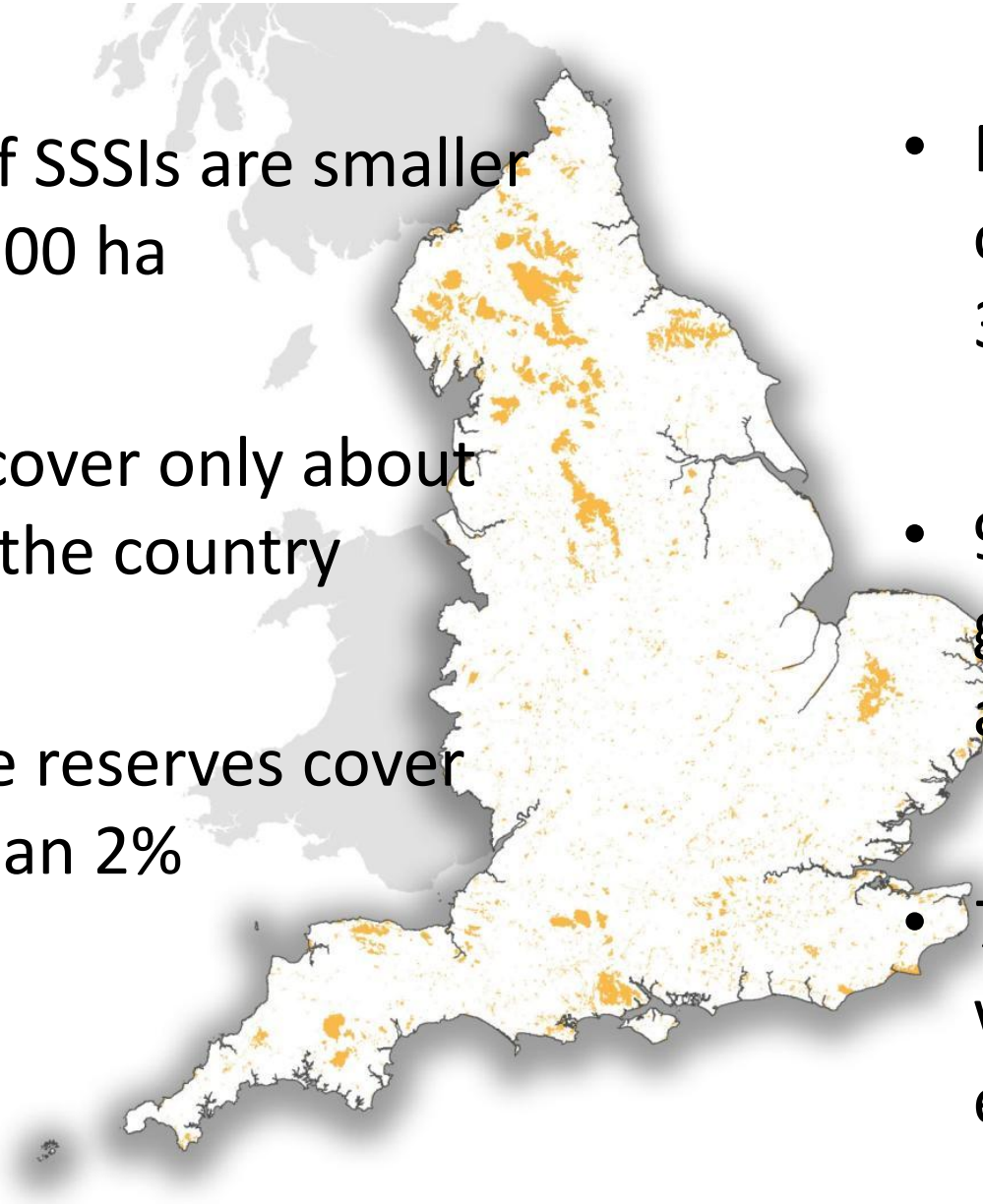
Beyond the fragments: from sites to ecological networks

Nicholas Macgregor
Natural England

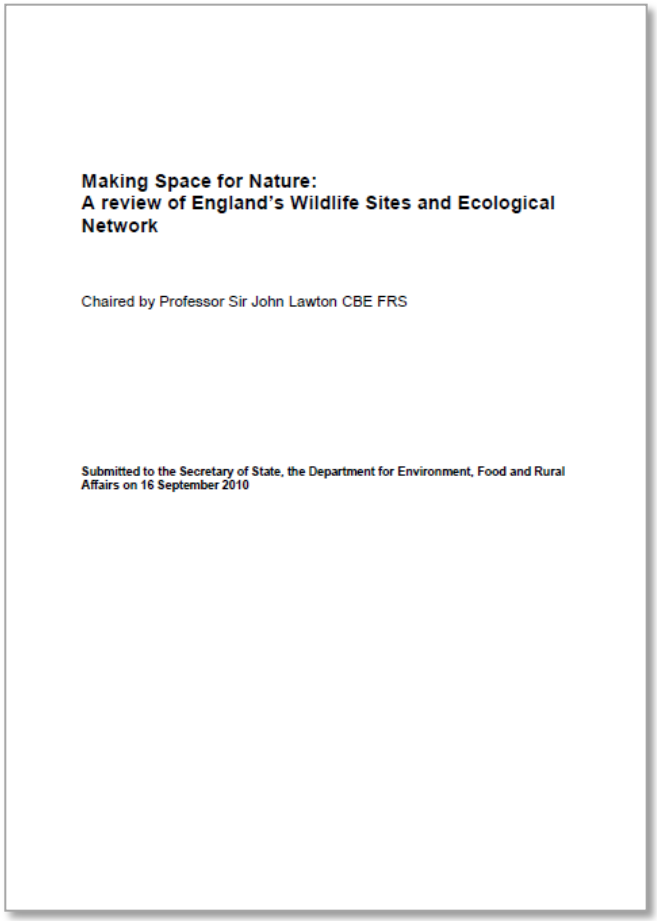

Steve Pullan, Natural England



- 77% of SSSIs are smaller than 100 ha
- SSSIs cover only about 7% of the country
- Nature reserves cover less than 2%
- Median patch size of reedbeds is 3.3ha
- 90% of calcareous grassland patches are under 15ha
- 74% of forest is within 100m of an edge

England's protected areas
"…clearly [do] not … comprise a coherent and resilient ecological network"

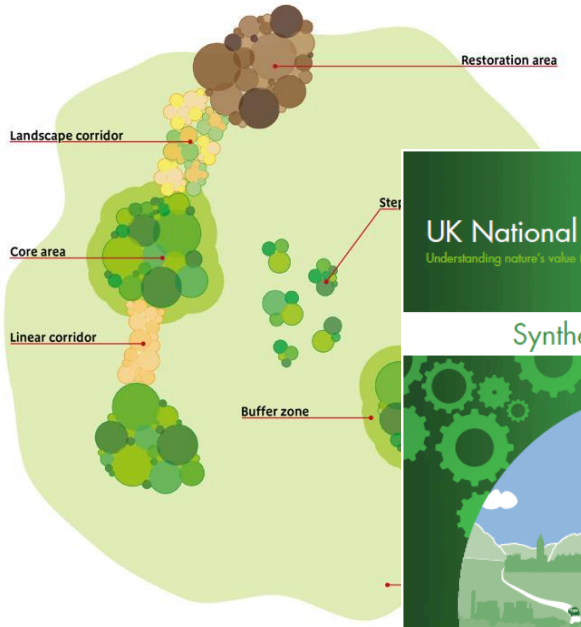
(Lawton et al. 2010)



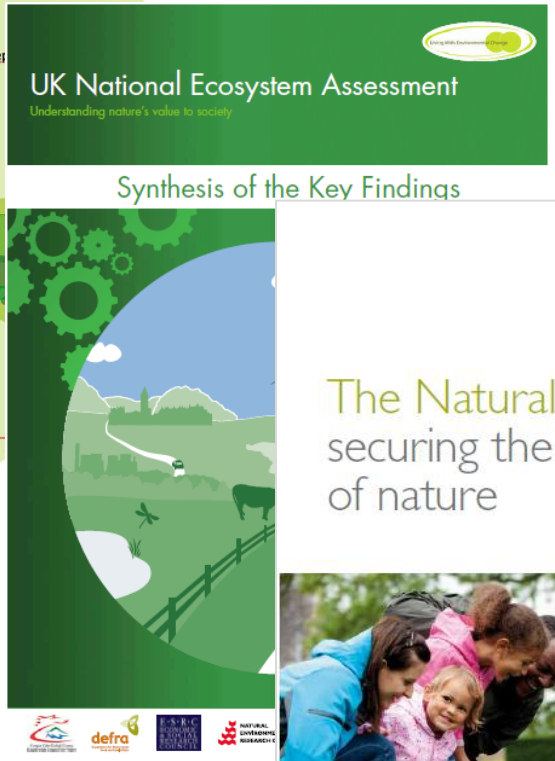
Making Space for Nature:
A review of England's Wildlife Sites and Ecological Network

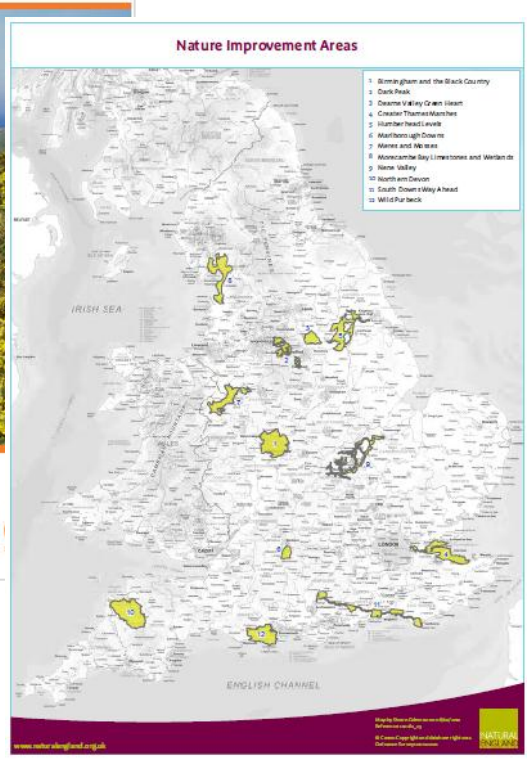
Chaired by Professor Sir John Lawton CBE FRS

Submitted to the Secretary of State, the Department for Environment, Food and Rural Affairs on 16 September 2010



"We want to create a resilient and coherent ecological network at national and local levels across England…





… Achieving this will require a fundamental shift in approaches to conservation and land management."

