Bulletin de la Société royale belge d'Entomologie/Bulletin van de Koninklijke Belgische Vereniging voor Entomologie, 151 (2015): 40-51

Tree cavity beetles in Haspengouw and Pays De Herve: *Crepidophorus mutilatus* (Elateridae) new for the Belgian fauna and rediscovery of *Gnorimus variabilis* (Cetoniidae) (Insecta: Coleoptera)

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Summary

We present the results of an exploratory research on the beetle diversity of cavity trees using pitfall traps, hand searching and pheromones. The 48 pitfalls resulted in 161 beetle species including 77 saproxylic beetles from which 23 species are listed on the German red list. *Crepidophorus mutilatus* was found as a new species for the Belgian fauna and *Gnorimus variabilis* was rediscovered for the first time in Belgium since 1932. Despite the use of the pheromones, *Osmoderma eremita* was not rediscovered. Possibly the species is still present as the number of suitable trees is not lower than in many European sites where the species is still present. *Elater ferrugineus* was found on 13 of 16 locations with pheromone traps and seems to be a good indicator of sites with important relics of a bocage landscape. Especially the high number of red listed species indicates that the studied relic bocage landscape has a high conservation value.

Keywords: Saproxylic beetles, hollow trees, *Elater ferrugineus.*

Introduction

The Northwest European lowlands have been densely populated for many centuries resulting in a low historic and present forest cover (RACKHAM, 1980; TACK *et al.*, 1993; DE KEERSMAEKER *et al.*, 2001). The remaining forests were managed very intensively so that nearly no dead wood remained in the forests. Branches were gathered as fire wood and stumps were dug out (VANDEKERKHOVE *et al.*, 2011). On the other hand, these regions were characterized by bocage, i.e. a half open landscape with hedges, shelterbelts, avenue trees, pollards, high standard orchards (further referred to as old orchards) and parks. As an old hollow pollard still produces more firewood than a new one, we can expect that hollow pollards remained in the landscape. The same accounts for hollow fruit trees that likely remained as long as the crown was big enough to bear more fruits than a newly planted tree. Also in parks of castles and abbeys the esthetics of a tree were more important than its commercial value and they were thus allowed to grow old (JONSELL, 2004).
A large part of the forest biodiversity is so called saproxylic, i.e. depends on dead wood (MÜLLER *et al.*, 2008). Currently, there is more dead wood in our forest and some saproxylic species are known to have returned only very recently, e.g. *Bolitophagus reticulatus* (RAEMDONCK, 2010; TROUKENS, 2004). In some relic forests that have historically been managed less intensively, the saproxylic beetle diversity has restored remarkably well (DUFRENE *et al.*, 2006; VANDEKERKHOVE *et al.*, 2011). However, in many other forest the diversity in saproxylic beetles is quite low due to historic lack of habitat. As the continuity of hollow trees might have been better in the bocage, more cavity dwelling species might be present in relics of these landscapes and consequently they might be more important for conservation. Unfortunately, the tree densities in our bocage landscapes are in steep decline.

The large scale production of fruit in regions like Haspengouw and Pays the Herve started in the second half of the 19th century as a consequence of industrial processing of fruit and increased transport possibilities by train combined with a growing market in nearby cities. In 1936, the first low standard orchards appeared in this region and soon after the Second World War the high standard orchard lost their economic meaning. However, this short bloom of high standard orchards created a new generation of hollow trees within a landscape that at that time was already impoverishing in pollards and other trees. Therefore, regions with many relic high standard orchards might have the highest chance for the survival of cavity dwelling saproxylic organisms. In the sixties and seventies, efforts were taken to remove old orchards while later they got protected and subsidies are now paid to plant new ones. Nevertheless, also old orchards with hollow trees are currently strongly declining.
In this study, we would like to explore the species diversity and in particular the presence of *Osmoderma eremita* and *Elater ferrugineus* in hollow trees in relic bocage landscapes in Eastern Belgium: i.e. Haspengouw and Pays de Herve. As hypotheses, we pose that the beetle assemblage between trees differs and can be explained by general characteristics of the tree. Furthermore, we want to explore the value of *O. eremita* and *E. ferrugineus* as indicators of landscapes with a high conservation value for cavity inhabiting beetles.

Material and methods

Sampled sites

Ten sites were selected in the village Voeren (Limburg). This area is still rich in pollards and old orchards. *E. ferrugineus* was found here by the first author in 2011, just before the project started and *O. eremita* was found nearby for the last time in Belgium in 2002 (RANIUS *et al.*, 2005). Furthermore, two extra sites were selected in Haspengouw at the forest reserve Kolmont where *E. ferrugineus* was found in 1999 (VERSTEIRT *et al.*, 2000) and four sites in Pays de Herve including some sites with historical records of *O. eremita* (Fig. 1, Table 1).

