

Remarks on the distribution and use of a provisional red list of the ants of Flanders (Formicidae, Hymenoptera)

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Abstract

In the beginning of 2001 all available data of ants in Flanders (northern part of Belgium) were brought together and several inventory works were started. Some general conclusions on the distribution and diversity of the ants of Flanders and their habitat width are discussed and a provisional Red List is presented and its possible use is evaluated. Further we assess for which habitat-types ants could be indicators. In Flanders heathlands have the most stenotopic and threatened ant fauna. We provide a list of species which should be monitored in those sites and can be used to evaluate sites together with red list of other invertebrate groups.

Introduction

Red Lists of particular taxonomic groups have become increasingly indispensable tools in nature conservation research and practice. At a local scale (for example Flanders, the northern part of Belgium) those lists are used in the development of a modern nature conservation policy and in site assessment studies and monitoring (Maelfait, 1993; Maes et al., 1995; Hoogeveen, 1998; Maelfait *et al.*, 1998). The use of less well known taxonomic groups, such as several orders of insects and other invertebrates, in assessments of the effects of management measures, is a recent development. However, a critical approach should be maintained in using groups of insects to evaluate sites (Samways, 1993; Barendregt *et al.*, 1998; Heijerman & Turin, 1998; Ellis, 1998). Because of their small size, they are often considered as difficult to identify, hard to study and it is time-consuming to prepare inventories. Moreover, they generally lack sympathy from the public. Sometimes populations can persist in very small areas, which could not support larger animals. One cannot compare macrobiota (birds, plants, mammals) with insects and other invertebrate groups and treat them as equal in evaluating different sites (Ellis, 1998). Sometimes butterflies, grasshoppers and dragonflies are used as representatives for all insect groups, or all invertebrates, and the evaluation and protection of sites is based on the occurrence of species of only these very mobile groups, which are often poor in species and with low abundances. These groups, however, represent a small part of the invertebrate and insect fauna. Sometimes their responses to management and changes in the environment differ greatly. An approach which uses many species, with representatives from several taxonomic groups, could give more complete and representative information. A drawback of this approach may be that long lists of species will have to be followed up and that this may lead to conflicting recommendations. For example, monitoring dragonflies and water bugs would accentuate the importance of the

water quality and quantity, but would neglect the very different needs of bees, wasps and ants or soil macro-invertebrates.

In Belgium and especially Flanders, Red Lists of several insect and macro-invertebrate groups are available and have proved useful:

- Coleoptera, Carabidae – Desender *et al.*, 1995;
- Odonata – De Knijf & Anselin, 1996;
- Spiders – Maelfait *et al.* 1998;
- Butterflies – Maes & Van Dyck, 1999;
- Orthoptera – Decler et al., 2000;
- Diptera, Dolichopodidae – Pollet, 2000;
- Diptera, Empididae – Grootaert *et al.*, 2001.

Until now, there was no Red List case for ants. How could ants fit in this multi-species approach using insects and other invertebrates? To be able to use ants in nature conservation, management and evaluation, reliable information was needed on the distribution, habitat width and rarity of all ant species occurring in our region. The distribution of ants was poorly documented in Flanders, but recent studies (Dekoninck & Vankerhoven, 2001a, 2001b; Schoeters & Vankerhoven, 2001a, 2001b) have raised the need for a coherent survey of all known Flemish records. There was also an increasing need to include ants in several conservation management and evaluation initiatives in Flanders. A recent report on the ecology and distribution of ants in Flanders was published, including distribution maps, the habitat preferences, and status of each ant species, together with other information (Dekoninck *et al.*, 2003).

In this paper we present some general conclusions on the distribution and diversity of the ants of Flanders (Figure 1), their habitat width is discussed and a provisional Red List is proposed. We also evaluate habitat types for which ants can be used as indicators and provide a list of species that should be monitored in these habitats and which can be used to evaluate sites when used with species from other invertebrate groups.



Figure 1. Location of Flanders, the northern part of Belgium

Materials and methods

Data collection

In the beginning of 2001 all available data of ants in Flanders (northern part of Belgium) were brought together and several surveys were started. Several sampling methods were used: pitfall trap, coloured water-traps, ecclectors-traps, malaise traps, nest collections and hand collecting. Each method has its advantages and disadvantages (Dekoninck *et al.*, 2003). If still available, specimens in museum collections were checked. More than 20,000 records (mostly dating from after 1990) were gathered in the database FORMIDABEL (FORMIcidaeDATABELgium). The presence of each species was checked in as many as possible of the UTM 5x5km squares covering Flanders. Identifications, using an Olympus SZH10 binocular microscope (magnification 150x), relied on Seifert (1996) and Schoeters & Vankerhoven (2001b) as key works.