(White Paper)

An international issue

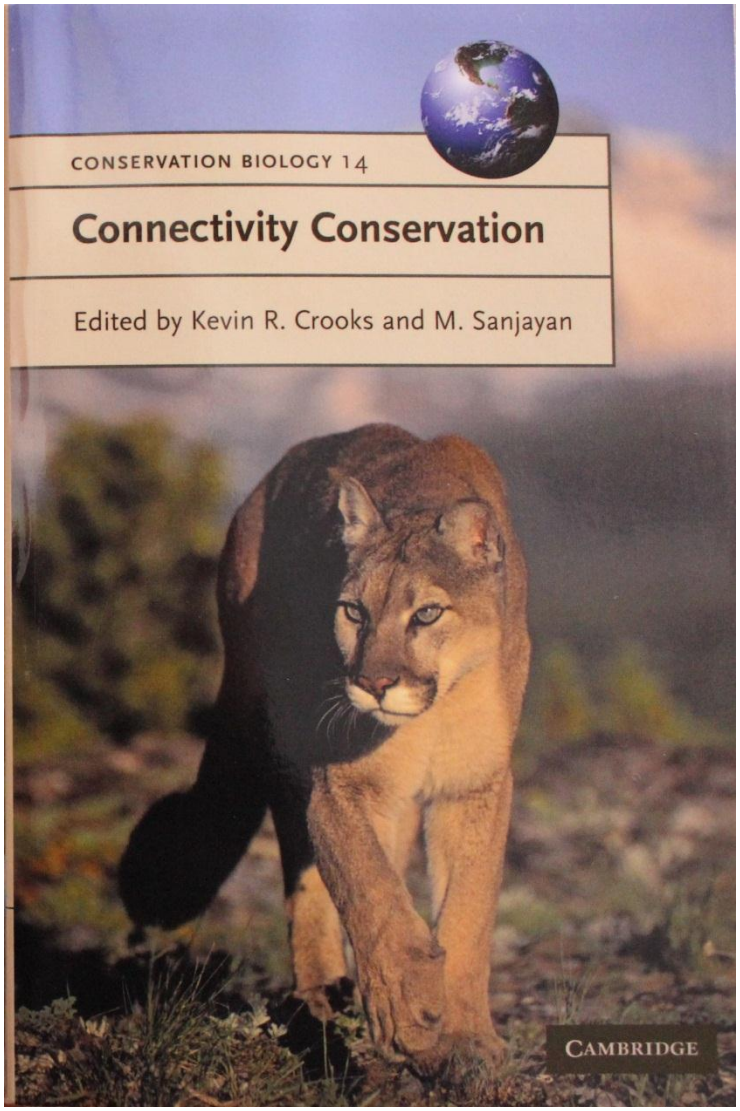
- Aichi target 11:

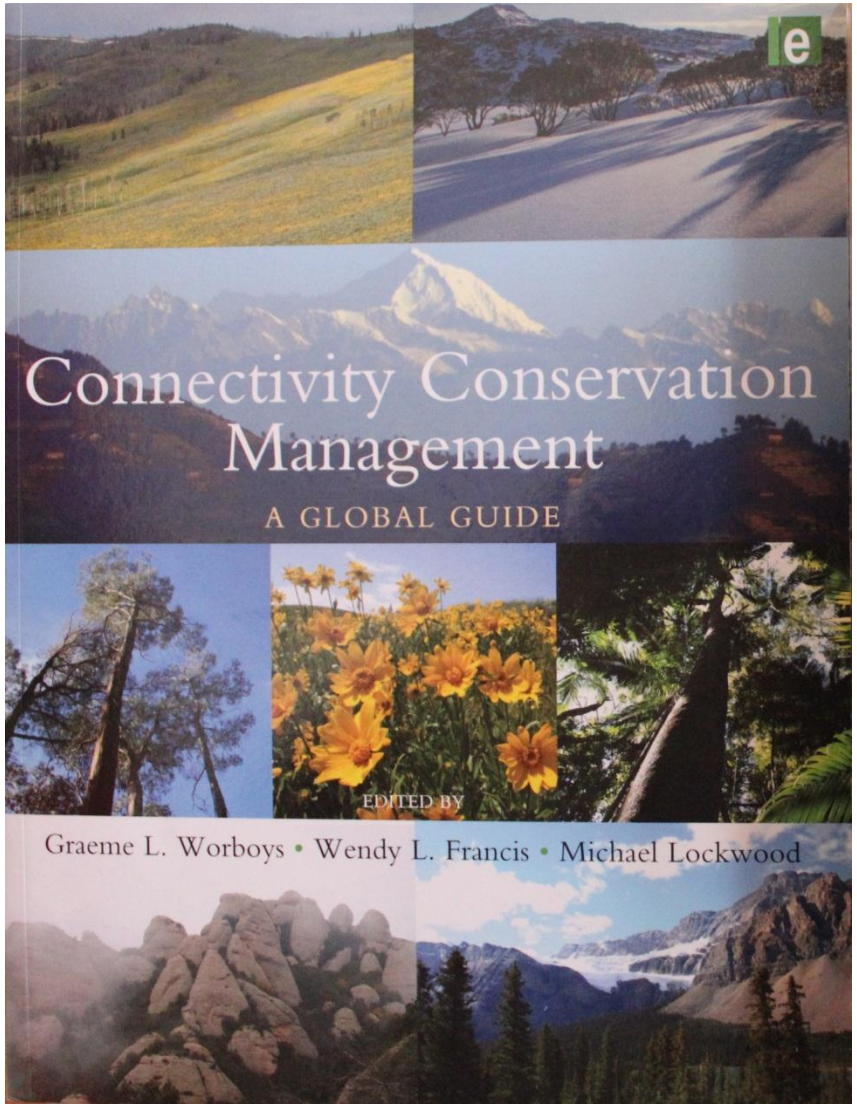
"By 2020, at least 17% of terrestrial and inland waters and 10% of coastal and marine areas…, especially areas of particular importance for biodiversity and ecosystem services, are conserved through … **well-connected systems** of protected areas and other effective area-based conservation measures, and **integrated into the wider landscapes and seascapes**"

IUCN
WORLD PARKS CONGRESS
SYDNEY 2014

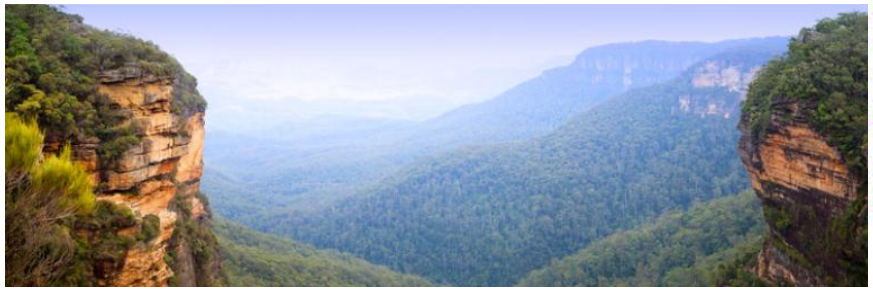
- “Protected areas… need to be embedded into **integrated conservation systems**, and **large-scale connectivity and ecological restoration** mainstreamed into landscape and seascape planning.”

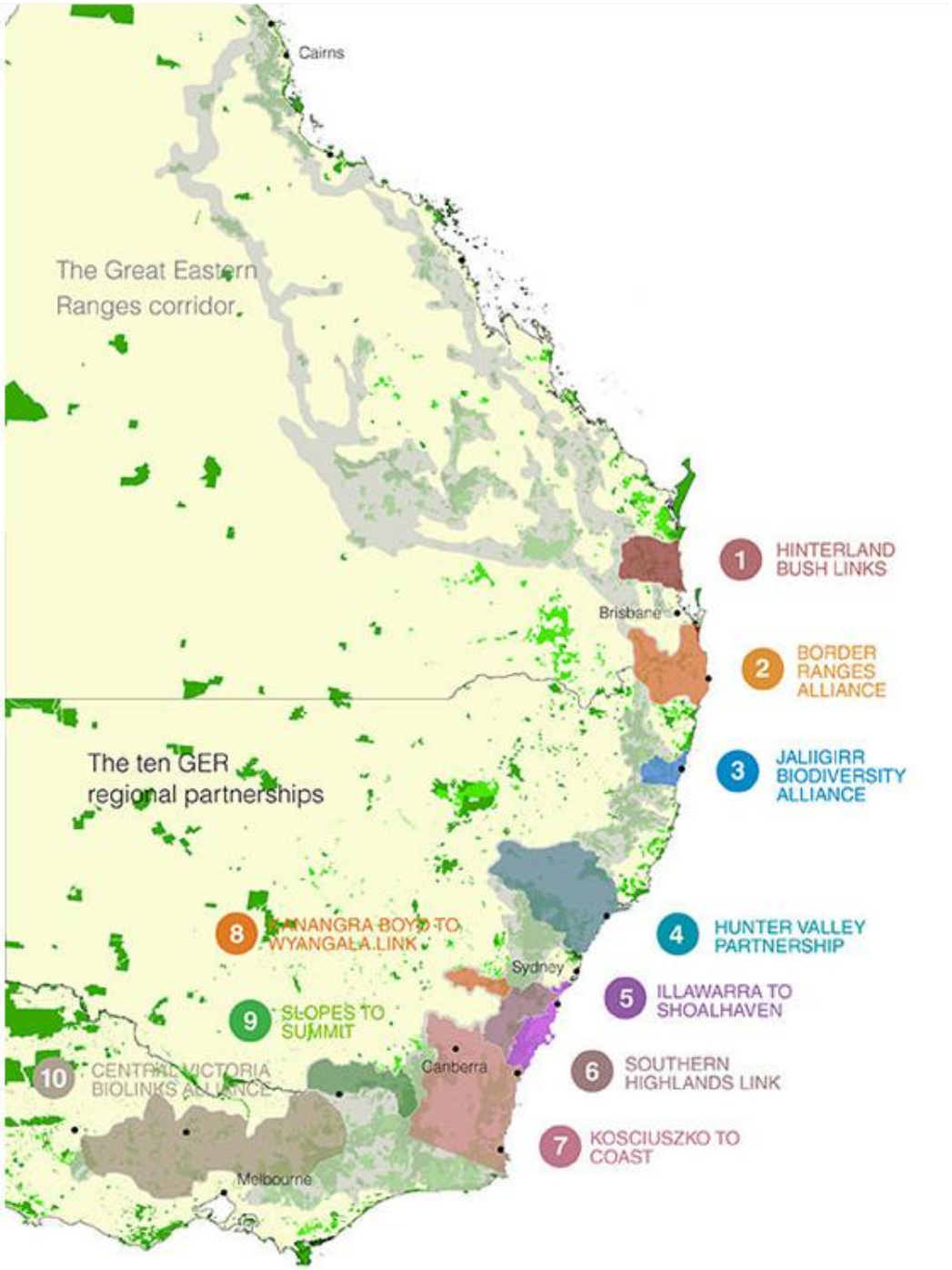
'Connectivity conservation'





