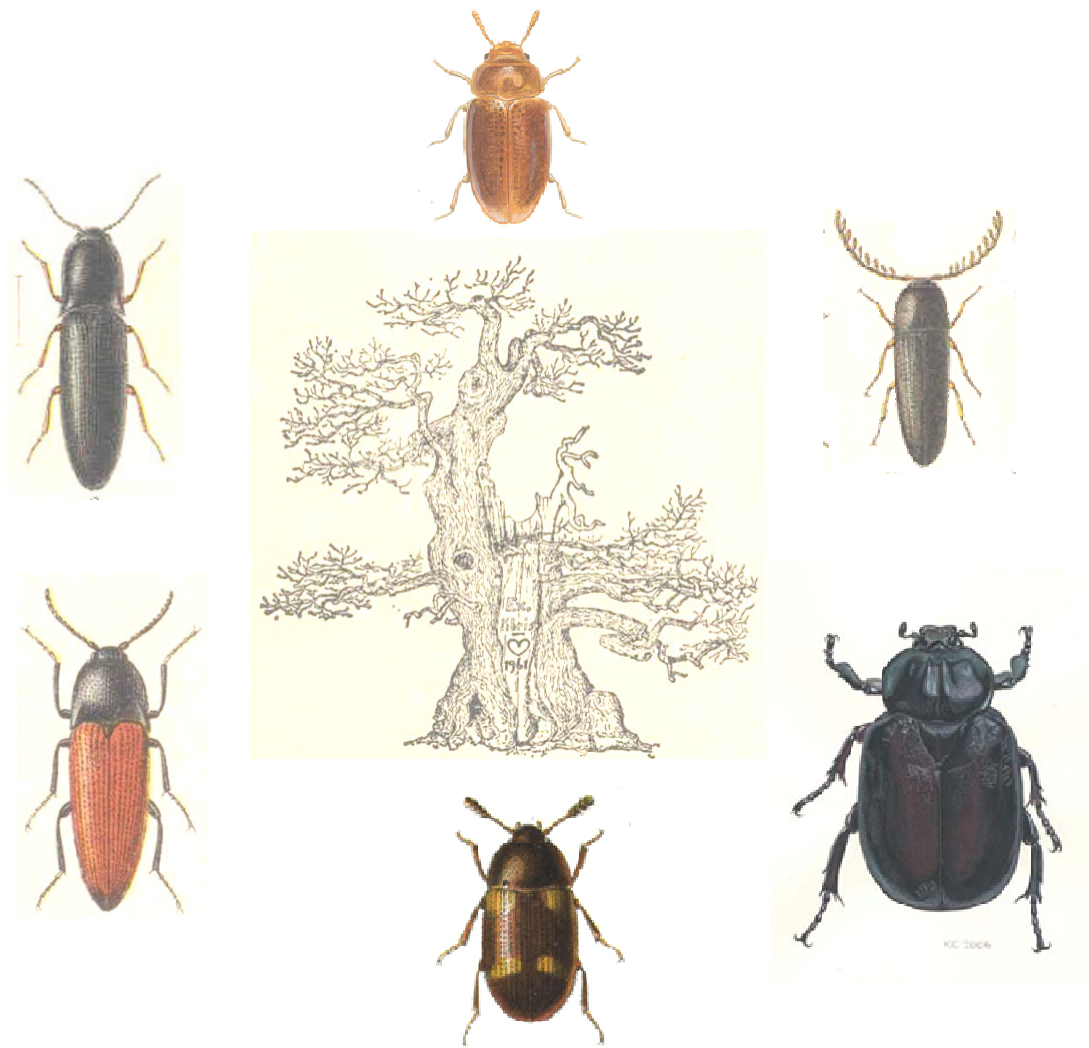




Saproxylic beetles in Wulfshagen and Stodthagen

A pre-study of the fauna before an experiment of translocation of
saproxylic beetles living in hollow trees via nesting boxes



A study made in 2022 by Nicklas Jansson, Dorcatoma bi & nature, Sweden,
in cooperation with Hauke Drews Stiftung Naturschutz, Schleswig-
Holstein, Germany in the frame of the LIFE Open woods project. The LIFE
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The drawing of the oak on frontpage is made by Tore-Erik Leiler and the beetles are copied from E. Reitter. 1908-1912. Fauna Germanica – Die Käfer des Deutschen Reiches.

