

Light or Dark ?

Zoning woodland management for a more effective conservation of threatened moths and butterflies

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Conservation priority

TRADITIONALLY

Rare
Localised
Specialist



RECENTLY

(formerly) Common
(formerly) Widespread
Generalist



e.g. *Coenonympha tullia*
Large Heath



e.g. *Lasiommata megera*
Wall Brown

Birds – New Zealand
Marsupials – Australia

(Elliott et al 2010)
(Lindenmayer et al 2011)

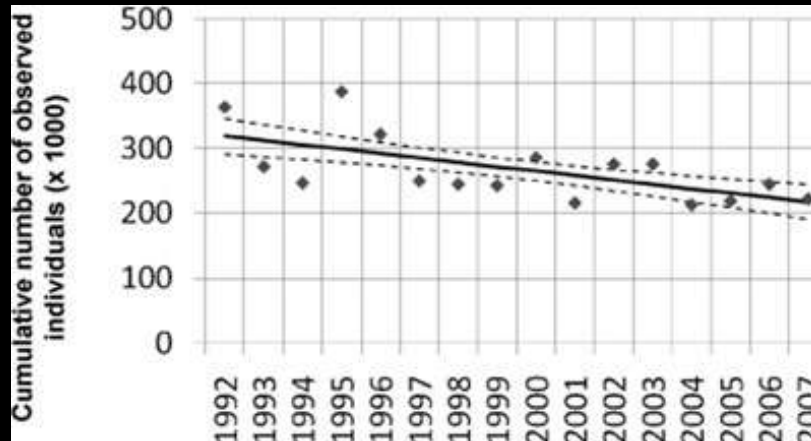


Van Dyck et al 2009: Butterflies - The Netherlands

20 common, widespread species

11 species suffered severe declines

Overall abundance -30% over 16 years



Endangered (IUCN)

Flanders: Endangered (IUCN) ((Maes et al 2012)

UK: BAP Priority species (-37%/10yrs)

Declines in Common, Widespread Butterflies in a Landscape under Intense Human Use

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Abstract: Analyses of species population trends typically show a dichotomy between strongly affected, rare, and localized species and apparently unaffected, common, and widespread species. We analysed 16 years (1992–2007) of butterfly transect count data from The Netherlands in a reevaluation of the trends of common, widespread species. Fifty-five percent (11 of 20 species) of these species suffered severe declines in distribution and abundance. Overall, cumulative butterfly abundance declined by around 30%. Some of the species in decline used to be omnipresent in gardens and parks, and 2 of the species were previously considered agricultural pests. Based on their declines over the last 16 years, 2 of the 20 species (*Lasiommata megera* and *Gonepteryx rhamni*) reached endangered status in The Netherlands under the IUCN (International Union for Conservation of Nature) population-decline criterion, and 2 species (*Inachis io* and *Thymelicus lineola*) met vulnerable criterion. Butterflies in farmland, urban, and particularly woodland areas showed the largest decline in species abundance. The abundance of species associated with vegetation types found mainly in nature reserves (dunes, heathland, and, to a lesser extent, semi-natural grassland) increased or remained stable. The decline of widespread species requires additional conservation strategies in the wider landscape.

Keywords: biodiversity, butterflies, habitat generalist, habitat specialist, intensive land use, species abundance, species distribution, species richness

Declinaciones en Mariposas Comunes, con Distribución Amplia, en un Paisaje Bajo Uso Humano Intenso

Resumen: Los análisis de tendencias de poblaciones típicamente muestran una dicotomía entre especies fuertemente afectadas, raras y localizadas y especies aparentemente no afectadas, comunes y con distribución amplia. Analizamos datos de 16 años (1992–2007) de censos de mariposas en transectos en Holanda en una reevaluación de las tendencias de especies comunes, con distribución amplia. Cincuenta y cinco por ciento (11 de 20 especies) de estas especies sufrieron declinaciones severas en distribución y abundancia. En general, la abundancia acumulativa declinó alrededor de 30%. Algunas de las especies en declinación anteriormente eran omnipresentes en jardines y parques, y dos de las especies previamente eran consideradas plagas agrícolas. Con base en sus declinaciones en los últimos 16 años, dos de las 20 especies (*Lasiommata megera* y *Gonepteryx rhamni*) alcanzaron el estatus en peligro de acuerdo con el criterio de declinación poblacional de la IUCN (Unión Internacional para la Conservación de la Naturaleza), y dos especies (*Inachis io* y *Thymelicus lineola*) cumplieron con el criterio de vulnerabilidad. Las mariposas en áreas agrícolas, urbanas y particularmente en bosques mostraron la mayor declinación en abundancia de especies. La abundancia de especies asociada con tipos de vegetación encontrados principalmente en reservas naturales (dunas, matorrales, y, en menor grado, pastizal semi-natural) incrementó o permaneció estable. La declinación de especies con distribución amplia requiere estrategias de conservación adicionales en la amplitud del paisaje.

Paper submitted June 19, 2008; revised manuscript accepted November 17, 2008.

specialists

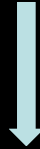


widespread but declining species



Resource requirements:

highly specific



broader



Conservation approach:

targeted

???

Conservation practitioners/scientists slow in tackling this problem

- Specialists somehow more valuable?
- Distraction / conflict with efforts to conserve specialists?

What is clear !