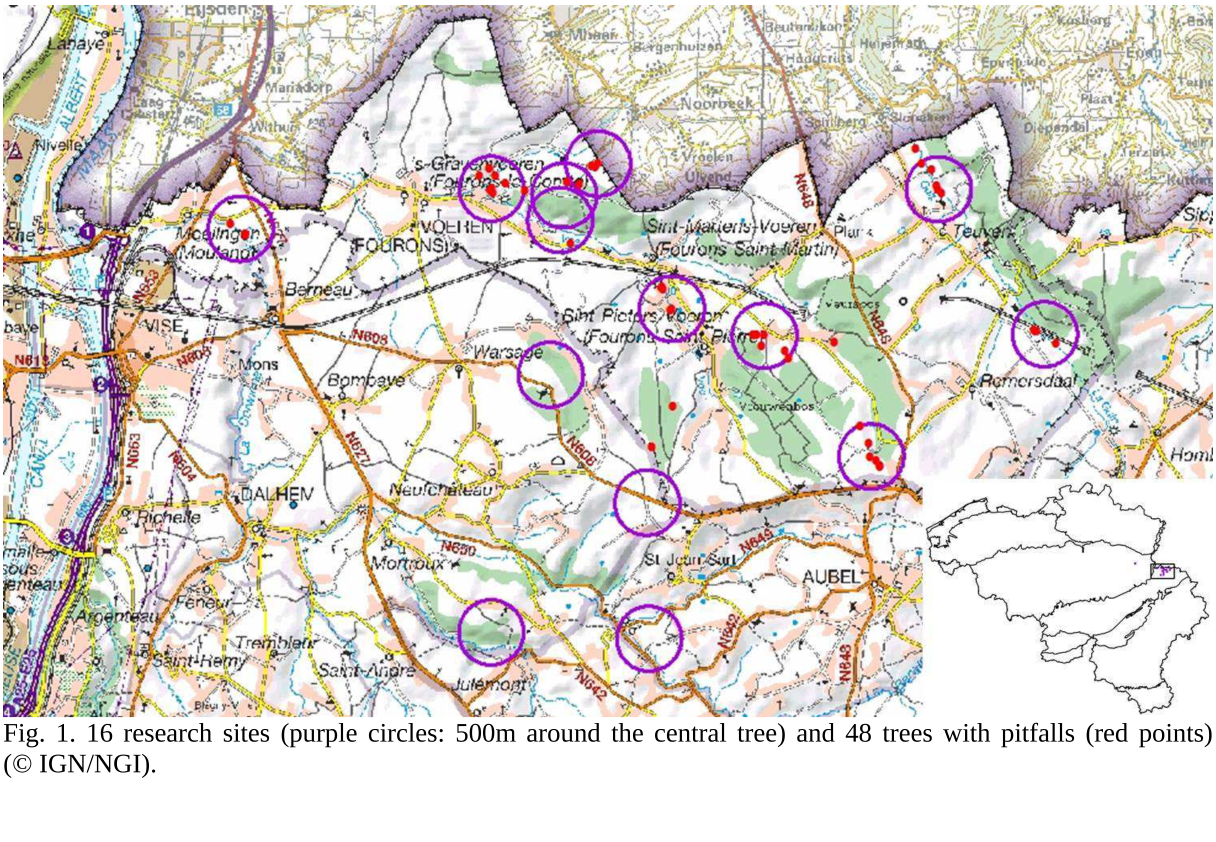

Fig. 1. 16 research sites (purple circles: 500m around the central tree) and 48 trees with pitfalls (red points) (© IGN/NGI).

Table 1. Overview of selected research sites.

Type	Name	Town	Main cavity trees
Bocage: Valley	Berg Bois de Mortroux Gulp Middelhof	Voeren Dalhem Voeren Voeren	Willow, Ash Willow Ash, Willow Willow
Bocage: loam plateau	Kijs** Sart*	Voeren Aubel	Ash Limited number of hollow trees
Park	Altenbroek Val Dieu*	Voeren Aubel	Ash Oak, Black alder
Forest	Bois du Roi Kolmont noord** Kolmont zuid**	Dalhem Tongeren Tongeren	Ash Beech, Ash, Willow Beech, Ash, Willow
Orchard	Altenbroek orchard Moelingen Schoppem Veurs Vitchen	Voeren Voeren Voeren Voeren Voeren	Apple Apple, Ash Apple, Ash Hornbeam, apple Ash, Apple

*: Historic records for *Osmoderma eremita* and **: Historic records for *Elater ferrugineus.*

Sampling

In each site a central hollow tree with an interesting wood mold holding cavity was selected. In this tree, two pheromone traps were hanged, 2m from the cavity in opposite directions. The traps were placed from the 4th to 29th of July in 2011. The traps existed out of a 1 liter plastic jar (11cm diameter). Just underneath the lid a 3 cm high opening (half the circumference long) was made. The bottom of the jar was covered with a layer of wood mold for weight and to allow the beetles to hide. The pheromones hanged on the underside of the lid. One trap was equipped with an eppendorf with pheromones of *E. ferrugineus* (Swedish University of Agricultural Sciences, SVENSSON *et al.*, 2004). The second trap had 0,4 ml pheromones of *O. eremita* in a 2ml eppendorf with a 10mm cotton dental rolls (Celluron, Paul Hartmann, S.A., France) as dispenser (SVENSSON *et al.*, 2004). Traps were checked every two to three days and their position was switched after every second control. Trapped beetles were marked uniquely with a sliver marker on the elytra with the same coding as LARSSON & SVENSSON (2011) to detect recaptures.

In total 48 pitfalls of 9,5cm diameter and 6cm depth were placed in the wood mold at the bottom of tree cavities in the 10 sites in Voeren and three trees in other locations in Voeren (Fig. 1). Pitfalls were filled with 2cm Scheerpeltz solution (four parts ethanol, three parts water, two parts glycerol and one part acetic acid). Three other pitfalls were placed in trees outside the selected sites in Voeren. Traps were installed between 9 and 24 May and the content was collected at the end of May, June and July. The content was spread out in a scale with a bit of water and beetles (and ants) were collected and stored for determination on ethanol.

At the 16 sites, all hollow and dead trees within 500m (radius) of the central tree were mapped. From each tree the position, tree species, position of the cavity (base, stem, branch), surface of the biggest cavity opening (estimated as an oval or triangle), cavity stadium (according to Gouix 2011), status (dead/alive) and decay status for dead trees (DE KEERSMAEKER *et al.*, 2005) was determined. Hollow trees were quickly checked for obvious signs of the presence of large beetles (like fragments, excreta or galleries).

Analyses

For the ordination analyses the data from the saproxylic beetles found in the pitfalls was used. Only the results of 29 trees were used from which the pitfall collecting of at least two months were successful, as pitfalls were regularly unsuccessful (see results). Data was transformed to presence/absence data. A PERMANOVA model (a direct linear model for presence/absence data) was built with following response variables: tree species, site, position of the cavity, surface of the cavity

opening, cavity stadium and number of months for which data is available. The model was made in R 3.0.1 (R Development Core Team 2009) with library Vegan (DIXON, 2003). The function Adonis was used with 1000 permutations. Forward selection was applied to select terms with the highest residual R^2 till new terms no longer significantly improved the model ($p<0.05$).
To evaluate the indicator value of *E. ferrugineus,* the relation between the numbers of *E. ferrugineus* beetles trapped was compared with 1) the number of living trees with wood mold containing cavities (stage 3 to 5, i.e. the habitat of the species) and 2) the number of saproxylic beetles species within the pitfalls. This comparison was done with generalised linear models (glm) with Poisson distribution in R 3.0.1 with the lme4 library (BATES *et al.*, 2012).