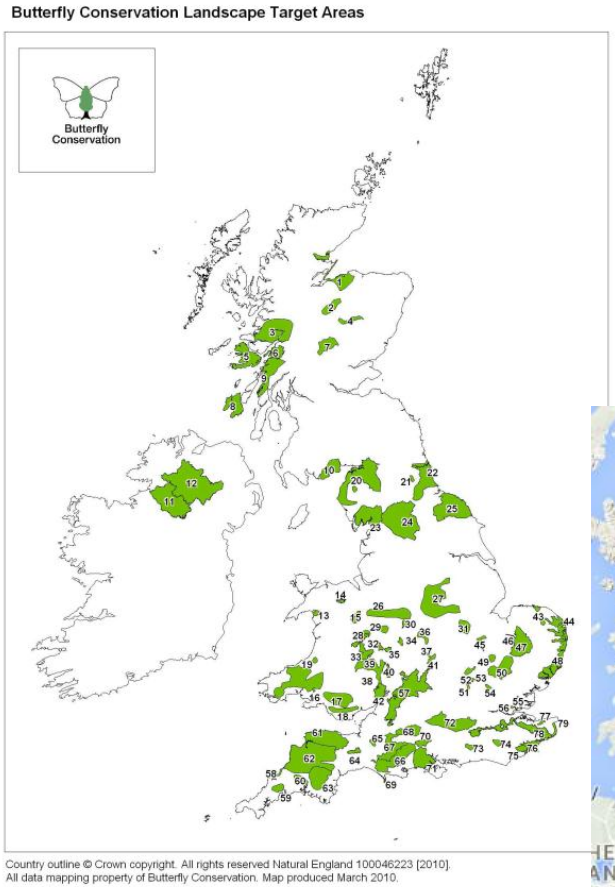
Great Eastern Ranges, Australia





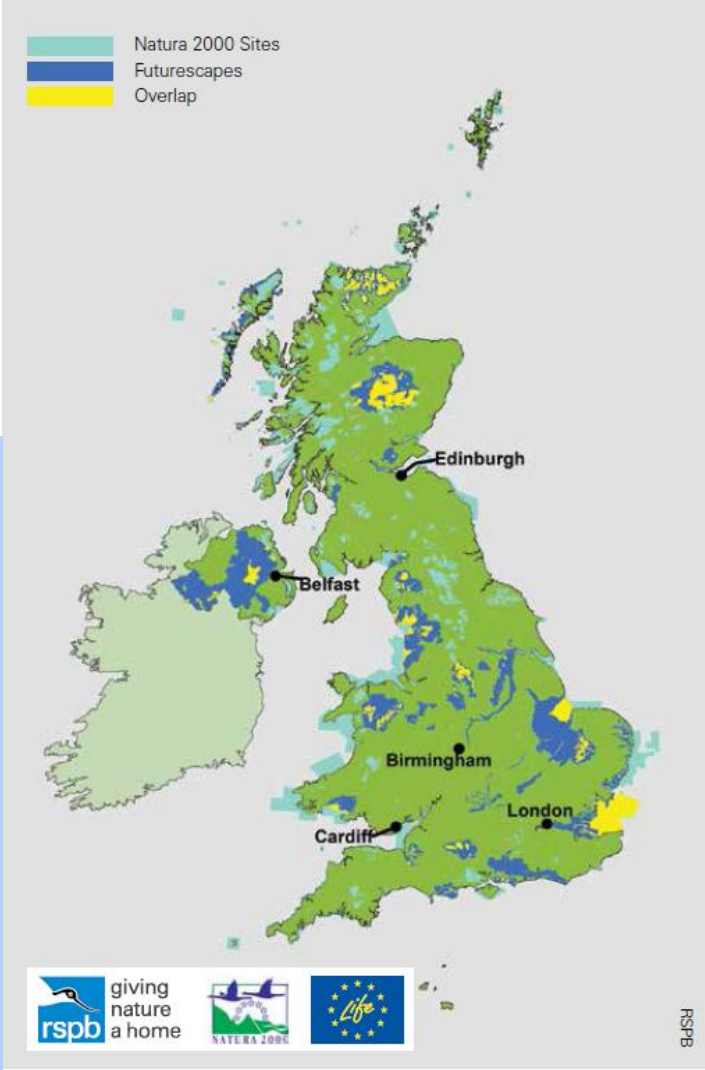
European Green Belt

europeangreenbelt.org



Butterfly Conservation landscape target areas

Wildlife Trust Living Landscapes



RSPB Futurescapes

Connectivity

- "Connectivity is inherently about the degree of movement of organisms or processes – the more movement, the more connectivity"
  (Crooks and Sanjayan 2006)

  - **Species**
  - Ecosystem processes (water, nutrients, energy)
  - (People)

Designing connected landscapes and ecological networks

- Networks (especially under climate change) need to support both:
  - Persistence of species in sites
  - movement across the landscape between sites

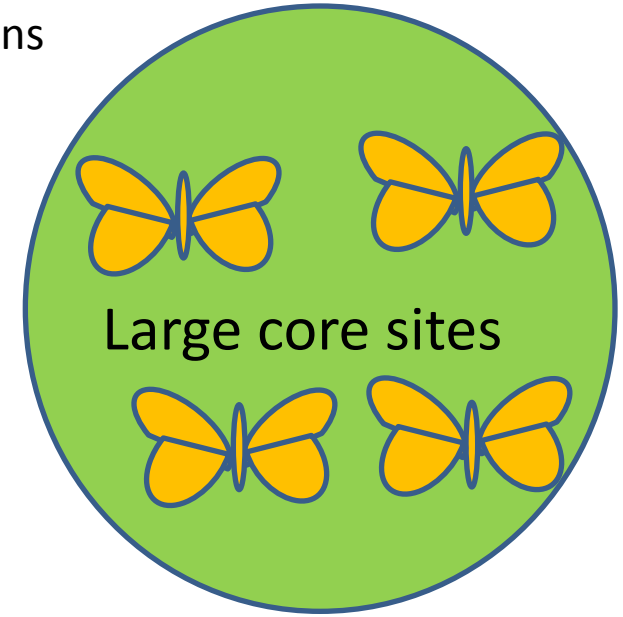
- Multiple scales
- Microclimate and refugia
- Species’ habitat requirements

1. Networks need to be planned and implemented at multiple scales

Source populations for dispersal

Places for dispersers to colonise

Large populations



Greater variety of land cover/resources – greater species diversity

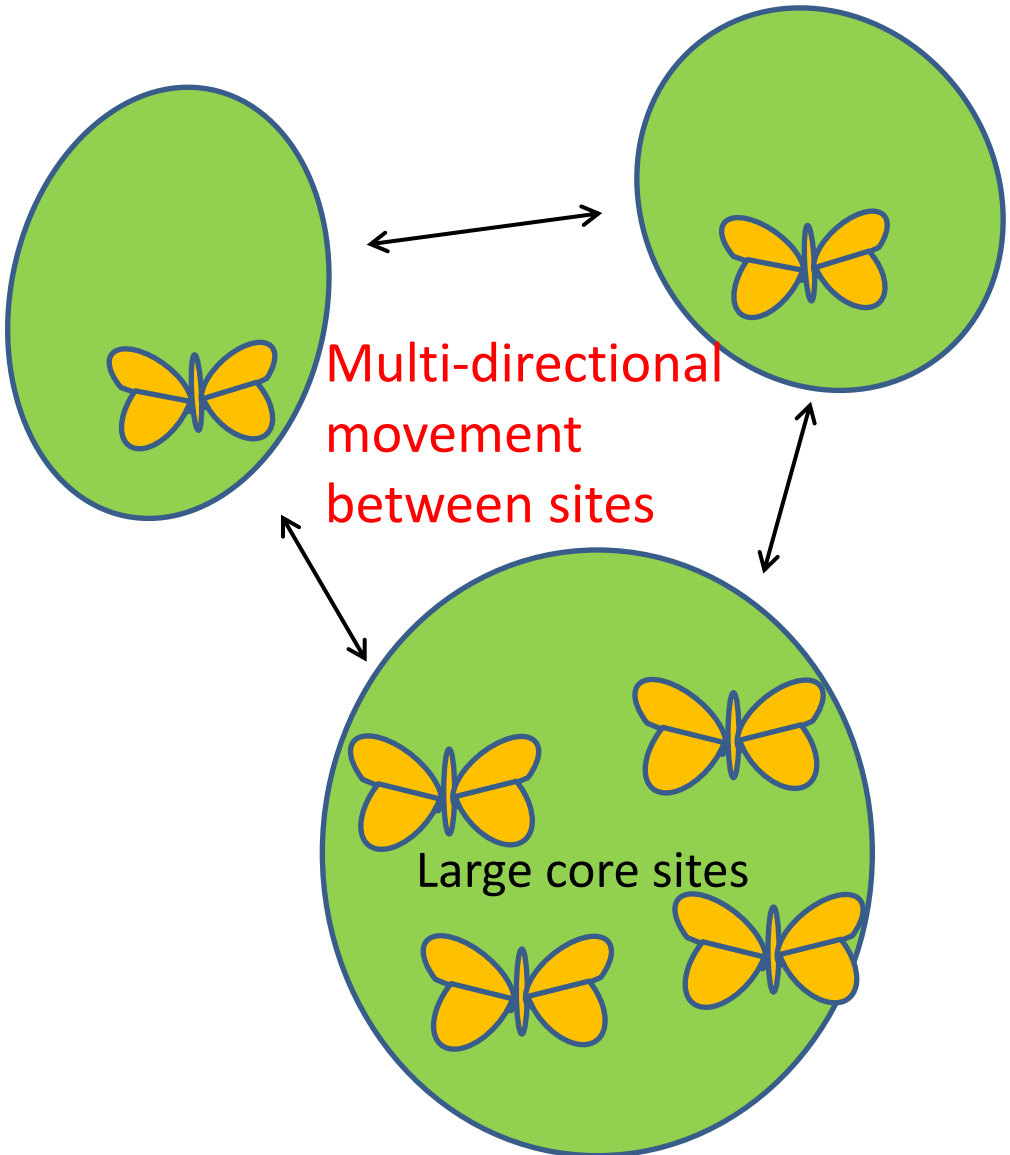
Better places for people?

