

Do ants need protecting?

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Generally, species can be protected by the conservation and sustainable management of the ecosystems in which they occur. However, some vulnerable and threatened species need special attention. In order to protect these species effectively, data should be available on their conservation status, their decline and the threats that are operating. Such data are lacking in the recent Red List of the IUCN. Most ant species mentioned in this list are social parasites. The question arises whether these species can be protected more effectively by protecting and managing the biotope of their more easily found host species. Presently, it is not clear who will collect and interpret the data for making a selection of Red List species. Attention should also be paid to umbrella species, which are important for the survival of other species, and keystone species, which play an important role in an ecosystem.

Introduction

The most recent Red List of Threatened Species of the IUCN (International Union for the Conservation of Nature and Natural Resources) mentions 149 ant species, whereas only eleven species were mentioned in the Red List of 1983 (21 species in 1986, nine in 1996 and 50 in 2002; IUCN 1983, 1986, 1996, 2002, 2006). The increased number of so-called threatened species is mainly due to myrmecologists using different criteria for placing species on the Red List. In 1983, information was given on the status (*e.g.* distribution and trend) of the species, but such information is lacking in more recent Red Lists. Most species mentioned in the 2006 Red List are social parasites; they can be protected by conservation measures for their host species, or at least the biotope of their host species. However, as long as data on status are lacking, the Red List will not be an effective tool for the protection of the species mentioned. Other species might not be threatened themselves, but play important ecological roles, justifying their protection. The question is: which ant species should be selected as target species for nature conservation practices?

The ants

Ants are social insects; their workers are able to communicate and divide their tasks quite well. Young workers operate inside the nest, for example they feed the queen and her larvae, while older workers perform tasks outside the nest, such as repairing and defending the nest, milking aphids, capturing prey or collecting seeds. The worker generations overlap, which implies that the younger workers can share or take over tasks from the older ones. Consequently, the colony is able to adapt to some extent to changes in its environment. Ants occur in nearly all terrestrial biotopes, most species being found in tropical and subtropical areas. Ants play a wide range of important roles in the biotopes (ecosystems) in which they occur, being predators, scavengers, honey collectors, seed dispersers, fungus growers, guests of other species, slave makers or parasites.

According to Norman Johnson (personal communication), by 1976 a total of 9104 ant species had been described, 9903 by 1990 and 12,012 by 2006. More descriptions may follow, despite the continuing destruction of those ecosystems that are the richest

in ant species. The total number is estimated to be around 22,000 species (Agosti & Johnson 2003). Which of these species can be considered for the Red List? A group of ant specialists needs to make a proposal.

Ant specialist group

Relevant data for the protection of threatened ant species were collected by the Social Insect Specialist Group (SISG), which is the successor of the Ant Specialist Group. This group of myrmecologists advised the IUCN on Red List species. Agosti & Johnson (2005) made a start by making distribution data of Red List species widely available on the internet. However, this initiative is developing slowly, due to the lack of financial support. Recently, I tried to find SISG on the internet, but only one Invertebrate Specialist Group (ISG) was mentioned. At the moment, this group can only deliver data about dragonflies (Odonata) and snails (Mollusca). Do ants belong to the 'Forgotten Kingdoms'? I asked this question to the chairman of the Species Survival Commission (SSC, a commission of the IUCN involved in making Red Lists) and the IUCN Red List Officer. They explained that many Invertebrate Specialist Groups, among which the SISG, have been temporarily dissolved as part of the reconstruction of the SSC. According to the chairman of the SSC, ant specialists can send data on Red List species to a so-called Ant Focal Point. However, it is unclear who will give advice on the species that should be mentioned in the Red List, and who will process data concerning their status.

