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ORIGINAL PAPER

Veteranised oak cavities attract saproxylic beetles within two years

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Abstract Veteran oaks are vitally important for saproxylic beetles due to the diversity of tree-related microhabitats they contain which have developed over centuries. Veteran oaks are however in decline across Europe. Veteranisation is a conservation tool that aims to create or speed up the formation of these rare microhabitats, potentially helping to mitigate losses, although empirical studies on the effectiveness of veteranisation are still very rare. We compared flight interception trapped beetle assemblages from 2-year old veteranised cavities in young oaks (2 methods: 'nestbox with topping' – NBT (n=28) and 'woodpecker hole' – WPH (n=26), with untreated control trees (n=29) across 14 sites in southern Sweden. In total, 13010 individuals representing 493 beetle species were identified, of which 315 were saproxylic. The trapped beetles were assigned into one of four guilds with respect to their ecological association with wood ('wood-living', 'partly wood-living', 'associated with wood living fungi' and 'other, non-saproxylic'). Both NBT and WPH supported significantly higher numbers of species and individuals than controls, particularly within the wood-living guild. Species such as *Cryptarcha undata*, *Haploglossa villosula*, and *Quedius mesomelinus* were abundant, reflecting an early-successional community. The presence of *Lymexylon navale* (NT) and *Carphacis striatus* (VU) indicates that the cavities provide ecologically relevant cues, even though reproduction could not yet be confirmed. No significant differences were detected between the two cavity types, suggesting that exposure of fresh wood and cavity creation alone are key drivers of early attraction. Our findings demonstrate that artificial cavities can rapidly increase habitat value for saproxylic beetles in young oaks, contributing to the restoration of oak sites.

Implications for insect conservation Artificially created cavities in young oaks can rapidly attract saproxylic beetles. Such interventions can help alleviate the current scarcity of natural tree hollows, thereby reducing future extinction risks for saproxylic beetles associated.

Keywords Veteranisation · Artificial tree microhabitats · Hollows · Biodiversity conservation · Oak restoration · Chainsaw carved cavities

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Introduction

Large old trees are in decline globally, yet they serve as 'keystone structures' for a vast range of species (Lindenmayer et al. 2012; Cálix et al. 2018; Cannon et al. 2022), particularly saproxylic beetles (Speight 1989; Parmain and Bouget 2017), due to their diversity of tree-related microhabitats - TreMs (Siitonen 2012) such as cracks, cavities, and exposed heartwood. Among deciduous trees in Sweden, oaks (*Quercus* spp.) host the highest number of associated species (Sundberg et al. 2019). However, the loss of old oaks is severe in Sweden, where at least 82% were lost between 1790 and 1820 (Eliasson and Nilsson 2002), and with continued losses thereafter due to felling and loss of oak dominated wood pastures (Cousins et al. 2015; Jacobsen et al. 2023). In addition, the lack of trees available to replace old trees as they die, with the resulting gap in suitable habitat (e.g. hollows) has been identified as a problem for saproxylic beetles across Europe (Pilskog et al. 2016; Cálix et al. 2018; Jacobsen et al. 2023; Ranius et al. 2024). Tree microhabitat diversity increases with age and size (Kraus et al. 2016; Kôrkjas et al. 2021), however not in a linear fashion since certain features, such as hollows in oaks, may take over 200 years or more to develop (Ranius et al. 2009a). Kôrkjas et al. (2021) also highlight the fact that it is not enough to just retain existing live trees rich in microhabitats and suggest that actively creating TreMs should be considered.

Veteranisation is a conservation management technique that aims to increase the number of TreMs in living young (60–120 years) trees using tools. The aim with this method is to create valuable habitats suitable for saproxylic species, such as cavities, dysfunctional sapwood, and exposed heartwood, earlier than they would occur normally in natural conditions (Read 2000; Pilskog et al. 2016; Hedin et al. 2018; Cizek et al. 2025). In addition to enhancing habitat diversity, veteranisation may help mitigate both the missing cohorts and the long-term effects of old tree loss on biodiversity (Bengtsson and Wheater 2021) and it has been undertaken in several countries across the world in recent decades, but more rarely focusing on invertebrates (Best et al. 2026).

Early efforts to create artificial tree cavities primarily aimed to benefit threatened birds (Carey and Sanderson 1981; Best et al. 2026). More recently, research on artificial tree cavities has expanded to include other vertebrates (e.g. Ruegger 2017; Griffiths et al. 2018; Griffiths et al. 2020; Bengtsson and Wheater 2021; Best et al. 2026), insects (e.g. Cavalli and Mason 2003; Hedin et al. 2018; van Steenis 2023; Cizek et al. 2025), and fungi (e.g. Menkis et al. 2022; Wainhouse and Boddy 2022; Pyne et al. 2023). Despite these recent studies, the field of veteranisation of trees for conservation purposes is still at its infancy, with major knowledge gaps remaining.

In 2011 and 2012, the authors established an international research trial to test veteranisation treatments on oak (*Quercus robur*) in 20 sites (16 in Sweden, 1 in Norway, and 3 in England) to evaluate the potential biodiversity benefits of veteranisation in young, live oaks (Bengtsson et al. 2012). Utilising this international research trial, in this study we compared flight interception trapped beetles (Coleoptera) attracted by the two artificially created hollows with beetles trapped from untreated control oaks (without any microhabitats) in the same sites. We conducted the study two years after the holes were made in 14 sites in the south of Sweden (Fig. 1). We hypothesised that the two types of artificial hollows would attract a higher proportion of saproxylic beetles compared to the fauna attracted to the control oak trees without veteranisation treatments.

Method

Veteranisation trial sites and treatments

Only oak trees lacking biologically important natural microhabitats and with a diameter at breast height of between 25 and 60 cm were selected in the original trial set up and before treatments. Stratified random sampling was used to decide which tree would have which treatment and which trees would be controls. The two types of cavities that were created at 4 m height, were a 'woodpecker hole' (WPH) and a 'nestbox with topping' (NBT) (see Fig. 2 and S2). The WPH was made by carving out an oval-shaped cavity with a chainsaw to a depth of 10 cm, with a width of 8 cm and height of 12 cm. The resulting cavity replicates the dimensions of a black woodpecker hole (Fig. 2b; and S2). For the NBT, using a chainsaw a rectangular cavity was cut out. The width of the cavity opening measured approximately one third of the stem diameter (typically c. 10 cm) and the length of the cavity was 50 cm (see Fig. 2c and S2). A vertical cut was made in the side of the tree, perpendicular to the front to allow removal of the resulting rectangular piece of wood. From the extracted piece of wood, still using a chainsaw, the heartwood and the upper 10–15 cm was cut off. The remaining piece of wood, with bark intact was then put back into its original position, secured with two nails, thereby creating a large cavity inside the tree, as well as an opening (See S2 for more details). As mentioned above, this treatment was combined with topping of the tree, whereby the upper third of the live crown was removed, to reduce the risk of the tree failing at the 'nestbox'. At the point of topping, the cut was made to look like a natural breakage (see Fig. 2d). There were 7 WPH, 7 NBT and 14 control

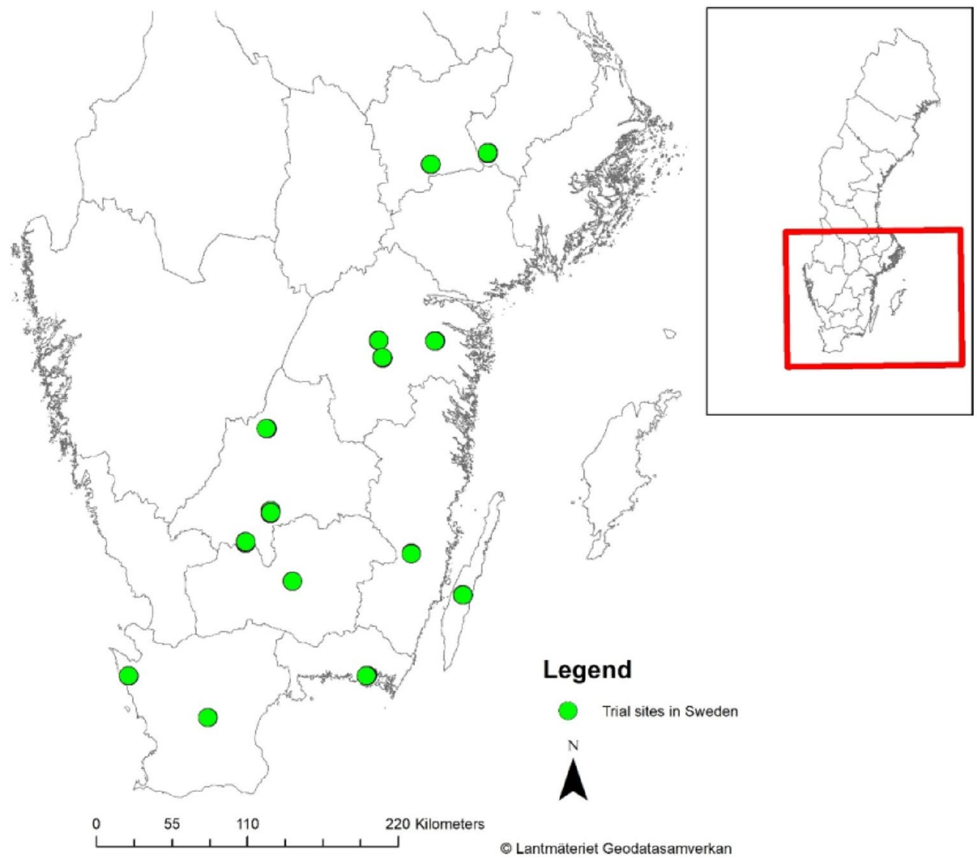

Fig. 1 Map showing the locations of the 14 sites included in this study. The distances are approximately 460 km from north (59.60, 17.02) to south (55.97, 13.63) and 260 km from east (56.69, 16.62) to west (56.12, 12.69)

Fig. 2 **a** control tree, **b** woodpecker hole, **c** nestbox, **d** topping made in combination with the nestbox and made to look like storm damage

(C) trees, 28 oaks in total at each site potentially available for monitoring. The cardinal orientation of the veteranisation treatments was not randomly selected, but was chosen by the arborists undertaking the work, ensuring that each cardinal point was represented at least once (N, S, E, W) if possible. However, the safety and logistics for the arborists were the primary drivers for the orientation of veteranisation treatments (i.e. where it was possible to climb and undertake the work safely). The original study was initiated in 2011 and 2012 and further details are available in Bengtsson et al. (2012).

