

Conservation of *Maculinea* butterflies at landscape level

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To enhance the establishment of new populations of reintroduced *Maculinea* species and increase dispersal between sites, a regional action plan has been started. Public communities, nature conservation organizations, amateurs and farmers participate in the agreements on management of sites. The study describes the changes in the ant fauna in the Action Plan Area after changes in the management of canal borders, road verges and ditch sides.

Keywords: reintroduction, *Maculinea*, *Myrmica*, regional action plan, management

In many plant and animal species a severe decline and loss of populations has been observed during the last century. This sad development has not only taken place in cities, villages and agricultural landscapes, but also in nature reserves, where species were supposed to survive under relatively protected conditions (Hunter 1996). Meta-population systems were first diluted by the loss of subpopulations until only unconnected core populations were left. These core populations are sensitive to stochastic extinction and were lost consecutively, often without any clear reason (Hanski & Gilpin 1997). For nature conservationists and reserve wardens, the loss of species is a problem, especially when a flagship species is concerned. After a species is reintroduced, special measures are taken to facilitate the new settlement of a population and its increase in numbers. However if reintroduction concentrates only on the welfare of the new population, the chances for a new stochastic extinction are still high and might eventually lead to new extinction. Therefore it is essential to include measures on landscape scale too.

The large blue butterfly species *Maculinea teleius* and *M. nausithous* are good examples for flagship species. In the 1970's both butterfly species were lost in the Netherlands, but in 1990 they were reintroduced into a nature reserve close to the city of 's Hertogenbosch. The new populations developed well and showed a considerable increase in numbers (Wynhoff 1998). *Maculinea nausithous* settled first on a location in the nature reserve, from where a subpopulation on the road verges south of the reserve was established. Later, another subpopulation at a distance of 5 km from the reintroduction site was found, too. On the contrary, *Maculinea teleius* colonized only the meadow where it was released, but did not disperse to other locations. It became obvious that the habitat quality of the road verges, ditch sides and embankments are very important for the long-term persistence of both species. They could fulfil a role as dispersal corridor but also as a temporary or semi-permanent habitat (Oostermeijer & Wynhoff 1996).

Maculinea teleius and *M. nausithous* are obligate parasites of ants. The caterpillars live for a period of about 10 month in the nests of *Myrmica scabrinodis* and *Myrmica rubra* where they feed on ant larvae. The eggs are deposited on the only host plant *Sanguisorba officinalis* (Thomas 1984). Hence, the suitability of a certain habitat patch is determined by the presence of the host plant and the specific host ants. Both components are sensitive to management. To encourage an increase in *Myrmica* ant nest density and further dispersal of the *Maculinea* populations, the Province of Northern Brabant designated a *Maculinea* Action Plan Area (Provincie Noord-Brabant 1997). In this area the management of nature reserves and public property areas was changed to increase *Myrmica* ant nest densities. In the surrounding of the Moerputten nature reserve the density of *Sanguisorba officinalis* is high on road verges and in nature reserves, whereas it is missing in the meadows and fields under agricultural use. The density of *Myrmica* ants is in comparison much lower. This study describes the changes in ant fauna in the Action Plan Area three years after starting management changes.

Ecology of the investigated ant species

Within Europe, ants of the genus *Myrmica* and *Lasius* are common and widespread (Seifert 1994, 1996, Van Loon & Mabelis 1996). Each species lives in ecologically distinct habitats. However, there is always a degree of overlap between species and in many sites, two or three *Myrmica* or *Lasius* species occur in competition with each other (Elmes & Wardlaw 1982, Elmes *et al.* 1998). *Myrmica rubra*, the host ant of *Maculinea nauithous*, prefers a warm and moist habitat with only a low level of disturbance. This ant species occurs in rough grassy vegetation along edges of bogs, rivers and woods. *Myrmica scabrinodis*, to which *Maculinea teleius* is specialized, occurs in grasslands, bogs and moors. Generally, it is a slightly more thermophilous species compared to *Myrmica rubra*. The vegetation of *Myrmica scabrinodis* nest sites is mostly shorter and more open. Normally worker ants collect the food only relatively close to the nest site. The distances they walk are not more than about 2 m from the nest entrance for *Myrmica scabrinodis* and 5-6 m for *Myrmica rubra*. *Myrmica scabrinodis* usually stays on the ground. The workers explore their surrounding walking through the plants, under the litter and under moss cushions. *Myrmica rubra* also moves up into the vegetation, bushes and small trees like willows (Van Boven & Mabelis 1986, Elmes *et al.* 1998).