Habitat types and ecological preferences

Nine types of habitat and landscape were defined to collect accurate information on the habitat preference of all ant species (Table 1). The nine types were based on the EIS-code and the Flemish nature types (see Vandenbussche, 2002; Zwaenepoel *et al.* 2002). A habitat types was included with each record, but when no habitat description was available for a record (for example, with some older records) the habitat was coded as 'Not known or not observed'.

Table 1. Nine landscape and habitat types defined for use with the species records.

Description landscape type	Landscape Code
Antropogenic habitats	AN
Woodlands	WO
Shrubs	SH
Heathland	HE
Fens and highland bogs	BO
Dry grasslands	DG
Moist grassland	MG
Chalk grasslands, stony slopes and other rocky xerothermic habitats	RO
Coastal and inland dunes	DU
Not known or not observed	X

Habitat width of each ant species

To identify whether a species is restricted to one or more habitat types in its distribution area, counts were made of the number of habitats in which each species was recorded in Flanders. From these counts, four categories of stenotopy were defined:

- Stenotopic species (ST): a species found in only one habitat type;
- Almost stenotopic species (AST): species present in only two or three habitat types;
- Moderate stenotopic (MST): species present in four or five different habitat types, with no discernable preference for any one;
- Eurytopic species (EU): species found in six or more habitat types.

Results

General results: Flanders is a moderately ant-rich region

A total of 79 species of ants have been recorded in the whole of Belgium. In Flanders 52 species, plus one hybrid (*Formica rufa* x *polyctena*) and one microgyne (*Myrmica ruginodis*), can be found in natural habitats. In addition, two exotic species (*Monomorium pharaonis*, *Hypoponera bondroiti*) are frequently discovered in buildings, bringing the Flemish total on 56 distinct taxa. There has been at least one record of each of these taxa since 1986, and no species have been lost during the last 20 years. Compared with some neighbouring countries and regions Flanders is a moderately ant-rich region (Table 2).

Table 2. Comparison of the ratio of number of species of ants to the surface area in Flanders and four other areas.

Species	Stenotopicity	Habitat and % of records
<i>Anergates atratulus</i>	ST	HE 100%
<i>Formicoxenus nitidulus</i>	ST	HE 100%
<i>Myrmica sulcinodis</i>	ST	HE 100%
<i>Polyergus rufescens</i>	ST	HE 100%
<i>Tapinoma ambiguuum</i>	ST	HE 100%
<i>Tapinoma erraticum</i>	ST	HE 100%
<i>Lasius jensi</i>	ST	RO 100%
<i>Lasius myops</i>	ST	RO 100%
<i>Camponotus vagus</i>	ST	AN 100%
<i>Hypoponera bondroiti</i>	ST	AN 100%
<i>Solenopsis fugax</i>	ST	AN 100%
<i>Lasius neglectus</i>	ST	AN 100%
<i>Tetramorium impurum</i>	AST	AN 99%; DG 1%
<i>Lasius emarginatus</i>	AST	AN 97%; MG 3%
<i>Myrmica lonae</i>	AST	HE 95%; WO 5%
<i>Leptothorax muscorum</i>	AST	HE 92%; WO 8%
<i>Formica lusatica</i>	AST	HE 83%; DG 17%
<i>Hypoconera punctatissima</i>	AST	AN 56%; MG 33%; X 11%
<i>Leptothorax affinis</i>	AST	AN 57%; WO 29%; SH 14%
<i>Stenammas westwoodi</i>	AST	WO 50%; DG 25%; X 25%
<i>Strongylognathus testaceus</i>	AST	HE 69%; DG 9%; X 22%

Flemish hot-spots for ants

In Figure 2 the number of ant species per 5x5 km square of the UTM grid are shown. Many ant species were recorded in some squares and those with more than 25 species were classified as hot-spots. All the hot-spot squares in the province of Limburg and, although it is the smallest province of Flanders, 49 different taxa (87.5% of the total Flemish ant fauna) were found there. There are extensive heathland areas in Limburg, with many potentially suitable habitat types for ants. Almost all the Flemish hot-spots for ants are situated in large heathlands and their surroundings.

