



Hedgerow connectivity

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<http://www.hedgelink.org.uk/>



Keynote address

Hedgerow Futures Conference 3-5 September 2012
Staffordshire University, UK

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Hedgerows are part of networks



Hedgerows are part of agricultural landscapes



They provide shelter, wood, property limits
They are part of the farming systems

Hedgerows were, in part, planted to act against

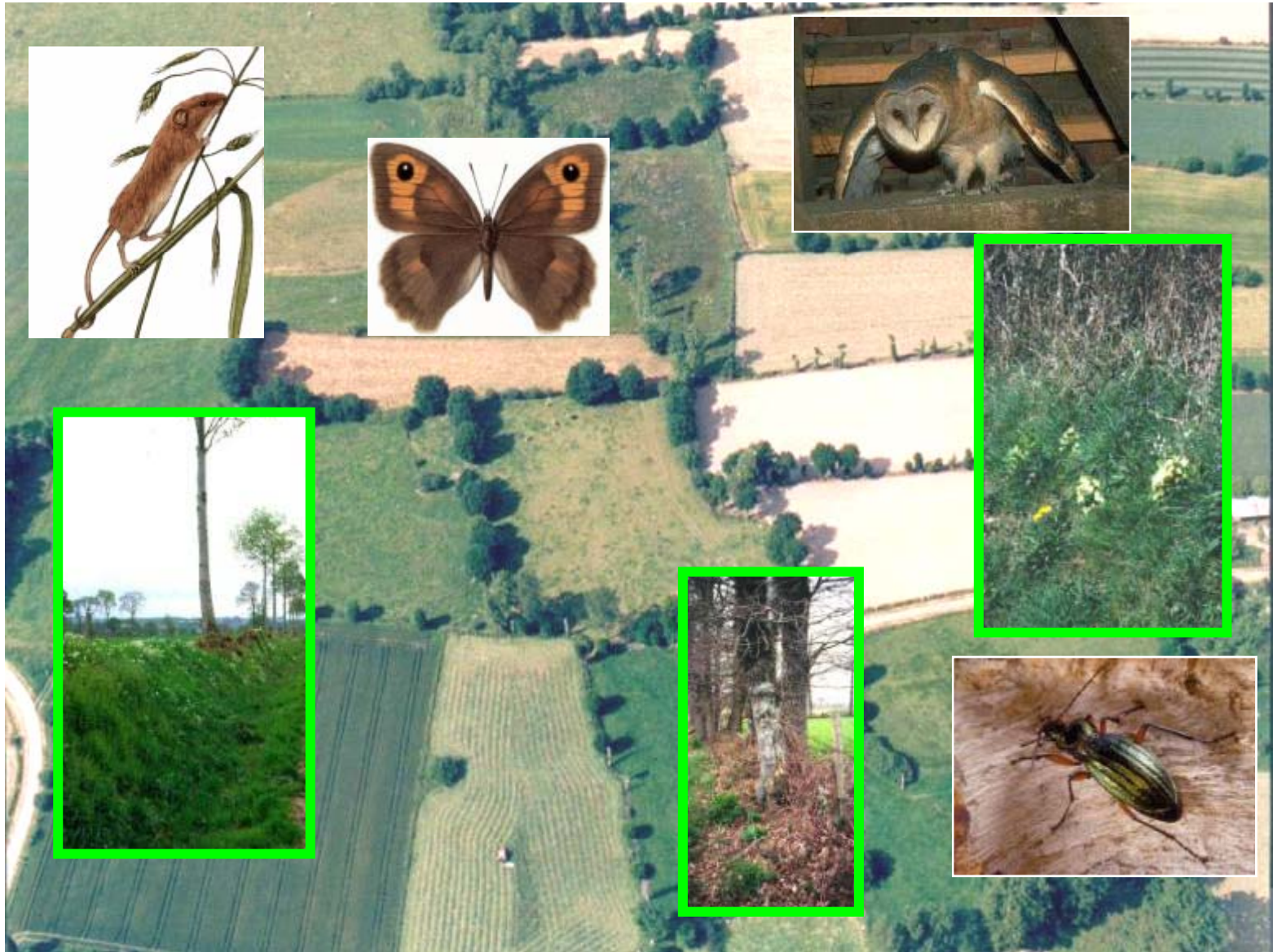
Soil erosion
Wind damages



They control water fluxes

Now recognized as regulating
ecosystem services

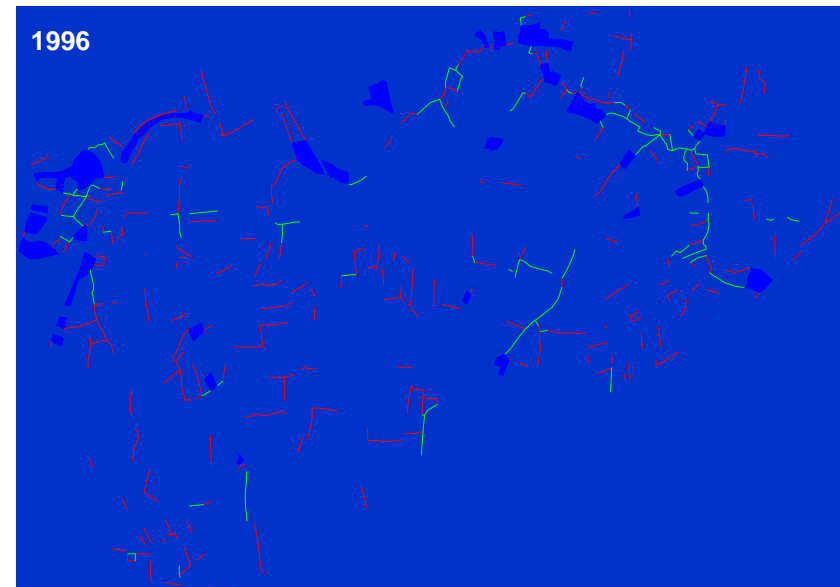
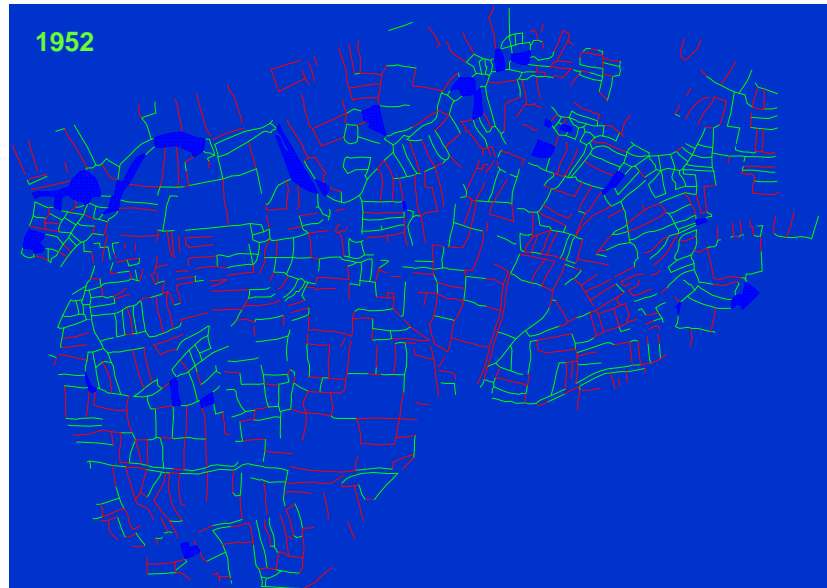
They harbour a high biodiversity: **habitat provision service**