Greater range of microclimates and reduced edge effects – more resilience

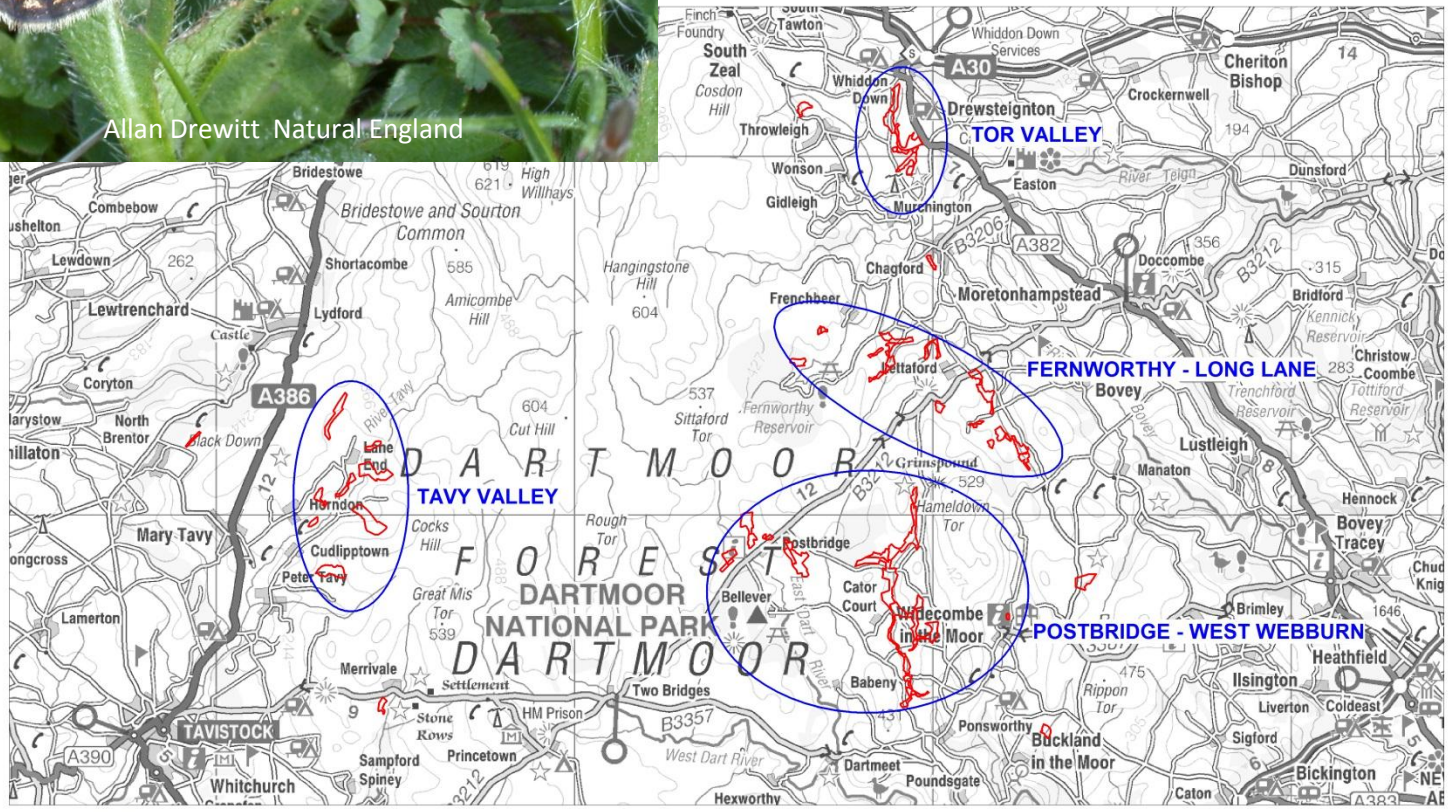
Some species need big areas

Better functioning of ecosystem processes

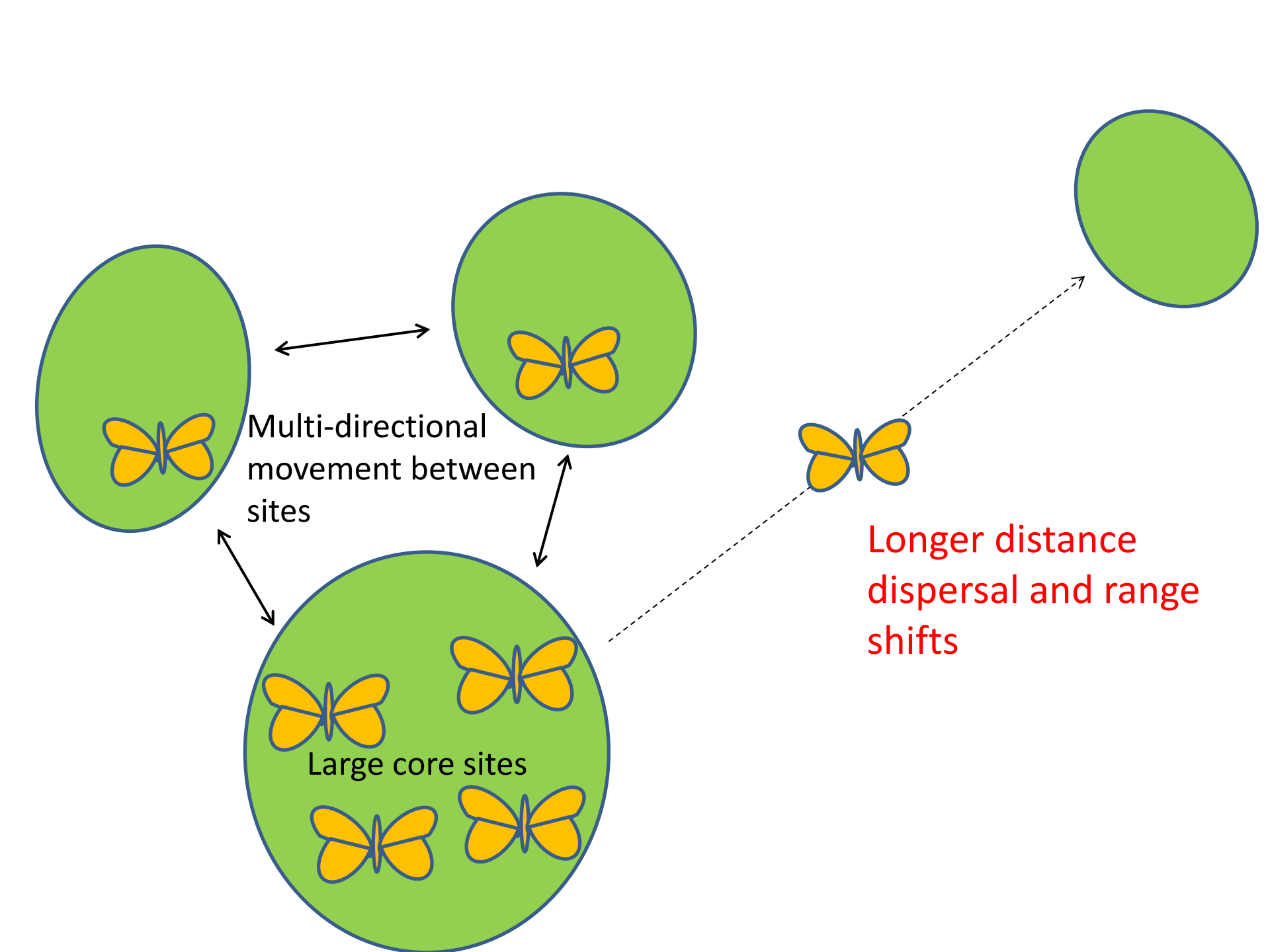
Some ecosystem services need large areas


Multi-directional
movement
between sites
Large core sites

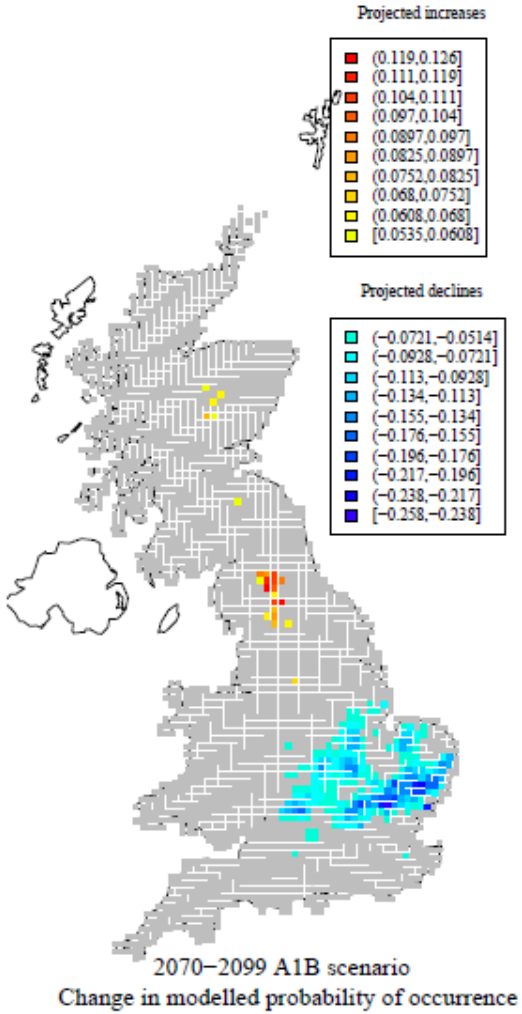
Butterfly Conservation
Saving butterflies, moths and our environment



Climate change–induced extreme events make damage to habitat and local extinction more likely


Multi-directional movement between sites
Large core sites
Longer distance dispersal and range shifts

Major shifts in climate space likely for some species



2070−2099 A1B scenario
Change in modelled probability of occurrence

Growing evidence that protected areas are important for enabling colonisation and range shifts