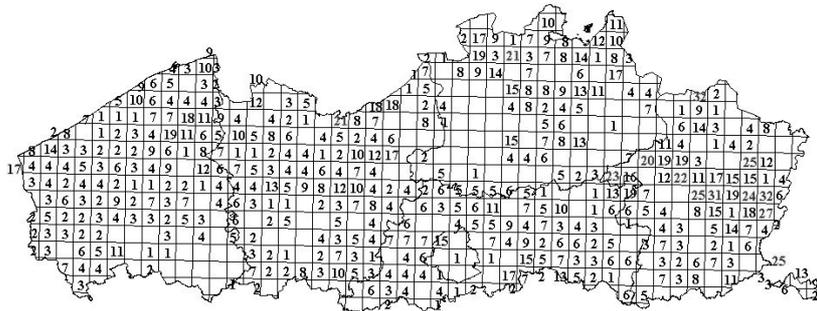


Figure 2. Number of ant species recorded in each 5x5 km square of the UTM grid.

Diversity in different habitat types

Figure 3 shows the number of ant species in each of none habitat types. Heathlands are the richest habitat type for ants in Flanders. In this habitat type 42 different species (75% of the Flemish ant fauna) were found. Perhaps surprisingly, anthropogenic habitats contained 66% of the Flemish ant fauna. In bog and peat habitats only 25% of the ant fauna was collected.

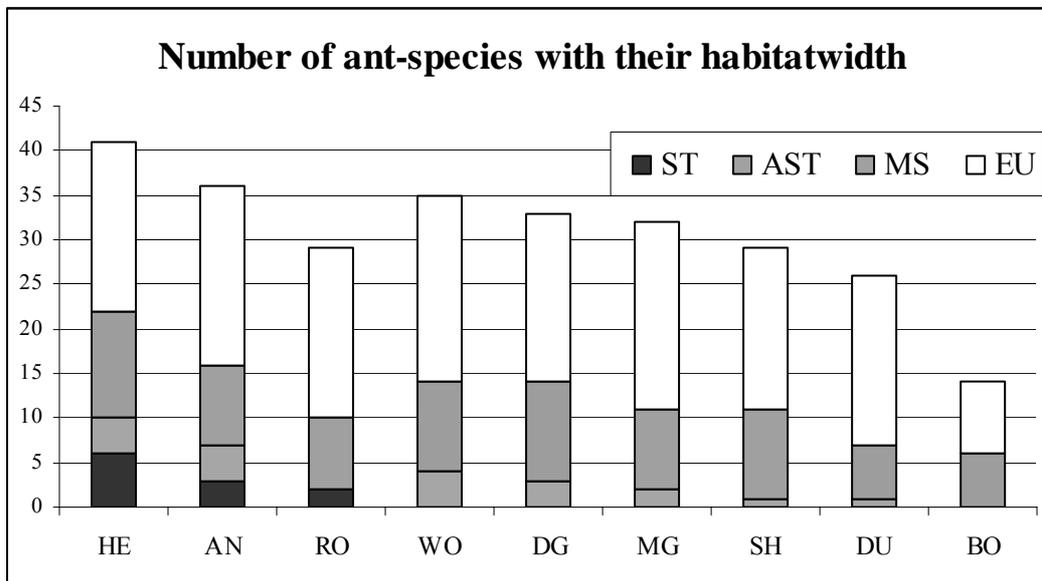


Figure 3. Number of ant-species in each of the nine habitat types with their habitat width found in each type.

(ST= Stenotopic, AST= Almost Stenotopic, MS= Moderately Stenotopic, EU= Eurytopic; HE: heathland; RO: rocky xerothermic habitats; AN: Anthropogenic habitats; WO: forests; MG: moist grassland; DG: dry grassland; SH: shrubs, DU: dunes; BO Fens and bogs).

A search for Flemish stenotopic ant species

Twelve species can be considered as Stenotopic (ST). *Anergates atratulus*, *Formicoxenus nitidulus*, *Myrmica sulcinodis*, *Polyergus rufescens*, *Tapinoma ambiguum* and *Tapinoma erraticum* were only found in heathland in Flanders. However, in the southern part of Belgium *T. erraticum* is a common species on rocky soils and chalky grasslands. In Flanders *Lasius jensi* and *Lasius myops* are stenotopically bound to rocky soils and *Camponotus vagus*, *Hypoponera bondroiti*, *Solenopsis fugax* and *Lasius neglectus* were only found in anthropogenic habitats. The nine species considered as Almost Stenotopic (AST) were found in only two or three habitat types (Table 3). Their habitat width is also rather restricted and they can be considered as an important part of the characteristic ant-auna in those habitats.