Monitoring target species

Generally, species can be protected by the conservation and sustainable management of the biotopes in which they occur. However, monitoring target species will be necessary to check the effectiveness of the measures taken (Agosti *et al.* 2000). Species belonging to the following categories would be suitable as target species:

- vulnerable and threatened species (*e.g.* Red List species), including habitat specialists (often stenotopic species, which are dependent on other species, (*e.g.* parasites and slave makers), species with a very limited distribution area (many endemic

species) and species which are sensitive to changes in the environment, such as desiccation (e.g. species of peat bogs), eutrophication (e.g. species of nutrient poor grasslands), habitat fragmentation (species with a poor dispersal and/or establishment capacity) or pollution (species which accumulate harmful substances),

- umbrella species (e.g. *Formica* species as host of parasites),
- keystone species (e.g. *Formica* species as polyphagous predators).

Monitoring of a species is only meaningful if enough knowledge is available. If we consider the group of vulnerable and threatened species mentioned in the IUCN Red Data Book, we could base our selection of species to be monitored on the following criteria:

- 1 the distribution area is more or less known,
- 2 there are indications the distribution area is shrinking and/or local populations decline strongly and
- 3 the causes of decline are known or inferred.

For this purpose, the data on which the decisions are based to add species to the red List should be presented with it. I recommend that the following data are collected and included in future Red Lists:

- 1 any dependency of a species on other species, either as host species or as slave-maker,
- 2 the distribution of the species and their habitats (for social parasites, also of the host species) and
- 3 the degree of specialism (stenotopy) of the species (for social parasites, also of the host species).

If these data are known, monitoring of selected species can be effective.

Protecting social parasites

Most species mentioned in the 2006 Red List are social parasites. As host species can generally be found more easily than their social parasites, the latter can be protected more effectively by protecting their host species. I illustrate this with two examples.

The parasite *Formicoxenus nitidulus* (Nylander) is mentioned in the IUCN Red List of Threatened Species and lives in nests of at least six *Formica* species (*Formica polyctena* Foerster, *F. rufa* Linnaeus, *F. pratensis* Retzius, *F. truncorum* Fabricius, *F. exsecta* Nylander and *F. pressilabris* Nylander). The nest mounds of these species can be easily found, in contrast to the small *Formicoxenus* workers (figures 1-2, 4). This parasite disperses in late summer with young queens leaving the *Formica* nest, either flying or wal-



Figure 1. Nest of the red wood ant (*Formica polyctena*). Photo: Bram Mabelis
Nest van de kale bosmier (*Formica polyctena*).



Figure 2. Nest of the trunk ant (*Formica truncorum*). Photo: Bram Mabelis
Nest van de stronkmier (*Formica truncorum*).

king in search of other nests. The distribution area of the parasite, as expected, overlaps with that of the six hosts in The Netherlands (figure 3). Four of the six host species have a protected status in The Netherlands (*F. polyctena*, *F. rufa*, *F. pratensis* and *F. truncorum*). This implies that *F. nitidulus* can be protected most easily by managing the habitats of red wood ants to promote sustainable population densities of the social parasite. This is why *F. nitidulus* has been removed from the list of protected species in The Netherlands, whereas its host species *F. truncorum* has been added (Ministry of LNV 2002). There may also be valid arguments for adding the mound building ants of the *F. exsecta* group to the Red List (figure 4), not only as the host species of *F. nitidulus*, but also because they are living in nutrient-poor grasslands, which are rapidly declining.

The parasite *Strongylognathus testaceus* (Schenck) lives in nests of *Tetramorium* species (*T. caespitum* (Linnaeus) in The Netherlands). The nests of these host species can be found easily, whereas the parasite can only be found by opening *Tetramorium* nests or by observing sexuals which leave the nest for their mating flight in summer. The distribution of the parasite in The Netherlands overlaps only for a small part with that of its host species (figure 5). The parasite will be under-sampled, because its workers are difficult to find: only a small percentage of the workers in a *Tetramorium* nest can be *Strongylognathus* workers. However, this cannot explain the fact that the species is not found in several regions of The Netherlands which have been investigated thoroughly by ant specialists and where much habitat (i.e. *Tetramorium* nests) is available. It seems more likely that the parasite has a poor dispersal capacity and cannot colonize remote habitat areas. If so, then the parasite will be sensitive to further fragmentation of *Tetramorium* habitats. In this case, collecting data on the distribution of the host species will not be sufficient to protect *S. testaceus*; the dispersal capacity of young queens needs to be taken into account for protection to be effective. Although this parasite is considered threatened in several European countries, it is still not included in the IUCN Red List.