1. Summary

This study was made by Nicklas Jansson, Dorcatoma in collaboration with Hauke Drews, from the Stiftung Naturschutz, Schleswig-Holstein, Germany in the frame of the Danish LIFE open woods project, where Stiftung Naturschutz is a partner in.

For more information:

<https://www.stiftungsland.de/was-wir-tun/entwicklungshelfer/mehr-urwald-im-stiftungsland/open-woods/> or

<https://naturstyrelsen.dk/ny-natur/life-projekter/life-open-woods>

In the study two large sites in the Kiel region with deciduous trees have been investigated by using beetle traps during the field season of 2022. Wulfshagen has a large number of old hollow oaks (*Quercus robur*) but also many old beech trees (*Fagus sylvatica*). Stodthagen has a few old hollow oaks and a few old beeches but a lot of oaks and beeches in the next generation of trees, but also a mixture of many other tree species as black alder (*Alnus glutinosa*) and birches (*Betula* spp) in different succession stages. In Wulfshagen the protected beetle species Hermit beetle (*Osmoderma eremita*) was known before this study but very few other records and in Stodthagen a first study of saproxylic insects was made in 2005 (Gürlich).

The aim with this study was to increase the knowledge about the content of saproxylic beetles living in old hollow trees in both Wulfshagen and Stodthagen. The reason is to have the chance to see if an attempt with translocation of tree hollow living beetles, by letting them colonizing wood mould boxes placed in Wulfshagen and then move them to Stodthagen, when the same study will be repeated in the future.

In total 6990 beetle individuals were identified from 421 species and of these 307 are classified as saproxylic. From these 43 are on the German national Red List.

When compare the two studied sites, 244 saproxylic beetle species were found at Stodthagen and of these 36 species (5 from the higher categories) are on the German national Red List. At Wulfshagen 205 saproxylic beetle species were found and of these 32 species (5 from the higher categories) are on the Red List. From the traps on oaks (*Quercus*) 29 Red Listed species were found in Wulfshagen and 27 in Stodthagen and from the traps on beeches (*Fagus*) 23 Red Listed were found in Wulfshagen and 17 in Stodthagen. The traps on birch and alder trees in Stodthagen gave 9 and 11 Red Listed species respectively.

Among the saproxylic beetles 45 can be identified as developing in nests (like birds, ants, bees and wasps) or wood mould in trunk cavities (hollows). Of these 38 were found in Wulfshagen and 36 in Stodthagen.

The most threatened species found is the death watch beetle (Ptinidae, Anobiinae) *Cacotemnus thomsoni* caught in Stodthagen. Other rare species found from the category “highly threatened” are the hermit beetle *Osmoderma eremita*, the click beetle (Elateridae) *Ampedus rufipennis*, the fungus beetle (Mycetophagidae) *Mycethophagus decempunctatuspunctatus*, the darkling beetles (Tenebrionidae) *Corticeneus fasciatus* and *Allecula rbenana*.

This study has given a good overview of the richness of beetles living in the hollow trees in both areas. As the effort in Wulfshagen was concentrated to hollow oaks and beeches it has not given the full picture of the wood living species in the area. study of other tree species as ash and lime tree would probably give some more species. The studied trees were also in medium stages of the hollow tree succession so studies of weak or dead trees, fallen trees or high stumps or dead wood with bracket fungi would for sure give other species. For Stodthagen the traps covered a larger range of tree species and to some extent a wider range of succession stages of the trees but studies of some more birches, some aspens and coniferous trees would complement and give a lot of valuable information especially for a comparison with the study of Stephan Gürlich (2005) has made in the area.