In this study, we evaluated these two types of artificial chainsaw cavities WPH, NBT in comparison with untreated control trees (C) (Fig. 2), in 14 of the 20 sites (practical and resource limitations), 2 years after their creation.

Insect sampling

Two years after the treatments were created, in 2014, we randomly selected six trees at each of the 14 sites included in this study (Fig. 1; Table 1): two control trees (from 14), two WPH trees (from 7) and two NBT trees (from 7). A flight interception trap was put up (Fig. 3) on each tree, at a 90-degree angle to the treatments or in a random direction at 4 m above ground on the control trees, primarily driven by where it was safe to climb the tree and possible to attach it. Cardinal position did not therefore form a part of our study;

Table 1 The number of actual traps deployed per treatment and site

Site name	C	NBT	WPH	Comments
Bondberget	2	2	2	
Brunnstorp	2	1	2	1 NBT trap only included because Coleoptera samples were lost from the 1 trap
Ekenäs	2	2	1	1 WPH trap only, because 1 was storm damaged
Fulltofta	2	2	2	
Haga Ekbackar	2	2	2	Veteranisation done 2011
Harsbo Sverkersholm	2	2	2	
Hjälmshult	2	3	1	Extra trap on NBT instead of WPH, in error
Huseby	3	2	2	3 controls with traps (1 extra set up in error)
Strömsholm	2	2	2	
Tinnerö	2	2	2	Second period of sampling spoiled
Toftaholm	2	2	2	
Tromtö	2	2	2	Second period of sampling spoiled
Vanserum	2	2	2	
Västerby	2	2	2	
Total	29	28	26	83 traps

NBT nestbox and topping, *WPH* Woodpecker Hole, *C* Control, *RDB* Red DataBook

Fig. 3 A flight interception traps as used in this study showing how it was mounted adjacent to a chainsaw carved Woodpecker Hole (WPH), with a tray containing propylene glycol, water and washing up liquid. The colour is extra detergent (washing up liquid) used here to show the level of fluid in the trap

other factors influencing trap position are usually cited as being of more importance (van Achterberg et al. 2010). The flight interception trap was made from a pane (30 cm x 40 cm) of polycarbonate sheeting and a plastic tray (20 cm x 30 cm x 10 cm). The traps were attached to the tree using two small screws and an angle iron. The tray was attached to the polypropylene sheet using two long nails threaded through a pre-drilled hole. Due to storm damage and the resultant tree failure, our data is represented by 83 traps out of the 84 deployed (see Table 1). The trays were filled with 500 ml propylene glycol and 50 ml water, with a drop of detergent (washing-up liquid) to reduce surface tension. This ensured that the insects falling into the trap would be killed and conserved. The trays were emptied into jars using a funnel, filters and water to rinse them properly, ensuring all material captured was transferred to the jars, which were then filled with ethanol. Due to the long distances between sites, the traps were put up over a three-week period, with all traps installed by the 15 May. Each trap was emptied once between 2 June and 15 July. They were then emptied and taken down between the 15 August and 19 September. The jars were labelled with the tree number, treatment, trap type and date and sent to specialists for sorting and then identification of the Coleoptera fauna.

12,964 out of a total of 13,010 Coleoptera individuals collected from 83 traps were identified to species (46 remaining to genus) and entered into an Excel database. The species data were then uploaded to www.artportalen.se (project 'Ekveteraniseringsförsök', open access). Each Coleoptera species was allocated one of four broad ecological guilds based on current knowledge (e.g. Palm 1953; Speight 1989; Bouget et al. 2019) and the authors' experience: 'wood-living' (WL), 'partly wood-living' (PWL), 'associated with wood-living fungi' (WLF), and 'other, not saproxylic' (OTH) (see Table 8).

Statistical analyses

The site effect was modelled using a negative-binomial GLM with treatment, site and the interaction between treatment and site as fixed factors. The site effect was then tested with a type 2 chi-square test. Pairwise comparisons between sites were tested using Tukey tests. Following examination of the GLM, the number of species and the number of individuals were analysed with generalised linear mixed models (GLMM). The treatment was included as a fixed effect and the site, and treatment nested within site, were included as random effects. The response distribution was set to a negative-binomial and the estimated model was checked for under and overdispersion using the simulation approach from the DHARMa R package. Treatment effects were tested with a type 2 Wald chi-square test for overall differences and a Tukey test for pairwise comparisons between treatments. Models were estimated both for the full set of captured Coleoptera and for each of the four guilds. Statistical analysis used R version 4.5.3 (Reassured Reassurer) and Rstudio 2026.01.1+403. The packages tidyverse, lme4, car, DHARMa, emmeans and vegan were used.

Table 2 Overview of the numbers of taxa per site and Red Data Book (RDB) taxa according to the Red Data Book 2020, (Ljungberg et al. 2020), see also S3b for the results of analysis

Site	Total taxa per site	RDB total taxa per site
Strömsholm	99	10
Hjälmshult	100	3
Fulltofta	100	4
Brunnstorp	107	2
Västerby	108	4
Toftaholm	110	4
Haga Ekbackar	112	4
Huseby	113	4
Ekenäs	117	7
Tinnerö	117	7
Tromtö	120	14
Vanserum	121	7
Bondberget	121	4
Harsbo Sverkersholm	162	2

See Table 1 for numbers of traps per sites

Table 3 Overview of the total numbers of individuals per site and Red Data Book (RDB) individuals according to the Red Data Book 2020, (Ljungberg et al. 2020), see also S3c for the results of analysis

Site	Total individuals per site	RDB individuals per site
Tromtö	447	44
Fulltofta	606	33
Ekenäs	622	11
Hjälmshult	640	5
Strömsholm	711	45
Haga Ekbackar	755	6
Bondberget	849	11
Toftaholm	918	9
Vanserum	932	18
Brunnstorp	1010	7
Tinnerö	1071	38
Harsbo Sverkersholm	1466	2
Huseby	1486	9
Västerby	1497	18

See Table 1 for numbers of traps per sites

Results

In total, 13,010 individuals were identified (46 to genus only) representing 493 beetle species. The mean number of species per site was 114 (range 99–162, see also Table 2) and the mean number of individuals per site was 929 (range 447–1497, see also Table 3). The five most abundant species were *Atheta vaga* ($n=1586$, 13 sites, PWL), *Cryptarcha undata* ($n=832$, 14 sites, WL), *Quedius mesomelinus* ($n=735$, 13 sites, PWL), *Haploglossa villosula* ($n=622$, 13 sites, WL) and *Athous subfuscus* ($n=612$, 13 sites, OTH). Three species in addition to *C. undata* were recorded from all 14 sites: *Dalopius marginatus* ($n=277$, 14 sites, PWL),

Table 4 Tukey pairwise comparisons between treatments

Measure	Pairwise comparisons	z ratio	P value
Number of individuals	C/NBT	−2.775	0.0153
	C/WPH	−2.436	0.0394
	NBT/WPH	0.284	0.9565
Number of taxa	C/NBT	−3.215	0.0037
	C/WPH	−3.251	0.0033
	NBT/WPH	−0.093	0.9952

C control, *WPH* woodpecker hole, *NBT* nestbox and topping

Athous haemorrhoidalis ($n=225$, 14 sites, OTH) and *Dasytes plumbeus* ($n=67$, 14 sites, WL). For the full list of species, guild assignment and numbers see Annex 8 and Supplementary Information Table S1.

The GLM tests for Coleoptera individuals and taxa revealed significant differences between sites (individuals DF = 13, $P<0.0001$; taxa DF = 13, $P=0.0003$, Table S3a). The significant groupings of sites for both taxa and individuals are in Table S3b and S3c. There were also significant treatment effects (individuals DF = 2, $P=0.0001$; taxa DF = 2, $P<0.0001$, Table S3a). There were no significant interactions between site and treatment.

The GLMM Anovas show significant differences between treatments for both individual Coleoptera (chi-square = 9.279, DF = 2, $P=0.0097$) and taxa (chi-square = 13.928, DF = 2, $P=0.0009$). Pairwise comparisons indicate that both the NBT and the WPH treatments had significantly more individuals and taxa of Coleoptera than did the controls (Table 4). There were no significant differences between the two treatments.

Guilds

315 of the Coleoptera species identified were saproxylic (i.e. WL, PWL and WLF). The analysis of Coleoptera by guild identified significant effects for WL for both numbers of individuals (chi-square = 22.352, DF = 2, $P<0.0001$) and taxa (chi-square = 18.134, DF = 2, $P=0.0001$) and for PWL for numbers of individuals (chi-square = 11.346, DF = 2, $P=0.0034$), but not for number of taxa. For the other guilds (WLF and OTH) there were no significant differences between treatments either in terms of taxa or individuals (Table S3d). Pairwise comparisons (Table 5 and S3e) indicate that for WL there were significantly more individuals and taxa in the NBT and WPH than the C, although no significant differences between the two treatments were found. For the PWL guild there were significantly more individuals in both the NBT and WPH than the C, but not between the treatments.

For the saproxylic guilds (WL, WLF, PWL), the results showed that the NBT has 1.73 as many individuals as the control, and WPH 1.59 times as many individuals as the

Table 5 Tukey pairwise comparisons between treatments within guilds

Measure	Pairwise comparisons	z ratio	*P* value
Number of individuals for WL	C/NBT	−4.362	<0.0001
	C/WPH	−3.759	0.0005
	NBT/WPH	0.550	0.8463
Number of taxa for WL	C/NBT	−3.945	0.0002
	C/WPH	−3.486	0.0014
	NBT/WPH	0.421	0.9071
Number of individuals for PWL	C/NBT	−3.171	0.0043
	C/WPH	−2.561	0.0282
	NBT/WPH	0.551	0.8461

Significant results shown here, full results presented in S3e

C control, *WPH* woodpecker hole, *NBT* nestbox and topping, *WL* wood-living guild, *PWL* partly wood-living

control. When looking at a species level comparison between the treatments, we found that just under half (40.8%) of the species were found only in the WPH or NBT traps (bold in Table 6) and just over a quarter (26.4%) were saproxylic (italics in Table 6). Around 15% of the species were unique to each of the treatments and 33.5% were ubiquitous (found in both treatments and the controls – see Table 6 and Table S1).

47 species are listed on the Swedish Red Data Book (RDB) (Ljungberg et al. 2020) of which 45 are saproxylic (Table 7). The total number of individuals of RDB species collected was 256, mean number of RDB species per site was 5.4 (range 2–14) and mean number of RDB individuals per site was 18.3 (range 2–45) (Tables 2 and 3, Annex 9). 4 RDB species *Calambus bipustulatus* ($n=18$, 5 sites, WL), *Carphacis striatus* ($n=38$, 4 sites, WL), *Ischnomera cinerascens* ($n=15$, 7 sites, WL) and *Lymexylon navale* ($n=93$, 7 sites, WL) were found from 4 or more sites and in larger numbers. Almost all the remaining 43 RDB species were found from only one or two sites and with only one or two individuals (Annex 9).

