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Red List of the saproxylic scarab beetles (Coleoptera: Lucanidae, Cetoniidae and Dynastidae) for Flanders

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Abstract

The Red List status of the saproxylic scarab beetles for Flanders was assessed. We evaluated 15 species belonging to the stag beetles (Lucanidae), rhinoceros beetles (Dynastidae) and flower chafers (Cetoniidae). Further, four other species are discussed which are only present in Wallonia or their (historic) presence in Belgium is unsure. One of these species is assessed as near threatened, five as endangered, two as critically endangered (*Gnorimus nobilis* and *Osmoderma eremita*) and two as regionally extinct (*Gnorimus variabilis* and *Protaetia marmorata*). The changes in distribution and population trends of the species are presented. The most important Flemish hotspots are Voeren and the Sonian forest. Based on the Red List, six species could be included on the list of protected species of Flanders and *Cetonia aurata* no longer needs protection. Conservation measures need to focus on the protection and restoration of their habitat. Concerning the protection of dead wood in forest, a lot is already realised but the protection of old and hollow trees outside forests clearly needs more attention. The four most threatened species are not coincidentally cavity depending species.

Keywords: saproxylic scarab beetles, Belgium, regional red list, hot spots, species protection.

Samenvatting

De Rode-Lijststatus van de saproxyle bladsprietkevers voor Vlaanderen werd beoordeeld. Wij evalueerden 15 soorten behorende tot de Vliegende herten (Lucanidae), Neushoornkevers (Dynastidae) en Gouden torren (Cetoniidae). Tevens, worden vier soorten besproken maar deze zijn enkel aanwezig in Wallonië of hun (historisch) voorkomen in België is onduidelijk. Een van de soorten werd beoordeelt als bijna in gevaar, vijf als bedreigd, twee als ernstig bedreigd (*Gnorimus nobilis* en *Osmoderma eremita*) en twee als regionaal uitgestorven (*Gnorimus variabilis* en *Protaetia marmorata*). De veranderingen in de verspreiding en populatie trend van deze soorten worden weergegeven. De meest belangrijke Vlaamse hotspots zijn Voeren en Zoniënwoud. Gebaseerd op de Rode Lijst, zouden zes soorten kunnen toegevoegd worden aan de lijst met beschermde soorten van Vlaanderen en *Cetonia aurata* heeft niet langer nood aan bescherming. De bescherming dient zich te focussen op de bescherming en herstel van hun habitat. Betreffende de bescherming van dood hout in het bos is er reeds veel gerealiseerd maar de bescherming van oude en holle bomen buiten de bossen heeft duidelijk meer aandacht nodig. De vier meest bedreigde soorten zijn niet toevallig holte bewonende soorten.

Résumé

La mise sur liste rouge de certaines espèces de scarabées saproxyliques a été estimée pour la Flandre. Nous nous sommes focalisés sur 15 espèces appartenant aux lucanes (Lucanidae), aux dynastes (Dynastidae) et aux cétoines (Cetoniidae). En outre, quatre autres espèces sont discutées qui, soit ne

sont présentes qu'en Wallonie, soit que leur présence (historique) en Belgique est incertaine. Parmi ces 15 espèces, une est évaluée comme quasi menacée, cinq en danger, deux en danger critique (*Gnorimus nobilis* et *Osmoderma eremita*) et deux éteintes pour la région (*Gnorimus variabilis* et *Protaetia marmorata*). Les changements dans la distribution et les tendances au niveau de la dynamique des populations des espèces sont présentés. Les endroits en Flandre où la biodiversité est la plus importante sont représentés par les Fourons et la forêt de Soignes. Sur base de cette liste rouge, six espèces pourraient être incluses sur la liste des espèces protégées de Flandre et la cétoine dorée (*Cetonia aurata*) n'a plus besoin de protection. Les mesures de conservation doivent se concentrer sur la protection et la restauration de leur habitat. Concernant la protection des bois morts dans la forêt, de nombreuses réalisations ont déjà été effectuées, mais pour ce qui est de la protection des arbres anciens et creux en dehors des forêts, clairement, plus d'attention s'avère nécessaire. Les quatre espèces les plus menacées étant de fait des espèces liées aux cavités de ce type d'arbres.