Hedgerow networks decreased in western Europe since the 1960's



Changes of a hedgerow network landscape in Brittany



Longueur (km)

 Hedgerows with continuous tree cover

 Hedgerows with discontinuous tree cover

 wood(ha)

1952	1966	1982	1990	1996
61,50	35,75	18,50	12,00	7,00
58,00	52,25	31,00	27,50	19,50
15,25	15,50	19,50	15,25	18,25

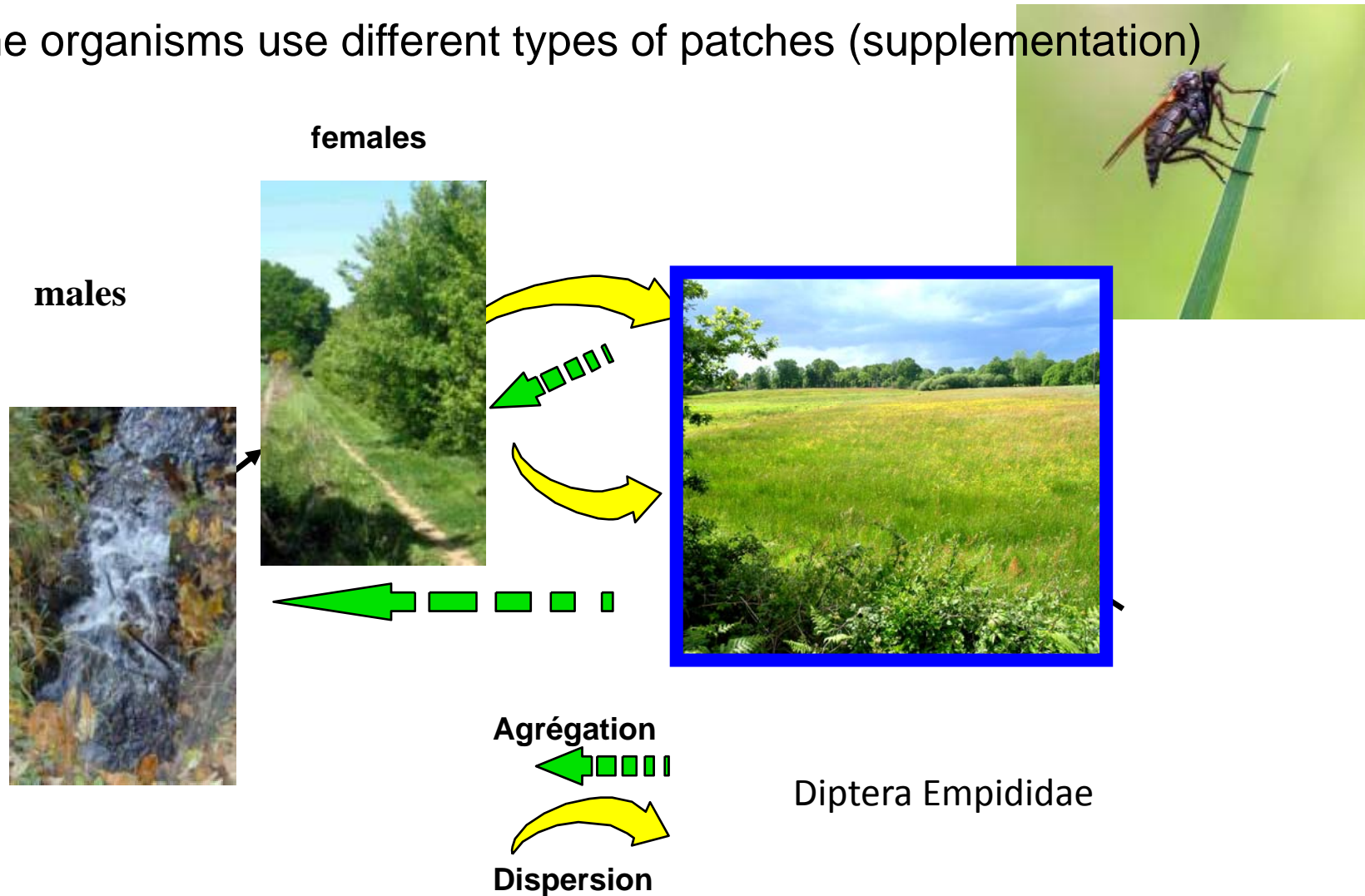
In heterogeneous and fragmented landscapes movement is a key process for population survival

