Rewilding – definition, continuum, ecological concepts and application

Mark Fisher and Steve Carver
Wildland Research Institute
Hardwick Hall Hotel, 23 March 2018

CEM | WRi Wildland Research Institute | Rewilding Foundation | University of Cumbria | Task Force on Rewilding IUCN Commission Ecosystem Management

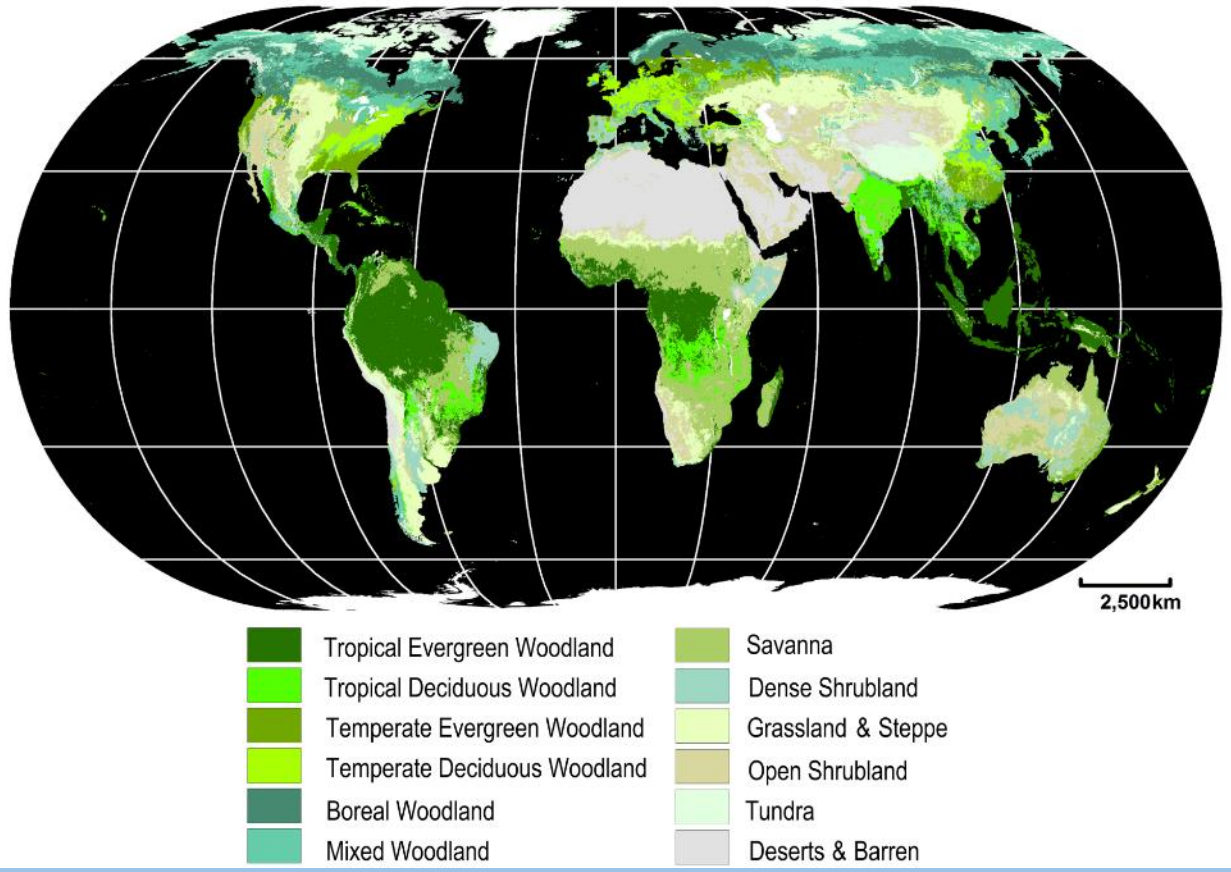
Our route map to rewilding

- Definitions and usage
- A rewilding continuum
- Food chains, webs and pyramids
- Trophic cascades
- UK examples
- Back to the continuum
- Conclusions

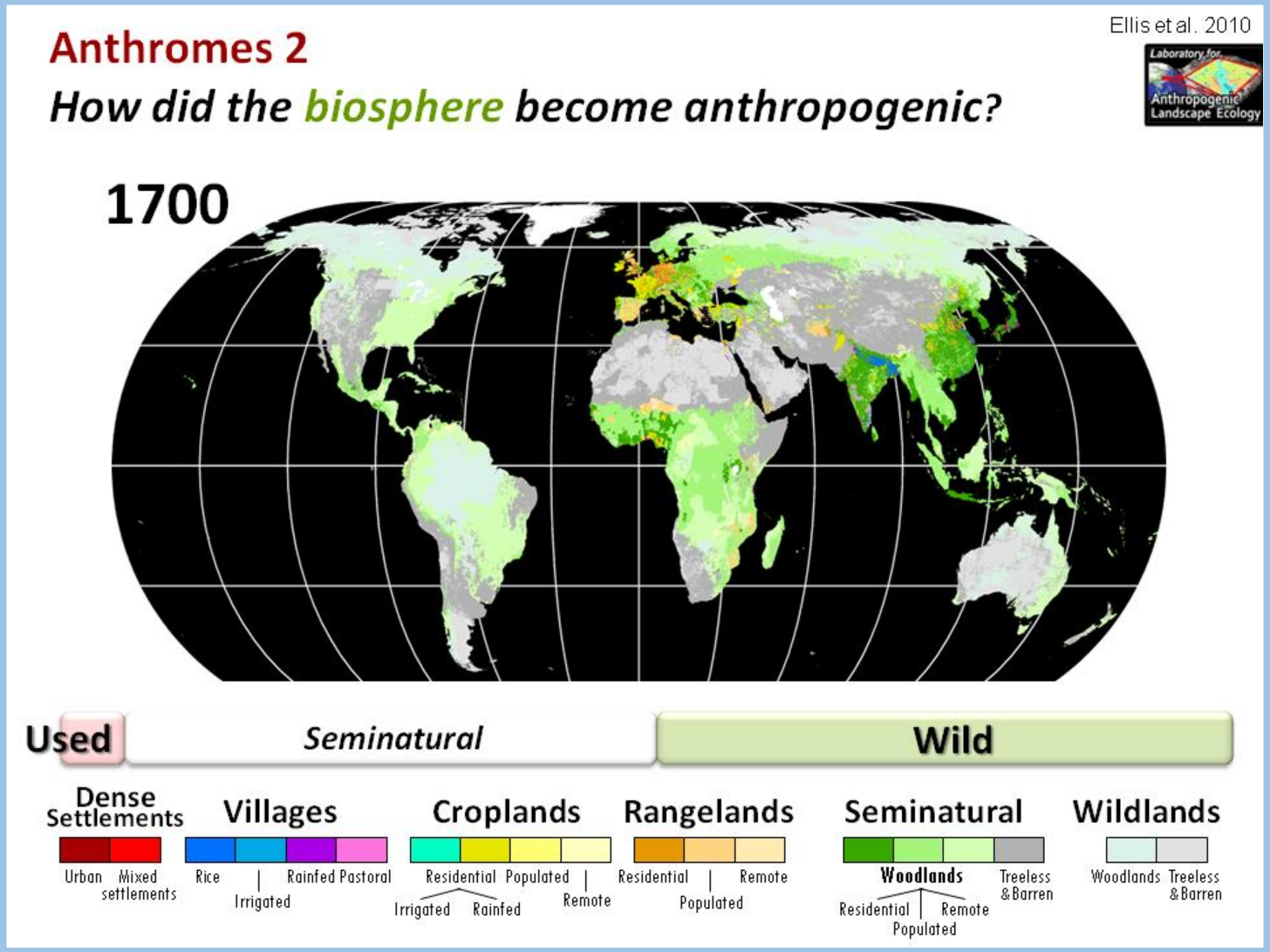
The world transformed

Potential Natural Vegetation

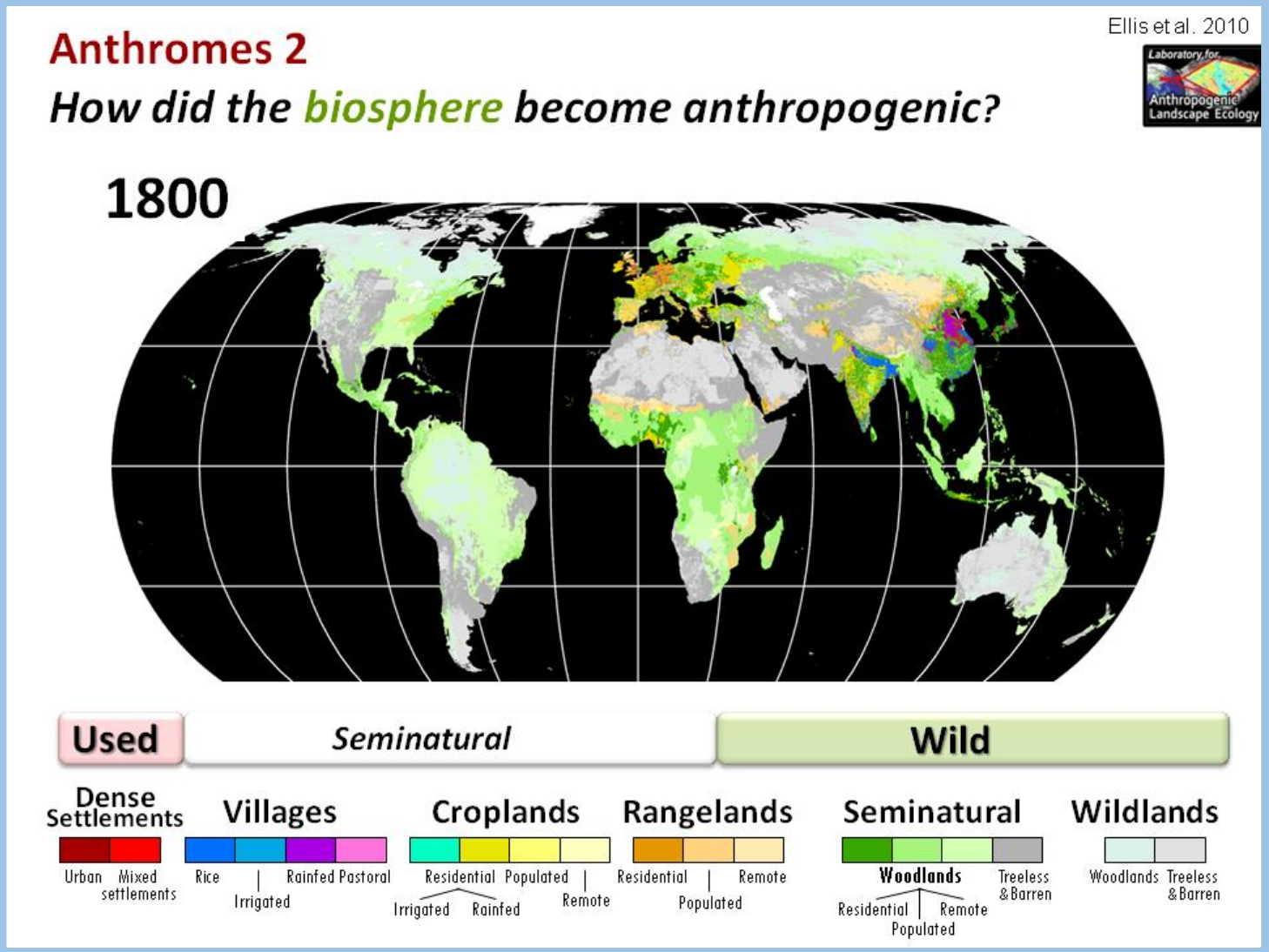
After: Ramankutty, N. and J. A. Foley. 1999. Estimating historical changes in global land cover: Croplands from 1700 to 1992. Global Biogeochemical Cycles **13**:997-1027.



