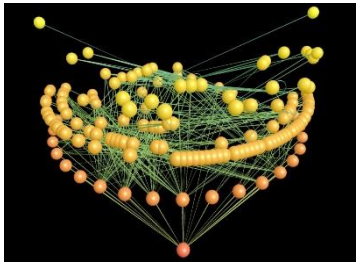
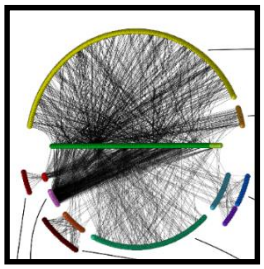


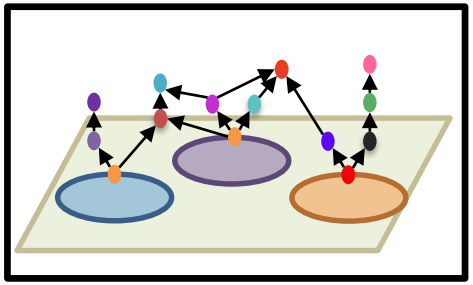




Ecology and conservation at the community level

Professor Jane Memmott,
University of Bristol



Outline

Introduction to communities, networks & interactions

The projects

1) The Norwood Farm project
2) The Urban Pollinators project

} How to make food webs

3) The Landscape project
4) The Species Extinction project

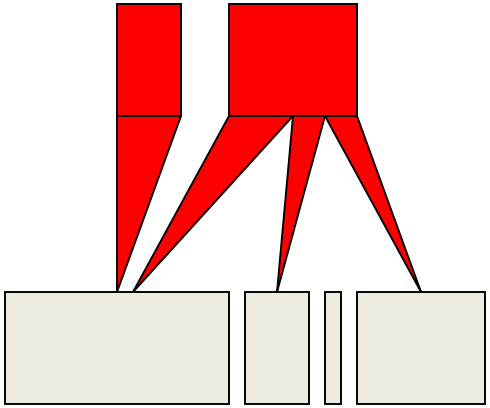
} Field experiments

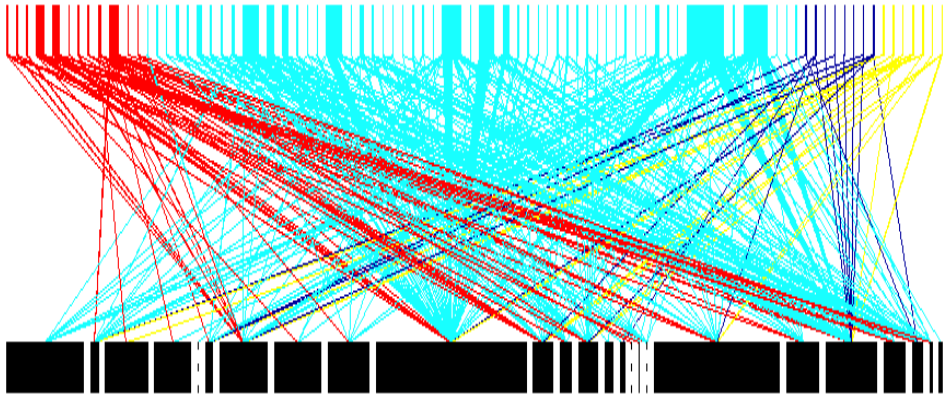
Summary

Communities, networks & interactions

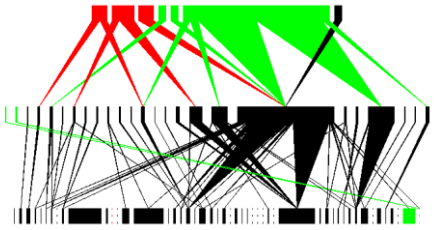
Pollinators

Flowers





Memmott (1999) Ecology Letters



Why study networks?

If ecologists are to manage biodiversity in the long term, then they need to understand the ways in which species interact, since these interactions can have a profound impact on a community's response to species loss, stress and ecological restoration.

The Norwood Farm Project

Can we remove the taxonomic constraints from food webs?

- Parasitoids webs
- Pollination webs
- Seed dispersal webs
- Aphid, leaf miner, caterpillar webs etc

Can we make a network of networks?

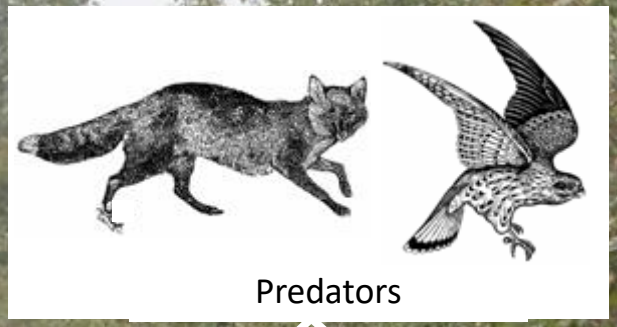
And can we identify keystone species – as these are the priority in conservation/restoration projects?