Habitat patches are small: animals need to complement

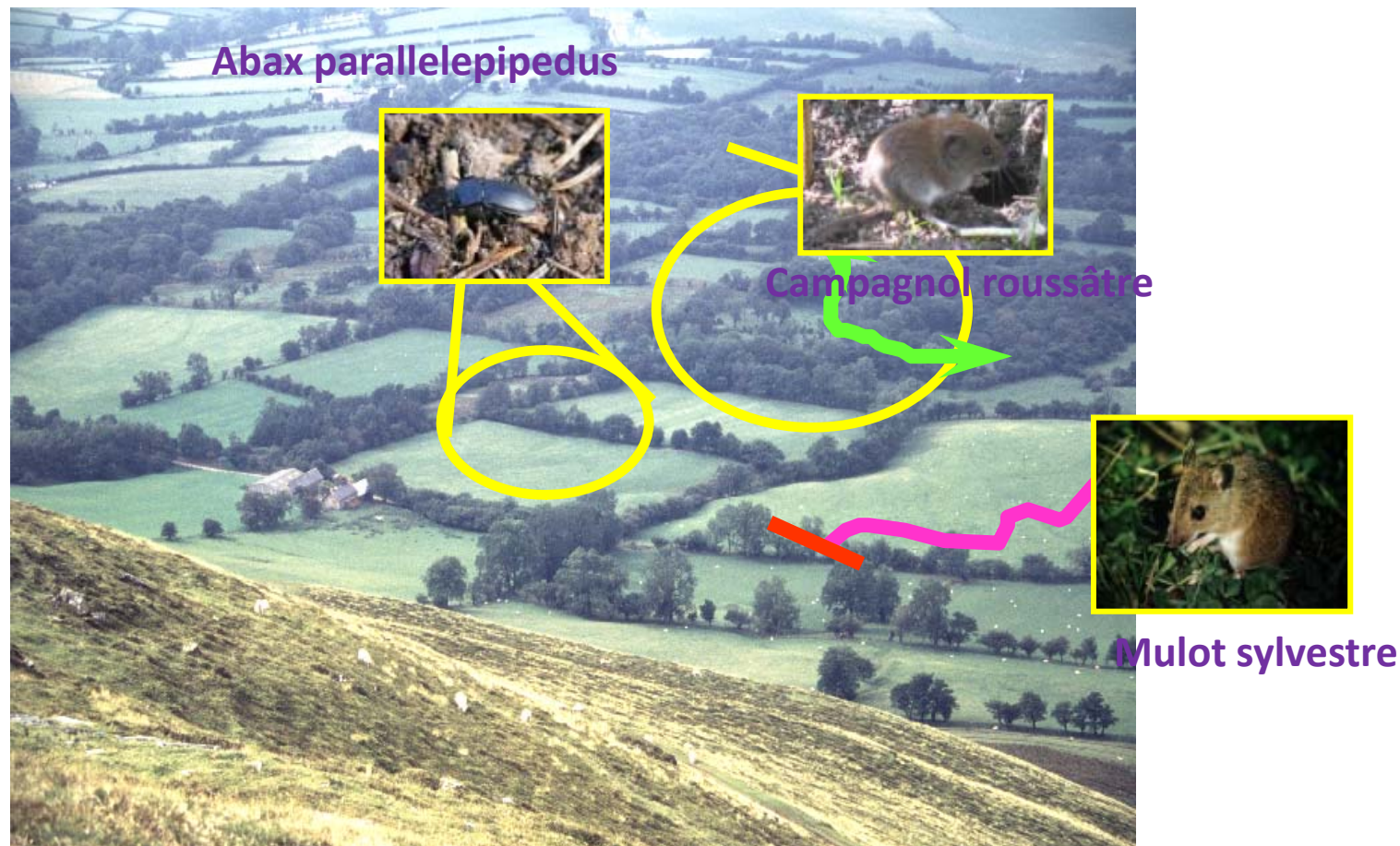


In heterogeneous and fragmented landscapes movement is a key process for population survival

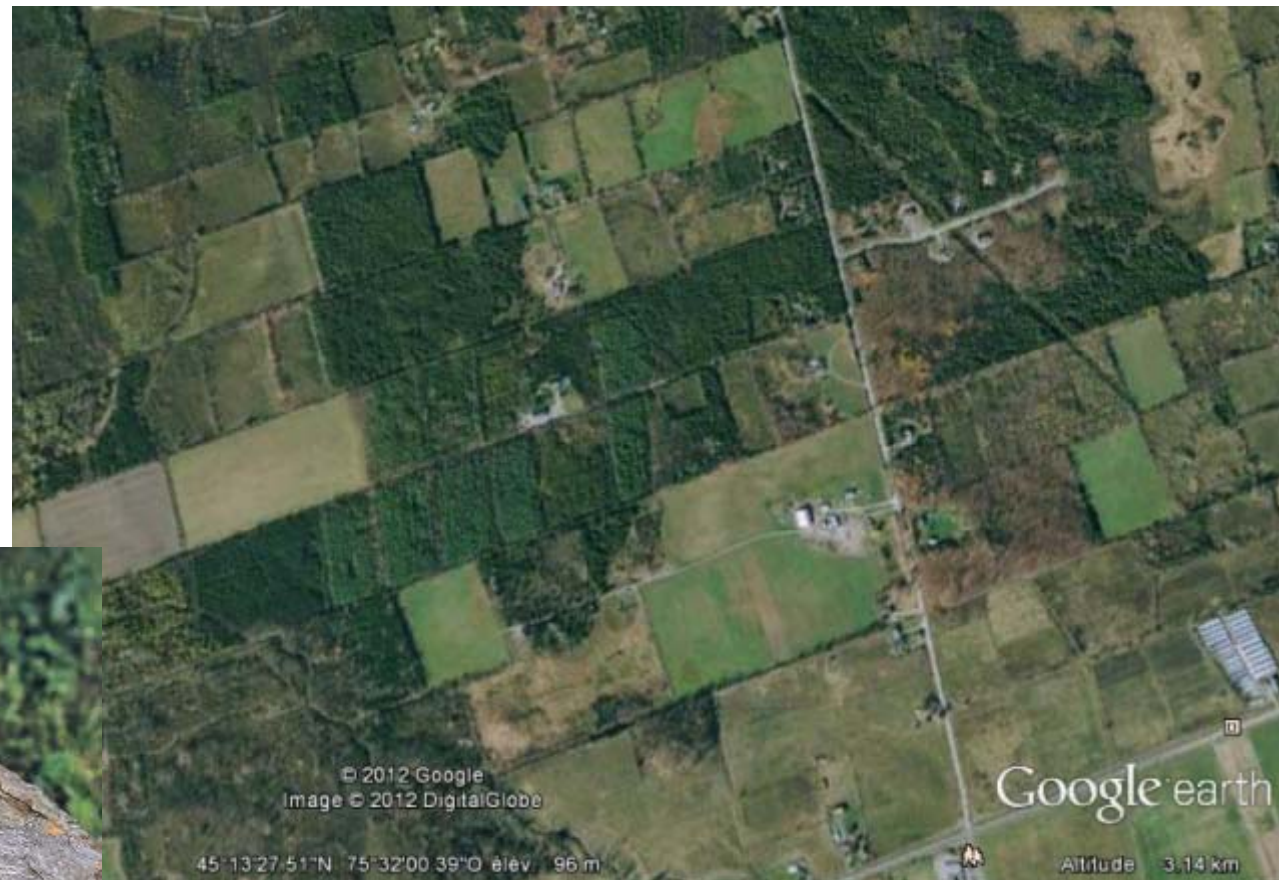
Some organisms use different types of patches (supplementation)



« Landscape connectivity is the degree to which the landscape facilitates or impedes movement along resources patches »
(Taylor et al. 1993)



Pioneer work on hedgerows connectivity : small mammals in Canada



Survival is enhanced by the presence of hedgerows connecting woodlots

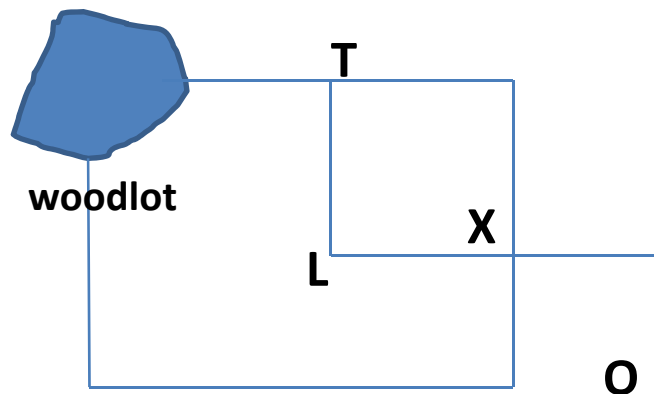
Local populations are subjected to frequent extinction and recolonisation events. Woody hedgerows facilitate movement between woodlots.