Protecting red wood ants

Eight species of red wood ants (*Formica* spp.) are on the IUCN Red List of Threatened species. Most of them are not threatened, but they are vulnerable to disturbances like the commercial collection of pupae for bird food and nest damage by wild boars and woodpeckers. The *Formica* species are not only protected for their intrinsic value, but mainly to maintain their role in the fo-



Figure 3. Distribution of *Formicoxenus nitidulus* (●) and its habitat: the nests of six *Formica*-species (□) (database EIS-Nederland, Leiden).
Verspreiding van de glanzende gastmier (*Formicoxenus nitidulus*) (●) en haar habitat: de nesten van zes *Formica*-soorten (□) (gegevens van EIS-Nederland, Leiden).

rest ecosystem: (1) they are polyphagous predators and are thus assumed to stabilize prey populations, (2) the nest of red wood ants is the habitat of many ant guests, for example c. 30 species of beetles in The Netherlands alone, (3) red wood ants disperse seeds of myrmecochorous forest plants (e.g. of *Viola* species) and (4) red wood ants are a reliable food source for several other species (e.g. woodpeckers, ant lions, amphibians). Therefore, red wood ants are a good choice as target species for nature conservation, with the advantage that their nests can be monitored easily.

Three of the eight *Formica* species on the IUCN Red List occur in The Netherlands: *F. polyctena*, *F. rufa* and *F. pratensis*. (As an aside: there are good reasons for considering *F. rufa* and *F. polyctena* as one species with different survival strategies, but in the present context it is more convenient to use the names given in the literature and on the IUCN Red List.) The fourth indigenous *Formica* species, *F. truncorum*, is not mentioned in the list, although this species seems to be more vulnerable than the other three: local populations have a higher extinction probability and it is doubtful whether this is compensated by a higher probability of colonizing empty habitat patches (Mabelis & Korczyńska 2001, Mabelis & Chardon 2006). The vulnerability of this species is the main reason that it is protected in The Netherlands (Ministry of LNV 2002).

In many forests throughout Europe, red wood ants have been (re)introduced as a method of biological control of harmful insects. This has mainly been done in production forests, but sometimes also in National Parks. Before a decision is made to reintroduce a species in a National Park (or other protected area) the following conditions should be fulfilled: (1) the species should have occurred there earlier, but has disappeared, (2) habitat quality should be appropriate, (3) the distance to the nearest potential source population for immigrants should be too

great for natural recolonization and (4) reintroduction should not affect the survival of other characteristic species.

In some regions, nests of red wood ants are protected by foresters with fences against wild boars. However, it would probably be preferable to manage these forests and their wild boar populations in such a way that red wood ants can survive despite natural losses due to disturbances by these animals. Some foresters also protect red wood ant nests with nets against woodpeckers. This should be discouraged. Red wood ants are a reliable food source for these birds in winter and healthy populations will survive these natural losses (de Bruyn *et al.* 1972). Woodpeckers can be regarded as keystone species as well, because the tree holes they create for nesting are potential breeding habitats for birds and bats.

Nature management

If a strong decrease of local populations of target species is established and the causes of decline are known, then it can be decided to take management measures to improve the situation, i.e. to increase the survival probability of these species. Umbrella species and keystone species, such as red wood ants, can be chosen as indicators of local biodiversity.

