



Ecosystem service provision by establishing temporal habitats in agricultural environments

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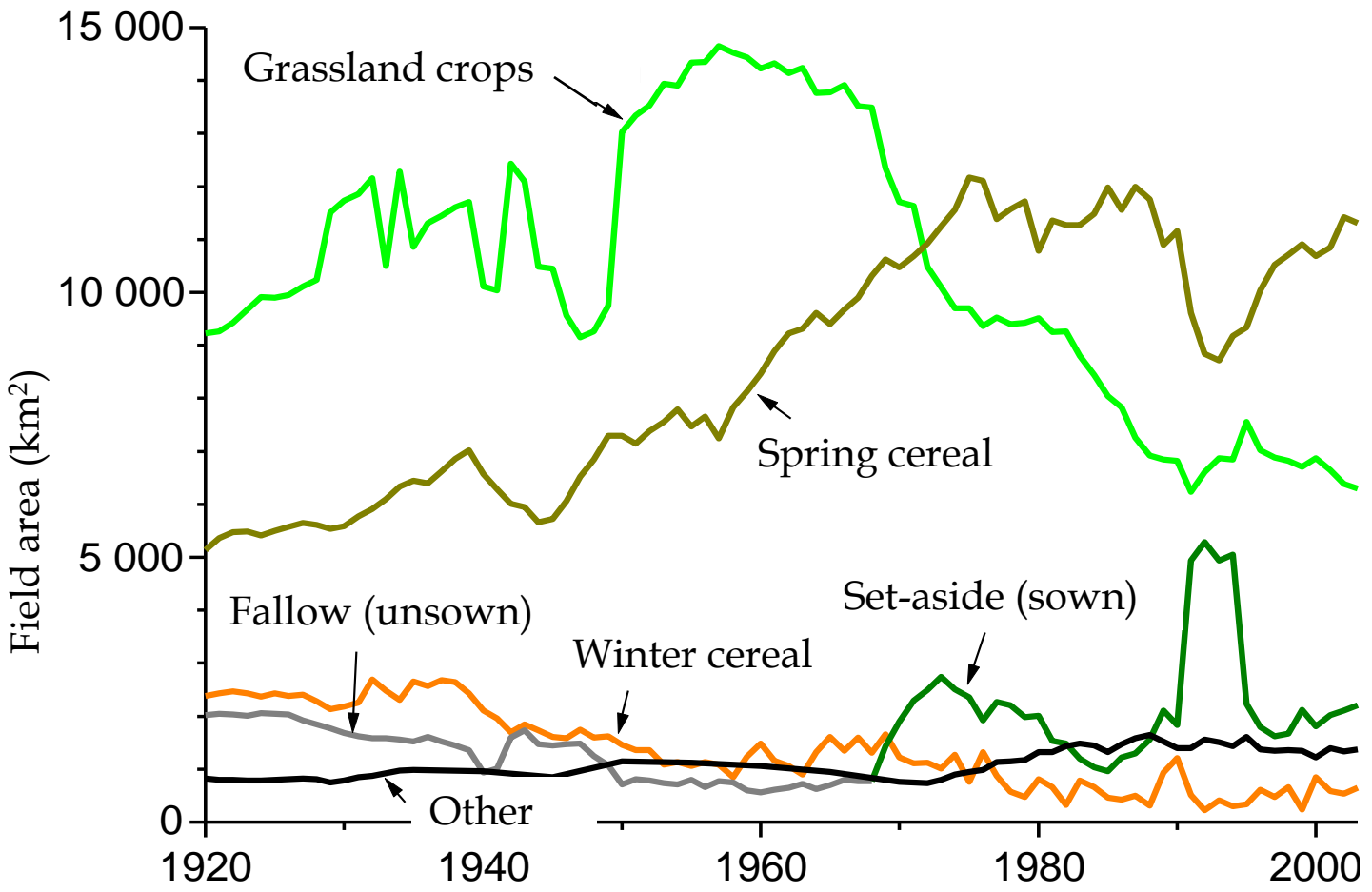
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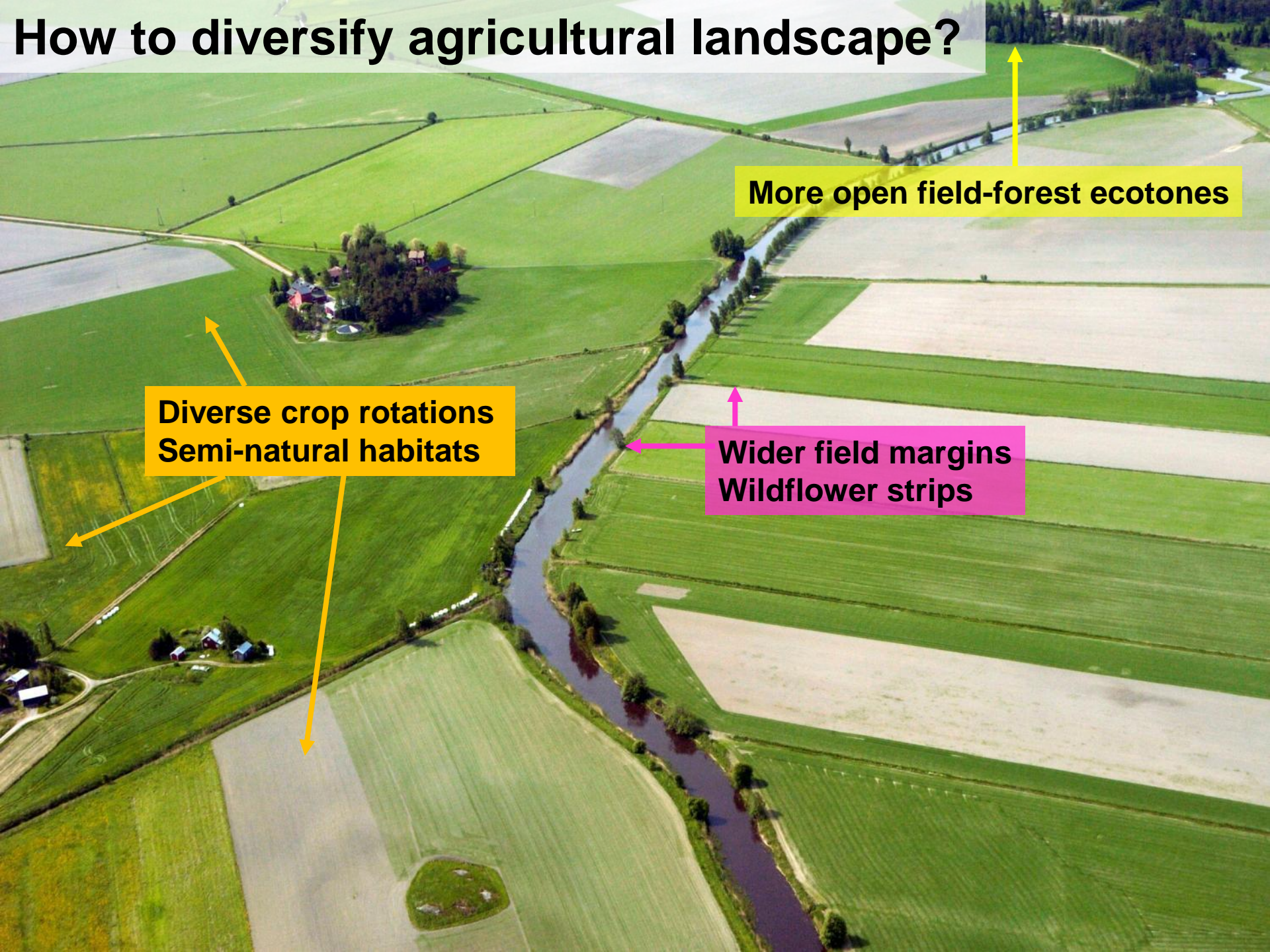
Background