Introduction

The Habitat and Birds directives are the main European regulations on nature conservation. Each region or country has to incorporate these directives in local legislation, policy and management plans. Among the species listed on the Habitat directive there are 14 saproxylic beetles (out of 38 beetles) from various families (10 in total). Several species are (potentially) present in Flanders: *Lucanus cervus* (Linnaeus, 1758), *Osmoderma eremita* (Scopoli, 1763) (see further in this article), *Cucujus cinnaberinus* (Scopoli, 1763) (see CREVECOEUR, 2015), *Cerambyx cerdo* Linnaeus, 1758 (found as transported species or locally present, DRUMONT *et al.*, 2012), *Rosalia alpina* (Linnaeus, 1758) (as transported species, www.waarnemingen.be) and *Limoniscus violaceus* P. W. J. Müller, 1821 (found in increasing number of places in the close vicinity of Belgium, GOUIX *et al*., 2012). In Flanders, legal protection of species of the Habitat directive and other species is based on their Red List status. A Red List is a scientific assessment of the chance of extinction of a group of species in a certain region, land or continent (IUCN, 2003). In Flanders, Red Lists are incorporated in the policy after evaluated by the Research Institute for Nature and Forest (INBO) and declaration by the minister. In this way, threatened species (including regionally extinct, critically endangered, endangered and vulnerable) become legally protected and eventually further supported with a species protection program.
The Red List of the saproxylic scarab beetles (Scarabaeoidea) was made at the request of the Agency for Nature and Forest to further cover the Red List status of the species of the Habitat directive. We judged that there was sufficient data available of the saproxylic scarab beetles to make a Red List of these (THOMAES *et al*., 2015B). In this way, the Red List status of two Habitat directive species was determined, *L. cervus* and *O. eremita*. In a later stadium, we hope to cover at least the Long horn beetles (Cerambycidae).
The scarab beetles (Scarabaeoidea) are differentiated from other beetles by the lamellas on the last antennal segments. Formerly, this group was subdivided in stag beetles (Lucanidae) with hairbrush like antennas and true scarabs (Scarabaeidae) with hand fan like antennas. Currently, this last group is further subdivided in different groups (families or subfamilies depending on the author). Two of these groups contain, but are not limited to, saproxylic beetles that are found in Belgium: i.e. the flower beetles (Cetoniidae) and the rhinoceros beetles (Dynastidae).
From these three groups (Lucanidae, Cetoniidae, Dynastidae), the Flemish distribution data were compiled and their Red List status was assessed.

Material and methods

The data for the Red List was obtained by compiling several databases: nl. www.waarnemingen.be (Natuurpunt), saproxylic beetles from Belgium (Royal Belgian Institute of Natural Sciences, RBINS, GROOTAERT *et al*., 2010), literature and project data (INBO), insects from Belgium (University of Gembloux), invertebrates of Limburg (Limburgse koepel voor natuurstudie), Zoology Museum (Ghent university), Natural history museum of Maastricht, collection of Seghers (Royal Entomological Society of Antwerp) and private collections of Guido BONAMIE, Anne FOBERT, Kevin SCHEERS, Koen SMETS, Eugene STASSEN, Arno THOMAES and Jan VERHELST. Finally, the species database of the Walloon government was consulted but did not contain any new data for Flanders. The database of

waarnemingen.be delivered nearly half of the data. This online platform delivers a large stream of recent distribution data, mainly including common and easy detectible species. As this data comes from a broad public that is not always conversant enough with the different species and their diagnostics. Therefore, all data with pictures of the observed specimen were checked and corrected if needed. Based on this sample of checked records, we concluded that for some species the observations without pictures were unreliable up to species level (see results).
The evaluation of the Red List status was based on the population trend and the current area of the species (for detail on methodology see MAES *et al.* (2013) and application see THOMAES *et al*. (2015B)). Therefore, the data of each species were subdivided in three periods, i.e. the historic records (till 1950) the old records (1951-1990) and the current records (1991-2014). These dates were selected as 1950 demarks a period with many new landscape shifts (e.g. DESENDER & TURIN, 1989) while data after 1990 might indicate populations that are still present. The trend of common and easy detectable species (nl. *Dorcus parallelipipedus, Oryctes nasicornis, Cetonia aurata, Valgus hemipterus* and *Trichius gallicus*) was based on a compensated trend where the partitioning of the given species in the total number of records for each period was used. This was necessary to compensate for the strong increase in non-specialised observers on platforms like www.waarnemingen.be. The rare and difficult to observe species, for which records mainly depend on specialist, were consequently not compensated for the total number of records in the different periods.
Hot spots were outlined by plotting the number of all or all threatened species on a map. All utm squares with at least six species or two threatened species are considered as hotspots. The underlying area (village, forest, nature reserve) and species list of this area are discussed.