- Landscape-scale conservation projects need to cater for threatened specialists and generalists alike
- Conservation biologists need to provide evidence on how best to do so

Macro-moths can help provide the evidence



- highly species-rich
- many **specialists** under threat (e.g. 81 UK BAP species)
- **common, widespread species** – Britain (Conrad et al 2006):
 - N_{total} 35 yrs: -1/3
 - 2/3 of species declined during the last few decades
 - 71 (out of 337) species threatened (IUCN)
- Similar picture The Netherlands (Groenendijk & Ellis 2011)

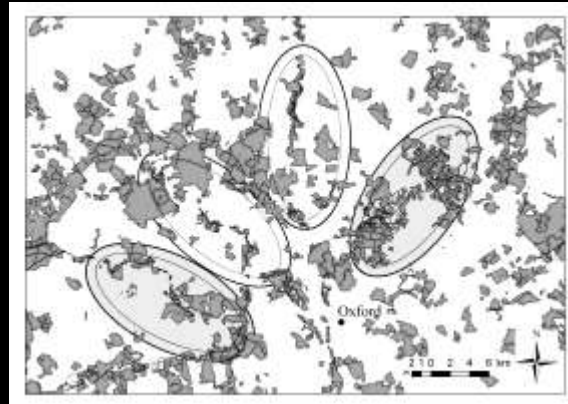




Recent work on macro-moths:

often focused on **Farmland / design of AES:**

- wide, nectar-rich field margins
- hedgerow trees
- landscape-scale implementation



Benefits:

- widespread species (Merckx et al 2009, Fuentes-Montemayor et al 2011)
- localized species (Merckx et al 2010)

However, declines widespread moths only partly understood

Factors other than farmland management likely to be important



WOODLAND

Woodlands lost a significant proportion of butterfly richness since 1950 (van Swaay et al 2006)

Both

- woodland specialists
- species of open areas (rides/clearings/heaths/glades)



Probable reason:

- afforestation of open areas
- intensive, high forest management practices



Causing **habitat quality** declines (total woodland area stable / increase)

Sympathetic management offers **great potential**:

- Native woodland dominant biotope
- Over half of all UK macro-moth species depend on woodland (500/900)
- But management impacts on moths not well studied (>< butterflies)



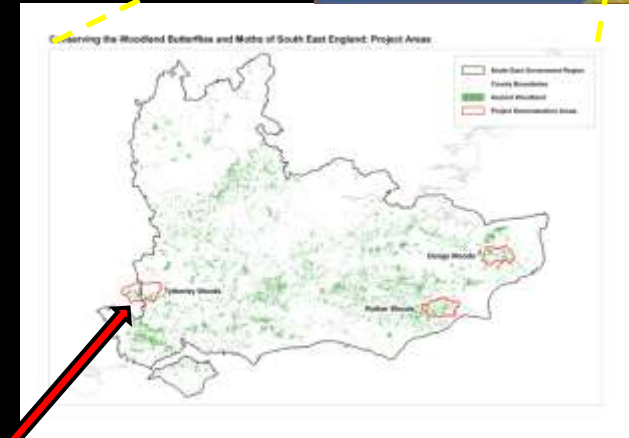
Landscape-scale experiment

Can woodland conservation management cater both for:

rare, localised species
of traditional
conservation concern



widespread
but declining species



Ancient woodland in SE England

We test:

- management effects on **presence-absence / abundance / species richness**
- differential effects among **species groups of different conservation status**

- 6 'woodland management' treatments
- 6 trap sites each: 36 sites

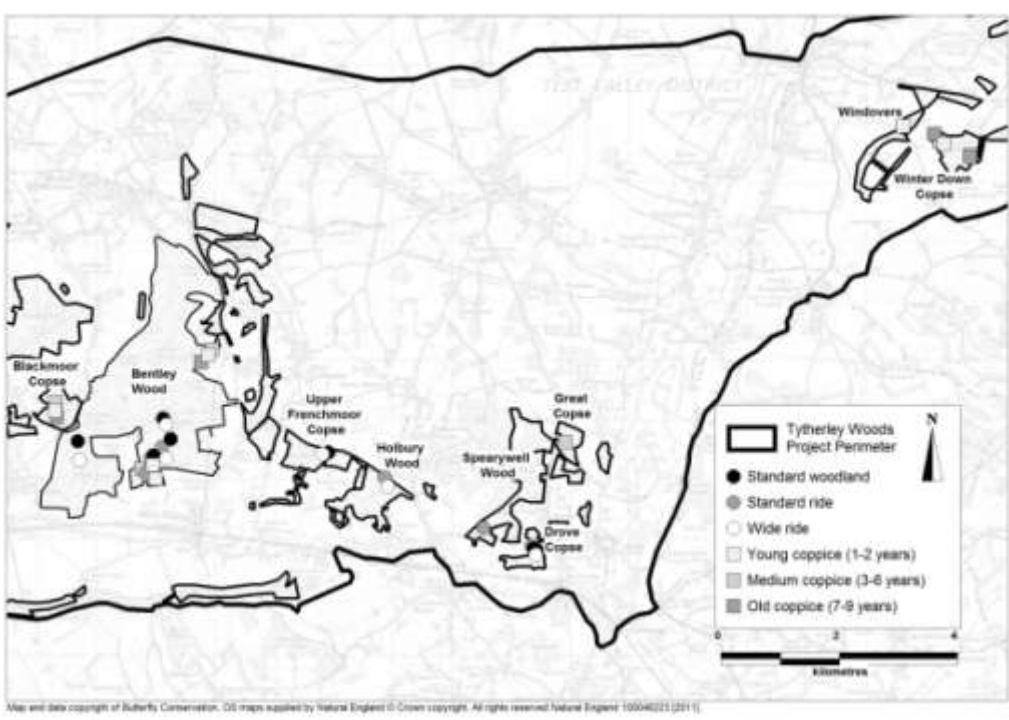
HAZEL COPPICE



RIDES



STANDARD WOODLAND



Trapping

- Heath traps
 - each site sampled 9 times ($36 \times 9 = 324$ events)
 - 12 sites sampled / night
 - 27 trap nights
 - July-October 2010