Table 3. Stenotopy and % of records for each habitat type for Stenotopic (ST) and Almost Stenotopic (AST) ant species in Flanders.

HE: heathland; RO: rocky xerothermic habitats; AN: Anthropogenic habitats; WO: forests; MG: moist grassland; DG: dry grassland; SH: shrubs; X not known or not observed.

Habitat type	% of not Eurytopic ant-species found in each habitat type
AN	44,4 %
WO	40 %
DG	42,42 %
DU	26,92 %
HE	53,66 %
MG	34,38 %
RO	34,48 %
SH	37,93 %
BO	42,86 %

The habitat type heathland is the only type that has more than half of the non-eurytopic ant-species (22 species, 54 %). Although fens and bogs have only six ant species that are non-eurytopic, the relative amount of stenotopic (ST, AST and MS) species is comparable with all other habitat types (between 34% and 44%) except that for the habitat type dunes (7 species, 26 %):

A provisional Red List of Flemish ants

Based on the distribution patterns, the habitat choice and the number of records, a provisional Red List has been prepared by assigning each species to one of the following categories (see also Binot *et al.*, 1998; Maelfait *et al.*, 1998).

- Extinct in the wild (EW): species not recorded in the wild during the last fifty years.
- Critical (CR): species with few recent observations, that became very rare due to a drastic reduction of their preferred habitat or living in highly threatened habitats, which are stenotopic and were found in less than five UTM 5x5 km squares and less than 10 records.
- Endangered (EN): species that became rare because of the extensive deterioration and destruction of their habitat, which are at least moderately stenotopic (ST, AST or MST), which were found in 5-10 UTM5x5 squares and for which we have less than 15 records.

- Vulnerable (VU): species which became quite uncommon or with a restricted distribution in Flanders, which are at least moderately stenotopic (ST, AST or MST) and which were found in 10 to 40 UTM 5x5 km squares;
- Indeterminate (IN): species assumed to be threatened, but for which there is not enough information (e.g. recently discovered species) to decide which of the preceding categories is appropriate;
- Restricted Geographically (RG): rare, geographically restricted species in Flanders;
- Introductions and living in buildings (IB): Species introduced by human activities or which can only survive in Flanders in heated buildings;
- Not Threatened (NT): common and widespread, eurytopic (EU) species that are not currently threatened.

All Flemish ant species are listed in Table 4, with their provisional Red List status. About half of the Flemish ant species (29 species, 48%) are threatened in one or another way (CR, EN, VU, IN or RG). Most of them are or became very rare because they depend upon one or more other species of ant to complete their life cycle. In many cases their hosts have also greatly declined or they are very sensitive to disturbance and destruction of their habitat. The Critical, Endangered and Vulnerable species are especially associated with heathlands. Some also occur on rocky soils (chalk grasslands) and anthropogenic habitats.

Introductions and species living in buildings – Invasive species in Flanders?

Five species (*Camponotus vagus*, *Hypoponera bondroiti*, *Hypoponera punctatissima*, *Lasius neglectus* and *Monomorium pharaonis*) are rare in Flanders because they do not occur here naturally or they can survive here only in (heated) buildings. Most of them are introduced by human activities. If they can survive here during several, consecutive mild winters it is possible that they could spread locally and even cause a threat to the native ant fauna. At a local scale species such as *Lasius neglectus* can become a noticeable part of the ant fauna (Dekoninck *et al.*, 2002). Such species are not considered as being threatened.

Table 4. List of all Flemish ant species, their habitat width, provisional Red List status, number of UTM 5x5km squares where the species was recorded and number of Flemish records.

