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Restoring Resilient Ecosystems

Moving with the times – a shift to survival ecology

James Bullock

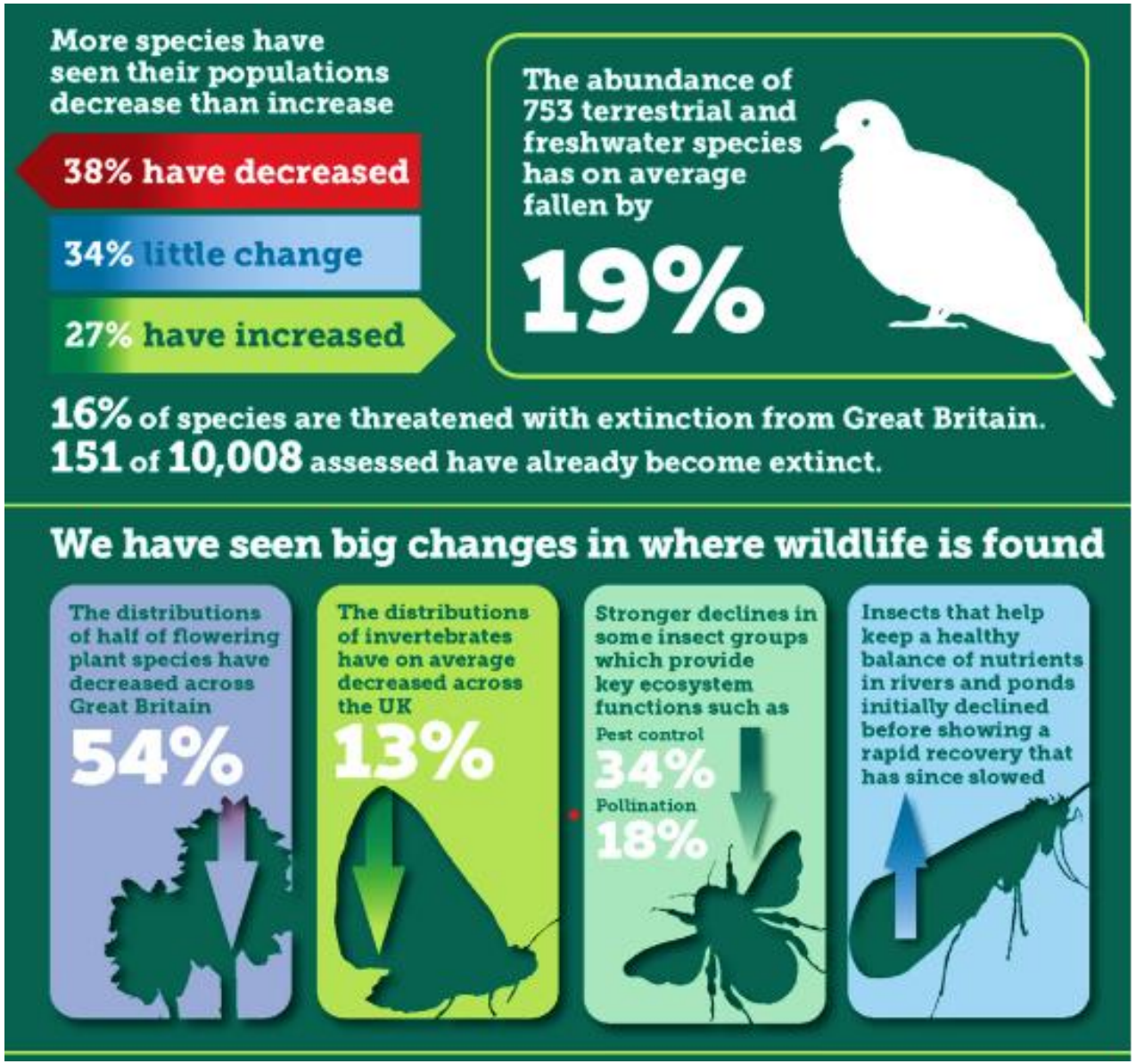
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Biodiversity loss – UK (State of Nature Report)

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The response: More conservation action?

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RESPONDING TO THE CRISIS

The UK and many of the UK Overseas Territories and Crown Dependencies are party to a new set of international biodiversity targets under the Convention on Biological Diversity (CBD): the Global Biodiversity Framework. To support the delivery of these, each UK country has committed to developing and implementing national biodiversity strategies. In many cases, countries have developed (or are committed to developing) legally binding targets to restore nature. In this report, we have grouped the CBD targets into the five broad areas discussed below.

IMPROVING SPECIES STATUS:

There is good evidence that conservation can be effective for individual species when it can be applied to a large proportion of the population, and targeted conservation action has set some species on the path to recovery. Halting and reversing biodiversity decline is vital, but it is only the first step towards a healthy environment with resilient species populations, thriving habitats and functioning ecosystems.