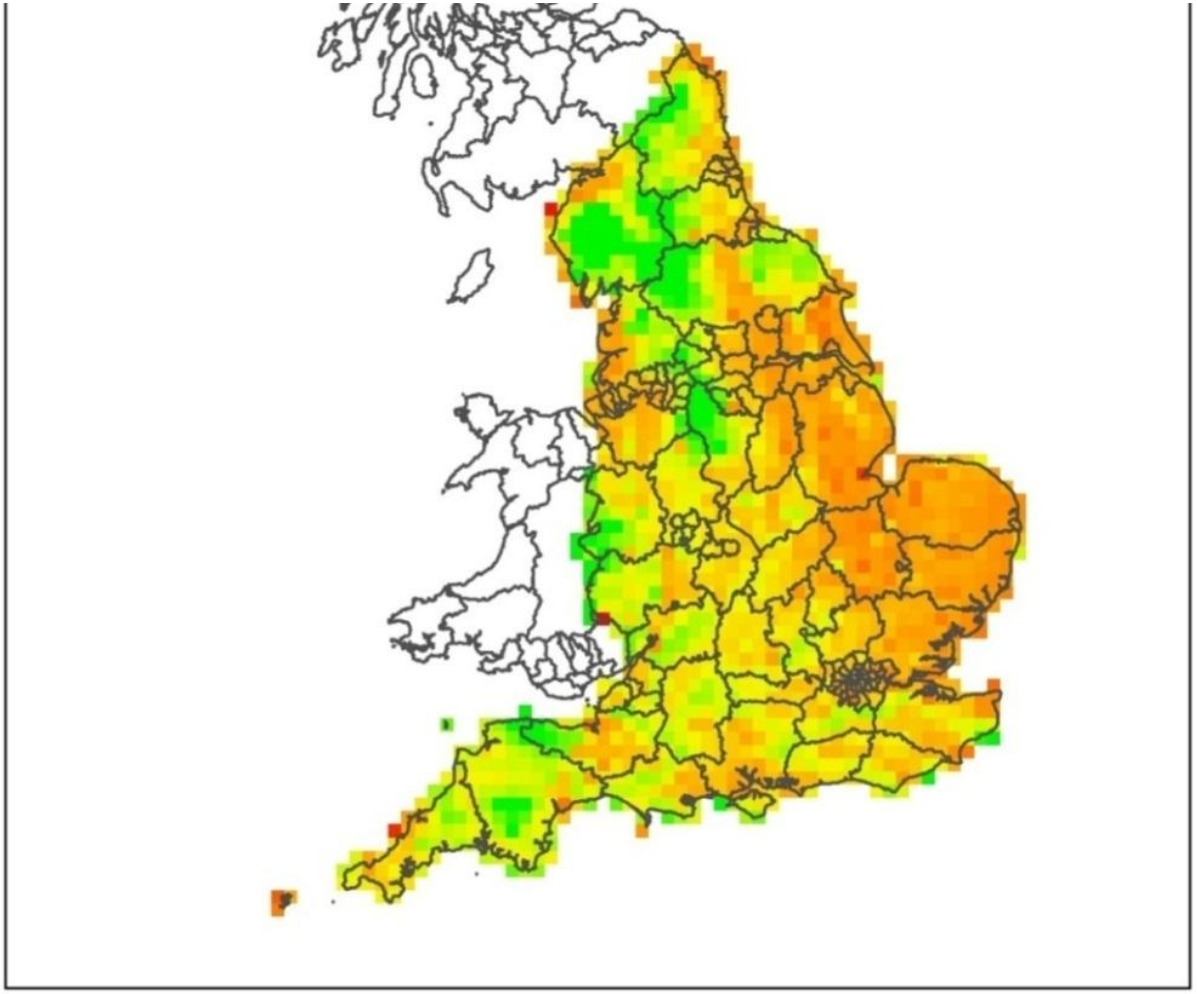
Thomas et al. 2012; Lawson et al. 2013; Hiley et al. 2013; Gillingham et al. 2014

2. Planning of networks should also consider microclimate and potential refugia

Refugium potential across England at 10km resolution

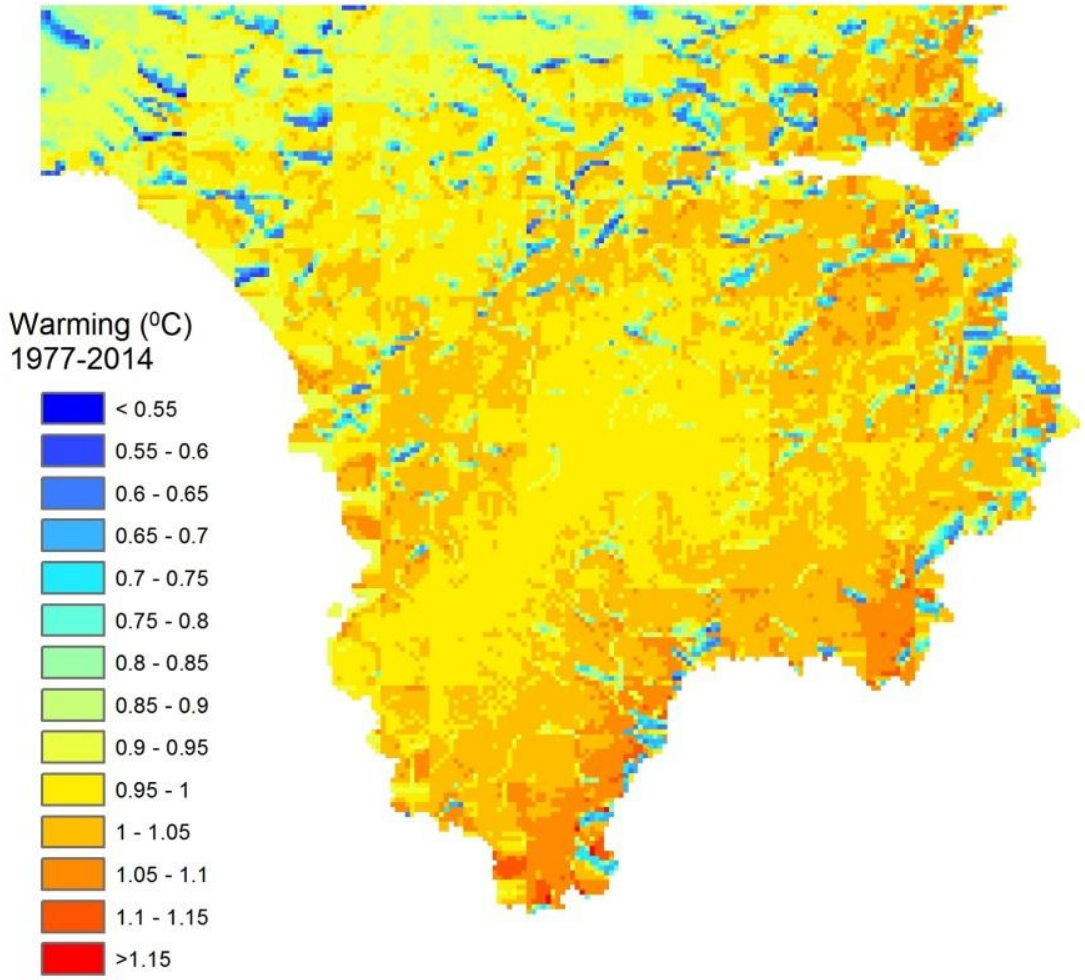
High refugium Potential

Low refugium potential



Suggitt et al. (2014)