- Intensification of arable production
 - specialisation, larger farm size, monoculture
- Decline in area of semi-natural grasslands and field margins
 - Simplified the structure of agro-ecosystems
 - Lower agrobiodiversity
- In several European countries, agri-environment support schemes are targeted to enhance biodiversity

Changing areas of crops in Finland



How to diversify agricultural landscape?



More open field-forest ecotones

Diverse crop rotations
Semi-natural habitats

Wider field margins
Wildflower strips

Use of agricultural area in Finland 2010

	1 000 ha	%
Cereals (dominated by spring barley and oats)	1012.2	44.2
Grasslands under 5 years (inc. hay, silage, green fodder pasture and seed production)	659.3	28.8
Grasslands at least 5 years (inc. natural meadows, pastures and grazing grounds)	33.0	1.4
Fallows (inc green, stubble, bare fallows)	82.2	5.3
Environmental fallows	162.8	7.1
Green manure	61.9	2.7
Other crops	274.9	10.2

'seminatural grasslands'

The Finnish Agri-Environment Scheme

- 92% of area (90 % of farmers) under AES in 2010
- AES includes obligatory and optional support measures
 - mainly aimed to water protection (reducing nutrient run-off)
 - only a few measures targeted to enhance biodiversity
 - organic production (7%), management of traditional biotopes (1%), promoting biological and landscape diversity (0.5%)

Background and Objectives

- **AES (agri-environment schemes)** : currently not sufficient to protect and enhance biodiversity in intensively cultivated landscapes

Aim: to study **establishment and management of temporal habitats in agroecosystems**

Develop old practical measures:

Rotational fallows
Long-term set-asides

Create new ones:

Wildflower strips
Field-forest ecotones



Ecosystem services and their measurement

Seed food production for farmland birds

Number of all seeds on soil top layer (~2-3 cm)



Insect food production for farmland birds

All insects caught by sweep net (or D-vac sampler)



Pollination

- honey bee (*Apis mellifera*)
 - bumblebees (*Bombus* and *Psithyrus*)
 - butterflies
 - diurnal moths
- found in transect counts