2. Introduction

Beetles are a very useful group when evaluating the nature quality of an area. This is true not only for forest habitats but also city parks, tree lines along roads or always when old trees and dead wood are important features. Dead wood occurs in a wide range of forms. It can vary in size from massive trunks to fine twigs, it can be high up in the canopy or lying on the ground, it can be in sun or in shade, in a dry or in a wet place, it can be standing or fallen and it can be in different stages of decay. On this variable resource, a large number of insects live on the different types of dead wood.

The beetles associated with the first succession after a tree or a part of a tree has died mainly consume the nutrient-rich tissues under the bark (xylem, phloem and cambium). Unrotted oak wood is very hard and many of the saproxylic insect species larvae require partial fungal decomposition of wood before they can consume or even gnaw their tracks in it. The fungi that first colonize the wood will largely determine the succeeding flora of decaying fungi (Niemelä et al., 1995) and the succession of invertebrates is probably affected in a similar way. Different species live on the bracket, the mycelia and the wood modified by fungal activity. Probably, the number of species depending on fungi and its mycelia is underestimated, because it is hard to distinguish them from true wood eaters (Jonsell et al., 1998).

More than one fungus, species or individual, may be active within a trunk of a particular tree at any one time. These may breakdown the wood in parallel, or exploit material at different stages of decay (Alexander, 2001). There are two key successions, following the two main types of decay fungi. Some heart-rot fungi digest only the cellulose, leaving the lignin as a reddish-brown brittle material known as 'brown-rot'. Other fungi digest both cellulose and lignin, leaving a whitish soft, pliable material: 'white-rot' (Kirby, 2001). It is dominantly lignin which in some circumstances may form thick beds in hollow oak trees (Whitehead, 2003). The two types of decay support distinct assemblages of invertebrates (Araya, 1993; Alexander, 2001).

Fungi causing heart wood rot invade the inner cylinder of non-conductive tissue. The resulting heart wood rot hollows out the trunk whilst often leaving an intact region of functional sapwood around the outside. The rotting heart wood in unsplit trunks has a relatively stable temperature and humidity regime which is critical for many saproxylic fungi and insect larvae (Warren and Key, 1991). A long-lived tree, such as oak, can provide a breeding site for a particular insect species for a century or more (Kirby, 2001; Siitonen, 2012). Large, living trees carry a substantial fraction of the total dead wood in an old forest; in fact, dead wood last longer in living trees than in snags and fallen logs.

The rot causes hollows in the trees and the form of these may be critical in determining which invertebrates live in them (Dajoz, 1966; Speight, 1989). According to Ranius et al. (2009) 50% of oaks have hollow trunks when they are between 200 and 300 years old. In the hollow trunk there are different rot and wood mould types. Wood mould inside hollow trunks is the main habitat for a number of threatened beetle species. Wood mould is the soil or sawdust-like material that accumulates in the bottom of the cavities. The importance of hollows that host rich saproxylic assemblages is now indisputable. Several researchers highlight that cavities containing wood mould are keystone habitats for saproxylic conservation as they host endangered species (Ranius and Jansson 2000; Sirami et al. 2008; Micó et al. 2010; Chiari et al. 2012; Gouix et al. 2015). Moreover, cavities seem to be more diverse functionally and phylogenetically than other woody resources (Müller et al. 2013).

Typical wood mould is mainly a complex mixture of decayed organic material as coarse woody debris, fungi, remnants of leaves and seeds, dead animals, vertebrate faeces, invertebrate faecal pellets etc. in different stages of decay and decomposition (Jansson, 2002; Zach, 2002). Jansson and Antonsson (2002) have presented an example of dividing the succession in oaks in different hollow stages (Figure 3).

