Ecological Networks, Connectivity and Conservation: Back to Basics

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The Challenge







Network Definitions

"Systems of nature reserves and their interconnections that make a fragmented natural system coherent, so as to support more biological diversity..." - Jongman (2004)

"...a set of ecosystems of one type, linked into a spatially coherent system through flows of organisms, and interacting with the landscape matrix in which it is embedded." - Opdam *et al.* (2006)

"... a representation of the answers to two questions: (1) who eats whom?, and (2) at what rate?" - Ulanowicz (2004)

Literature


Land Mosaic
The ecology of landscapes and
Richard
1992
Linkages in the Lan
The Role of Corridors and Co
in Wildlife Con
Andre
KEVIN J.
Applyi
Ecology
Conser
Springer
CONSERVATION BIOLOGY
Connectivity C
Edited by Kevin R. Croc
CAMBRIDGE Studies in Landscape Ecology
Edited by Jianguo Liu & William W. Taylor
Integrating Landscape Ecolo
into Natural Resource Mana
CAMBRIDGE Studie
Edited by Rob Jongman
Ecological N
Concept, Des
CORRIDOR
Jodi A. Hilty
William Z. Lid
Adina M. Mere
Ecological Networks: Science and Practice
Proceedings of the 16th Annual IALE (UK) Conference
Edinburgh University, 1-3 September 2009
Edited by Roger Catchpole, Richard Smithers, Phil Baarda and Amy Eycott
ialeUK
INTERNATIONAL ASSOCIATION FOR LANDSCAPE ECOLOGY • UK REGION
2009
Scottish Natura
ENGLAND
Forest Research

Spatially Explicit Initiatives

Aspen International

bridging science, policy and practice

Knowledge Gaps

Aspen International
bridging science, policy and practice

The great divide

The gap between theory and practice remains surprisingly wide in conservation biology.

"Conservation biologists write and publish papers, which the practitioners seldom read. The practitioners, in turn, rarely document their actions or collate their data in forms useful to conservation biologists. Typically, practitioners make decisions based on personal experience and intuition. Their knowledge stays untapped by others — and can be impervious to fresh scientific findings."

nature
Vol 450 | Issue no. 7167 | 8 November 2007

Conservation MEMEs

Member States shall endeavour …. to encourage the management of features of the landscape which are of major importance for wild fauna and flora. Such features are those which, by virtue of **their linear and continuous structure (such as rivers with their banks or the traditional systems for marking field boundaries)** or their function as stepping stones (such as ponds or small woods), are essential for the migration, dispersal and genetic exchange of wild species.

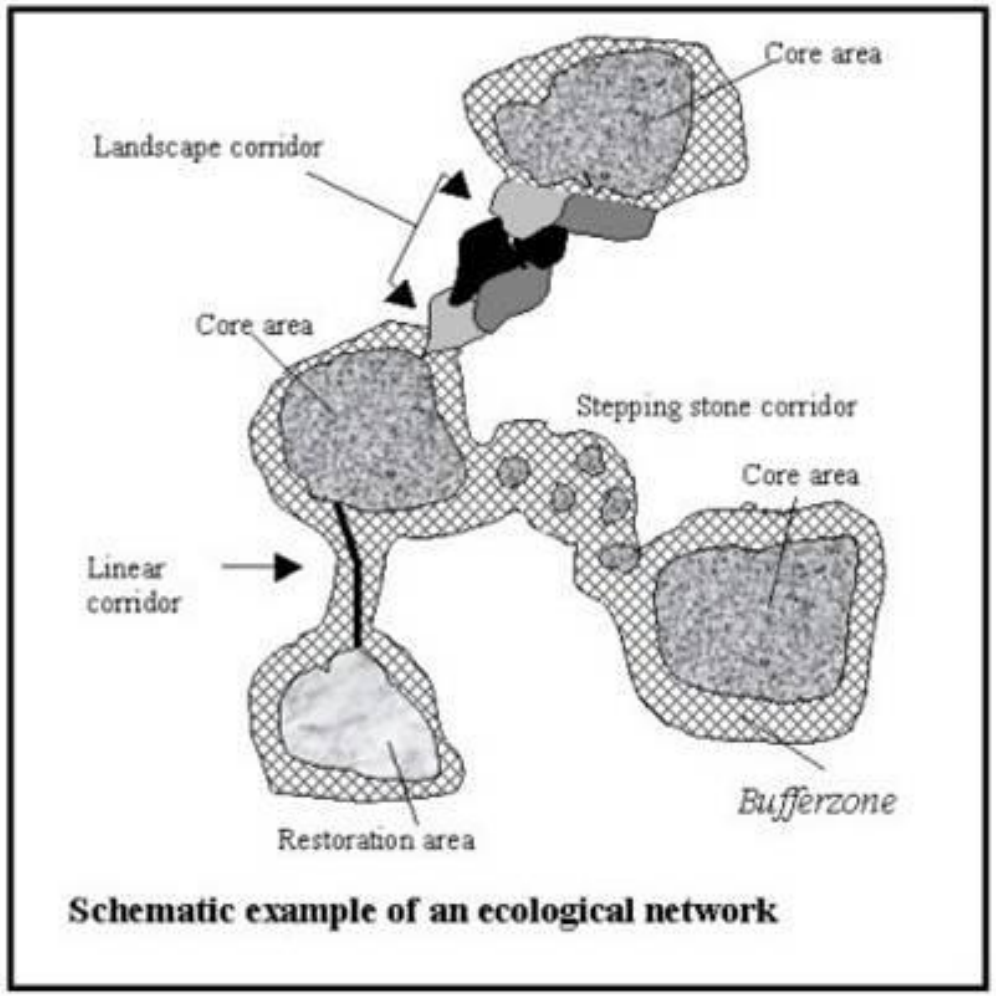
Article 10, Council Directive 92/43/EEC

It's the nature of the job

Shooting & Conservation Magazine
January-February 2013

"Connectivity – This involves planting hedgerow and woodland and fencing off river banks to connect woodlands and provide wildlife corridors for less mobile species"