Natural enemies of pests

Ground-living arthropods by pitfall traps

Rotational fallows 2003-2006

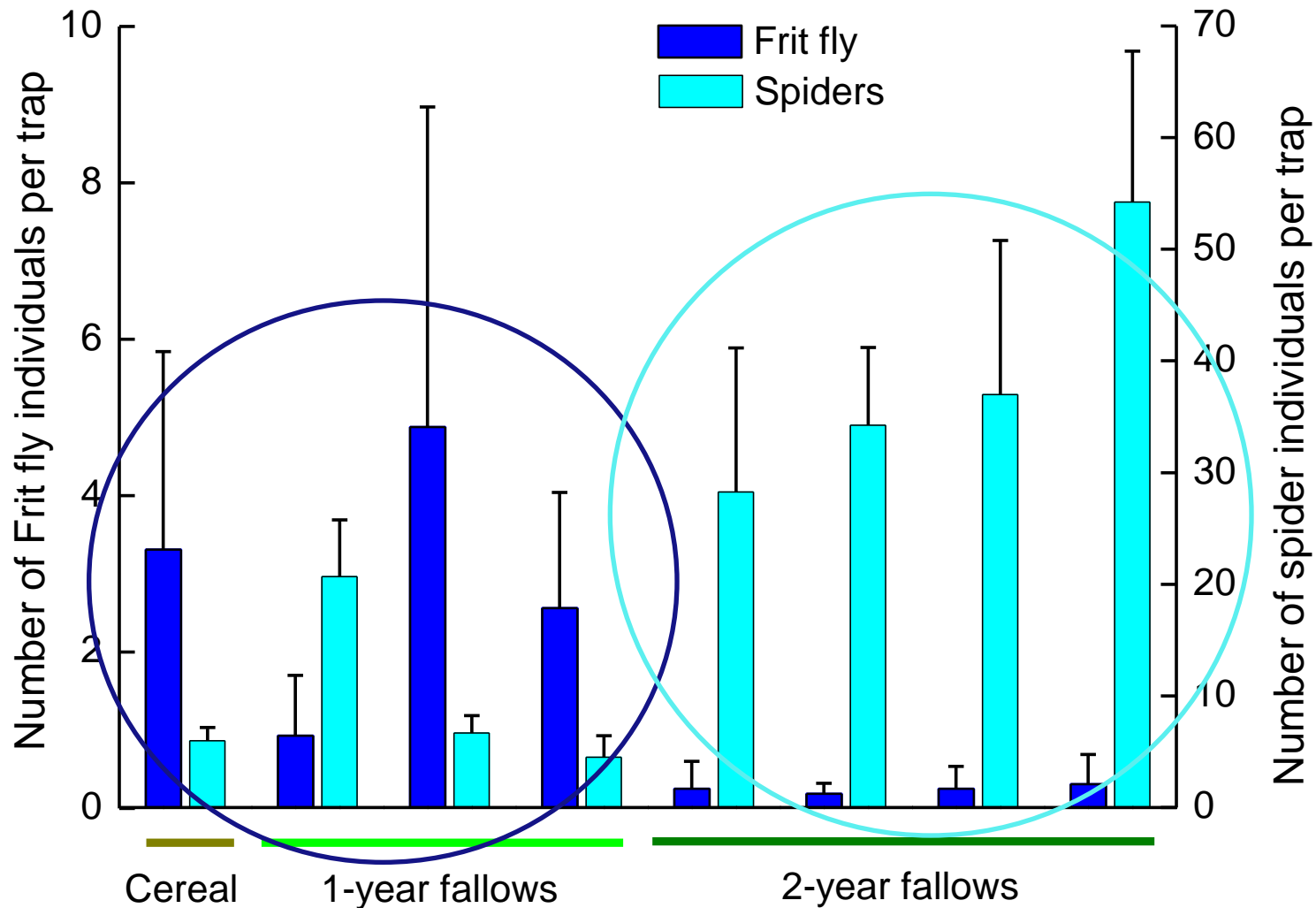


Field experiment:

- type of set-aside: green, stubble
- duration: 1 or 2 years
- seed mixture:
 - **'standard'**
(*Festuca pratensis* - *Phleum pratense* - *Trifolium pratense*)
 - **'less competitive'**
(*Agrostis capillaris*-*Festuca ovina*)
- establishment
 - undersown, not undersown

row-column design (4 replicates, 8 treatments)
plot size 0.3 ha

Rotational fallows 2003-2006



Long-term set-aside 2003-2008



Field experiment:

- strip-plot design
- 4 replicates
- plot size 0.25 ha (50 m x 50 m)

Establishment: 3 seed mixtures

”Standard”



”Less competitive”



”Meadow plants”

