25 years of the Catalan BMS: results and lessons learnt

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CBMS
Catalan Butterfly Monitoring Scheme

Museu de Ciències Naturals

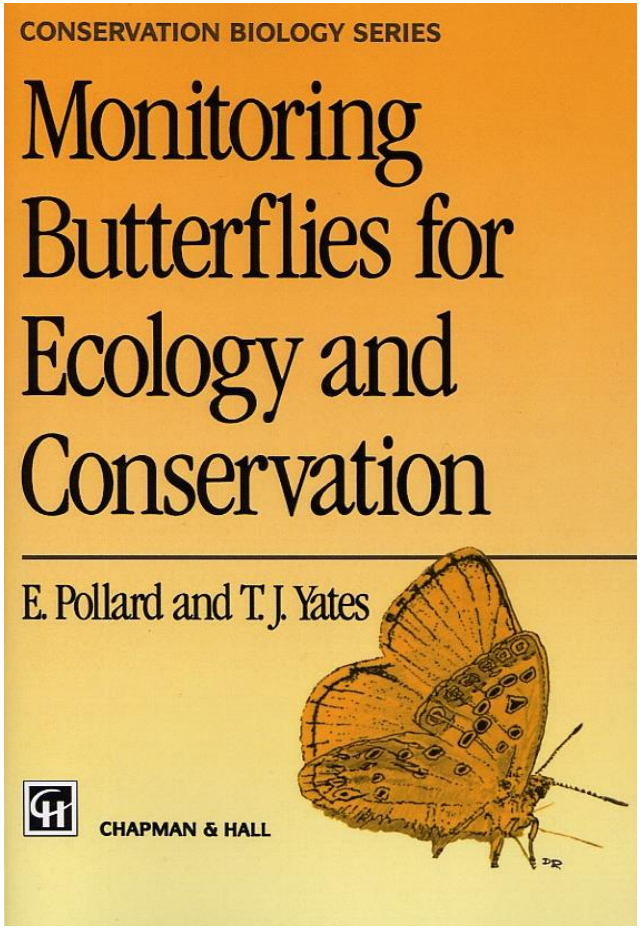
Generalitat de Catalunya
Departament de Territori i Sostenibilitat

The Butterfly Monitoring Scheme (BMS)

1. They respond very fast to environmental change

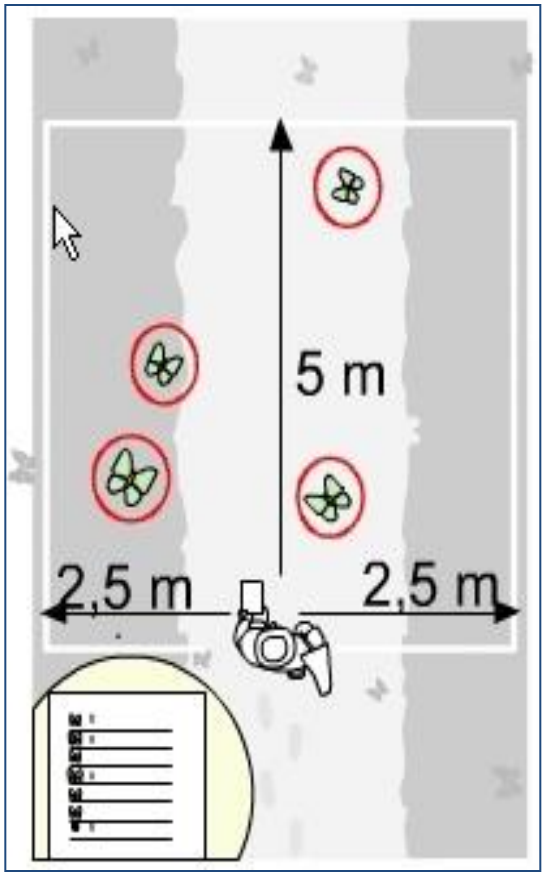
2. They are very popular among the general public

3. They are easy to monitor

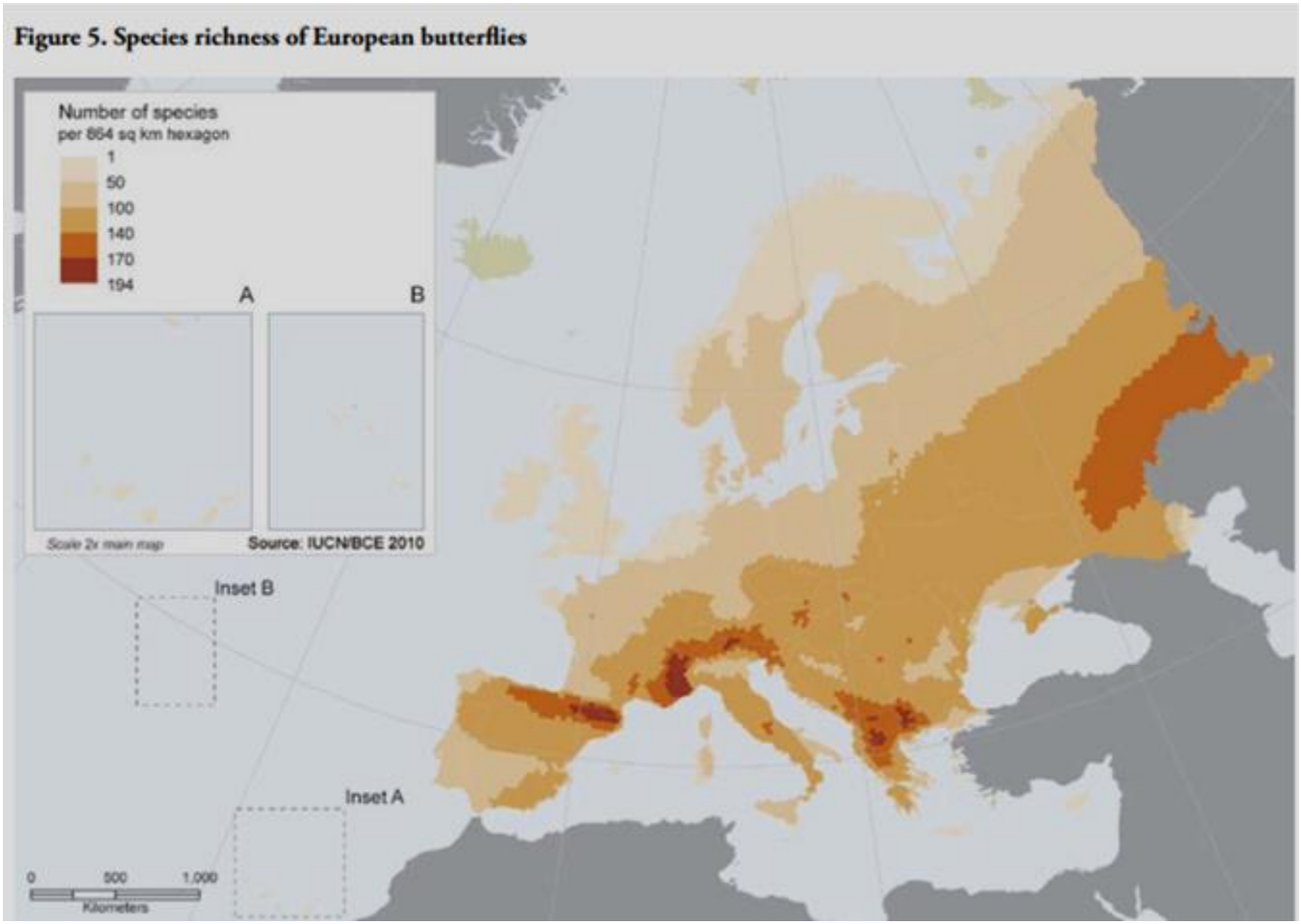


The Butterfly Monitoring Scheme (BMS)

- Weekly counts of adult butterflies along a fixed transect under favourable weather conditions
- Albeit simple, the method provides robust measures of population levels and how they change over time