Results

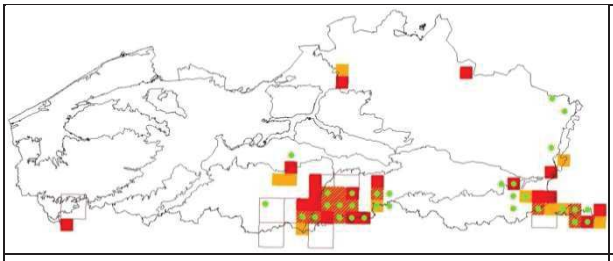
Lucanidae

Of the five stag beetles known for Belgium, four occur in Flanders. *Aesalus scarabaeoides* (Panzer, 1794), which was mentioned by JANSSENS (1960) as potentially present, has not yet been found. *L. cervus* (Fig. 1) is a well-known species with a life cycle of three to four years. The species has a hidden life which makes it difficult to gather distribution data (THOMAES *et al*., 2010). The species occurs in the region between Halle and Leuven and in the eastern part of Limburg. Further, there are some doubtful records from East-Flanders that need further investigation (Fig. 2). Based on the trend and distribution, this species was labelled as *endangered* (Table 1). To further monitor the rarity of this species, a transect monitoring has been designed and deployed (VERCAYIE & THOMAES, 2014). Currently, the network of transects is installed and volunteers are sought. *Dorcus parallelipipedus* (Linnaeus, 1758) is common in Haspengouw and the eastern part of Flemish Brabant. Outside this region, the species is probably on the rise. This species has a low demand for his food habitat and is likely a good flyer which makes him the most common Lucanidae in Flanders. The fact that the adults live several years also helps to colonise distant places. *Platycerus caraboides* (Linnaeus, 1758) is mainly found in large oak and beech forests (Sonian, Meerdaal, Haller, Rode forest and the forests of Voeren), but sometimes also in birch in heathlands. The species has a declining trend and is therefore *endangered*. In the High Fens (Wallonia) a second species, *P. caprea* (De Geer, 1774), is known to occur (MEGANCK & PAULY, 2001). *Sinodendron cylindricum* (Linnaeus, 1758) has a very limited distribution in the south of Flanders, only in Voeren the species is remarkably more common. The species is mainly found in large forests but also in pollards and high standard orchards. The species received the category *endangered*.

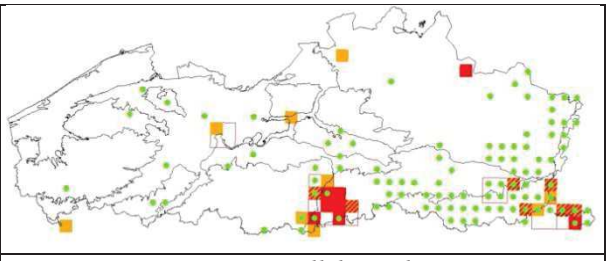
Dynastidae

Oryctes nasicornis (Linnaeus, 1758) has become a very common species in Flanders thanks to the current attention for composting. The larvae of this species are found in large numbers in compost heaps with woody material. In contrast to what is often stated, the species is not a recent emigrant from South-Europe (e.g. JANSSENS, 1960) that that can only live as a hemerophile in piles of saw dust or woody compost. This species appears to be native as it is at least present since 1873 (specimen from Geraardsbergen and Aarschot in the collection of RBINS) and remains have even been found in Roman wells (BONAMIE, 1997). Furthermore, the species can still be found in his natural habitat, underground dead wood (pers. observations of the first author).