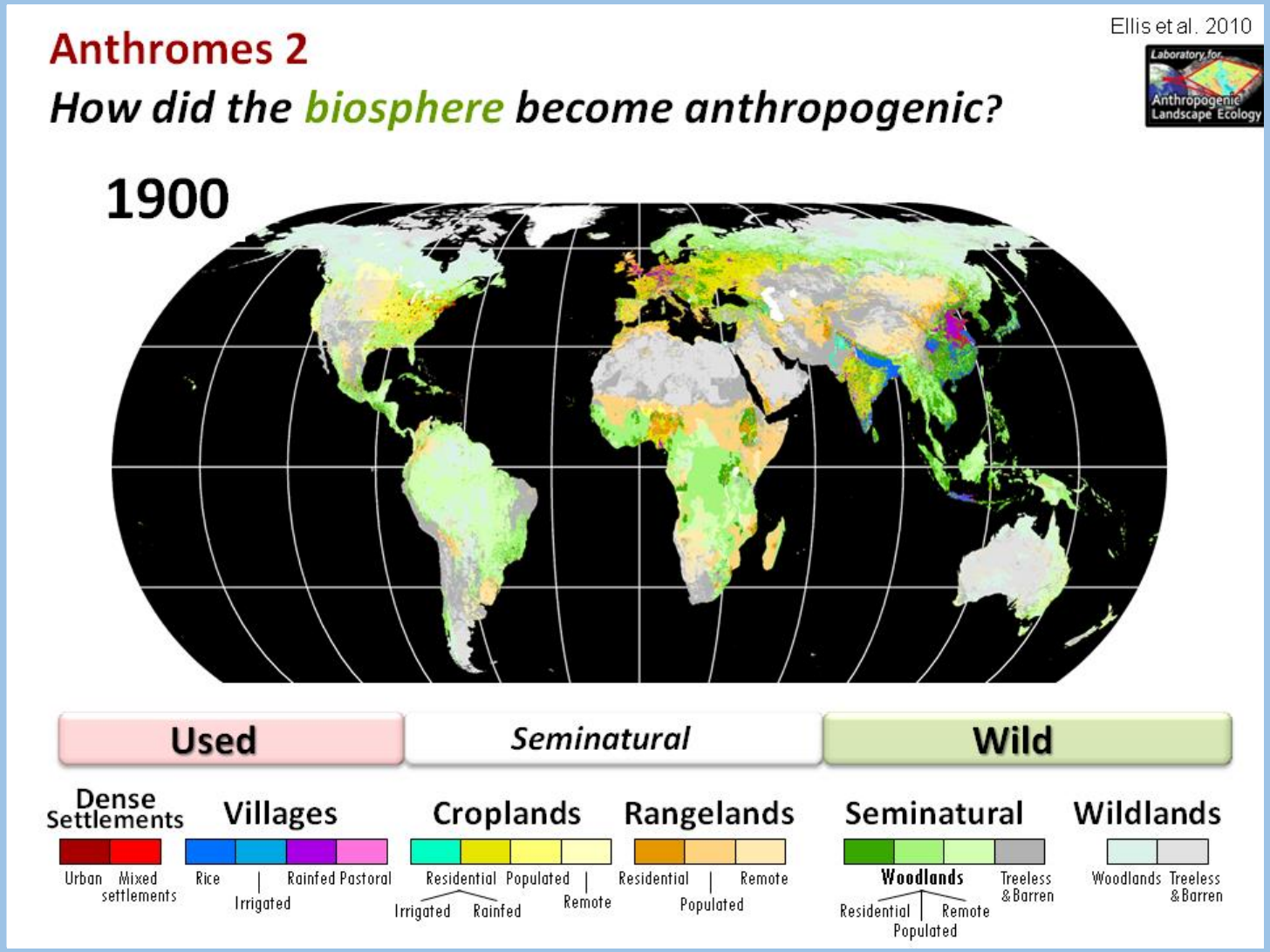
The world transformed



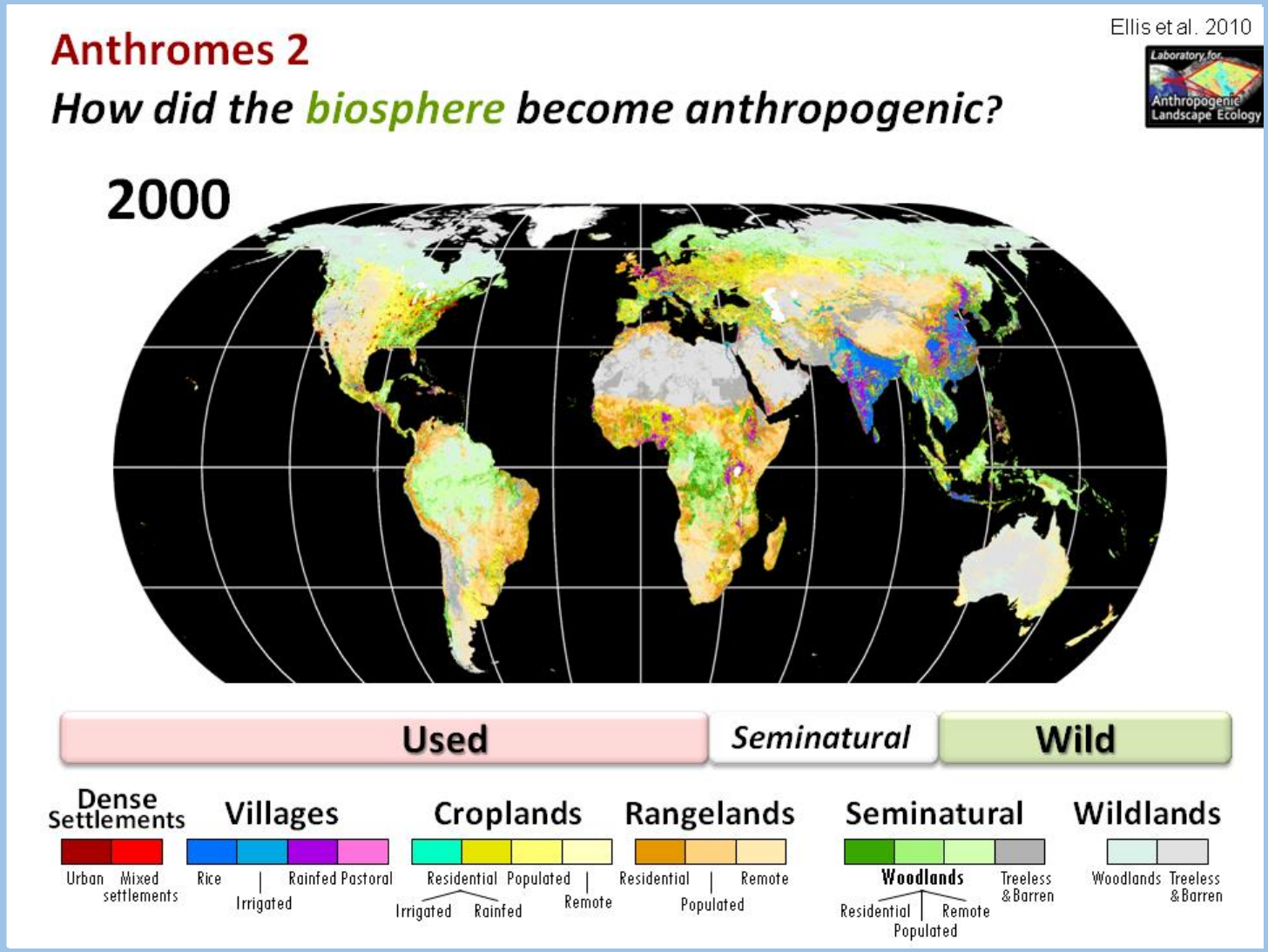
The world transformed



The world transformed



The world transformed



An abundance of definitions simplified

HOUSES OF PARLIAMENT
PARLIAMENTARY OFFICE OF SCIENCE & TECHNOLOGY

POSTNOTE

Number 537 September 2016

Rewilding and Ecosystem Services

This POSTnote explores the consequences of increasing the role of natural processes within landscapes. Evidence from the UK and abroad suggests that rewilding can benefit both wildlife and local people, but animal reintroductions could adversely affect some land-users.

Overview

- Rewilding aims to restore natural processes that are self-regulating, reducing the need for human management of land.
- Few rewilding projects are underway, and there is limited evidence on their impacts.
- Rewilding may provide ecosystem services such as flood prevention, carbon storage and recreation. It often has low input costs, but can still benefit biodiversity.
- Some valued and protected priority habitats such as chalk grassland currently depend on agricultural practices like grazing. Rewilding may not result in such habitats.
- No government policy refers explicitly to rewilding, but it has the potential to complement existing approaches to meet commitments on habitat restoration.

What is Rewilding?

There is no single definition of rewilding, but it generally refers to reinstating natural processes that would have occurred in the absence of human activity.[1,2] These include vegetation succession, where grasslands develop into wetlands or forests, and ecological disturbances caused by disease, flooding, fire and wild herbivores (plant eaters). Initially, natural processes may be restored through human interventions such as tree planting, drainage blocking and reintroducing "keystone species"[3,4] like beavers. In the long term, self-regulating natural processes may reduce the need for human management. Rewilding can have unpredictable outcomes, but it may also represent a cost-effective way to provide ecosystem services (benefits provided by natural processes)[5] such as flood prevention.[6] Rewilding might help to reduce or offset negative impacts of intensive agriculture including: soil degradation [POSTnote 502]; greenhouse-gas emissions [POSTnotes 453 & 486]; water pollution [POSTnote 478]; insect pollinator declines [POSTnote 442] and a reduction in biodiversity (the variety of living things).[7]

This briefing outlines approaches to rewilding land across Europe, as well as the potential benefits and risks involved. Rewilding has not been referred to by the UK government, so it is put into the context of relevant policy on agriculture and biodiversity. While some advocate rewilding of the seas using no-fishing zones,[8] this is not discussed here.

Rewilding and Current Conservation Practice

UK landscapes have been managed to produce food and wood for millennia, and 70% of land is currently farmed.[9] €3bn per year is spent on environmental management of farmland across the EU.[10,11] This includes maintaining wildlife habitats on farmland such as heathland and chalk grassland, which involves traditional agricultural practices such as fire and grazing.[12,13] Rewilding involves ecological restoration (the repair of degraded ecosystems),[14] and differs from mainstream conservation in two main ways:

- Existing policies promote the conservation of specific endangered species and habitats. Rewilding focuses on restoring natural processes and dynamics, and the groups of species that emerge from this.[15]
- Existing practices use active management to increase biodiversity in nature reserves. This may involve low-intensity livestock grazing, but rewilding generally has a long term goal of reduced management by humans.[16]

Conflicting Views on Rewilding

Interest in rewilding has increased rapidly in recent years.[15] Some see rewilding as a positive vision for restoring ecosystems,[17] but others feel that it is poorly defined and may result in people being excluded from natural spaces.[18] Rewilding is generally seen as an open-ended approach, but there has been a considerable amount of debate about the type of ecosystem that it should aim to restore (Box 1).

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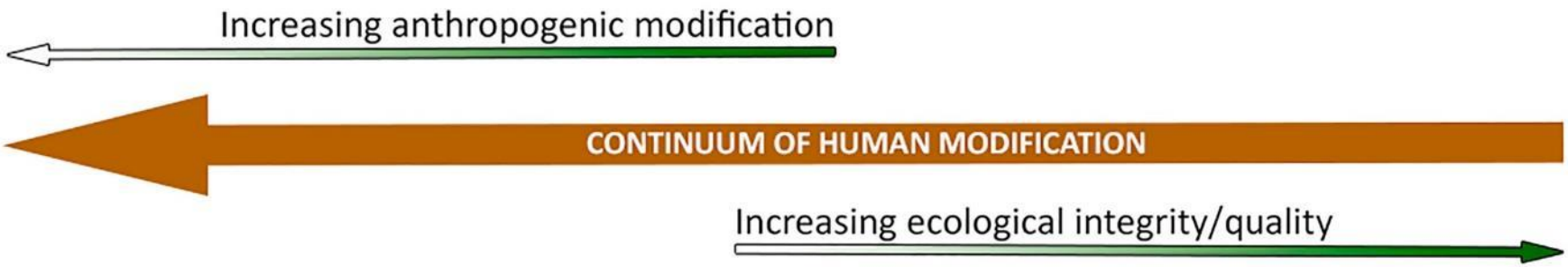
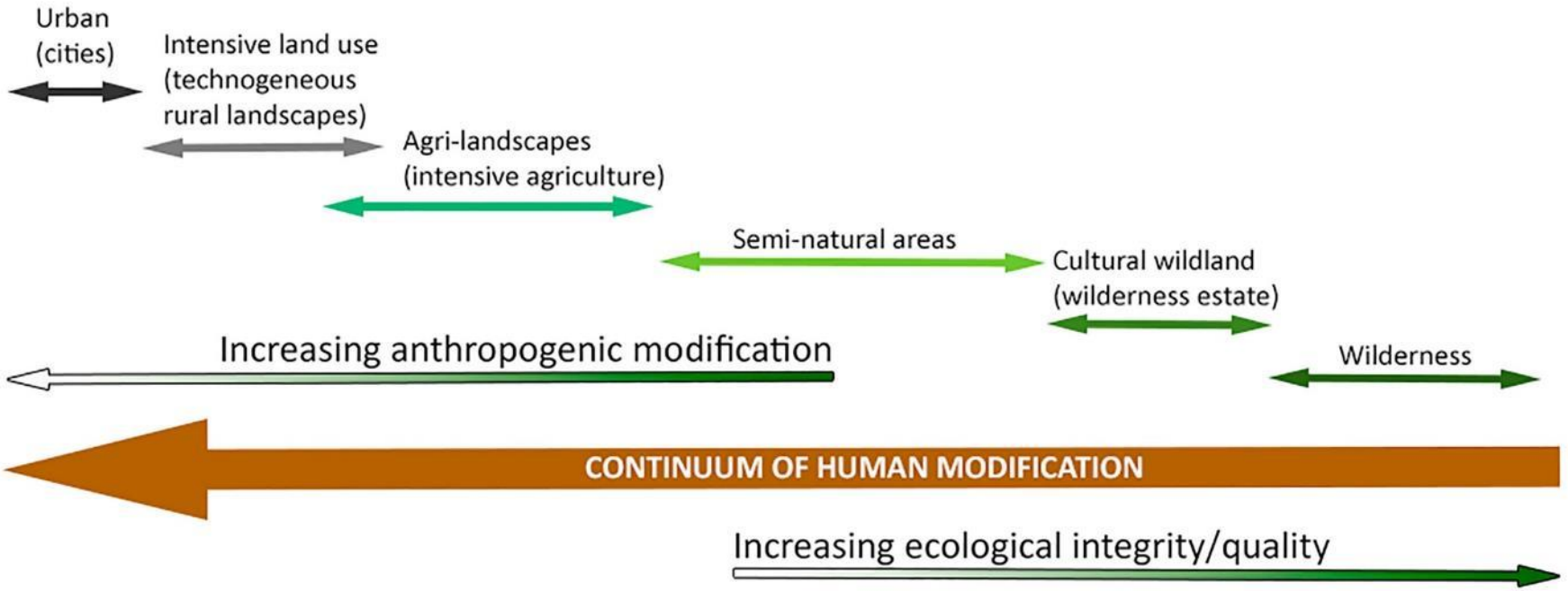
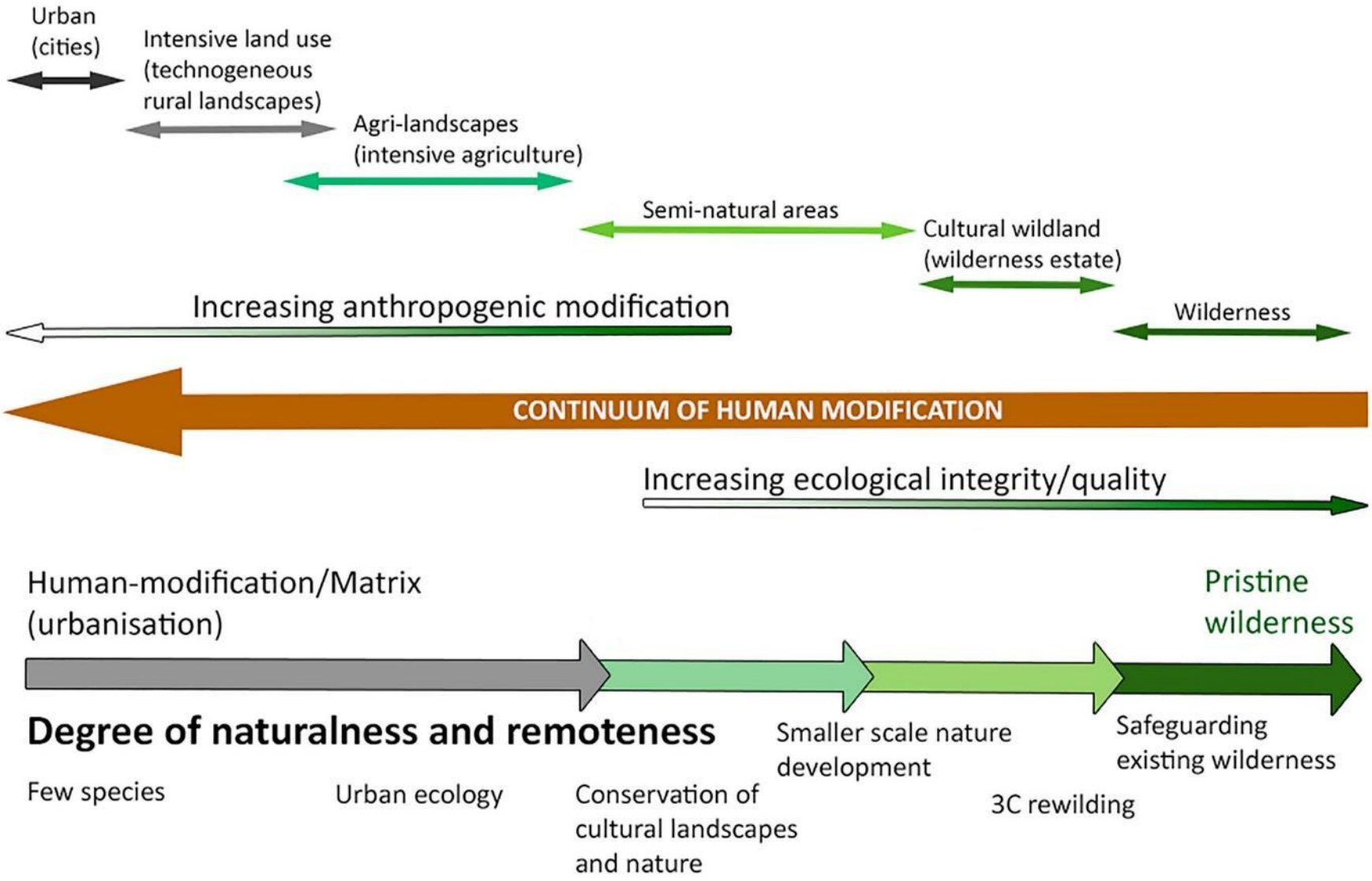
A rewilding continuum