Butterfly monitoring and species richness in Europe



Source: Van Swaay et al. 2010. *European Red List of Butterflies.*

The Catalan BMS

-Oldest monitoring programme in the Mediterranean based on volunteers

- 154 transects up to 2017

- ca. 55.000 km sampled

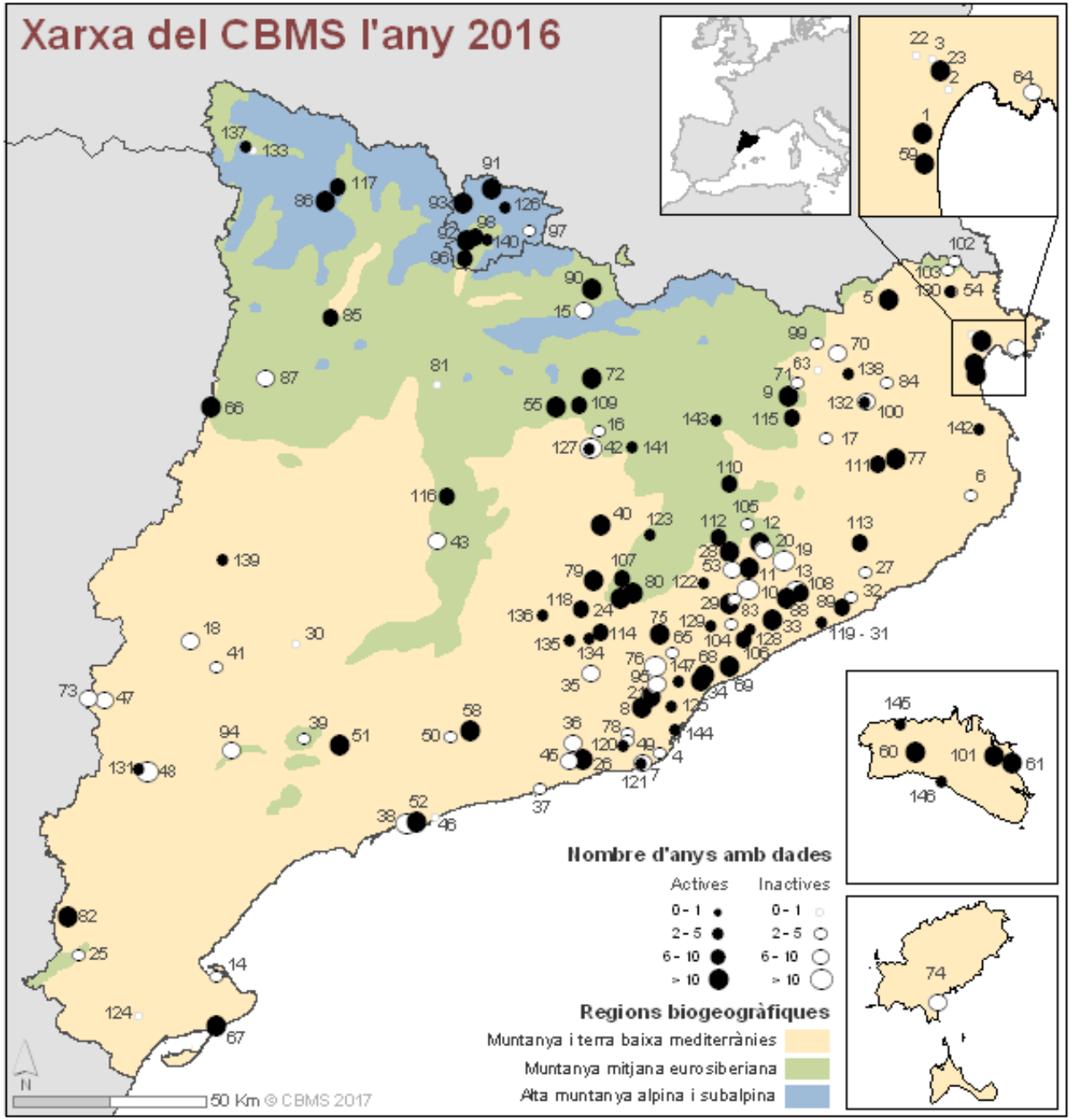
- ca. 40.000 h accumulated (4.5 years)

-150 people collaborating

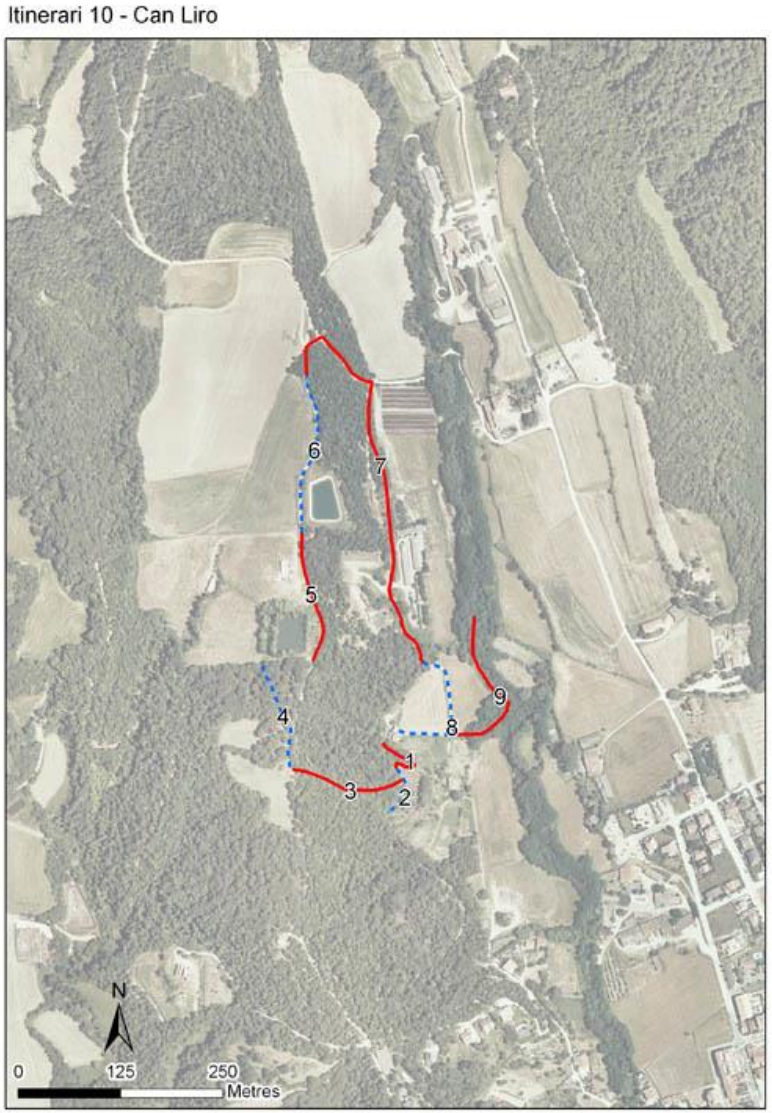
-ca. 2.500.000 butterflies

-186 species recorded

- High diversity of climates and habitats

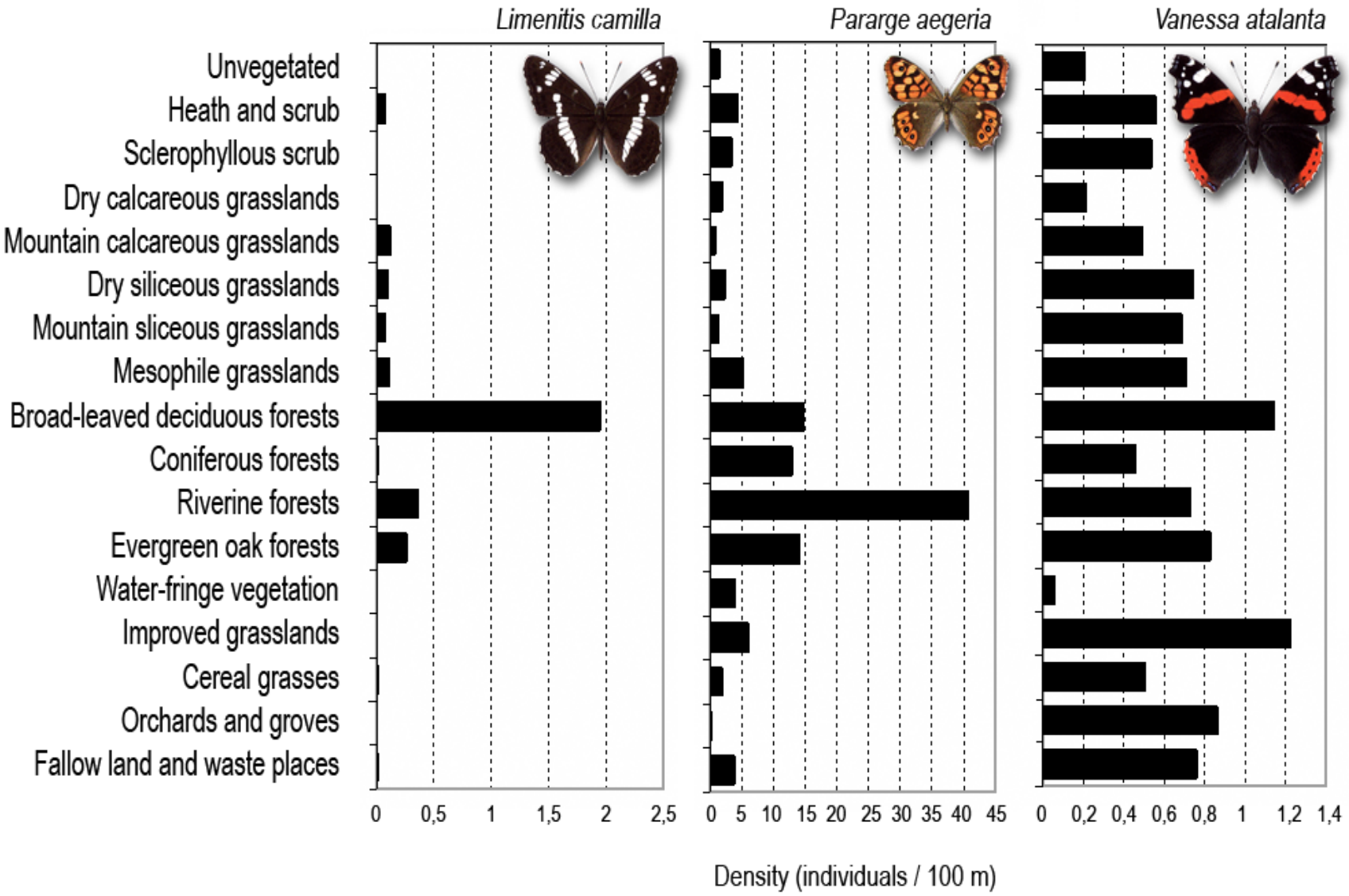


The transects



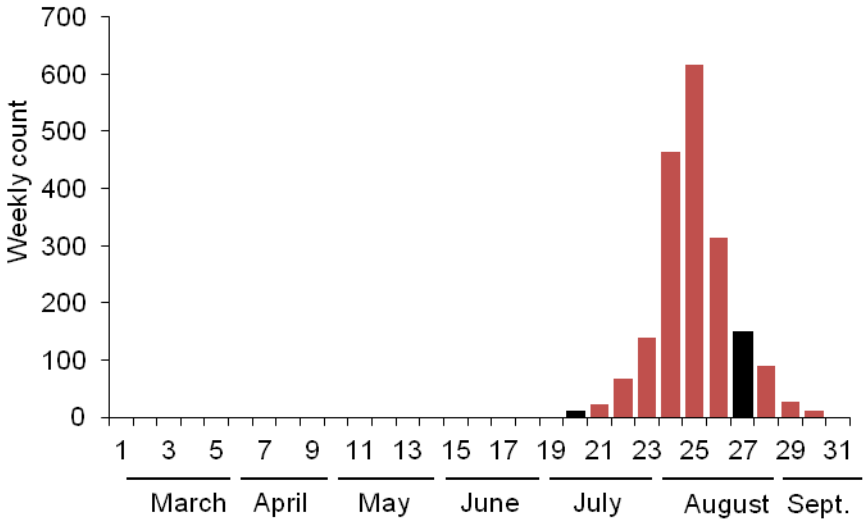
- About 2 km in length
- Divided into sections coincident with different habitats
- Habitats characterized by their plant communities (CORINE classification)
- The cover of plant communities is recorded for each active transect every 6 years at the section level
- Impacts are recorded during counts following a standard European classification