> *"targeted conservation action has set some species on the path to recovery"*

INCREASING NATURE-FRIENDLY FARMING, FORESTRY AND FISHERIES:

In the UK a fifth of farmland is in agri-environment schemes, but only a part of this could be considered as nature-friendly farming. 44% of woodland is certified as sustainably managed and half of marine fish stocks are sustainably harvested. All three measures have improved over the past 20 years, but there is a long way to go. Sustainable management is a positive step but does not necessarily mean the same as well-managed for nature. At a local level, many species benefit from nature-friendly farming, but the impact of different schemes on species populations has been variable. The best available information suggests that nature-friendly farming needs to be implemented at a much wider scale to halt and reverse the decline in farmland nature. The increased proportion of sustainably harvested fish stocks appears to be having a positive impact, with the proportion of large fish in landings, an indication of population health, increasing since 2002.

> *"nature-friendly farming needs to be implemented at a much wider scale to halt and reverse the decline in farmland nature"*

EXPANDING AND MANAGING PROTECTED AREAS:

11% of UK land is in protected areas (areas subject to a legal nature conservation designation). However, within this only 44% of the measured attributes of terrestrial and freshwater Areas or Sites of Special Scientific Interest are in favourable condition. In protected areas on land, there is some evidence that target species or species of conservation concern have more positive trends than outside them. Although 38% of UK waters are designated as protected areas, we lack a comprehensive condition assessment and management is not yet fully implemented at most sites. Work is ongoing to designate marine protected areas and implement fisheries management within them. This will contribute towards the 2030 target of 30% of land and sea under effectively managed protected areas or other areas well-managed for nature.

> *"Only 11% of UK land is in protected areas, and not all of these are well-managed for nature"*

INCREASING ECOSYSTEM RESTORATION:

Restoration is taking place across a wide range of ecosystems, from peatlands to urban forests to seagrass beds, with more than 5,000 hectares (ha) of degraded peatland being restored each year. Despite this, only 14% of priority habitats, 7% of woodland and 25% of peatlands are assessed to be in good condition. Large areas of the UK seafloor do not meet Good Environmental Status because of habitat disturbance from fishing. Restoration and creation of carbon-rich habitats have clear co-benefits for climate change mitigation and adaptation, as well as biodiversity, but realising these will require a step-change in the rate and scale of restoration.

> *"Only 25% of peatlands are in good condition"*

CO-ORDINATING OUR RESPONSE:

Action to restore nature is best co-ordinated with action to mitigate and adapt to the impacts of climate change because land-use scenarios suggest that wildlife is likely to benefit from maximising nature-based solutions (for example, native woodland creation and peatland restoration) in order to achieve net-zero in the land sector. However, this will need to be achieved whilst meeting people's needs for food, energy and access to nature. Access to nature supports human health and well-being but there is inequality, with people in poorer socio-economic settings having less access to wildlife-rich natural spaces.

> *"Access to nature supports human health and well-being"*

The power of volunteers

It is through the collective efforts of thousands of skilled people, most of whom are volunteers, that we can report on the state of nature. Without their enthusiasm and commitment, we could not understand the pressures on nature, or whether our efforts to address these pressures through conservation action have been effective.

UK State of Nature Report

Traditional conservation – protection & past states

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Objective	**Maintaining the diversity of life** i.e. maximising species persistence in the short term
Approach	**Reactive** Seeks to prevent or reverse biotic change
Prioritisation	**Prioritising present diversity** Prioritise conservation of most threatened species, and places currently harbouring rich and endemic biodiversity
Key actions	Protected areas, sustainable resource use, threatened species recovery, *ex situ* conservation, ecosystem restoration







