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From detection to restoration: lessons from butterflies to improve conservation efficiency

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Introduction

Establishing the conservation status and distribution trends of species or taxonomic groups is considered a valuable task for conservation. Further and increasing efforts to survey more species or taxonomic groups have been advocated before, and will be advocated several times at this Belgian Biodiversity meeting. I do support this view, but measuring or estimating changes in distribution -in particular using current approaches- is only a first step in a conservation process. Moreover, there are several potential problems with analyses based on typical distribution datasets. Much more detailed ecological knowledge is required to bridge the gap between detection and restoration.

To do so, critical, scientific approaches are required, but they do not necessarily guarantee any impact on conservation practice if conclusions do not fit within the framework of practical conservation management and/or policy (PULLIN & KNIGHT 2001). So far, a few attractive species have been used as conservation targets, but the use of species as tools for site- or landscape-oriented conservation is yet poorly developed. I will address some issues to implement species-specific knowledge using butterflies (Rhopalocera) as an example.

Why butterflies, why Flanders?

I refer to results on butterflies in Flanders, the northern region of Belgium. This is because conservation policy and practice are mainly a matter of the regions rather than of the federal Belgian government. Butterflies are among the best-studied groups of animals, particularly among invertebrates (NEW 1997). For Flanders there is an extensive distribution dataset (> 190.000 records), a Red List (MAES & VAN DYCK 1996), a documented distribution atlas (MAES & VAN DYCK 1999), and relative abundance is monitored in a standardised way for about 10 years (although on a small sample of sites). Note that there is a general bias in conservation biology towards attractive species including birds, mammals and vascular plants.

Butterflies are among the few invertebrates that easily attract public attention, but also quite a lot of scientific interest. Aesthetic values should not be mixed with ecological functions and knowledge to derive conservation surrogates or indicators. Nevertheless, the use of butterflies for conservation purposes has been advocated several times before: butterfly species have high demands for habitat quality and they often respond fast to habitat changes (THOMAS 1994, WOIWOD & THOMAS 1993). However, it should be realised that no single species or taxonomic group can be considered a universal bioindicator (e.g. SIMBERLOFF 1998). Within this context, we recently finalised a study for the Flemish Ministry of Nature Conservation on the use of multi-species approaches (VAN DYCK *et al.* 2001), which is not further discussed here.

Status and trends of butterflies

Our analyses clearly indicate that butterflies have experienced severe losses in Flanders: 19 of the 64 indigenous species went extinct and half of the remaining species are threatened to a certain extent. The number of extinct species is among the highest throughout Europe. Using 5 × 5 km distribution grid cells (UTM projection), the number of diversity hot spots decreased considerably and present-day hot spots are almost exclusively found in NE-Flanders (de Kempen). Butterflies have the advantage that several aspects of their ecology have been studied. Hence, further analyses to get a better understanding of butterfly diversity loss are possible. We, for instance, found that species with low dispersal capacities and species from oligotrophic habitats decreased significantly more than mobile species and species from eutrophic habitats. Such relationships point to effects of destruction and fragmentation of suitable butterfly habitats and to the strong impact of intensification of agriculture (including high nitrogen input), respectively. An example of a butterfly that declined severely is *Lycaena tityrus* (fig.1). For more detailed results and a discussion on the severe loss of butterfly diversity in Flanders, I refer to MAES & VAN DYCK (2001).

Problems with distribution data

Distribution data are of great potential value to conservation. However, distribution datasets collected over many years with different people typically carry several biases making sound analyses not evident. In order to make sound comparisons of former and current butterfly diversity throughout Flanders, we applied strict criteria on recording intensity to keep a grid cell in the analysis (MAES & VAN DYCK 2001). Hence, we only used 23 % of all grid cells, but since they were fairly well spread over the different ecoregions of Flanders, this reduced sample was still representative of Flanders as a whole. Problems on biases in distribution data due to temporal and spatial differences in recording efforts have been analysed and discussed in much detail for British butterfly data (e.g. DENNIS *et al.* 1999, DENNIS & THOMAS 2000).

Another issue that has often been denied is the effect of grid resolution on detecting trends. In Belgium (like elsewhere), units of distribution are often coarse-grained grid cells like 5 × 5 km or even 10 × 10 km square grids of the UTM-projection. Using such grid cells as surrogates in stead of real distribution -which is a large amount of work to define- implies that the distribution of several species is overestimated and their decline underestimated. This particularly matters for species that are still widely occurring, but which are (strongly) declining (e.g. COWLEY *et al.* 1999). These issues are clearly not typical for butterfly data, and should be taken into account for any analysis using similar data resources. The importance of standardised methods to collect data should be realised when new (volunteer) survey projects are initiated.

Detailed ecological knowledge and practical conservation: the Alcon blue case

We have recently finalised a recovery plan for the butterfly *Maculinea alcon*, a habitat specialist of wet heathlands and