Species	Provisional Red list status	Habitat width	number of UTM 5x5km squares after 1986	number of records in Flanders
<i>Myrmica sulcinodis</i>	CR	ST	1	1
<i>Anergates atratulus</i>	CR	ST	4	6
<i>Formicoxenus nitidulus</i>	CR	ST	1	1
<i>Polyergus rufescens</i>	CR	ST	1	1
<i>Solenopsis fugax</i>	CR	ST	2	2
<i>Tapinoma erraticum</i>	CR	ST	2	2
<i>Formica transkaucasica</i>	EN	MS	10	12
<i>Leptothorax muscorum</i>	EN	AST	6	7
<i>Myrmica lonae</i>	EN	AST	8	8
<i>Ponera coarctata</i>	EN	MS	5	5
<i>Strongylognathus testaceus</i>	EN	AST	8	10
<i>Tapinoma ambiguum</i>	EN	ST	7	7
<i>Formica polyctena</i>	VU	MS	25	25

<i>Formica pratensis</i>	VU	MS	28	28
<i>Formica rufa</i>	VU	MS	20	20
<i>Formica rufibarbis</i>	VU	MS	24	24
<i>Formica sanguinea</i>	VU	MS	37	40
<i>Lasius meridionalis</i>	VU	MS	20	40
<i>Lasius psammophilus</i>	VU	MS	22	40
<i>Myrmecina graminicola</i>	VU	MS	11	11
<i>Myrmica schencki</i>	VU	MS	40	40
<i>Myrmica specioides</i>	VU	MS	31	40
<i>Formica lusatica</i>	IN	AST	6	6
<i>Lasius myops</i>	IN	ST	1	1
<i>Formica rufa x polycтена</i>	IN	MS	5	5
microgyne of <i>Myrmica ruginodis</i>	IN	EU	9	17
<i>Stenamma westwoodi</i>	IN	AST	2	3
<i>Lasius jensi</i>	RG	ST	2	2
<i>Leptothorax affinis</i>	RG	AST	6	8
<i>Camponotus vagus</i>	IB	ST	1	1
<i>Hypoponera punctatissima</i>	IB	AST	4	5
<i>Hypoponera bondroiti</i>	IB	ST	2	2
<i>Lasius neglectus</i>	IB	ST	1	50
<i>Monomorium pharaonis</i>	IB	NG	?	?
<i>Formica cunicularia</i>	NT	EU	> 50	> 50
<i>Formica fusca</i>	NT	EU	> 50	> 50
<i>Lasius brunneus</i>	NT	EU	> 50	> 50
<i>Lasius emarginatus</i>	NT	AST	> 50	> 50
<i>Lasius flavus</i>	NT	EU	> 50	> 50
<i>Lasius fuliginosus</i>	NT	EU	> 50	> 50
<i>Lasius mixtus</i>	NT	EU	18	18
<i>Lasius niger</i>	NT	EU	> 50	> 50
<i>Lasius platythorax</i>	NT	EU	> 50	> 50
<i>Lasius sabularum</i>	NT	EU	15	15
<i>Lasius umbratus</i>	NT	EU	> 50	> 50
<i>Leptothorax acervorum</i>	NT	EU	34	40
<i>Leptothorax nylanderi</i>	NT	EU	> 50	> 50
<i>Myrmica microrubra</i>	NT	EU	15	18
<i>Myrmica rubra</i>	NT	EU	> 50	> 50
<i>Myrmica ruginodis</i>	NT	EU	> 50	> 50
<i>Myrmica rugulosa</i>	NT	EU	> 50	> 50
<i>Myrmica sabuleti</i>	NT	EU	> 50	> 50
<i>Myrmica scabrinodis</i>	NT	EU	> 50	> 50
<i>Stenamma debile</i>	NT	EU	> 50	> 50
<i>Tetramorium caespitum</i>	NT	EU	> 50	> 50
<i>Tetramorium impurum</i>	NT	AST	> 50	> 50

Discussion

Flanders can be considered to be a moderately ant-rich region where their distribution is well known and properly documented (Dekoninck *et al.*, 2003). It is possible that a few, previously undiscovered species could be added to the fauna. If so, any additional species would be likely to be rare in Flanders because the recent, intensive study covered all major habitats and species that are not stenotopic are known common and widespread over the region. Only exceptionally would naturally immigrant species or imported species become abundant, for example due to climatic or other major environmental changes.

Only two species that are widespread in Flanders, *L. emarginatus* and *T. impurum*, are almost stenotopic in their association with anthropogenic habitats. The apparent stenotopicity of some species (*C. vagus*, *S. fugax* and *L. neglectus*) should be interpreted with caution because there are few records of these species. Two stenotopic species are known to have been introduced to Flanders (*C. vagus* (Dekoninck & Pauly, 2002) and *L. neglectus* (Dekoninck *et al.*, 2002)) so that they could not be allocated a meaningful stenotopicity status. Some habitat types lack stenotopic species, for example dry grasslands, humid grasslands, dunes, bogs and peatlands, woodlands and scrub. Only two stenotopic species occur on rocky soils in Flanders because this habitat type is very rare in the northern Belgium, although it is widespread in Wallonia (southern Belgium). For these reasons the scale of the use of the Red List needs to be considered carefully. The possible number of habitats and locations in Flanders is different from that in Wallonia, where there are more rocky soils and fewer heathlands.