A farm food web


Butterflies


Parasitoids


Parasites


Predators


Leaf Miners


External Feeders

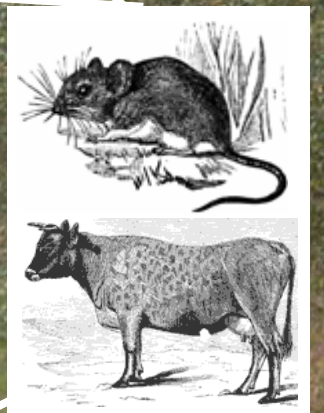

Aphids

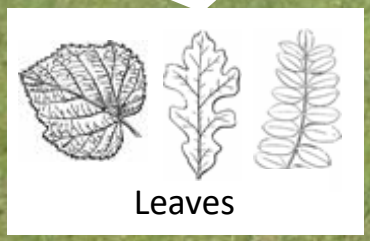

Gall Formers

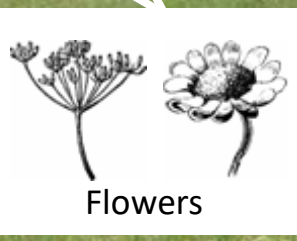

Pollinators


Seed Feeders


Seed-feeding Birds


Seed-feeding Mammals


Leaves


Flowers


Seeds (including crops)

Darren Evans and Michael Pocock

Plant seeds
Plant flowers
Plant leaves
Insects
Birds
Mammals
Herbivory
Pollination
Seed dispersal
Parasitoid attack
Parasitism