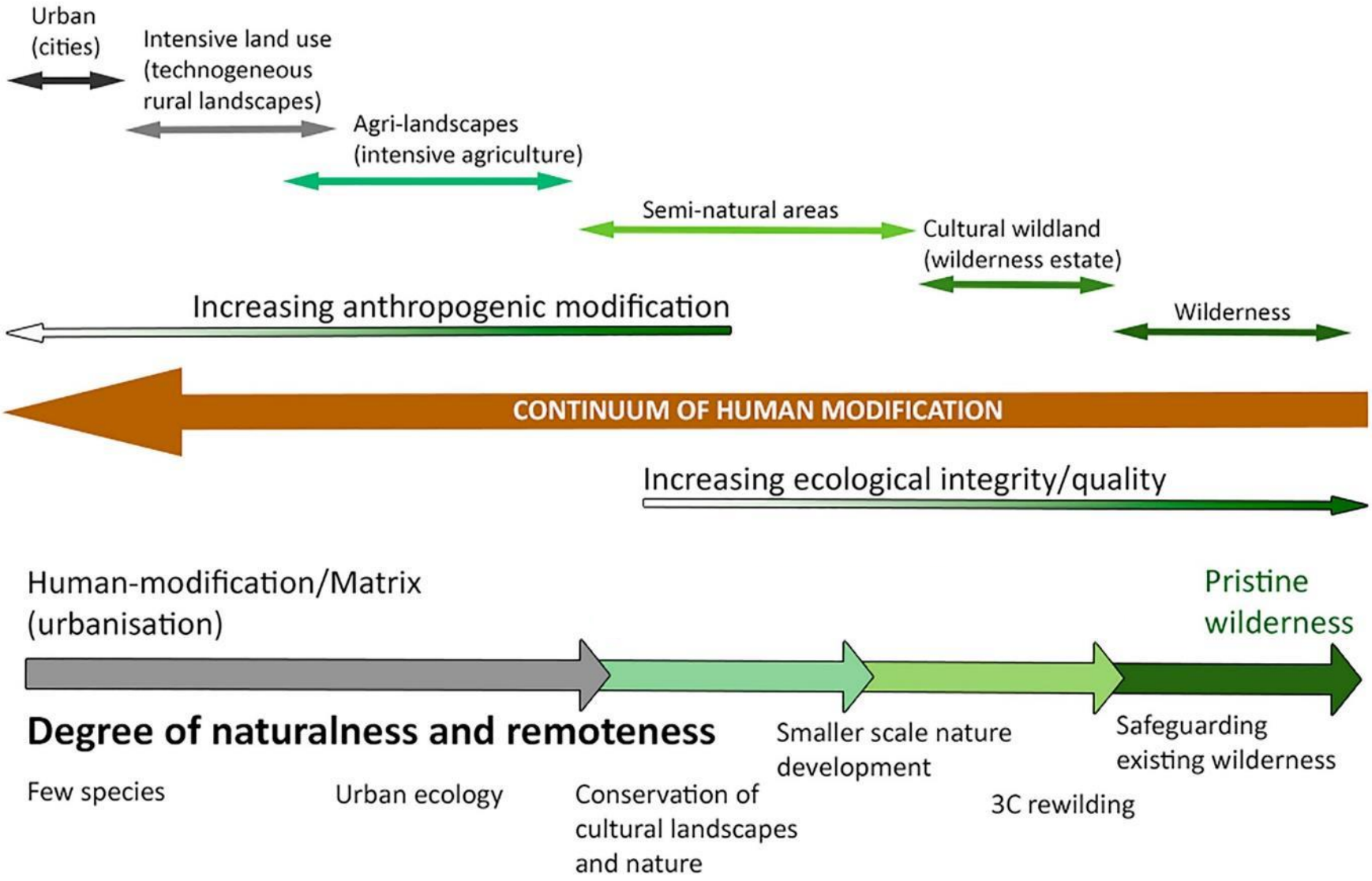
A rewilding continuum



A rewilding continuum



A rewilding continuum



The Pandora's box of rewilding

Rewilding

"restoring big wilderness based on the regulatory roles of large predators" (Cores, Corridors and Carnivores)

1998
Soule and Noss

Pleistocene rewilding

"aims to restore some of the evolutionary and ecological potential that was lost 13,000 years ago" (introducing relatives or functional equivalents of extinct taxa)

2005
Donlan *et al.*

Passive rewilding

"passive management of ecological succession with the goal of restoring natural ecosystem processes and reducing human control of landscapes"

"non-intervention"

2011
Gillson *et al.*

Active rewilding

"seeks to restore missing or dysfunctional ecological processes and ecosystem function via a process of species reintroduction"

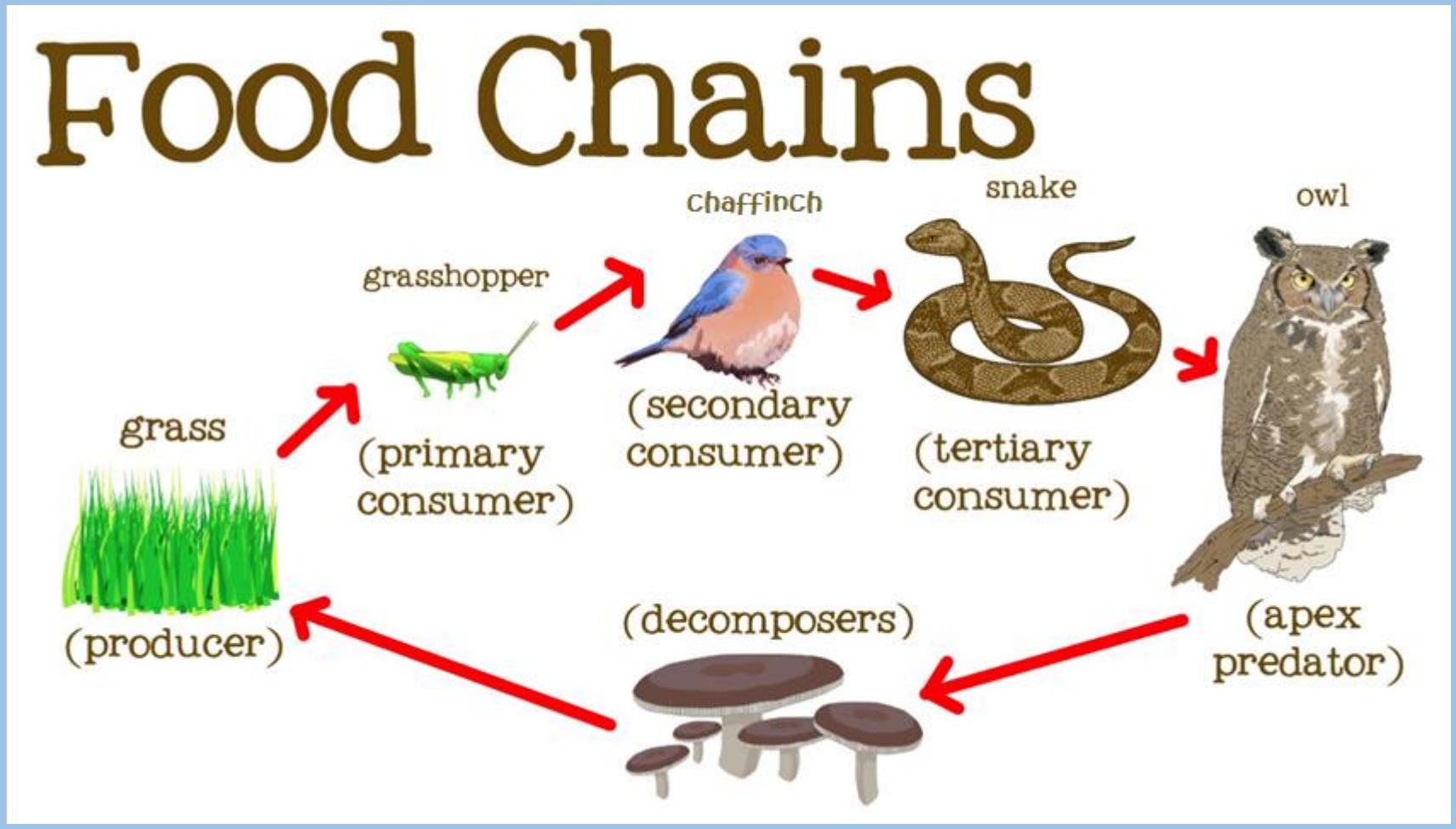
"managed rewilding"

2014
Seddon *et al.*

Nogués-Bravo, D., Simberloff, D., Rahbek, C., & Sanders, N. J. (2016). Rewilding is the new Pandora's box in conservation. Current Biology, 26(3), R87-R91.

Big things eat little things, little things eat grass – and everything DECOMPOSES

Charles Elton (1927) Animal Ecology. Macmillan



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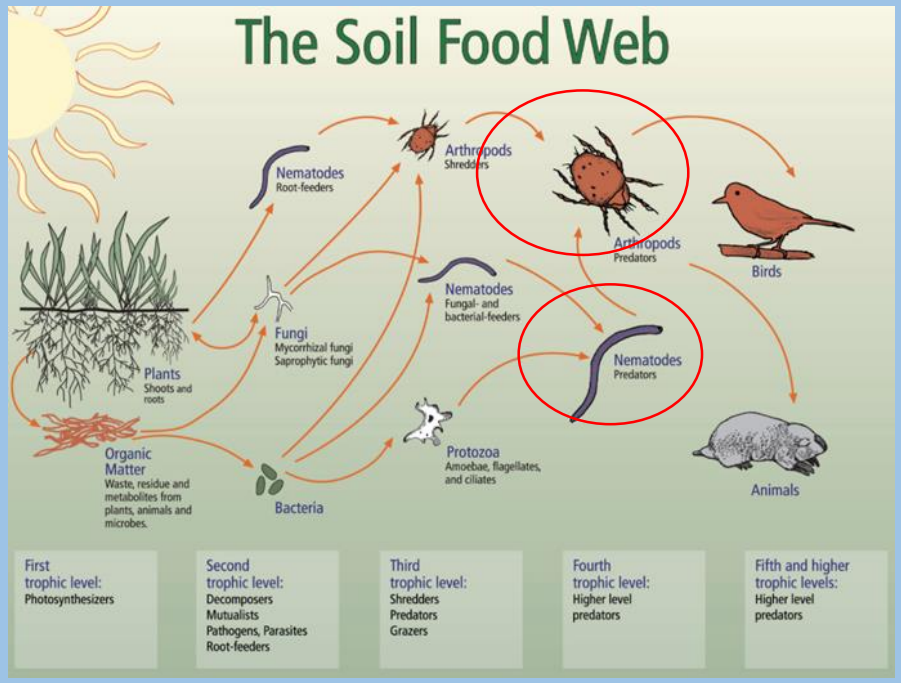
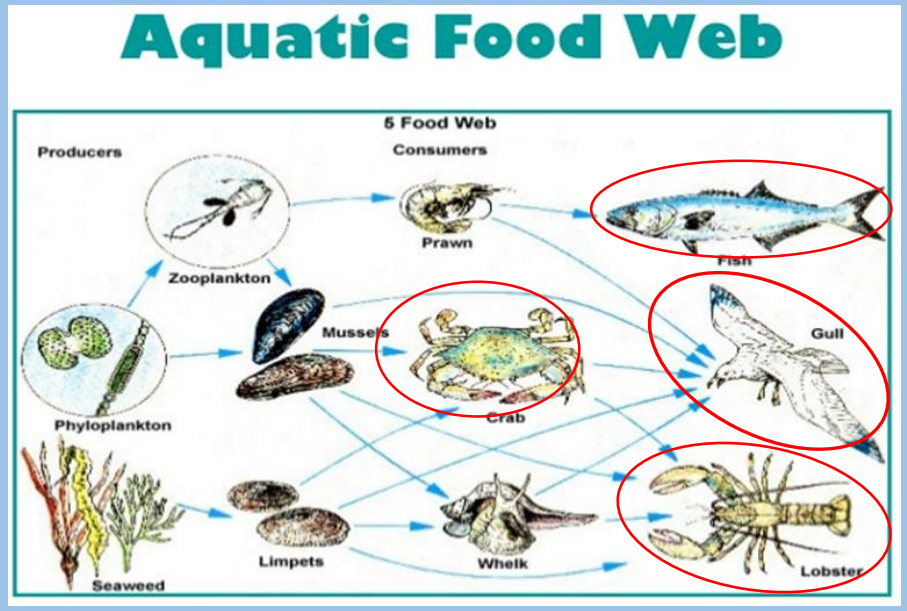
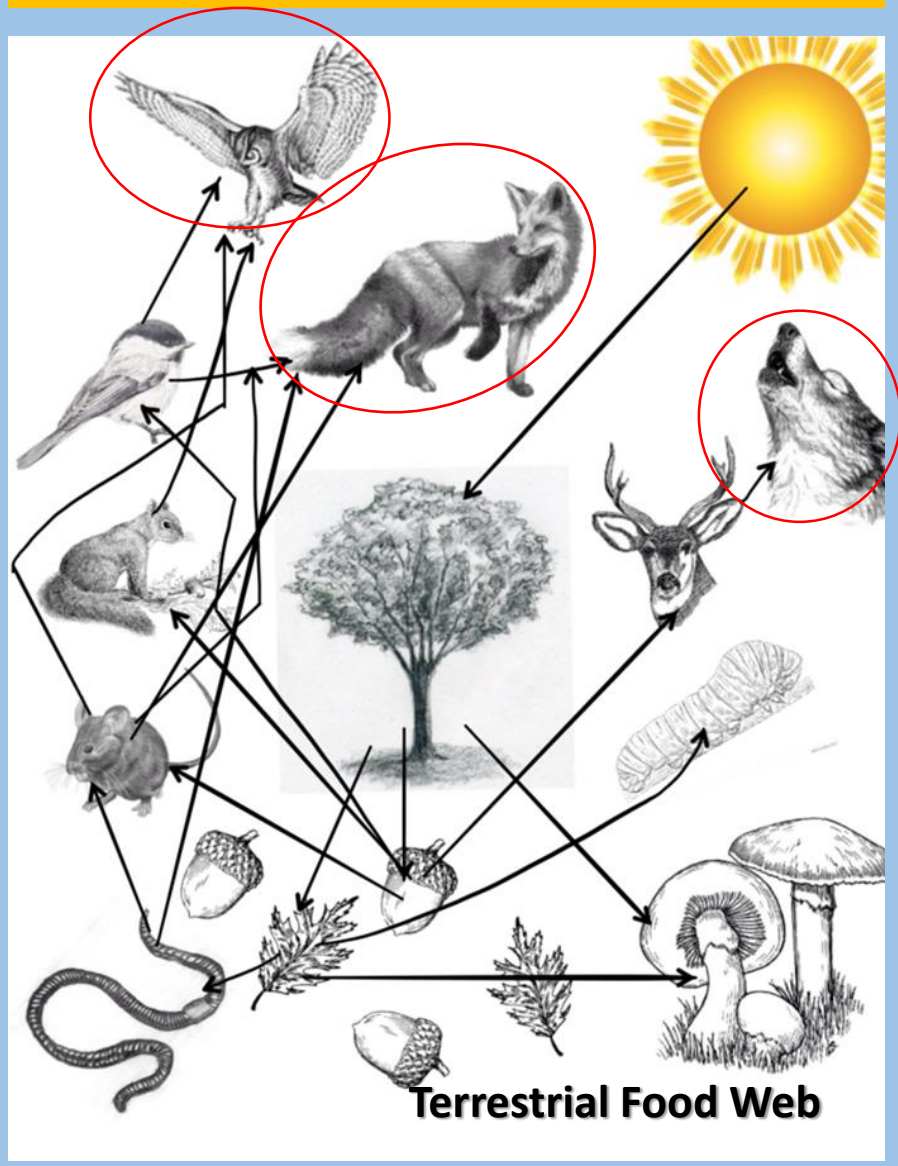




All food webs have **PREDATORS**




ANIMAL ECOLOGY

BY
CHARLES ELTON

WITH AN INTRODUCTION BY
JULIAN S. HUXLEY, M.A.

