

# 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 <u>-30% over 16 years</u>



#### Contributed Paper

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

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Abstruct: Analyses of geocies' population locus hybridity about a dicholony between strongly affected, rare, and localized species and application locus hybridity about a dicholony between strongly affected, rare, (1992-2007) of builterfly instance cound data from The Netherhands in a revulantilism of the brends of common, with dispirated species. Phyloto percend (1 a 20 appecies) of these species anffrond accere dictions in distribution and a domainee. Overall, communitative builterfly aboundance decimast by arcound 30%. Soon of the species in decime used to be complexation in synchronic and particle, and 2 of the lipecies user previously considered approximate percent and the decimes over the local 1 oyans, 2 of the 20 species (Lacionauta transgers and Geocpereys: thannu) reached addingerout status in The Netberlands under the NCAC (International Union for Conservation of Native (Doparitation-decime or testerion, and 2 species functions) in courts in the local activities about a constraint of the domain access of species and particularly approximate the local activity in a domain decime to be constrained by the domain of species associated with vegetarist hyper subwed the largest doctime traject about hours, the advector statilis of species associated with vegetarist hyper subwed the largest about the species about hours. The domain access advector statilism of particularity in constant and pression of the largest and about the doctime of statienty Doparitation-decime statistics of species associated with vegetarity hyperstable. The doction of statienty Doparitation database additional constraintion al pression hyper species about the largest about the species additional constraintion and particularity in terms and a species about the largest about the doction of statienty Doparitation-decime additional constraintion at the species of the largest about the doction of statienty Doparitation advector as advector associated with vegetarises the largest about the doction of statienty Doparitation advector astat

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

Restrumen: Los análitas de péridias de pôstaciones tipicamente enuestena una dicotomia entre espectes portenmos el apricindas, rarar y inclaimada y aplacetes aplanemenante en onfociadas, comunas y con distribución amplia, Analizamos datos de 16 años (1932-2027) de conteos de maniposas en transacios em Biolanda en una resentínación de las istandardas de alexplesta comunes, con distribución amplia. Analizamente portectivo (11 de 20 especies) de estas adpectos suffereron declinaciones securas en determinica as anteriorismente en espectas comunes y con discritante (11 de 20 especies) de estas adpectos suffereron declinaciones securas en distribución y abundancia. En genaral, las abundáncias acamunidatas dactivas advectos de las depoies persistemente eran consulteradas advectamente estas nomípresentes en sua declinaciones en los stilimos 16 años, dos de las 20 espectes (Lusioumais megera y Gonepterys tunctura) alcanzarron el satura en palagro de acavario com el criterio da declinación pobla doma de las IDCON (Otitón Internacional para las Conservación de la Naturativa), y dos espectes (taucturas las polars) de as suburabilidad. Las materiosas en en as declinaciones en en advectava en las declinacions de las Naturativas), y dos espectes (taucturas las polars) de acavarias en las advectavas en declinacion de las Naturativas), y dos espectes (taucturas las polars) de acavarias en las advectavas en las declinaciones entrenarios con el criterio de declinacias mentas en las advectavas en las advectavas en las advectavas en las status en las as advectavas en las as a polars de acavarias do com el criterio de declinacias entrenas y entrenas y particularmente en bosques mostnaron la mayor declinación en abundancia de especies. La abundancia de especies acocidada on ligos de regisción enconstruction principalmente en reservas naturatas (dimación das especies con datiribución ampliar negariere estimaligas de conservación ad advectavas entravas estimas), en menor grado. pautasia seminastanta) (incoremento o permaneci

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

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#### Endangered (IUCN)

Flanders:Endangered (IUCN) ((Maes et al 2012)UK:BAP Priority species (-37%/10yrs)

#### widespread but declining species



#### specialists



#### **Resource requirements:**

**Conservation approach:** 





#### **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):
  - Ntotal 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)



Figure 1. Historical distribution of Rothamsted light-traps in Great Britain, drewing his boundaries of the North. Southwest and Southeast trajons along the 4300 E and 4500 N L/K mutional gridhuus and intensity of trapping.





#### 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

young (1-2 years)

#### RIDES









#### STANDARD WOODLAND

non-coppiced high deciduous oak forest



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## Trapping

- Heath traps
- each site sampled 9 times (36\*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

#### Number of species



#### 265 macro-moth species

11,670 individuals

#### **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 < 0.0001S: 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



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

#### **Species Composition**



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

• 22 unique species (8%)

#### **Explaining the Overall pattern**



#### 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





#### 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)











41 species

## 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.

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