Network Elements

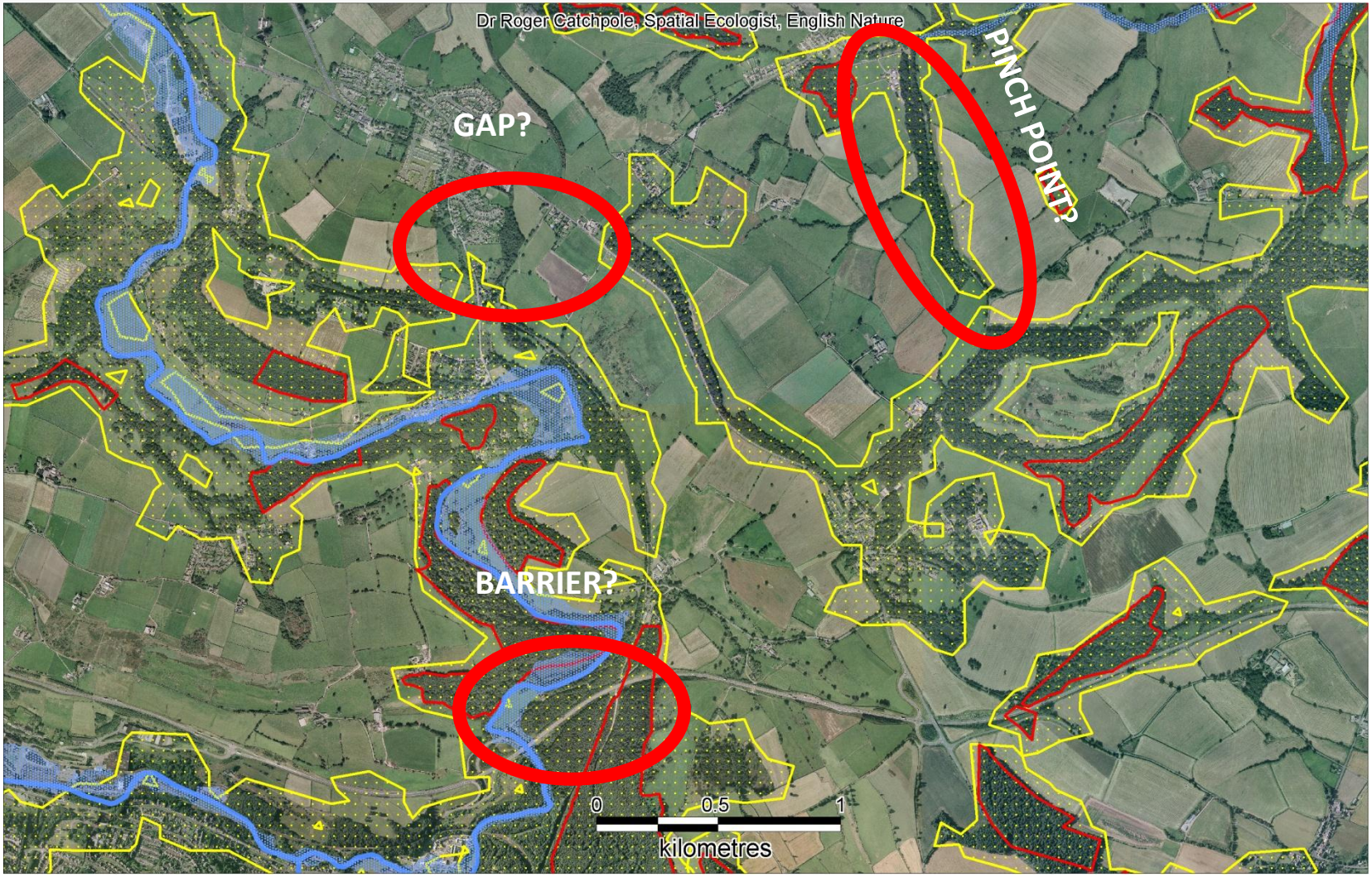


land cover

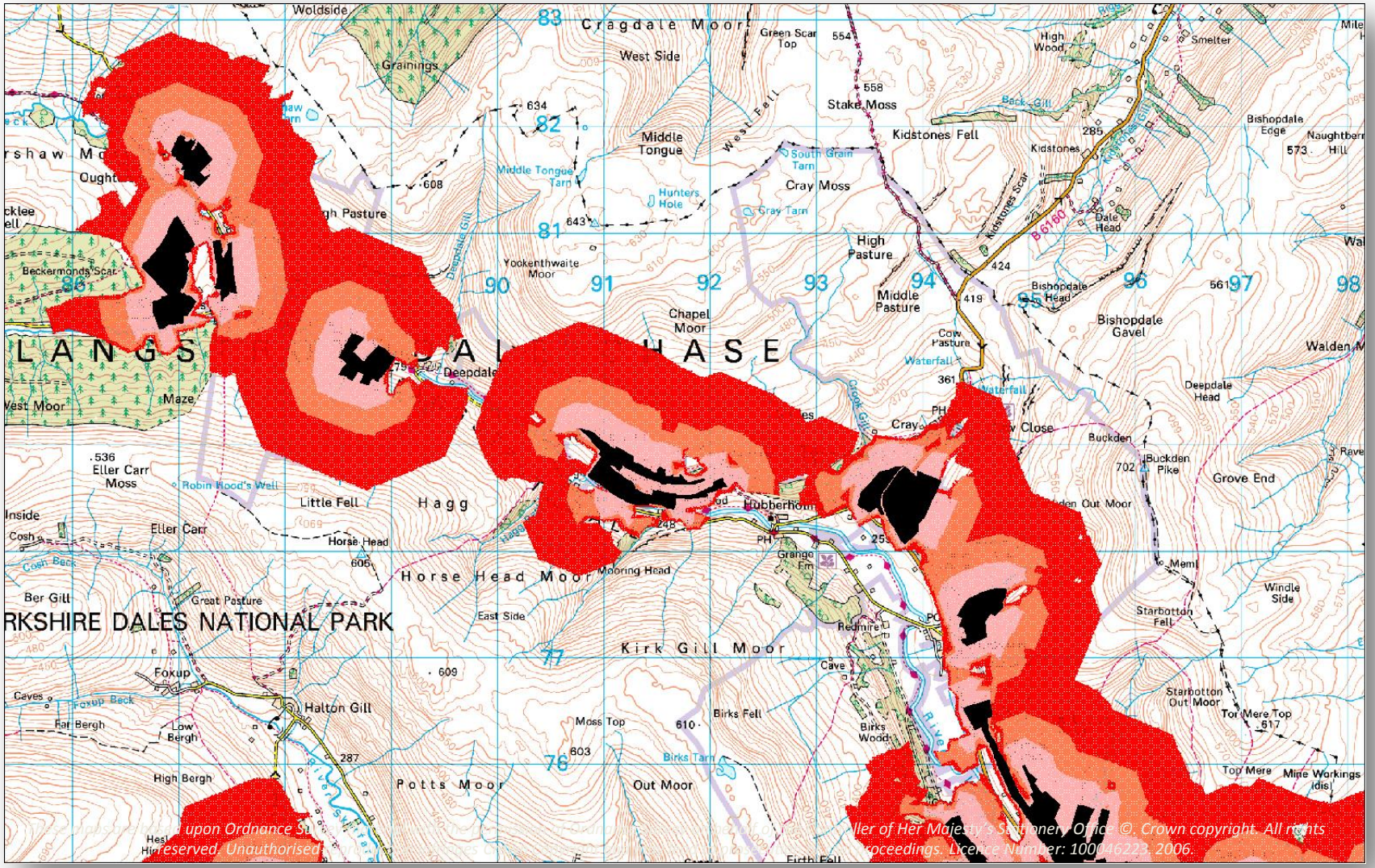
habitat patches

'permeable' areas

A Real Network

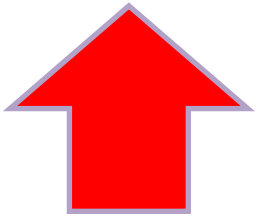


Calcareous Grassland Networks

