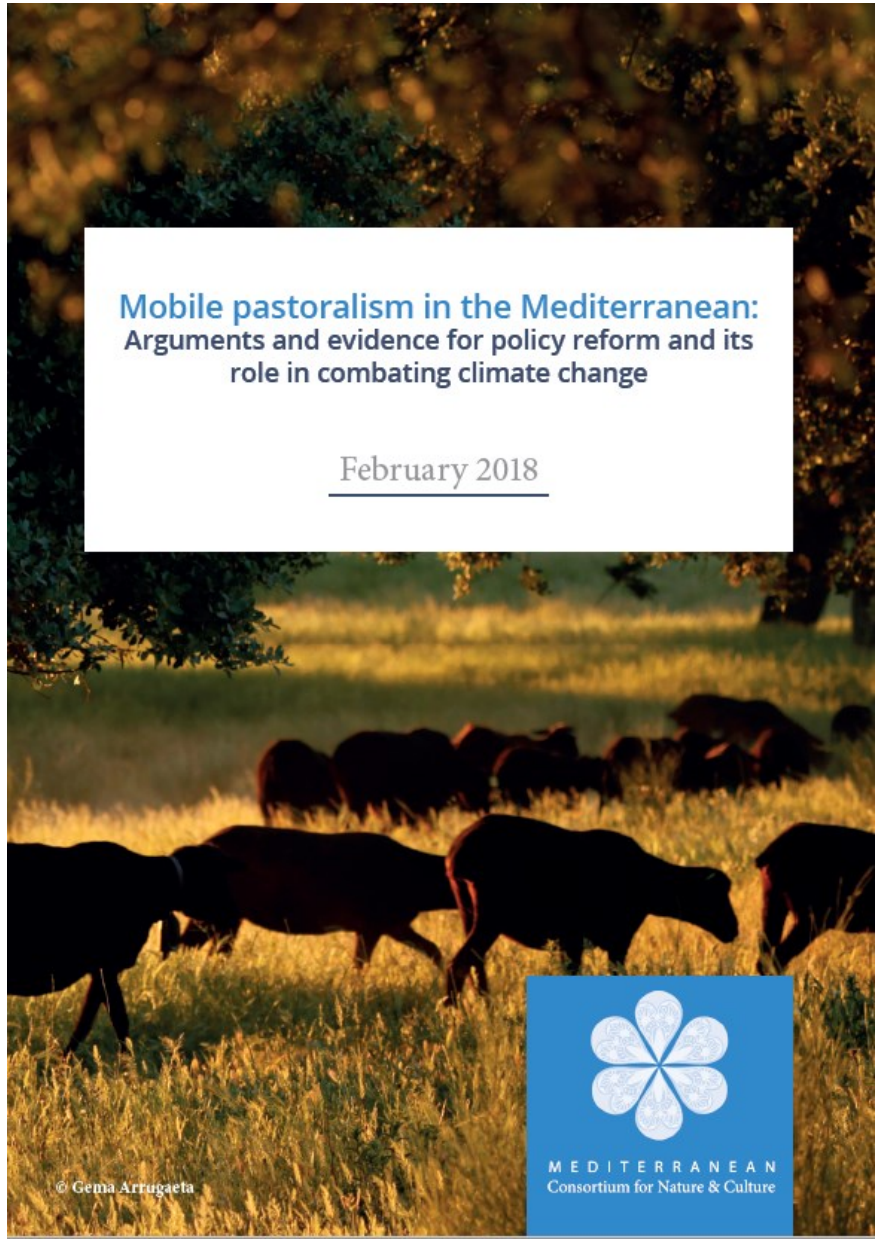
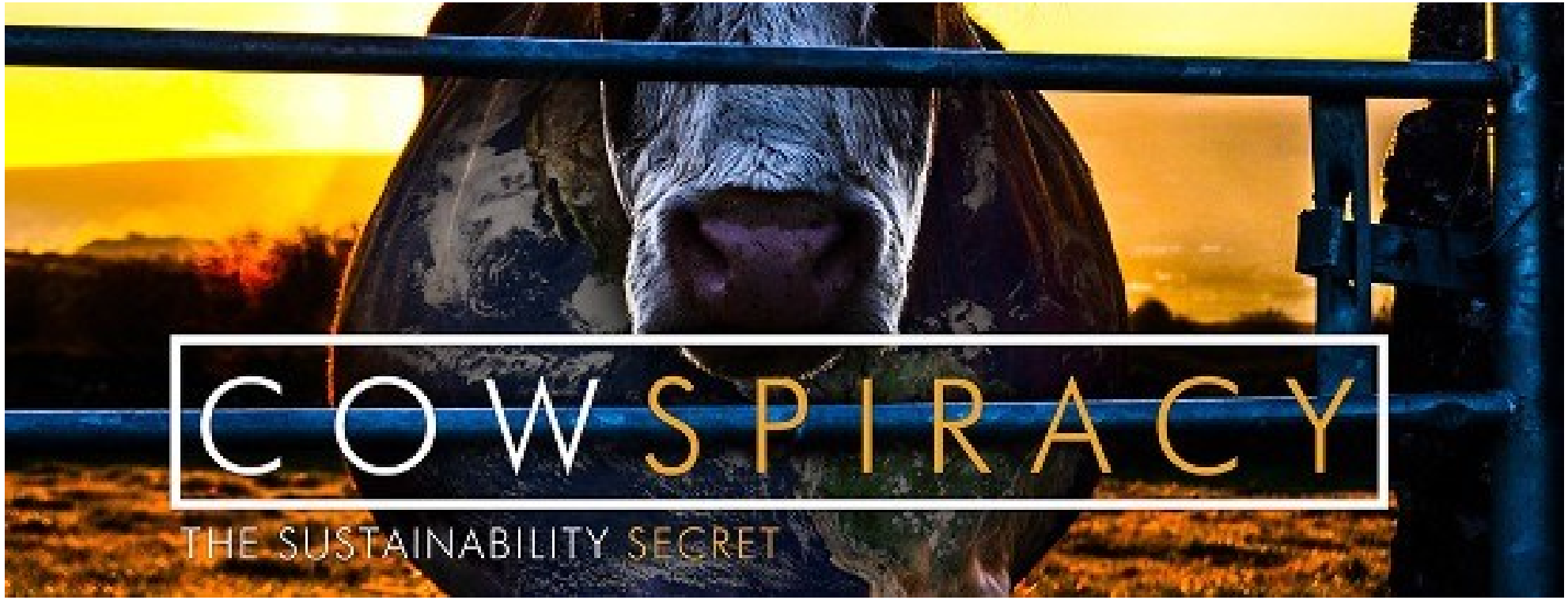
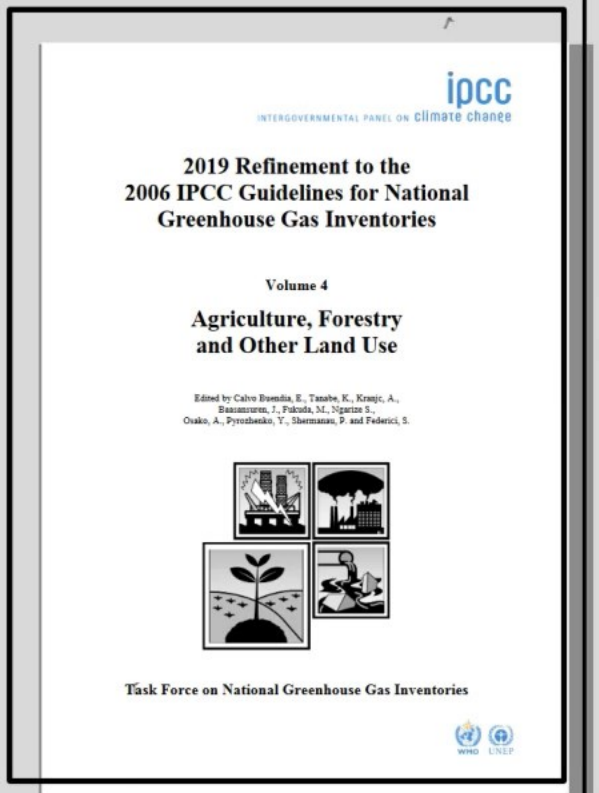
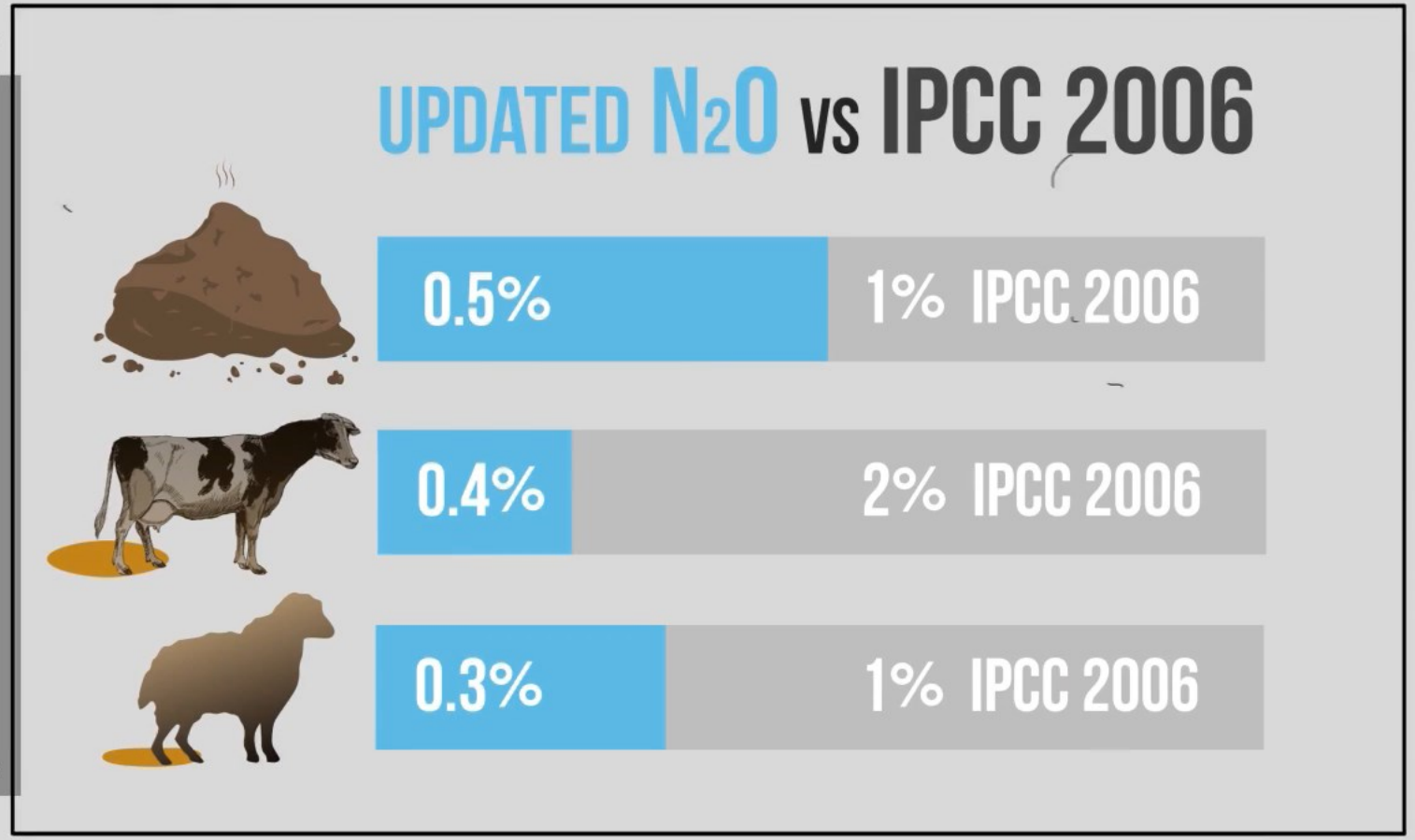
[13]Department of Forest & Rangeland Stewardship, Colorado State University, Fort Collins, CO 80523, USA
[14]Department of Anthropology and Geography, Colorado State University, Fort Collins, CO 80523, USA
[15]The Africa Center, Colorado State University, Fort Collins, CO 80523, USA
[16]These authors contributed equally
[17]Lead 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