Conservation status:

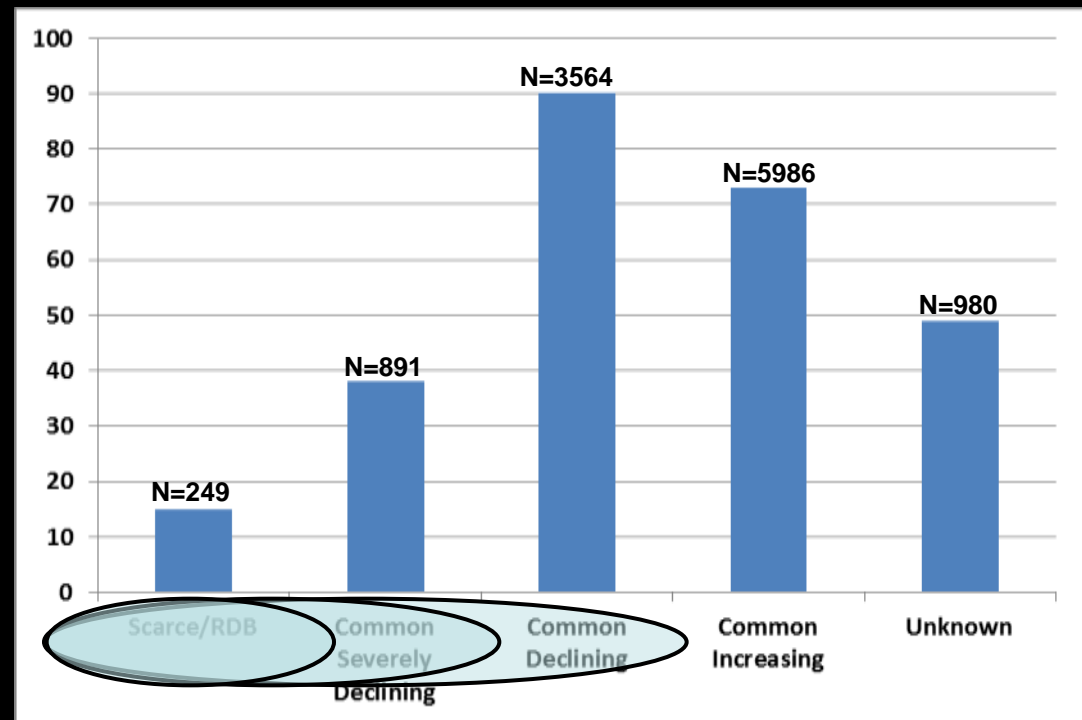
- **Scarce/RDB:**
- **Common Severely Declining:**
- **Common Declining:**
- **Common Increasing:**
- **Unknown**

nationally scarce and **Red Data Book** species
severely declining **common** and **widespread** species:
national abundance trends 35 years > **69% decline**
0-69% decline
> **0% increase**
-