Metapopulation survival is higher as the number of connections between woodlots increases

Farhig & Merriam 1985

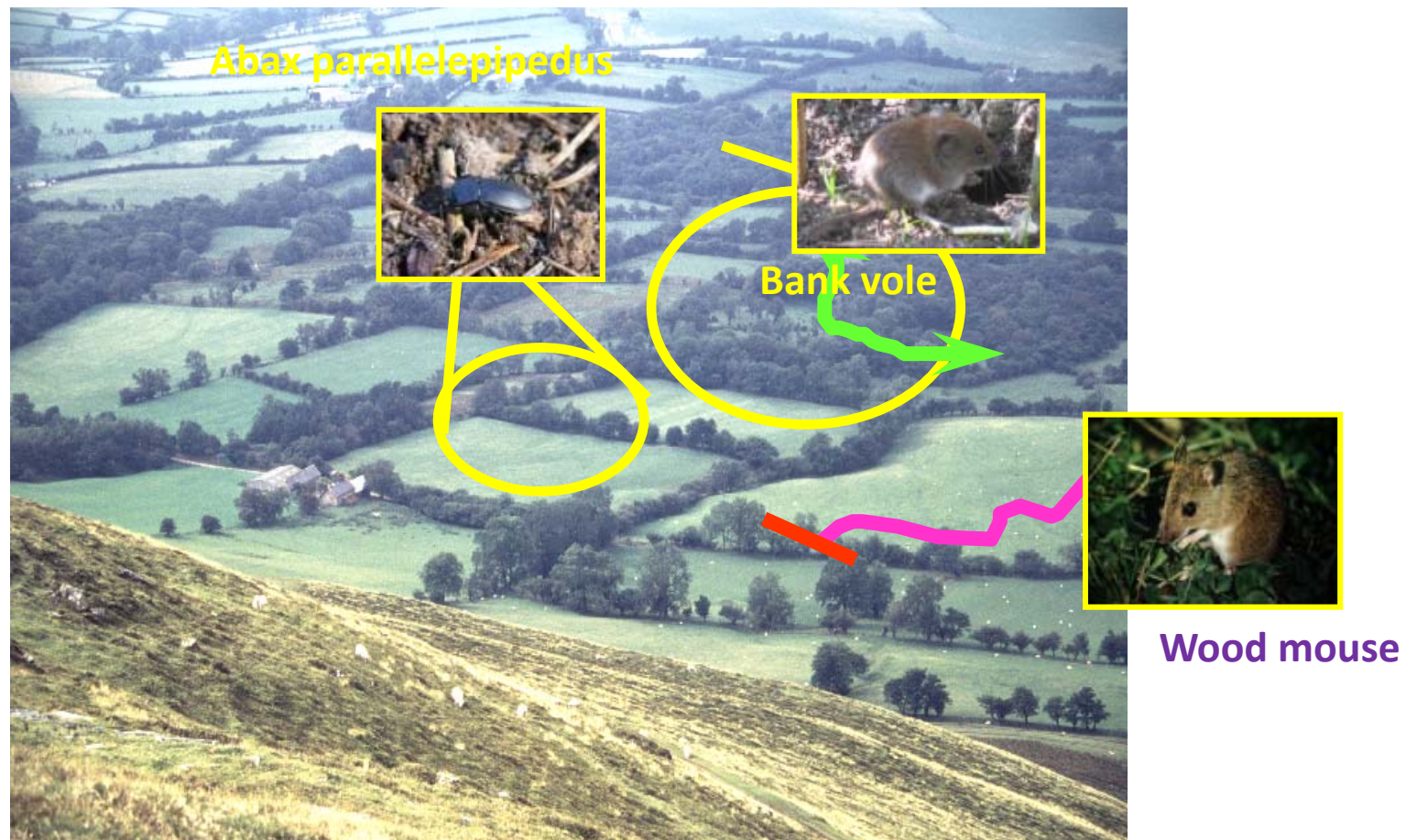
Structural connectivity vs functional connectivity



- Length of the network
- Number of connections
- Quality of connections

Baudry & Merriam 1998

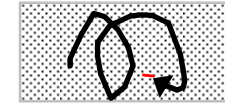
Functional connectivity



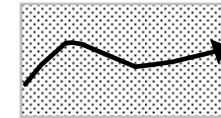
corridors are linear elements which act as



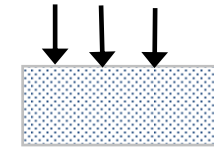
★ habitat



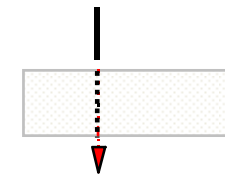
★ conduit



★ barrier



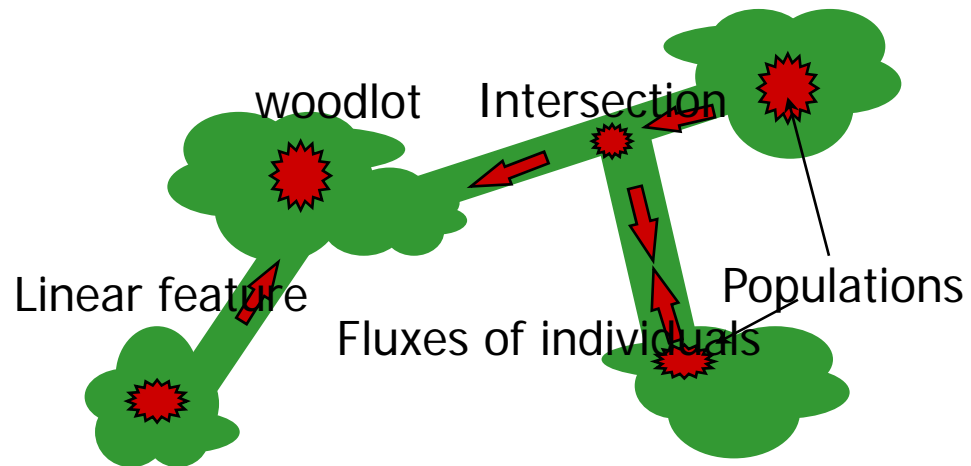
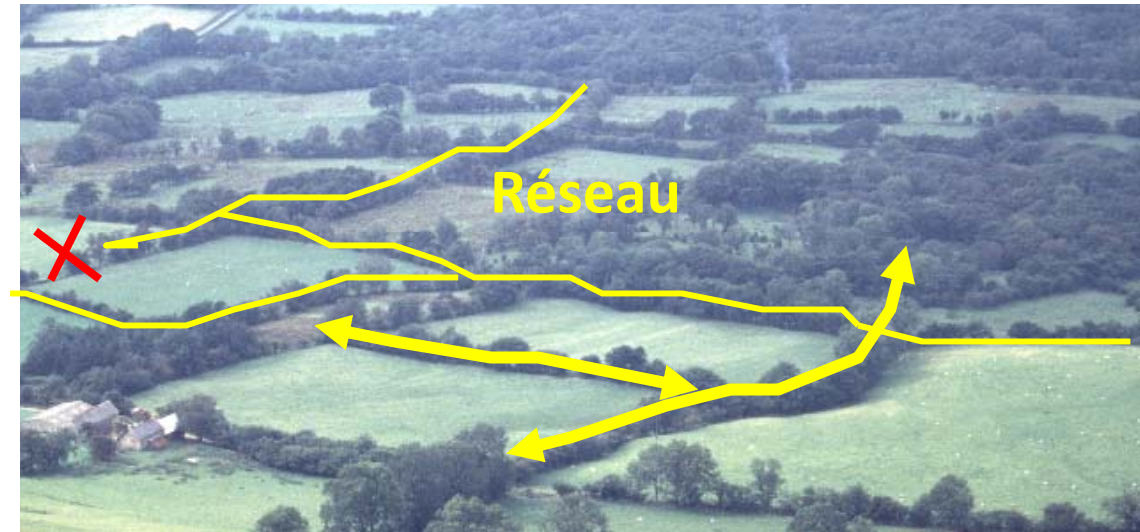
★ filter



Hedgerows act as corridors for forest species



Abax parallellepipedus



Petit & Burel, 1998

There is still no strong evidence that hedgerows are effective corridors between fragments of woodland habitats (Davies and Pulliam 2007)