Red wood ants prefer to build their nests in open forests and on the southern edge of dense forests. Just like many other social insects, most ant species need the warmth of the sun for a quick development of the brood in the nest. In the trees, the ants can find aphids, which provide them with honeydew ('aphid milk'), which is an important source of energy. They can find prey, an important source of protein, mainly in open areas. In natural conditions small open areas can arise by windfall, while big herbivores sometimes can keep the areas open long enough for giving forest edge species, like the red wood ants, a chance to establish. However, most of the forested area of Europe is planted and managed for wood production and consequently rather dense. For wood ant conservation in these forests, open areas can be created by felling trees or by pulling them down. This would not only create habitat for red wood ants but for many other open-forest species as well. Biodiversity of a forest can thus be maintained (or enlarged) by maintaining a varied forest structure with small open areas.

Habitat fragmentation

The absence of red wood ants in a woodland may be the result of poor habitat quality, but it may also be that the woodland is so isolated from inhabited areas that the colonization probabili-



Figure 4. Nest of *Formica exsecta*. Photo: Bram Mabelis
Nest van de gewone satermier (*Formica exsecta*).

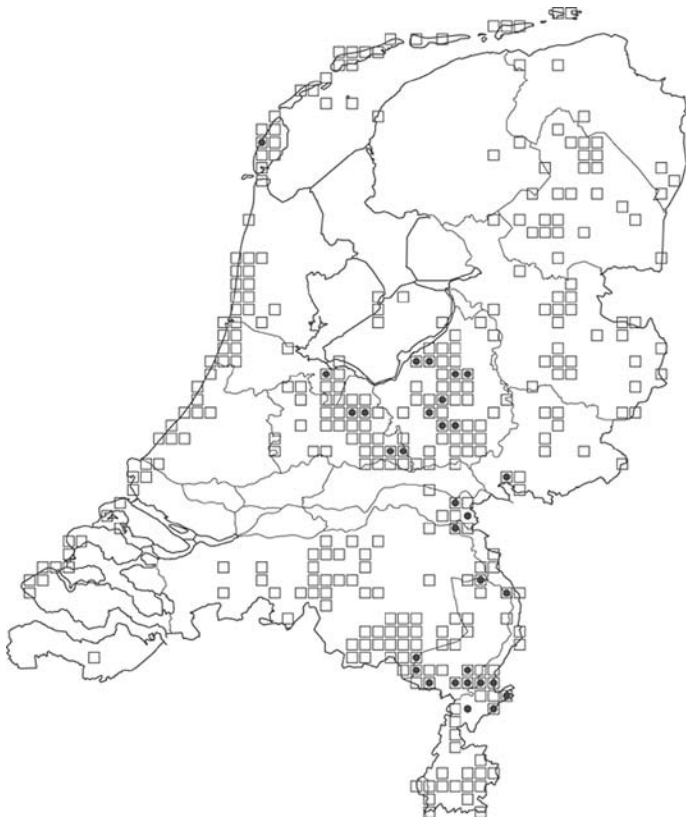


Figure 5. Distribution of *Strongylognathus testaceus* (●) and its habitat: nests of *Tetramorium caespitum* (□) (database EIS-Nederland, Leiden). Verspreiding van de sabelmier (*Strongylognathus testaceus*) (●) en haar habitat: de nesten van *Tetramorium caespitum* (□) (gegevens van EIS-Nederland, Leiden).

ty is extremely low. Red wood ant species differ in their ability to colonize vacant areas, due to different survival strategies. The difference in strategy is related to the tolerance of workers to accepting more queens in their nest, either fertilized daughters or young queens from other nests. A colony of a species that accepts many queens, like *F. polyctena*, has a lower probability of going extinct than a colony of a species that accepts just one or only a few queens, like *F. rufa* (Mabelis 1986). Moreover, a species which has many queens per nest can disperse by means of budding, during which workers transport several queens from the mother nest to newly built daughter nests. This is a much safer means of dispersal than trying to colonize an area by means of flying queens (Rosengren & Pamilo 1983, Rosengren et al. 1993). However, the advantage of budding is lost if the habitat area is small. In that case, it may be a better option for a young queen to leave the area by flying.