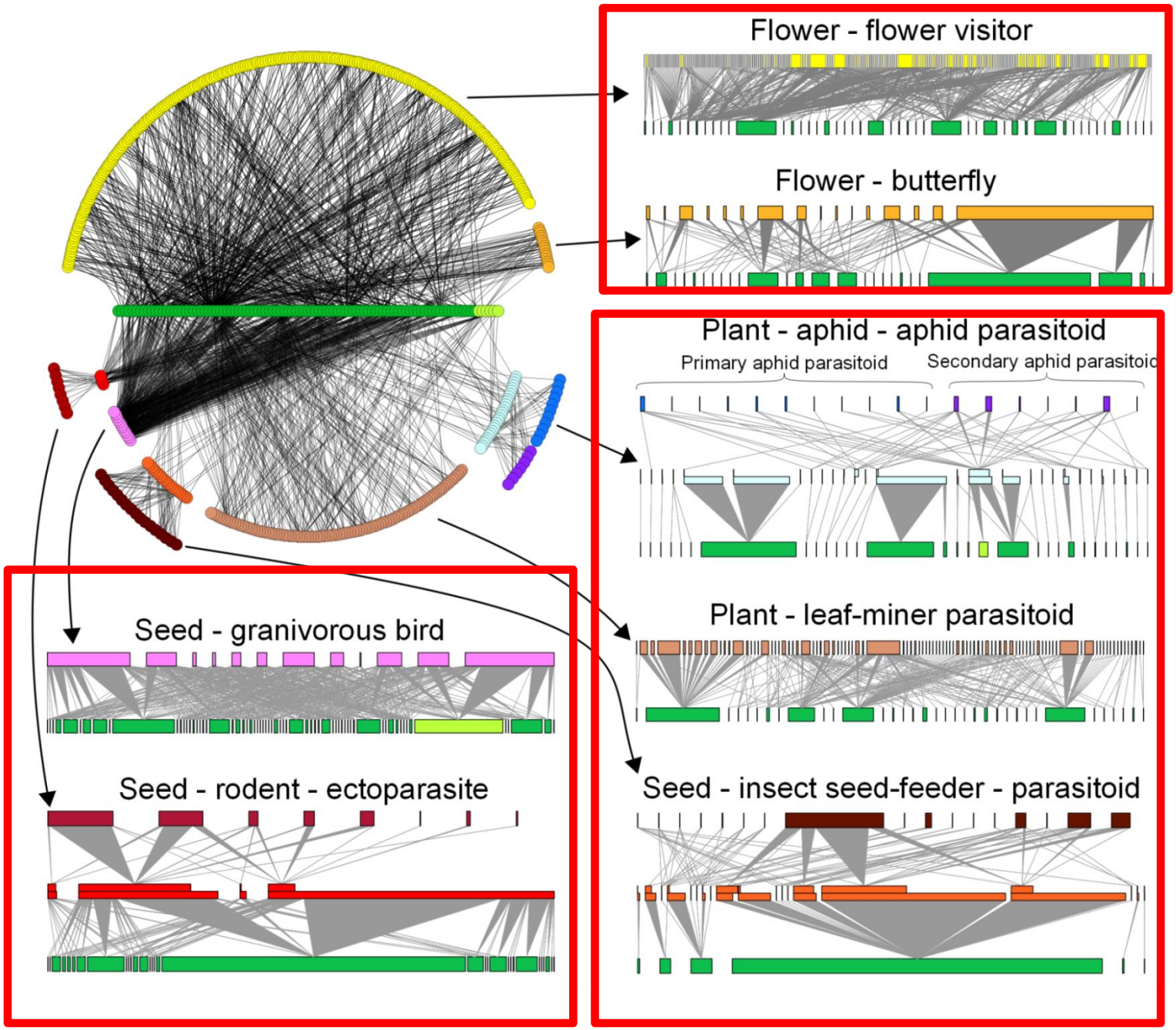









560 species
Plants
Insects
Birds
Mammals
Abundance, habitat, interactions


Flower - flower visitor
Flower - butterfly
Plant - aphid - aphid parasitoid
Primary aphid parasitoid
Secondary aphid parasitoid
Plant - leaf-miner parasitoid
Seed - insect seed-feeder - parasitoid
Seed - granivorous bird
Seed - rodent - ectoparasite

Key results

Keystone plants: non-woody taxa in non cropped ground (weeds!), e.g. *Cirsium vulgare, Anthriscus sylvestris*

Pollination network is the least robust to species loss

Pocock, Evans & Memmott, Science 2012

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Urban Pollinator Project




Academics: Universities of Bristol, Reading, Leeds & Edinburgh







Conservation practitioners in the 4 cities



Taxonomists at the National Museum of Wales

£1.3M Insect Pollinator Initiative

The questions

- How good are cities for pollinators c.f. farmland and nature reserves?
- Where exactly are pollinators in cities
- How can we make cities better for pollinators?

First field season sampled plants and pollinators in:

12 Cities

12 Farms

12 Nature Reserves

1 km

Triplets – Dundee to Southhamton to Cardiff

Key result

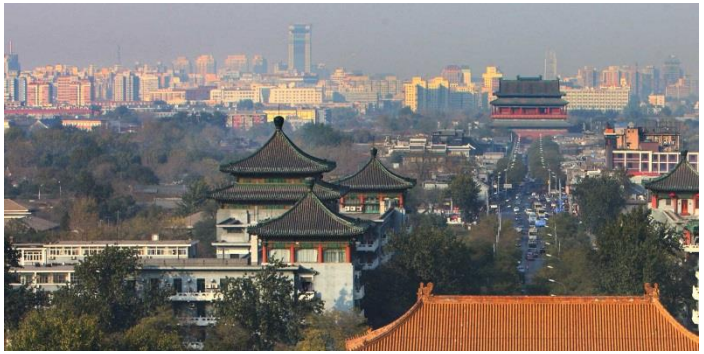
Significantly more bee species in cities than in the surrounding farmland

2nd & 3rd field seasons: where are pollinators in cities and how can we improve their lot?