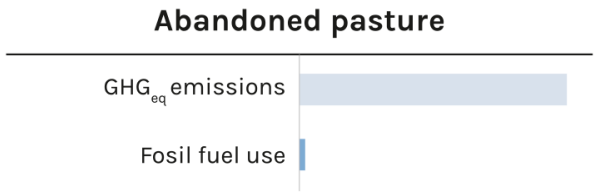
- 14,5 % of anthropogenic climate change
- Grazing livestock (rumimants) mainly to blame

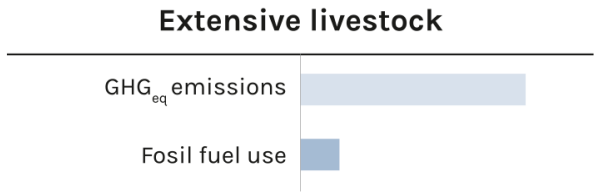


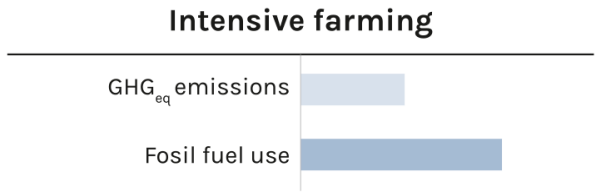




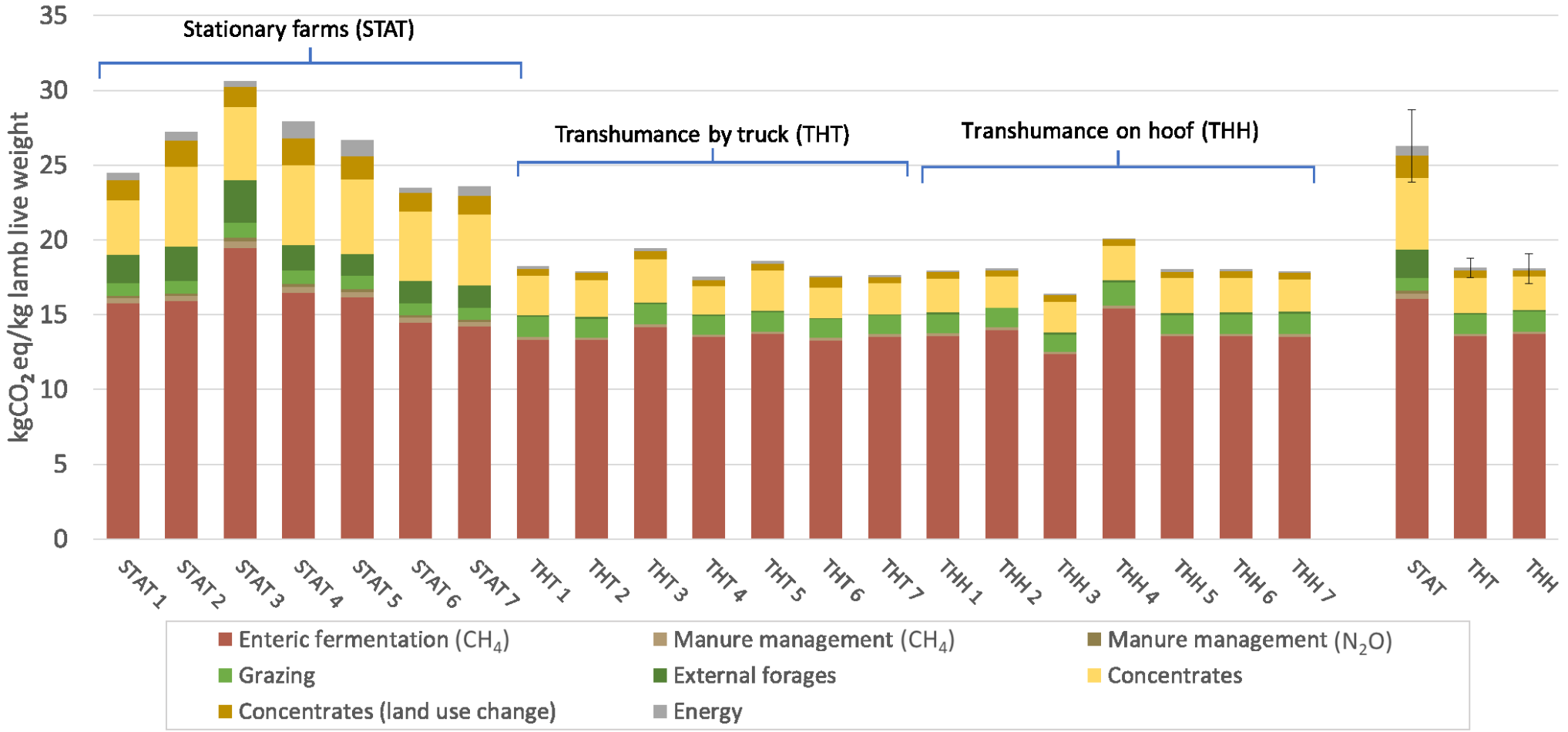
https://youtu.be/NbO4EEaH7YM





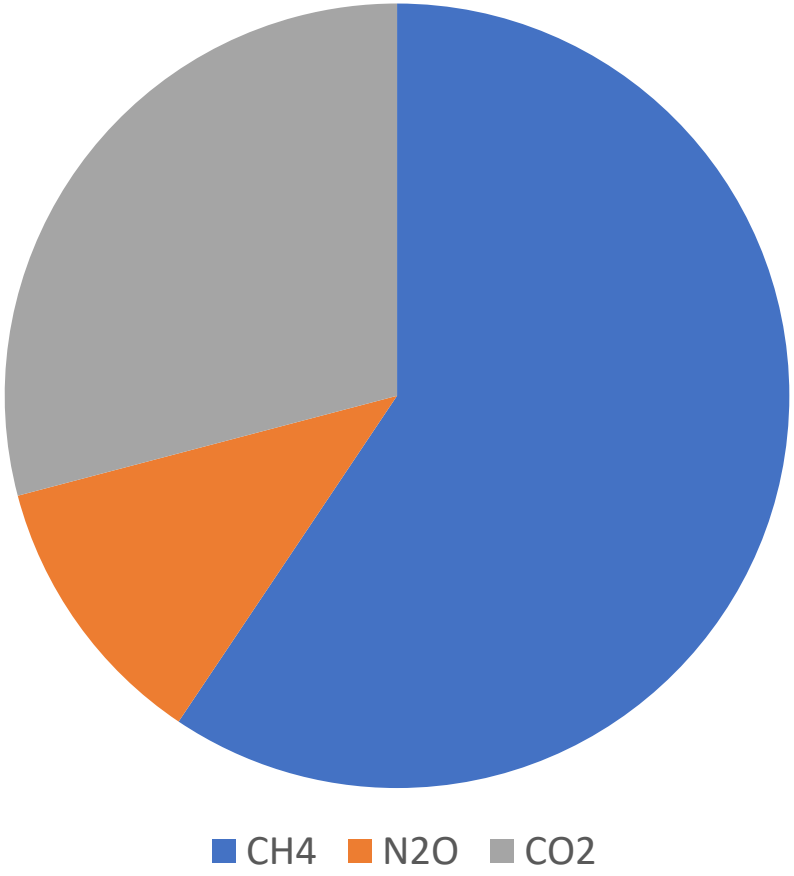


Manzano & White (2019) https://doi.org/10.3354/cr01555

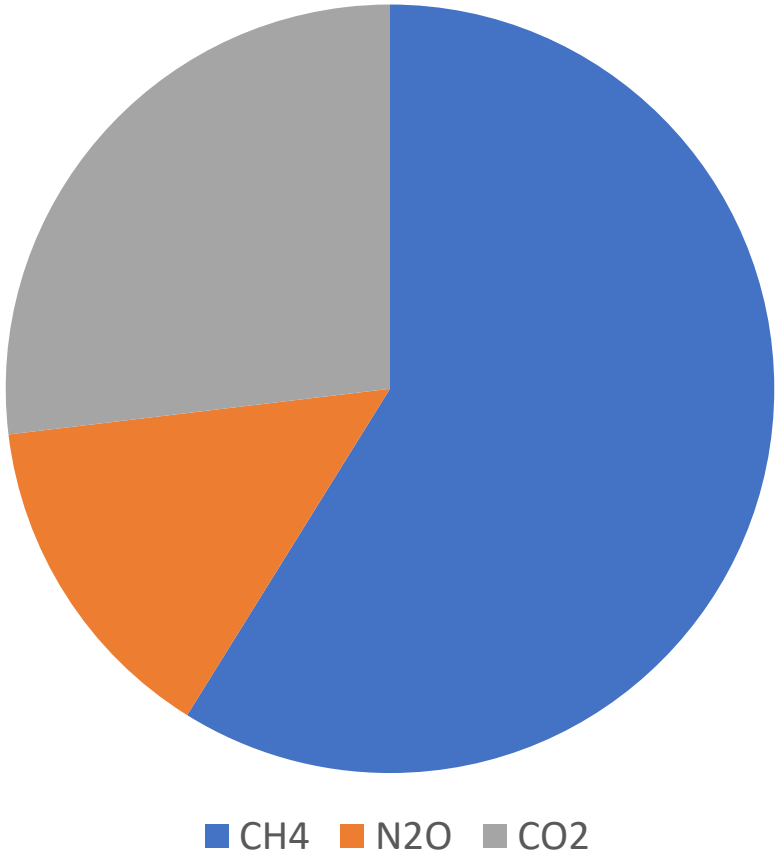