265 macro-moth species

11,670 individuals

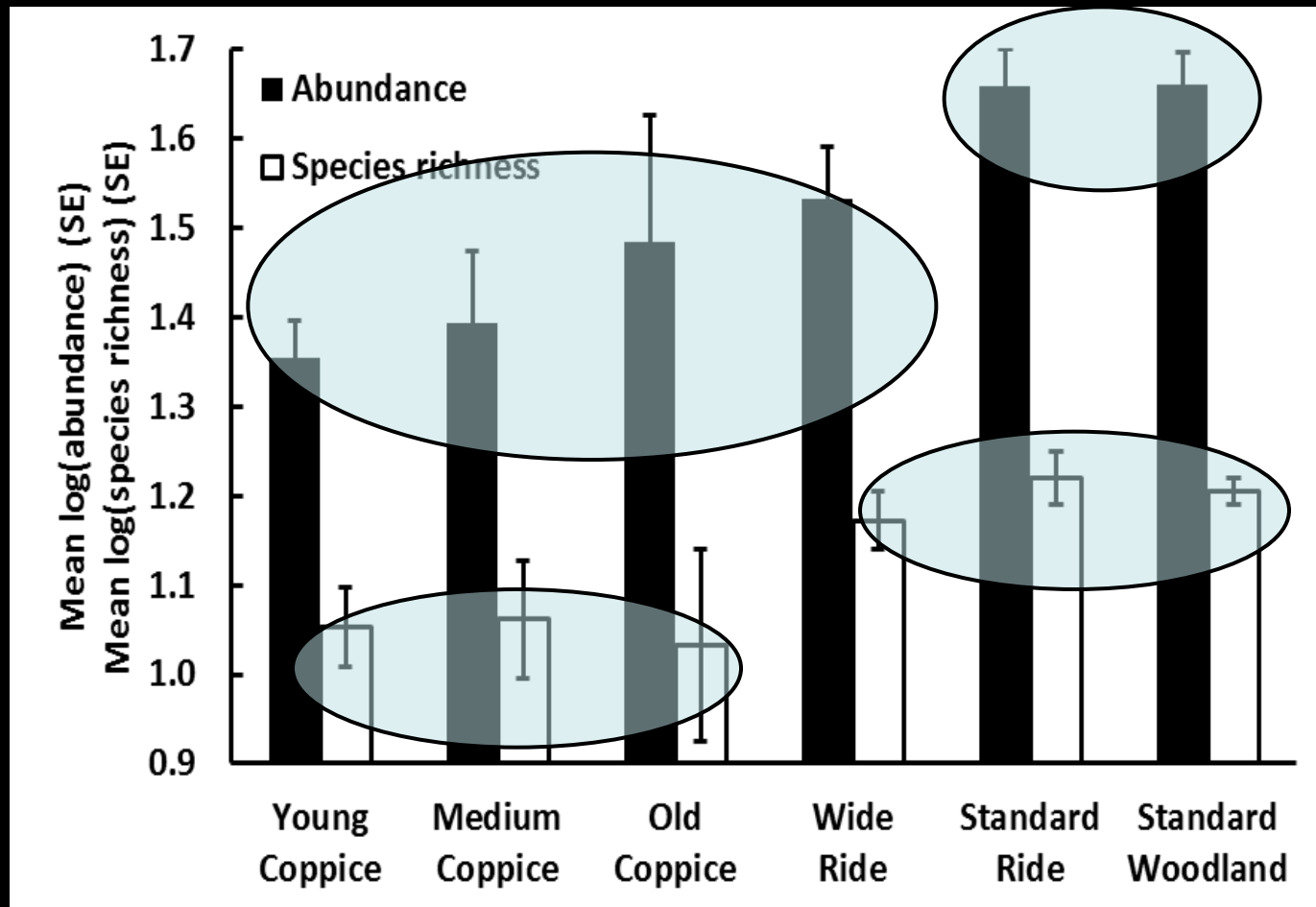
Number of species



GLMMs:

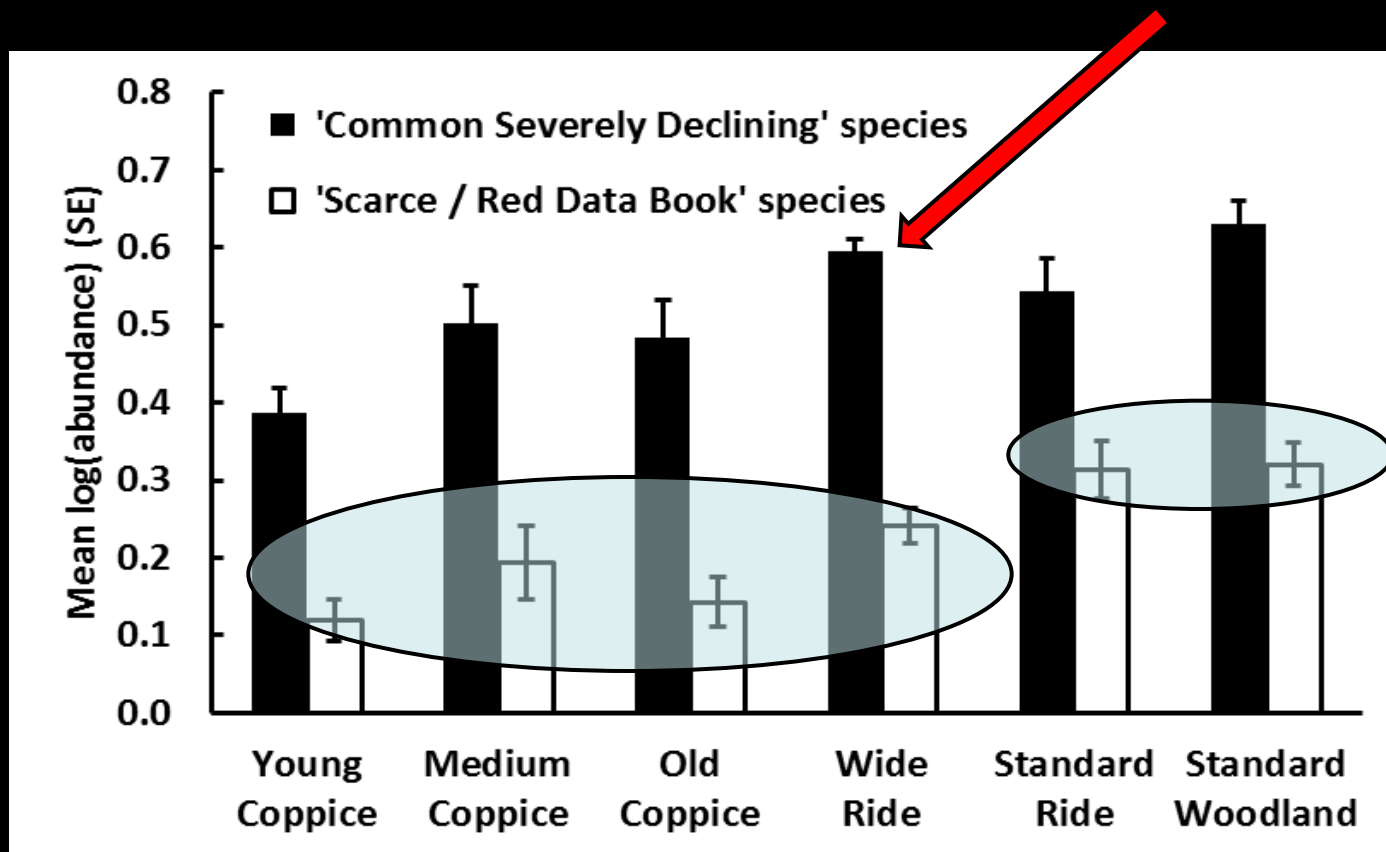
N and S ~ woodland treatment + conservation status + patch size + all interactions