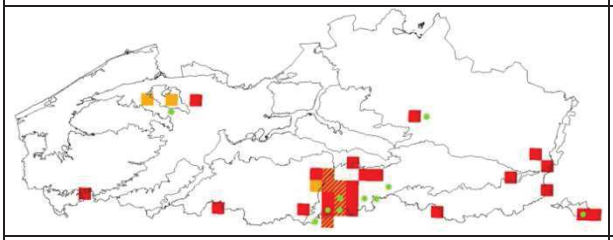
Fig. 1. a *Lucanus cervus*, b *Dorcus parallelipipedus*, c *Platycerus caraboides*, d *Sinodendron cylindricum*, e *Oryctes nasicornis*, f *Cetonia aurata*, g *Protaetia metallica*, h *Protaetia marmorata*, i *Oxythyrea funesta*, j *Osmoderma eremita*, k *Gnorimus variabilis*, l *Gnorimus nobilis*, m *Valgus hemipterus*, n *Trichius gallicus* and o *Trichius fasciatus* (photos: Arno Thomaes except, 1c: Denis Keith, 1e: Gyorgy Csoka, Bugwood.org, 1g: Jean-Luc Renneson, 1h: Nicklas.Jansson, 1i: Kris Vandekerkhove and 1o: Zdeněk Hromádko).