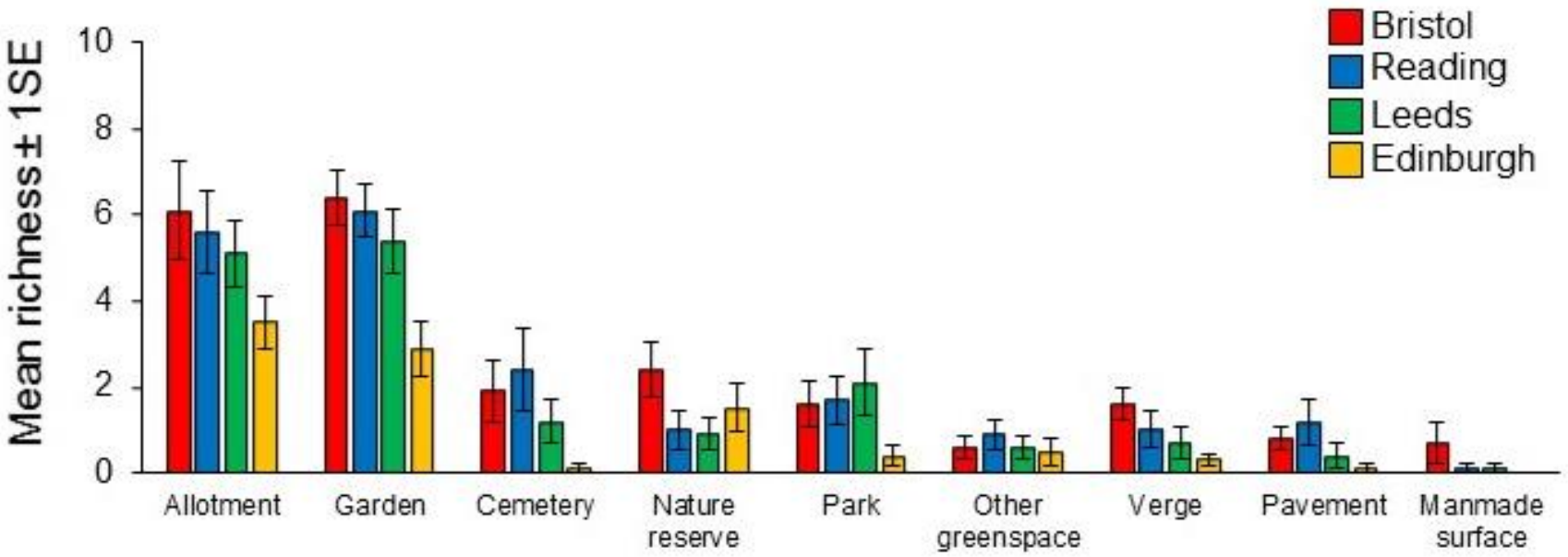

Gardens
Road verges
Urban Nature Reserve
Parks
Cemetery/churchyard
Allotment
Pavements
Railways
Other Green Space
Water
Roads
Man-made Surface

Sampling effort – 4 cities

- 4500 transect walks
- 7861 flower visitors, 390 species
- 641 plant taxa
- 427191 floral units counted
- **360 local plant-pollinator networks**



Results – effect of land use on pollinator species richness



How can we make cities better for pollinators?

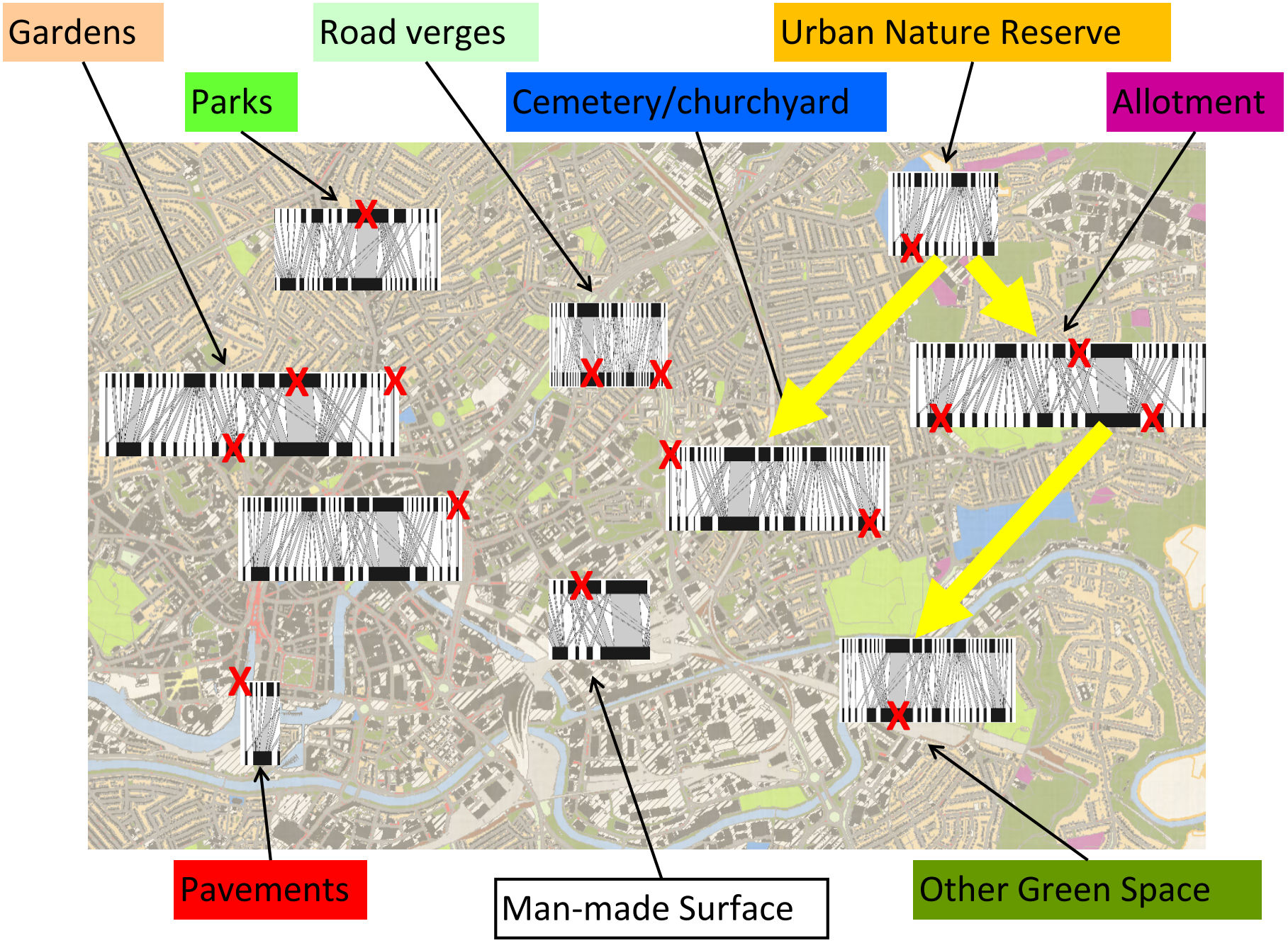
Increase the quantity and/or quality of habitats