Random: trap site (woodland patch)



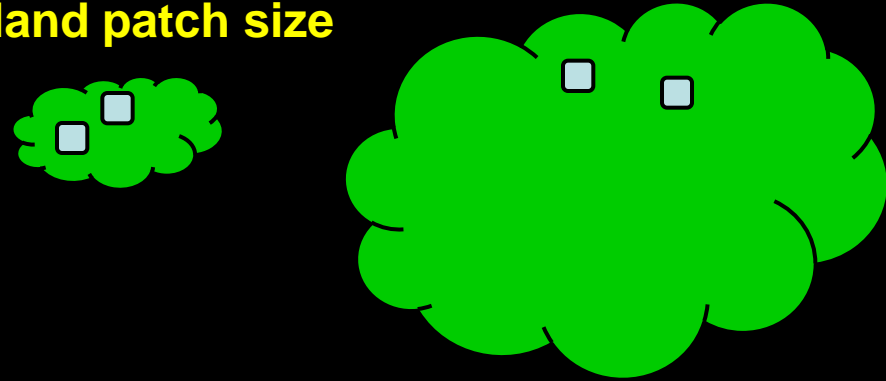
N: treatment: $F_{5, 24} = 8.70$; $p < 0.0001$

S: treatment: $F_{5, 24} = 7.39$; $p = 0.0003$

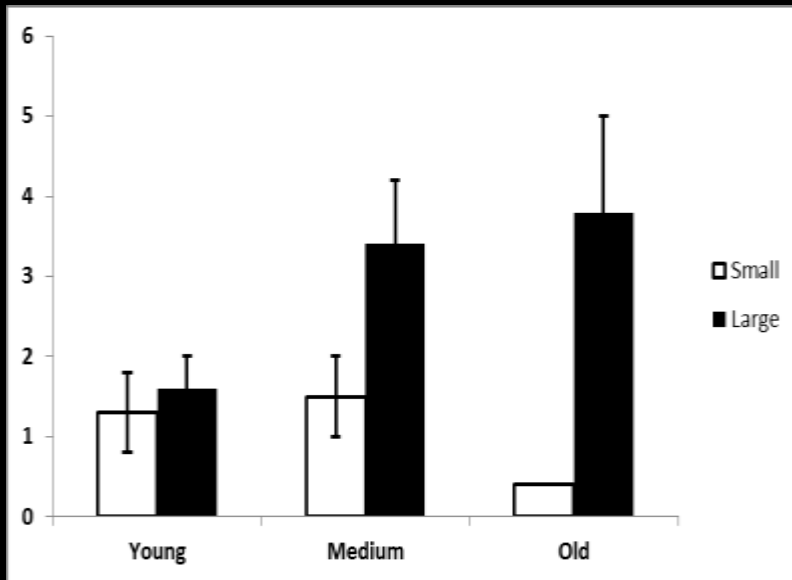


treatment x status: $F_{20, 96} = 2.05$; $p = 0.011$

Surrounding woodland patch size



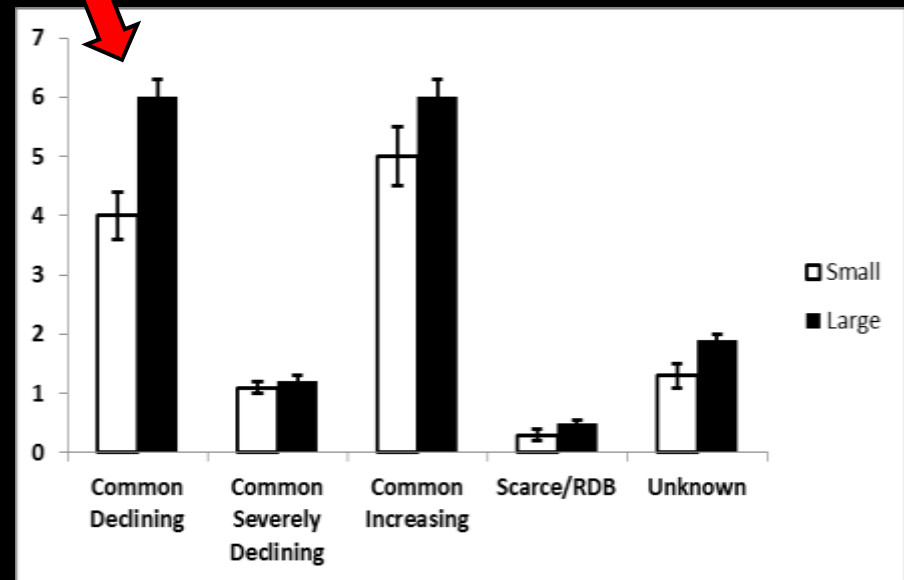
Abundance 'Common Severely Declining' at coppice