Habitat preferences

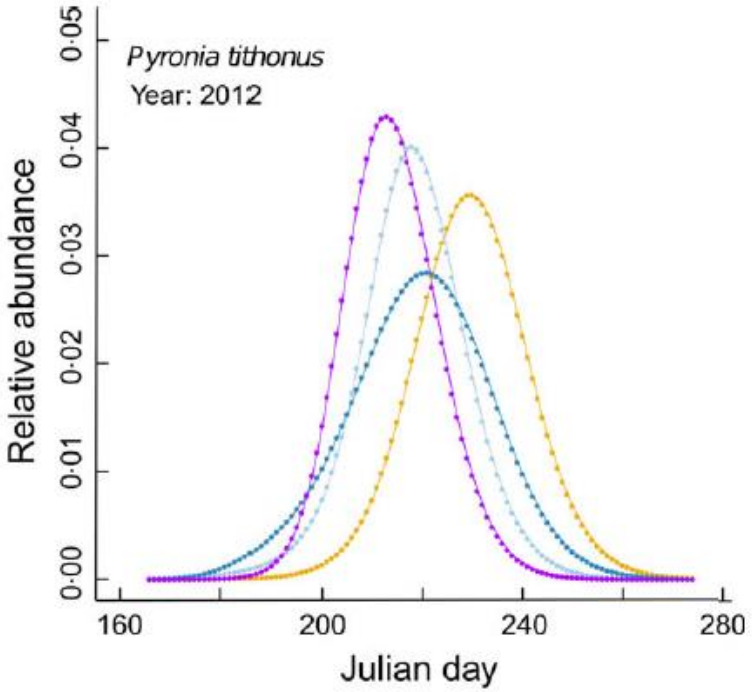


Stefanescu *et al.*, 2011. *J. Insect Conserv.*

Annual indices and population trends



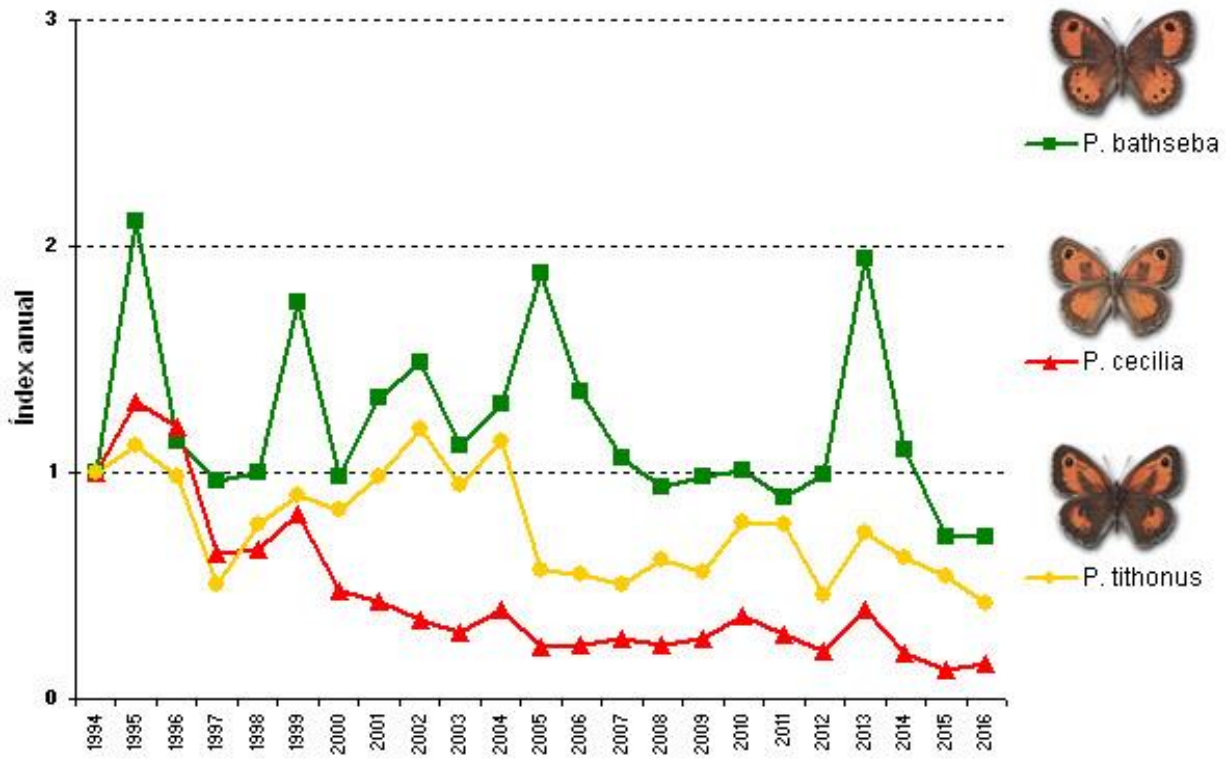
Annual counts of *Pyronia tithonus* at one montane site, 2012.



- Up to now, **Annual Indices** at individual sites have been calculated using the linear interpolation method (i.e. missing counts are estimated from the counts recorded at either side of the missing observations)

- Starting in 2017, **Annual Indices** will be calculated using the GAM regional methodology (Schmucki et al. 2015), that extracts a yearly flight period curve from multiple sites with a similar climate, that is then used to predict missing counts at local sites

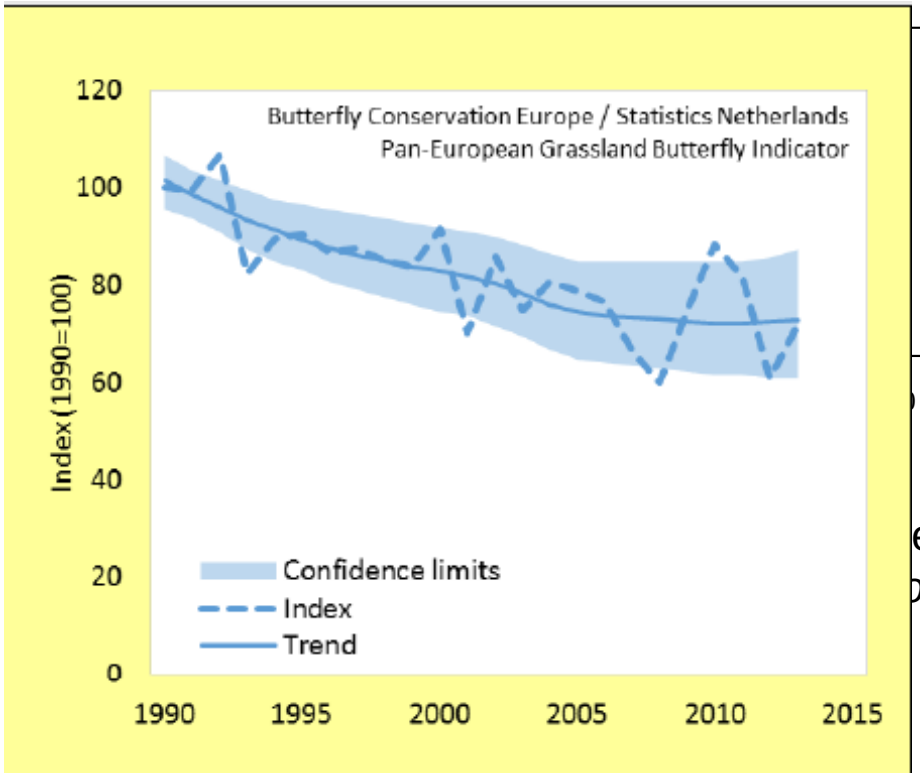
Annual indices and population trends



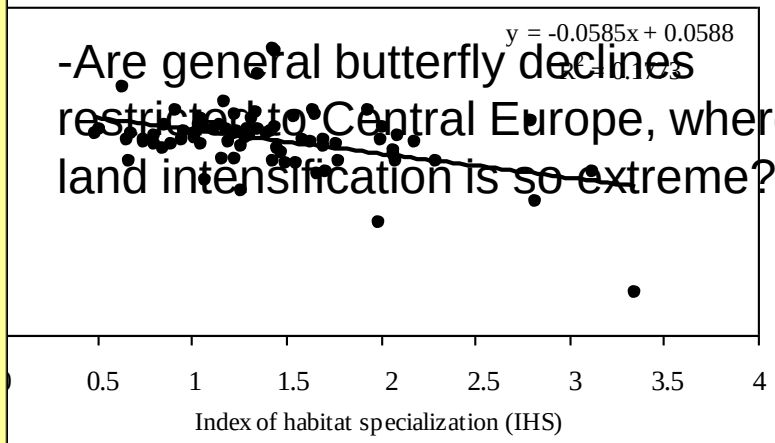
- Population trends at the regional level are calculated using TRIM, with a reference value of 1 for the first year of the CBMS (1994)

- In 2016, regional indices were calculated for 105 species with data from 15-107 sites

Are there general trends in the last two decades?