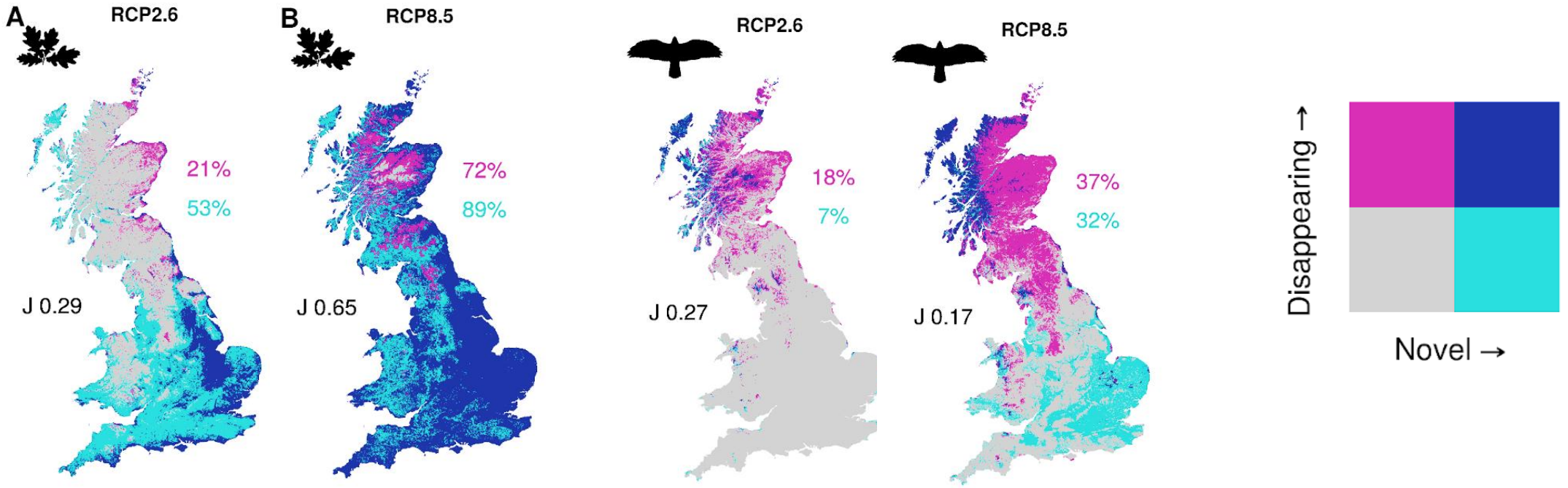
Gardner & Bullock (2021) *Frontiers in Conservation Science*

The threat from climate change

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Ecological communities will experience climates outside those which they have previously experienced – 'novel bioclimates'

And climates which they have lived in historically will be lost – 'disappearing bioclimates'

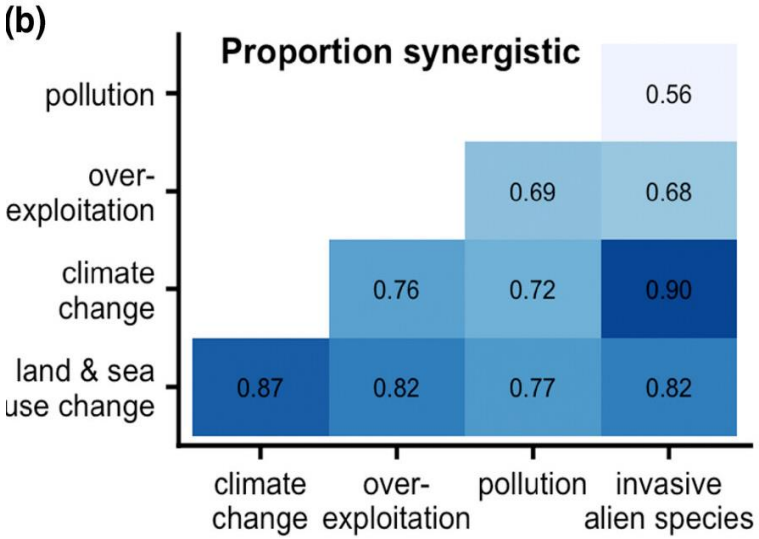


Cooke et al. (in revision)

Uncertainty about climate change impacts

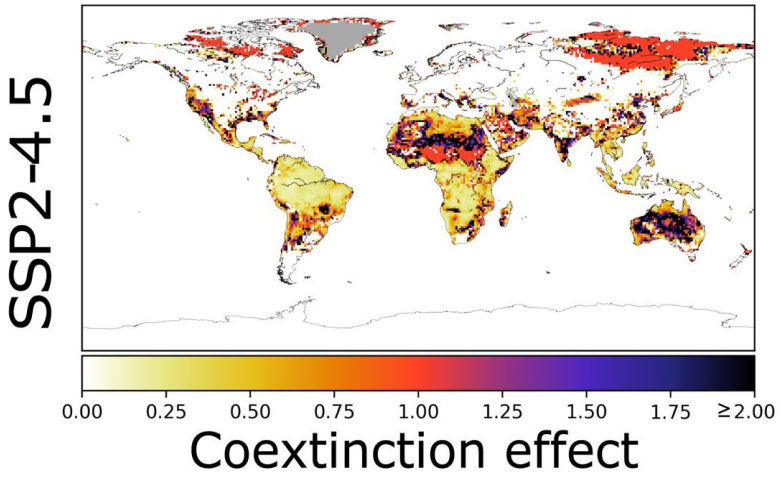
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Interactions with other drivers