Table 7 Number of taxa (total and RDB) as recorded by guild and their respective percentage

Guild allocated (*saproxylic)	Number of taxa	Percentage (%)	Red data book taxa (2020)
WL *	221	44.8	35
PWL *	32	6.5	2
WLF *	62	12.6	8
OTH	178	36.1	2
Total	493		47

OTH other, non-saproxylic, *PWL* partly wood-living, *WL* wood-living, *WLF* associated with wood-living fungi

Discussion

This study provides the first quantitative evidence that artificially created cavities in oaks can attract a diverse assemblage of saproxylic beetles shortly after treatment (2 years). Both veteranisation techniques tested (Fig. 2) supported significantly more wood-living individuals and species of Coleoptera than untreated control trees. Almost two thirds (63.9%) of all species recorded were saproxylic and of these 14% were RDB species.

Attraction of saproxylic beetles to newly created cavities

Although the trees in this study were much younger and without existing natural microhabitats prior to treatment (estimated mean age c. 80 yrs) the veteranisation treatments, based on the beetles caught, appear to mimic several microhabitats associated with naturally occurring hollows, including exposed heartwood and sapwood, accumulation of frass and organic material (Ranius et al. 2009b, 2024; Quinto et al. 2014). Many saproxylic beetles, particularly the early successional species are known to be attracted to volatile compounds released from fresh wounds or decaying sapwood (Dajoz 2000; Wainhouse and Boddy 2022). Attraction itself is ecologically meaningful, as it does indicate that the treatments produce cues strong enough to attract dispersing beetles within a short time (Siitonen and Ranius

Table 6 Percentages of species by guild and treatment

Treatment	OTH	PWL	WL	WLF	Total %
C	6.09	1.42	6.69	1.01	15.21
C+NBT	1.83	0.00	2.84	0.20	4.87
C+NBT+WPH	11.36	2.84	14.81	4.46	33.47
C+WPH	2.43	0.20	2.03	1.01	5.68
NBT	5.88	*0.81*	*5.48*	*1.83*	**14.00**
NBT+WPH	2.64	*0.61*	*6.29*	*1.42*	**10.95**
WPH	5.88	*0.61*	*6.69*	*2.64*	**15.82**
Total %	36.11	6.49	44.83	12.58	100.00

C control, *NBT* Nestbox and topping, *WPH* woodpecker hole, *OTH* other, non-saproxylic, *PWL* partly wood-living, *WL* wood-living, *WLF* associated with wood-living fungi) highlighting those that were specific to one treatment or ubiquitous

2015; Cizek et al. 2025). In addition, it cannot be excluded that some of our trapped species were already breeding in the dead wood substrate in and around the created cavities in line with similar investigations by Sverdrup-Thygeson and Birkemoe (2009) who showed that flight interception traps also reflect species colonising the substrate where the trap is attached.

Based on the high abundance of early-successional taxa such as *Cryptarcha undata* (larvae develop under bark in association with sap), *Quedius mesomelinus* (often associated with birds' nests in cavities) and *Haploglossa villosula* (Pilskog et al. 2016 found this abundantly in hollow-oak assemblages) supports our interpretation that the beetle assemblage reflects an early successional community (see S1) (Palm 1953; Speight 1989; Koch et al. 2012; SLU Artdatabanken 2025b).

Our data shows that for the WL guild there were significantly more individuals and taxa in the traps at the treatments, whereas there was no such difference for the WLF and OTH guilds, further supports the fact that the veteranised trees appear to specifically attract wood-living species. That there was no similar significant result for those species associated with fungi (WLF) is not surprising given that the decay processes were at only a very early stage (Menkis et al. 2022; Wainhouse and Boddy 2022). Menkis et al. (2022) showed that six years after the treatments were done, there were few heartwood decay fungal species found in the veteranised trees. A similar pattern for the OTH guild indicates that the treatments are not attracting species without a saproxylic ecology.

Differences between veteranisation treatments

Both the WPH and NBT treatments supported significantly higher beetle richness and abundance than untreated controls, yet no significant differences emerged between the two cavity types. However, the species comparison does suggest potential differences that could be further explored, given that around 15% of the species were in fact unique to each of the treatments. *Oxypoda brevicornis* and *Haploglossa marginalis* were both species only found in the NBT, and which are known to use cavities for hunting and have also been connected with the nests of tree ants and birds (Palm 1953; Pilskog et al. 2016; SLU Artdatabanken 2025e). The presence of these two species in the NBT treatment is possibly due to it being a much larger cavity. The NBT cavities more commonly contained both tree ants and bird nesting material which might also explain the occurrence of these species (Bengtsson and Wheater 2021). This is somewhat in line with Quinto et al. (2014) who found that natural hollow volume was the main determining factor for saproxylic guild richness and abundance, with large hollow volume being usually related to higher diversity. We also found that 26% of species only found in the treatments (WPH and NBT) and not in control trees, were saproxylic. Some of these are known deciduous dead wood specialists such as the two click beetles *Ampedus nigroflavus* and *Melasis buprestoides* (SLU Artdatabanken 2025d, 2025f).

Several other species, whilst having been recorded as ubiquitous, were much more abundant from the veteranised cavities. The RDB *Lymexylon navale* (NT) is a good example of this where only one individual was recorded from a C (3% traps), 65 from NBT (35% traps) and 27 from WPH (27% traps). We hypothesized that this species would be favoured by veteranisation because its larvae develop in hard exposed parts of standing or living large oaks, a substrate which in our study has been created in relatively large quantities in association with the NBT treatment (Palm 1953). This species can live in sun-exposed wood on living trees for decades and has been caught from 7 of the studied sites and in good numbers. Both *Cryptarcha undata* (28 C 41% traps, 363 NBT 75% traps, 441 WPH 65% traps) and *Haploglossa villosula* (80 C 59% traps, 398 NBT 68% traps, 144 WPH 73% traps) were more common in the veteranised cavity treatments compared to the controls (see S1). Another such example is the RDB *Carphacis striatus* (VU) where only one was recorded from a C (3% traps), 33 from NBT (18% traps) and 4 from WPH (12% traps). This is a species associated with large old broadleaved trees and lives in association with sap runs and fungi such as *Laetiporus sulphureus*. It is also interesting to note that two of the chafers *Protaetia marmorata* and *Cetonia aurata*, which were ubiquitous (see Table S1), had relatively similar numbers in each of the C, NBT and WPH. This is likely a reflection on the fact that they search for pollen during their imago stage and are thus relatively easily caught in flight interception traps. Both species are usually associated with later stages of decay in large hollow trees, so would not be expected in the artificial cavities after only two years.

The fact that no significant differences emerged between the two treatments at this stage may indicate that the availability of newly exposed wood and open cavities is more important than the exact geometry or volume of the cavity during early colonisation (Griffiths et al. 2020; Cizek et al. 2025). Nevertheless, some ecological differences between the treatments are plausible, not least due to the volume (Quinto et al. 2014) and the 'lid' left in place in the NBT treatment, which is a discrete piece of dead wood that in itself may attract species. In addition, the fact that the larger NBT may retain more moisture and collect more organic material such as birds' nests and tree ants' nests could also have an impact (Grüebler et al. 2013; Griffiths et al. 2020; Bengtsson and Wheater 2021). Such differences between treatments could, in the longer term contribute to heterogeneity in beetle assemblages, as different species respond to microclimatic variation and decay development (Jansson et al. 2009; Quinto et al. 2014; Wainhouse and Boddy 2022; Ranius et al. 2024). To verify if these artificial cavities are suitable for reproduction, future surveys employing emergence traps (Gouix and Brustel 2011) would be required.

Over time, these cavities are expected to decay due to fungal succession and colonisation, leading to the development of heartwood decay and internal detritus (Schwartze et al. 2000; Boddy 2021; Wainhouse and Boddy 2022; Marciulynas et al. 2023). Menkis et al. (2022) found that six years after veteranisation, oaks were dominated by endophytic rather than decay fungi, suggesting that it may require one or more decades for the veteranised cavities to develop decay suitable for later successional species (Ranius et al. 2009a, 2009b; Pyne et al. 2023). Further monitoring is therefore needed to determine whether differences in community composition will emerge as decay progresses.

The amount of overlap in terms of numbers of individuals and taxa between sites given their geographic spread, climate, topography, local landscapes, and logistical sampling issues was surprising. In addition the loss of samples such as at Tromtö, and uneven numbers of traps (due to storm damage), could also have contributed to differences between sites. However, although there were significant differences found, there was a large degree of overlap, and the site differences did not interact with the treatment. Landscape-level factors such as the density of existing hollow oaks, dispersal ability and the availability of decaying wood will likely influence colonisation dynamics (Ranius and Jansson 2000; Pilskog et al. 2016; Miklin et al. 2017; Wetherbee et al. 2020; Weatherbee et al. 2021) and would be an interesting focus for future study.

Conservation and management implications

The demonstrated attraction of saproxylic beetles to artificial cavities underscores the potential of veteranisation as a practical tool for biodiversity management. In landscapes where old oaks are scarce and the connectivity and quantity of hollow tree habitats has declined, such interventions can help 'bridge the gap' between existing veteran trees and younger generations (Bengtsson and Wheater 2021). The technique presented here therefore complements other restoration measures aimed at increasing the availability of tree-related microhabitats (TreMs) (Spînu et al. 2022; Cizek et al. 2025). Given the great diversity of naturally occurring TreMs in old trees our methods will likely emulate only a few (Bütler et al. 2020). Thus, it is also important to use several different methods when creating artificial microhabitats and over time to ensure a wide variety of tree microhabitats in different successional stages (Stokland et al. 2012; Quinto et al. 2014; Platek et al. 2019; Großmann et al. 2020). Many studies highlight the fact that to support a range of species, particularly rarer ones, a large population of hollow trees is necessary (Ranius 2007; Larsson and Svensson 2011; Lindenmayer and Laurance 2016). Importantly, veteranisation should never be applied to veteran trees or those that already have natural microhabitats or decay, as this could damage existing features (Read 2000; Lonsdale 2013; Wainhouse and Boddy 2022).

Future research

Future monitoring of these same trees in our study will provide valuable insight into the changes in beetle communities over time and may shed light on more specific questions such as if or when obligate old-oak cavity specialists establish and if they reproduce, as the artificial cavities age and decay develops. Future comparative studies repeating the use of flight interception traps and emergence traps could help clarify the link between attraction and reproduction. It would also be interesting to study if trees with artificial cavities can develop decay at higher rates if they have also been inoculated with fungi (Wainhouse and Boddy 2022). It would also be interesting to know at what age the artificial cavities host similar species richness and diversity to natural cavities.