Response variable – city wide robustness

Robustness & conservation biology

A high level of community robustness to species loss is increasingly recognised as an important goal in restoration ecology, since robust communities are more able to withstand perturbations

Robustness can be measured as a network statistic


Gardens
Road verges
Urban Nature Reserve
Parks
Cemetery/churchyard
Allotment
Pavements
Man-made Surface
Other Green Space

Habitat quantity

- Increasing the area of allotments made the biggest difference to city-wide pollinator robustness in 3 cities and the second biggest difference in the remaining city
- Allotments are c. 1% of the area of each city.

Baldock *et al.* Nature Ecology & Evolution, in review

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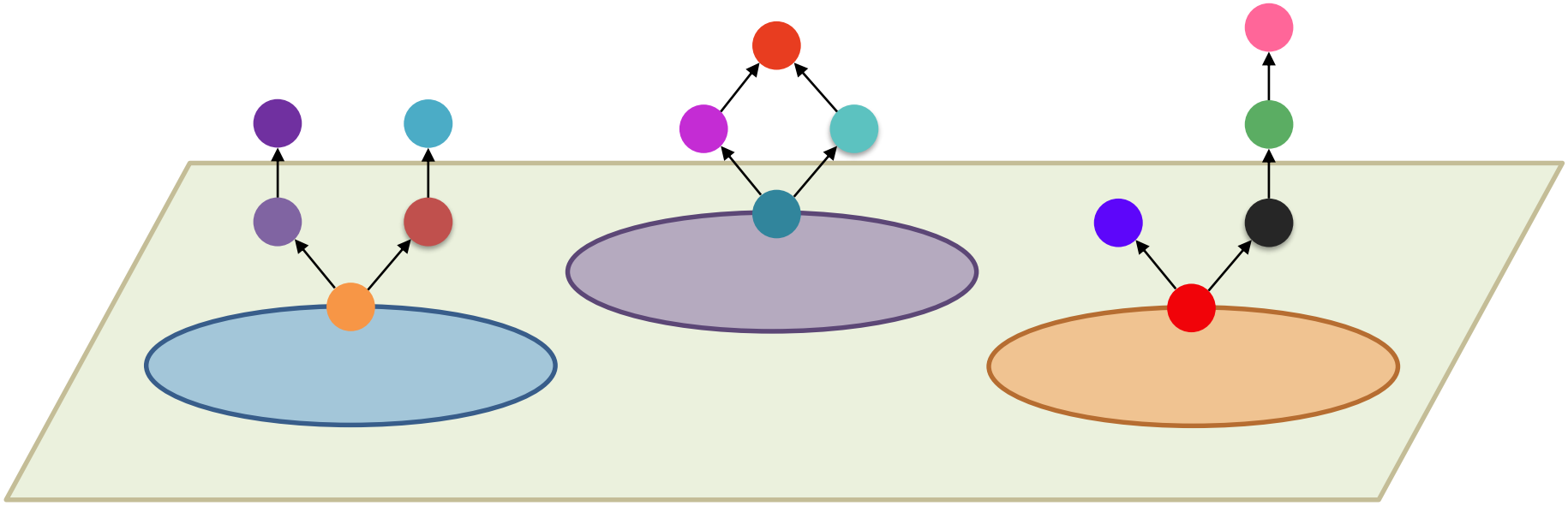
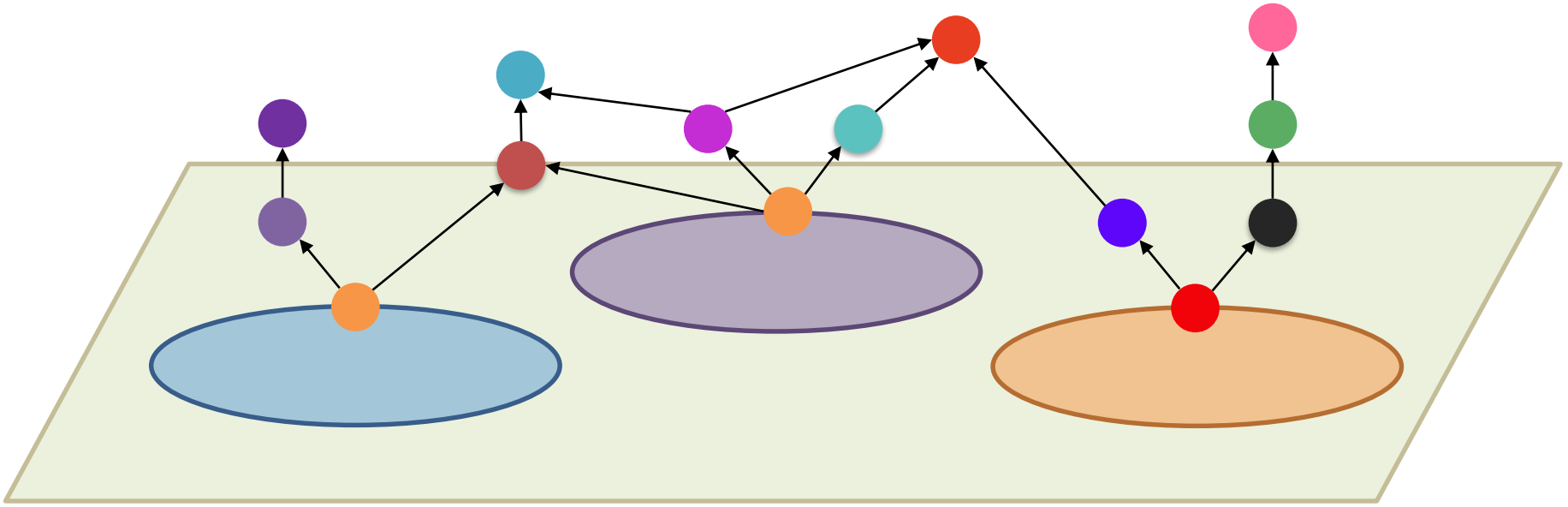
Landscape level conservation