Deposition of specimens

The collected beetles are saved in de collection of Luc Crevecoeur and the ants were determined by François Vankerkhoven and deposited in his collection. A reference collection of *E. ferrugineus* is kept in the collection of Arno Thomaes.

Results

The sites had six (Sart) to 192 (Bois de Mortroux) hollow trees including three to 151 mold containing hollow trees. This means 3,8 to 192 (mean 85) mold containing hollow trees per square kilometer. At most sites 45 to 65% of the hollow trees contain mold, which are of the highest importance for saproxylic beetles. The percentage of mold containing trees was remarkably higher in Bois the Mortroux and Kolmont North and South (79, 71 and 75% respectively) and low at Bois du Roi (33%). In contrast, Bois du Roi has many cavities with an early development (stage 1 and 2, 64%) compared to only 16% in Bois de Mortroux. Only 3 sites had more than 4 trees with a cavity of stage 6, i. e. Bois de Mortroux, Veurs and Vitchen.
The number of dead trees varies from 0 to 304 (mean 60). There are remarkably more dead trees in Kolmont north and south (304 and 302), Gulp (56) and Bois de Mortroux (51). Most of the trees are rather thin and are in the decomposition stages 1 or 2. Only in Bois de Mortroux and Kolmont north and south ticker dead trees and all the decay stages are present.
Pitfalls often failed to collect beetles as they were taken out the cavity, crushed together or disappeared. This was likely due to cows and badgers in low cavity’s and owls or other birds in higher cavity’s. Furthermore, some pitfalls were retrieved completely or partly filled with wood mold again explained by birds or mammals inhabiting the cavities or in other cases they got filled by wood mold from higher parts of the cavity. This often resulted in a very low number of species. For example in the site Moelingen none of the collected samples was successful.
In total, 161 beetle species (Appendix 1) were determined including 77 saproxylic beetles from which 23 species are listed on the German red list (GEISER, 1998). The red listed species include one species threatened with extinction (*Biphyllus lunatus*), six threatened species (i.e. *E. ferrugineus*, *Platycis cosnardi, Pseudocistela ceramboides, Rhyncolus punctatulus, Taphrorychus villifrons* and *Sphinginus lobatus*) and 16 others are vulnerable.
A dead hollow apple tree in Altenbroek contained the most beetle species (29), saproxylic beetles (17) and four red listed species. This cavity contained owl droppings and other nest remains which resulted in

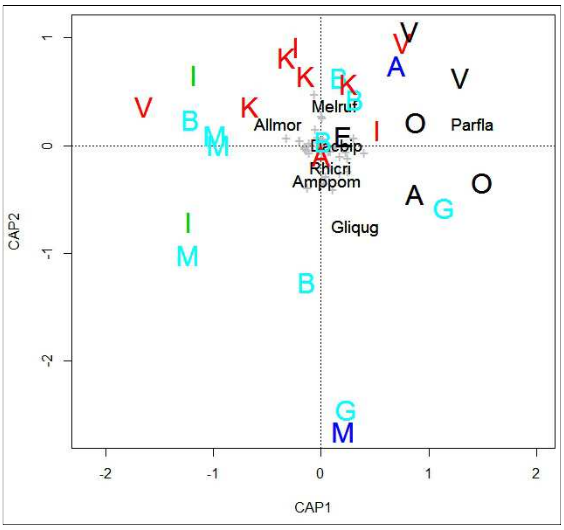

Fig. 2. Ordination of the captured saproxylic beetles from 29 pitfalls in hollow trees. Black: Apple, red: Ash, green: Oak, light blue: Willow and dark blue: other tree species. **O**: Altenbroek orchard, **A**: Altenbroek, **B**: Berg, **G**: Gulp, **K**: Kijs, **M**: Middelhof, **S**: Schoppem,**V**: Veurs, **I**: Vitchen and **E**: Veursbos. Grey crosses and abbreviated names (Appendix 1) represent the position of the different beetles.

extra species (e.g. *Attagenus pellio*, *Dendrophilus punctatus*, *Dermestes lardarius*, *Philonthus subuliformis* en *Veileius dilatatus*). A gigantic pollarded willow (girth 630 cm) at Gulp had the second most saproxylics (10) and total beetles (21) and again four red listed species. A pollarded Ash in Altenbroek also contained four red listed species. The other trees with the most species and most red listed species were mainly apple trees. In an oak at Vitchen, one specimen of *Crepidophorus mutilatus* was found, a new species for the Belgian fauna (see box 1).

In the PERMANOVA model, the research site and tree species explained the largest part of the variation but both terms were not significant (df 15,9,4; p resp. 0.57 and 0.60, Fig. 2).

In the pheromone traps *E. ferrugineus* was found in 13 of the 16 research sites while this species was only found in one pitfall trap. The number of trapped beetles was positively correlated to the number of mold containing hollow trees at the site (Fig. 3, Table 2). In five sites with less than 50 suitable trees, no more than 2 beetles were found with the pheromone traps. While, more beetles were found in all other sites. However, we found no significant relation with the species richness found in the pitfalls of each site. Only one of the marked *E. ferrugineus* was recaptured in the same trap (Vitchen). Finally, *O. eremita* was not found.

Hand captures included mainly *Dorcus parallelipipedus* and sometimes *Sinodendron cylindricum*. Two remarkable species were found, i.e. *Lucanus cervus* at Schoppem and *Gnorimus variabilis at* Bois de Mortroux (see box 2). For a complete overview of the results (including ants collected in the pitfalls) we refer to THOMAES (2014).

Table 2. Parameter estimates and p-values of GLM explaining (a) number of mold containing hollow trees and (b) species richness of saproxylic beetles by the number of *Elater ferrugineus* in traps.