More replicated and controlled field investigations are required
Long term monitoring is necessary



Mammals



Hedgerow density
Number of connections



birds



Number of
hedgerows
connected to
studied woodlots

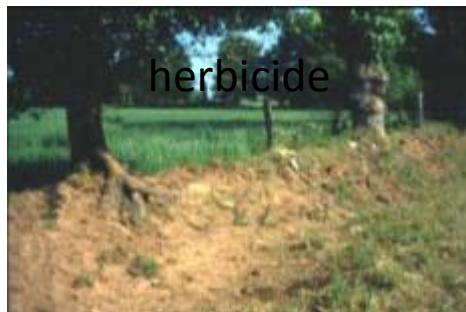


invertebrates

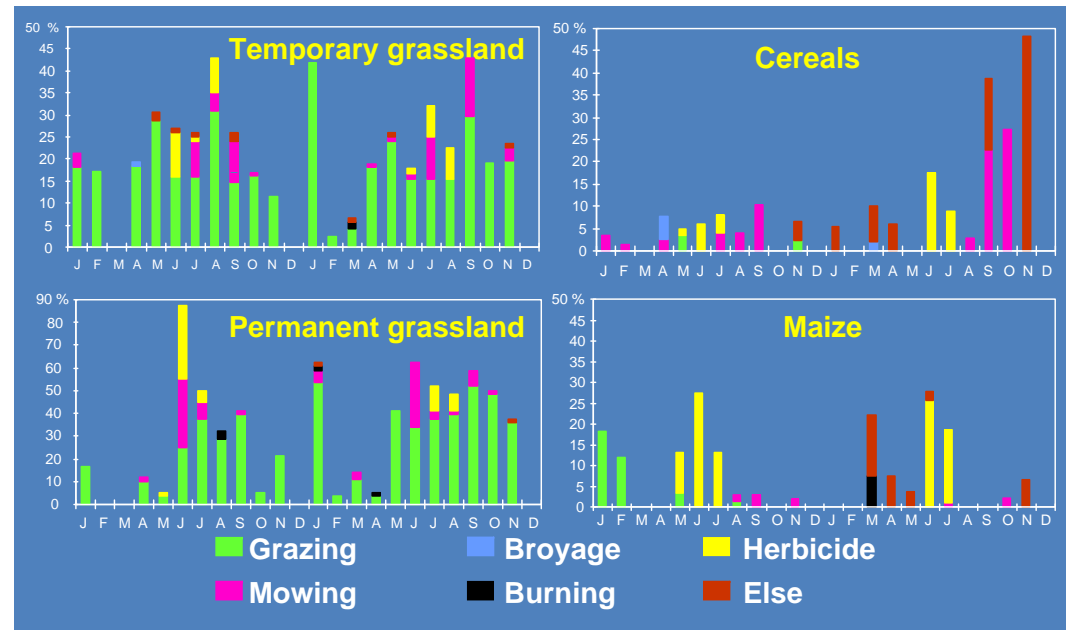


Vegetation cover
Structural complexity

Corridor efficiency of hedgerows depend on the way they are managed



herbicide



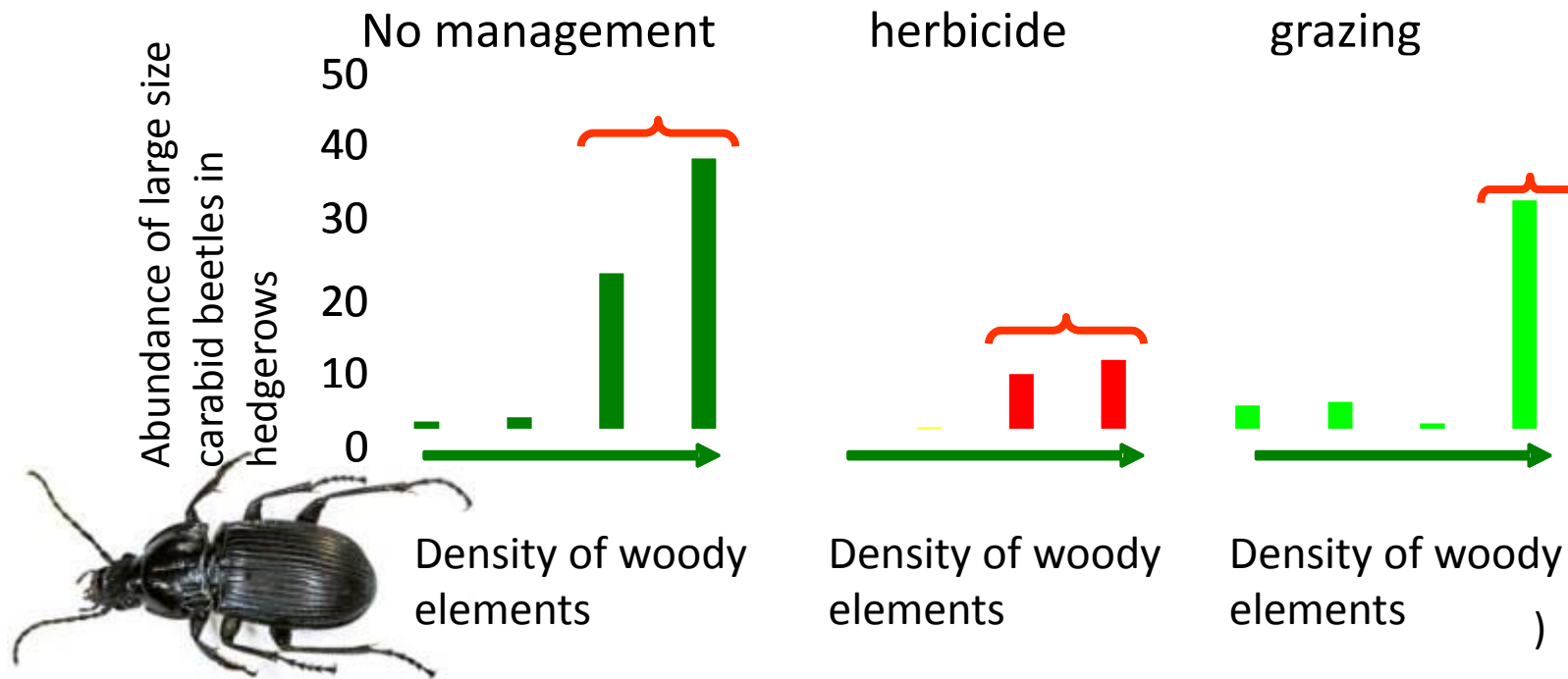
Movement of *Abax parallelepipedus* depends on vegetation cover