Dr Talya Hackett Dr Alix Sauve

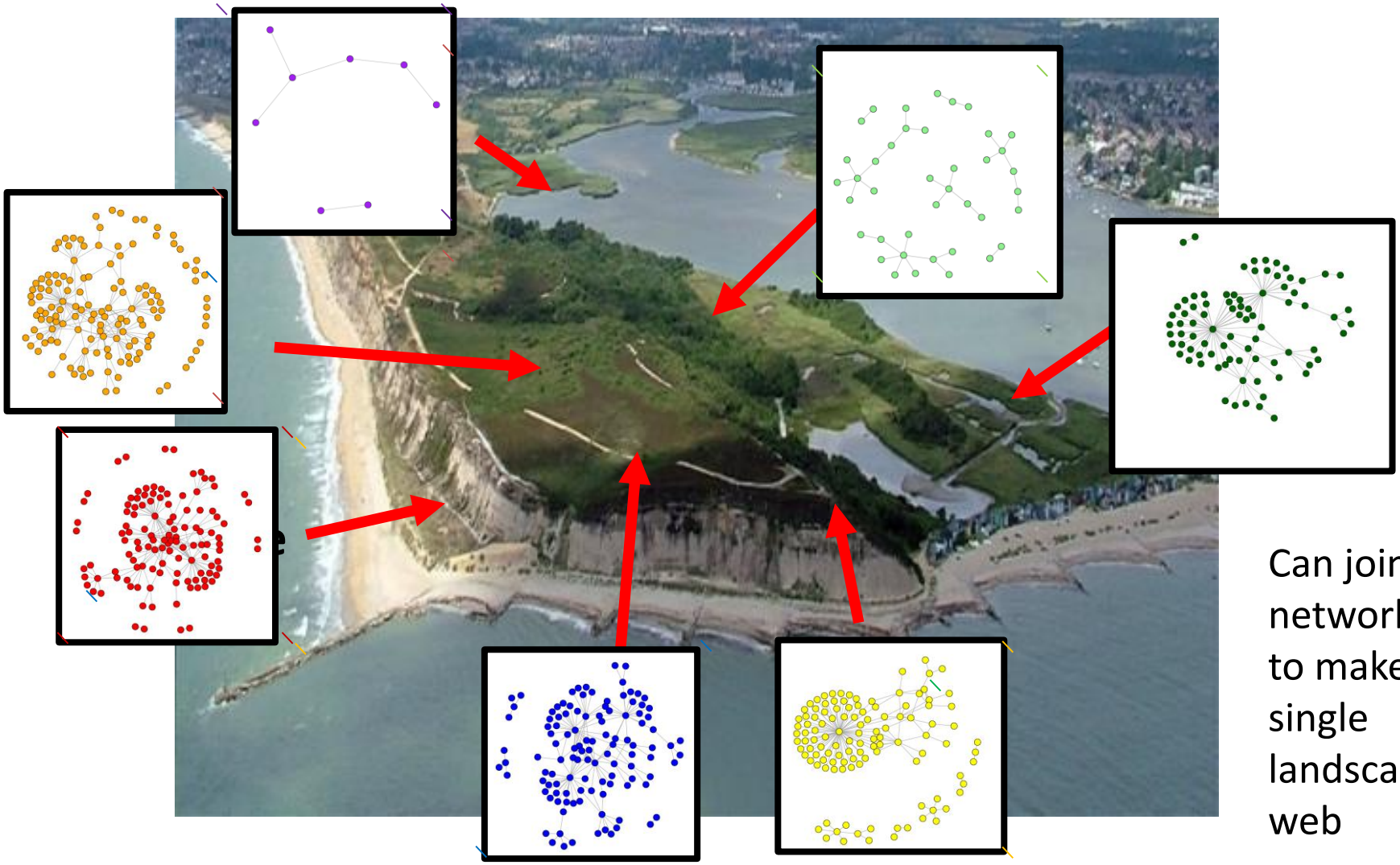
The question

- While conservation is increasingly at landscape level
- Networks to date are habitat specific (meadows, farmland, heathland etc)
- How do ecological functions (pollination) work at the landscape level in a mosaic of habitats?