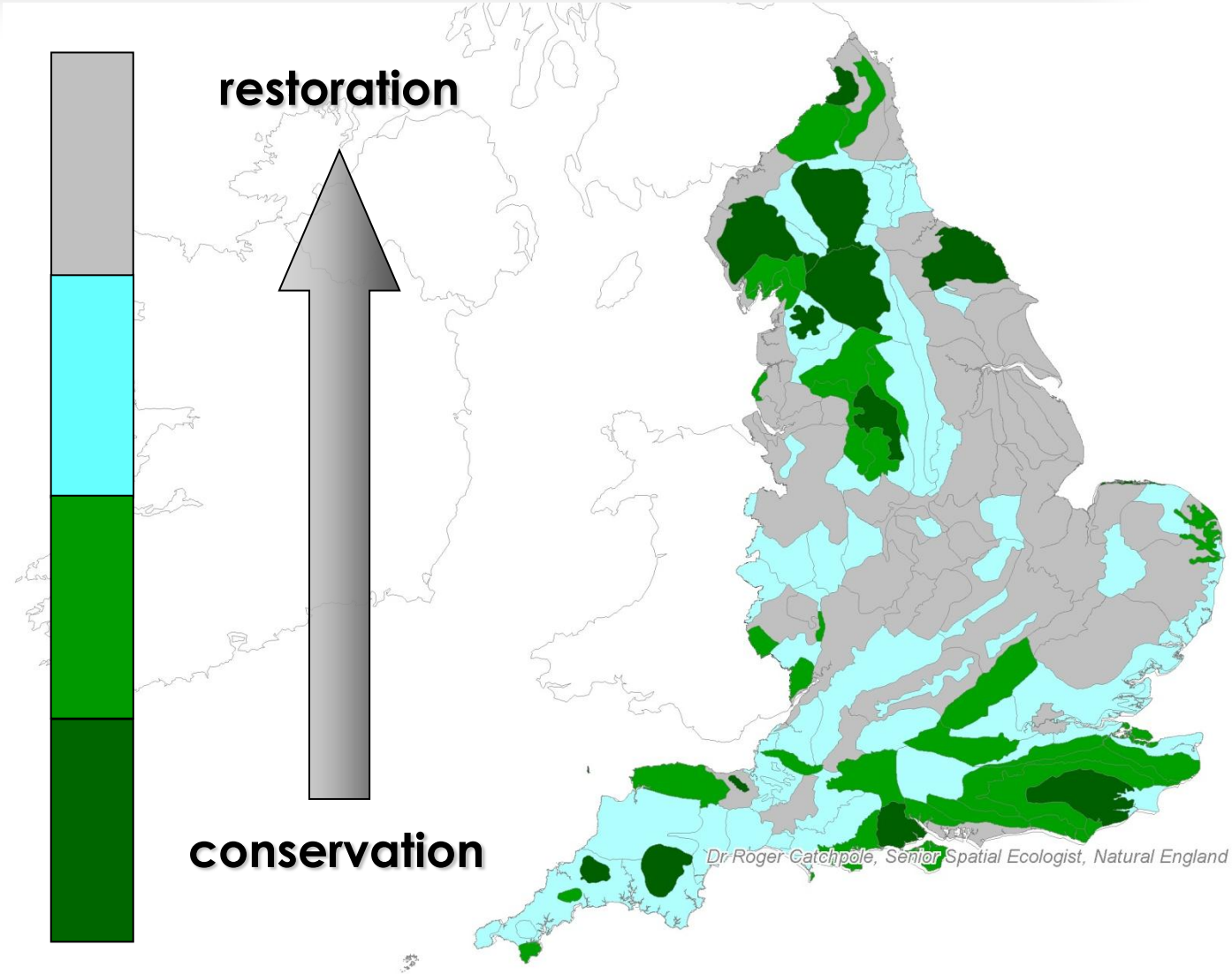


Summary Statistics

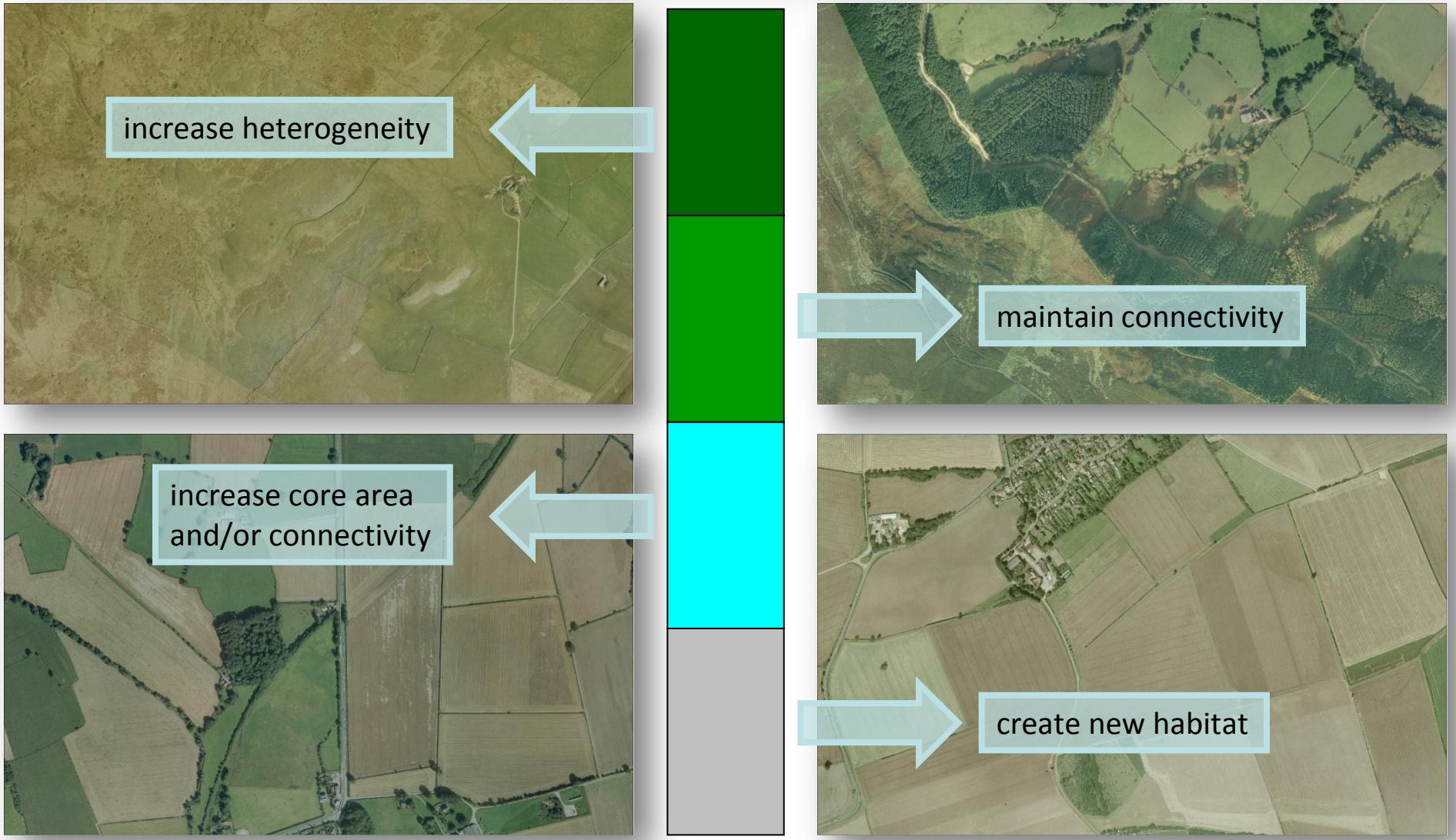
	patch area (ha)	proportion of England	network area (ha)	proportion of England	total
woodland	543,362	4.2%	565,819	4.3%	**1,109,181 (9%)**
heathland	339,851	2.6%	59,454	0.5%	**399,305 (3%)**
grassland	127,745	1.0%	103,503	0.8%	**231,248 (2%)**
mire, fen & bog	479,337	3.7%	30,767	0.2%	**510,104 (4%)**
total	**1,490,295**	**11.5%**	**759,543**	**5.8%**	**2,249,838 (18%)**