NEW YORK
THE MACMILLAN COMPANY
1927

Elton's pyramid of numbers - 1927

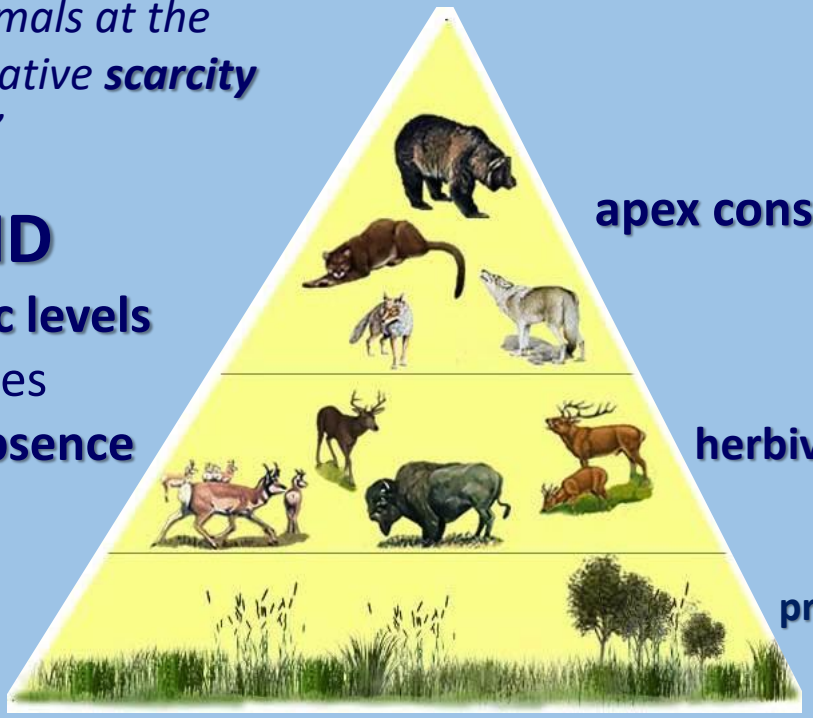
The Pyramid of Numbers

21. "One hill cannot shelter two tigers." In other and less interesting words, many carnivorous animals, especially at or near the end of a food-chain, have some system of territories, whereby it is arranged that each individual, or pair, or family, has an area of country sufficiently large to supply its food requirements. Hawks divide up the country in this way,

*"Pyramid of Numbers in a community, by which is meant the **greater abundance** of animals at the **base of food-chains**, and the comparative **scarcity** of animals at the **end of such chains**"*

A TROPHIC PYRAMID

- a **food chain** organised by **trophic levels**
- the base of the food chain becomes **overgrazed** and **degraded** in the **absence of predators**



"Green World Hypothesis" 1960

Vol. XCIV, No. 879 The American Naturalist November–December, 1960

COMMUNITY STRUCTURE, POPULATION CONTROL, AND COMPETITION

NELSON G. HAIRSTON, FREDERICK E. SMITH, AND LAWRENCE B. SLOBODKIN

Department of Zoology, The University of Michigan, Ann Arbor, Michigan

- **PHOTOSYNTHESIS** = **GREEN** world
- **uncontrolled herbivore pressure** = **BROWN** world

herbivores would normally expand to the point of depletion of the vegetation, as they do in the absence of their normal predators and parasites.

Ecological Meltdown in Predator-Free Forest Fragments

John Terborgh,[1]* Lawrence Lopez,[2] Percy Nuñez V.,[3] Madhu Rao,[4,5] Ghazala Shahabuddin,[6] Gabriela Orihuela,[7] Mailen Riveros,[8] Rafael Ascanio,[9] Greg H. Adler,[11] Thomas D. Lambert,[10] Luis Balbas[12]

SCIENCE VOL 294 30 NOVEMBER 2001

Intact vegetation in unaltered area

Almost no plants left where herbivores overpopulated

Predator-limited herbivore carrying capacity
- evidence of a **TROPHIC CASCADE**

Food-limited herbivore carrying capacity
- the **ECOLOGICAL MELTDOWN**

Vegetation dynamics of predator-free land-bridge islands

JOHN TERBORGH, KENNETH FEELEY*, MILES SILMAN†, PERCY NUÑEZ‡ and BRADLEY BALUKJIAN*

Journal of Ecology 2006 94, 253–263

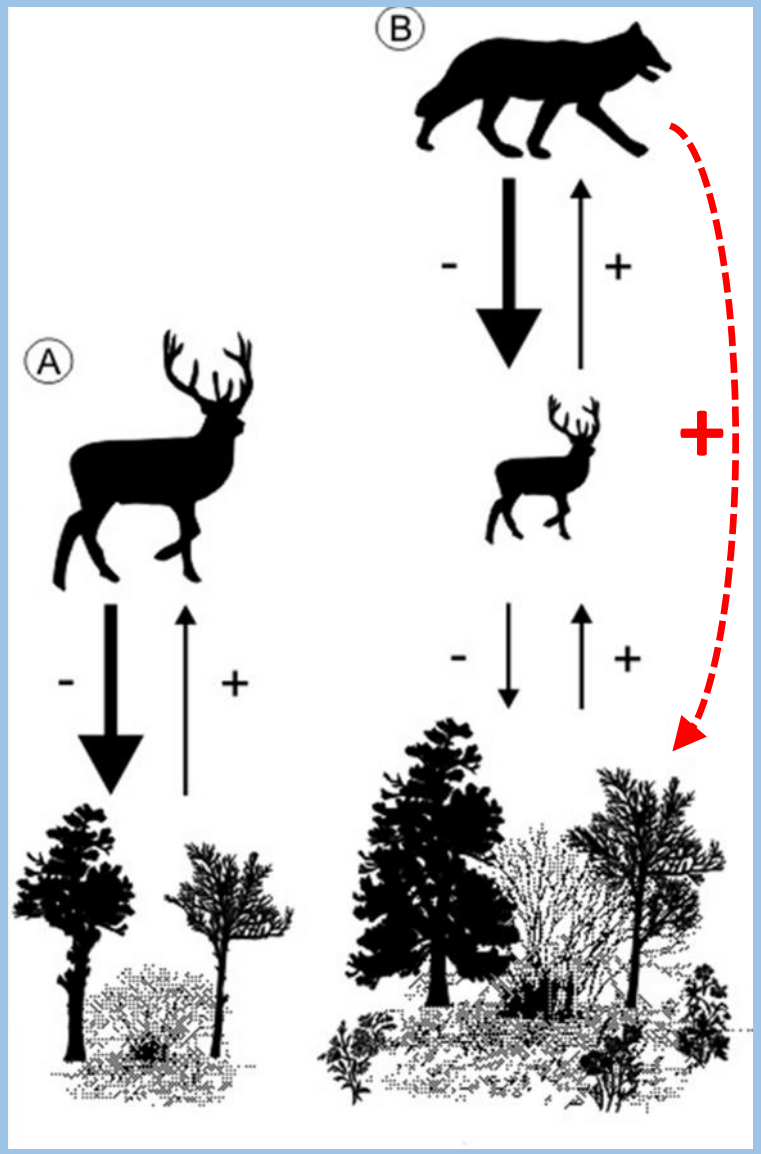
Summary

1 We tested the 'green world' hypothesis of Hairston, Smith and Slobodkin by monitoring vegetation change on recently created predator-free land-bridge islands in a huge hydroelectric impoundment, Lago Guri, in the State of Bolivar, Venezuela.

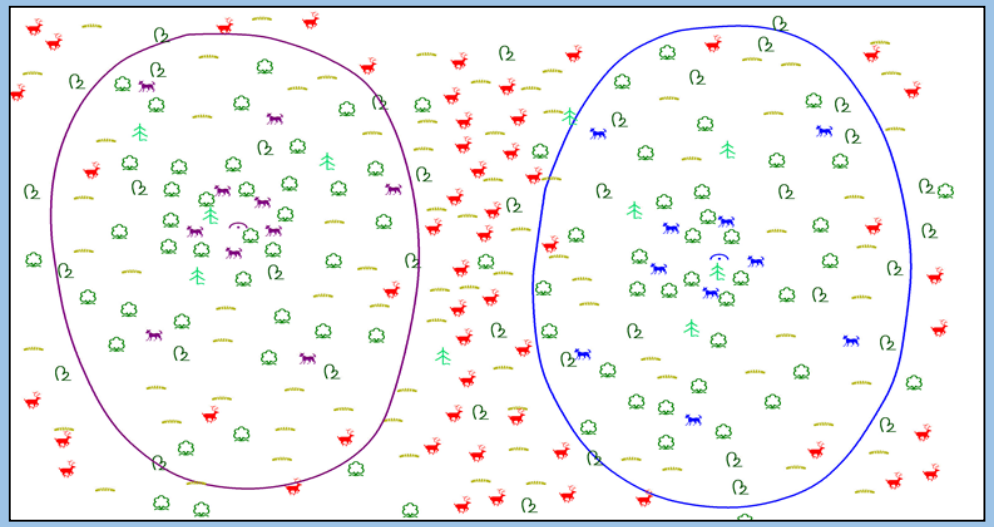
2 Our results affirm the green world hypothesis and expose the operation of a strong top-down trophic cascade that negatively impacted nearly every plant species present, implying that community stability is maintained through the action of predators.

Lago Guri, Venezuela, flooded by hydro-electric dam, creating **predator free islands**
- predators **present** (top)
- jaguar, cougar, and harpy eagles **absent** (bottom)

What is a TROPHIC CASCADE?



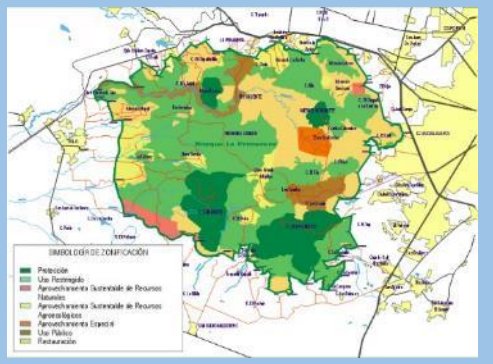
A **trophic cascade** occurs when the animals at the top of the food chain - the **apex predators** - modify the numbers not just of their prey, but also of species with which they have **no direct connection**. Their impacts **cascade down the food chain**



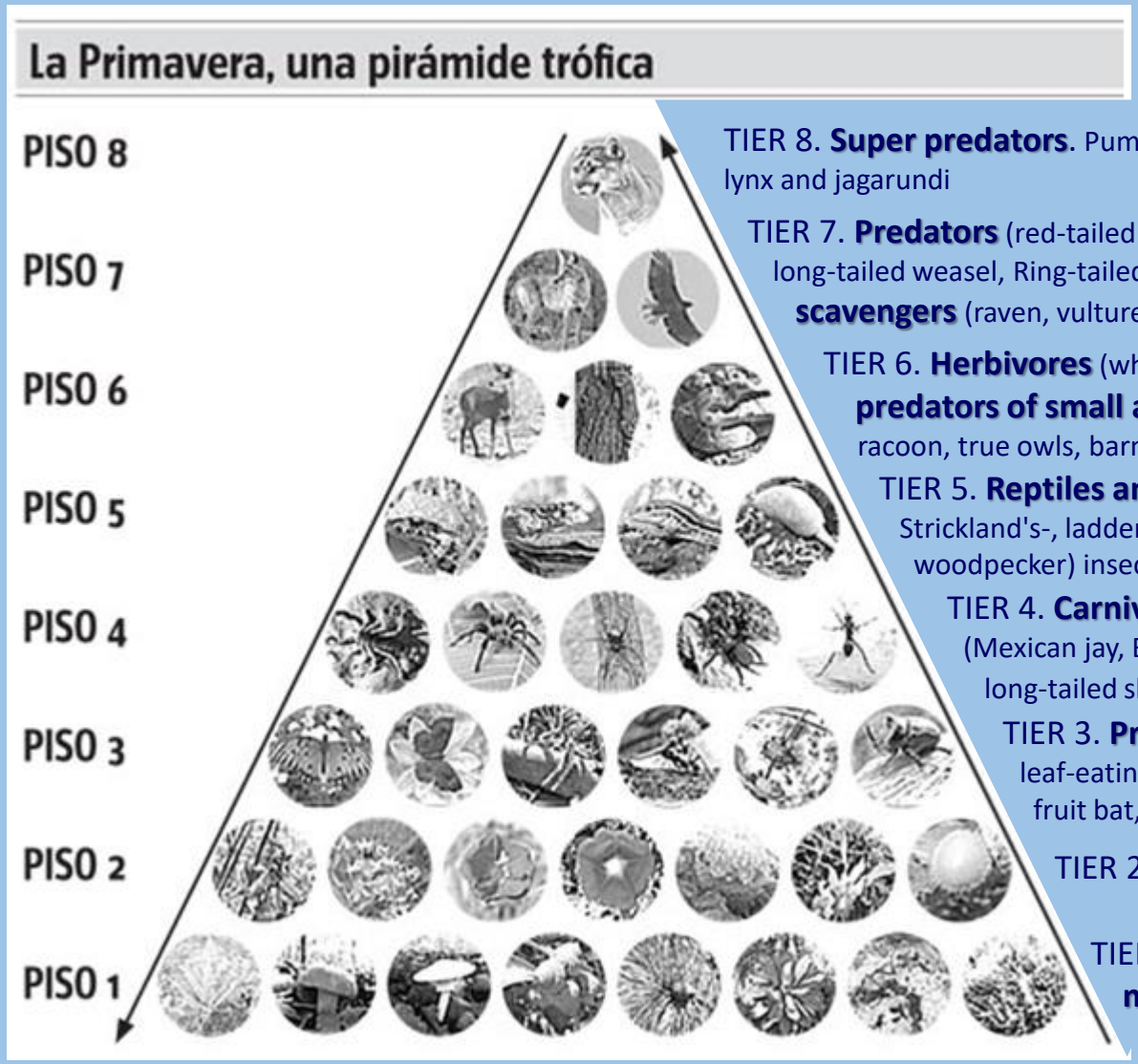
Deer **avoid** the dens in two **wolf pack** territories