Isbell et al. (2023) *FEE*

Extinction cascades



Strona & Bradshaw (2022) *Sci Adv*

Impacts of extremes





The need for conservation to adapt to uncertainty



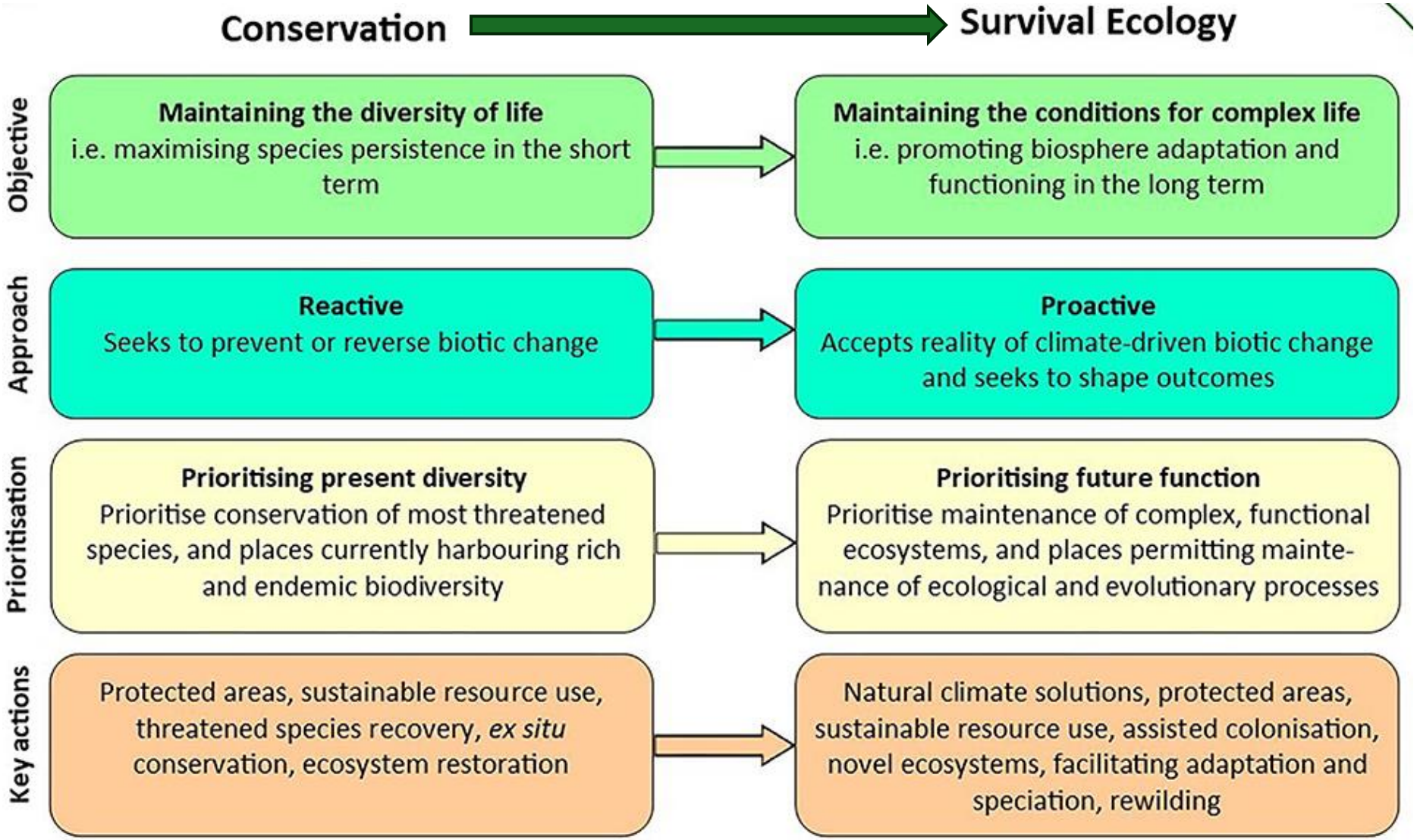
"given the accelerating and nonlinear nature of climate change impacts

... the recent past is not a reliable guide to future change

... <u>conservation must look to the future</u> if it is to successfully anticipate and mitigate biodiversity loss"

Thierry et al (2022) *Cons Lett*

Is a new paradigm needed?