Setting the Context



Setting Objectives



Connectivity

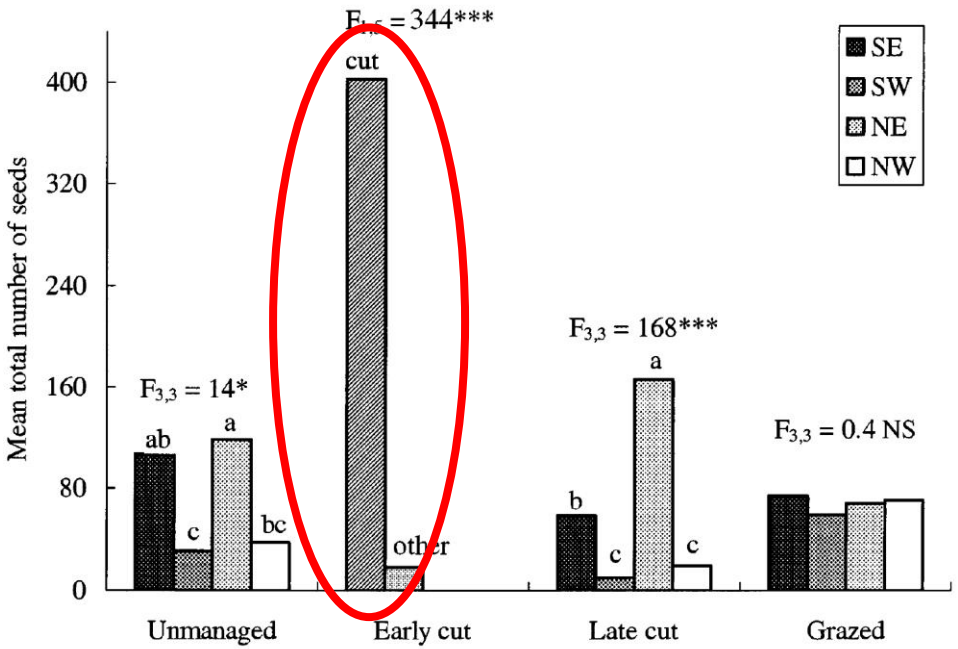
"Landscape connectivity can be defined as the degree to which the landscape facilitates or impedes the movement of species, genetic interchange and other ecological flows." - Santiago Saura (2009)