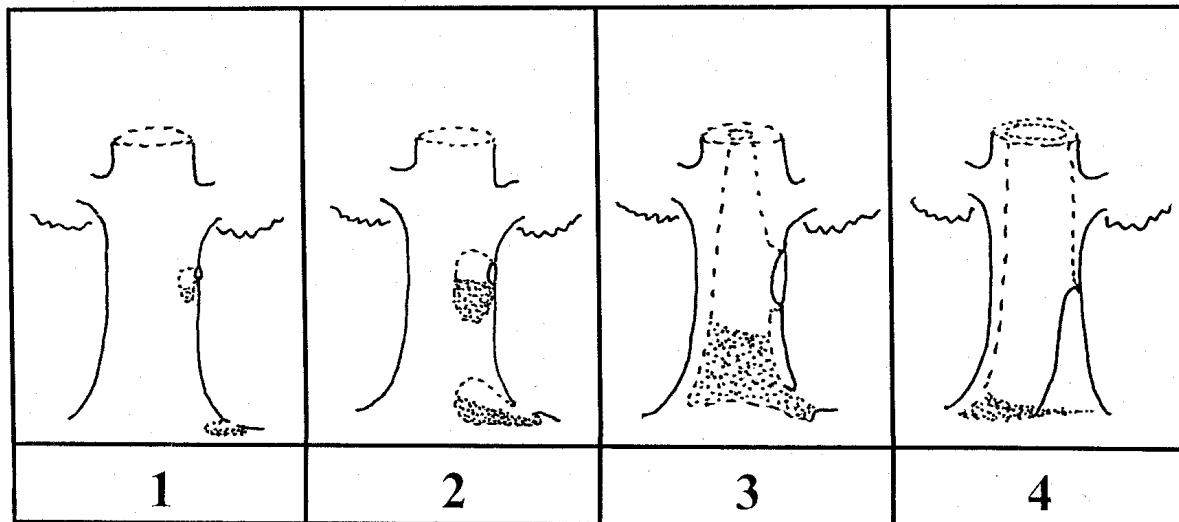


Figure 1. An example of classification of the hollow stages of deciduous trees (From Jansson and Antonsson, 2002).

When authors have found that the quality/amounts of dead wood in local stands influences species richness of saproxylic taxa (Nilsson and Baranowski, 1997; Scheigg, 2000; Ranius, 2000), it is only the larvae that are affected by these factors. The adults may feed and mate away from dead wood, so saproxylic insects may require more than one habitat in order to complete their life cycle (Stubbs, 1972). Many saproxylic beetle species seems to be dependent on flowers for mating, eating pollen or nectar (Bense, 1995).

Ecological theory predicts that for species that can live for many generations in the same place, selection has not favoured dispersal ability to the same extent as for species whose individuals live on temporary unstable food resources. The former species are therefore believed to be more vulnerable to habitat fragmentation than species adapted to unstable environments (Johnsson and Gaines, 1990; Noss and Csuti, 1997; Southwood, 1977). Field studies suggest that the spatial structure of the habitat is important for species associated with hollow trees as they have been shown to occur in lower frequencies in smaller stands (Ranius, 2000b; Ranius, 2002a). It has also been shown that some of the species in hollow trees have low dispersal rates and ranges in comparison with saproxylic beetles in other microhabitats (Ranius and Hedin, 2001). Examples of unstable habitats are wood substrate evolved after a forest fire or a newly broken branch.

The apparent failure of much of the saproxylic fauna to colonise older trees in surrounding areas of younger woodland provides circumstantial evidence that many species have very poor powers of dispersal, although it might also reflect a lack of suitable niches (Buckland and Dinnin, 1993; McLean and Speight, 1993; Lättman et al., 2009). Since only a small portion of trees may be suitable for a given species at any one time, survival of original levels of saproxylic diversity before the widespread habitat loss, will be possible only in the largest sites (Peterken, 1996).