(a)	df	Parameter estimate	Z value	p-value
Intercept	1	4.07	85.399	***
Elater	1	0.05	5.303	***
Residual	14			
(b)				
Intercept	1	1.68	10.512	***
Elater	1	0.02	0.731	0.47
Residual	14			

p-value: ***: p≤0.001

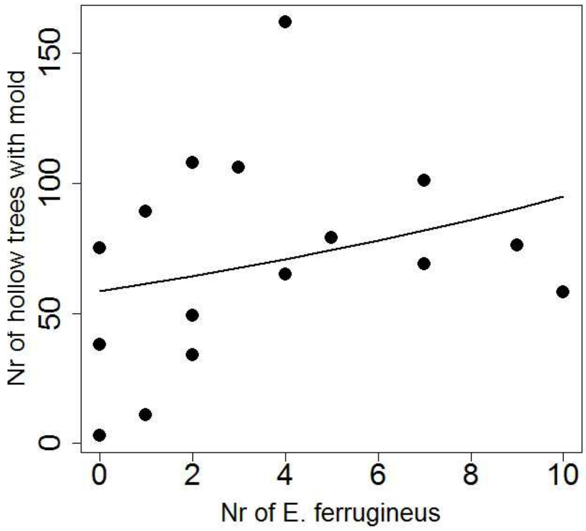

Fig. 3. Relation between the number of mold containing trees (phase 3 to 5) at a site and the number of captured individuals of *Elater ferrugineus*.

Box 1: *Crepidophorus mutilatus*: New species for Belgium

One specimen of this click beetle (*Elateridae*) was captured in a pitfall in June in a pollarded oak at Vitchen (Voeren). This is the first time that this species is recorded in Belgium. The species is not known from the Netherlands. The species is typical for old oak forests and parks with old hollow broadleaved trees. Larvae are predators, while adults hibernate in the hollow and become active in May and June. The European red list (NIETO & ALEXANDER, 2010) mentions the species as near threatened as in most countries only a handful of populations are known (MERTLIK, 2014). (BRUSTEL, 2004, 2005) listed this species in the highest category (7) for a species indicating dead wood continuity. On the German red list, the species is mentioned as threatened (GEISER, 1998).

Possibly, this species is expanding or is becoming more frequent in relic populations, based on the recent discovery of the species in well studied sites, e.g. Urwald Von Taben (2011), Hunsrück (2012) and Eifel (2012; Köhler, pers. comm.).

Box 2: *Gnorimus variabilis:* First record since 1932

A population of this species was found at Bois the Mortroux. In august 2011, we found elytra and other remains in 4 different trees and two larvae. The material is stored in the collection of Arno Thomaes. We found this species independently from S. Bouvy who discovered them earlier that year at the same site (MIESSEN & THIEREN 2014). In Belgium, only 5 records (Diepenbeek, Hasselt, Maaseik, Tamines, Vliermaalroot) were known and the most recent being from 1932. In the Netherlands and in Luxembourg no recent records are known and in Germany the species is known from only a handful of locations. In the nearby Rhineland-Pfalz and Northrine the species is known from only two hot spots for saproxylic beetles, i.e. Bienwald and Urwald Von Taben (Köhler, pers. comm.).

Gnorimus variabilis is a *Cetoniidae* which can be found both in hollow trees and dead wood but only in wood that is decayed by brown rot (Köhler, pers. comm.). The species prefers wet conditions and Alder trees as this species is often associated with brown rot. In general the species is even rarer than *O. eremita* in northern Europe while it is more frequent in southern Europe.

We share the concern of MIESSEN & THIEREN (2014) that this relic population is severely threatened by collectors who destroy the habitat on a senseless way. At 11 February 2014, the first author visited the site together with the forest guards in order to discuss this problem and to advise them on the management requirements of this species.

Fig. 4. *Crepidophorus mutilatus* (photo by L. Crevecoeur).

Fig. 5. *Gnorimus variabilis* (photo by Y. Adams).

Discussion

The PERMANOVA model failed to find significant characteristics that explained the saproxylic beetle community present in the hollow tree. This is likely explained by the limited number of hollow trees included in the study. Nevertheless tree species and site seem to be the best explaining variables. *E. ferrugineus* was found at several sites and can be considered as an indicator for landscapes with a high number of remaining hollow trees (ANDERSSON, 2012; cf. RANIUS, 2002a). *Osmoderma eremita* was not found in this study but many other rare saproxylic beetles were found indicating that relics of bocage landscapes in Belgium are important hot spots for saproxylic organisms.

In North West France 100 and 500 mold containing hollow trees were found per km² in the departments Sarthe and Orne respectively (RANIUS *et al.*, 2005) in comparable agricultural landscapes. DUBOIS *et al.* (2009) found 491 mold containing hollow trees in an area of 16 km² (31/km²) in Orne. JONSELL (2012) studied 27 parks and woodpastures in Sweden and found inbetween 10 and 300 hollow trees in sites of maximally some hectares but often less than 1ha in size. Another Swedish study compared 4 wood pastures with 1 to 79 hollow trees per km². The area of those sites varied from 1km² with the highest abundance to 200km² with the lowesyt abundance (RANIUS *et al.*, 2011). All these values are comparable or a bit higher then the values encountered in this study (3,8 to 192) but in all of the cited studies *O. eremita* is still present. This and the records of many other rare species indicates that this elusive species might still be present in this region.

These high numbers of hollow trees are very important for the survival of high demanding saproxylic organisms (e.g. RANIUS *et al.*, 2011). This is mainly explained by the fact that every species has specific demands on its habitat and not every tree fits the requirements of all cavity inhabiting species. In some of the study sites it was difficult to even find five trees with cavities that where accessible and

large enough to fit a pitfall, despite much more hollow trees were present. Also the poor colonization rate of many cavity dwelling species increases the need for many hollow trees to maintain a population.
Further, we notice that the number of trees with cavities in an early stage of development is very low in our study sites. This limits the future presence of suitable hollow trees. This is mainly explained by a lack of new orchard trees that are planted and the cessation of pollarding. Trees in stadium 6 are no longer suitable for many species living in the wood mold of hollow trees but can be inhabited by particular species that live in a mixture of soil and wood mold.
We want to underline that the species lists of the different sites cannot be considered as (nearly) complete lists of the present species. To elaborate this, different techniques and samples of different years should be included. Therefore, the data are insufficient for a detailed statistical analysis and some of our results that have been concluded to be not significant might be very important in reality. Other studies (JONSELL *et al.,* 1998; HORAK & PAVLICEK, 2013; LINDHE & LINDELOW, 2004; HORAK, 2011; JONSELL *et al.*, 2007) have for example found clear differences in beetle assemblages between tree species. Consequently, protection is better not limited to certain sites, tree species or habitats.
Also the number of trapped *E. ferrugineus* individuals is rather low as a result of the limited size and quality of the traps. RANIUS (2002b) and ANDERSSON (2012), who used large funnel traps, found that this species is a good indicator for the number of hollow trees and the diversity in cavity living beetles.