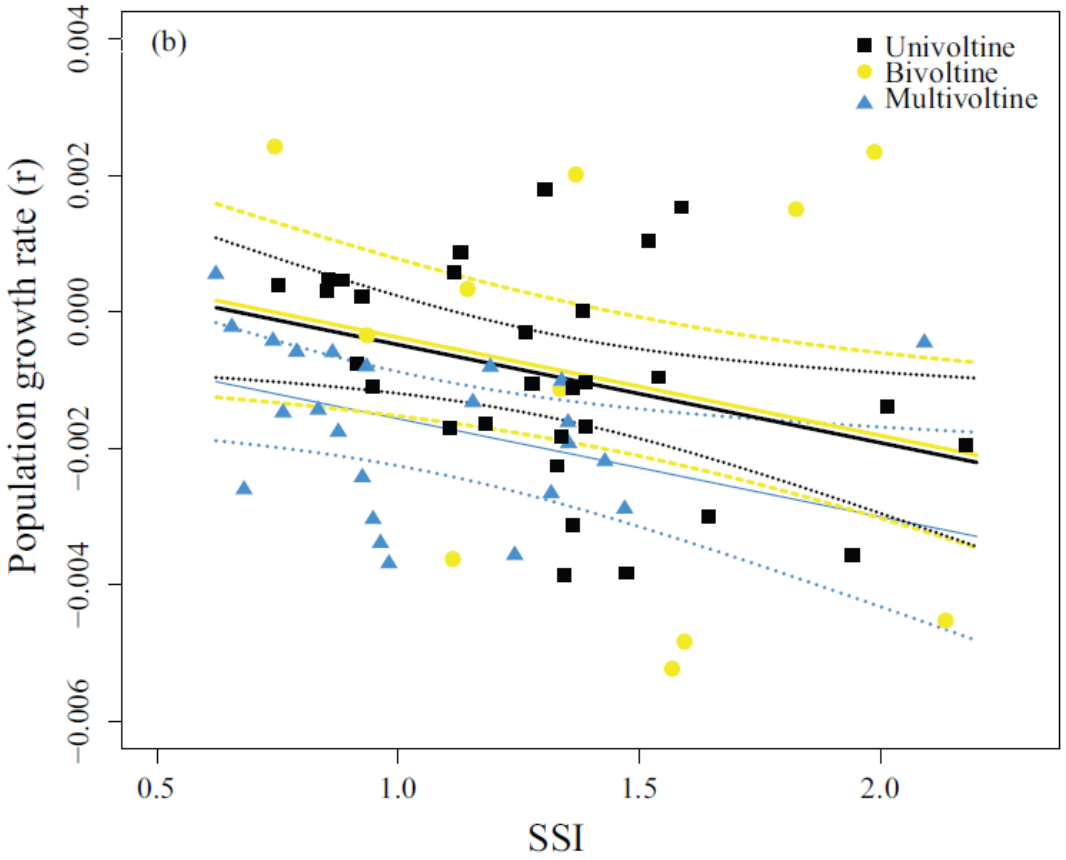
Butterfly declines according to the European Grassland Butterfly Indicator (Van Swaay et al. 2015)



-Are general butterfly declines restricted to Central Europe, where land intensification is so extreme?

efanescu et al., 2011. *J. Insect onserv.*, 15: 83-93

Are there general trends in the last two decades?



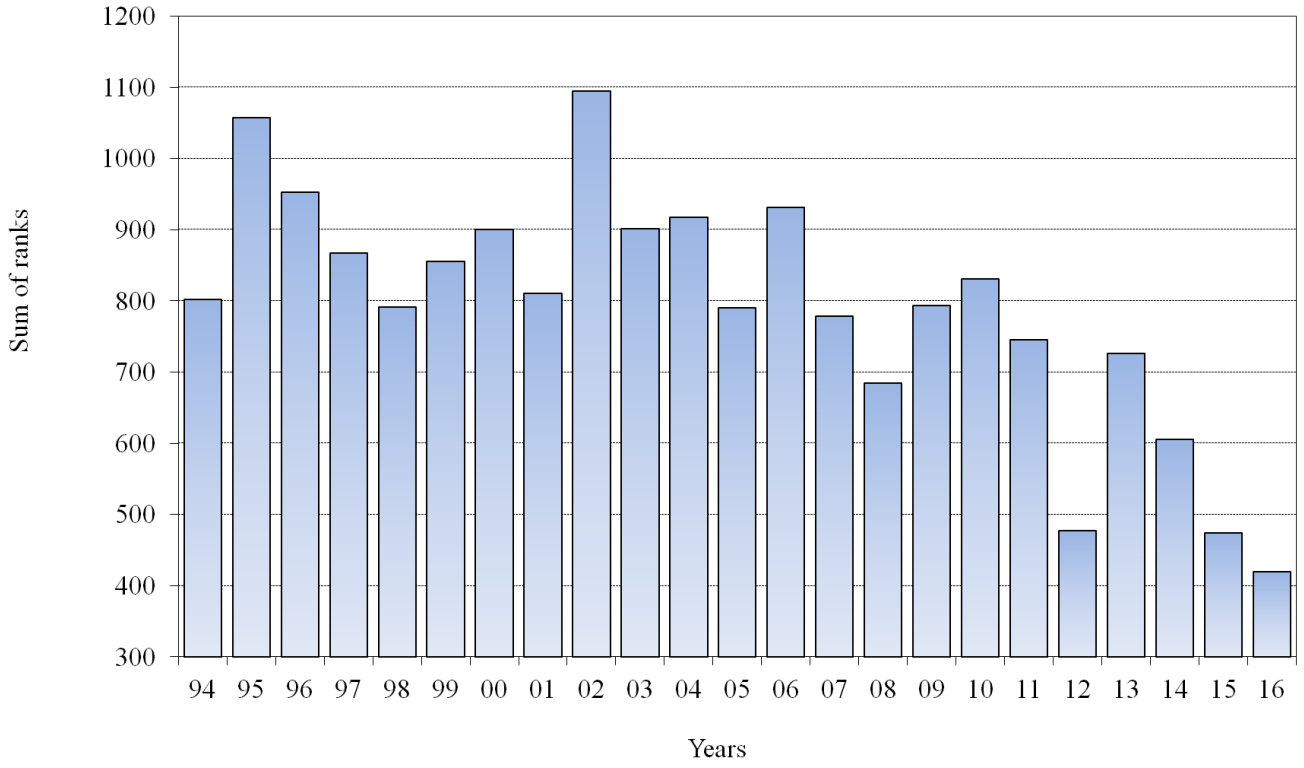
-General declines have been further confirmed in a more recent analysis, using a Bayesian approach allowing for imperfect detection. Out of 66 species analysed, 46 (70%) showed significant declines, and only 15 (23%) positive increases

Melero et al. 2016. *Biol. Conserv.* 201: 336-342

-Habitat specialists are suffering more than habitat generalists

- Multivoltine species are doing worst, and the climate (and the increasing effect of summer drought) may be one of the reasons

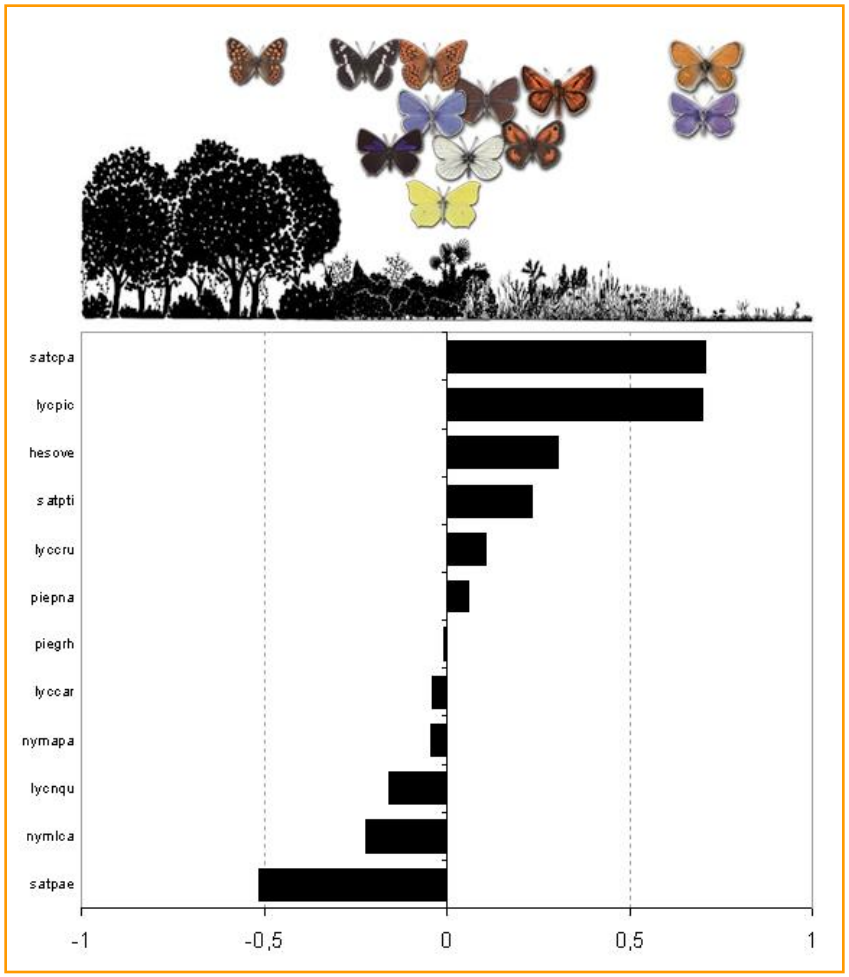
Are there general trends in the last two decades?