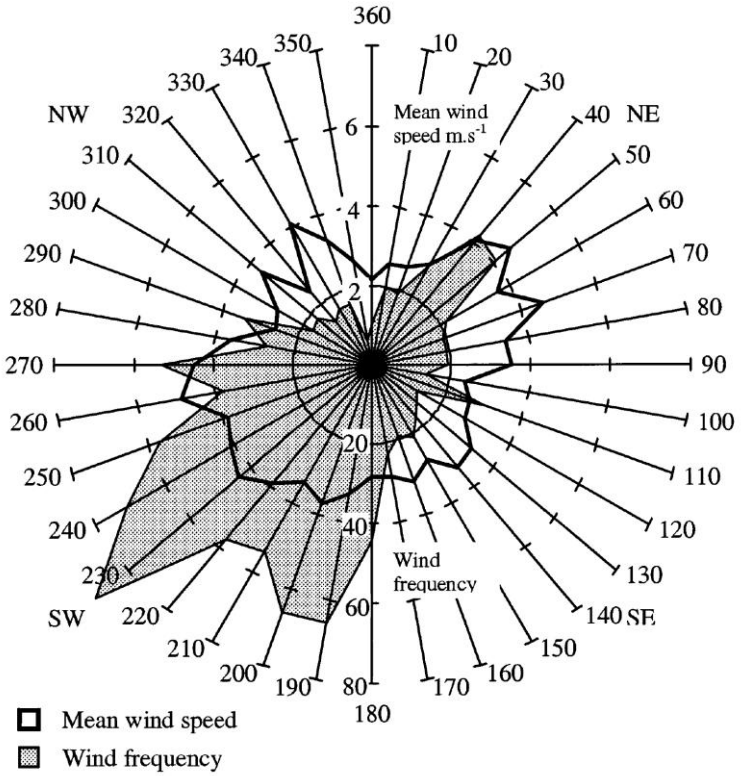
Structural vs Functional Connectivity

Genetic Exchange

Anemochory

Yellow Rattle





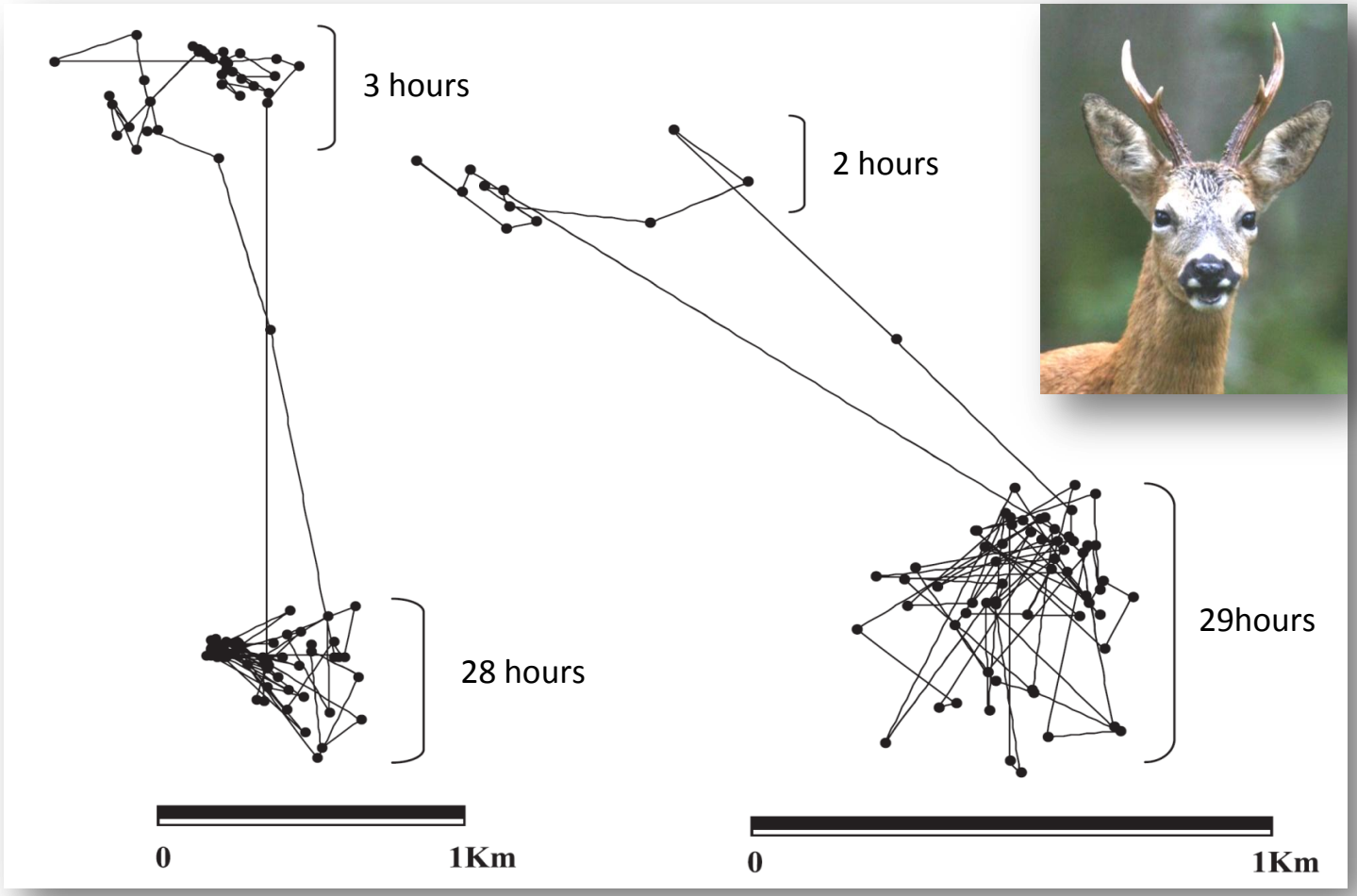
Bullock, J.M. (2003) Ecography 26: 692–704.