Conclusion

This research shows at least that hollow trees in this region have a high conservation value for the biodiversity of saproxylic beetles. They form an important relic for many rare and threatened species. As many of these species do not colonise new sites easily, maintenance of these populations is very important.
The first priority is to safeguard the remaining orchard and pollarded trees as much as possible. Many of the studied trees are already within nature reserves but also trees outside these reserves show high biodiversity values. As the composition of species differs between tree species and site, it is important to focus the protection on various sites and tree species. The current species richness is mainly explained by the historic landscape but can only remain high when the traditional management is not neglected. For the pollards, it is important to continue pollarding them. If the pollarding is ceased, the branches become too heavy and the tree will fall over or break open. There is also a change that the pollard will rot and water will find access to the cavity making it no longer suitable for many beetles. Cavities with wet or waterlogged wood mold can be interesting for peculiar species like hoverflies. However a sudden change in moisture conditions might mean the loss of most of the species already inhabiting the cavity. Trees that have not been pollarded for a very long time, must be pollarded stepwise, otherwise the tree might die (READ, 2000; CORNELIS *et al.*, 2012). Furthermore, it is important to prevent that old trees are overgrown by young trees as they might die due to lack of light. Old trees, pollards and high standards are much lower and less vital than young trees. Therefore, keep a hallow open around these kind of trees. Finally, prevent cattle harming the trees.
The safeguarding of these relic populations is only meaningful if the direct surrounding landscape can provide new cavities in the future. Many of the current pollards are old and are standing isolated in the landscape. In this case, new pollards and high standards need to be planted. These trees can generate new cavities within a short period. It is proposed that a willow pollard can have a suitable cavity after 30y of intensive pollarding and oaks after about 50y (VIGNON, 2006). Ash probably needs an inbetween age while hornbeam has cavities that quickly rot entierly open so they are only interesting during a short period of time. Among fruit trees, it is clear from the study sites that apples are the most interesing, pears become rarely hollow and wood of cherries rots fast resulting in a quick dead of a certain part or even the entire tree after an injury. For apple trees, we propable need to count for an age of 30y before they become interesting for cavity dwelling species.
On the short term new pollards and fruit trees are still needed, while on the long term other habitats could provide cavities. The current forests barely have large cavities and these might only appear after a very long term (100y or more). Also wood pastures will only offer new cavity’s after more than 100y while current trees with cavity’s will disappear much sooner. So these habitats can only

guarantee suitable habitat in the long future and other measures have to be taken aside from this to ensure the continuity in suitable cavity's at every site in the coming decennia.

Finally, there are some possibilities to create cavities in a more artificial way. In the surrounding countries there are experiences with re-erecting trees, transplanting old and even dead trees to a more suitable landscape, provide nest boxes filled with saw dust or introduce mycelia in young vital trees to initiate their hollowing (JANSSON *et al.*, 2009; STEGNER *et al.*, 2009; SUNHEDE, 2010).

Acknowledgment

We would like to thank the forest administration in Flanders and Wallonia (ANB, SPW), Natuurpunt, Regionaal Landschap Haspengouw en Voeren and other owners and managers for their cooperation and allowance of this research. We thank Thierry Kervyn and Vincent Fievet for their help with the wallonian sites. We are grateful to Mattias Larsson and Glenn Svensson for the pheromones of *E. ferrugineus* and for their assistance with the setup. Thanks to Frank Köhler for giving additional information on some beetles and to an anonymous reviewer for improving an earlier version of the manuscript.

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Appendix 1. Number of specimen found in the pitfall traps from each Species seperated for each site. Abbr.: the abbreviated name used in Figure 2, Habitat: the habitat of the saproxylic species, RL: German red list status (Geiser 1998), I: Alserbos, II: Altenbroek, III: Altenbroek orchard, IV: Berg, V: Gulp, VI: Kijs, VII: Moelingen, VIII: Middelhof, IX: Schoppem, X: Veurs, XI: Veurs north, XII: Vitchen.