Wolves drive woodland in a landscape of fear

La Primavera Biosphere Reserve, Mexico



The **trophic ecology** of La Primavera shown as a **TROPHIC PYRAMID**



TIER 8. **Super predators**. Puma at the summit of La Primvera, along with coyote, lynx and jagarundi

TIER 7. **Predators** (red-tailed hawk, sharp-shinned hawk kestrel, fox, long-tailed weasel, Ring-tailed cat, opossum, vampire bat) and **scavengers** (raven, vultures, rock squirrel and some mammals)

TIER 6. **Herbivores** (white-tailed deer, peccaries, armadillo) and **predators of small animals** (snakes, skunks, ring-tailed coati, racoon, true owls, barn owl, great horned owl)

TIER 5. **Reptiles and birds devouring insects** (northern flicker, Strickland's-, ladder-backed-, golden-fronted-, Gila-woodpecker) insectivorous bat (vesper bat)

TIER 4. **Carnivorous insects and small birds, mammals** (Mexican jay, Black-throated magpie, ground squirrel, long-tailed shrew,) **amphibians**

TIER 3. **Primary consumers**: butterflies & pollinators, leaf-eating insects (acorn woodpecker, long-tongued bat, fruit bat, cottontail rabbit, gray squirrel, gopher, vole)

TIER 2. **Plants with flowers. Herbs and trees**

TIER 1. **Bacteria. Microorganisms, fungi and mycorrhizae**

What's missing "in a country where the fauna is practically limited to birds, insects and the smaller mammals"? (Addison Committee, 1931)

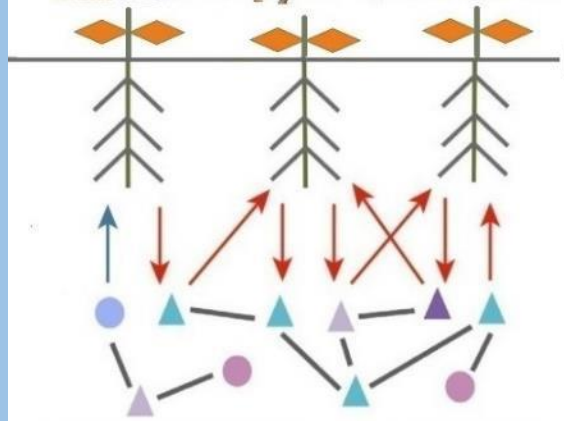
Agricultural systems

Report
OF THE
NATIONAL PARK
COMMITTEE

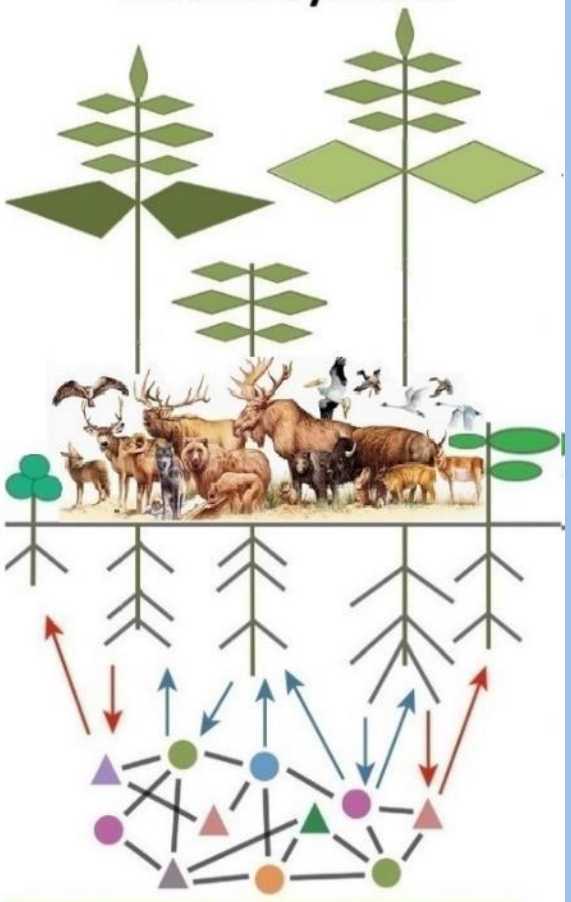
Presented to Parliament by the Financial Secretary to the Treasury by Command of His Majesty. April, 1931.

Chapter II.—The Significance of National Parks for Great Britain.

in a country where the fauna is practically limited to birds, insects and the smaller mammals.



Natural systems



Plant & animal species

Low ← Diversity → High

Soil organisms

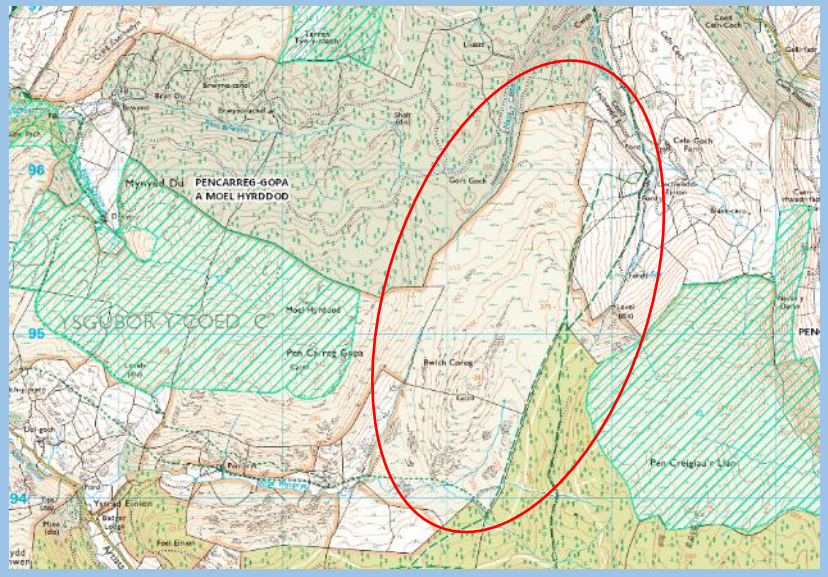
Monoculture External resource inputs Low diverse soil biota Simplified tropic interactions	Low ← Trophic network complexity → High High ← Nutrient inputs and disturbance → Low	High species and trait diversity Closed nutrient cycle Diverse soil biota Complex trophic interactions

BWLCH COROG- Cambrian Wildwood habitat restoration

Many upland areas are **LANDSCAPE TRAPS** where entire landscapes are shifted into, and then **trapped in a highly degraded structural and functional state** resulting from **anthropogenic disturbances**

Woodland Trust own 140ha of moorland **dominated by purple moor grass**

- held on a 125-year lease by the Wales Wild Land Foundation
- Cambrian Wildwood project intends to **restore the native forest** and other natural habitats
- reintroduce some **missing native species**
- **not been grazed** for over six years



SOUTH HOUSE MOOR - ecological restoration under similar biophysical conditions

INGLEBOROUGH NNR
THE REWILDING OF SOUTH HOUSE MOOR
PROJECT BRIEF

MAJOR VEGETATION COMMUNITIES AND DESIRED UNGRAZED ALTERNATIVES

Community	NVC Type	Approx Area (ha)	Ungrazed NVC Type
Hill Top Blanket Bog	M19a	5	M19
Hill top calcareous grassland	CG1Oa	10	? (W9a at lower altitude)
Heath on scree/steep slopes	H18c	10	W19/W17
Richer acidic grassland (lower slopes)	U4b	15	W11?
Acidic grassland (drier slopes)	U5A	40	W17 + W19/23
Modified blanket bog/ wet acidic grassland	M20/U2b	65	M19 + W4
Acidic flushes	M6a,c,d	20	W4 + W7, M25
Marshy grassland (below flushes)	M23b	10	W1
	Total Area	174ha	

- **sheep grazing ceased 1999**
- **10,000 native trees and shrubs** planted 1999-2002 in copses & along gill sides (~5%)
- **juniper** & **willow** scrub on **scree slopes**
- supplemental tree planting 2012 (~ 1%)
- aim to establish **NVCs** shown in table

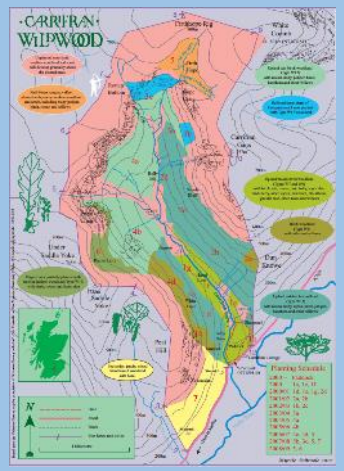
grass and moss hummocks drilled with runs and tunnels of **small mammals**

- vegetation height > **doubled**, dramatic comeback of **dwarf shrubs**, bog asphodel spreading
- BTO 5y survey showed **37 species of birds** many **never seen on grazed areas**, including willow warbler, redpoll, black cap
- 6mo survey showed **45 times more small mammals**, matched capture had **56 field voles** and **34 common shrews** in **ungrazed area -** one of each on **grazed area**
- **raptor pellets** found only on **ungrazed area**, frequent sightings of **short-eared owls**

TROPHIC CASCADES – between **grasses, slugs, worms, field voles, common shrews** & **short-eared owls**

CARRIFRAN - ecological restoration under similar biophysical conditions

Borders Forest Trust bought 665ha Carrifran Burn watershed in 2000
- altitude range **165-820m**
- phased **sheep removal** 2000-2004
- >500,000 **trees and shrubs planted**, based on ESC (50%)



- **heather regenerating** down hillside below ~ 450m
- **suckering** of surviving trees and **rapid growth** of **suppressed** upland **dwarf shrubs and tree seedlings** (mainly rowan)
- **natural regeneration** in several areas
- **leaf litter** and **woody debris** beginning to accumulate
- thicker **vegetation mat** over valley brings increase in **field voles**, prey for many predators – **TROPHIC CASCADE**
- **foxes** and **badgers** now common plus **otters**, **stoats** and **weasels**
- **greater than expected** voluntary return of **nearly 50 avian species** with more to come, including **kestrel**, **buzzard**, **peregrine falcon,** raven, **short-eared**, **long-eared** and **barn owls**

Conservation Letters
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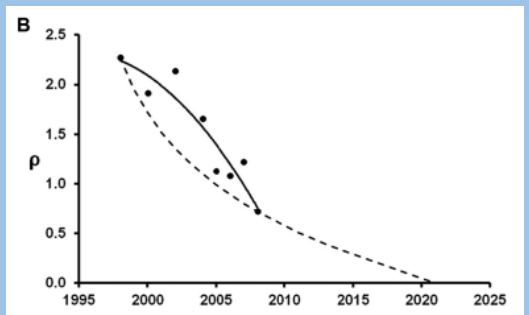
Open Access
LETTER

Predicting and Assessing Progress in the Restoration of Ecosystems

A.R.E. Sinclair[1], Roger P. Pech[2], John M. Fryxell[3], Kevin McCann[3], Andrea E. Byrom[2], C. John Savory[4], Justin Brashares[5], Anthony D. Arthur[6], Peter C. Catling[7], Maggie D. Triska[8], Michael D. Craig[9,10], Tim J.E. Sinclair[11], Jennie R. McLaren[12], Roy Turkington[1,13], Rene L. Beyers[1], & William L. Harrower[1,13,14]

accelerated restoration index for the annual counts of **all bird species** in the Carrifran woodland over the first ten years



The accelerated restoration index for the annual counts of all bird species in the Carrifran woodland over the first ten years (solid line). Accelerated arrival produces a convex curve compared to the expected concave curve (broken line) for a constant arrival per unit time of the same number of species (Savory 2016).

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Carrifran: Ecological Restoration in the Southern Uplands

New native woodland and vegetation succession in the Moffat Hills

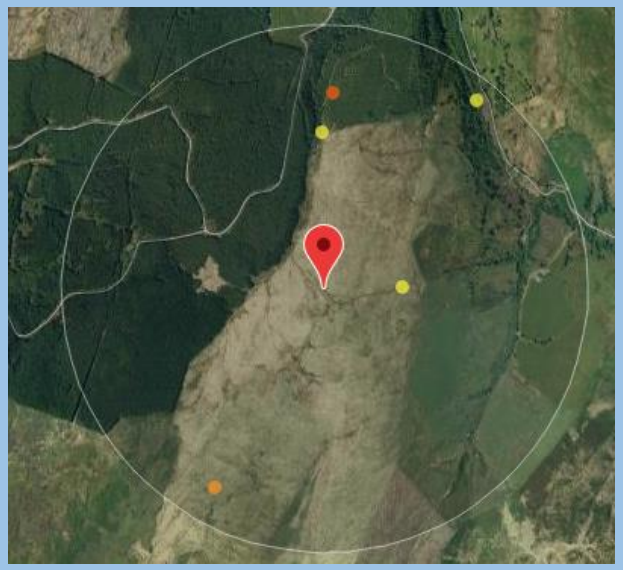
Stuart Adair
Habitat ecologist and member of Carrifran Wildwood Project of Borders Forest Trust, Old Town, Peebles, EH45 8JE stadair@tiscali.co.uk

Colonisation by woodland birds at Carrifran Wildwood: the story so far

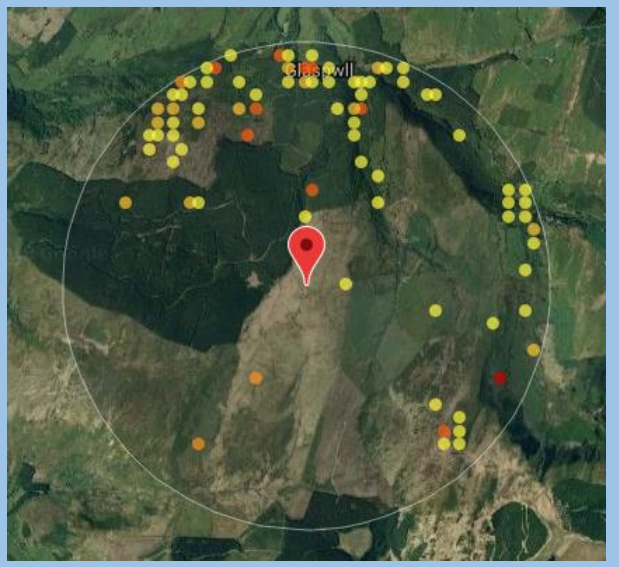
C.J. SAVORY
36:2 (2016) *Scottish Birds: 135–149*

The art of the achievable at Bwlch Corrog:
"birds, insects and the smaller mammals"

1km radius (SN734957)



2km radius (SN734957)



Use of **NBN atlas** data to build a picture of species on site & could migrate in to Bwlch Corog **during habitat restoration** - walk, fly, blown, drop (from birds)!