Fine-scale differences in warming on the Lizard Peninsula

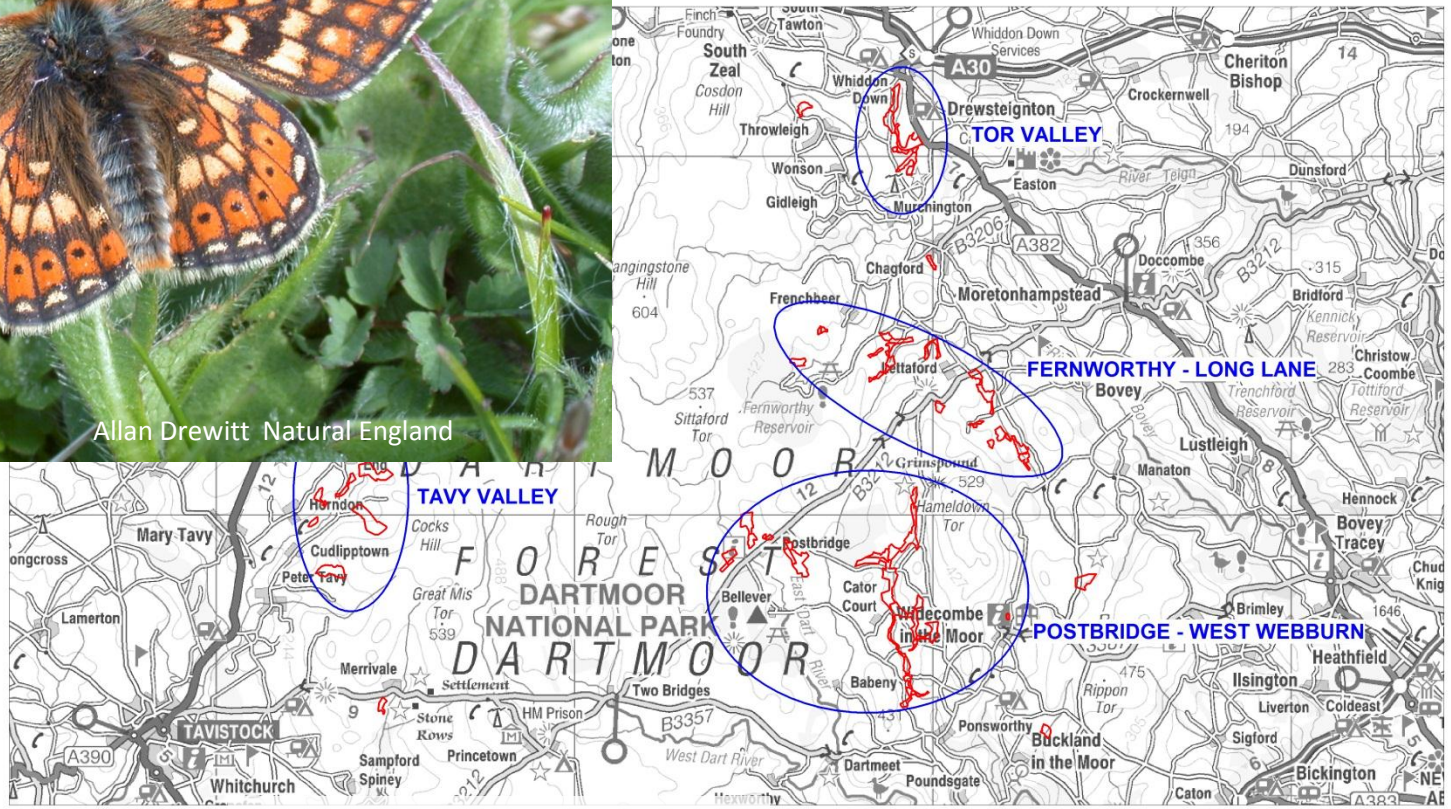


University of Exeter/Natural England new data

3. Network design should be based on species' habitat requirements

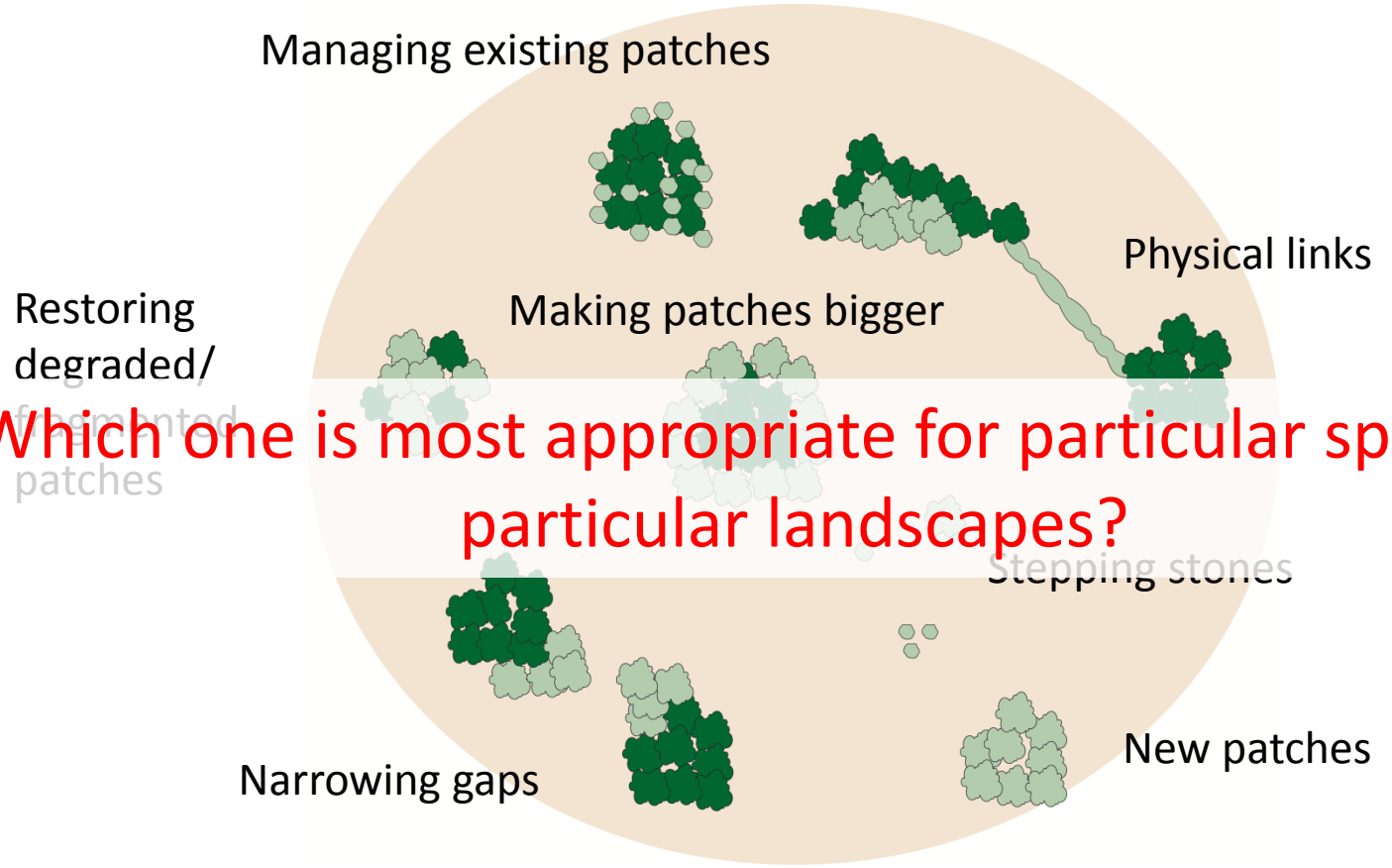
E.g. marsh fritillary needs habitat over 5-9% of landscape

Allan Drewitt Natural England



Butterfly Conservation/Ordnance Survey

Lots of different management options could be appropriate to promote functional connectivity



What do we know so far?

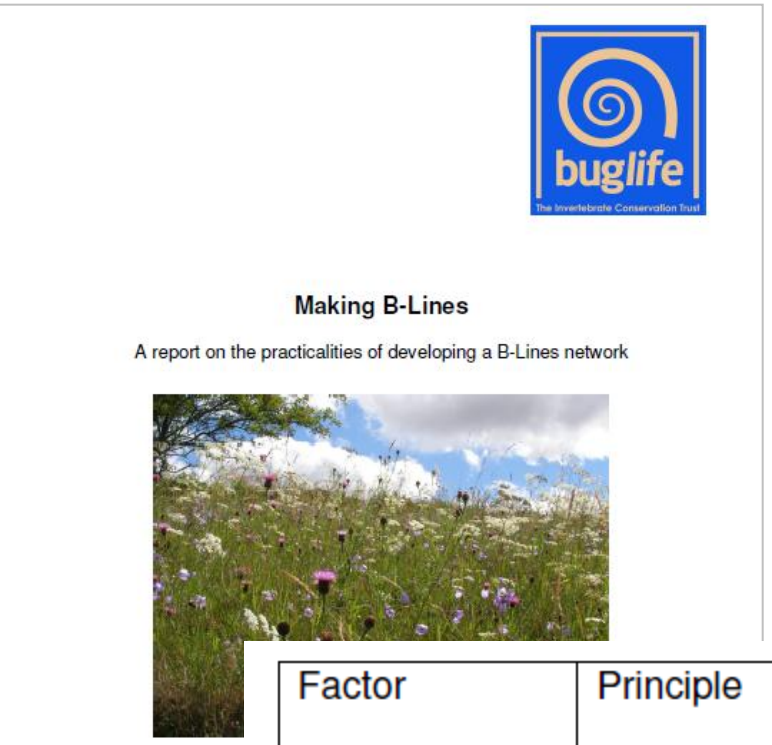
- The picture is incomplete but gradually coming together…

Review of literature on connectivity and metapopulations, to inform agri-environment schemes (Skirvin et al. 2013)

- Priority:
  1. Increase patch quality (availability of resources within a patch)
  2. Increase patch size
  3. Increase links between patches

- "However, increasing any of these three will always be beneficial to (meta)population persistence"

B-Lines rules of thumb (Evans 2012)



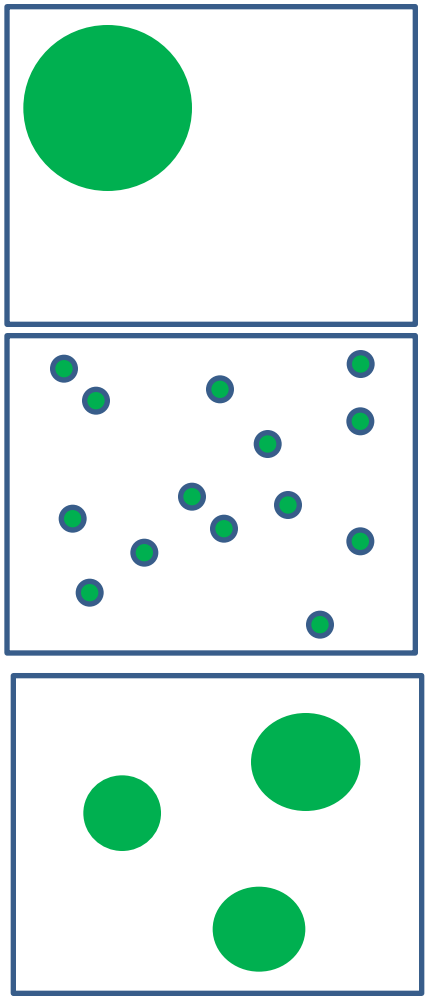
Factor	Principle	Guidelines for wide range of pollinator species
Habitat patch size and quality	Local population persistence	> 2ha habitat patches where possible, smaller if high quality
Landscape-wide habitat availability	Medium-term viability of populations and dispersal success	At least 10% habitat within each 3km stretch of the 3km wide B-Line
Long-distance route design	Populations that can respond to environment change and re-colonise following disasters	B-Line routes should connect up major "hotspots" of biodiversity (e.g. but not exclusively large SSSI, National Parks, NIA etc). Aiming for no absolute gaps in the route of > 0.5-1km

Evans 2012

SCALES project (Kunin et al.)

Modelling how different landscape configurations affect different aspects of biodiversity

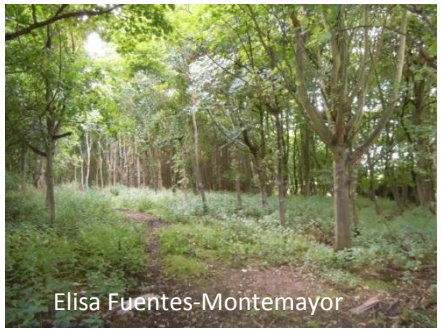
- More contiguous big blocks favour genetic heterozygosity and population viability
- More diffuse reserve networks favour community diversity and ecosystem service provision
- Intermediate strategies are fairly good across multiple criteria, and may make good compromise solutions.



Report on woodland birds (Fuller et al. 2014)

- There are six structures of woodland that together will support high abundance or high occurrence of most woodland bird species

- Make sure they are all included in a landscape



Current research by Natural England and partners

UNIVERSITY OF STIRLING

NATURAL ENGLAND

NATURAL ENGLAND

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

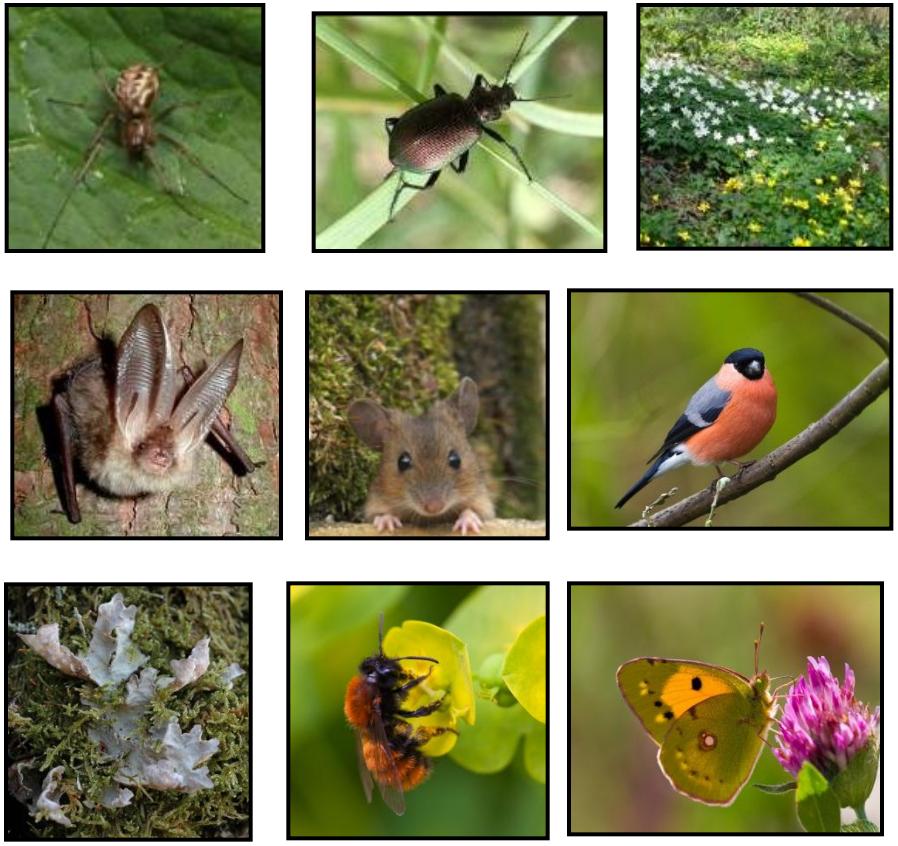
Forest Research

THE NATIONAL FOREST

Scottish Natural Heritage
All of nature for all of Scotland

Department for Environment Food & Rural Affairs

How do:



Photos: E. Fuentes-Montemayor; Natural England

Respond to…

Patch age, size, shape, vegetation structure?