Conclusions

Our results demonstrate that artificially created cavities in young oaks rapidly attracted diverse assemblages of saproxylic beetles, including species of conservation concern. The lack of interaction between site and treatment implies that these methods could be widely applicable. Such interventions can thus help alleviate the current scarcity of natural tree hollows, thereby reducing future extinction risks for saproxylic species associated with natural tree hollows. Future monitoring will clarify the long-term effectiveness of artificial hollows and veteranisation as a restoration tool to mitigate the loss of ancient oaks.

Annex

See Tables 8, 9 and 10.

Table 8 Full species list with the guild assigned in this study

Coleoptera species	Guild assigned
Acanthocinus aedilis	Wood-living
Acrotrichis sp.	Wood-living
Adalia decempunctata	Other
Agabus congener	Other
Agathidium laevigatum	Associated with wood-living fungi
Agathidium rotundatum	Associated with wood-living fungi
Agrilus angustulus	Wood-living
Agrilus laticornis	Wood-living
Agrilus sulcicollis	Wood-living
Agrypnus murinus	Other
Aleochara curtula	Other
Aleochara lanuginosa	Other
Aleochara moerens	Partly wood-living
Alosterna tabacicolor	Wood-living
Amara aenea	Other
Amara familiaris	Other
Ampedus balteatus	Wood-living
Ampedus cardinalis	Wood-living
Ampedus cinnabarinus	Wood-living
Ampedus nigrinus	Wood-living
Ampedus nigroflavus	Wood-living
Ampedus pomorum	Wood-living
Ampedus rufipennis	Wood-living
Ampedus sanguinolentus	Wood-living
Anaglyptus mysticus	Wood-living
Anaspis flava	Wood-living
Anaspis frontalis	wood-living
Anaspis marginicollis	Wood-living
Anaspis rufilabris	Wood-living
Anaspis sp.	Wood-living
Anaspis thoracica	Wood-living
Anchomenus dorsalis	Other
Anisandrus dispar	Wood-living
Anisotoma axillaris	Associated with wood-living fungi
Anobium punctatum	Wood-living
Anomognathus cuspidatus	Wood-living
Anostirus castaneus	Wood-living
Anotylus rugosus	Other
Anthonomus phyllocola	Other
Anthrenus museorum	Partly wood-living
Anthribus nebulosus	Wood-living
Aphidecta obliterata	Other
Aphthona euphorbiae	Other
Aplocnemus nigricornis	Partly wood-living
Archarius pyrrhoceras	Other
Archarius salicivorus	Other
Atheta crassicornis	Partly wood-living
Atheta fungi	Partly wood-living
Atheta graminicola	Other
Atheta nidicola	Partly wood-living
Atheta sp.	Other
Atheta vaga	Partly wood-living
Athous haemorrhoidalis	Other
Athous subfuscus	Other
Athous vittatus	Other
Atomaria diluta	Associated with wood-living fungi
Atomaria hislopi	Partly wood-living
Atomaria morio	Partly wood-living
Atomaria nigripennis	Partly wood-living
Atomaria pusilla	Associated with wood-living fungi
Atomaria rubella	Partly wood-living
Atomaria sp.	Other
Atomaria turgida	Associated with wood-living fungi
Atomaria wollastoni	Partly wood-living
Attagenus pellio	Partly wood-living
Aulonothroscus brevicollis	Other
Bembidion obtusum	Other
Betulapion simile	Other
Bibloplectus spinosus	Partly wood-living
Bibloporus bicolor	Wood-living
Bibloporus minutus	Wood-living
Bisnius subuliformis	Wood-living
Bitoma crenata	Associated with wood-living fungi
Bolitophagus reticulatus	Associated with wood-living fungi
Bryaxis bulbifer	Partly wood-living
Byrrhus pilula	Other
Byturus tomentosus	Other
Cacotemnus rufipes	Wood-living
Calambus bipustulatus	Wood-living
Calathus rotundicollis	Other
Calosoma inquisitor	Other
Calvia quatuordecimguttata	Other
Cantharis figurata	Other
Cantharis fusca	Other
Cantharis nigra	Other
Cantharis nigricans	Other
Cantharis obscura	Other
Cantharis pellucida	Other
Cantharis quadripunctata	Other
Cantharis rufa	Other
Cantharis rustica	Other
Carabus hortensis	Other
Carcinops pumilio	Partly wood-living
Carpelimus elongatulus	Other
Carphacis striatus	Wood-living
Carpophilus marginellus	Partly wood-living
Cartodere nodifer	Wood-living
Cerylon ferrugineum	Wood-living
Cerylon histeroides	Wood-living
Cetonia aurata	Partly wood-living
Ceutorhynchus obstrictus	Other
Ceutorhynchus pallidactylus	Other
Ceutorhynchus typhae	Other
Chaetocnema picipes	Other
Chilocorus bipustulatus	Other
Chilocorus renipustulatus	Other
Cimberis attelaboides	Other
Cis comptus	Associated with wood-living fungi
Cis dentatus	Associated with wood-living fungi

Table 8 (continued)

Coleoptera species	Guild assigned
Cis fagi	Associated with wood-living fungi
Cis sp.	Associated with wood-living fungi
Cis submicans	Associated with wood-living fungi
Coeliodes rana	Other
Coeliodes transversealbofasciatus	Other
Coeliodinus rubicundus	Other
Conopalpus testaceus	Wood-living
Contacyphon coarctatus	Other
Contacyphon ochraceus	Other
Contacyphon padi	Other
Contacyphon variabilis	Other
Corticaria sp.	Other
Corticarina minuta	Associated with wood-living fungi
Corticarina similata	Associated with wood-living fungi
Corticeus linearis	Wood-living
Cortinicara gibbosa	Associated with wood-living fungi
Crepidodera aurata	Other
Cryptarcha strigata	Wood-living
Cryptarcha undata	Wood-living
Cryptocephalus labiatus	Other
Cryptocephalus querceti	Other
Cryptocephalus sexpunctatus	Other
Cryptolestes ferrugineus	Wood-living
Cryptophagus sp.	Other
Cryptophagus badius	Associated with wood-living fungi
Cryptophagus confusus	Associated with wood-living fungi
Cryptophagus dentatus	Associated with wood-living fungi
Cryptophagus denticulatus	Associated with wood-living fungi
Cryptophagus distinguendus	Associated with wood-living fungi
Cryptophagus fuscicornis	Associated with wood-living fungi
Cryptophagus labilis	Associated with wood-living fungi
Cryptophagus micaceus	Associated with wood-living fungi
Cryptophagus reflexus	Associated with wood-living fungi
Cryptophagus scanicus	Associated with wood-living fungi
Crypturgus subcribrosus	Wood-living
Ctenicera pectinicornis	Other
Ctesias serra	Wood-living
Curculio nucum	Other
Curculio venosus	Other
Curculio villosus	Other
Cychramus luteus	Associated with wood-living fungi
Cypha apicalis	Associated with wood-living fungi
Dacne bipustulata	Associated with wood-living fungi
Dalopius marginatus	Partly wood-living
Dasytes aeratus	Wood-living
Dasytes caeruleus	Wood-living
Dasytes niger	Wood-living
Dasytes plumbeus	Wood-living
Dendrophilus punctatus	Wood-living
Dendroxena quadrimaculata	Other
Denticollis linearis	Wood-living
Dermestes lardarius	Other
Dermestes murinus	Other
Diaperis boleti	Associated with wood-living fungi
Diplocoelus fagi	Associated with wood-living fungi
Dircaea australis	Wood-living
Dorcatoma chrysomelina	Associated with wood-living fungi
Dorcatoma dresdensis	Associated with wood-living fungi
Dorcatoma flavicornis	Associated with wood-living fungi
Dorcatoma robusta	Associated with wood-living fungi
Dromius agilis	Other
Dromius fenestratus	Other
Dromius quadrimaculatus	Other
Dropephylla gracilicornis	Wood-living
Dropephylla ioptera	Wood-living
Dryocoetes alni	Wood-living
Dryocoetes villosus	Wood-living
Elateroides dermestoides	Associated with wood-living fungi
Enicmus fungicola	Associated with wood-living fungi
Enicmus rugosus	Associated with wood-living fungi
Enicmus testaceus	Associated with wood-living fungi
Ennearthron cornutum	Associated with wood-living fungi
Epuraea aestiva	Wood-living
Epuraea biguttata	Wood-living
Epuraea boreella	Wood-living
Epuraea guttata	Wood-living
Epuraea melina	Wood-living
Epuraea muehli	Wood-living
Epuraea neglecta	Wood-living
Epuraea pallescens	Wood-living
Epuraea sp.	Other
Epuraea unicolor	Wood-living
Epuraea variegata	Wood-living
Ernobius nigrinus	Wood-living
Ernoporus tiliae	Wood-living
Eucnemis capucina	Wood-living
Euglenes oculatus	Wood-living
Euplectus karstenii	Wood-living
Euplectus piceus	Wood-living
Euplectus punctatus	Wood-living
Exochomus quadripustulatus	Other
Gabrius splendidulus	Wood-living
Gastrophysa polygoni	Other
Gaurotes virginea	Other
Geodromicus plagiatus	Other
Glaphyra umbellatarum	Wood-living
Glischrochilus hortensis	Wood-living
Glischrochilus quadriguttatus	Wood-living
Glischrochilus quadripunctatus	Wood-living
Gnathoncus buyssoni	Wood-living
Gnathoncus rotundatus	Wood-living
Gnorimus nobilis	Wood-living
Grammoptera ustulata	Wood-living
Grynocharis oblonga	Wood-living
Gymnetron veronicae	Other
Hapalaraea pygmaea	Wood-living
Haploglossa gentilis	Wood-living
Haploglossa marginalis	Wood-living

Table 8 (continued)