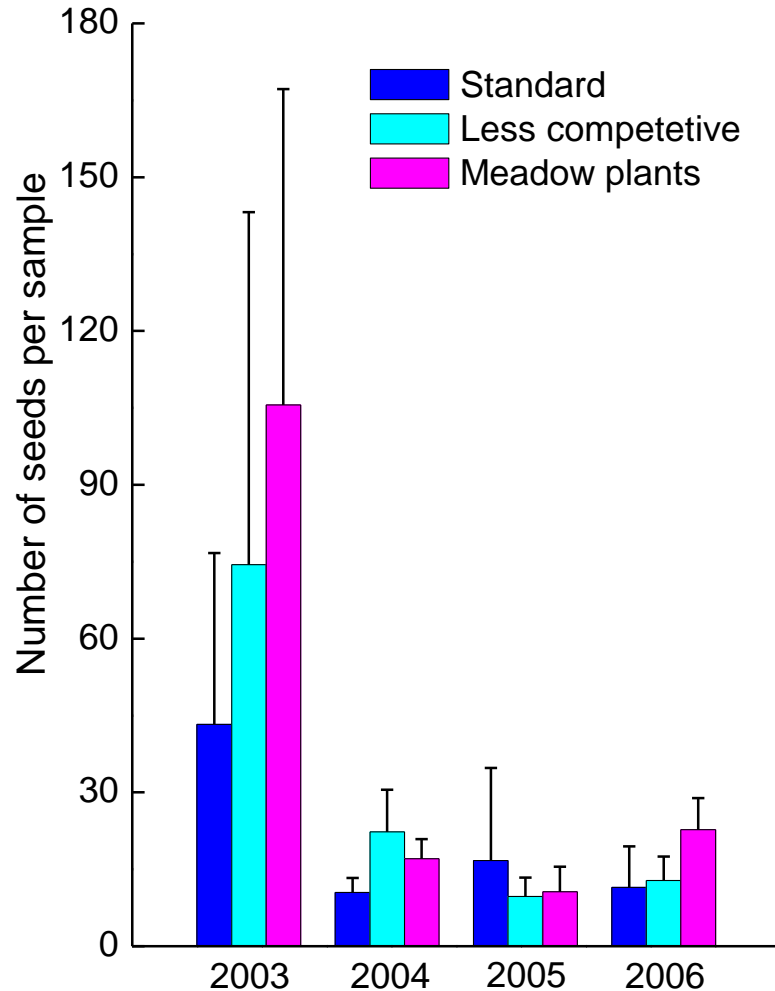


Management: mowing / no m.