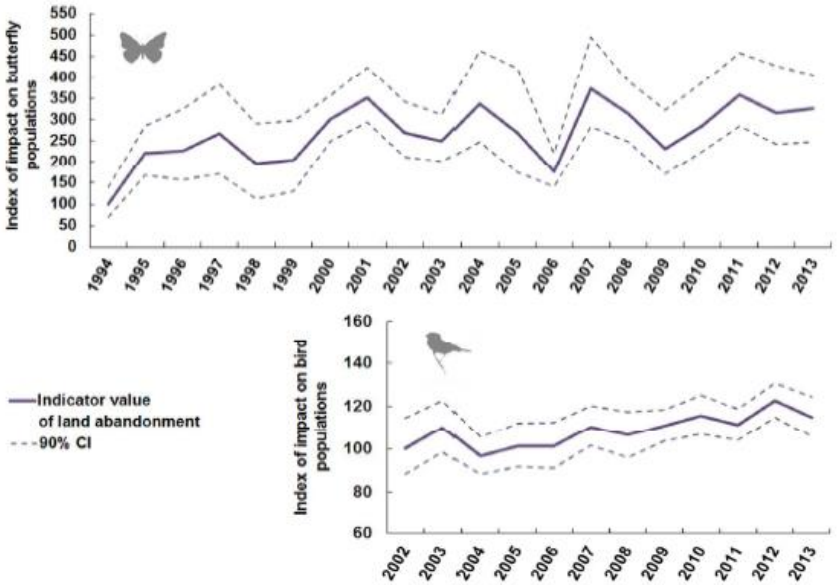
-Ranking of good/bad butterfly years based on data of 66 common species. Calculations following the method by Greatorex-Davies & Roy (2001).

- 8 of the 10 worst yr are concentrated in the last 10 yr (out of 23 yr). The worst 4 yr are concentrated in the last 5 yr.

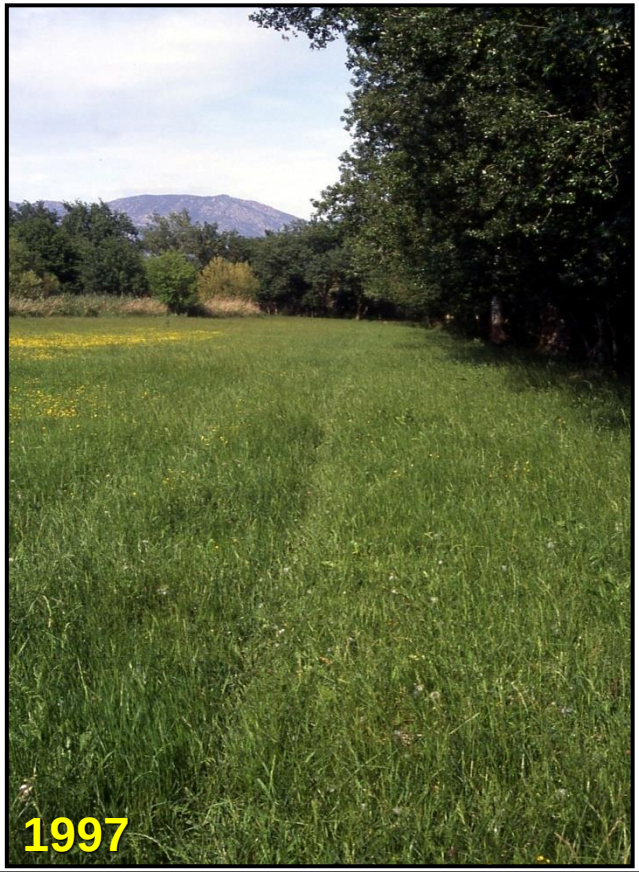
Land abandonment and population declines

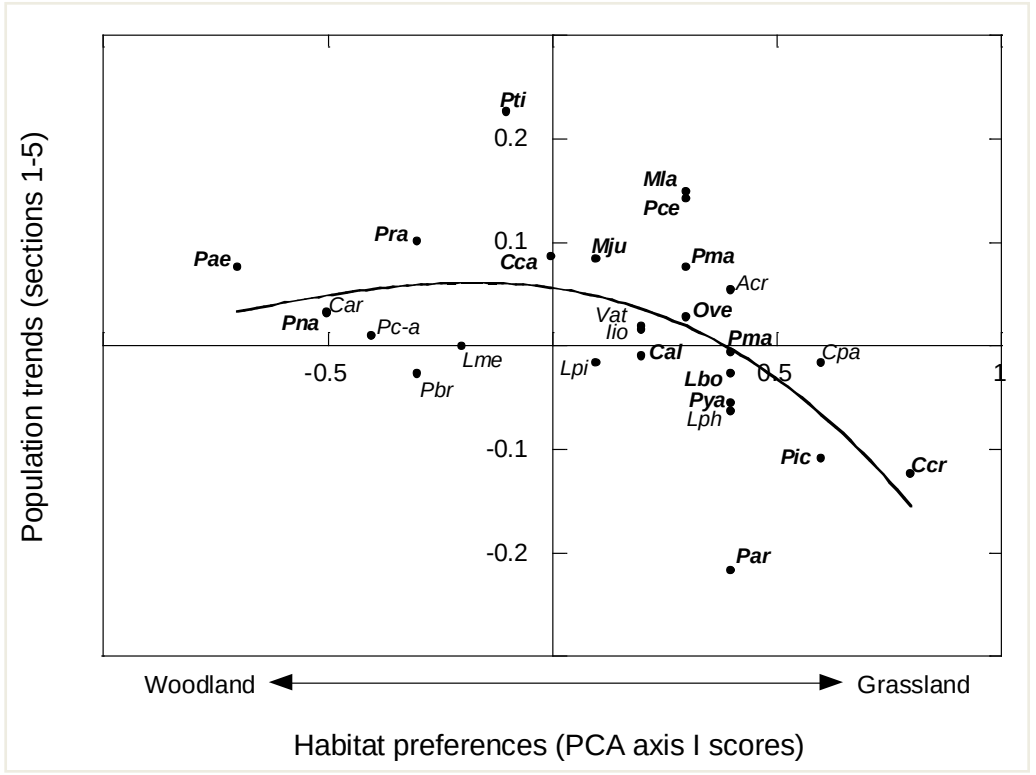


Suggitt et al., 2012. *Biol. Lett.* 8:590-593



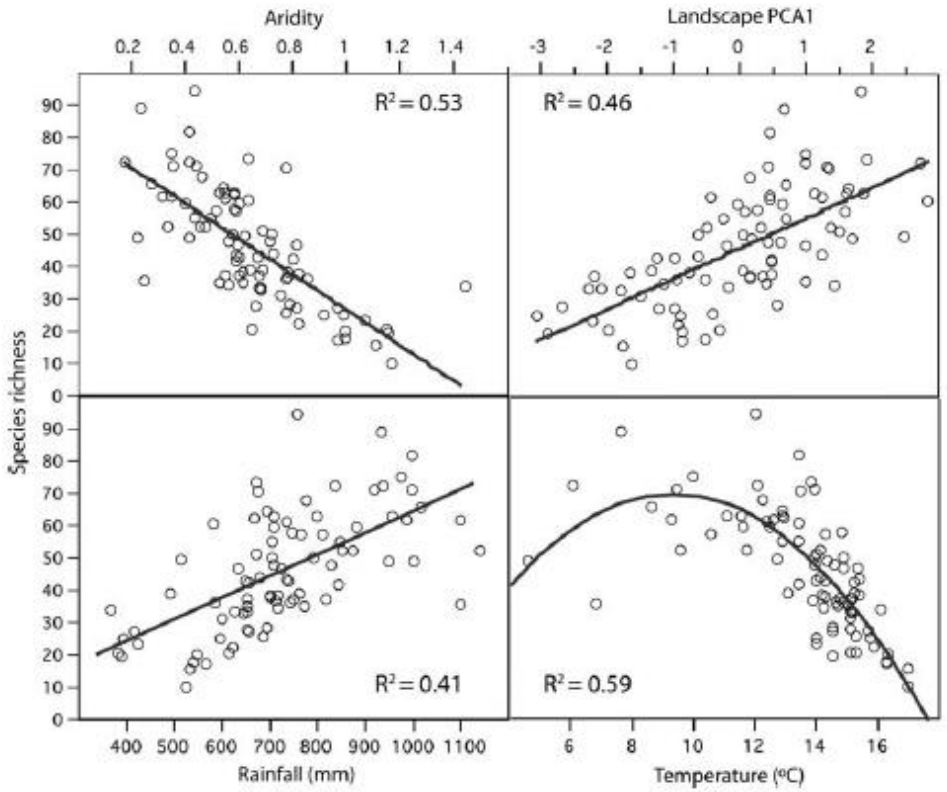
Herrando et al., 2016. Environ. Conserv. 43: 69-78

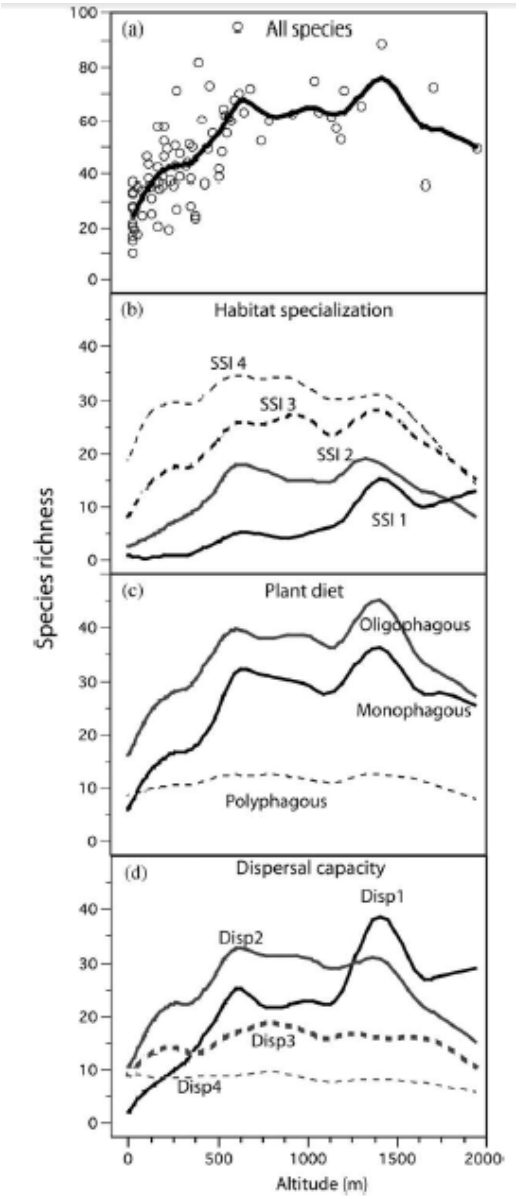




Stefanescu et al., 2009. *Insect Conserv. Div.*, 2: 261-269.