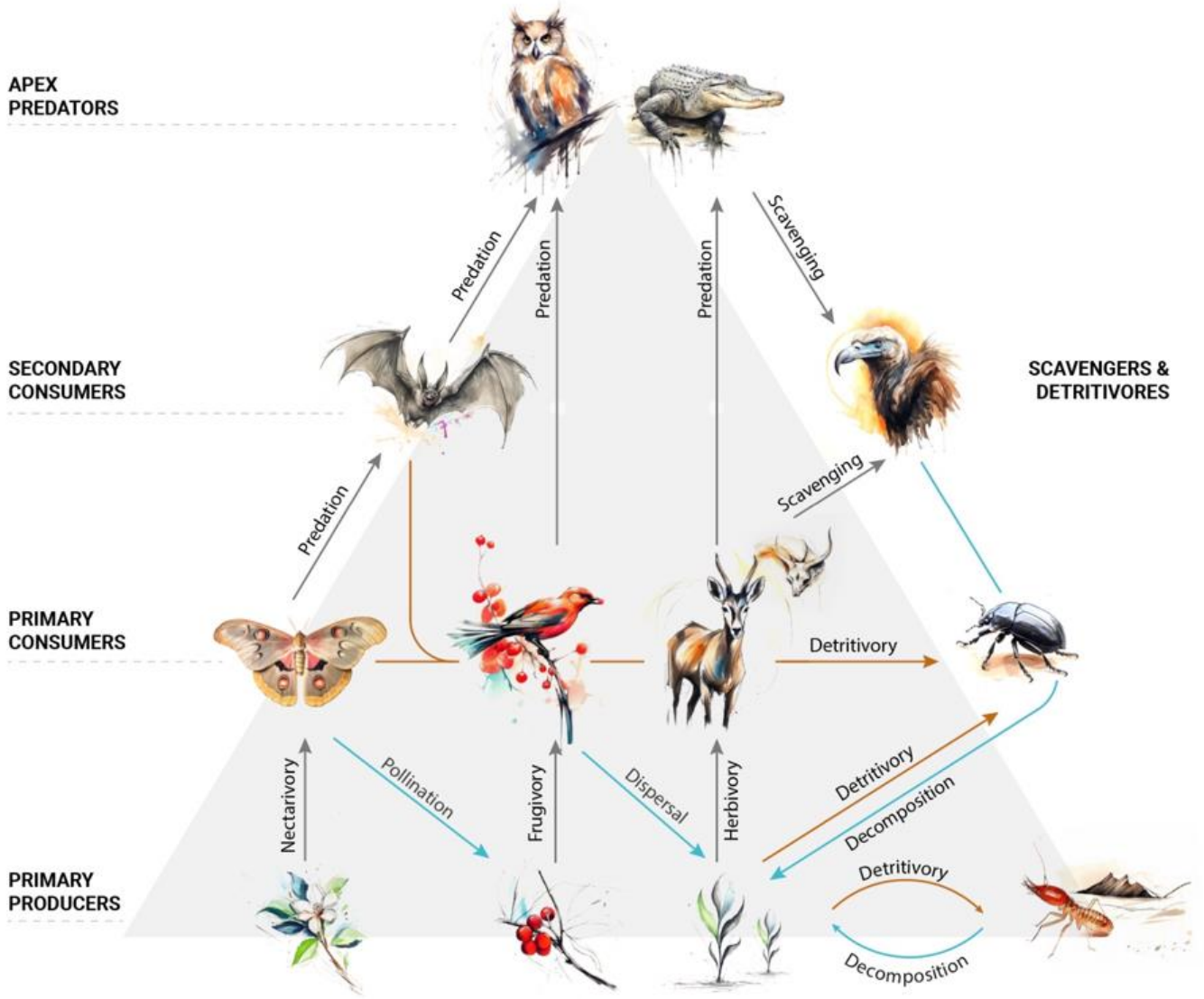
Gardner & Bullock (2021) *Frontiers in Conservation Science*

"Rather than seeking to maintain a world which will no longer exist,

Survival Ecology acknowledges unavoidable change and seeks to shape the world that will:

it looks to the future, not the past"