To establish a new colony, a single dispersing queen has to become accepted in a nest of a species belonging to the subgenus *Serviformica* (generally *F. fusca*), because she is not able to raise her own first brood. The success rate of being adopted by

these 'alien' host ants is very low (Gösswald 1952), so that colonizing new areas by means of flying queens is very risky. Nevertheless, it may be a good survival strategy when the habitat is fragmented, such as small patches of woodland in an open area. It seems that the higher probability of a colony with one or a few queens going extinct can be compensated by the higher probability of colonizing a habitat patch which is still unoccupied. Consequently, a monogynous/oligogynous species is better adapted to a situation in which the habitat is fragmented, whereas a polygynous species will thrive better in an area where habitat patches are connected.

The distribution pattern of nests and local populations reflects these social structures: *F. polyctena* colonies occur more often in woody areas without barriers, whereas *F. rufa* is more common in small and isolated habitat patches (Mabelis 1994). This difference appears to be clearer in an area where the edges of the patches have good habitat quality, than in a situation where the edges are contaminated with animal manure and pesticides from adjacent agricultural fields, as so often in The Netherlands (Mabelis 1991). Not only the size and the quality of habitat patches are important predictors for their occupancy, but also the degree of isolation from areas where the species occurs. This concerns mainly species which only disperse by walking, but also species which can fly.

Conclusions

Based on the examples, I give the following recommendations concerning the protection of ants: 1) species can be protected most easily by protecting their biotopes and by managing these areas in a sustainable way, 2) besides biotope protection, attention should be paid to the conservation of the most vulnerable and threatened species (Red List species), 3) for these Red List species, data should be available on their distribution, population trend and the threats in order to protect them effectively, and 4) besides these species, attention should be paid to the maintenance of umbrella species, which can function as hosts for parasites, and to keystone species, which play an important role in the ecosystem concerned.

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Samenvatting

Hebben mieren bescherming nodig?

Soorten kunnen het best worden beschermd door het biotoop waarin ze voorkomen goed te beheren. Behalve biotoopbeheer zal er aandacht besteed moeten worden aan het behoud van de meest kwetsbare en bedreigde soorten mieren (Rode-Lijstsoorten). Van deze soorten zullen gegevens beschikbaar moeten zijn over hun status en mate van bedreiging, op grond waarvan maatregelen kunnen worden genomen om hun overlevingskans te vergroten. Dergelijke gegevens werden wel vermeld in de Rode Lijst van de IUCN van 1983 (elf soorten), maar ontbreken in de Rode Lijst van 2006 (149 soorten). De toename van het aantal mierensoorten op de Rode Lijst is een gevolg van het feit dat mierenkenners die aan de lijst hebben gewerkt verschillende criteria hebben toegepast voor opname van een soort. De vraag is echter wie gegevens over de status van kwetsbare soorten gaat opslaan en interpreteren om een goede selectie te maken van Rode-Lijstsoorten nu de Social Insect Specialist Group van de Species Survival Commission van IUCN (tijdelijk?) is opgeheven. Voorlopig stelt men zich tevreden met de instelling van een 'Ant Focal Point', maar het is nog niet duidelijk hoe deze constructie in de praktijk zal werken. Verreweg de meeste soorten van de recente Rode Lijst leven als parasiet in nesten van andere soorten mieren. Dit roept de vraag op of deze soorten niet gemakkelijker te beschermen zouden zijn door hun gastheer te beschermen, of in ieder geval de habitat van de gastheer. Gastheren zijn immers makkelijker te traceren dan hun parasieten. Naast aandacht voor het behoud van Rode-Lijstsoorten zouden ook hoeksteensoorten (die een belangrijke rol in een ecosysteem vervullen) en paraplu-soorten (die van belang zijn voor het behoud van andere soorten) beschermd moeten worden.



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