The impact of climate change on southern-edge populations





-Climate has a huge influence on butterfly communities in the Mediterranean, with a very strong negative relationship between species richness and aridity

- This leads to peaks of diversity at mid elevations in mountain areas

- It can be predicted that strong decreases in diversity will occur as a result of climate change in the future

Stefanescu et al. 2011. *Ecography*, 34: 353-363

The impact of climate change on southern-edge populations

Mills et al. 2017. *Global Ecol. Biogeogr.*

$$N_{it} = N_{it-1}\exp(\alpha_i + \log N_{it-1} + W_{1it} + \ldots + W_{8it} + \varepsilon_{it-1})$$

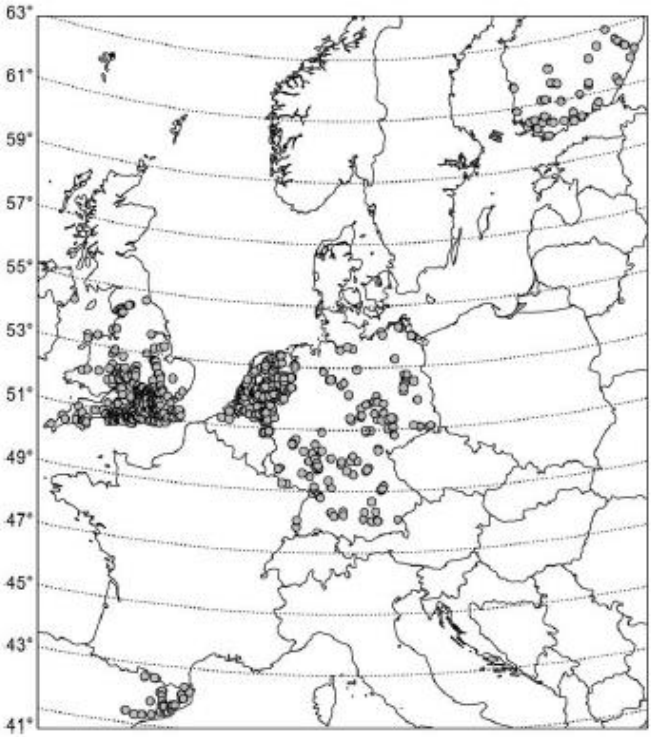


FIGURE 2 Sites retained after exclusion based on criteria outlined in the text, with 2° latitudinal bands overlaid (dotted lines)

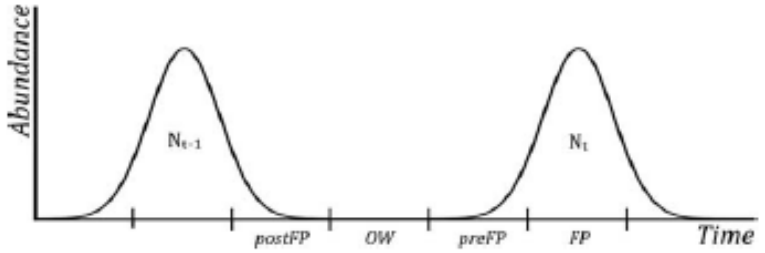
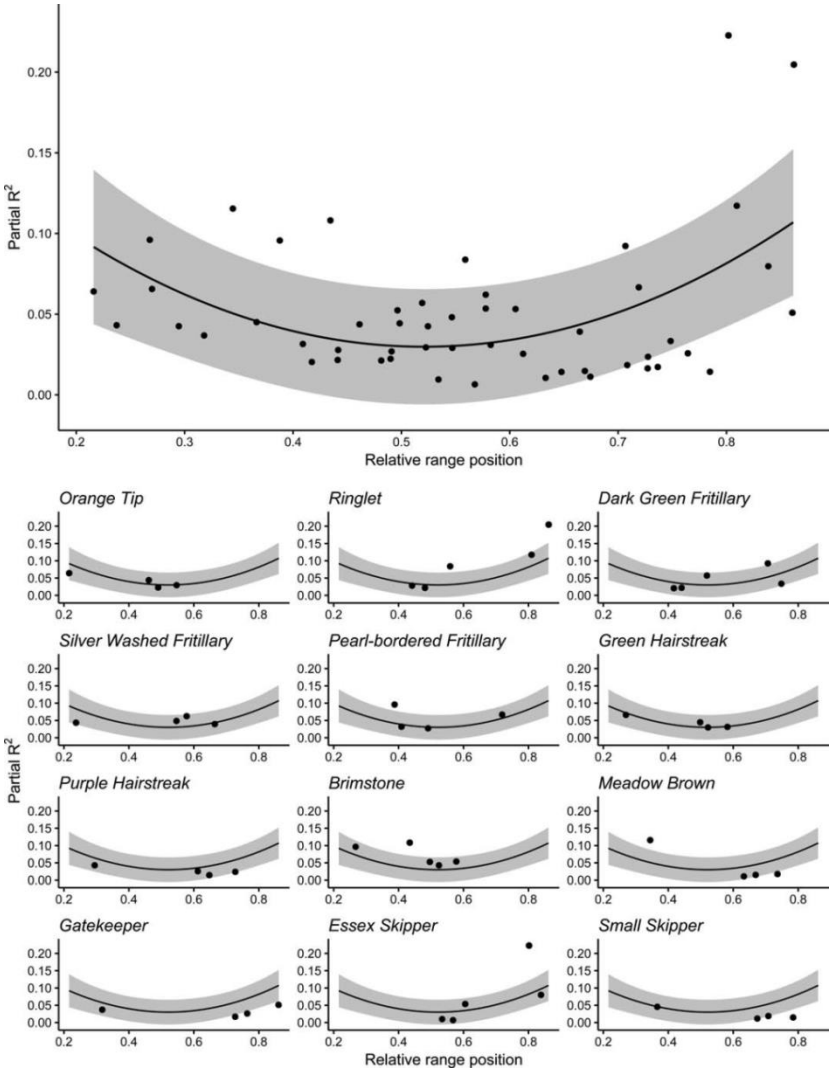


FIGURE 1 Schematic diagram of life-cycle periods and their correspondence to two annual abundance indices, N_t and N_{t-1}. Life-cycle periods are as follows: post flight-period (postFP), over-wintering period (OW), pre-flight period (preFP) and flight period (FP)

The impact of climate change on southern-edge populations



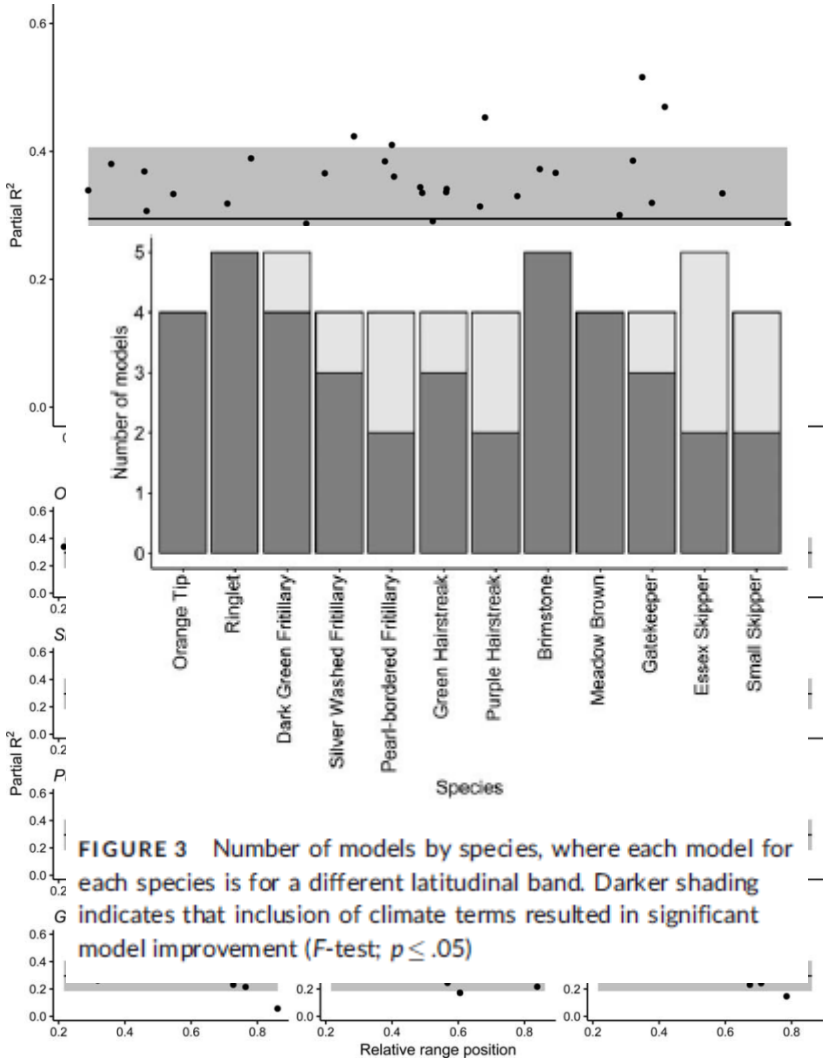
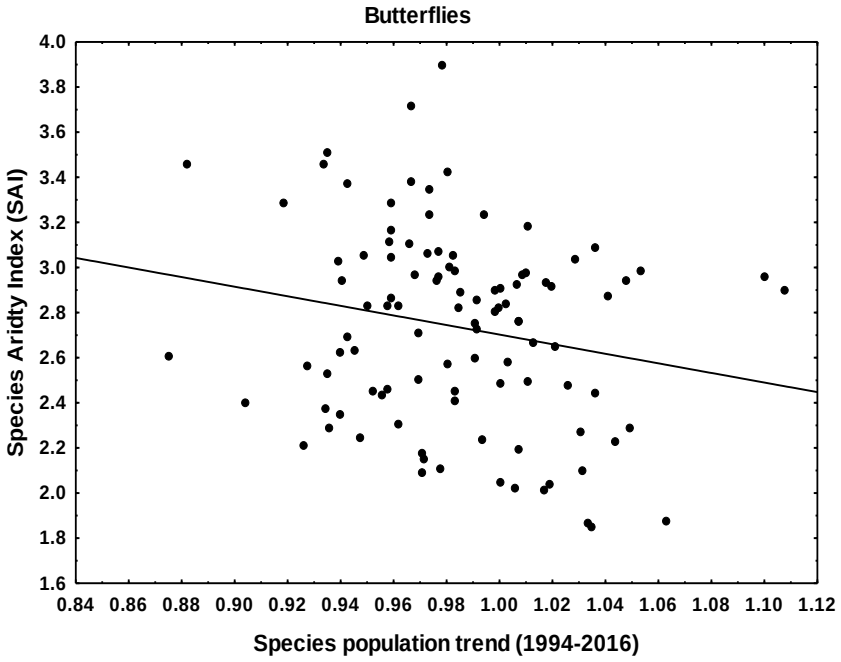