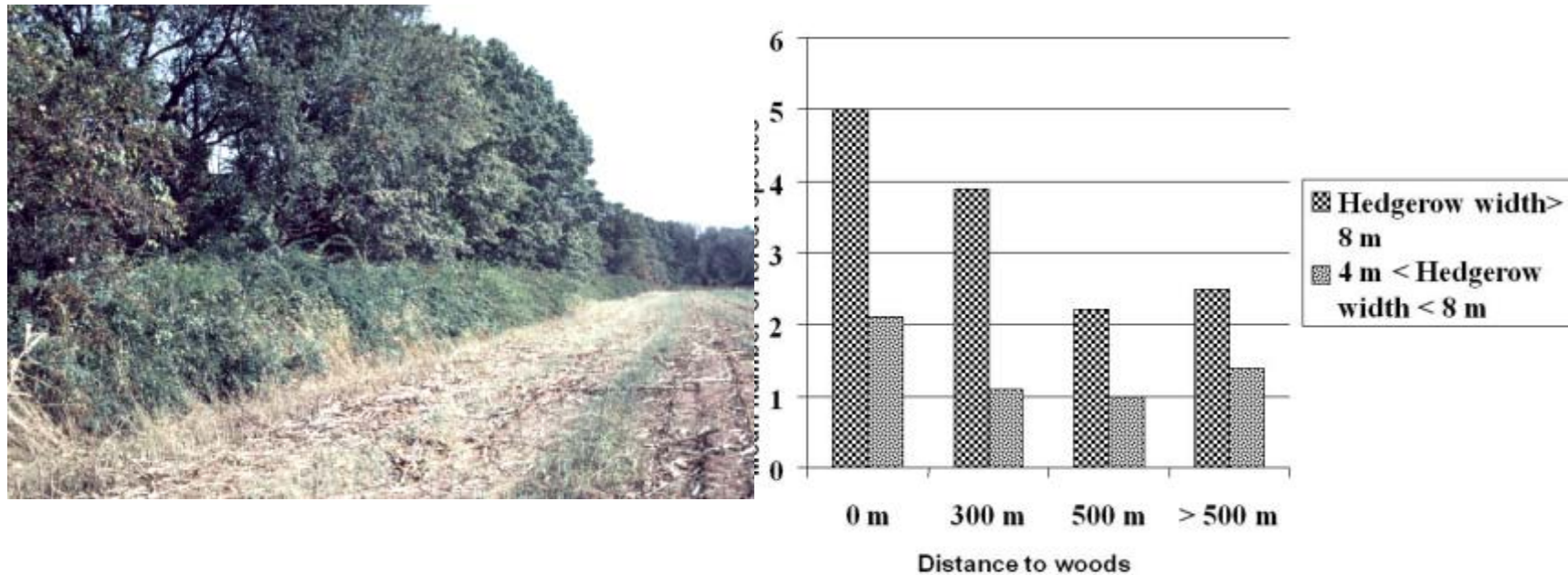
In hedgerows with a dense herbaceous and a continuous tree cover, movement was significantly longer than in hedgerows with a sparse tree cover and less dense herbaceous one



Hedgerow structure and landscape structure



Corridor efficiency depends on the width of the corridor



In New jersey, baudry and Forman, showed that presence of forest herb species depend on distance to woods as well as on width of the hedgerows

Lanes bordered by two hedgerows are good corridors

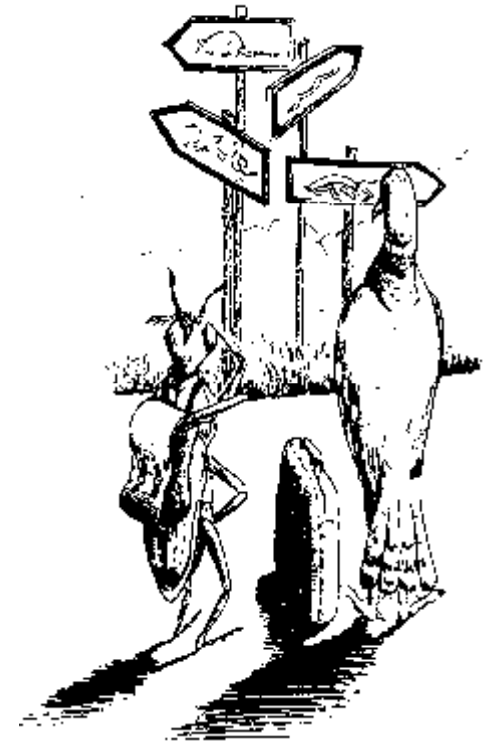
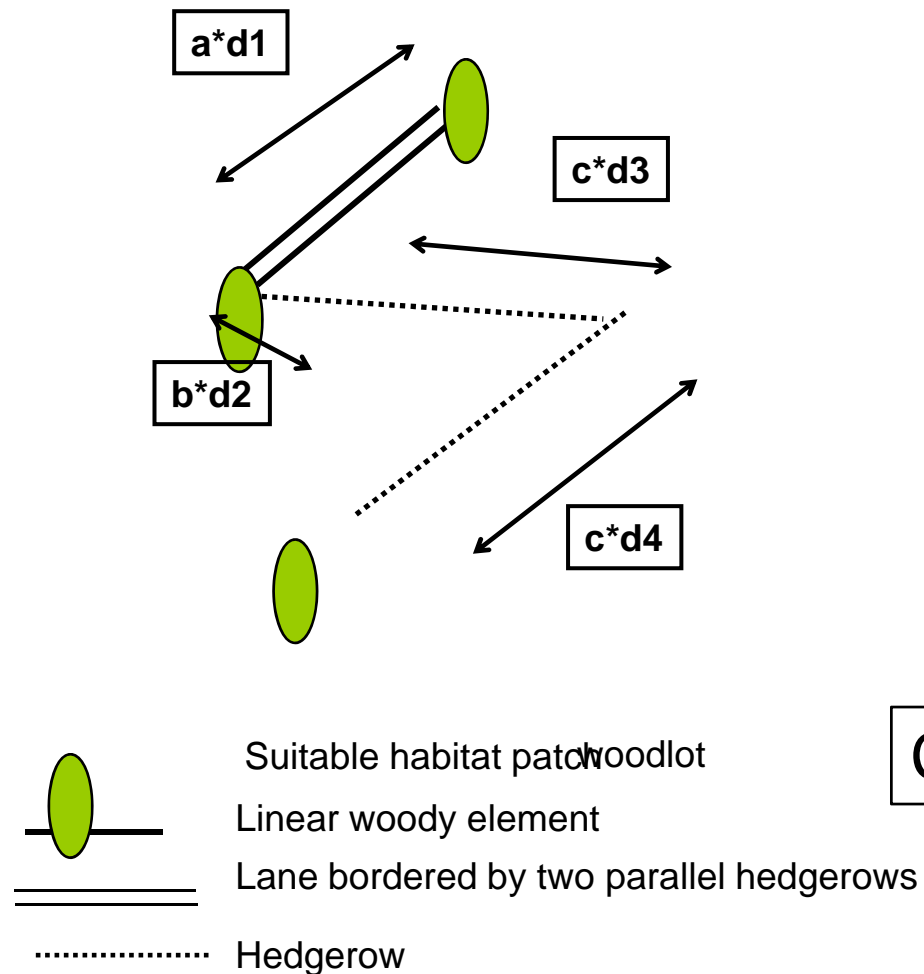
Sunken roads are habitats for forest species
Richness increases with age and connectivity
Deckers et al. 2005

Chemins creux are good routes for
dispersion of forest carabid species
Charrier et al. 1997

Bird species richness is higher in green
lanes than in single hedgerows
Walker et al. 2005