Epizoochory - Internal

Epizoochory - External

Epizoochory - External

Animal Movement

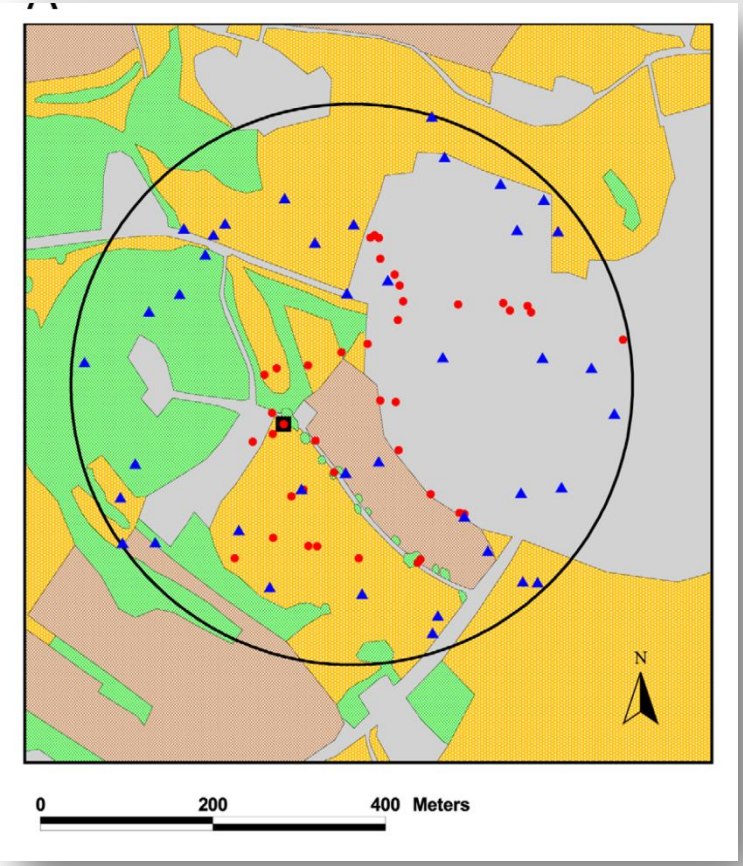


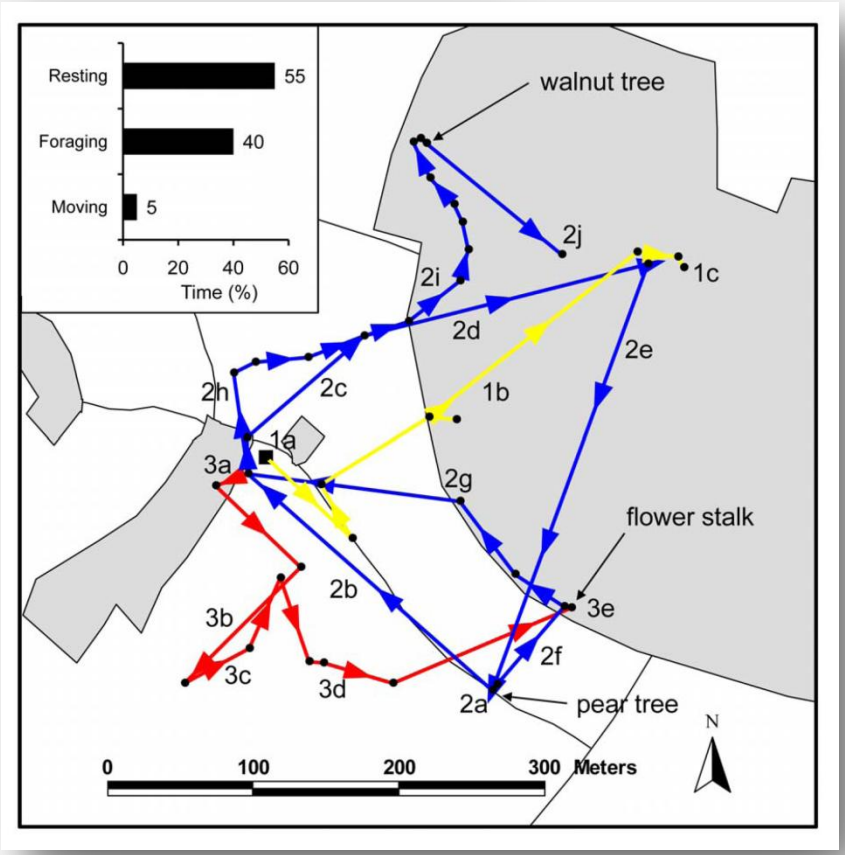
Lovari , S.et al. (2008) Ethology, 114: 886–896.

Migratory Movement

Invertebrate Movement

Bombus Radiotracking





Trees (incl. hedges and forest patches)

Fields

Meadows

Village (buildings, gardens and roads)