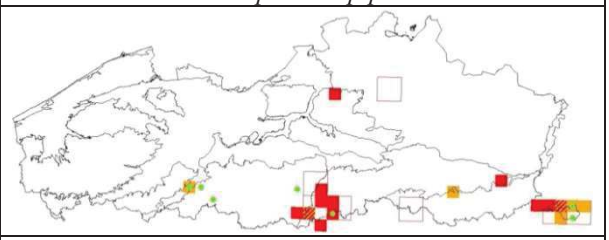
Lucanus cervus



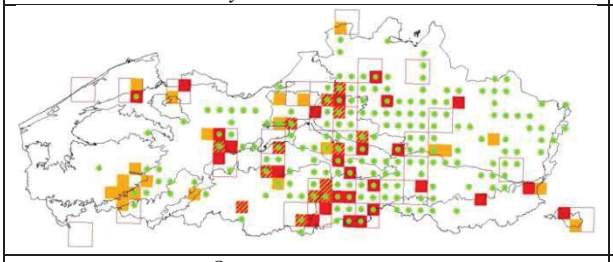
Dorcus parallelipipedus



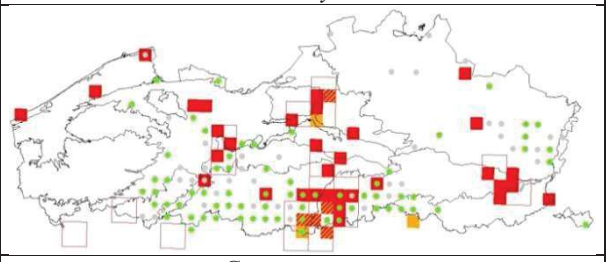
Platycerus caraboides



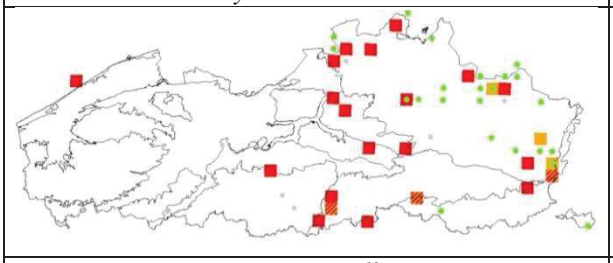
Sinodendron cylindricum



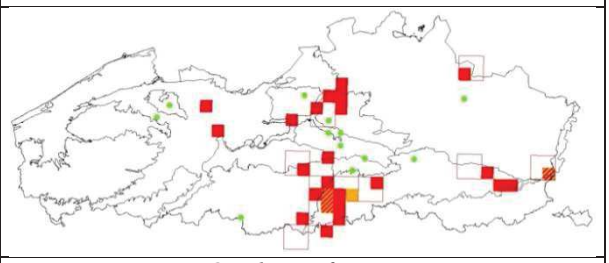
Oryctes nasicornis



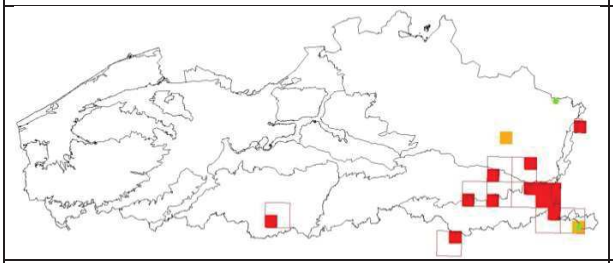
Cetonia aurata



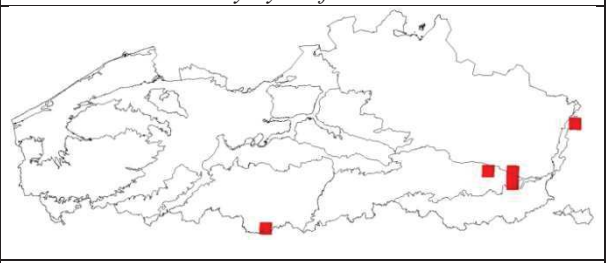
Protaetia metallica



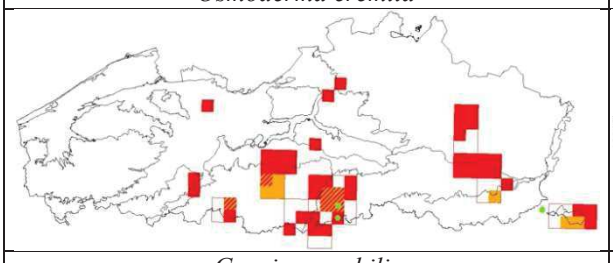
Oxythyrea funesta



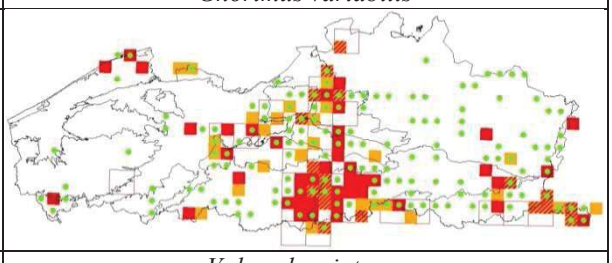
Osmoderma eremita



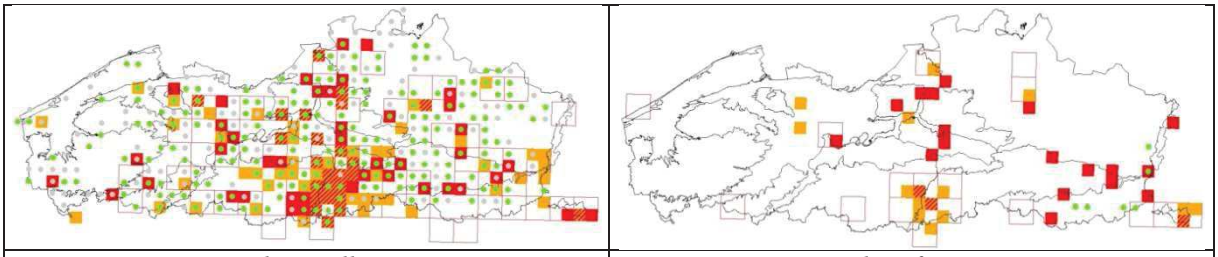
Gnorimus variabilis



Gnorimus nobilis



Valgus hemipterus



Trichius gallicus | *Trichius fasciatus*

Fig. 2. Distribution maps of the different species based on 5x5 km squares. Red: <1951, orange: 1951-1990, green: >1990 and grey: data from www.waarnemingen.be without picture plotted on the map of the most likely species. Red delineated 10x10 km squares based on the Atlas of Gembloux (LECLERCQ *et al.*, 1973; LECLERCQ & VERSTRAETEN, 1976).

Table 1. Overview of the species with their Red List status and habitat. LC: Least concern, NT: Near Threatened, EN: Endangered, CR: Critically endangered, RE: Regionally extinct.