Family	**Name**	**Abbr.**	**Habitat**	**RL**	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**	**X**	**XI**	**XII**
Alleculidae	*Allecula morio*	Allmor	mold	3	0	0	0	0	0	2	0	0	0	0	1	2
Alleculidae	*Mycetochara linearis*	Myclin	wood		0	1	1	0	0	0	0	0	0	0	0	0
Alleculidae	*Prionychus ater*	Priate	mold	3	0	0	0	1	0	0	0	0	0	1	0	0
Alleculidae	*Pseudocistela ceramboides*	Psecer	mold	2	1	2	0	1	0	2	0	2	0	2	0	1
Anobiidae	*Anobium nitidum*	Anonit	wood		0	0	1	0	0	0	0	0	0	0	0	0
Anobiidae	*Anobium punctatum*	Anopun	wood		0	0	1	1	0	1	0	1	0	2	0	0
Anobiidae	*Grynobius planus*	Grypla	wood	3	0	0	0	0	0	0	0	0	0	0	0	1
Anobiidae	*Priobium carpini*	Pricar	wood		0	1	0	0	1	0	0	0	0	1	0	0
Anobiidae	*Ptilinus pectinicornis*	Ptipec	wood		0	0	0	0	0	0	0	0	1	1	0	0
Anthribidae	*Choragus sheppardi*	Choshe	fungi	3	0	0	0	0	0	0	0	0	0	1	1	0
Biphyllidae	*Biphyllus lunatus*	Biplun	fungi	1	0	0	0	0	0	2	0	0	0	0	0	0
Byrrhidae	*Byrrhus pilula*	Byrpil			0	0	0	0	0	0	0	0	0	0	0	1
Cantharidae	*Cantharis fusca*	Canfus			0	0	0	1	1	0	0	0	0	0	1	0
Carabidae	*Amara familiaris*	Amafam			0	0	0	0	0	1	0	0	0	0	0	0
Carabidae	*Badister bullatus*	Badbul			0	0	0	0	0	0	0	0	0	0	0	1
Carabidae	*Bembidion lampros*	Bemlam			0	0	0	0	0	1	0	0	0	0	0	0
Carabidae	*Calathus rotundicollis*	Calrot			0	0	0	0	0	1	0	0	0	0	0	0
Carabidae	*Carabus coriaceus*	Carcor			0	0	0	0	0	0	0	1	0	0	0	0
Carabidae	*Carabus monilis*	Carmon			1	0	0	1	0	2	0	0	1	0	0	0
Carabidae	*Carabus nemoralis*	Carnem			0	0	0	0	0	0	0	1	0	0	0	0
Carabidae	*Carabus problematicus*	Carpro			1	0	0	0	0	0	0	0	0	0	0	0
Carabidae	*Carabus violaceus*	Carvio			0	0	0	0	0	2	0	0	0	0	0	0
Carabidae	*Leistus fulvibarbis*	Leiful			0	1	0	0	0	0	0	0	0	0	0	0
Carabidae	*Leistus rufomarginatus*	Leiruf			0	0	0	0	0	1	0	0	0	0	0	1
Carabidae	*Limodromus assimilis*	Limass			0	0	0	0	1	0	0	1	0	0	0	0
Carabidae	*Nebria brevicollis*	Nebbre			3	3	0	2	3	3	0	0	3	2	1	5
Carabidae	*Notiophilus biguttatus*	Notbig			0	0	0	0	0	1	0	0	0	0	0	0
Carabidae	*Pterostichus madidus*	Ptemad			0	0	0	0	0	0	0	1	0	0	0	1
Carabidae	*Pterostichus melanarius*	Ptemel			0	0	0	0	0	2	0	0	2	0	0	0
Carabidae	*Pterostichus niger*	Ptenig			0	0	0	0	0	0	0	1	0	0	0	0
Cerambycidae	*Clytus arietis*	Clyari	wood		0	0	0	0	0	0	0	1	0	0	0	0
Cerambycidae	*Leiopus nebulosus*	Leineb	bark		0	0	1	0	0	0	0	0	0	0	0	0
Cerambycidae	*Phymatodes testaceus*	Phytes	bark		0	0	1	1	0	0	0	0	0	0	0	0
Cerylonidae	*Cerylon fagi*	Cerfag	mold		0	0	0	0	0	0	0	0	0	0	0	1
Cerylonidae	*Cerylon histeroides*	Cerhis	mold		0	1	1	0	1	0	0	0	0	0	0	0
Cholevidae	*Catops fuliginosus*	Catful			0	0	0	0	0	0	0	1	0	0	0	0
Cholevidae	*Catops picipes*	Catpic			0	0	0	0	2	2	0	0	0	0	0	0
Cholevidae	*Nargus anisotomoides*	Narani			0	0	0	0	0	0	0	0	0	0	0	2
Cholevidae	*Nargus velox*	Narvel			0	0	0	0	1	0	0	0	0	0	0	0
Cholevidae	*Ptomophagus subvillosus*	Ptosub			0	0	0	1	0	0	0	0	0	0	1	0
Cholevidae	*Sciodrepoides watsoni*	Sciwat			0	0	0	0	1	0	0	1	0	0	0	0
Chrysomelidae	*Crepidodera aurata*	Creaur			0	0	0	2	0	0	0	1	0	0	0	2
Ciidae	*Cis castaneus*	Ciscas	fungi		0	1	0	0	0	0	0	0	0	0	0	0
Cucujidae	*Pediacus depressus*	Peddep	bark		0	0	0	0	0	0	0	0	0	0	0	1
Curculionidae	*Acalles ptinoides*	Acapti	wood		0	0	0	0	0	1	0	0	0	0	0	0
Curculionidae	*Barypeithes pellucidus*	Barpel			0	0	0	1	0	0	0	0	0	0	0	0
Curculionidae	*Ceutorhynchus sulcicollis*	Ceusul			0	0	0	1	0	0	0	0	0	0	0	0
Curculionidae	*Cossonus cylindricus*	Coscyl	wood	3	0	0	0	0	1	0	0	0	0	0	0	1
Curculionidae	*Kyklioacalles roboris*	Kykrob	wood		0	0	0	1	0	0	0	0	0	0	0	0
Curculionidae	*Leiosoma deflexum*	Leidef			0	0	1	0	0	0	0	0	0	0	0	0
Curculionidae	*Otiorhynchus raucus*	Otirau			0	0	1	0	0	0	0	0	0	0	0	0