On site: lichens x 3, weevils x 4, moths x 9 buzzard, sparrowhawk, carrion crow, jay, raven fieldfare, blackbird, meadow pipit, skylark, tree pipit, siskin, dunnock, wren, great tit, coal tit, blue tit, whinchat, goldcrest, woodpigeon, chaffinch, chiffchaff, robin, tree pipit, crossbill, redwing, mistle thrush, song thrush, willow warbler, grasshopper warbler, cuckoo

Just off-site: moorland grasses, vascular plants (cranberry, bog ashphodel, sundew, crowberry, cotton grass, rowan, willow, heather) ferns and many liverwort and moss species of the moor rowan willow heather

NO MAMMALS

Mammals: common shrew, water vole, field vole, brown hare, otter, rabbit, mole, red and grey squirrel, Brandt's bat, weasel, badger, fox, fallow deer

Birds: carrion crow, raven, grey heron, sparrowhawk, kestrel, jay, jackdaw, rook, magpie, woodpecker x2 and tawny owl, as well as many other insectivores and herbivores

Trees & shrubs: field maple, alder, willows, small-leaved lime, beech, wych elm, rowan, wild service tree, holly, yew, elder, guelder rose, gorse, dog rose, bramble, raspberry

Bryophytes: many mosses and lichens

Moorland and woodland vegetation species

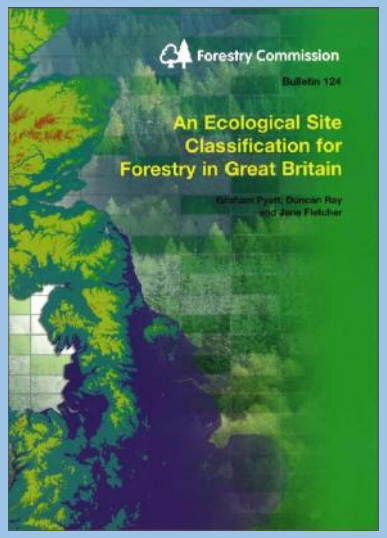
Seeding woodland restoration at Bwlch Corrog

Assessment for **LANDSCAPE TRAPS** has to be made on whether ecological restoration is **limited by the absence locally of potential in-migrating species**. The project will begin with planting around **8,000 native trees** to provide a **seed source** for future colonisation of woodland across the site

Choice of woodland species indicated at **coarse** and **fine** scale:

NATURAL VEGETATION MAPPING OF EUROPE (2003)

Bwlch Corrog lies in the band of **oak forest** (F2 - Quercus robur, Q. petraea, mostly with Betula pubescens, Ilex aquifolium, Blechnum spicant) between the raised bog areas (S8) of Foel Goch and Foel fras



ECOLOGICAL SITE CLASSIFICATION (ESC)

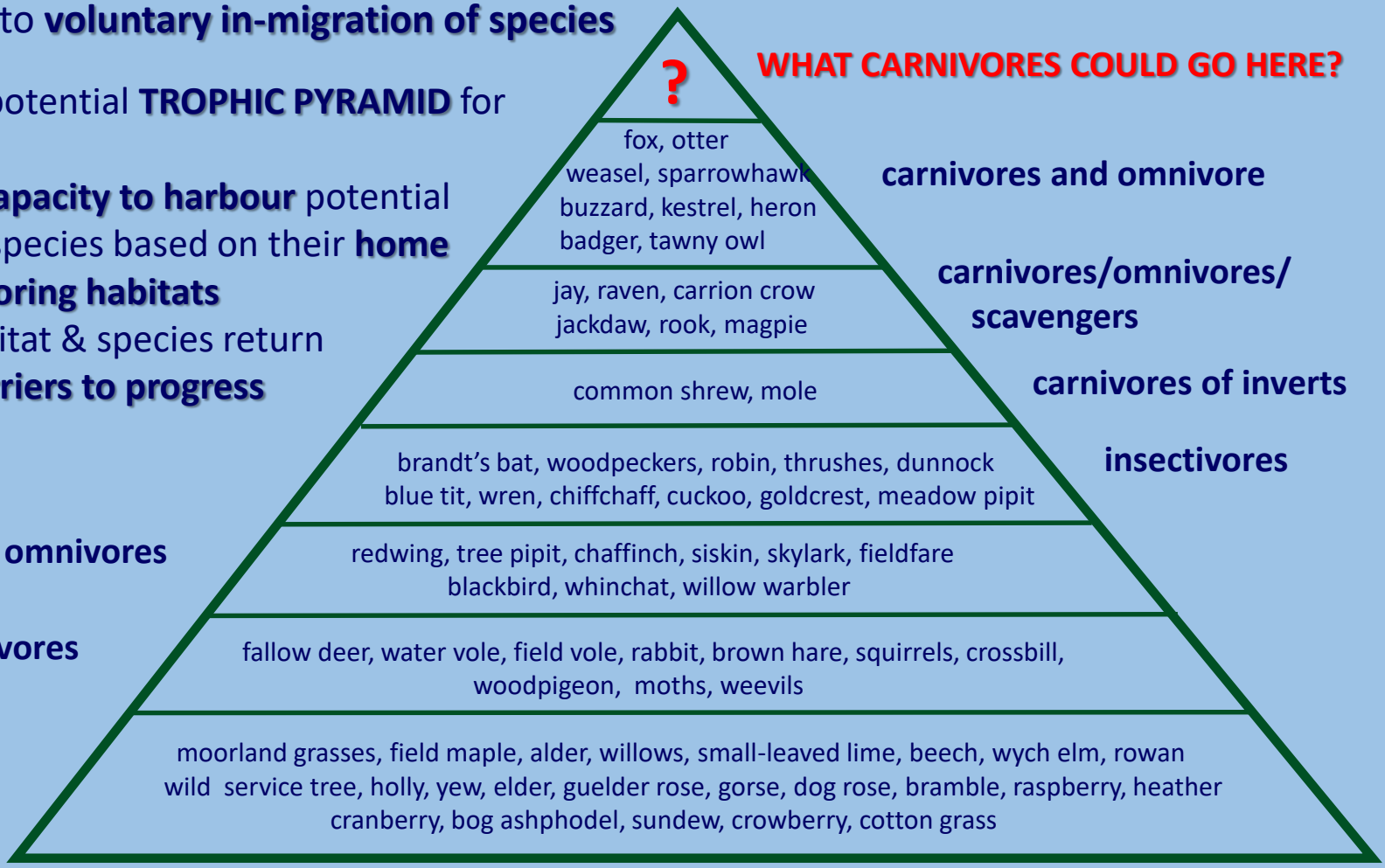
Developed by Forestry Commission, a decision support system that predicts **woodland communities** of the **National Vegetation Classification** (NVC) system based on:

- **climate:** elevation, windiness and temperature
- soil **moisture**
- soil **nutrient**

Assessing the potential trajectory and progress of restoration at Bwlch Corrog

Potential OUTCOMES can be predicted from the community of species and their interactions that can be restored, based on **initial habitat seeding** in upland **LANDSCAPE TRAPS** linked to **voluntary in-migration of species**

- construct a potential **TROPHIC PYRAMID** for the location
- calculate a **capacity to harbour** potential in-migrating species based on their **home ranges** in **restoring habitats**
- **monitor** habitat & species return
- **evaluate barriers to progress**



What are the potential TROPHIC CASCADES in this TROPHIC PYRAMID?

Characteristics of rewilding

These characteristics move us past the **ecologically illiterate** *"process-led"* approach that **holds rewilding back** i.e. Oostvaardersplassen

An **ecological approach** to **rewilding** based on **outcome**:

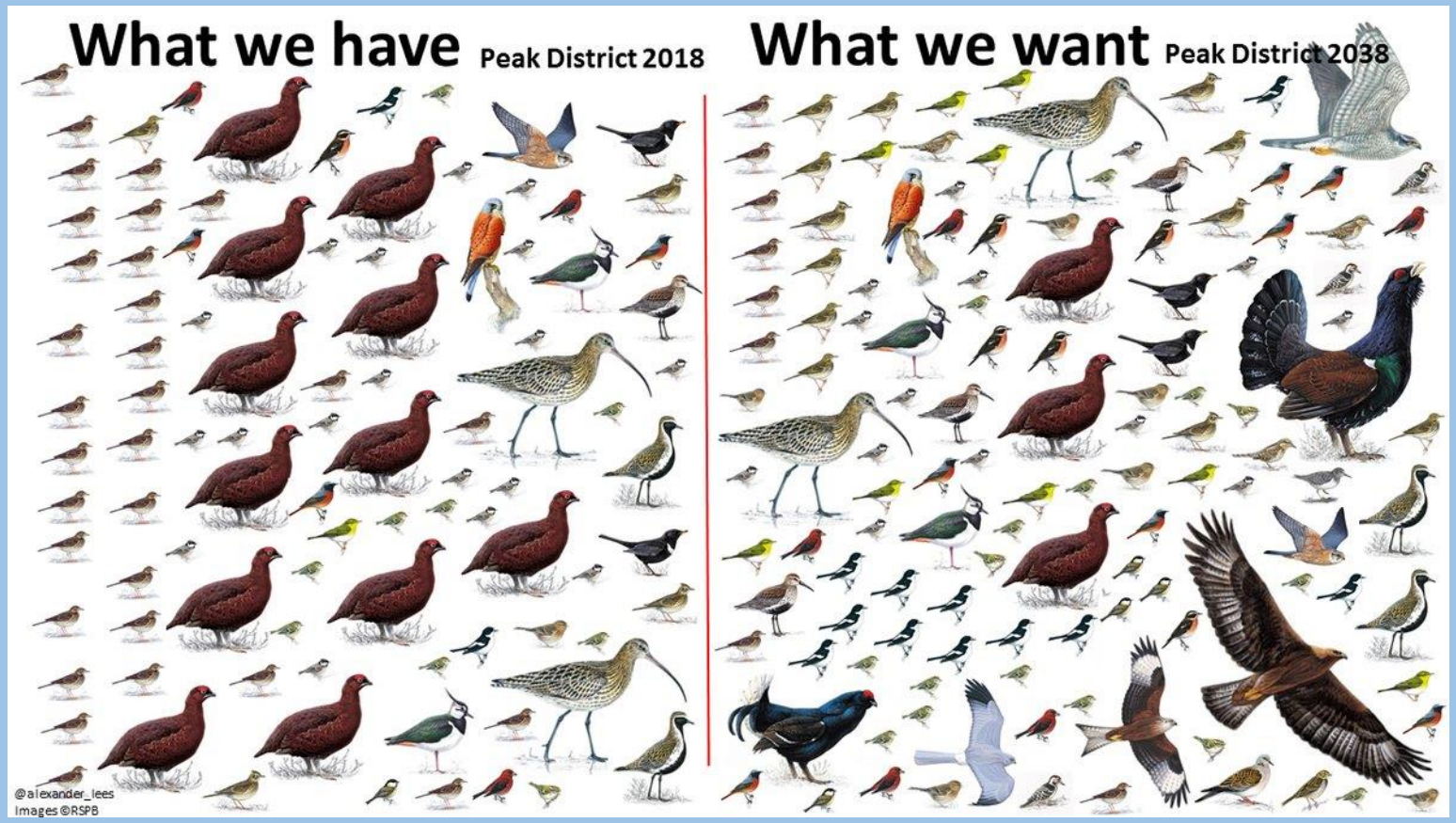
- restores **trophic occupancy**, structure and cascades in degraded ecosystems
- focuses on **communities of species and their interaction** rather than just species composition
- switches human involvement from management intervention to being a **facilitator of autogenic recovery**
- based on an **ecologically feasible trajectory** and **outcome**
- **trajectory** and **progress** of **autogenic recovery** are **monitored**
- identifies **barriers to restoration** arising through **failure to locally recruit species** (i.e. tree and shrub species) or **trophic imbalance** (herbivore unmatched by its predator)
- restores **non-human autonomy** where humans are observers of natural processes and wild nature
- **future oriented**
- **reimagines** the identities of **humans** in relation with **non-humans**

(with thanks to **Andrea Gammon**)

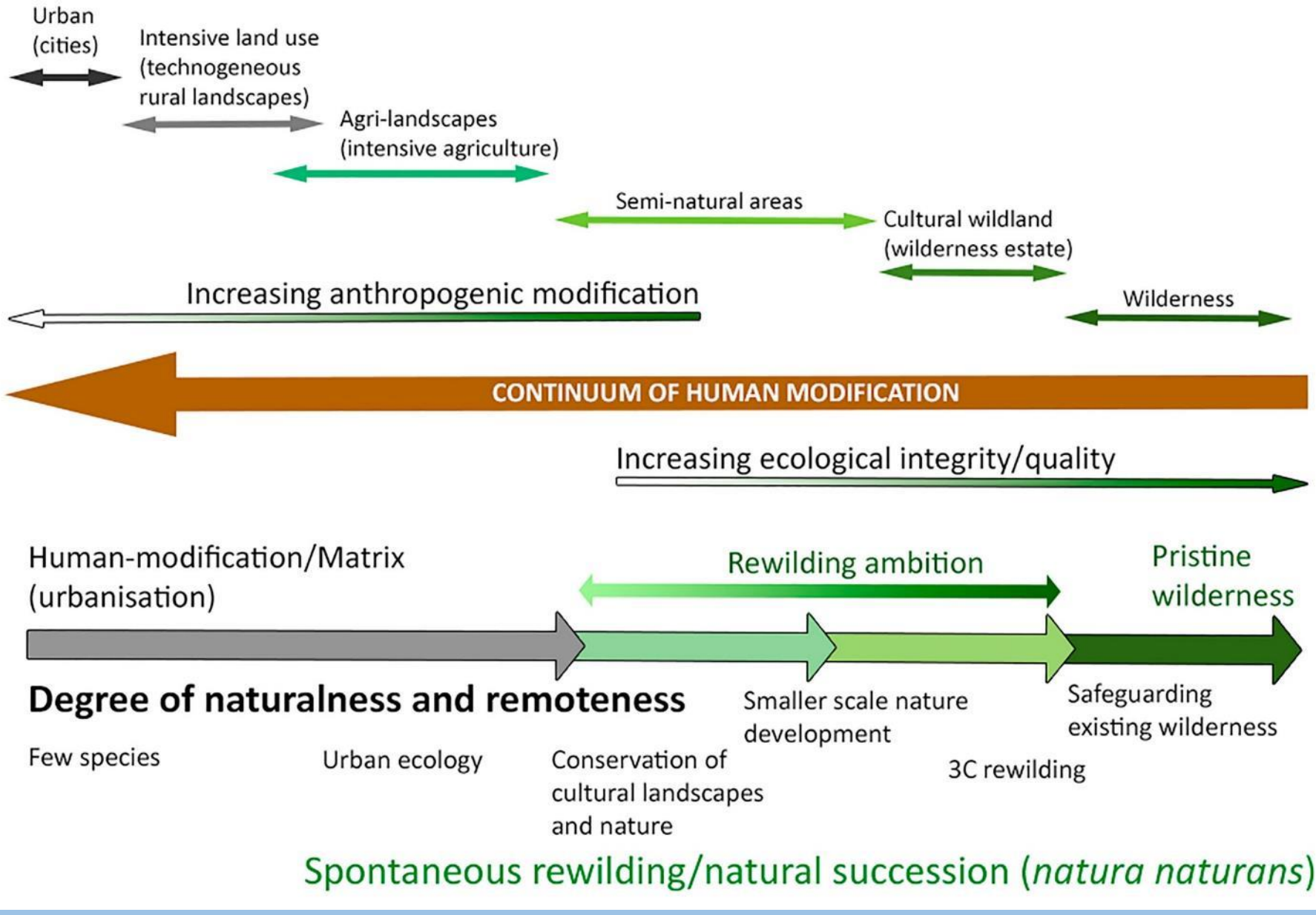
Restoring avian TROPHIC OCCUPANCY in the PEAK DISTRICT