Lasius flavus is in its abundance and ecology comparable to *Myrmica* ants. The workers build very large nest moulds and are, like *Myrmica* species, sensitive to disturbance. *Lasius niger* is a rapid colonizer of disturbed grounds. It can stand high levels of disturbance and is a competitor of *Myrmica* ants.

The *Maculinea* Action Plan

The main objective of the *Maculinea* Action Plan is the facilitation of further dispersal of the reintroduced butterfly species to create a metapopulation. Hence the vegetation in the nature reserves and on grounds under public property, such as road verges, should be managed in a way that at first colonization by the host ant species and later by the *Maculinea* butterflies should be possible. Four actions are formulated: (a) adaptations in the management of nature reserves, (b) extensions of nature reserves, (c) adaptations in the management of for instance road verges, canal borders, ditch sides, embankments, and (d) monitoring of actions and effects. This paper concentrates on action (c).

Adaptation in the management means mainly that areas are mown less often. It is of vital importance that occupied *Maculinea* habitat is not mown at all during the butterfly's flight period. The eggs and early caterpillar instars would be removed, while they could be safely in the ants nests just some weeks later. Mowing only one side of road or ditch at a time can reduce the disturbance of mowing to the whole insect fauna. Especially for the benefit of *Myrmica rubra* strips of vegetation should be left unmown for one or two years. Furthermore rough vegetation with flowers should be mown only late in the year.

Participants in the agreement of the *Maculinea* Action Plan are (a) the Municipalities of Heusden, 's Hertogenbosch and Vught, (b) State Forestry and "Natuurmonumenten", (c) Polder (Waterschap) de Maaskant, (d) Province of Northern Brabant, (e) Ministry of Agriculture, Nature Conservation and Fisheries, Department South, (f) Dutch Butterfly Conservation and (g) the localfarmers.

MATERIAL AND METHODS

In 1990, an intensive inventory of the *Maculinea* host plant *Sanguisorba officinalis* was carried out in the nature reserves and the agricultural landscape around Moerputten nature reserve (Oostermeijer & Wynhoff 1996). In the designated Action Plan Area (Fig. 1) 177 plots with host plants were selected for ant inventories. During 15 minutes we searched for ants in an area of about ten square metres around one or several *Sanguisorba*'s. On plots along roadsides we searched in the whole gradient from dry strips directly next to the asphalt until the humid bottom of the road side ditches. This way data for relative density of ant nests can be obtained while it is still possible to cover many plots in one season. In 1997 the management changes according to the *Maculinea* Action Plan started. In 2000 a new inventory of the ants was done to check whether there were effects of the changes in the mowing regime.

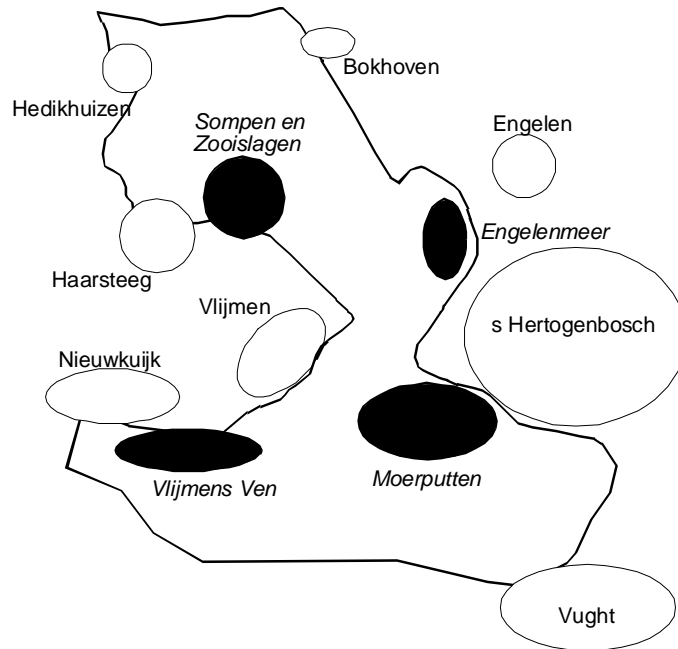


Figure 1. *Maculinea* Action Plan Area in the Province of Northern Brabant. Black circles: nature reserves, white circles: villages and cities, black line: Action Plan Area

RESULTS

In 1996, on 38 from 177 plots no ants were found. In 2000 after three years of mowing according to the agreements of the *Maculinea* Action Plan, 65 from 178 plots were empty.