treatment x status x area: $F_{20, 96} = 2.21$; $p = 0.0056$

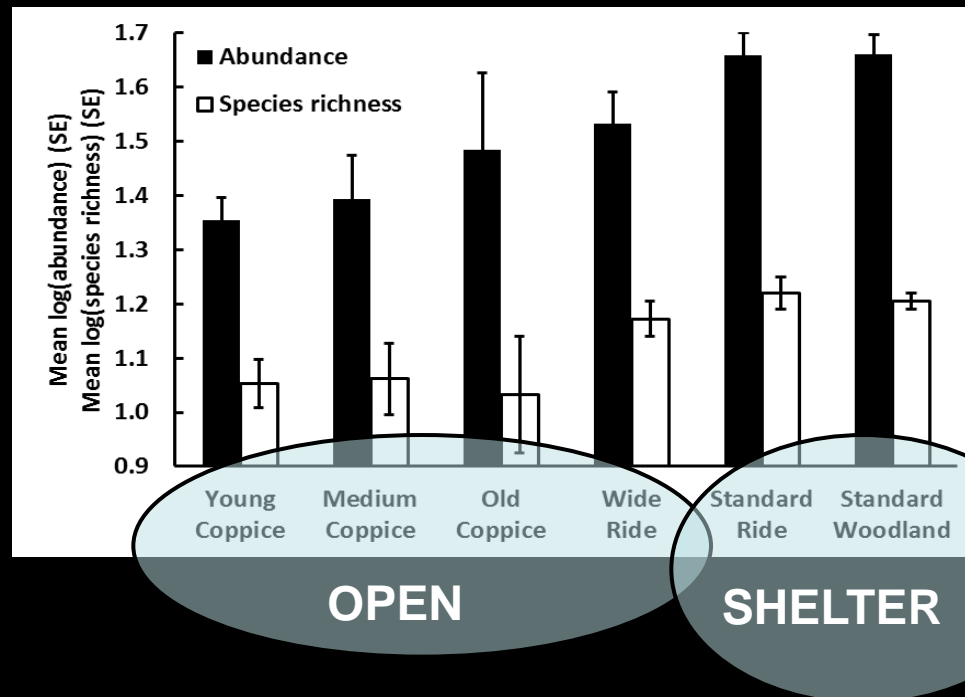
Overall Species richness at medium/old coppice: treatment x area: $F_{5, 24} = 5.70$; $p = 0.0013$

Species richness



status x area: $F_{4, 136} = 3.63$; $p = 0.0077$

Species Composition



- 49 unique species (18%)
 - 10 'Common Severely Declining'
 - 5 'Scarce/RDB'
- 22 unique species (8%)
- 124 species (47%) with equal/higher N
- Strongest for 'Common Severely Declining':
 - 58% with equal/higher N

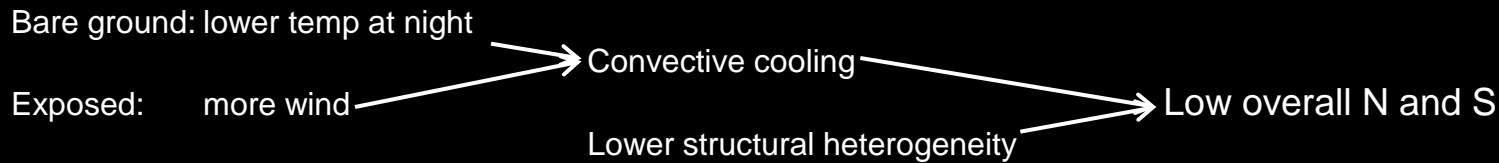
Explaining the Overall pattern



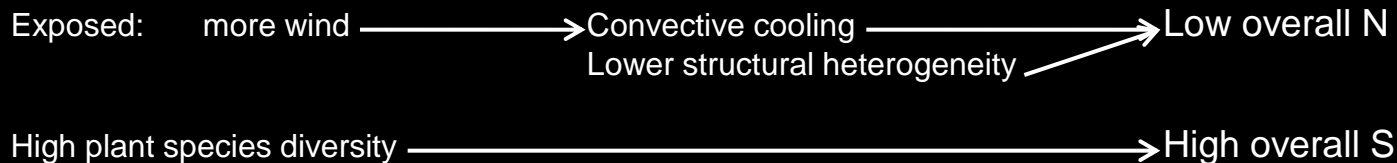
heliothermic **butterflies** (>< myothermic moths)

Open sites: high temp at day
high plant diversity → **High overall N and S**

Coppice



Wide rides



Sheltered, dark, humid, late-successional, high deciduous forest biotope

- high numbers of individuals and species
- especially important for Scarce and RDB species

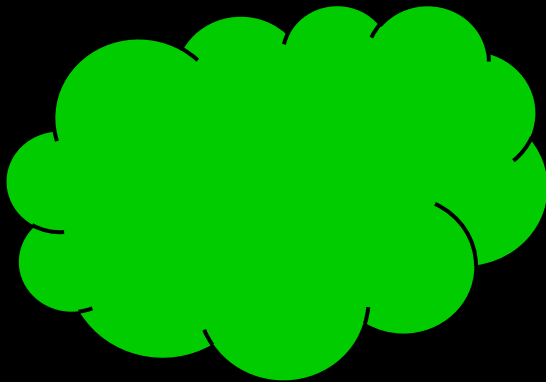
(Summerville & Crist 2008; Summerville et al 2009; Broome et al 2011)



SUMMARISED



+ MOTHS

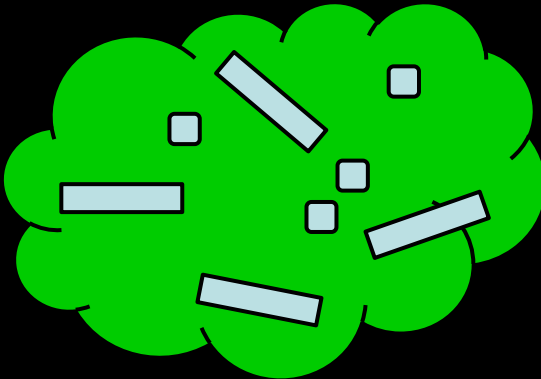


S total increases: open sites added 49 species (18%)