Alex Lees, lecturer in biodiversity at Manchester Metropolitan University, lives in the Peak District

- produced this graphic as his **avian rewilding manifesto** for the Peak District
- counters the **common misconception** that rewilding results in a **loss of biodiversity**
- **rewilding** results in a **different diversity –** losses and **GAINS**

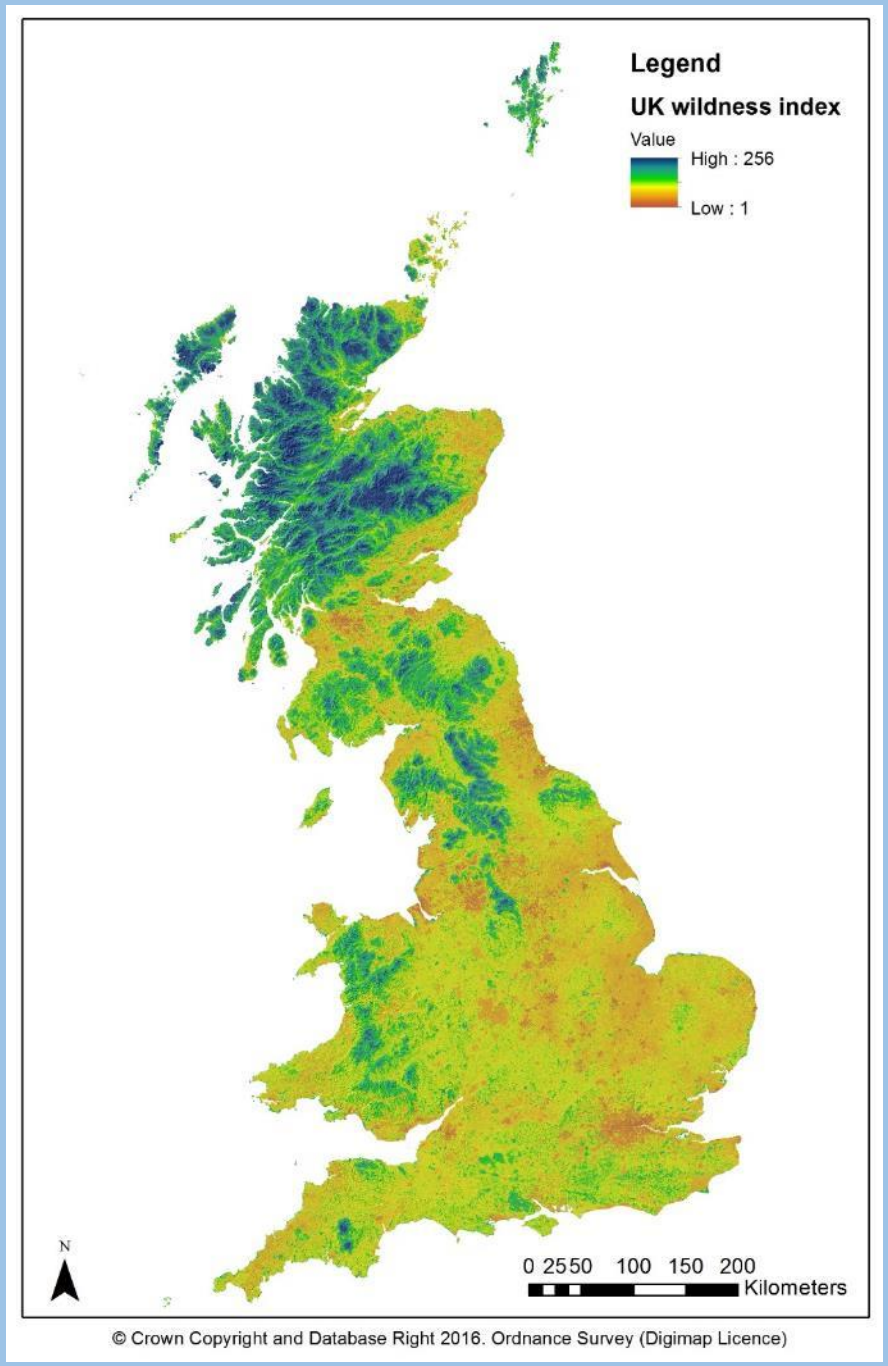


A rewilding continuum



Rewilding or nature gardening?

"In the end if a term, either restoration or rewilding, applies to everything, it also means nothing" **(Anthony Sinclair, 2017)**



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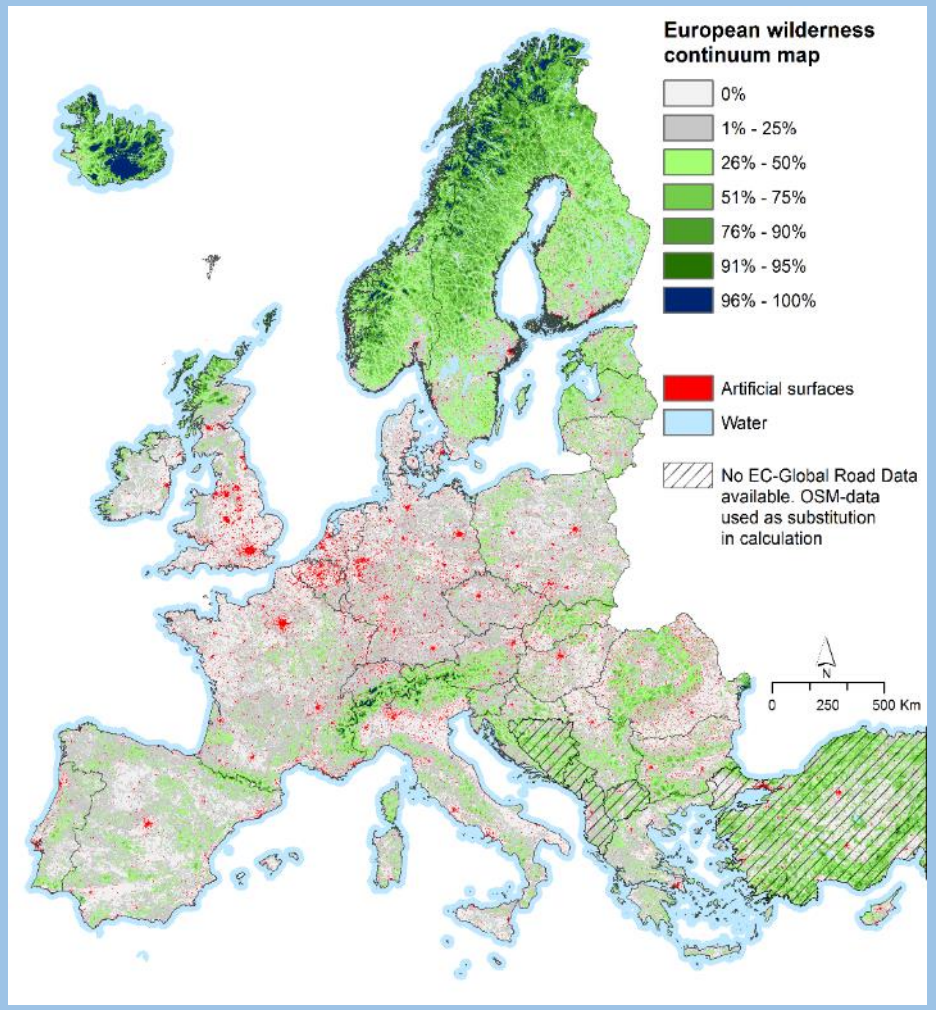
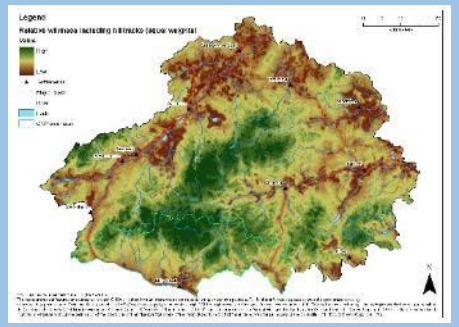
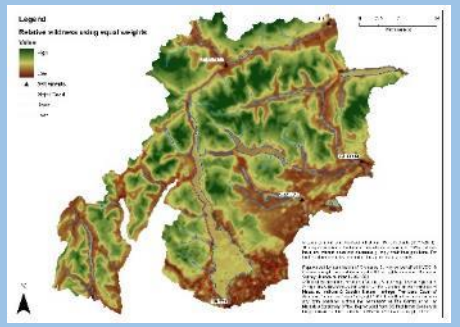
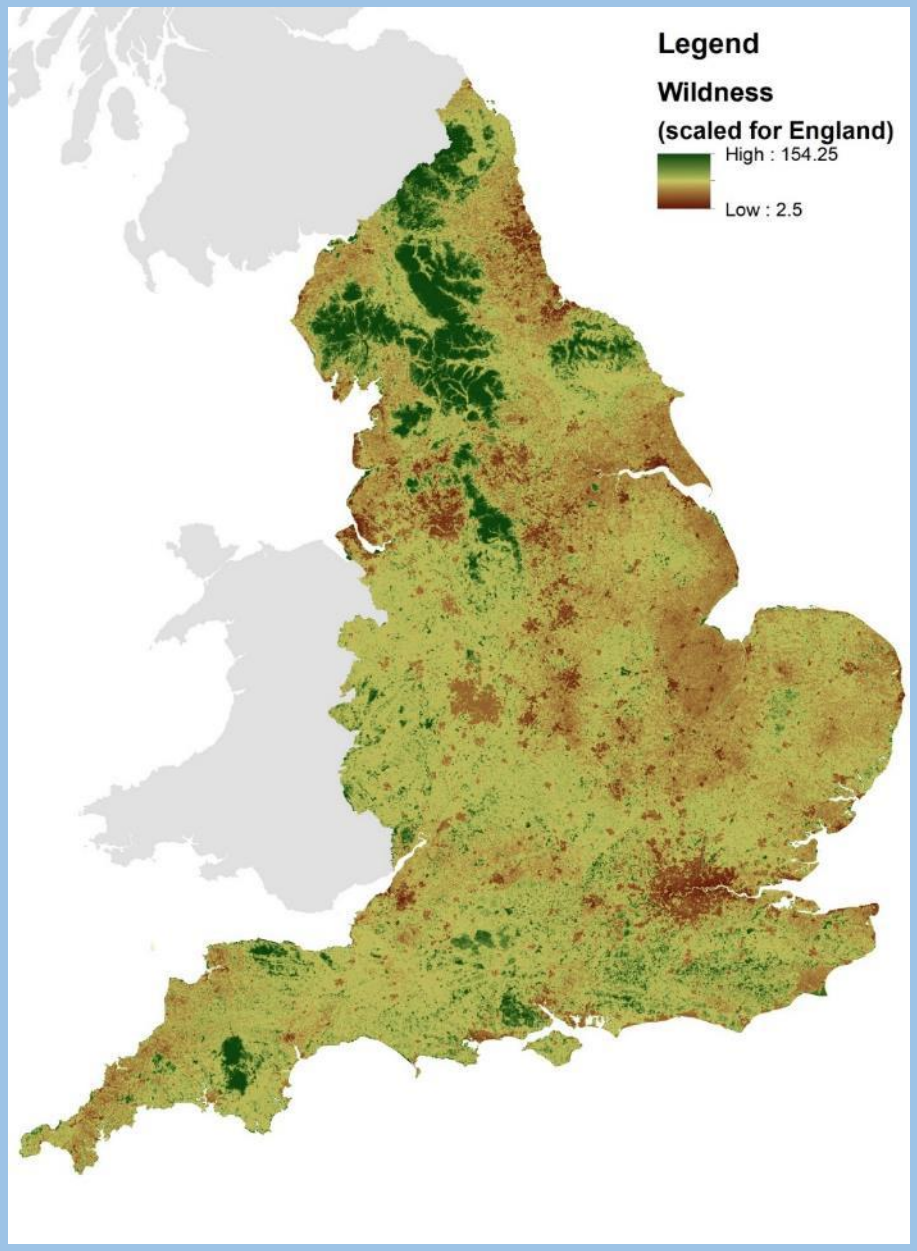
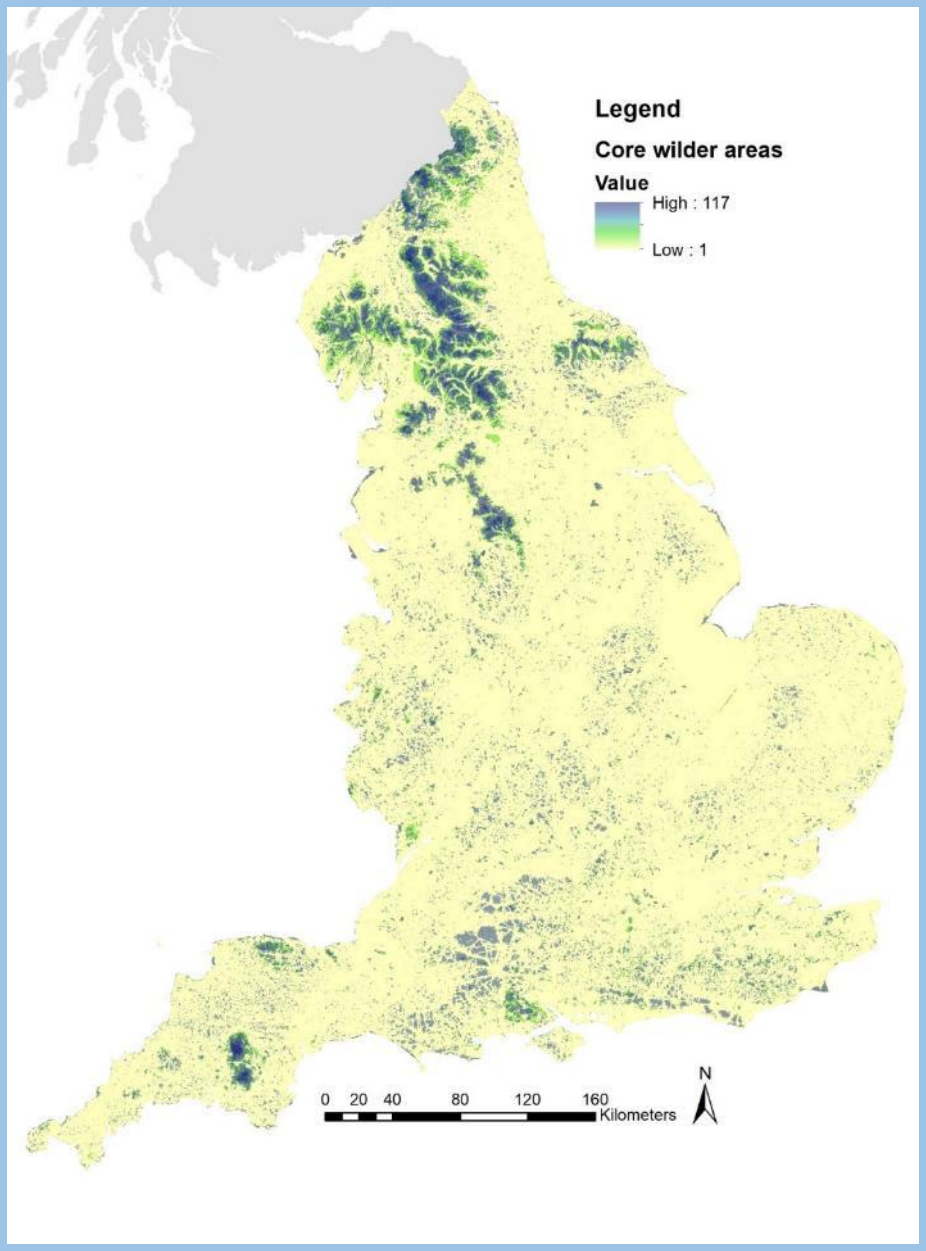
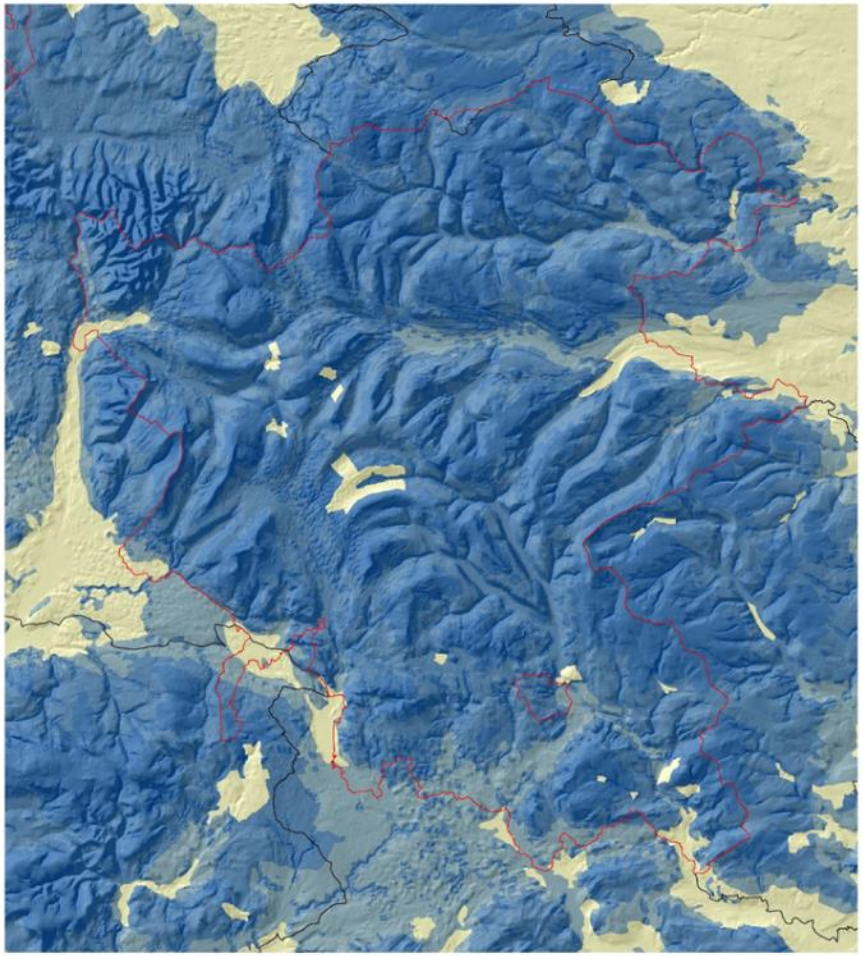