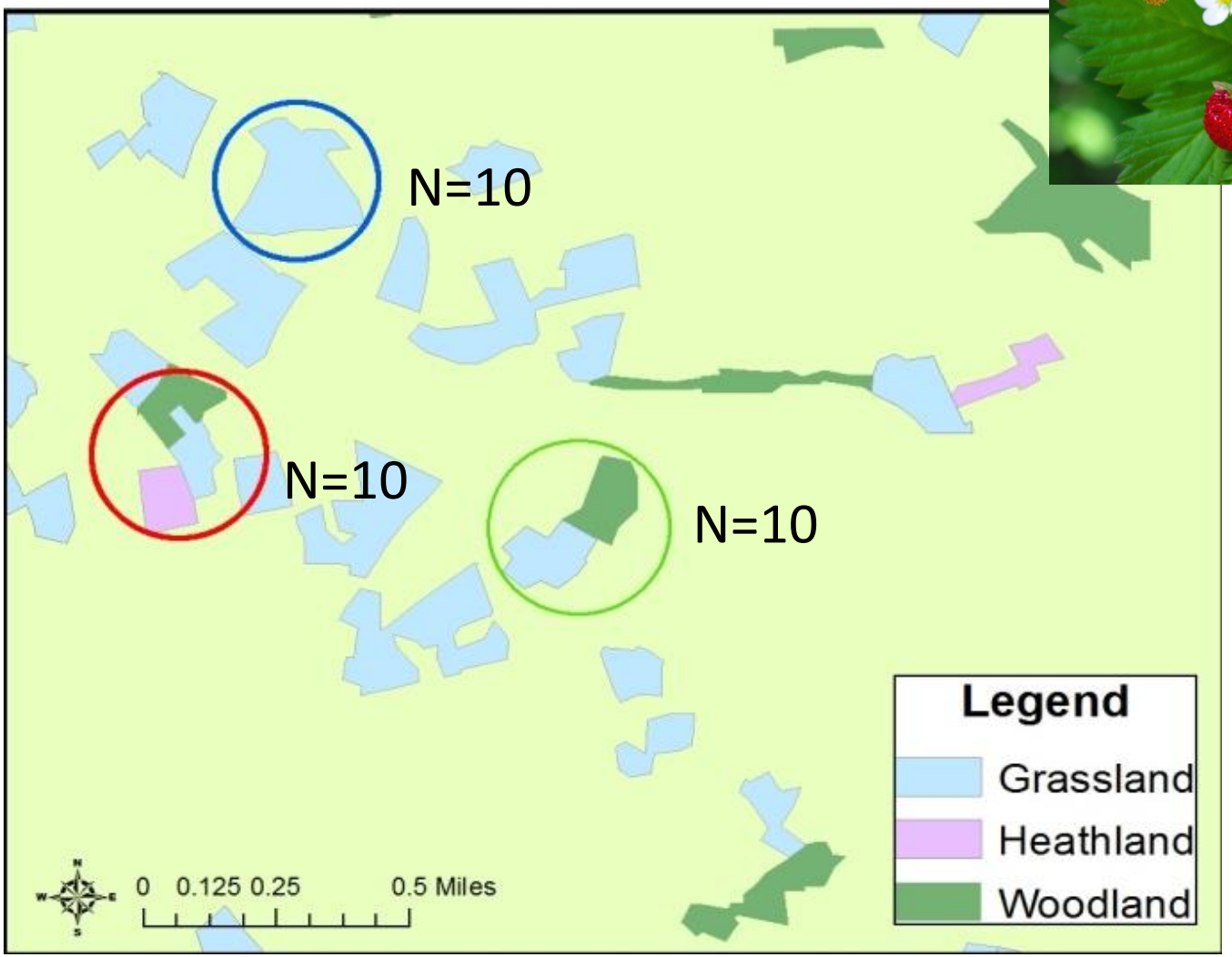


Year 1: Make landscape scale webs



Can join networks to make a single landscape web

Year 2: n = 30


N=10
N=10
N=10
Legend
Grassland
Heathland
Woodland
0 0.125 0.25 0.5 Miles

Results

Strawberries placed in monads, & triads for 2 weeks

Strawberries weighed significantly more in triads than monads

Heavier = more seeds in fruit, i.e. better pollination function in triads vs monads

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Effect of species loss on community function

Sergio Timoteo

Seed dispersal

Sergio's question

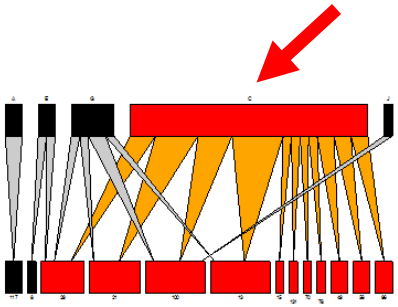
How do networks respond to the extinction of their most abundant species with respect to ecological function?