This difference is significant (Pearson = 9.76, $df=1$, $P=0.002$). In general, on many plots also fewer ant nests were found compared to the beginning of the project. The changes in relative occupancy are not evenly distributed over all ant species (Fig. 2). The only significant decrease in the number of occupied plots was found in the species *Lasius niger*. *Myrmica ruginodis* also showed a slight decrease. *Lasius flavus*, *Myrmica rubra* and *Myrmica sabuleti* have increased their abundance, while *Myrmica scabrinodis* is stable.

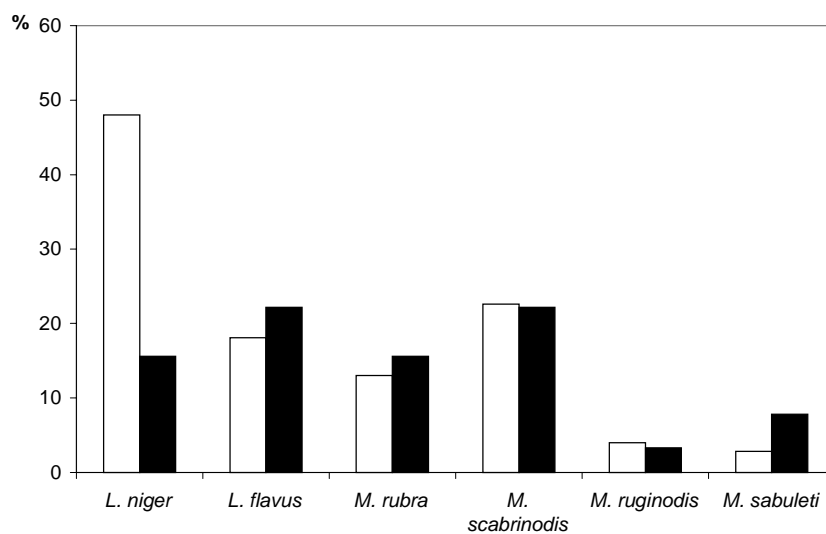


Figure 2. Changes in relative occupancy of plots with ants from 1996 (white bars) to 2000 (black bars) in the *Maculinea* Action Plan Area ($n=180$). Significant changes were found in *Lasius niger* ($P<0.0001$) and *Myrmica ruginodis* ($0.01<P<0.05$) (Wilcoxon Signed-Rank test)

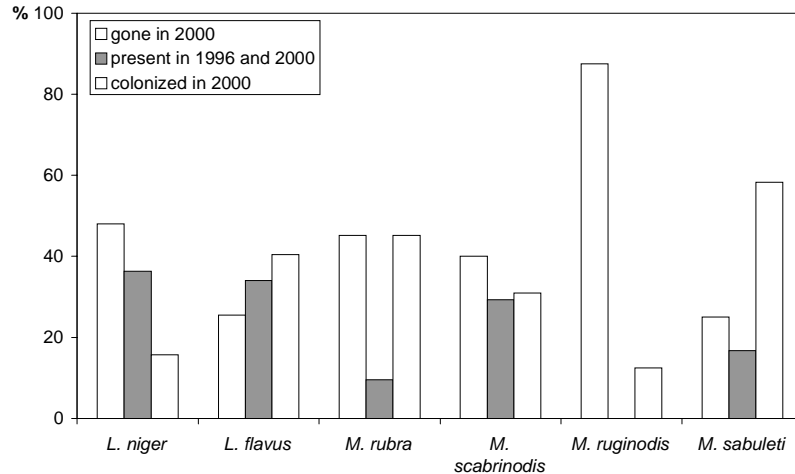


Figure 3. Relative changes of occupation of ant colonies in the *Maculinea* Action Plan Area from 1996 to 2000. The maximum number of occupied plots of a species in 1996 or 2000 is set to 100 percent

Fig. 3 gives some more details on the changes per species. *Lasius niger* has gone extinct in almost three times as much plots as it has been able to colonize. Per plot the number of colonies was also reduced compared to 1996. Extinctions and reductions in ant nest density were found in all regions of the Action Plan Area, with many of them on the road verges south of Moerputten nature reserve and the western part of Drongelens Kanaal. The colonizations also took place almost evenly distributed over the Action Plan Area.