Pardo et al. (under revision; International Journal of Life Cycle Assessment)

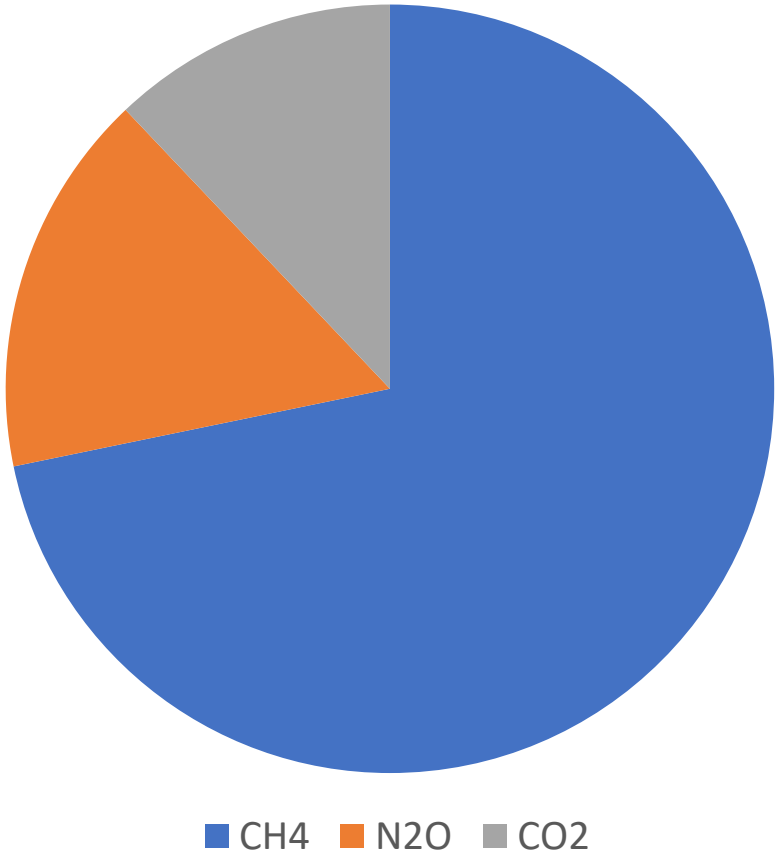
Intensive



Sedentary



Transhumant



* sourced from Ripoll-Bosch et al. 2013 Agr Syst 116: 60–68

Carbon footprint of transhumant sheep farms:

Table 4 Estimated natural emissions from wild herbivores in Mediterranean grasslands ecosystem and comparison with transhumant grazing-based sheep.