Scientific name	Dutch name	Red List	Habitat	Flower visiting
Dorcus parallelipipedus	Klein vliegend hert	LC	White rot wood and hollow trees, sun exposed and shaded	No
Oryctes nasicornis	Neushoornkever	LC	Underground dead wood, wood compost piles, sun exposed	No
Trichius gallicus	Penseelkever	LC	All kinds of wood compost and completely degraded wood, sun exposed and shaded	Yes
Valgus hemipterus	Valgus	LC	Underground dead wood, sun exposed	Yes
Cetonia aurata	Gouden Tor	LC	All kinds of molded wood and hollow trees, sun exposed and shaded	No
Protaetia metallica	Koperen Tor	NT	Dead wood in nests of *Formica* spp., sun exposed	Yes
Sinodendron cylindricum	Rolrond vliegend hert	EN	White rot wood and hollow trees, sun exposed and shaded	No
Lucanus cervus	Vliegend Hert	EN	Underground dead wood, sun exposed	No
Oxythyrea funesta	Rouwende gouden tor	EN	All kinds of compost, organic matter and manure, sun exposed	Yes
Platycerus caraboides	Blauw vliegend hert	EN	Lying dead wood of thick branches, sun exposed and shaded	No
Trichius fasciatus	Penseelkever	EN	All kinds of wood compost and completely degraded wood, sun exposed and shaded	Yes
Osmoderma eremita	Juchtleerkever	CR	hollow trees, sun exposed	No
Gnorimus nobilis	Edelman	CR	hollow trees, sun exposed and shaded	Yes
Gnorimus variabilis	Variabele Edelman	RE	hollow trees, sun exposed and shaded	No
Protaetia marmorata		RE	hollow trees, sun exposed	Yes
Aesalus scarabaeoides		-	Thick dead standing trees, sun exposed and shaded	No
Platycerus caprea	Blauw vliegend hert	-	Lying dead wood of thick branches, sun exposed and shaded	No
Tropinota hirta	Behaarde gouden tor	-	All kinds of compost, organic matter and manure, sun exposed	Yes
Protaetia speciosissima		-	hollow trees, sun exposed	Yes

Cetoniidae

Ten species of Cetoniidae have been found in Flanders but two of them already went extinct. *Cetonia aurata* (Linnaeus, 1761) apparently disappeared completely in Flanders between the fifties and nineties of the previous century. Since then, the species became common again in the southern part of East Flanders and Flemish Brabant and a clear area expansion is observable. A very similar species is *Protaetia metallica* (Herbst, 1782) (till recently *P. cuprea metallica* see RENNESON *et al.*, 2012 and TAUZIN, 2015), whose larvae live from dead wood in sunlit nests of the ants *Formica polyctena* Förster, 1850, *F. rufa* Linnaeus, 1761 and *F. pratensis* Retzius, 1783. The area of this species seems to withdraw to the Campine leading to the conclusion that this species is *near threatened*. *Protaetia marmorata* (Fabricus, 1792), is a brown to black *Protaetia* species which has been found at Yvoir in 1884 (PREUDHOMME DE BORRE, 1888). In the Netherlands, the species was found in Brummen (unknown date) and in Valkenburg (1914, see HUIJBREGTS, 2010). Therefore, it is plausible that the species went *extinct* in Flanders a long time ago.