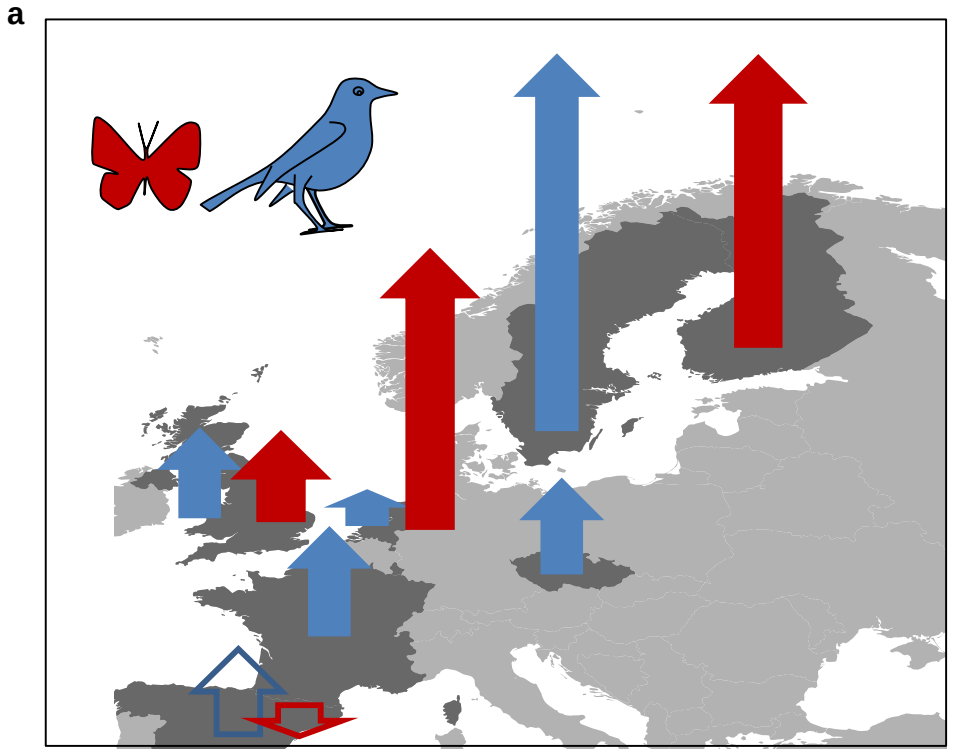
FIGURE 3 Number of models by species, where each model for each species is for a different latitudinal band. Darker shading indicates that inclusion of climate terms resulted in significant model improvement (*F*-test; $p \leq .05$)

The impact of climate change on southern-edge populations



-Population trends are related to the climatic niche of the species: those species living in the more arid environments are doing worst than those from more humid habitats

-Herrando, Stefanescu et al., in prep.



Devictor et al. 2012. *Nature Climate Change*, 2: 121-124.

Thanks for your attention!

Catalan Butterfly Monitoring Scheme:

www.catalanbms.org

CBMS
Catalan Butterfly Monitoring Scheme

Museu de Ciències Naturals

The CBMS as a data provider for autoecological studies

Generalist hyperparasitoid
Gelis agilis

Specialist primary parasitoid
Hyposoter horticola

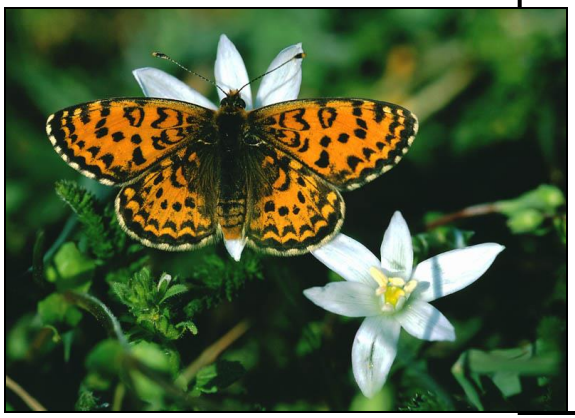


Figure 8.2.
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(*Cotesia m*
parasitoids
Drawings

The CBMS as a data provider for autoecological studies

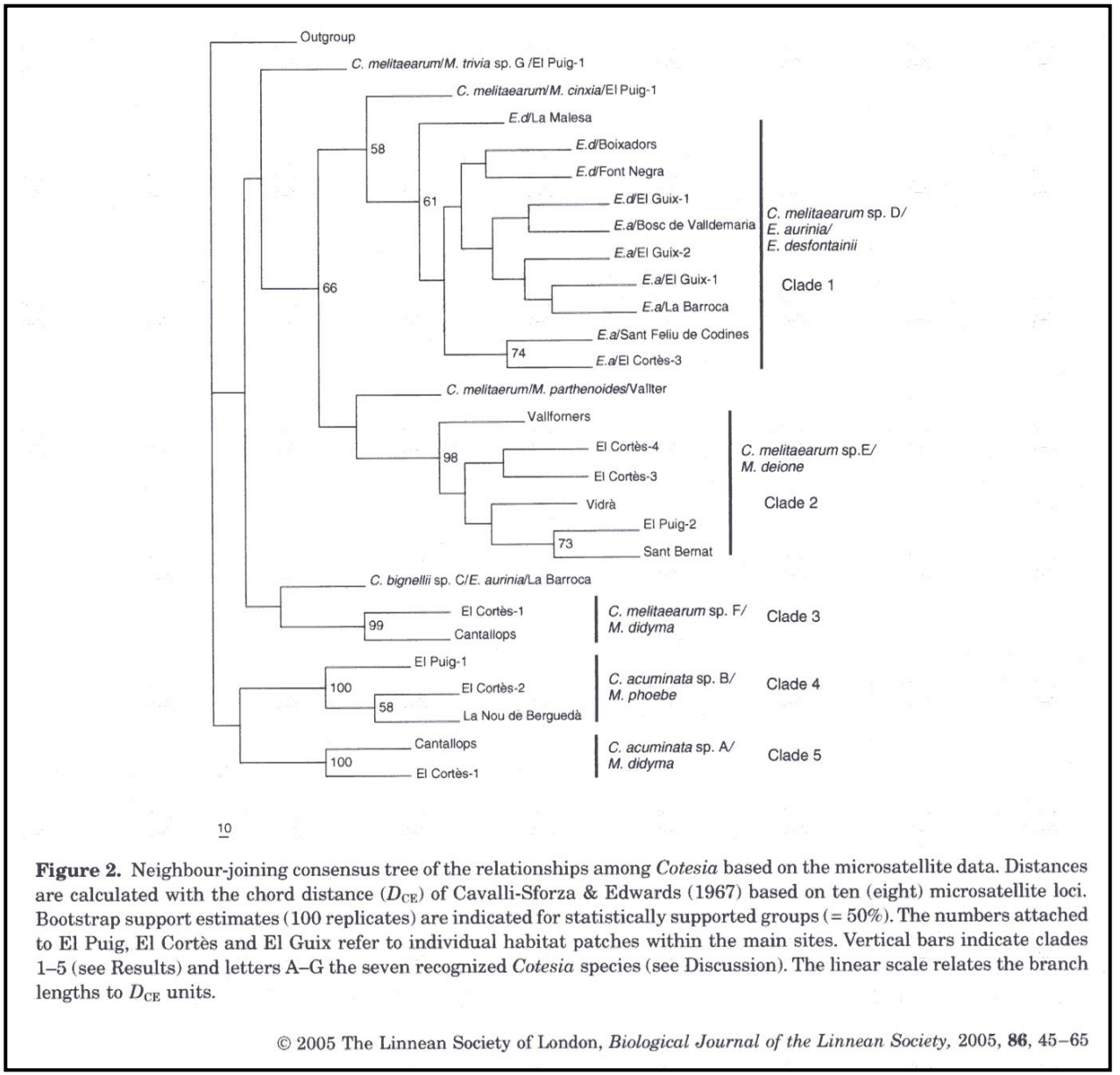
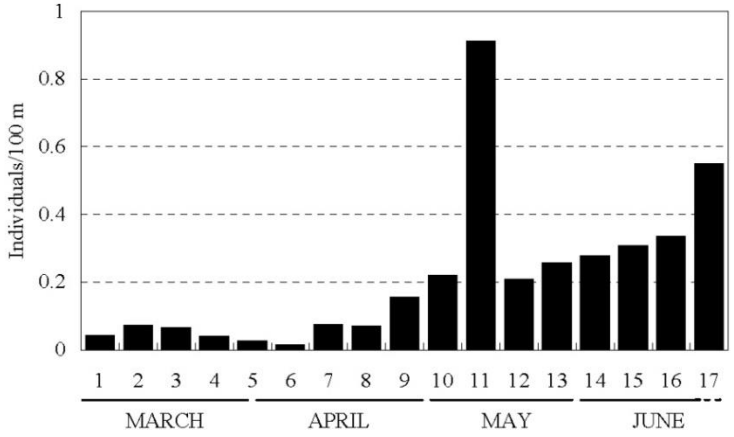
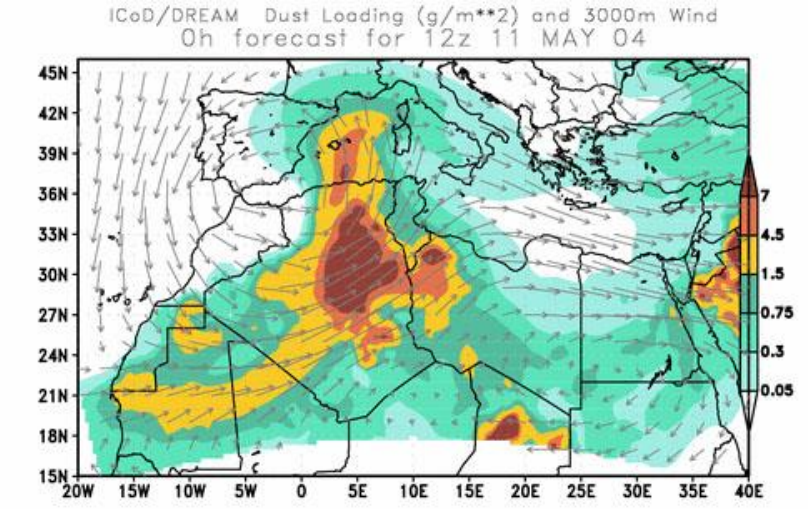