Animal class	Density	Biomass	Enteric CH_4	Manure CH_4+N_2O	TOTAL
	No/km^2	kg/km^2		(Mg CO_2eq/km^2)	
Wild herbivores					
Red deer[1]	32.9	4814	20.5	4.7	25.3
Red deer[2]	32.9	4814	22.0	4.7	26.8
Domestic herbivores					
Transhumant sheep	105.0	5775	42.6	5.1	47.7

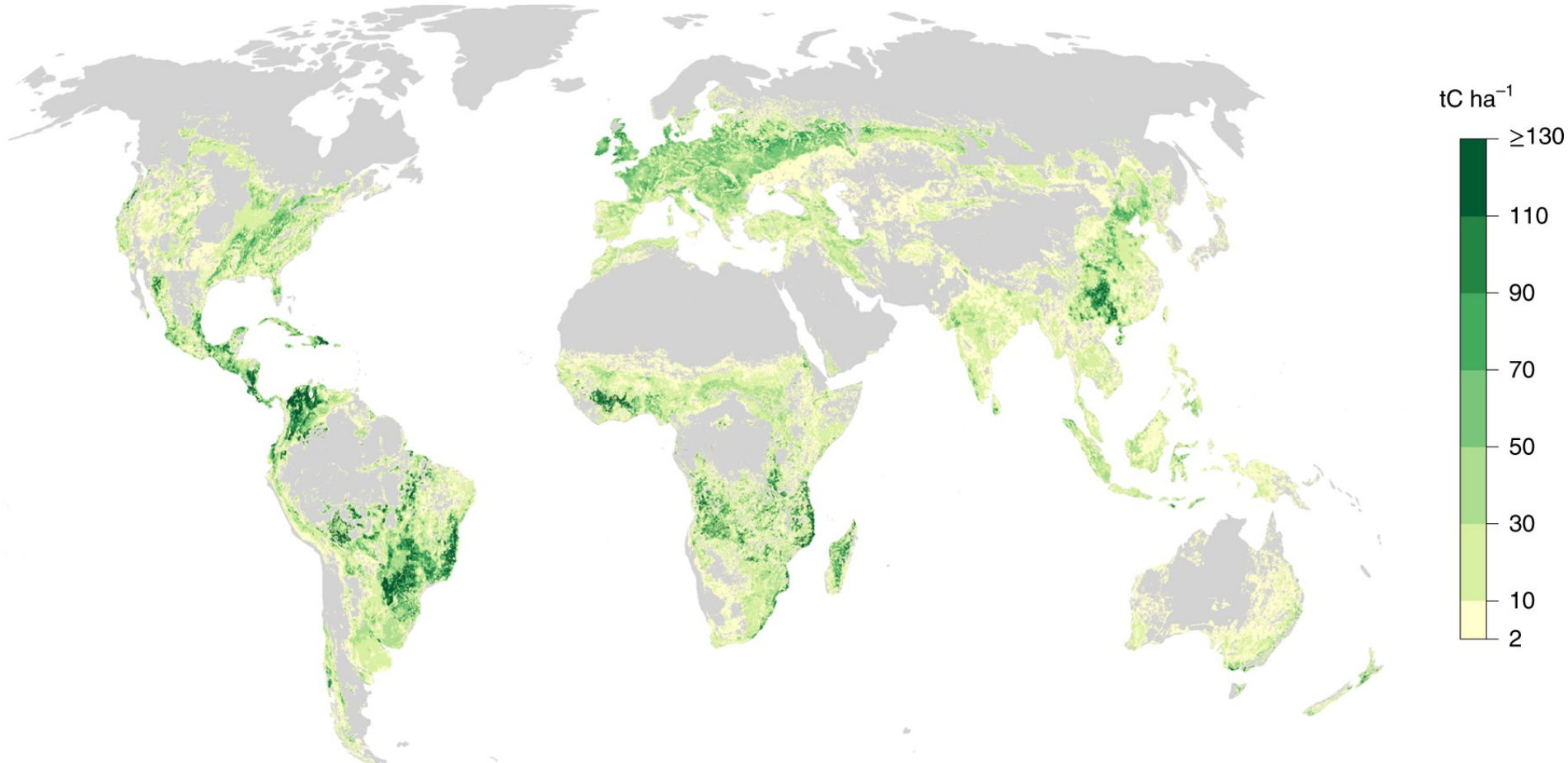
When considering the natural baseline emissions, the CF of transhumant lamb meat is reduced by almost 30%, reaching values quite below those reported for intensive lamb production systems in Spain.