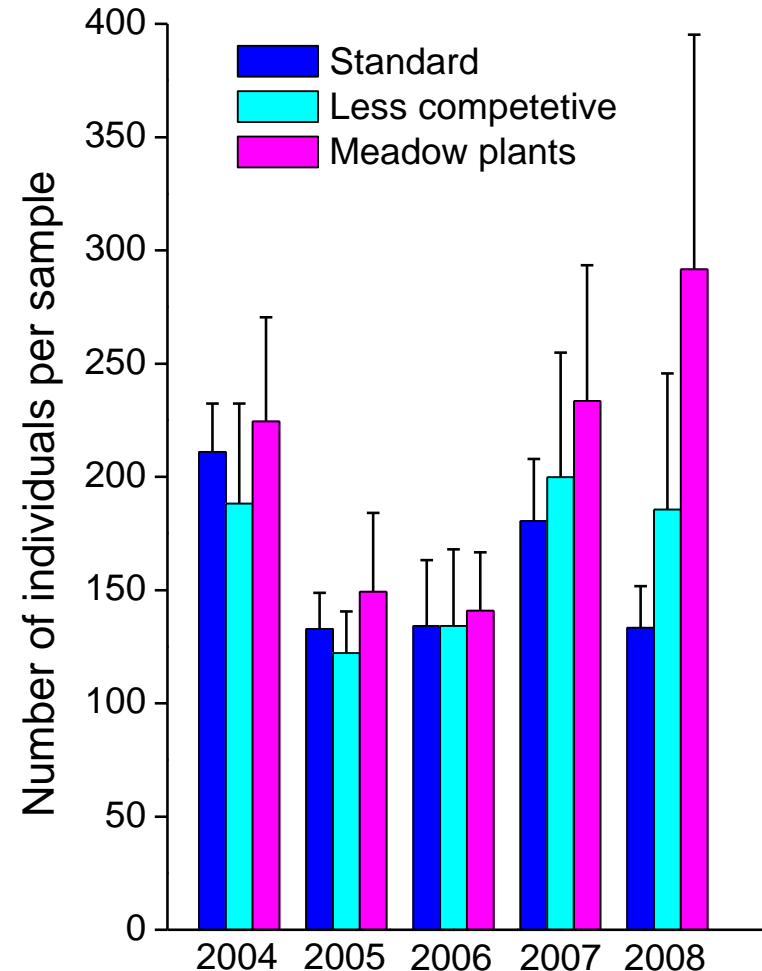


Long-term set-aside 2003-2008

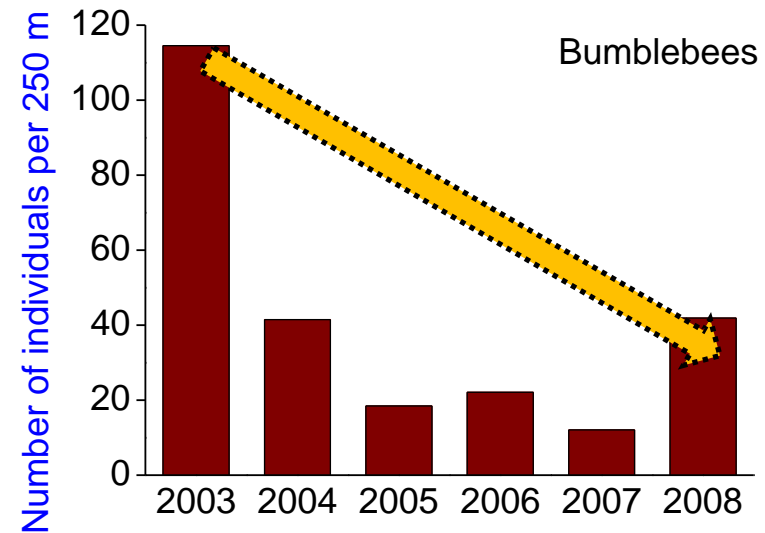
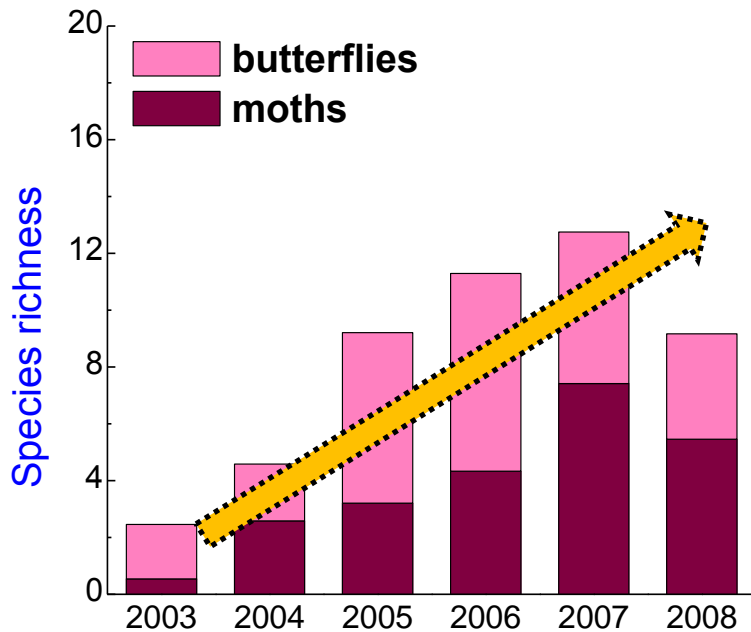
SEED FOOD



CHICK-FOOD



Long-term set-aside 2003-2008



Alanen, E-L, Hyvönen, T, Lindgren, S., Härmä, O. & Kuussaari, M. 2011. Differential responses of bumblebees and diurnal Lepidoptera to vegetation succession in long-term set-aside. *J. Appl. Ecol.* *in press*