Field experiment in Portugal

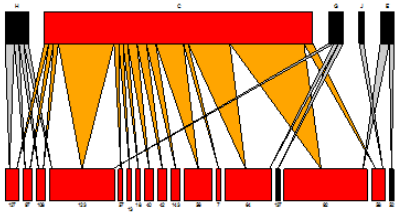
Huge perturbation: removed ant *B. messor* - 65% of dispersal
Expectation: dispersal severely affected

Results: the networks

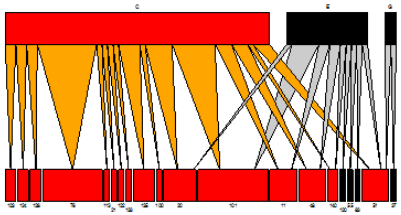
Forest x 6



Grazed forest x 6



Cereal field x 6



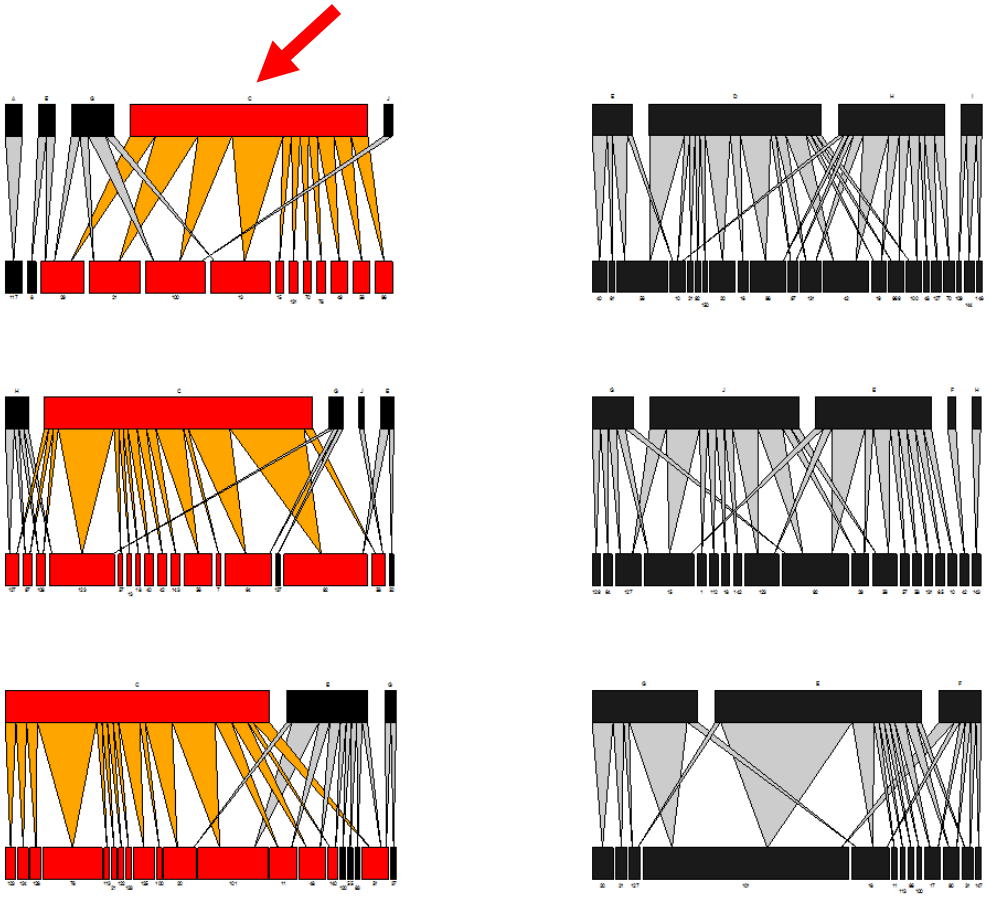
Control

Results: the networks

Forest x 6

Grazed forest x 6

Cereal field x 6



Control

Experimental

Results: removal did not affect the networks

Self healing – existing ant species expand their range, new ant species move in

Simulated extinction models dramatically overestimated the effect of local extinction

Need more data and better theory

Timoteo, Ramos, Vaughan & Memmott (2016) *Current Biology*

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Take home message

Ecological networks can be a powerful tool for understanding the structure and functioning of natural and managed ecosystems

Thanks to:

And collaborators and funding gods

Thank you for listening