Increased structural diversity

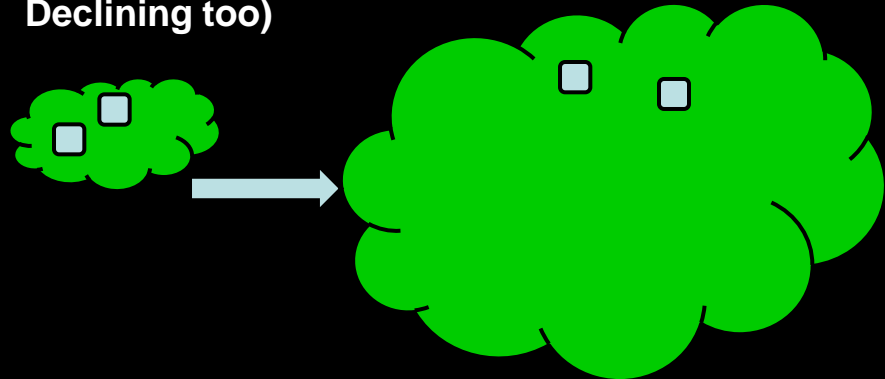
micro-climatic diversity

additional resources



Especially benefits **'Common Severely Declining'** species:

- 10 unique species
- Smallest difference among treatments
- High N at wide rides = standard rides / woodland
- 58% of species in equal/higher N at open sites
- Greatest benefit of coppicing in large woods (Common Declining too)

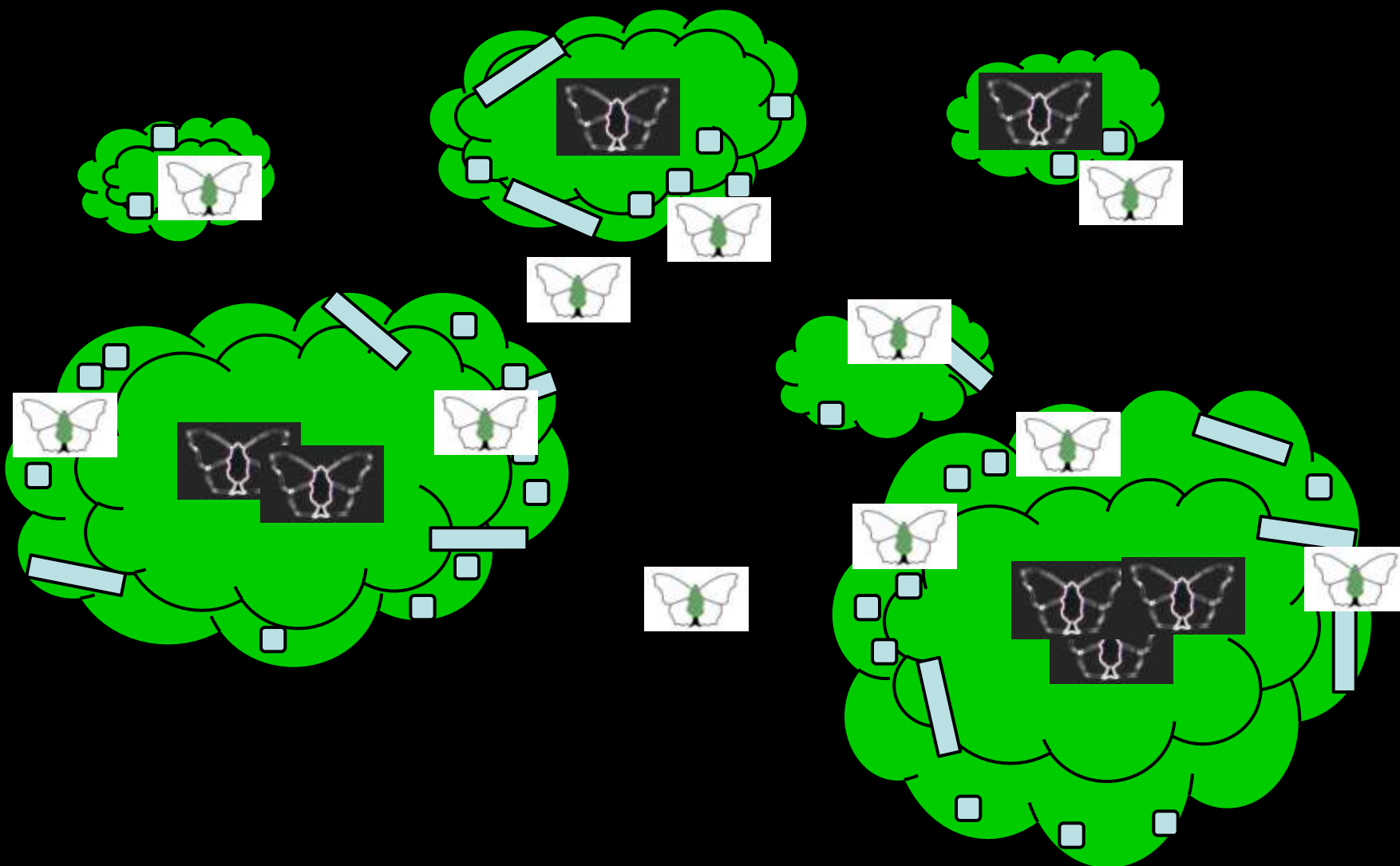


Coppicing in smaller woods will result in biodiversity gains, but larger and hence more cost-effective gains (with similar effort) in larger woods

Main recommendations: two-tier approach

Enlarge woodlands + create new ones: sufficient cores of typical dark woodland

Buffer dark cores from open 'matrix' with light zones (coppicing/wide woodland rides)