Protaetia speciosissima (Scopoli, 1786) has not been discovered in Belgium, JANSSENS (1960) presumes its presence based on the distribution in Alsace, Lorraine and Rhineland. As the species is colonizing northwards (NIEHUIS, 2007; LILLIG, 2012) it is not unlikely to discover this species in Wallonia in the coming decades. *Oxythyrea funesta* (Poda, 1761) also disappeared in Flanders halfway the 20th century, surviving only at some Southern parts of Belgium (THOMAES *et al*., in prep.). Only very recently the species seems to reestablish with at least one certain population at Den Battelaer (Mechelen). Despite the fact that some records refer to flower or plant shops, it is more likely that the species is recolonizing on his own, as it also did in many other North European countries (THOMAES *et al*., in prep.). This species ends up as *endangered*. *Tropinota hirta* (Poda, 1761) was found eight times in Belgium but nearly always in the High Fens (Wallonia). In 1949 the species was found in Ter Kameren Bos (Brussel, specimen in the RBINS collection) and in 1978 a introduced specimen was discovered in Schaarbeek (BAGUETTE *et al*., 1985). As Ter Kameren Bos was historically well studied by entomologists and only one specimen was found, it is presumable that also this species was introduced by transport of compost or that the species temporally established at Ter Kameren Bos. Also PAULIAN & BARAUD (1982) mention settlement of this species in North American cities. Therefore, we concluded that the species has never been present in Flanders. *O. eremita* is our biggest Cetoniidae (about 3,5cm). As adults rarely leave the cavity they life in, they are poor colonisers and are rarely observed (e.g. HEDIN *et al*., 2008). The species was still observed in Sint-Martensheide (Kinrooi) in 1994 and in Visé in 2002 (RANIUS *et al*., 2005). It was concluded that the species is *critically endangered*. We expect that the species is still present at some parks or bocages with high numbers of old hollow trees. Mainly the odour and the large excrements of the larvae can give away his presence. *Gnorimus variabilis* (Linnaeus, 1758) was found only a few times in Limburg and once in Enghien, but since 1932 the species is no longer found in Flanders. In Dalhem (Wallonia), the species is recently rediscovered (MIESSEN & THIEREN, 2014; THOMAES *et al*., 2015A). As the species has not been found in the last decades, it was concluded that the species is *extinct* in Flanders. *Gnorimus nobilis* (Linnaeus, 1758) was common in the 19th century but since then became very rare. The current population is largely limited to the Sonian forest. However, this year an observation was done in Huizingen (Beersel, www.waarnemingen.be). Finally, the species is also reported in Eben-Emael (just south of Voeren) so it is possible that the species is also present in Voeren. This small distribution leads to the conclusion that the species is *critically endangered*. *Valgus hemipterus* (Linnaeus, 1758) is a 6 to 10mm sized beetle from which the larvae live underground dead wood. The species is one of the most common Cetoniidae in Flanders and is present all over Flanders. Finally, there are two *Trichius* spp. present in Flanders (Fig. 3). *T. gallicus* Dejean, 1821 (syn. *T. zonatus* of *T. rosaceus,* see KRELL, 2012) is the most common species in Flanders while *T. fasciatus* (Linnaeus, 1758) (syn. *T. abdominalis*) is a rather rare species and the distribution shows a strong decline making the species *endangered*.

Hot spots

Hot spots for the total species number and number of threatened species strongly complied. Hot spot analyses reveilles that the Sonian forest and Voeren are the main hot spots, followed by Meerdaal forest, Hoge Kempen and Kempenbroek (Fig. 4). The Sonian forest and surroundings harbours nine out of 15 species. *O. funesta, P. metallica, O. eremita* and *T. fasciatus* are the missing species together with the extinct species. The extinct species and *O. eremita* have historically never been found at the Sonian forest, while the others have been present. In the different utm-squares of Voeren ten species are known. However, *O. eremita* and *G. nobilis* are only known from the Wallonian part. Missing species are *O. nasicornis, O. funesta* and *T. fasciatus* (besides the extinct species). Besides the extinct species, *O. funesta* is the only specimen that historically has not been found in Voeren. Meerdaal forest counts seven species, Hoge Kempen six species and Kempenbroek closes the list of hot spots with five species present (including *L. cervus* and *O. eremita*).

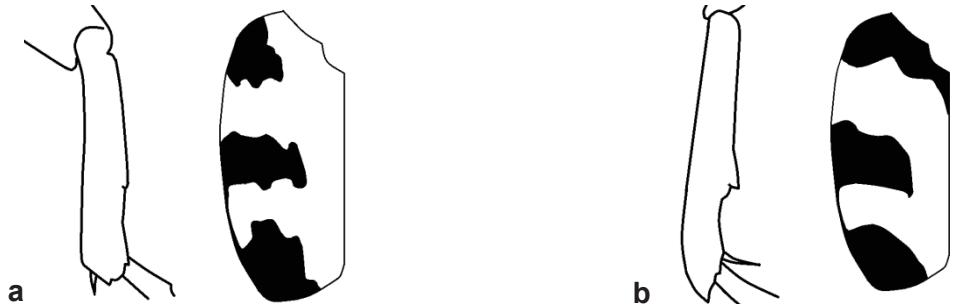


Fig. 3. Tibias of the middle leg and the most common pattern on the elytra of a: *Trichius gallicus* and b: *Trichius fasciatus*.