Gaps in size or age distribution of trees exist in many of the most important sites for saproxylic fauna and the current lack of young or middle-aged trees will cause a problem in the future (Dudley and Vallauri, 2004; Key and Ball, 1993). Such gaps within a particular site might not matter if the surrounding landscape contains an adequate mixture of age classes of appropriate species that would be allowed to grow into senescence (McLean and Speight, 1993). This is rarely the case in many landscapes as the stands with old oaks form small and isolated islands in a 'sea' of managed forests and agricultural fields. In combination with a lower number of stands available for colonization and fewer dispersing individuals of species dependent on old oaks, it is expected that the connectivity between stands has severely decreased (Ranius, 2000b).

Franc (2007) showed that the oak-associated saproxylic beetles prefer a landscape with high connectivity of oak-dominated woodland key habitats. This means, that in many fragmented landscapes, we must for a foreseeable future sustain invertebrate populations within their current sites (Key and Ball, 1993).

In my previous studies of saproxylic beetles living on old hollow deciduous trees (1992-2023) cover in total over 200 sites and at each site at least 5 trees have been studied with window and pitfall traps and its over 1200 studied trees. Most of the trees are oaks (*Quercus* spp) but also beech (*Fagus* spp), lime trees (*Tilia* spp), maple (*Acer* spp), elm (*Ulmus glabra*), ash (*Fraxinus* spp), horse chestnut (*Aesculus hippocastaneus*), black alder (*Alnus glutinosa*), plane trees (*Platanus orientalis*) studies are made in Sweden but some also in Latvia, Italy and Turkey.

The study of the two sites in this report covered mainly the wood living beetles but the wood living dipterans, hymenopterans and pseudoscorpions have been sorted out to be identified in a later stage.

The aim with the study was to increase the knowledge about the content of saproxylic beetles living in old hollow trees in both Wulfshagen and Stodthagen. The reason is to have the chance to evaluate the success of an attempt with translocation of tree hollow living beetles, by letting them colonizing wood mould boxes placed in Wulfshagen and then move them to Stodthagen, when the same study will be repeated in the future.

Redlisted species

The international Union for Conservation of nature (IUCN) and their specialist groups regularly present the status for the species. Every country has their own committees evaluating the species status. The IUCN Red List Categories indicate how close a species is to becoming extinct.

The categories of the German Red List

0 Extinct or Lost ('Ausgestorben oder verschollen')

A species that has disappeared from a defined geographical area or in which no wild population have been reported anymore. Either there is reasonable proof that populations have become extinct, usually as a result of human activity (historic habitats or locations have been transformed to such a degree that makes re-discovery unlikely), or that they are definitely lost. This means that there is no reasonable doubt that the last individuals have disappeared because targeted searches for the species in known historic habitats have been unsuccessful over a longer period of time.

1 (ER) Threatened with Extinction ('Vom Aussterben bedroht')

A species that is endangered to such a degree that it is likely to become extinct in the near future unless appropriate urgent action is taken. Survival of the species within the geographical coverage can only be achieved if the causes of threat are eliminated immediately or if effective protective measures are put in place to support remaining populations.

2 (HT) Highly Threatened ('Stark gefährdet')

A species showing a significant population decline or subject to substantial threat caused by continuous or anticipated human impact. If the current threat to the species is not adequately mitigated, it is likely to be re-classified as 'Threatened with Extinction' in the future.

3 (T) Threatened ('Gefährdet')

A species showing a significant population decline or one that is probably threatened by human impact. If the current threat to the species is not adequately addressed, it is likely to be re-classified as 'Highly Threatened' in the future.

G Threat of Unknown Extent ('Gefährdung unbekannten Ausmaßes')

Species in this group are threatened. Research has shown that the species is threatened, but the available information is not sufficient to allow a precise assignment to categories 1 to 3.

R Extremely Rare ('Extrem selten')

Extremely rare species, often with very local populations; total number of populations or individuals within populations do not show a long-term or short-term decline. The species is not immediately threatened, but it is particularly vulnerable to potentially threatening events.

V (NT) Near Threatened ('Vorwarnliste')

Species displaying a substantial population decline but not yet considered as threatened. If the current causes of threat persist, a re-classification into category 'Threatened' is likely in the near future.