Coleoptera species	Guild assigned
Haploglossa picipennis	Wood-living
Haploglossa villosula	Wood-living
Harpalus latus	Other
Hemicoelus canaliculatus	Wood-living
Hemicoelus fulvicornis	Wood-living
Hemicrepidius hirtus	Wood-living
Hemicrepidius niger	Wood-living
Homalota plana	Wood-living
Hydraena britteni	Other
Hylastes brunneus	Wood-living
Hylesinus crenatus	Wood-living
Hylesinus wachtli	Wood-living
Hylis cariniceps	Wood-living
Hylis olexai	Wood-living
Hylis procerulus	Wood-living
Hylobius abietis	Wood-living
Hylobius excavatus	Wood-living
Hylurgops palliatus	Wood-living
Hypera meles	Other
Hypera nigrirostris	Other
Hypoganus inunctus	Wood-living
Ipidia binotata	Wood-living
Ips typographus	Wood-living
Ischnomera cinerascens	Wood-living
Korynetes caeruleus	Wood-living
Lagria hirta	Other
Latridius brevicollis	Associated with wood-living fungi
Latridius gemellatus	Associated with wood-living fungi
Latridius hirtus	Associated with wood-living fungi
Latridius minutus	Associated with wood-living fungi
Leiopus linnei	Wood-living
Leiopus nebulosus	Wood-living
Leptura quadrifasciata	Wood-living
Leptusa fumida	Wood-living
Leptusa ruficollis	Wood-living
Limnebius truncatellus	Other
Limonius poneli	Other
Litargus connexus	Associated with wood-living fungi
Lochmaea caprea	Other
Lordithon lunulatus	Associated with wood-living fungi
Lucanus cervus	Wood-living
Lyctus linearis	Wood-living
Lymexylon navale	Wood-living
Magdalis duplicata	Wood-living
Magdalis flavicornis	Wood-living
Malachius bipustulatus	Other
Malthinus facialis	Wood-living
Malthinus flaveolus	Wood-living
Malthinus frontalis	Wood-living
Malthodes brevicollis	Wood-living
Malthodes fibulatus	Wood-living
Malthodes guttifer	Wood-living
Malthodes marginatus	Wood-living
Malthodes minimus	Wood-living

Table 8 (continued)

Coleoptera species	Guild assigned
Malthodes sp.	Wood-living
Margarinotus merdarius	Partly wood-living
Mecinus pascuorum	Other
Megatoma undata	Wood-living
Melanotus castanipes	Wood-living
Melanotus villosus	Wood-living
Melasis buprestoides	Wood-living
Meligethes aeneus	Other
Meligethes pedicularius	Other
Meligethes viridescens	Other
Melinopterus prodromus	Other
Mesosa nebulosa	Wood-living
Metoecus paradoxus	Other
Micrambe abietis	Associated with wood-living fungi
Micrambe woodroffei	Other
Microcara testacea	Other
Microrhagus lepidus	Wood-living
Microrhagus pygmaeus	Wood-living
Molorchus minor	Wood-living
Monotoma longicollis	Partly wood-living
Mordella aculeata	Wood-living
Mordellistena neuwaldeggiana	Wood-living
Mordellochroa abdominalis	Wood-living
Mycetochara axillaris	Wood-living
Mycetochara flavipes	Wood-living
Mycetochara maura	Wood-living
Mycetophagus fulvicollis	Wood-living
Mycetophagus multipunctatus	Wood-living
Mycetophagus piceus	Wood-living
Mycetophagus quadriguttatus	Wood-living
Mycetophagus quadripustulatus	Wood-living
Mycetoporus lepidus	Other
Myzia oblongoguttata	Other
Nargus anisotomoides	Other
Nebria brevicollis	Other
Necrodes littoralis	Other
Necydalis major	Wood-living
Nemadus colonoides	Wood-living
Nemozoma elongatum	Wood-living
Neocoenorrhinus germanicus	Other
Neocoenorrhinus minutus	Other
Nephus redtenbacheri	Other
Nicrophorus humator	Other
Nicrophorus investigator	Other
Nicrophorus vespillo	Other
Nicrophorus vespilloides	Other
Notoxus monoceros	Other
Oenopia conglobata	Other
Oiceoptoma thoracicum	Other
Omalium caesum	Other
Omalium rivulare	Other
Orchesia fasciata	Associated with wood-living fungi
Orchesia micans	Associated with wood-living fungi
Orchesia minor	Associated with wood-living fungi

Table 8 (continued)

Coleoptera species	Guild assigned
Orchesia undulata	Associated with wood-living fungi
Orchestes fagi	Other
Orchestes hortorum	Other
Orchestes pilosus	Other
Orchestes quercus	Other
Orchestes rusci	Other
Orsodacne cerasi	Other
Orthocis alni	Associated with wood-living fungi
Orthoperus atomus	Partly wood-living
Orthoperus sp.	Partly wood-living
Osmoderma eremita	Wood-living
Otiorhynchus carinatopunctatus	Other
Otiorhynchus singularis	Other
Oxypoda brevicornis	Partly wood-living
Oxypoda exoleta	Partly wood-living
Oxypoda procerula	Other
Oxypoda sp.	Other
Oxypoda spectabilis	Other
Oxytelus laqueatus	Other
Paraphotistus impressus	Other
Paromalus flavicornis	Wood-living
Pediacus depressus	Wood-living
Pedostrangalia revestita	Wood-living
Pelenomus commari	Other
Pella cognata	Other
Pella funesta	Other
Pella laticollis	Other
Pella lugens	Other
Phalacrus corruscus	Other
Philonthus carbonarius	Other
Philonthus cognatus	Other
Philonthus tenuicornis	Other
Phloeonomus punctipennis	Wood-living
Phloeonomus pusillus	Wood-living
Phloeotribus spinulosus	Wood-living
Phloiotrya rufipes	Wood-living
Phyllobius argentatus	Other
Phyllobius glaucus	Other
Phyllobius pyri	Other
Phyllobius virideaeris	Other
Phyllodrepa floralis	Wood-living
Phyllodrepa melanocephala	Wood-living
Phyllodrepa nigra	Wood-living
Phyllodrepa salicis	Wood-living
Phyllopertha horticola	Other
Phyllotreta undulata	Other
Phyllotreta vittula	Other
Phymatodes testaceus	Wood-living
Pityogenes chalcographus	Wood-living
Pityogenes quadridens	wood-living
Pityophagus ferrugineus	Wood-living
Placusa depressa	Wood-living
Placusa sp.	Wood-living
Placusa tachyporoides	Wood-living

Table 8 (continued)

Coleoptera species	Guild assigned
Platycerus caraboides	Wood-living
Platydema violaceum	Wood-living
Platynus assimilis	Other
Platynus krynickii	Other
Platystomos albinus	Associated with wood-living fungi
Plegaderus caesus	Wood-living
Podabrus alpinus	Other
Podistra rufotestacea	Other
Polydrusus mollis	Other
Polydrusus tereticollis	Other
Prionocyphon serricornis	Wood-living
Prionychus ater	Wood-living
Propylea quatuordecimpunctata	Other
Prosternon tessellatum	Other
Protaetia marmorata	Wood-living
Protaetia metallica	Wood-living
Protapion apricans	Other
Protapion fulvipes	Other
Pseudocistela ceramboides	Wood-living
Psylliodes affinis	Other
Ptenidium pusillum	Wood-living
Pterostichus diligens	Other
Pterostichus niger	Other
Ptilinus pectinicornis	Wood-living
Ptinomorphus imperialis	Wood-living
Ptinus fur	Partly wood-living
Ptinus rufipes	Partly wood-living
Ptinus subpillosus	Wood-living
Ptomaphagus varicornis	Other
Pyrochroa coccinea	Wood-living
Quedius brevicornis	Wood-living
Quedius cruentus	Wood-living
Quedius dilatatus	Wood-living
Quedius fuliginosus	Partly wood-living
Quedius maurus	Partly wood-living
Quedius mesomelinus	Partly wood-living
Quedius truncicola	Wood-living
Quedius xanthopus	Partly wood-living
Rhagium inquisitor	Wood-living
Rhagium mordax	Wood-living
Rhagonycha lignosa	Other
Rhagonycha lutea	Other
Rhagonycha nigriventris	Other
Rhagonycha testacea	Other
Rhamphus pulicarius	Other
Rhizophagus bipustulatus	Wood-living
Rhizophagus depressus	Wood-living
Rhizophagus dispar	Wood-living
Rhizophagus fenestralis	Wood-living
Rhyncolus ater	Wood-living
Rhyncolus sculpturatus	Wood-living
Salpingus planirostris	Wood-living
Salpingus ruficollis	Wood-living
Saperda scalaris	Wood-living

Table 8 (continued)

Coleoptera species	Guild assigned
Saprinus semistriatus	Wood-living
Scaphisoma agaricinum	Associated with wood-living fungi
Schizotus pectinicornis	Wood-living
Sciaphilus asperatus	Other
Scolytus intricatus	Wood-living
Scraptia fuscula	Wood-living
Scraptia testacea	wood-living
Scydmoraphes helvolus	Wood-living
Scymnus silesiacus	Other
Selatosomus aeneus	Other
Selatosomus cruciatus	Other
Sepedophilus testaceus	Other
Serica brunnea	Other
Silvanoprus fagi	Wood-living
Sinodendron cylindricum	Wood-living
Sitona obsoletus	Other
Soronia grisea	Other
Soronia punctatissima	Wood-living
Stagetus borealis	Wood-living
Stenagostus rhombeus	Wood-living
Stenocorus meridianus	Wood-living
Stenostola dubia	Wood-living
Stephostethus lardarius	Associated with wood-living fungi
Stephostethus pandellei	Associated with wood-living fungi
Stictoleptura maculicornis	Associated with wood-living Fungi
Stictoleptura scutellata	Wood-living
Strangalia attenuata	Wood-living
Strophosoma capitatum	Other
Synchita humeralis	Wood-living
Synchita variegata	Wood-living
Tachinus laticollis	Other
Tachyporus chrysomelinus	Other
Tachyporus solutus	Other
Tetrops praeustus	Wood-living
Thamiaraea cinnamomea	Partly wood-living
Thamiaraea hospita	Partly wood-living
Thanasimus femoralis	Wood-living
Thanasimus formicarius	Wood-living
Tillus elongatus	Wood-living
Trechus quadristriatus	Other
Trichius fasciatus	Other
Trichoceble floralis	Wood-living
Trichoceble memnonia	Other
Triphyllus bicolor	Associated with wood-living fungi
Triplax aenea	Associated with wood-living fungi
Triplax rufipes	Associated with wood-living fungi
Triplax russica	Associated with wood-living fungi
Tritoma bipustulata	associated with wood-living fungi
Trixagus carinifrons	Other
Trixagus dermestoides	Other
Trypodendron domesticum	Wood-living
Tychius stephensi	Other
Tytthaspis sedecimpunctata	Other
Xantholinus linearis	Other
Xestobium rufovillosum	Wood-living
Xyleborinus attenuatus	Wood-living
Xyleborinus saxesenii	Wood-living
Xyleborus monographus	Wood-living
Xyletinus longitarsis	wood-living
Xylotrechus antilope	Wood-living

Table 9 Red data book species listed with the guild, red data book category, numbers of individuals in each trap and total number of sites from which the species was recorded (Ljungberg et al. 2020)