Family	Name	Abbr.	Habitat	RL	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Curculionidae	*Rhyncolus punctatulus*	Rhypun	wood	2	0	1	0	0	0	2	0	0	0	0	0	2
Curculionidae	*Stereocorynes truncorum*	Stetru	wood		0	3	2	2	1	5	0	2	0	4	1	3
Curculionidae	*Strophosoma melanogrammum*	Strmel			0	0	0	0	0	0	0	0	0	1	0	0
Dermestidae	*Attagenus pellio*	Attpel			0	1	0	0	0	0	0	0	0	0	0	0
Dermestidae	*Dermestes lardarius*	Derlar			0	1	0	0	0	0	0	0	0	0	0	0
Dermestidae	*Dermestes undulatus*	Derund			0	0	0	0	0	0	0	1	0	0	0	0
Elateridae	*Ampedus pomorum*	Amppom	mold		0	0	0	0	0	0	0	1	1	0	0	0
Elateridae	*Athous bicolor*	Athbic			0	0	0	0	0	0	0	0	0	1	0	0
Elateridae	*Athous haemorrhoidalis*	Athhae			0	0	0	0	0	1	0	1	0	0	0	0
Elateridae	*Crepidophorus mutilatus*	Cremut	wood	1	0	0	0	0	0	0	0	0	0	0	0	1
Elateridae	*Elater ferrugineus*	Elafer	mold	2	0	0	0	0	0	0	1	0	0	0	0	0
Elateridae	*Denticollis linearis*	Denlin	mold		0	0	0	0	0	1	0	0	0	0	0	0
Elateridae	*Hemicrepidius hirtus*	Hemhir			0	0	0	0	0	0	0	0	0	1	0	1
Elateridae	*Hypoganus inunctus*	Hypinu	wood	3	0	0	0	0	1	0	0	0	0	1	0	0
Elateridae	*Melanotus rufipes*	Melruf	mold		0	2	0	0	2	5	0	0	1	2	0	1
Endomychidae	*Mycetaea subterranea*	Mycsub			0	1	0	0	0	0	0	0	0	0	0	2
Erotylidae	*Dacne bipustulata*	Dacbip	fungi		0	0	1	0	0	0	0	0	0	0	0	0
Eucnemidae	*Eucnemis capucina*	Euccap	wood	3	1	1	0	0	1	0	0	0	0	0	0	0
Eucnemidae	*Hylis olexai*	Hylole	wood	3	0	0	0	0	0	0	0	1	0	0	0	0
Geotrupidae	*Anoplotrupes stercorosus*	Anoste			0	0	0	0	0	0	0	1	0	0	0	0
Histeridae	*Abraeus perpusillus*	Abrper	mold		0	0	0	0	0	0	0	1	0	0	0	1
Histeridae	*Carcinops pumilio*	Carpum			0	0	0	0	0	0	0	0	0	1	0	0
Histeridae	*Dendrophilus punctatus*	Denpun	nest		0	2	0	0	1	0	0	0	0	0	0	0
Histeridae	*Gnathoncus buyssoni*	Gnabuy			0	3	0	0	0	0	0	0	0	0	0	2
Histeridae	*Margarinotus striola*	Marstr			0	2	0	0	0	0	0	0	0	0	0	0
Histeridae	*Paromalus flavicornis*	Parfla	bark		1	4	4	0	1	0	0	0	0	4	0	2
Hydrophilidae	*Helophorus grandis*	Helgra			0	0	0	0	0	0	0	1	0	0	0	0
Hydrophilidae	*Megasternum obscurum*	Megobs			0	0	0	0	1	0	0	0	0	0	0	0
Hydrophilidae	*Sphaeridium lunatum*	Sphlun			0	0	0	0	0	0	0	0	0	1	0	0
Lampyridae	*Lamprohiza splendidula*	Lamspl			0	0	0	1	0	0	0	0	0	0	0	0
Latridiidae	*Cartodere nodifer*	Carnod			0	0	0	0	0	0	0	1	0	0	0	0
Latridiidae	*Enicmus histrio*	Enihis			0	0	0	0	0	1	0	0	0	0	0	0
Lucanidae	*Dorcus parallelipipedus*	Dorpar	wood		0	8	4	8	4	12	1	2	2	9	1	8
Lucanidae	*Sinodendron cylindricum*	Sincyl	wood	3	0	0	0	0	0	0	0	0	0	0	1	0
Lycidae	*Platycis cosnardi*	Placos	mold	2	0	0	0	0	1	0	0	0	0	0	0	2
Malachiidae	*Sphinginus lobatus*	Sphlob	wood	2	0	0	0	0	1	0	0	0	0	0	0	0
Monotomidae	*Rhizophagus bipustulatus*	Rhibip			0	0	0	1	1	0	0	2	0	0	0	1
Monotomidae	*Rhizophagus cribratus*	Rhicri	bark		0	0	0	0	1	0	0	0	0	0	0	0
Monotomidae	*Rhizophagus parvulus*	Rhipar	bark		0	1	0	0	1	0	0	1	0	0	0	0
Monotomidae	*Rhizophagus perforatus*	Rhiper	bark		0	0	0	1	0	0	0	0	0	0	0	0
Monotomidae	*Rhizophagus picipes*	Rhipic	bark		0	0	0	0	1	0	0	0	0	0	0	0
Mordellidae	*Mordellochroa abdominalis*	Morabd	wood		0	0	0	0	0	0	0	1	0	0	0	0
Mycetophagidae	*Mycetophagus populi*	Mycpop	fungi	3	0	0	1	0	0	0	0	0	0	0	0	0
Mycetophagidae	*Mycetophagus quadriguttatus*	Mycqua			0	2	0	0	1	0	0	0	0	0	1	1
Nitidulidae	*Epuraea marseuli*	Epumar	wood		0	0	0	1	0	0	0	0	0	1	0	0
Nitidulidae	*Epuraea ocularis*	Epuocu			0	0	0	0	1	0	0	0	0	0	0	0
Nitidulidae	*Glischrochilus hortensis*	Glihor			0	6	2	5	6	4	1	1	2	1	0	7
Nitidulidae	*Glischrochilus quadriguttatus*	Gliqua	bark		0	0	1	1	3	0	0	1	0	0	0	2
Nitidulidae	*Glischrochilus quadrisignatus*	Gliqua			0	0	1	1	2	3	0	1	2	3	0	5
Nitidulidae	*Omosita discoidea*	Omodis			0	0	0	0	1	0	0	0	0	0	0	0
Nitidulidae	*Pityophagus ferrugineus*	Pitfer	bark		0	0	0	0	0	0	1	0	0	0	0	0
Nitidulidae	*Soronia punctatissima*	Sorpun			0	0	0	0	1	0	0	0	0	0	0	0
Pselaphidae	*Batrisodes delaporti*	Batdel	nest		0	0	0	0	1	0	0	0	0	0	0	1
Pselaphidae	*Batrisodes venustus*	Batven	nest		0	0	0	0	0	0	0	0	0	0	0	1
Pselaphidae	*Euplectus nanus*	Eupnan	mold		0	1	0	0	0	0	0	0	0	0	0	0
Ptinidae	*Ptinus fur*	Ptifur			0	0	0	0	1	1	0	0	0	0	0	4
Salpingidae	*Lissodema denticolle*	Lisden	bark		0	0	0	0	0	0	0	0	0	0	1	0
Scarabaeidae	*Aphodius prodromus*	Aphpro			0	0	0	0	0	1	0	0	0	0	0	0
Scarabaeidae	*Valgus hemipterus*	Valhem	wood		1	1	0	1	0	3	0	0	0	0	0	0