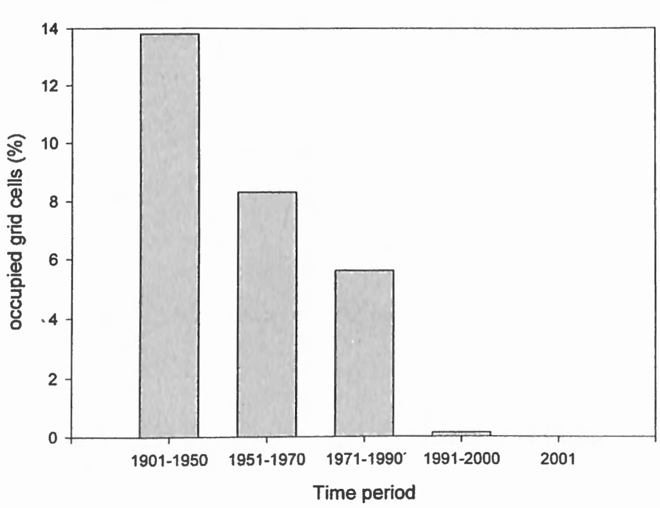

Fig. 1 — Severe decline in distribution of the butterfly *Lycaena tityrus* in Flanders (expressed as percentage of occupied 5x5 km UTM grid cells) during the 20th century. Distribution in the first periods is probably underestimated.

wet, nutrient-poor grasslands (VANREUSEL *et al.* 2000). Such a plan was requested and funded by the Flemish Ministry of Nature Conservation. So far, there is only little experience in species protection programs in this region, and this was the first plan for an invertebrate. *M. alcon* is in Belgium confined to the NE of Flanders. It is considered threatened at the Belgian (or Flemish) level, and vulnerable at the European level (VAN SWAAY & WARREN 1999).

Due to the peculiar life history of *Maculinea* butterflies, their occurrence and abundance are directly affected by other organisms in their habitat. *M. alcon* is a monophagous herbivorous specialist laying eggs on the Marsh gentian (*Gentiana pneumonanthe*). Young caterpillars leave their hostplant to be adopted by *Myrmica* ants. Hence, this butterfly has an obligate, ant-parasitic life stage adopting a cuckoo-strategy. Adoption of the caterpillars is mediated by complex chemical ant brood mimicry. The larval stage lasts either one or two years. Next, they pupate in the ant nest and emerge as adults in the summer. In our region, *Myrmica ruginodis* is recognised to be the optimal host ant, but other *Myrmica* ants also occur in wet heathlands. We collected detailed data on butterflies (MRR-data on adults, egg counts), hostplants (abundance, age distribution), host ants (density of colonies), vegetation structure and management in all but one populations that currently remain.

Many specialist species -including *M. alcon*- have disappeared also from nature reserves when specific knowledge was not available to be taken into account for conservation practices. Management is mainly based on tradition and intuition rather than on evidence (see PULLIN & KNIGHT 2001). For this project we particularly endeavoured to make a scientific-based plan that has a very practice-oriented output as well. Hence, one part of the report brought together all analysed data and discussed knowledge on the ecology and conservation of the species, its hostplant, host ants and complex relationships with its habitat. The other volume of the report summarised proposed measures per site indicating what should be done where and how (e.g. quantification of small scale sodcutting to restore small gentian populations). This approach was appreciated very much by reserve managers that require scientific output in a practice-oriented way and not only in an academic format. On the other hand, the extensive dataset also allowed to address more ecological questions like the controversial role of the host ants for oviposition decisions (VAN DYCK *et al.* 2000). We could, for instance, also illustrate that degree of experience has a strong impact on the quality of apparently simple data like *M. alcon* egg counts (fig. 2).

Butterflies as tools for site- or landscape-oriented conservation: the challenge of ecological networks

Ecological networks and corridors are hot topics in conservation. Connecting areas is very easy to do on a map. However, biological realism is often lacking when no role organisms are considered. There is a huge bias in our knowledge towards woodland systems. It remains, how-

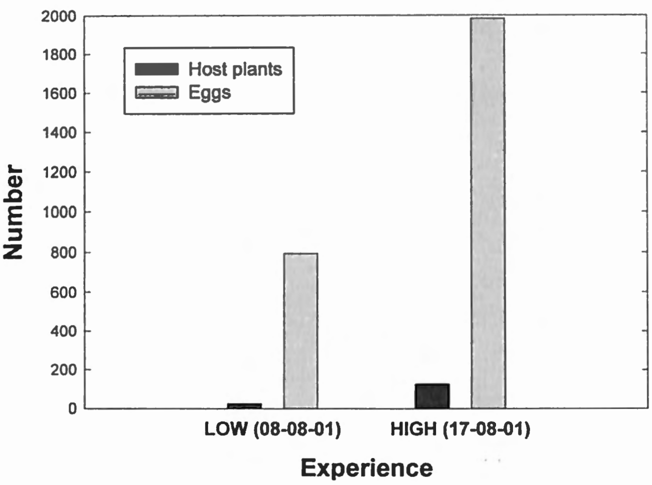

Fig. 2 — Effect of experience on the number of observed hostplants and counted eggs of *M. alcon* in the same population by a team with low and high experience, respectively. Time between the counts will explain some of the difference, but the major difference is attributed to missed host plants and hence eggs by the team with low experience.

ever, to be shown for most non-woodland species (e.g. species of heathlands or marshes) to what extent a hedgerow really provides a corridor for movements through non-habitat. Spatially explicit models using GIS provide interesting tools to take into account several landscape features (like the configuration of landscape components). It is, however, necessary to incorporate species-specific behavioural knowledge into these connectivity models to increase biological realism.

So far, there is few information on how animals perceive (and react on) non-habitat elements when traversing through a landscape (e.g. role of attractants like vegetation borders, resistance of different vegetation types). A careful quantification and critical validation of the used parameters is required. One of our other, more recent, lines of research addresses in particular these issues using again butterflies (but also other animals) as model organisms. This work of our group (Laboratory of Animal Ecology - headed by E. MATTHYSEN) is partly done in collaboration with UCL (M. BAGUETTE, E. BOULENGÉ).

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