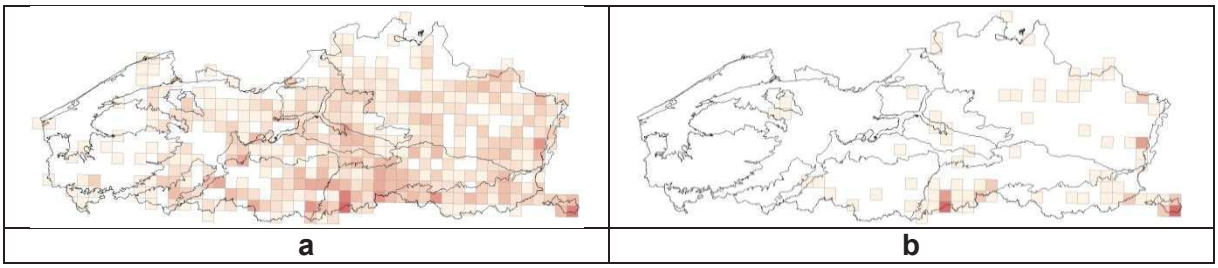


Fig. 4. Hot spot maps based on the number of species present since 1990 represented as a gradient from zero species (unmarked squares) to the maximum number of species (dark red) for a: all species (maximum of 9 species per square) and b: the threatened species (maximum of 4 species per square).

Discussion

In the discussion we will focus on the needed protection measures for these species. As clarified in the introduction, in Flanders Red Lists are confirmed by the minister in order to make the threatened species legally protected. This would result in the additional protection of *P. caraboides, S. cylindricum, P. marmorata, G. nobilis, G. variabilis and T. fasciatus*. *L. cervus, O. funesta, P. metallica* and *O. eremita* are already protected and *C. aurata* could lose his protection based on the current abundances of the species. Protected species may not be captured, killed or their habitat disturbed. For scientific research, there is a possibility to get a permission to study protected species. It is possible to apply for permission as a group under the name of an association. Therefore, it could be an idea to apply under our society. Prerequisites will at least be that the permit is not misused for collection purposes and that gathered data becomes available for further research (e.g. decennial reevaluation of the Red List).

In the last decennia, the amount of dead wood has already drastically increased in the Flemish forests. This was mainly realized by changing the management in public forests, the delegation of forest and nature reserves and the application of the criteria for sustainable management (BOS & GROEN, 2003). Despite these efforts, there are still as many threatened species bound to closed forest as to sun exposed habitat. This might be explained by the slow process of dead wood accumulation and the reaction of species upon this. It is also likely that many sites cannot be recolonized due to the high isolation of many forests. In hot spots and large forest complexes, connected networks should be delimited composed of large forest reserves, set-asides (small patches of non-intervention management), stands where the rotation period is doubled or tripled (ilots de senescence) and small groups and individual ancient and dead trees (e.g. BAUHUS *et al*., 2009).

Despite the progress in our forests, the number of old and hollow trees in half open landscapes is strongly in decline. In theory these trees are protected but in reality they often lack (proper) management, no new trees are planted and old trees slowly disappear and regularly trees are removed legally or illegally. Therefore, all hollow, old, tick, sick and other veteran trees need effective protection. As many of these trees depend on proper management (e.g. pollarding, pruning, hallowing: removal of competitive young trees), reestablishment of this management is as essential as the protection of the trees itself. To protect the oldest and thickest veteran trees in for example parks and tree alleys a clear policy is needed regarding the protection, management, subsidies and felling licenses. Furthermore, efforts should be made to map the veteran trees across Flanders. Besides

protecting the current situation, it is essential that new trees are planted or hollows are artificially created to ensure future habitat continuity.
Concerning habitat protection, it can be concluded that the main issues are: 1) effective protection and management of old, hollow and other veteran trees; 2) planting of new trees in old orchards, rows of pollards and other landscape elements; 3) continued attention for dead wood in forests; 4) more attention for the different types and decomposition stages and 5) elevated standards for dead wood and old and hollow trees in hot spots and other large forest complexes. The main attention should be paid to living hollow trees which is the habitat of the four most threatened species.
Finally, there is need for more research as there is currently little knowledge of the actual populations of the most threatened species.

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