Red-listed species	Guild	RDB	C	NBT	WPH	Total	No of sites
Agrilus laticornis	WL	NT		1		1	1
Ampedus cardinalis	WL	NT	2			2	1
Ampedus rufipennis	WL	VU		4		4	1
Ampedus sanguinolentus	WL	NT	1			1	1
Anaglyptus mysticus	WL	NT	4	3	4	11	3
Atomaria diluta	WLF	NT		1	1	2	1
Atomaria nigripennis	PWL	VU			2	2	1
Calambus bipustulatus	WL	NT	7	4	7	18	5
Carphacis striatus	WL	VU	1	33	4	38	4
Cis submicans	WLF	NT		1		1	1
Cryptophagus fuscicornis	WLF	NT		1		1	1
Cypha apicalis	WLF	NT	1			1	1
Diplocoelus fagi	WLF	NT			1	1	1
Dircaea australis	WL	VU	1	1		2	1
Eucnemis capucina	WL	NT			1	1	1
Gnorimus nobilis	WL	NT		1		1	1
Hemicoelus fulvicornis	WL	NT		1	1	2	1
Hylesinus crenatus	WL	NT			1	1	1
Hylesinus wachtli	WL	NT			1	1	1
Ischnomera cinerascens	WL	NT	2	9	4	15	7
Lyctus linearis	WL	VU		2		2	1
Lymexylon navale	WL	NT	1	65	27	93	7
Malthinus facialis	WL	NT		1	1	2	1
Mesosa nebulosa	WL	NT		1		1	1
Mordellistena neuwaldeggiana	WL	NT	3			3	1
Mycetophagus fulvicollis	WL	NT	1			1	1
Mycetophagus quadriguttatus	WL	NT			1	1	1
Orchesia fasciata	WLF	NT	1		1	2	2
Orchesia minor	WLF	NT			1	1	1
Osmoderma eremita	WL	NT		1		1	1
Pediacus depressus	WL	NT		3		3	1
Pedostrangalia revestita	WL	EN			1	1	1
Phyllodrepa salicis	WL	VU			1	1	1
Platydema violaceum	WL	NT			1	1	1
Platynus krynickii	Oth	NT			1	1	1
Quedius truncicola	WL	VU	3			3	1
Scymnus silesiacus	Oth	NT		2		2	1
Stagetus borealis	WL	NT		1		1	1
Stenagostus rhombeus	WL	VU	2			2	1
Stictoleptura scutellata	WL	VU	1			1	1
Strangalia attenuata	WL	NT	1	1		2	1
Synchita variegata	WL	NT	1			1	1
Thamiaraea hospita	PWL	NT	1	1	4	6	4
Triplax rufipes	WLF	NT	2	3	1	6	4
Xyleborus monographus	WL	NT	2	4	3	9	2
Xyletinus longitarsis	WL	NT	1			1	1
Xylotrechus antilope	WL	NT	1		1	2	1
Total			40	145	71		

OTH other, non-saproxylic, *PWL* partly wood-living, *WL* wood-living, *WLF* associated with woodlivingfungi, *NBT* nestbox and topping, *WPH* Woodpecker Hole, *C* Control, *RDB* Red Data Book

Table 10 Numbers of individuals of species per guild, treatment and number of sites, in alphabetical order

Species wood-living	Guild	RDB	C	NBT	WPH	Total	No of sites
Acanthocinus aedilis	WL				1	1	1
Acrotrichis sp.	WL		2			2	1
Agrilus angustulus	WL			1	1	2	2
Agrilus laticornis	WL	NT		1		1	1
Agrilus sulcicollis	WL		1	1		2	2
Alosterna tabacicolor	WL		2	1	2	5	3
Ampedus balteatus	WL		6	5	4	15	5
Ampedus cardinalis	WL	NT	2			2	1
Ampedus cinnabarinus	WL				3	3	1
Ampedus nigrinus	WL		5	5	3	13	4
Ampedus nigroflavus	WL			5	4	9	6
Ampedus pomorum	WL		4	3	1	8	5
Ampedus rufipennis	WL	VU		4		4	1
Ampedus sanguinolentus	WL	NT	1			1	1
Anaglyptus mysticus	WL	NT	4	3	4	11	3
Anaspis flava	WL		1			1	1
Anaspis frontalis	WL		12	20	10	42	11
Anaspis marginicollis	WL			1		1	1
Anaspis rufilabris	WL		14	10	16	40	11
Anaspis sp.	WL		2	1	2	5	2
Anaspis thoracica	WL		28	35	46	109	12
Anisandrus dispar	WL				3	3	1
Anobium punctatum	WL				3	3	1
Anomognathus cuspidatus	WL		1		4	5	4
Anostirus castaneus	WL				1	1	1
Anthribus nebulosus	WL		9	4	6	19	8
Bibloporus bicolor	WL				2	2	1
Bibloporus minutus	WL			1	2	3	2
Bisnius subuliformis	WL		16	59	27	102	13
Cacotemnus rufipes	WL			9	1	10	2
Calambus bipustulatus	WL	NT	7	4	7	18	5
Carphacis striatus	WL	VU	1	33	4	38	4
Cartodere nodifer	WL		1			1	1
Cerylon ferrugineum	WL		2	14	28	44	10
Cerylon histeroides	WL			2	2	4	4
Conopalpus testaceus	WL		1	2	2	5	4
Corticeus linearis	WL		1			1	1
Cryptarcha strigata	WL		57	194	187	438	13
Cryptarcha undata	WL		28	363	441	832	14
Cryptolestes ferrugineus	WL			1		1	1
Crypturgus subcribrosus	WL		1			1	1
Ctesias serra	WL		45	47	35	127	10
Dasytes aeratus	WL			3		3	2
Dasytes caeruleus	WL		9	9	15	33	9
Dasytes niger	WL			2	2	4	4
Dasytes plumbeus	WL		24	19	24	67	14
Dendrophilus punctatus	WL		2	1	1	4	1
Denticollis linearis	WL			1	1	2	2
Dircaea australis	WL	VU	1	1		2	1
Dropephylla gracilicornis	WL				4	4	3
Dropephylla ioptera	WL		1		2	3	3
Dryocoetes alni	WL		3			3	3
Dryocoetes villosus	WL		1	8	10	19	8
Epuraea aestiva	WL		1			1	1
Epuraea biguttata	WL			1		1	1

Table 10 (continued)

Species wood-living	Guild	RDB	C	NBT	WPH	Total	No of sites
Epuraea boreella	WL				2	2	1
Epuraea guttata	WL		2	20	15	37	6
Epuraea melina	WL			1		1	1
Epuraea muehli	WL		2		2	4	3
Epuraea neglecta	WL			3	1	4	1
Epuraea pallescens	WL				24	24	1
Epuraea unicolor	WL			14	1	15	3
Epuraea variegata	WL			3	134	137	5
Ernobius nigrinus	WL		1			1	1
Ernoporus tiliae	WL				1	1	1
Eucnemis capucina	WL	NT			1	1	1
Euglenes oculatus	WL			1		1	1
Euplectus karstenii	WL			1		1	1
Euplectus piceus	WL		1			1	1
Euplectus punctatus	WL				1	1	1
Gabrius splendidulus	WL		2	5		7	4
Glaphyra umbellatarum	WL		1			1	1
Glischrochilus hortensis	WL		41	91	65	197	12
Glischrochilus quadriguttatus	WL			1	4	5	2
Glischrochilus quadripunctatus	WL		2	6	5	13	5
Gnathoncus buyssoni	WL		7	75	33	115	12
Gnathoncus rotundatus	WL				1	1	1
Gnorimus nobilis	WL	NT		1		1	1
Grammoptera ustulata	WL		4	3	1	8	5
Grynocharis oblonga	WL			2	4	6	4
Hapalaraea pygmaea	WL		1	12	2	15	3
Haploglossa gentilis	WL			16	17	33	6
Haploglossa marginalis	WL			13		13	1
Haploglossa picipennis	WL		6	37		43	6
Haploglossa villosula	WL		80	398	144	622	13
Hemicoelus canaliculatus	WL		1	8	1	10	4
Hemicoelus fulvicornis	WL	NT		1	1	2	1
Hemicrepidius hirtus	WL		1			1	1
Hemicrepidius niger	WL		17	15	112	144	8
Homalota plana	WL		3	3	5	11	5
Hylastes brunneus	WL		63	2	1	66	2
Hylesinus crenatus	WL	NT			1	1	1
Hylesinus wachtli	WL	NT			1	1	1
Hylis cariniceps	WL			2	1	3	2
Hylis olexai	WL			1	1	2	2
Hylis procerulus	WL				3	3	1
Hylobius abietis	WL		2		1	3	1
Hylobius excavatus	WL				1	1	1
Hylurgops palliatus	WL		1			1	1
Hypoganus inunctus	WL		2			2	2
Ipidia binotata	WL				1	1	1
Ips typographus	WL		3			3	1
Ischnomera cinerascens	WL	NT	2	9	4	15	7
Korynetes caeruleus	WL			1		1	1
Leiopus linnei	WL		2	7	4	13	6
Leiopus nebulosus	WL				1	1	1
Leptura quadrifasciata	WL		2	1	3	6	3
Leptusa fumida	WL		5	8	1	14	3
Leptusa ruficollis	WL		5	9	6	20	6

Table 10 (continued)