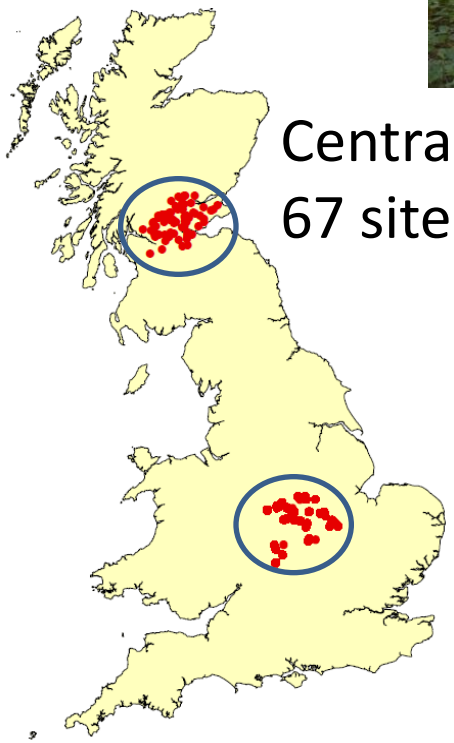
Distance to other patches?

Corridors and stepping stones?

Amount of surrounding vegetation?

Macgregor et al. (2014) ECOS

Woodland Creation & Ecological Networks

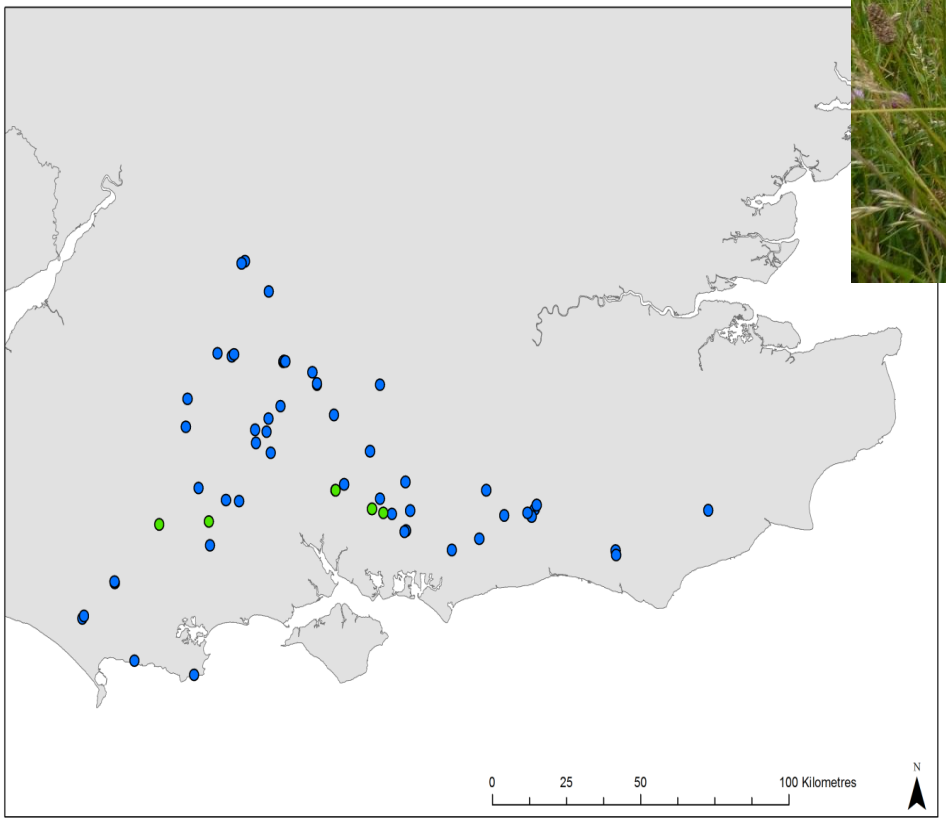


Central Scotland:
67 sites

Central England:
40 sites

- Ground invertebrates
- Trees/woodland features
- Ground flora
- Bats
- Birds
- Small terrestrial mammals
- Lichens and bryophytes

- 52 arable reversion sites (+ 5 NNRs for comparison) in southern England



- Wide range of invertebrates surveyed

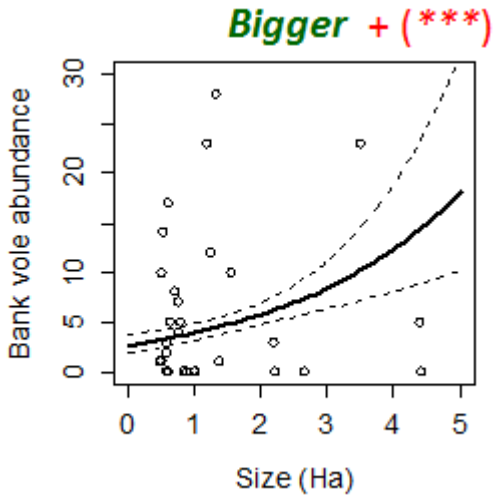
Woodland Creation & Ecological Networks

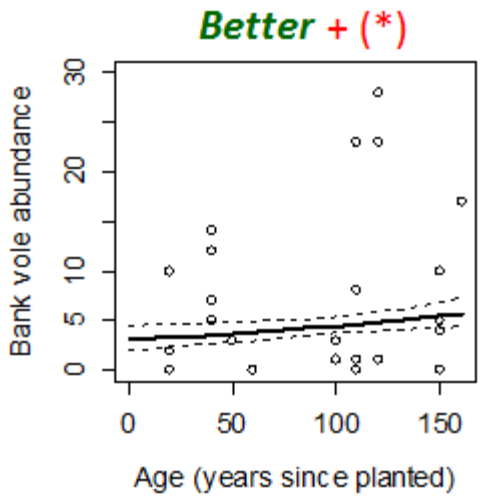
Woodland species literature review

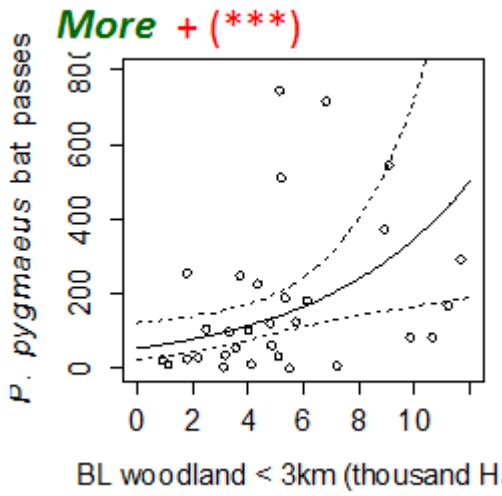
	Lichens, bryophytes, fungi	Vascular plants	Inverts	Vertebrates
Patch characteristics	+++	++	++	++
Patch area				++
Proximity to other sites		++		
Site age		+		
Amount of surrounding woodland			++	
Matrix				++

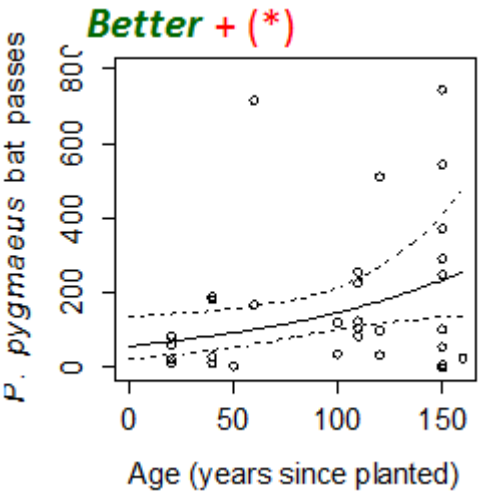
Some very early field results

2013 data only
(Central Scotland)