Heathlands are well represented in Flanders and it is significant that it was in this habitat type that most of the stenotopic, almost stenotopic and moderately stenotopic species of ants were found, with many fewer eurytopic species. Heaths contain the highest number of species of ants and of threatened ant species in Flanders. Ants are one of the invertebrate groups that should be used to develop and test habitat and landscape scale procedures for the conservation of heathlands on sandy soils. They could also be used in heathland habitats, together with other groups such as robberflies and bees, to monitor site management.

A provisional red list of the Flemish ants: sense or nonsense?

Ants and ant nests usually persist for several years in the same habitat, which makes them good indicators for the present state and the past history of a site and therefore Red Lists of ants are important instruments (Bauschmann & Buschinger, 1992; Agosti & Cherix, 1994; Seifert, 1996; 1998; Bauschmann *et al.*, 1996; Steiner & Schlick-Steiner, 2002). The short life cycles of other most other invertebrate groups can result in rapid fluctuations in population densities (Ellis, 1998), but these are less likely in colonial insects such as ants. Therefore ant populations can be monitored more easily than most other invertebrate groups, and they are easy to detect and sample (Bauschmann *et al.*, 1996; Seifert, 1996; Mabelis, 2002; Steiner & Schlick-Steiner, 2002).

Several criteria were used to give each species a provisional Red List status. Rarity (number of UTM 5x5 km squares and number of records) and stenotopicity of the species (only ST, AST and MST are threatened) were used to evaluate the present status of each ant species. Four species (*Lasius sabularum*, *Lasius mixtus*, *Myrmica microrubra* and *Leptothorax acervorum*) are eurytopic and were classified as Not Threatened, but were found in less than 40 UTM 5x5 squares. The first two are *Chthonolasius*-species, which are only found after intensive search underground and presumably their number of records is much higher as here present. The Red List of the ants of Flanders does not include the trends of the species,

because old observations are scarce. Also, because of recent taxonomic revisions in European myrmecology, the old records need to be checked and updated because some probably refer to recently described, new species, particularly in the genus *Lasius*. The list is dynamic and we hope to have the opportunity to update it after 10 years, including surveying all previous localities, plus additional ones, to compile a more complete and up-to-date view of the ant fauna of Flanders.

The diversity and the number of Red List ant species in heathlands can be an indication of the ecological importance of the site. The total number of Red List species (CR, EN, VU, IN and RG) in heathlands should be taken into account when evaluating sites and managing and restoring heathlands for nature conservation. The presence or absence of ant nests or workers of most of the species on this list can be easily checked and evaluated. The typical ant fauna of undisturbed heaths in Flanders was not found at restored sites after 25 years, even where source populations were very close to the restored heaths (Dekoninck *et al.* 2001).

In Flanders, some ant species are found only in areas with great ant diversity, at locations that have been undisturbed for a long time. With the exception of *T. erraticum* and *M. sulcinodis*, all endangered Flemish ants depend, in one way or another, on other species of ants. *Formicoxenus nitidulus* and *Anergates atratulus* need sufficient host nests, *Polyergus rufescens* cannot exist without enough potential slavery nests and *Solenopsis fugax* nests need other, larger, ant species from which they obtain their food. The local extinction of these endangered species is almost certainly caused by the loss of healthy, complete and species rich ant populations.

We favour a multi-species approach to the conservation of threatened Flemish biotopes and we suggest that for each habitat type an adequate species list, with typical species, should be compiled for conservation monitoring. When considering heathlands in Flanders, the number of nests of all the threatened ant species (Critical, Endangered, Vulnerable) should be monitored, as indicators of a rich ant fauna. Current threats to most species are related to the deterioration or destruction of their favoured habitats.

This Red List should be considered as a stepping-stone. Only by continuing the work, by adding new records and revising existing collections, will it be possible to compile a reliable Red List of our ants for use in evaluating the biodiversity of Flanders. Ants have a distinctive and important role to play as possible indicators of site history, habitat quality and sustainable management for nature conservation, and in helping to inform policies for nature conservation.

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