Legend
Wildness
(scaled for England)
High : 154.25
Low : 2.5


Legend
Core wilder areas
Value
High : 117
Low : 1
0 20 40 80 120 160
Kilometers
N



N

0 3.75 7.5 15 22.5 30 Kilometers

Legend

National Park

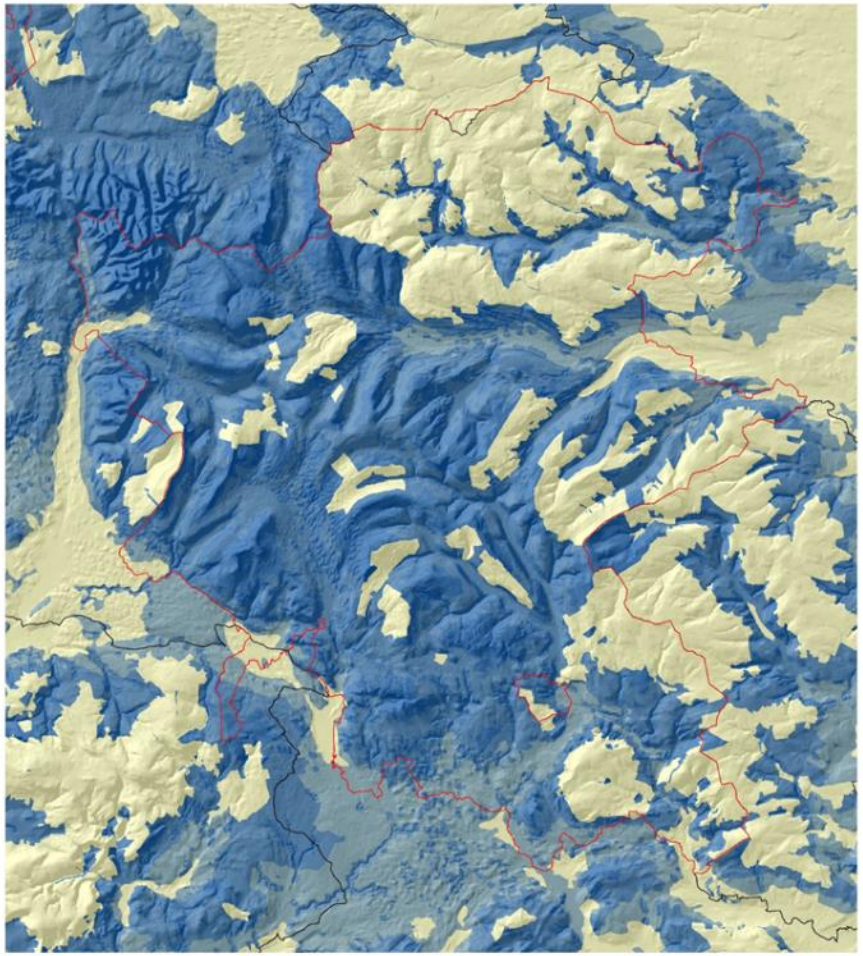
AONB

Threat level

Value

High

Low



N

0 3.75 7.5 15 22.5 30 Kilometers

Legend

National Park

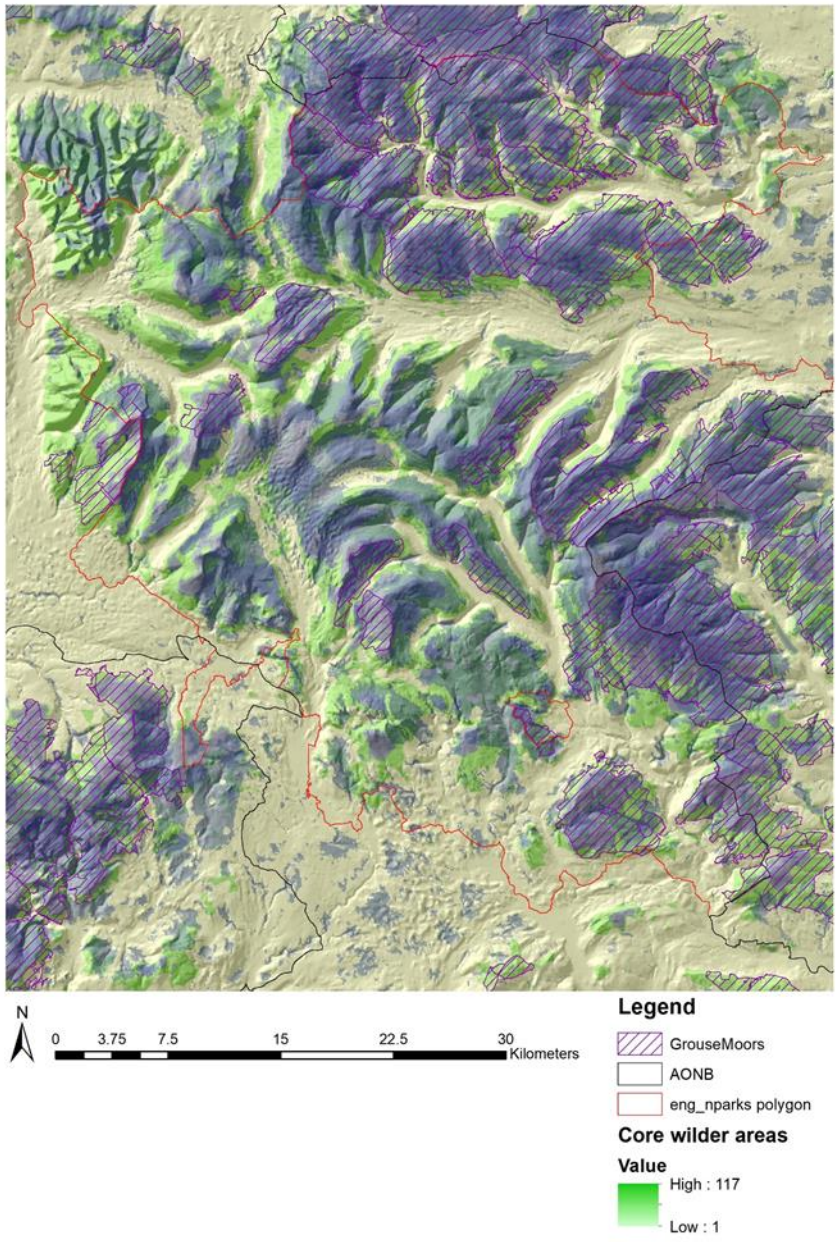
AONB

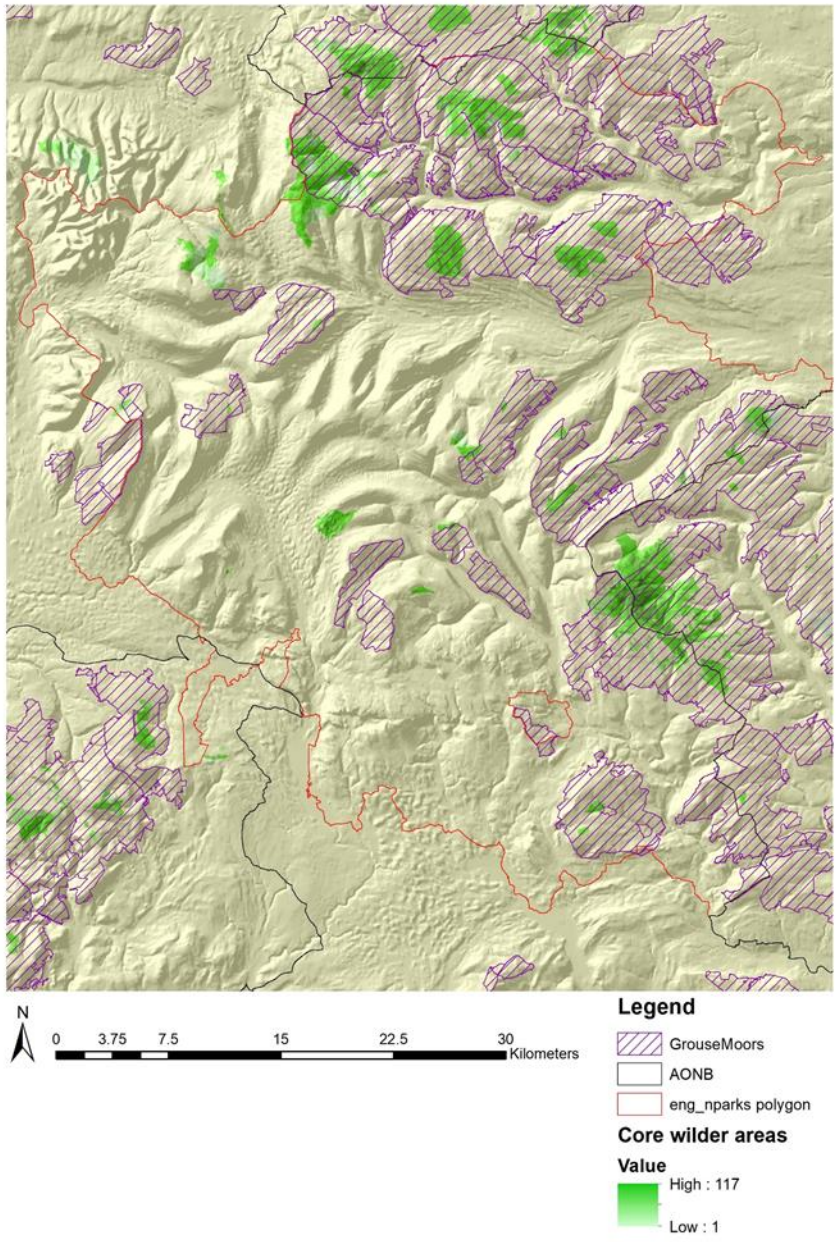
Threat level

Value

High

Low


N
0 3.75 7.5 15 22.5 30
Kilometers
Legend
GrouseMoors
AONB
eng_nparks polygon
Core wilder areas
Value
High : 117
Low : 1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eng_nparks polygon
Core wilder areas
Value
High : 117
Low : 1

The six rules of re(al)wilding

1. Don't confuse biodiversity and culturally mediated landscapes with wildness and naturalness
2. Nature can exist and thrive without our constant intervention
3. Natural succession should be the Favourable Conservation Status for rewilding projects
4. Work towards a continuum of approaches
5. Work towards a continuum of landscapes
6. Think big and think bold


“It isn't fear that drives us to extinguish fearsome beasts, but once they are gone, it's fear that keeps us from bringing them back”
J.B.MacKinnon (2014) *The Once and Future World* p.255