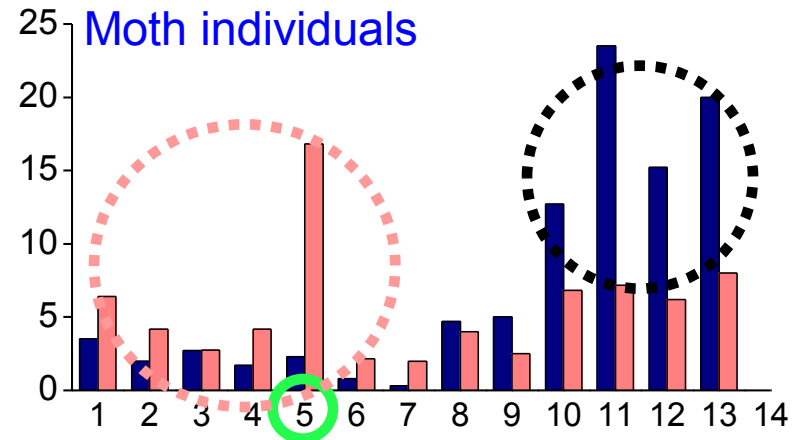
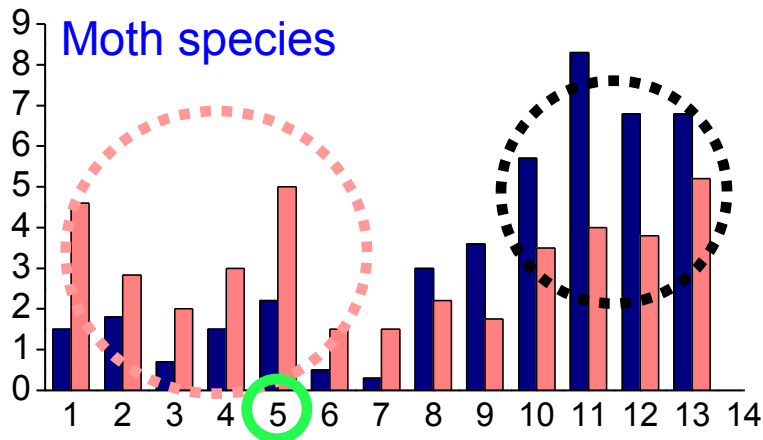
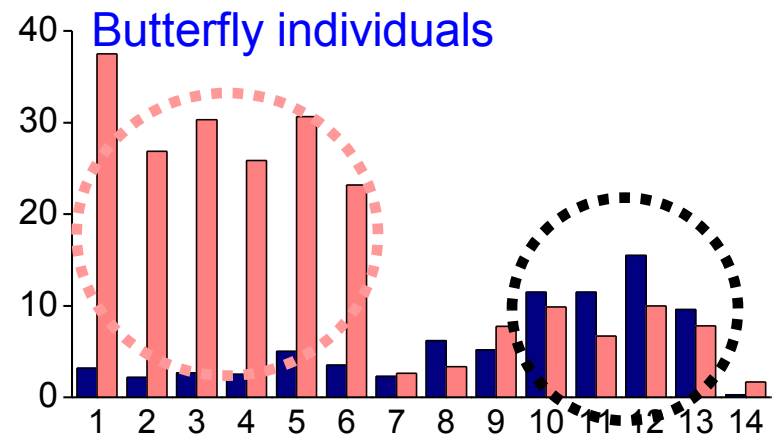
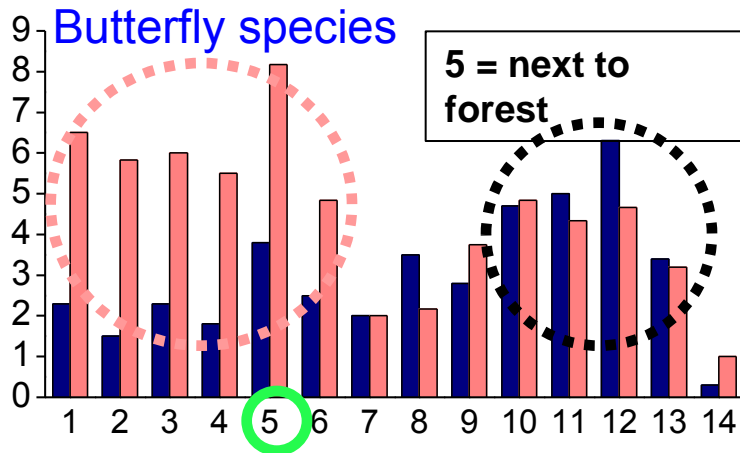
Wildflower strips 2007-2010



Field experiment:

- **Strips vs. matrix**
 - Wildflower strips
(*Centaurea jacea*, *C.phrygia*,
Leucanthemum vulgare, *Trifolium repens*, *Agrostis capillaris*)
 - Monoculture strip (*C. jacea*)
 - Control (*Phalaris arundinacea*)
- **Placement of the strip**
 - Next to forest
 - Next to field margin
 - lengthwise/crosswise
 - In the middle of the field

Wildflower strips 2007-2010



2007 2009

1-6: wildflower strips

10-13: field margins

Field-forest ecotones 2009→



- Idea: **Biodiversity zones in forests adjacent to fields**
 - Open meadow like habitats increase biodiversity
 - Income from forest logging can compensate bd costs