Process-based vs species-centric conservation



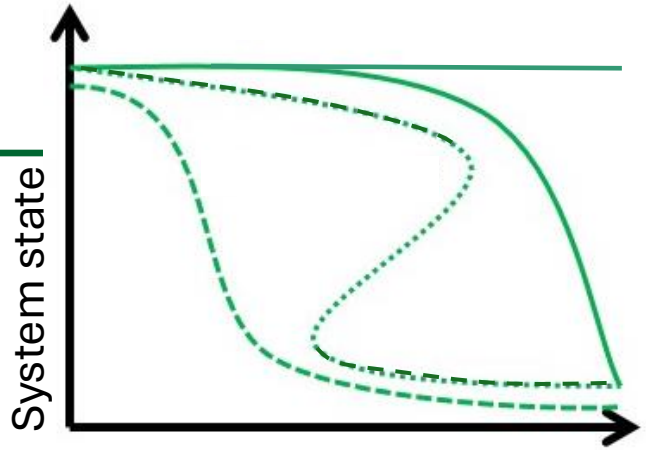
Tobias et al (2025) *PNAS*

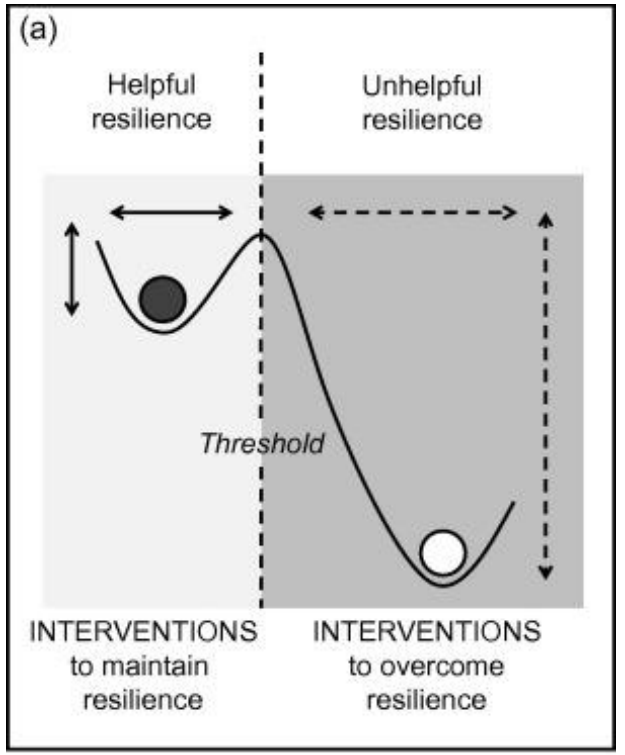
"Effective and sustainable conservation of ecosystems requires an integrated approach that extends beyond species conservation; indeed, species identity is arguably irrelevant"

(as conveyed by the AI-generated exemplars in this diagram)

Unpacking resilience

- Unhelpful (undesirable) resilience
  - Resilience properties that lock a system in an unfavourable state or trajectory, preventing transformation towards a more favourable state
  - e.g., management to maintain/restore a species assemblage that will likely fail under ongoing environmental change, leading to collapse
- Turnover as a form of resilience
  - Stability of species composition or of ecosystem functions?
  - Turnover in species communities might be the very thing that allows resilient functions
  - "*Resilience is not driven by the identity of elements of a system, but rather by the functions those elements provide*" (Allen et al, 2005)
- Resilience: of what, to what, for what?





Oliver et al (2015) *TREE*
Chapin et al (2018) *Global Sust*
Maes et al (2024) *J. Appl. Ecol*

Ecological complexity for functioning & resilience

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A pragmatic approach to complexity

"*the number of components in a system and the number of connections among them*"