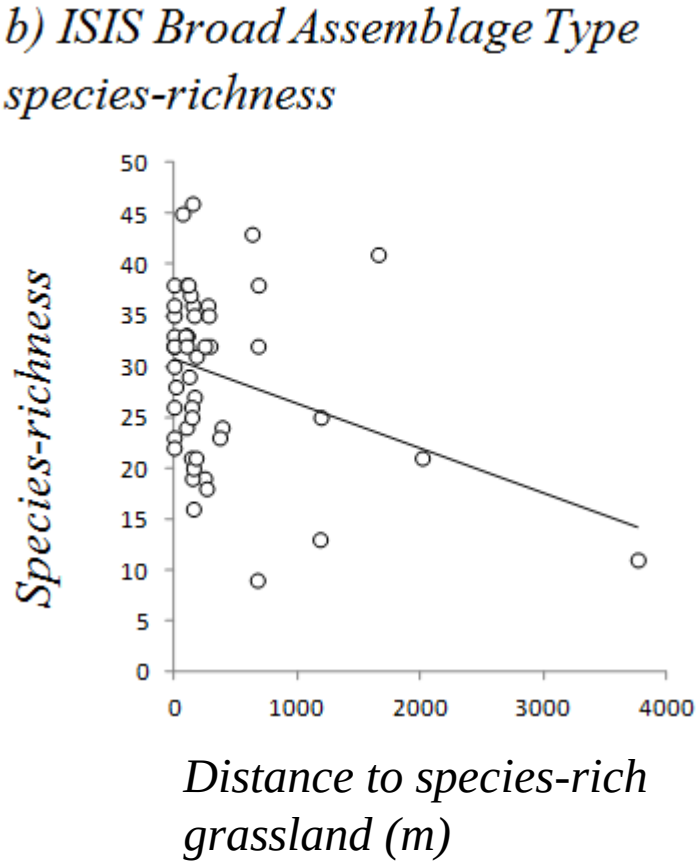






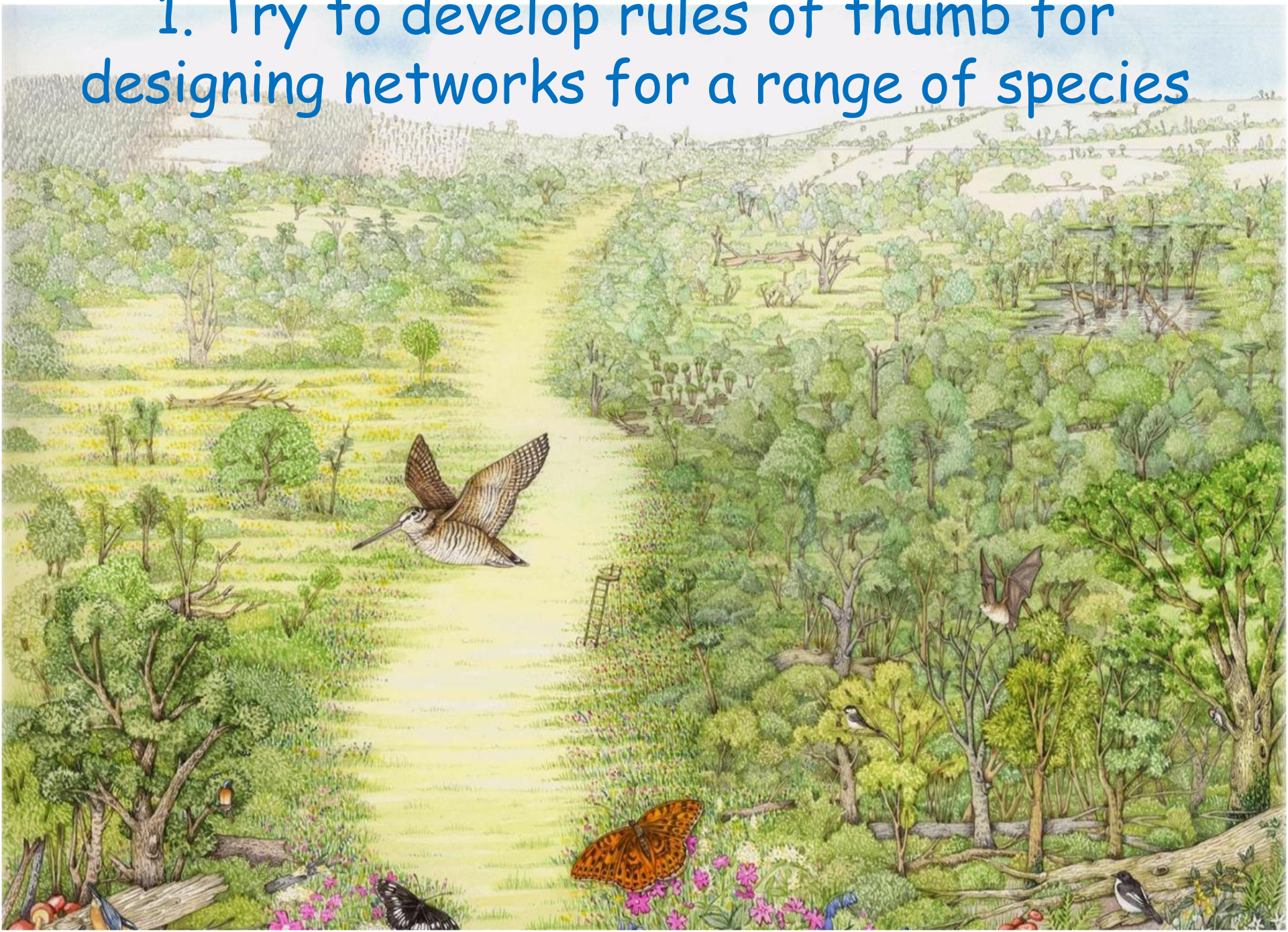
Grassland species: preliminary results

- Most important factors for all invertebrate groups:
  - 'Better' (floristic diversity of grasslands)
  - 'Joined' (proximity to species-rich grassland, and lower levels of intensive agriculture in surrounding landscape)



Two things we aim to do this year:

1. Try to develop rules of thumb for designing networks for a range of species



Current tentative conclusions:

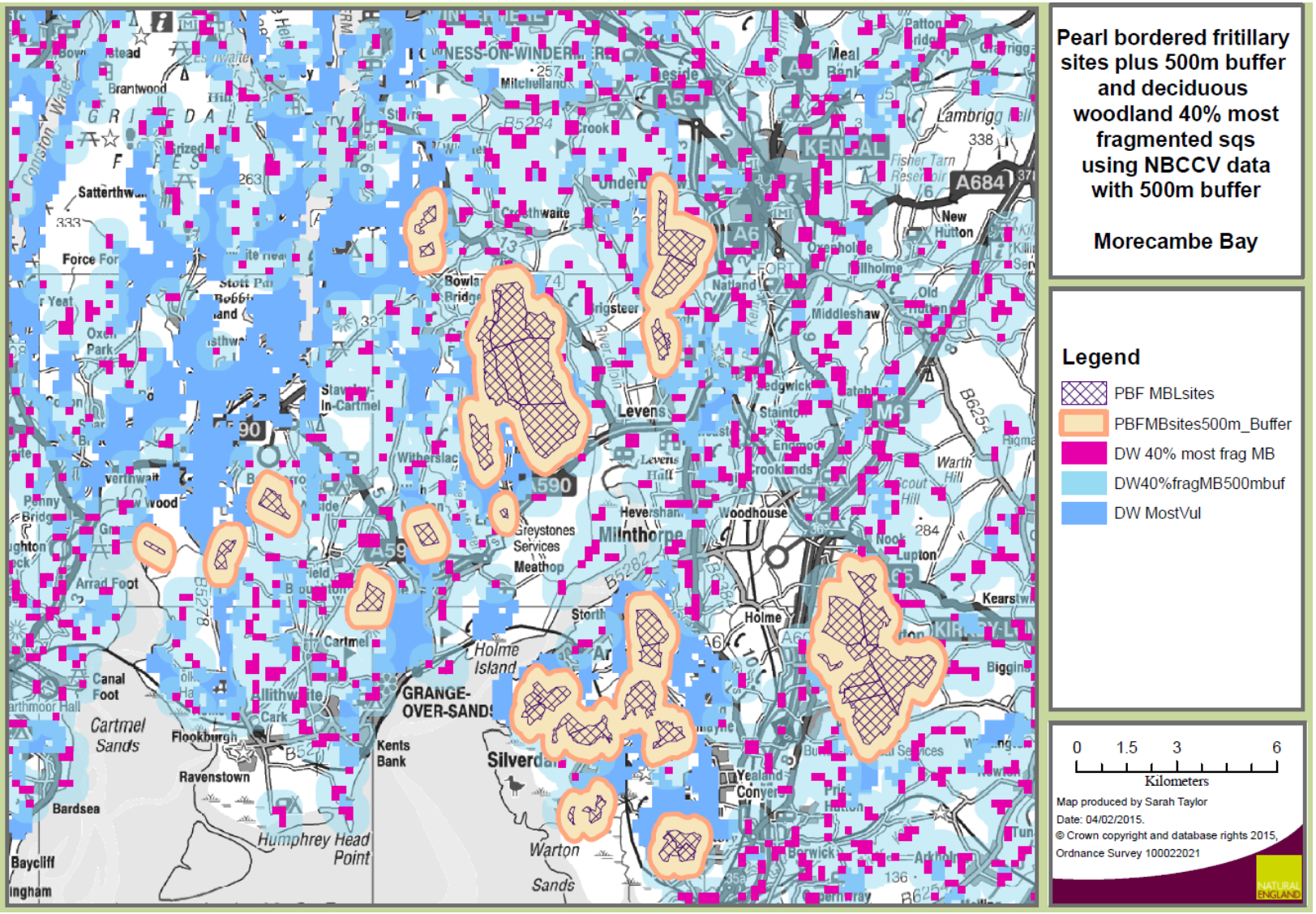
- Site quality/characteristics are crucial – **make sure that 'habitat creation' is really providing habitat**

- Relative importance of other factors varies across species (surprise!) but any 'bigger', 'better', 'more' or 'joined' helps

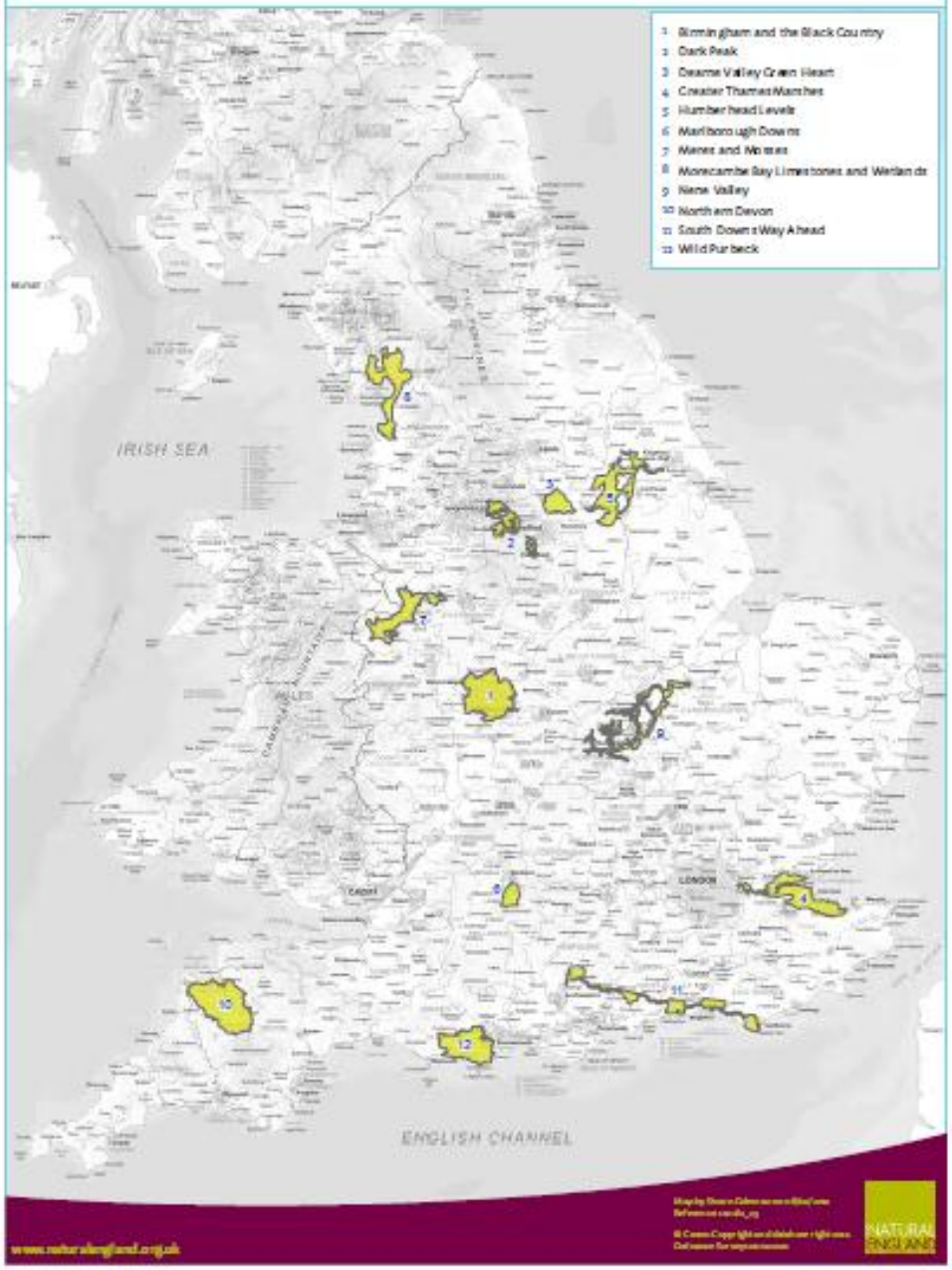
- Bigger/more aggregated patches seem beneficial for a wide range of taxa

- Structurally diverse mosaics of vegetation/other land cover across the landscape seem a good idea

2. Better integrate connectivity/ network models



Nature Improvement Areas



John Abbott