Zoning: Two-tier approach

- dark environment for shade/moisture-loving woodland specialists



- accessible woodland habitats for species of mixed/open biotopes

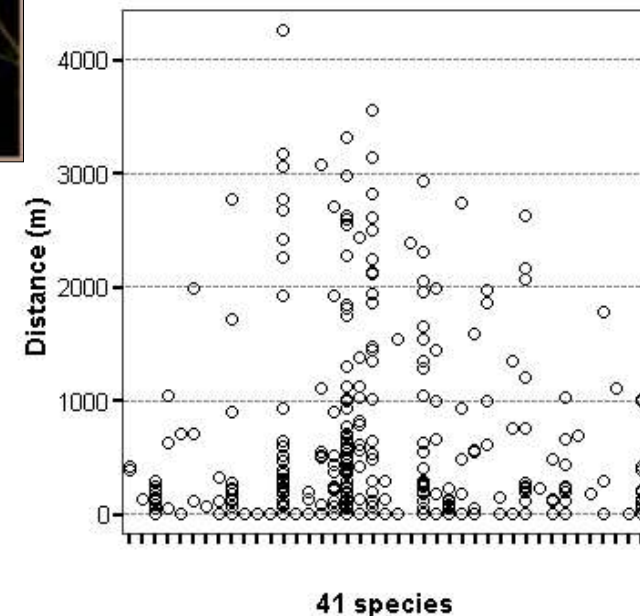
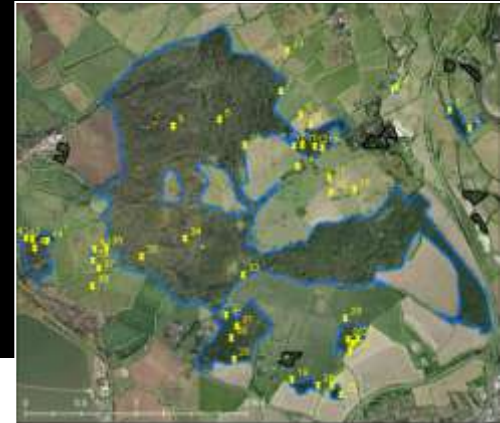


Conservation focus on **either** coppicing/ride widening **or** sheltered woodland will not deliver as much biodiversity value as the **combined** implementation

Two-tier approach may be vital **both** for threatened woodland specialists **and** declining, once-widespread species

Landscape-scale MRR (Slade et al *in prep.*)

- 87 species / N=14719 / R=5.2% (N=657)
- Highlights the value of **connectivity**:
 - Noverall 3 times higher at hedgerow trees >< isolated trees
 - Soverall twice as high at hedgerow trees >< isolated trees
 - Hedgerow trees 'captured' 4.6 times more marked individuals
- Woodland species do move through the matrix, but will do so mainly by using hedgerow(tree)s
- Many species move at the landscape-scale
(*Noctua fimbriata*: 13.7 km / 2 months)



Conclusion

We believe that populations of widespread, but nationally rapidly declining macro-moth species (and probably other declining invertebrate species too) could be significantly increased by an increased and **landscape-scale implementation of coppicing and ride widening within the outer zone of, preferentially, large woodlands**, without compromising habitat availability and quality for threatened woodland specialists.

[illegible]



Butterfly
Conservation

ADVISORY NOTE:

The management of woodland for moths

This guidance has been developed for woodland managers and landowners to promote best practice and to raise awareness of the importance of this diverse group of insects within the woodland environment.

Introduction

Moths are a diverse group of insects with c. 2,500 species recorded from the British Isles. Woodland is a key biotope for a wide range of moths, including nationally scarce and threatened species, with many being largely restricted to the woodland environment and many others using it in addition to other habitats. Many native tree species support their own suite of moth species, with deciduous oaks (*Quercus* spp.) alone supporting about 220 species.

Woodland invertebrates (moths and butterflies) are good biodiversity indicators as they respond rapidly to changes in the environment and to woodland management. The majority of species have an annual life cycle, while some have two or more generations a year and a small minority can take a few years to complete their life cycle. Many species have very specific requirements, needing continuity of habitat conditions year in, year out, for survival.

Moths are in serious decline across Britain, with major losses recorded for both common and nationally scarce species. The State of Britain's Larger Insects report (Fox et al, 2006) found that the total abundance of common and widespread moths had declined by a third over 35 years, with the decline greatest in southern England.

In addition to concern about moths themselves, there is serious concern about the impact of these declines on the ecosystem services they provide. Moths are significant pollinators in the countryside and both caterpillars and adult moths are an important food source for a wide range of other species, including other invertebrates, birds and bats. Several species in common and widespread moth groups are indicators of extensive change in the state of our environment. The causes of these declines are complex, and require further research and conservation action. In Britain, 71 species declared severely LUL (national declines, 40%) and were identified by species experts as requiring further research and listed as 'extremely bad' rapidly declining. Red-listed Action Plan Priority species as a result. Many of these species are found in woodlands.



Research

In 2012 a study was undertaken by the British Conservation Research Unit (BCRU) at CERN University, working in partnership with Butterfly Conservation, to increase our understanding of the effects of woodland management on these widespread but rapidly declining species. The study looked at moth abundance and species richness in different management treatments across a wooded agricultural landscape on the Hampshire/Wiltshire border. This advice note incorporates findings from that study and other sources, providing general as well as specific advice on the requirements of both threatened (sumneri) common widespread and scarce species.







Notes: Selection of butterfly scarce moths found during the research.





THANKS for your attention

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in the conservation of UK BAP moths*)