Species wood-living	Guild	RDB	C	NBT	WPH	Total	No of sites
Lucanus cervus	WL				1	1	1
Lyctus linearis	WL	VU		2		2	1
Lymexylon navale	WL	NT	1	65	27	93	7
Magdalis duplicata	WL		4			4	1
Magdalis flavicornis	WL		1			1	1
Malthinus facialis	WL	NT		1	1	2	1
Malthinus flaveolus	WL		5	2	2	9	5
Malthinus frontalis	WL		5		2	7	3
Malthodes brevicollis	WL		1	1		2	2
Malthodes fibulatus	WL		1			1	1
Malthodes guttifer	WL		1		1	2	2
Malthodes marginatus	WL		19	12	8	39	6
Malthodes minimus	WL		11	14	15	40	7
Malthodes sp.	WL		7	4	5	16	8
Megatoma undata	WL		36	49	32	117	11
Melanotus castanipes	WL		18	13	13	44	12
Melanotus villosus	WL		10	9	4	23	5
Melasis buprestoides	WL			14	4	18	5
Mesosa nebulosa	WL	NT		1		1	1
Microrhagus lepidus	WL		1			1	1
Microrhagus pygmaeus	WL		1	1		2	2
Molorchus minor	WL			1		1	1
Mordella aculeata	WL				1	1	1
Mordellistena neuwaldeggiana	WL	NT	3			3	1
Mordellochroa abdominalis	WL		2			2	2
Mycetochara axillaris	WL			1	18	19	3
Mycetochara flavipes	WL		6	11	1	18	3
Mycetochara maura	WL		29	16	10	55	5
Mycetophagus fulvicollis	WL		1			1	1
Mycetophagus multipunctatus	WL	NT		1	2	3	2
Mycetophagus piceus	WL		1	1	2	4	3
Mycetophagus quadriguttatus	WL	NT			1	1	1
Mycetophagus quadripustulatus	WL				1	1	1
Necydalis major	WL			2	2	4	3
Nemadus colonoides	WL			1		1	1
Nemozoma elongatum	WL		3			3	1
Osmoderma eremita	WL	NT		1		1	1
Paromalus flavicornis	WL		1	1	1	3	2
Pediacus depressus	WL	NT		3		3	1
Pedostrangalia revestita	WL	EN			1	1	1
Phloeonomus punctipennis	WL		1			1	1
Phloeonomus pusillus	WL		1	1		2	2
Phloeotribus spinulosus	WL		2	1		3	1
Phloiotrya rufipes	WL		2	4	5	11	5
Phyllodrepa floralis	WL			2	2	4	2
Phyllodrepa melanocephala	WL			4	5	9	6
Phyllodrepa nigra	WL				1	1	1
Phyllodrepa salicis	WL	VU			1	1	1
Phymatodes testaceus	WL		4	6	12	22	9
Pityogenes chalcographus	WL		10	4	2	16	5
Pityogenes quadridens	WL		29			29	2
Pityophagus ferrugineus	WL		1	1		2	2
Placusa depressa	WL		4	15	4	23	4
Placusa sp.	WL		1		1	2	1

Table 10 (continued)

Species wood-living	Guild	RDB	C	NBT	WPH	Total	No of sites
Placusa tachyporoides	WL				3	3	1
Platycerus caraboides	WL		1	1		2	2
Platydema violaceum	WL	NT			1	1	1
Plegaderus caesus	WL				1	1	1
Prionocyphon serricornis	WL		3	4	7	14	6
Prionychus ater	WL		3	5		8	2
Protaetia marmorata	WL		12	14	9	35	5
Protaetia metallica	WL		7	3		10	5
Pseudocistela ceramboides	WL			1		1	1
Ptenidium pusillum	WL				1	1	1
Ptilinus pectinicornis	WL		5	66	19	90	5
Ptinomorphus imperialis	WL		1	2	3	6	5
Ptinus subpillosus	WL		17	6	21	44	9
Pyrochroa coccinea	WL		13	2	14	29	5
Quedius brevicornis	WL		7	3	4	14	5
Quedius cruentus	WL			7	16	23	5
Quedius dilatatus	WL		2	20	11	33	8
Quedius truncicola	WL	VU	3			3	1
Rhagium inquisitor	WL		1	2	1	4	4
Rhagium mordax	WL		3	4	7	14	9
Rhizophagus bipustulatus	WL		9	18	38	65	11
Rhizophagus depressus	WL				1	1	1
Rhizophagus dispar	WL			4	2	6	2
Rhizophagus fenestralis	WL		2	1		3	3
Rhyncolus ater	WL			1		1	1
Rhyncolus sculpturatus	WL				4	4	3
Salpingus planirostris	WL			2	3	5	3
Salpingus ruficollis	WL		4	8	10	22	10
Saperda scalaris	WL			2	3	5	2
Saprinus semistriatus	WL		1			1	1
Schizotus pectinicornis	WL		2	9	5	16	10
Scolytus intricatus	WL		29	27	3	59	8
Scraptia fuscula	WL			5		5	4
Scraptia testacea	WL			2		2	1
Scydmoraphes helvolus	WL			1		1	1
Silvanoprus fagi	WL			1	2	3	3
Sinodendron cylindricum	WL				1	1	1
Soronia punctatissima	WL		98	131	117	346	13
Stagetus borealis	WL	NT		1		1	1
Stenagostus rhombeus	WL	VU	2			2	1
Stenocorus meridianus	WL		5	1	5	11	5
Stenostola dubia	WL			1	1	2	2
Stictoleptura scutellata	WL	VU	1			1	1
Strangalia attenuata	WL	NT	1	1		2	1
Synchita humeralis	WL			1		1	1
Synchita variegata	WL	NT	1			1	1
Tetrops praeustus	WL			1	2	3	3
Thanasimus femoralis	WL		1			1	1
Thanasimus formicarius	WL		3		1	4	3
Tillus elongatus	WL			1		1	1
Trichoceble floralis	WL			1		1	1
Trypodendron domesticum	WL		2		2	4	2
Xestobium rufovillosum	WL		5	4	2	11	8
Xyleborinus attenuatus	WL			1	1	2	2

Table 10 (continued)

Species wood-living	Guild	RDB	C	NBT	WPH	Total	No of sites
Xyleborinus saxesenii	WL		3	5	1	9	5
Xyleborus monographus	WL	NT	2	4	3	9	2
Xyletinus longitarsis	WL	NT	1			1	1
Xylotrechus antilope	WL	NT	1		1	2	1
Total			1029	2283	2032	5344	
Species associated with wood-living fungi	Guild	RDB	C	NBT	WPH	Total	No of sites
Agathidium laevigatum	WLF				1	1	1
Agathidium rotundatum	WLF				1	1	1
Anisotoma axillaris	WLF			4	1	5	3
Atomaria diluta	WLF	NT		1	1	2	1
Atomaria pusilla	WLF		1			1	1
Atomaria turgida	WLF		2	2		4	2
Bitoma crenata	WLF			1		1	1
Bolitophagus reticulatus	WLF		1			1	1
Cis comptus	WLF			1		1	1
Cis dentatus	WLF		1	1	1	3	2
Cis fagi	WLF				1	1	1
Cis sp.	WLF		1			1	1
Cis submicans	WLF	NT		1		1	1
Corticarina minuta	WLF		1	10	5	16	4
Corticarina similata	WLF			3	5	8	1
Cortinicara gibbosa	WLF		16	5	12	33	9
Cryptophagus badius	WLF		4	13	17	34	8
Cryptophagus confusus	WLF		1	1	1	3	1
Cryptophagus dentatus	WLF				3	3	1
Cryptophagus denticulatus	WLF			1		1	1
Cryptophagus distinguendus	WLF		1			1	1
Cryptophagus fuscicornis	WLF	NT		1		1	1
Cryptophagus labilis	WLF			1		1	1
Cryptophagus micaceus	WLF		11	75	59	145	12
Cryptophagus reflexus	WLF				5	5	2
Cryptophagus scanicus	WLF		21	65	28	114	8
Cychramus luteus	WLF		9	7	11	27	8
Cypha apicalis	WLF	NT	1			1	1
Dacne bipustulata	WLF		71	73	44	188	13
Diaperis boleti	WLF		163	100	186	449	13
Diplocoelus fagi	WLF	NT			1	1	1
Dorcatoma chrysomelina	WLF		15	6	2	23	6
Dorcatoma dresdensis	WLF		2	1	5	8	4
Dorcatoma flavicornis	WLF			1	1	2	2
Dorcatoma robusta	WLF				1	1	1
Elateroides dermestoides	WLF		1		1	2	2
Enicmus fungicola	WLF				4	4	2
Enicmus rugosus	WLF		17	39	33	89	13
Enicmus testaceus	WLF		1	3	6	10	5
Ennearthron cornutum	WLF		2		2	4	3
Latridius brevicollis	WLF			3		3	1
Latridius gemellatus	WLF			1		1	1
Latridius hirtus	WLF			3	5	8	4
Latridius minutus	WLF				4	4	1
Litargus connexus	WLF			1	1	2	1
Lordithon lunulatus	WLF		3		3	6	4
Micrambe abietis	WLF				1	1	1

Table 10 (continued)

Species associated with wood-living fungi	Guild	RDB	C	NBT	WPH	Total	No of sites
Orchesia fasciata	WLF	NT	1		1	2	2
Orchesia micans	WLF		1	2	1	4	3
Orchesia minor	WLF	NT			1	1	1
Orchesia undulata	WLF		1	4	1	6	4
Orthocis alni	WLF			2		2	1
Platystomos albinus	WLF		12	9	10	31	8
Scaphisoma agaricinum	WLF		2	3	3	8	5
Stephostethus lardarius	WLF				2	2	2
Stephostethus pandellei	WLF		97	34	109	240	8
Stictoleptura maculicornis	WLF		6	4	1	11	6
Triphyllus bicolor	WLF			2	1	3	3
Triplax aenea	WLF				1	1	1
Triplax rufipes	WLF	NT	2	3	1	6	4
Triplax russica	WLF		1		2	3	2
Tritoma bipustulata	WLF		2	3	2	7	3
Total			471	490	588	1549	
Species - other, non wood-living	Guild	RDB	C	NBT	WPH	Total	No of sites
Adalia decempunctata	OTH		1	3	1	5	4
Agabus congener	OTH		1			1	1
Agrypnus murinus	OTH			1		1	1
Aleochara curtula	OTH		2	1		3	2
Aleochara lanuginosa	OTH		1			1	1
Amara aenea	OTH				1	1	1
Amara familiaris	OTH		1			1	1
Anchomenus dorsalis	OTH			1		1	1
Anotylus rugosus	OTH			2		2	2
Anthonomus phyllocola	OTH		2			2	2
Aphidecta obliterata	OTH				1	1	1
Aphthona euphorbiae	OTH		1	4	2	7	3
Archarius pyrrhoceras	OTH		4	4	2	10	4
Archarius salicivorus	OTH		3	2	1	6	5
Atheta graminicola	OTH			1		1	1
Atheta sp.	OTH			1	1	2	2
Athous haemorrhoidalis	OTH		49	108	68	225	14
Athous subfuscus	OTH		485	60	67	612	13
Athous vittatus	OTH			5	7	12	5
Atomaria sp.	OTH		1	2	2	5	4
Aulonothroscus brevicollis	OTH			3	1	4	2
Bembidion obtusum	OTH				1	1	1
Betulapion simile	OTH		1	1		2	1
Byrrhus pilula	OTH			1		1	1
Byturus tomentosus	OTH		10		4	14	1
Calathus rotundicollis	OTH			1		1	1
Calosoma inquisitor	OTH		18	9	14	41	3
Calvia quatuordecimguttata	OTH				4	4	4
Cantharis figurata	OTH		1	1	2	4	2
Cantharis fusca	OTH		1			1	1
Cantharis nigra	OTH		1		3	4	2
Cantharis nigricans	OTH		1			1	1
Cantharis obscura	OTH		6	8	2	16	6
Cantharis pellucida	OTH		8	6	7	21	6
Cantharis quadripunctata	OTH				1	1	1
Cantharis rufa	OTH			1		1	1
Cantharis rustica	OTH		4	5	5	14	7