A measure of functional connectivity for *Abax parallelepipedus*



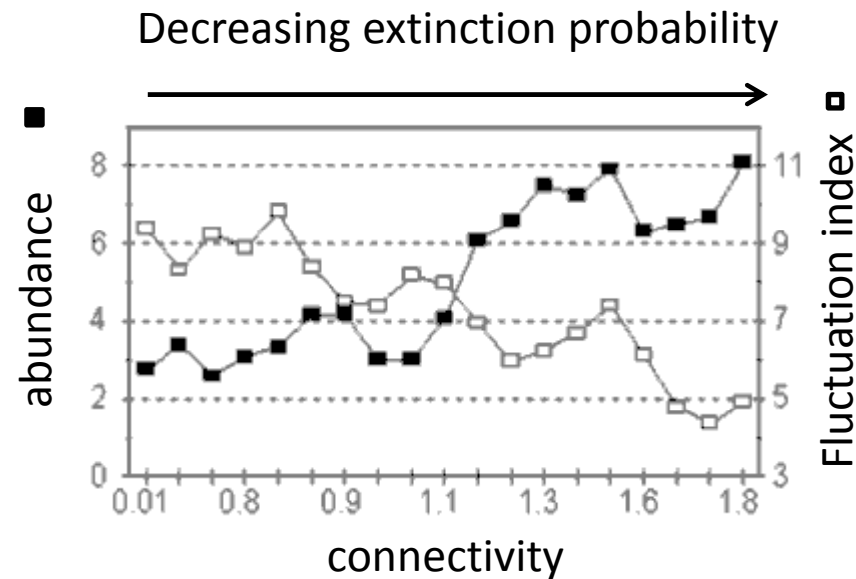
$$C = a*d1 + b*d2 + c*d3 + c*d4$$

But not all species use hedgerows as corridors

For some species gaps in the network are not a problem, as long as hedgerows are not too far apart

For others, hedgerows are barrier that impede connectivity

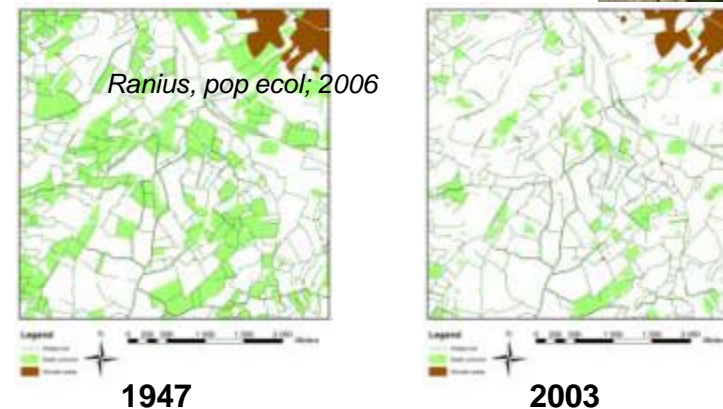
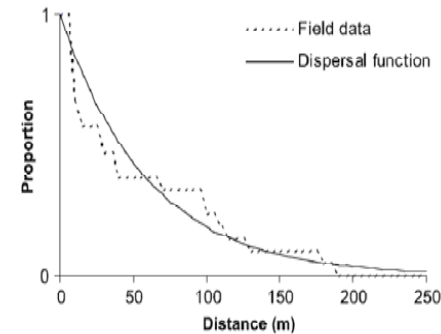
Connectivity may be measured as the density of hedgerows within the landscape context



Butet, 1995

Connectivity may be measured as the density of hedgerows within the landscape context

saproxylic beetle *Osmoderma eremita*



* Hedgerows changed less with time around inhabited trees than in the other parts of the landscape *O. eremita* would hence be very sensitive to landscape feature changes, hedgerows being of importance for its persistence by providing microhabitats

Hedgerows may act as barriers

Hedgerows may be barriers for butterflies
(*Lysandra bellargus*)



Hedgerows may act as barriers

Dispersal of *Primula acaulis* in a french alps hedgerow network, Champsaur



- * Isolation by distance pattern was shown
- * hedgerow network distances were found to contribute less than Euclidian distances to spatial genetic structure.
- * Pollen flow is probably the main factor shaping the spatial genetic structure
- * density of hedgerow networks impede gene flow.
- * high degree of habitat contiguity does not necessarily promote genetic connectivity.

Campagne et al., 2009

Implications for landscape design and management for biodiversity

For “forest species” network continuity is needed to serve as corridor between woodland (source of species)

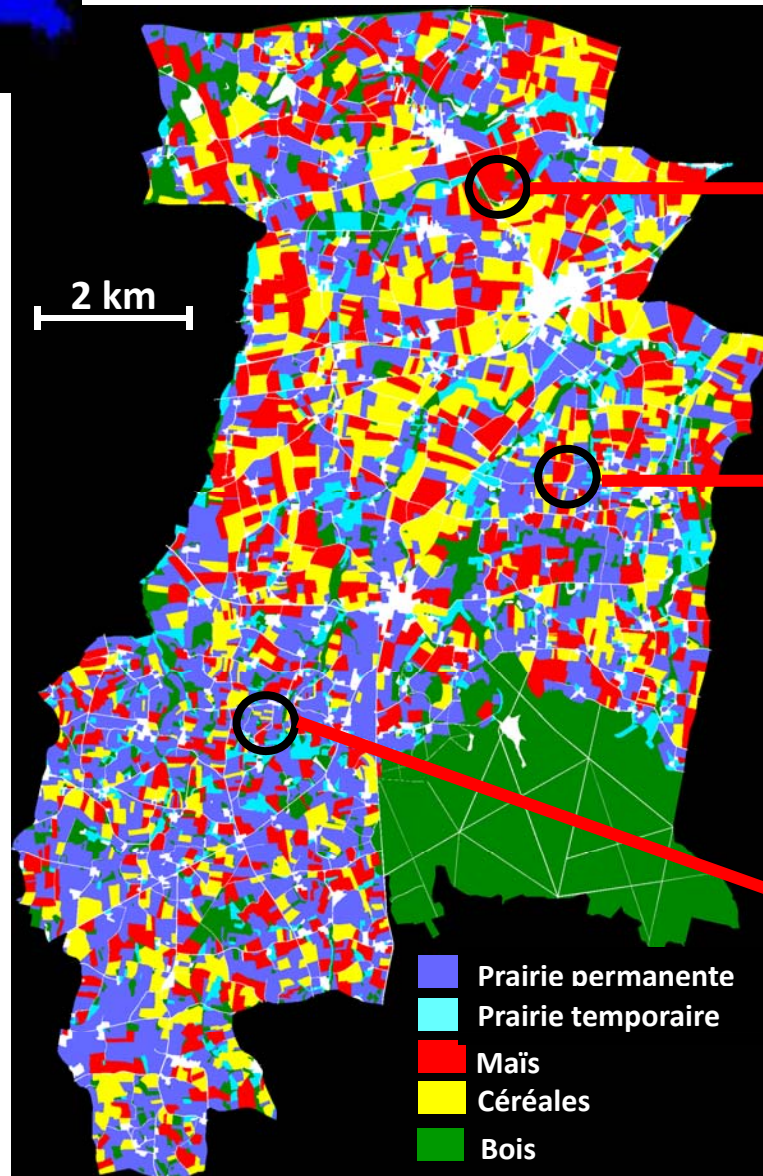
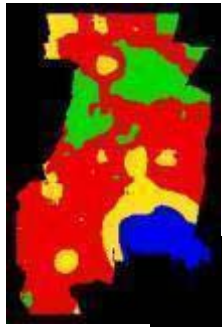
Continuity depends on hedgerow vegetation which is strongly related to farming activities