D (DD) Data Deficient ('Daten unzureichend')

Information on the distribution, biology or level of threat to a species is insufficient. Causes of data deficiency are, for example, that a species was not detected or not differentiated from another species in the past; that a species has only recently been assessed taxonomically or has not yet been clearly determined taxonomically; or that the number of specialists is too low to allow for a potential threat assessment.

*** Not Threatened ('Ungefährdet')**

Species are considered as currently 'Not Threatened' if their populations have increased, are stable or have decreased only slightly. They cannot, therefore, be assigned to Category 'V' as yet.

*** Not Evaluated ('Nicht bewertet')**

No threat assessment has been carried out for species in this category.

3. Study sites

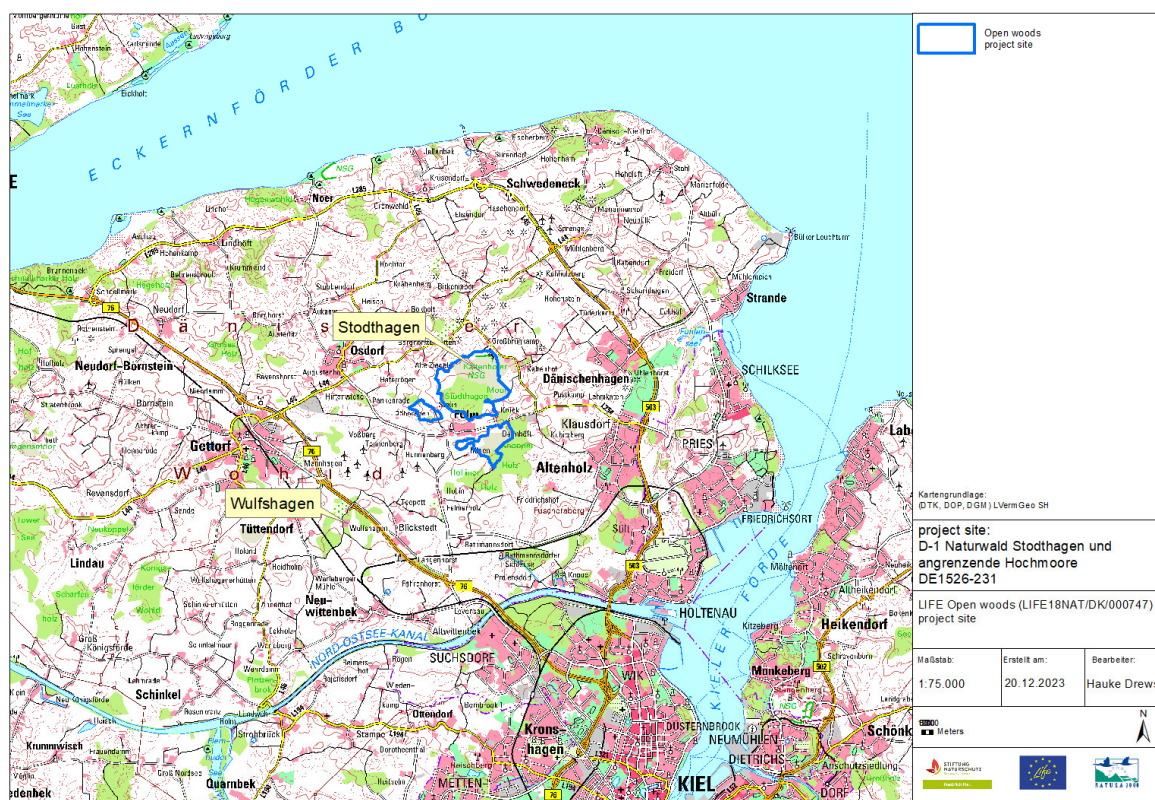


Figure 2. An overview of the landscape and the position of the two studied sites in Kiel region, Germany.