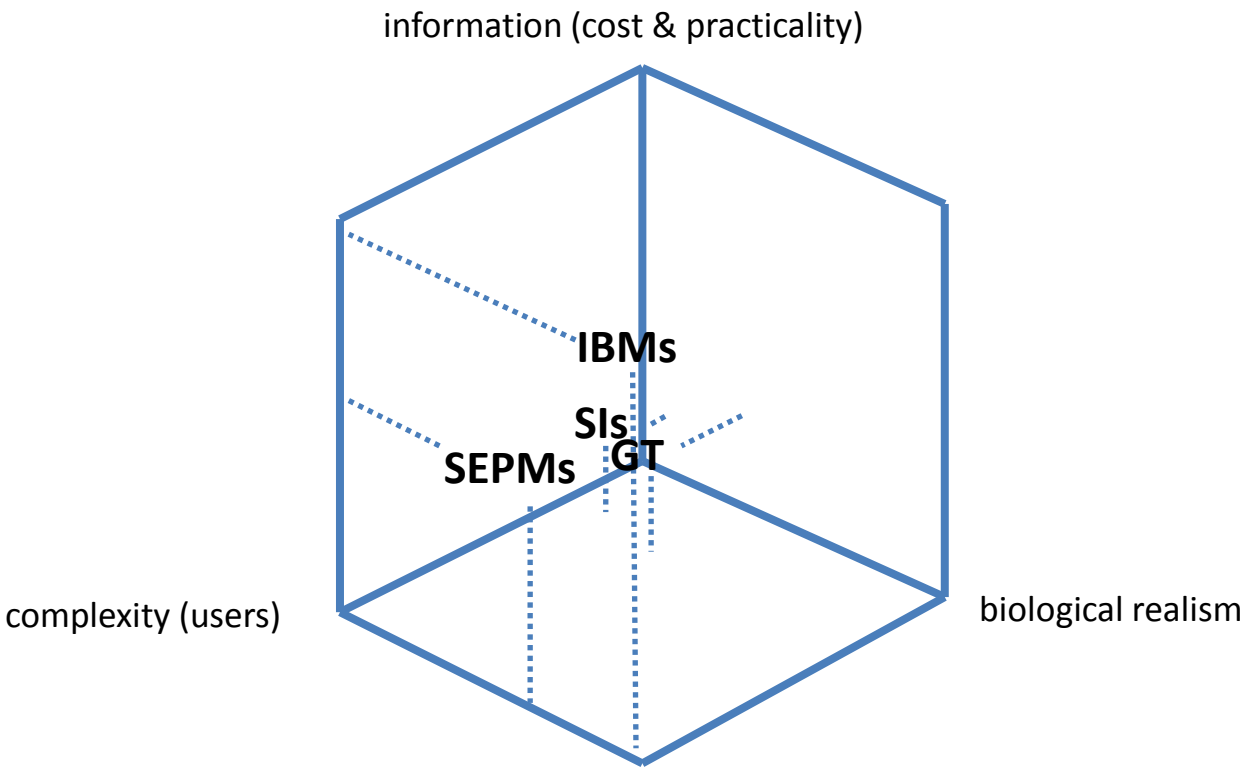
Hagen, M. et al. (2011) PLoS ONE, 6(5): e19997.

Which Species Matter?

*Vertigo geyeri^*	Geyer's whorl snail	***Rhinolophus ferrumequinum***	**Greater horseshoe bat**
*Vertigo angustior^*	Narrow-mouthed whorl snail	***Barbastella barbastellus***	**Barbastelle**
*Vertigo genesii^*	Round-mouthed whorl snail	***Myotis bechsteinii***	**Bechstein's bat**
*Vertigo moulinsiana^*	Desmoulin's whorl snail	***Tursiops truncatus***	**Bottlenose dolphin**
*Anisus vorticulus^*	Ram's-horn snail	***Phocoena phocoena***	**Harbour porpoise**
*Margaritifera margaritifera^*	Freshwater pearl mussel	***Lutra lutra***	**Otter**
Coenagrion mercuriale	**Southern damselfly**	***Halichoerus grypus***	**Grey seal**
*Euphydryas aurinia^*	Marsh fritillary butterfly	***Phoca vitulina***	**Common seal**
*Limoniscus violaceus^**	Violet click beetle	*Buxbaumia viridis^*	Green shield-moss
*Gortyna borelii lunata**	Fisher's estuarine moth	*Marsupella profunda ^*	Western rustwort
Lucanus cervus	**Stag beetle**	***Drepanocladus vernicosus***	**Slender green feather-moss**
Austropotamobius pallipes	**White-clawed crayfish**	***Petalophyllum ralfsii***	**Petalwort**
Petromyzon marinus	**Sea lamprey**	***Trichomanes speciosum***	**Killarney fern**
Lampetra planeri	**Brook lamprey**	***Rumex rupestris***	**Shore dock**
Lampetra fluviatilis	**River lamprey**	*Saxifraga hirculus^*	Marsh saxifrage
Alosa alosa	**Allis shad**	*Apium repens^*	Creeping marshwort
Alosa fallax	**Twaite shad**	***Gentianella anglica***	**Early gentian**
Salmo salar	**Atlantic salmon**	***Luronium natans***	**Floating water-plantain**
Cobitis taenia	**Spined loach**	***Najas flexilis***	**Slender naiad**
Cottus gobio	**Bullhead**	*Cypripedium calceolus^**	Lady's-slipper orchid
Triturus cristatus	**Great crested newt**	*Liparis loeselii^*	Fen orchid
Rhinolophus hipposideros	**Lesser horseshoe bat**		

Common Connectivity Models

Spatial Indicies (SIs) - nearest neighbour, patch proximity etc
Graph Theory (GT) – circuitscape, pathmatrix, beetle etc
Spatially Explicit Population Models (SEPMs) – spom, vm, metaphor etc
Individual Based Models (IBMs) – atlass, moab, swarm etc



Key Messages

Patch connectivity is not the same as landscape connectivity
Structural connectivity does not guarantee functional connectivity
Landscape connectivity is species-specific
Manage the matrix in combination with patches
Real landscapes are not random – question models
Landscape connectivity is not a panaecea – birth & death
Landscape connectivity is inherently neither good nor bad
Landscape connectivity is a dynamic concept
Define areas of residual connectivity before restoration
Analyse strategically but make decisions locally – situation specific

Modified from Taylor, P.D. et al. (2006) In: Connectivity Conservation. Conservation Biology 14. Cambridge University Press. 29-43

The Treachery of Images

Thank you for listening!