Table 10 (continued)

Species - other, non wood-living	Guild	RDB	C	NBT	WPH	Total	No of sites
Carabus hortensis	OTH		1		3	4	2
Carpelimus elongatulus	OTH		2			2	1
Cetonia aurata	OTH		21	13	19	53	12
Ceutorhynchus obstrictus	OTH		2	2	3	7	2
Ceutorhynchus pallidactylus	OTH		2	7	8	17	3
Ceutorhynchus typhae	OTH			2		2	1
Chaetocnema picipes	OTH			4		4	3
Chilocorus bipustulatus	OTH				1	1	1
Chilocorus renipustulatus	OTH		1	1	2	4	2
Cimberis attelaboides	OTH		5		1	6	1
Coeliodes rana	OTH				2	2	2
Coeliodes transversealbofasciatus	OTH			1		1	1
Coeliodinus rubicundus	OTH		1			1	1
Contacyphon coarctatus	OTH		6	6	11	23	6
Contacyphon ochraceus	OTH		1	8	2	11	4
Contacyphon padi	OTH		13	21	32	66	9
Contacyphon variabilis	OTH				1	1	1
Corticaria sp.	OTH			1		1	1
Crepidodera aurata	OTH			1	1	2	1
Cryptocephalus labiatus	OTH			1	1	2	1
Cryptocephalus querceti	OTH			1	1	2	1
Cryptocephalus sexpunctatus	OTH		1			1	1
Cryptophagus	OTH		1	5	3	9	4
Ctenicera pectinicornis	OTH				3	3	3
Curculio nucum	OTH				1	1	1
Curculio venosus	OTH		2	5	6	13	9
Curculio villosus	OTH		10	1	4	15	3
Dendroxena quadrimaculata	OTH		11	1	12	24	8
Dermestes lardarius	OTH			1		1	1
Dermestes murinus	OTH		4	4	1	9	2
Dromius agilis	OTH		37	29	28	94	13
Dromius fenestratus	OTH		1		4	5	4
Dromius quadrimaculatus	OTH		15	10	15	40	11
Epuraea sp.	OTH		1			1	1
Exochomus quadripustulatus	OTH			1	1	2	1
Gastrophysa polygoni	OTH				1	1	1
Gaurotes virginea	OTH				1	1	1
Geodromicus plagiatus	OTH		3			3	1
Gymnetron veronicae	OTH				1	1	1
Harpalus latus	OTH		1	2	1	4	4
Hydraena britteni	OTH		1			1	1
Hypera meles	OTH				1	1	1
Hypera nigrirostris	OTH		1			1	1
Lagria hirta	OTH		3		2	5	4
Limnebius truncatellus	OTH			1		1	1
Limonius poneli	OTH				1	1	1
Lochmaea caprea	OTH		1	1	2	4	3
Malachius bipustulatus	OTH		11	11	9	31	10
Mecinus pascuorum	OTH		1		1	2	1
Meligethes aeneus	OTH		13	12	21	46	11
Meligethes pedicularius	OTH				3	3	1
Meligethes viridescens	OTH		4	4	2	10	3
Melinopterus prodromus	OTH		1			1	1
Metoecus paradoxus	OTH		1			1	1
Micrambe woodroffei	OTH		1			1	1

Table 10 (continued)

Species - other, non wood-living	Guild	RDB	C	NBT	WPH	Total	No of sites
Microcara testacea	OTH		3	1	1	5	4
Mycetoporus lepidus	OTH		2			2	2
Myzia oblongoguttata	OTH		1			1	1
Nargus anisotomoides	OTH		1			1	1
Nebria brevicollis	OTH		2	1		3	2
Necrodes littoralis	OTH		1		1	2	2
Neocoenorrhinus germanicus	OTH		1			1	1
Neocoenorrhinus minutus	OTH		1	1		2	1
Nephus redtenbacheri	OTH				1	1	1
Nicrophorus humator	OTH			1		1	1
Nicrophorus investigator	OTH		3	2	6	11	4
Nicrophorus vespillo	OTH		1	1	2	4	2
Nicrophorus vespilloides	OTH		39	40	26	105	12
Notoxus monoceros	OTH			1		1	1
Oenopia conglobata	OTH		1	1		2	1
Oiceoptoma thoracicum	OTH		4	8	4	16	6
Omalium caesum	OTH			1		1	1
Omalium rivulare	OTH			1		1	1
Orchestes fagi	OTH		2	14	5	21	5
Orchestes hortorum	OTH		1	2	2	5	3
Orchestes pilosus	OTH		12	12	7	31	9
Orchestes quercus	OTH		93	21	39	153	9
Orchestes rusci	OTH		1			1	1
Orsodacne cerasi	OTH			1		1	1
Otiorhynchus carinatopunctatus	OTH				1	1	1
Otiorhynchus singularis	OTH		5	1	4	10	3
Oxypoda procerula	OTH		2	3	1	6	2
Oxypoda sp.	OTH		1			1	1
Oxypoda spectabilis	OTH		1			1	1
Oxytelus laqueatus	OTH		2		1	3	2
Paraphotistus impressus	OTH		2	2	1	5	4
Pelenomus commari	OTH		1			1	1
Pella cognata	OTH			3		3	1
Pella funesta	OTH				3	3	1
Pella laticollis	OTH		1			1	1
Pella lugens	OTH				1	1	1
Phalacrus corruscus	OTH			1		1	1
Philonthus carbonarius	OTH				1	1	1
Philonthus cognatus	OTH			1		1	1
Philonthus tenuicornis	OTH				1	1	1
Phyllobius argentatus	OTH				1	1	1
Phyllobius glaucus	OTH			1		1	1
Phyllobius pyri	OTH		84	95	63	242	12
Phyllobius virideaeris	OTH			3		3	1
Phyllopertha horticola	OTH				1	1	1
Phyllotreta undulata	OTH			2	1	3	3
Phyllotreta vittula	OTH			13	7	20	2
Platynus assimilis	OTH		3	17	8	28	3
Platynus krynickii	OTH	NT			1	1	1
Podabrus alpinus	OTH		1	1	1	3	3
Podistra rufotestacea	OTH				1	1	1
Polydrusus mollis	OTH			4	1	5	3
Polydrusus tereticollis	OTH		2		1	3	2
Propylea quatuordecimpunctata	OTH		1	1	1	3	3
Prosternon tessellatum	OTH		3	1		4	3

Table 10 (continued)

Species - other, non wood-living	Guild	RDB	C	NBT	WPH	Total	No of sites
Protapion apricans	OTH			1		1	1
Protapion fulvipes	OTH			4	7	11	7
Psylliodes affinis	OTH		1			1	1
Pterostichus diligens	OTH				1	1	1
Pterostichus niger	OTH			2	2	4	1
Ptomaphagus varicornis	OTH				1	1	1
Rhagonycha lignosa	OTH		3	5	3	11	7
Rhagonycha lutea	OTH		4	1	2	7	5
Rhagonycha nigriventris	OTH		1	2	3	6	2
Rhagonycha testacea	OTH		3	3	2	8	5
Rhamphus pulicarius	OTH			1		1	1
Sciaphilus asperatus	OTH		5		2	7	2
Scymnus silesiacus	OTH	NT		2		2	1
Selatosomus aeneus	OTH		17	16	15	48	9
Selatosomus cruciatus	OTH			2	1	3	1
Sepedophilus testaceus	OTH				1	1	1
Serica brunnea	OTH		1			1	1
Sitona obsoletus	OTH		2			2	2
Soronia grisea	OTH		33	52	47	132	11
Strophosoma capitatum	OTH		65	84	88	237	12
Tachinus laticollis	OTH		3	27	9	39	4
Tachyporus chrysomelinus	OTH		1			1	1
Tachyporus solutus	OTH			1		1	1
Trechus quadristriatus	OTH		1	1		2	2
Trichius fasciatus	OTH		1			1	1
Trichoceble memnonia	OTH		1	1		2	1
Trixagus carinifrons	OTH		2		1	3	1
Trixagus dermestoides	OTH		10	8	18	36	10
Tychius stephensi	OTH			1		1	1
Tytthaspis sedecimpunctata	OTH			1		1	1
Xantholinus linearis	OTH		1	1		2	2
Total			1215	862	807	2884	
Species—partly wood-living	Guild	RDB	C	NBT	WPH	Total	No of sites
Aleochara moerens	PWL		51	148	139	338	12
Anthrenus museorum	PWL			2		2	2
Aplocnemus nigricornis	PWL		3	1	1	5	3
Atheta crassicornis	PWL			1	2	3	3
Atheta fungi	PWL			2	5	7	2
Atheta nidicola	PWL		1	7	2	10	4
Atheta vaga	PWL		495	538	553	1586	13
Atomaria hislopi	PWL		1			1	1
Atomaria morio	PWL				2	2	2
Atomaria nigripennis	PWL	VU			2	2	1
Atomaria rubella	PWL		2			2	1
Atomaria wollastoni	PWL		1			1	1
Attagenus pellio	PWL		6	16	6	28	5
Bibloplectus spinosus	PWL			1		1	1
Bryaxis bulbifer	PWL		1			1	1
Carcinops pumilio	PWL		1			1	1
Carpophilus marginellus	PWL		1	4	9	14	5
Dalopius marginatus	PWL		109	99	69	277	14
Margarinotus merdarius	PWL		1	1	5	7	4
Monotoma longicollis	PWL			1		1	1
Orthoperus atomus	PWL		8	18	9	35	2
Orthoperus sp.	PWL				1	1	1

Table 10 (continued)

Species—partly wood-living	Guild	RDB	C	NBT	WPH	Total	No of sites
Oxypoda brevicornis	PWL			12		12	1
Oxypoda exoleta	PWL		1			1	1
Ptinus fur	PWL		5	14	4	23	9
Ptinus rufipes	PWL		4		1	5	4
Quedius fuliginosus	PWL		1			1	1
Quedius maurus	PWL			1	1	2	2
Quedius mesomelinus	PWL		143	376	216	735	13
Quedius xanthopus	PWL		2	13	11	26	11
Thamiaraea cinnamomea	PWL		5	38	54	97	11
Thamiaraea hospita	PWL	NT	1	1	4	6	4
Total			843	1294	1096	3233	

OTH other, non-saproxylic, *PWL* partly wood-living, *WL* wood-living, *WLF* associated with woodlivingfungi, *NBT* nestbox and topping, *WPH* Woodpecker Hole, *C* Control, *RDB* Red Data Book

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Declarations

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