Family	Name	Abbr.	Habitat	RL	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Scolytidae	*Scolytus mali*	Scomal	bark		0	0	1	0	0	0	0	0	0	0	0	0
Scolytidae	*Taphrorychus villifrons*	Tapvil	bark	2	0	1	0	0	0	0	0	0	0	0	0	0
Scolytidae	*Xyleborus dispar*	Xyldis	wood		0	1	0	0	0	0	0	1	0	0	0	0
Scolytidae	*Xyleborus monographus*	Xylmon	wood		0	0	0	0	0	1	0	0	0	0	0	0
Scolytidae	*Xyleborus saxeseni*	Xylsax	wood		0	0	1	0	0	0	0	0	0	0	0	0
Scraptiidae	*Scraptia fuscula*	Scrfus	wood	3	0	1	0	0	0	0	0	0	0	0	0	0
Silphidae	*Nicrophorus vespilloides*	Nicves			0	0	0	0	0	0	0	1	0	0	0	0
Silvanidae	*Uleiota planata*	Ulepla	bark		0	1	0	0	0	0	0	0	0	0	0	0
Staphylinidae	*Aleochara sparsa*	Alespa			1	7	1	7	4	5	0	8	1	1	1	14
Staphylinidae	*Anotylus rugosus*	Anorug			0	0	0	0	2	0	0	0	0	0	0	0
Staphylinidae	*Anotylus sculpturatus*	Anoscu			0	0	0	2	0	1	0	0	0	0	0	0
Staphylinidae	*Anotylus tetracarinatus*	Anotet			0	1	0	0	0	0	0	0	0	0	0	0
Staphylinidae	*Anthobium unicolor*	Antuni			0	0	0	0	0	1	0	0	0	0	0	0
Staphylinidae	*Atheta corvina*	Athcor			0	0	0	0	0	0	0	0	0	0	0	1
Staphylinidae	*Atheta hybrida*	Athhyb			0	1	0	0	0	0	0	0	0	0	0	0
Staphylinidae	*Atrecus affinis*	Atraff	mold		0	0	1	0	0	0	0	0	0	0	0	1
Staphylinidae	*Carpelimus elongatulus*	Carelo			0	0	0	1	0	0	0	0	0	0	0	0
Staphylinidae	*Coprophilus striatulus*	Copstr			0	0	0	0	2	1	0	0	0	0	0	0
Staphylinidae	*Hypnogyra glabra*	Hypgla	mold	3	0	1	1	0	0	0	0	0	0	1	0	0
Staphylinidae	*Ilyobates nigricollis*	Ilynig			0	0	0	0	1	0	0	1	0	0	0	0
Staphylinidae	*Lesteva longelytrata*	Leslon			0	0	0	1	1	0	0	0	0	0	0	0
Staphylinidae	*Omalium rivulare*	Omariv			0	0	0	0	0	0	0	1	0	0	0	0
Staphylinidae	*Philonthus marginatus*	Phimar			0	0	0	0	1	0	0	1	0	0	0	0
Staphylinidae	*Philonthus subuliformis*	Phisub	nest		0	1	0	0	0	0	0	0	0	0	0	0
Staphylinidae	*Philonthus succicola*	Phisuc			0	0	0	0	0	0	0	1	0	0	0	0
Staphylinidae	*Phloeostiba planus*	Phlpla	bark		0	0	0	1	0	0	0	2	0	0	0	0
Staphylinidae	*Placusa pumilio*	Plapum	bark		0	2	0	0	0	0	0	1	0	0	0	0
Staphylinidae	*Placusa tachyporoides*	Platac	bark		0	0	0	0	0	0	0	0	0	0	0	1
Staphylinidae	*Quedius cruentus*	Quecru			0	0	0	0	0	0	0	0	0	0	0	3
Staphylinidae	*Quedius mesomelinus*	Quemes			0	0	0	1	0	0	0	0	0	0	0	2
Staphylinidae	*Quedius scitus*	Quesci	mold		0	0	0	0	0	1	0	0	0	1	0	2
Staphylinidae	*Quedius truncicola*	Quetru	nest	3	0	0	0	0	1	0	0	0	0	0	0	0
Staphylinidae	*Scaphisoma boleti*	Scabol	fungi		0	0	0	0	0	0	0	1	0	0	0	1
Staphylinidae	*Sepedophilus bipunctatus*	Sepbip	mold		0	2	0	0	0	0	0	0	0	0	0	0
Staphylinidae	*Sepedophilus marshami*	Sepmar			0	0	1	0	0	0	0	0	0	0	0	0
Staphylinidae	*Sepedophilus testaceus*	Septes	mold		0	0	0	0	0	1	0	0	0	0	0	0
Staphylinidae	*Tachinus rufipes*	Tacruf			0	0	0	0	0	1	0	1	0	0	0	0
Staphylinidae	*Tachyporus nitidulus*	Tacnit			0	0	0	0	0	0	1	0	0	0	0	0
Staphylinidae	*Tasgius ater*	Tasate			0	0	1	0	0	0	0	0	0	1	0	0
Staphylinidae	*Thamiaraea cinnamomea*	Thacin	sap	3	0	1	1	1	0	0	0	1	0	1	0	0
Staphylinidae	*Veilleius dilatatus*	Veidil	nest	3	0	2	0	1	0	0	0	0	0	0	0	2
Staphylinidae	*Zyras haworthi*	Zyrhaw			0	0	0	0	0	1	0	0	0	0	0	0
Tenebrionidae	*Alphitobius diaperinus*	Alpdia			1	0	0	0	0	0	0	0	0	1	0	0
Tenebrionidae	*Corticeus unicolor*	Coruni	bark		0	1	0	0	0	0	0	0	0	0	0	0
Tenebrionidae	*Diaclina fagi*	Diafag			0	2	0	0	0	0	0	0	0	0	0	0
Tenebrionidae	*Diaperis boleti*	Diabol	fungi		0	0	0	0	0	0	0	0	1	0	0	0
Tenebrionidae	*Eledona agaricola*	Eleaga	fungi		0	0	0	0	0	0	0	0	1	0	0	0
Tenebrionidae	*Palorus ratzeburgi*	Palrat			0	1	0	0	0	0	0	0	0	0	0	0
Tenebrionidae	*Pentaphyllus testaceus*	Pentes	mold	3	0	1	0	0	0	0	0	0	0	0	0	0
Throscidae	*Trixagus dermestoides*	Trider			0	0	0	0	0	0	0	0	0	1	0	0
Trogidae	*Trox scaber*	Trosca			0	3	0	0	1	0	1	0	0	0	0	1