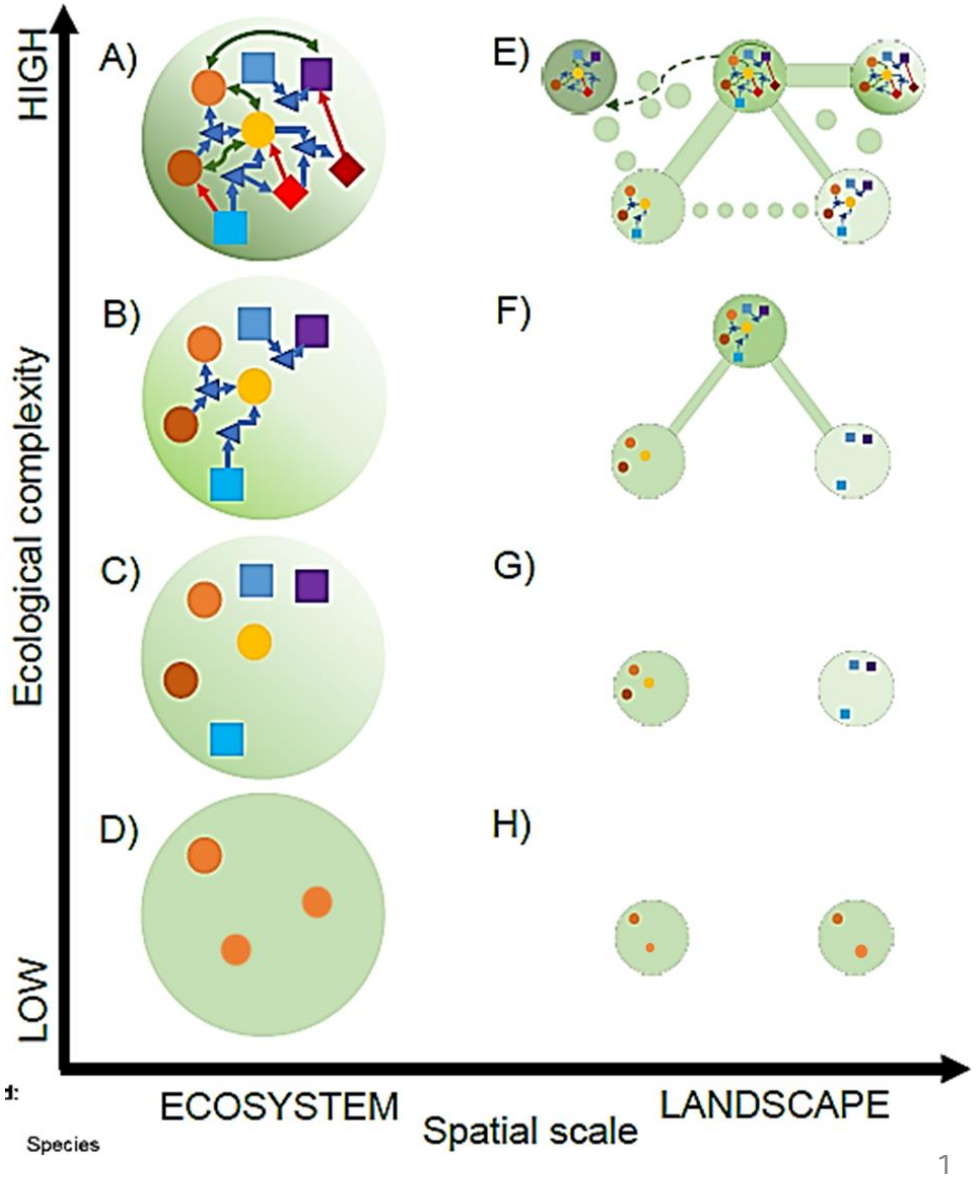
Linked to functioning & resilience

Components include species, height classes, functional groups, habitats

Connections include types of species interactions, energy flows among species, connectivity among habitat patches

Bullock et al (2022) ***Ecography***

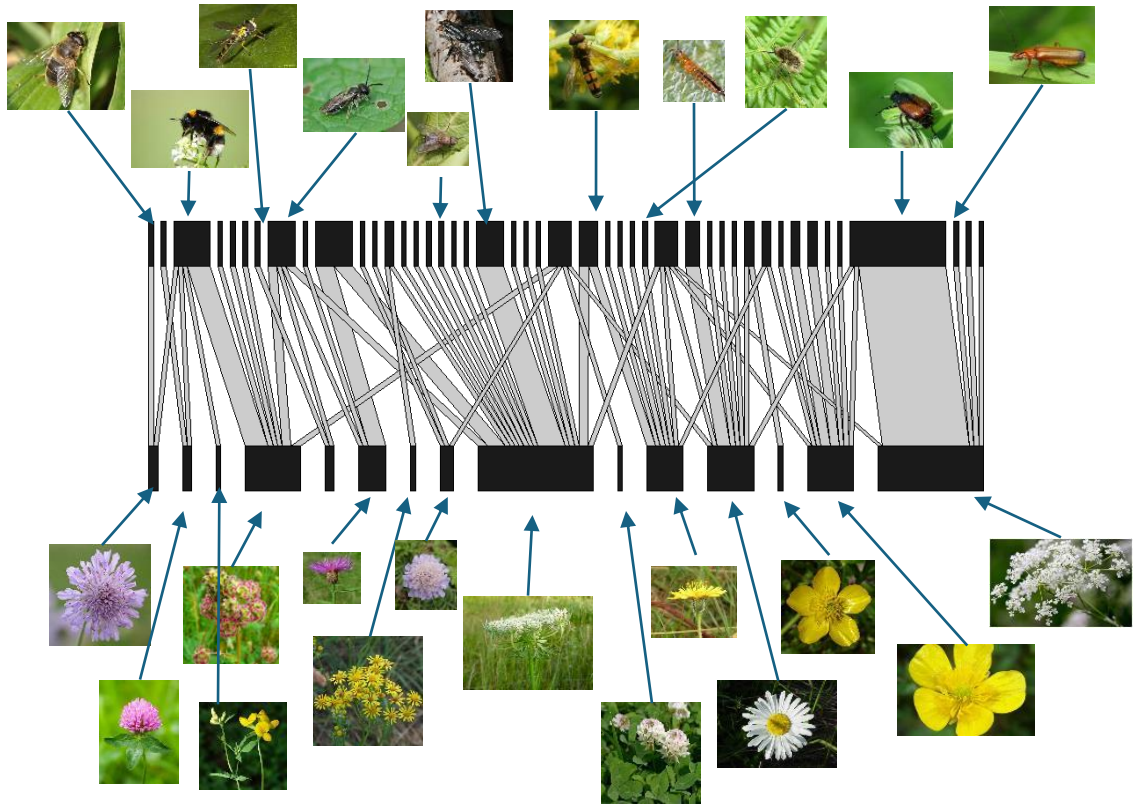




Actions:
Restoring for complexity rather than target communities

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"the number of components in a system and the number of connections among them"