Lasius flavus and *Myrmica rubra* show an overall slight increase of occupied plots. *Lasius flavus* has gone extinct in relatively few plots, but was stable on many and colonized quite many plots. *Myrmica rubra* shows a different pattern with extinctions and colonization. This species has been stable on only a few plots. Almost all extinctions were found to have taken place on the plots of Ruidigerdreef south of Moerputten nature reserve and along Drongelens Kanaal. The colonizations were evenly distributed over the southern part of the Action Plan Area. *Myrmica scabrinodis* has experienced no overall decrease since 1996. The numbers of empty, colonized and stable plots are almost equal. All of them are distributed almost evenly over the area of investigation. *Myrmica ruginodis* and *Myrmica sabuleti* have both only been found in Moerputten nature reserve and the borders of Drongelens Kanaal. The maps of the distribution of the ant species are given in Wynhoff & Janssen (2000).

DISCUSSION

The first investigation of the ant fauna in the *Maculinea* Action Plan Area has shown, that *Lasius niger* is by far the most common ant species. A negative correlation between the nest densities of this species and *Myrmica rubra* and *Myrmica scabrinodis* shows that these species do not occur together but rather compete for habitat space (Oostermeijer & Wynhoff 1996). Changes in the management for the benefit of the *Maculinea* butterflies should therefore increase abundance and nest densities of *Myrmica* species (and *Lasius flavus*) while *Lasius niger* should decrease.

Since the management of the road verges in the Action Plan Area has been adapted, the ant fauna has changed indeed. The mowing frequency has been reduced which resulted in less disturbance. The pioneer species *Lasius niger* is now less abundant than before and nest densities are reduced, too. The number of plots with *Myrmica* species has not increased. Therefore it seems like they have not been able to take over the empty space. However, the abundance of the ants has not changed equally in the whole Action Plan Area. For *Myrmica rubra*, newly colonized plots and plots with an increase in ant nest density are distributed equally over the whole study area, while the plots with extinctions are concentrated at two locations: the road verges directly south of the

Moerputten nature reserve (Ruidigerdreef) and a part of the canal borders of Drongelens Kanaal. These two sites were treated different from the others. The road verges of the Ruidigerdreef changed severely after the ditch sides were stripped off the vegetation and reconstructed. The original vegetation consisted of mainly *Phragmites communis*, in which there were many nests of *Myrmica rubra* and some *Myrmica scabrinodis*. These nests were used by the *Maculinea* caterpillars. On these verges the main subpopulation of *Maculinea nausithous* used to live until 1996. Since the ditch side reconstruction, *Myrmica* ants are missing, as well as *Maculinea* butterflies. The borders of Drongelens Kanaal used to be mown but are grazed by sheep nowadays. *Myrmica rubra* is very sensitive to trampling. The reduction in nest sites of this species might be explained by the change in management.

In general, the aims of the adaptations in the management of public property within the *Maculinea* Action Plan Area have been achieved. Except for two locations, a decrease of *Lasius niger* was found in combination with an increase in *Myrmica* species and *Lasius flavus*. Through the reductions in mowing frequency, more suitable sites for *Maculinea nausithous* and *Maculinea teleius* can be created. The more mobile *M. nausithous* can disperse better and found new subpopulations on the improved road verges. For *M. teleius* we expect positive effects only at a later term (Settele 1998).

The great changes at Ruidigerdreef also show how vulnerable the implication of an agreement such as the *Maculinea* Action Plan is. Even though improvements in habitat quality can be achieved by the management changes of the agreement, local actions within the recent flight area of the *Maculinea* butterflies can still have tremendous effects on the affected subpopulations. At the moment the butterfly metapopulation system is still too small to compensate for that. Therefore it is still necessary to put further effort into the information and motivation of all participants of the agreement.

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