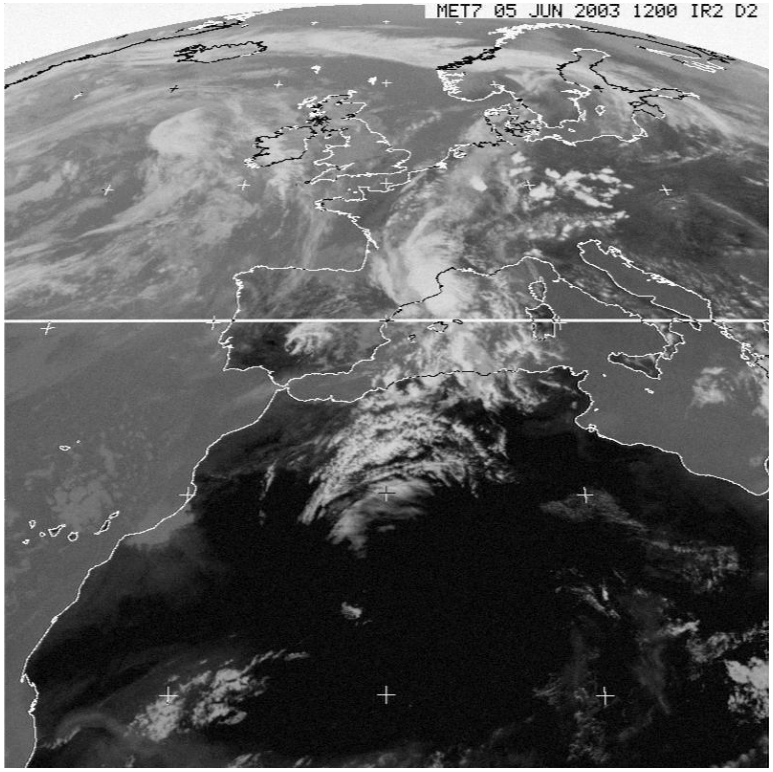
Figure 2. Neighbour-joining consensus tree of the relationships among *Cotesia* based on the microsatellite data. Distances are calculated with the chord distance (D_{CE}) of Cavalli-Sforza & Edwards (1967) based on ten (eight) microsatellite loci. Bootstrap support estimates (100 replicates) are indicated for statistically supported groups (= 50%). The numbers attached to El Puig, El Cortès and El Guix refer to individual habitat patches within the main sites. Vertical bars indicate clades 1–5 (see Results) and letters A–G the seven recognized *Cotesia* species (see Discussion). The linear scale relates the branch lengths to D_{CE} units.

© 2005 The Linnean Society of London, *Biological Journal of the Linnean Society*, 2005, **86**, 45–65

Spring migration of *Vanessa cardui* in the Mediterranean in relation to African winds

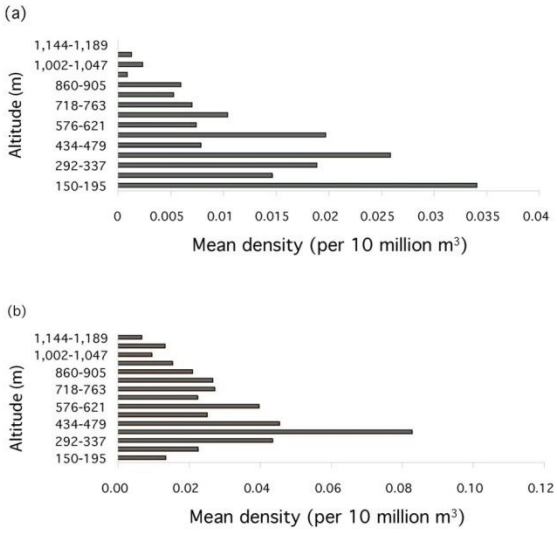


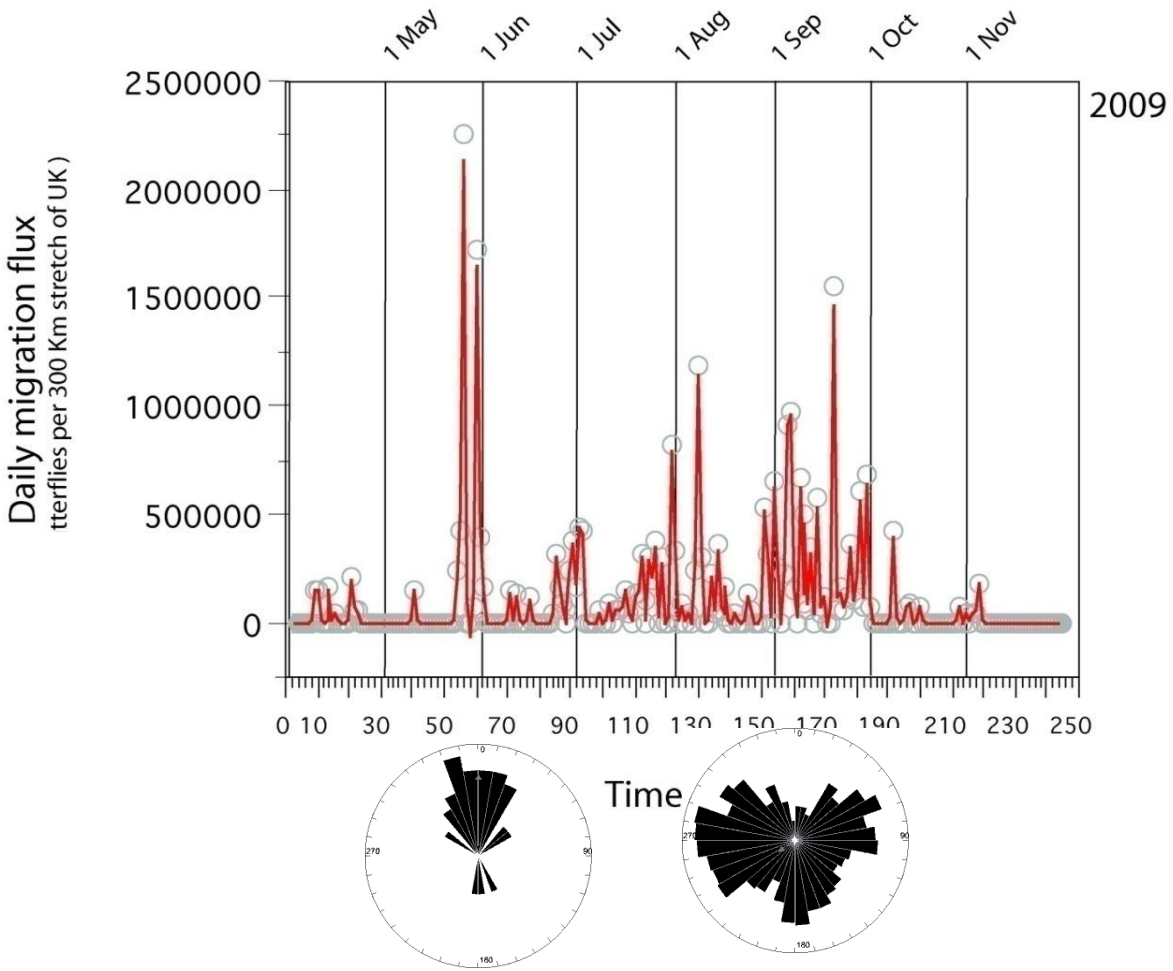




Stefanescu et al. 2007. *J. Anim. Ecol.* 76: 888-898

BMS data combined with radar data: improving our understanding of PL wind-assisted migration





Stefanescu et al. 2013. *Ecography,* 36: 474-486.