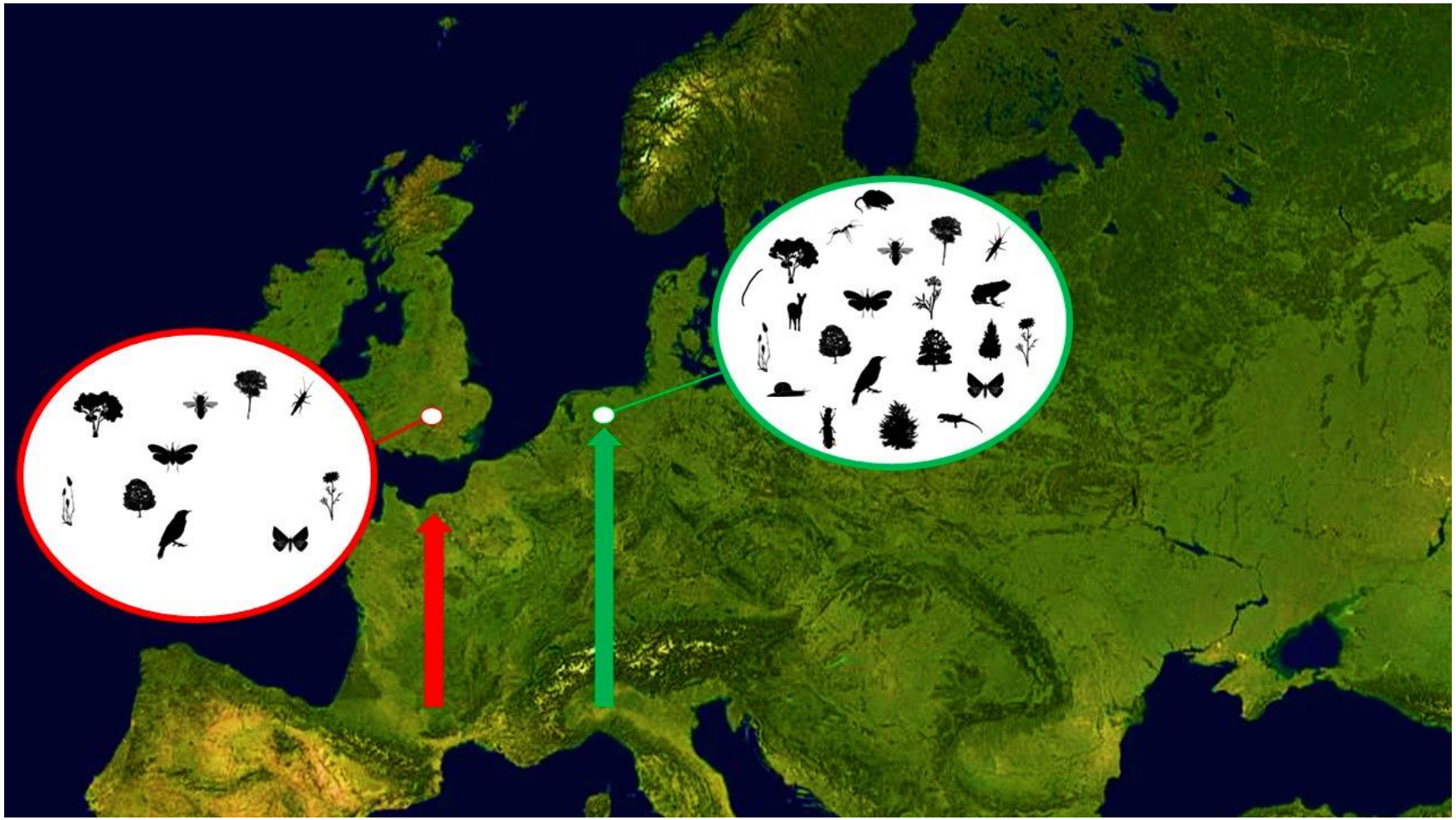
Restoring	Measuring
Time	Species/trait richness
Interventionist to natural processes	Architecture/ physical structures
Diversity of initiation approaches	Food/interaction webs
Targeting complexity – variety not references	Niche/habitat diversity
Adaptive	Soil microbial diversity
Large scale	Soundscapes

Bullock et al (2022) *Ecography*

Actions:
Assisted colonisation

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- Currently focussed on saving individual species from climate change
- But should we take a functional approach: key species, whole ecosystems?



Potential future composition of forest communities. In the absence of assisted colonisation, communities in British forests will become impoverished compared with those on mainland Europe because the Channel will prevent range expansion for species with limited dispersal abilities

Gardner & Bullock (2025) *J Applied Ecology*

Actions:
Novel ecosystems

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- A system of abiotic, biotic and social components that, because of human influence, differ from those that prevailed historically

- Should we deliberately produce novel ecosystems, which may function better, & be more resilient than historical ones in a changing world?



Harris et al. 2024. *The Niche* (BES).



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What is the point of conservation?

- To recover what we have lost?
- Or to build a resilient future?

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