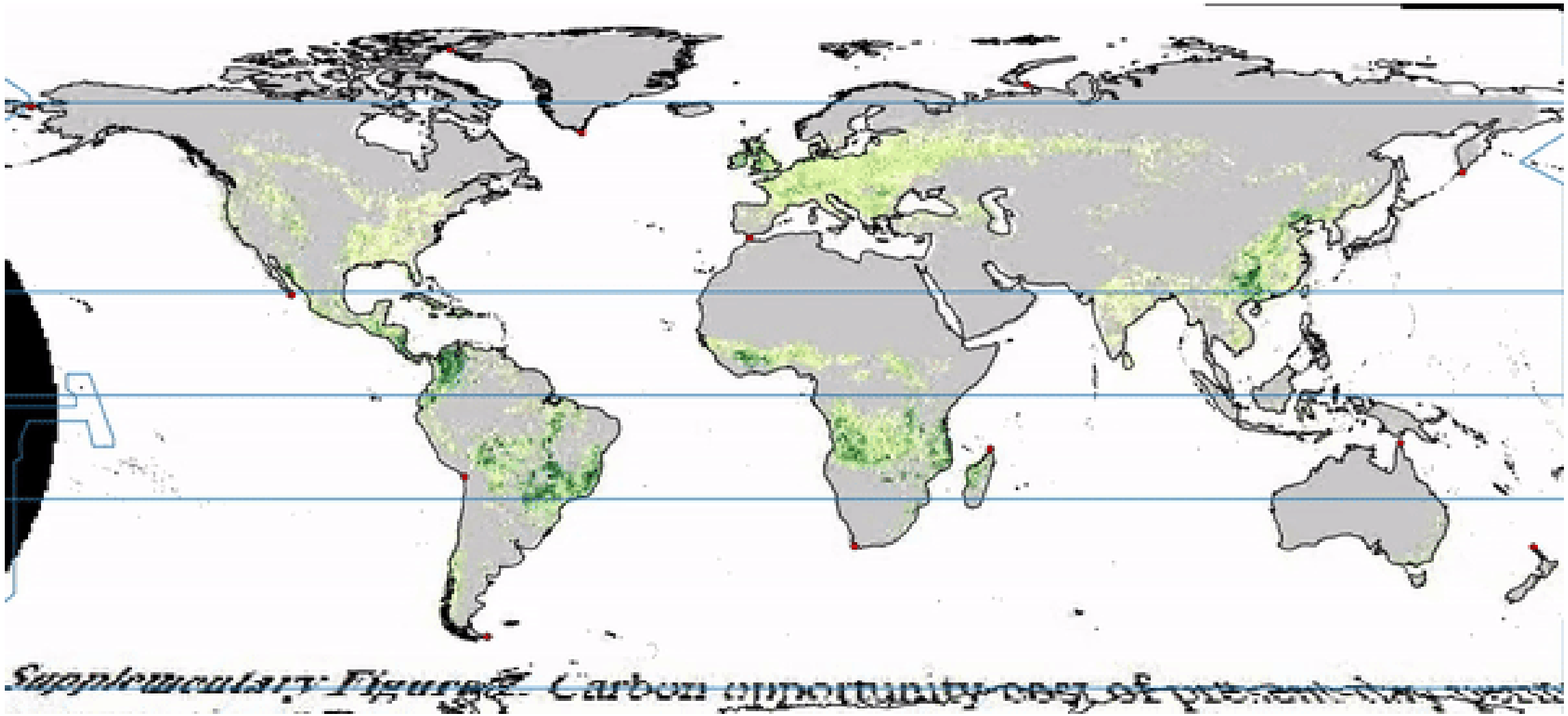
nature sustainability

BRIEF COMMUNICATION

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

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





Supplementary Figure 2. Carbon opportunity cost of permanent pastures

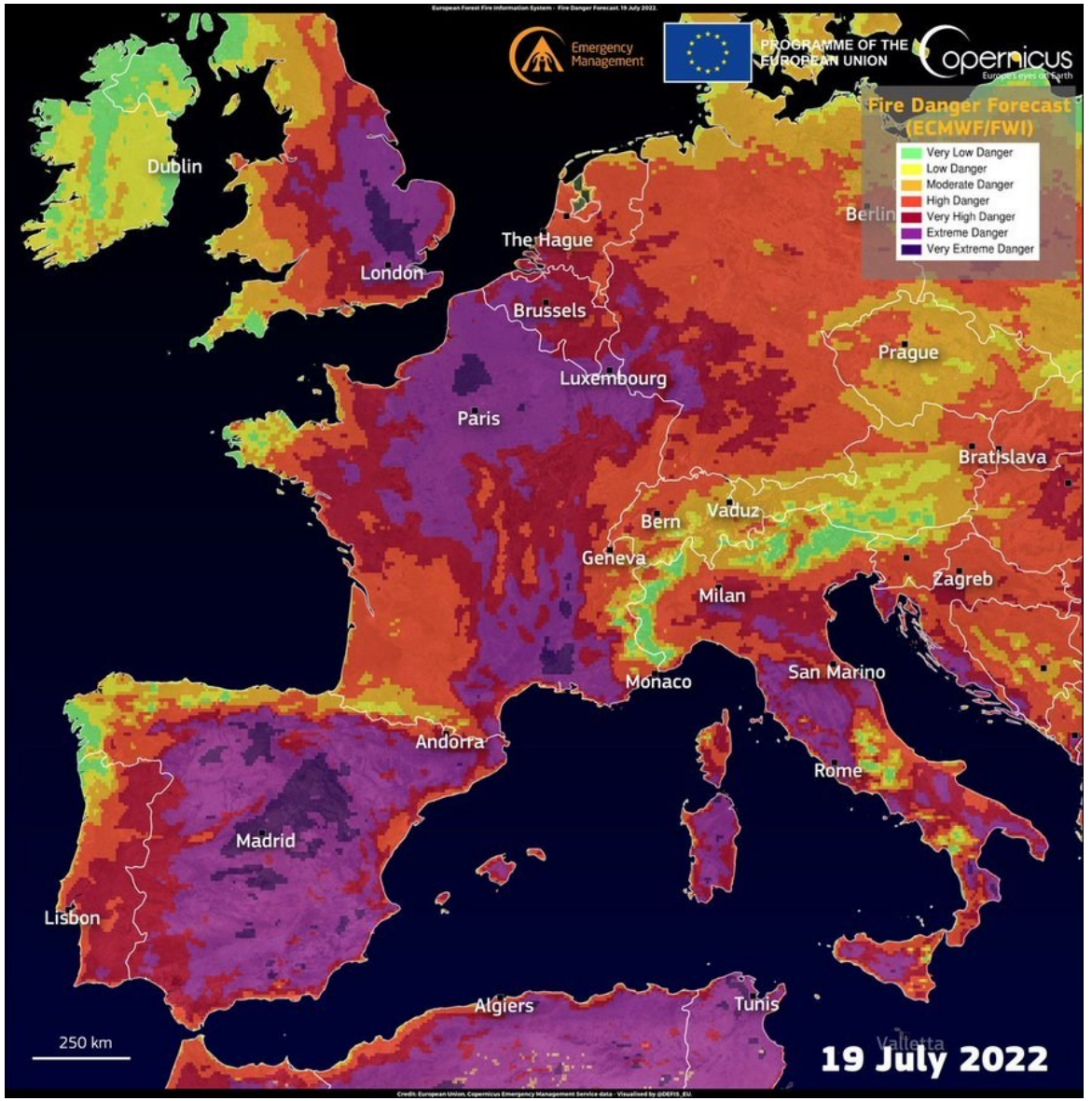
Example: “**permanent pastures** to forest”.

Who wins?

- Oil companies
- Airlines
- Automobile

shifts in global food production to plant-based diets by 2050 could lead to sequestration of 332–547 $GtCO_2$, equivalent to 99–163% of the CO_2 emissions budget consistent with a 66% chance of limiting warming to 1.5 °C.

Cumulative CO_2 emissions (anthropogenic emissions minus removal) must remain below 335 $GtCO_2$ after 2019 to limit warming to 1.5 °C at a 66% likelihood level[14]. CO_2 removal from terrestrial vegetation following ELC or VGN dietary shifts would increase permissible CO_2 emissions by 99% (63%–137%) or 163% (107%–222%), respectively. Adding net CO_2 uptake by native ecosystem soil and litter to this total increases the 1.5 °C budget by 139% or 230%, respectively.


European Forest Fire Information System - Fire Danger Forecast, 19 July 2022.
Emergency Management
PROGRAMME OF THE EUROPEAN UNION
Copernicus
Europe's eyes on Earth
Fire Danger Forecast (ECMWF/FWI)
Very Low Danger
Low Danger
Moderate Danger
High Danger
Very High Danger
Extreme Danger
Very Extreme Danger
Dublin
London
The Hague
Berlin
Brussels
Luxembourg
Prague
Paris
Bratislava
Vaduz
Bern
Geneva
Zagreb
Milan
San Marino
Monaco
Andorra
Rome
Madrid
Lisbon
Algiers
Tunis
Valletta
250 km
19 July 2022
Credit: European Union, Copernicus Emergency Management Service data - Visualised by @EFFIS_EU

Go raibh maith agat!

Thank you for your attention!

+ info:

@PabloPastos