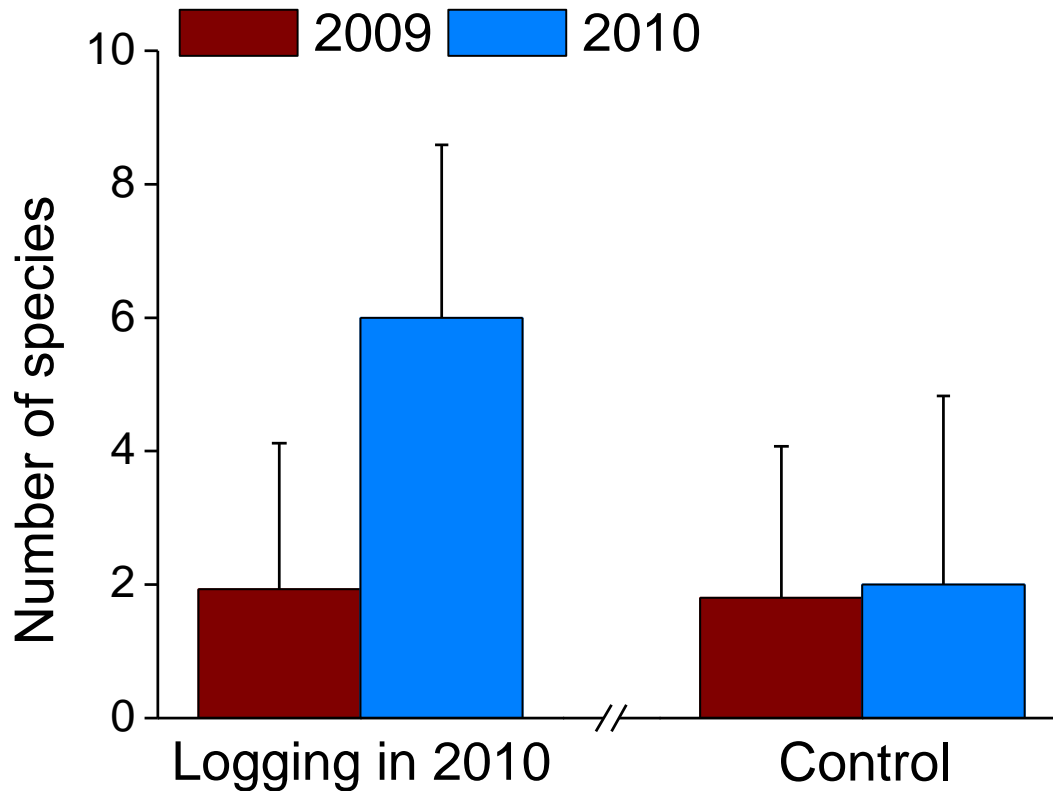


meadow strip (no trees) 5m



light selection logging 20 m

Field-forest ecotones 2009 →



Butterflies



How to improve the effectiveness of agri-environment scheme?



- **Rotational fallows**

- Stubble or seed of less competitive grasses best for pollinators
- Less pests, more natural enemies in two-years fallows than in cereal fields

- **Long-term set-aside**

- can maintain/enhance pollinator populations, if established using a suitable seed mixture (inc. nectar and pollen plants or less competitive grasses)
- Old (> 5 year) set-asides important to butterflies and moths
- The age of set-aside and vegetation structure are more important than seed mixture or plant species richness in supporting insect food for birds

- **Wildflower strips**

- Placement of the strip next to forest

- **Field-forest ecotones**

- Open meadow habitats increase bd of pollinators



How to support ecosystem services?



- *The promotion of each ecosystem service requires specific management*
- *Seed food production for farmland birds*
 - Short-term rotational fallows or new set-asides (specific seed-bearing crops)
- *Insect food production for farmland birds*
 - Set-asides of various ages, wildflower strips
 - Availability depends on vegetation height, density, heterogeneity
- *Pollination*
 - The long-term set-aside can maintain/enhance pollinator populations
 - Set-asides of various ages
 - ✓ social bees respond faster to set-aside (nectar and pollen)
 - ✓ butterflies and moths colonize slower (larval food plants)
 - Network of field margins important in the long run
 - Placement of wild-flower strips next to forest
- *Pest control by natural enemies*
 - Permanent grasslands, non-crop habitats



Conclusions

- *Ecosystem services can be promoted by establishing temporal habitats*
- *The most beneficial management varies between ecosystem services*
- *Area of temporal habitats supported by AES should be increased in agricultural landscape*



Thank you!