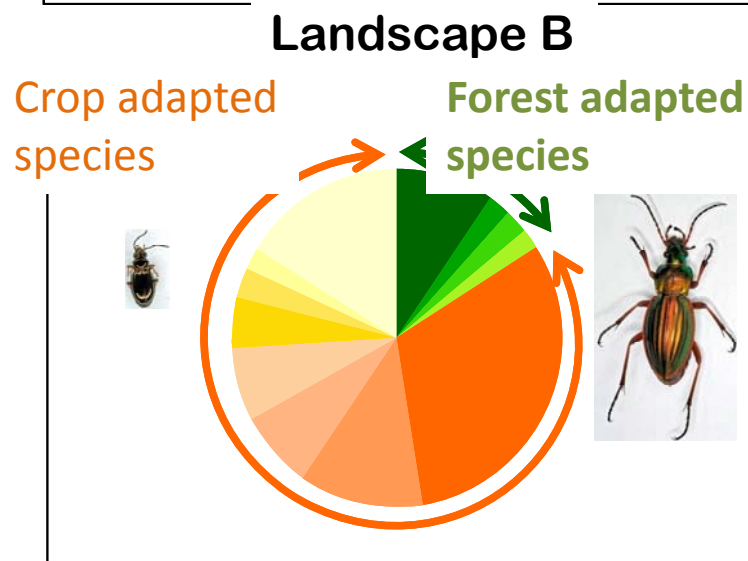
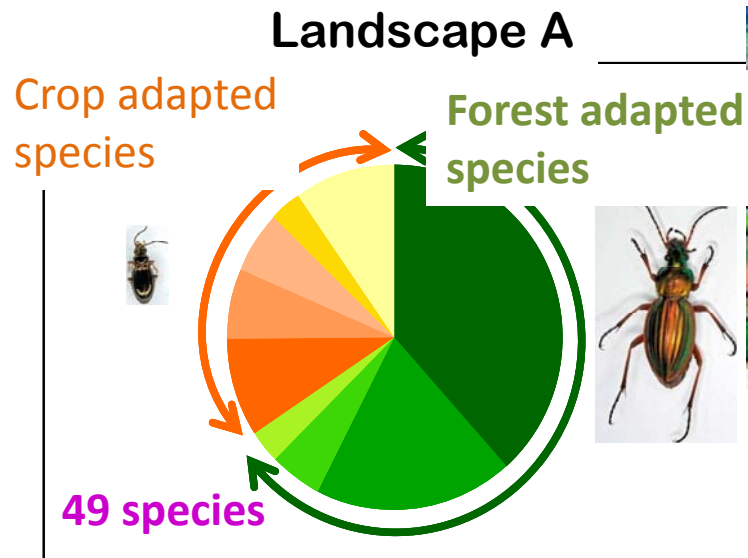
At a macro-regional scales there is a need to have different types of landscapes that provide different types of connectivity

This last point has been far less studied but is important to

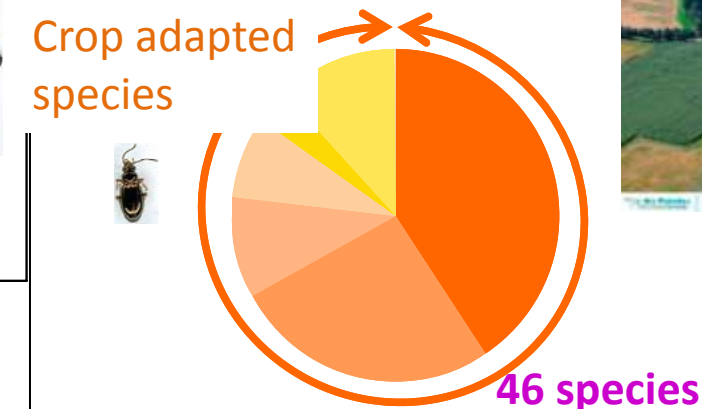
- Maintain β diversity
- to discuss species distribution and the service they provide to agriculture (pollination, biological control)

Pleine-Fougères LTER site





Landscape C



α diversity

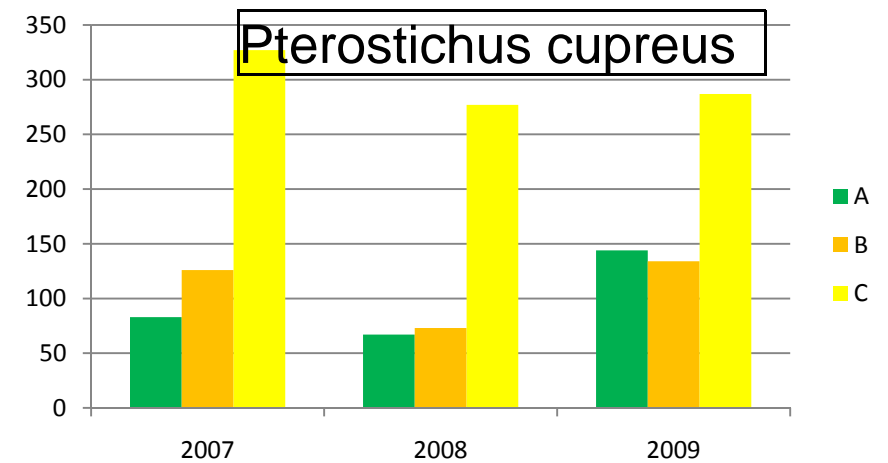
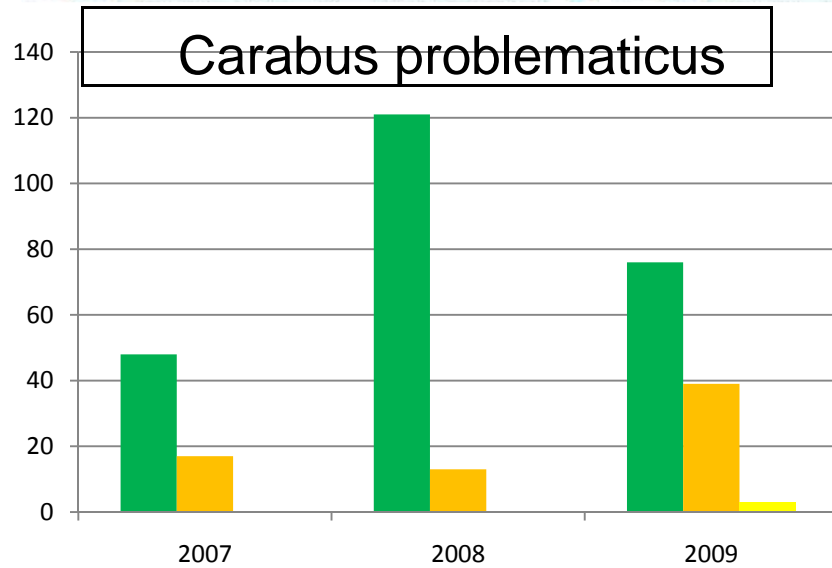
12 to 30 species
per hedgerow

γ diversity

78 species in total

B diversity: the between
landscapes diversity





A species of conservation interest



A predator of aphids





Thank you for your attention