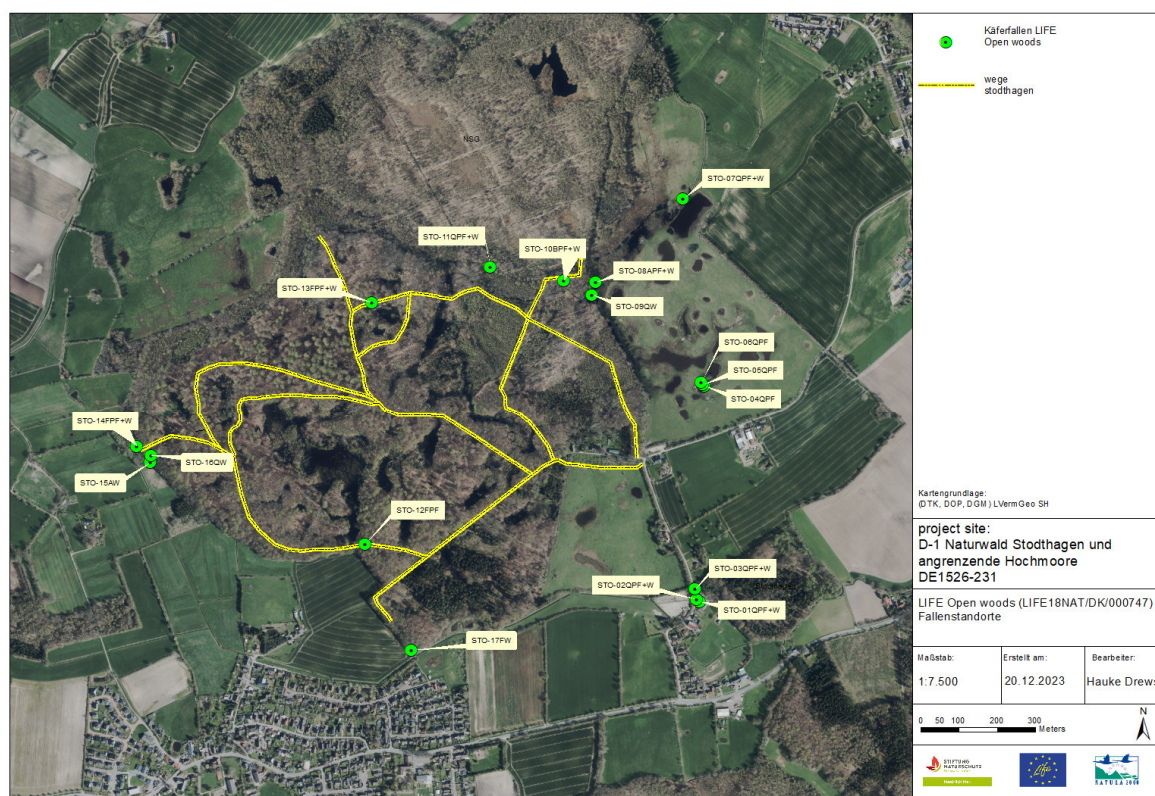


Figure 3. An aerial photo of Stodthagen and the position of the studied trees.



Figure 4. An aerial photo of Wulfshagen and the position of the studied trees.

4. Methodology

In this study two different trap types were used. First one is called a window trap and this one consisted of a 60 x 35 cm wide transparent plastic plate with an aluminum tray underneath (Jansson and Lundberg, 2000). They were placed near the trunk, beside or in front of a hole entrance or fungi infested part of the trunk. Their position was 1.5–8 m from the ground, dependent on where the hole entrance was situated on the studied trees. Pitfall traps were plastic cups with a top diameter of 65 mm, placed with the opening at level with the wood mould surface of the tree hollows. Both types of traps were partially (about 1/2 of the volume) filled with propylene glycol and water (50:50 v/v). Dishwashing detergent was added to reduce surface tension. The traps were placed in the trees 27–28 April and removed between 15 and 22 August in 2022 and were emptied three occasions during this period.

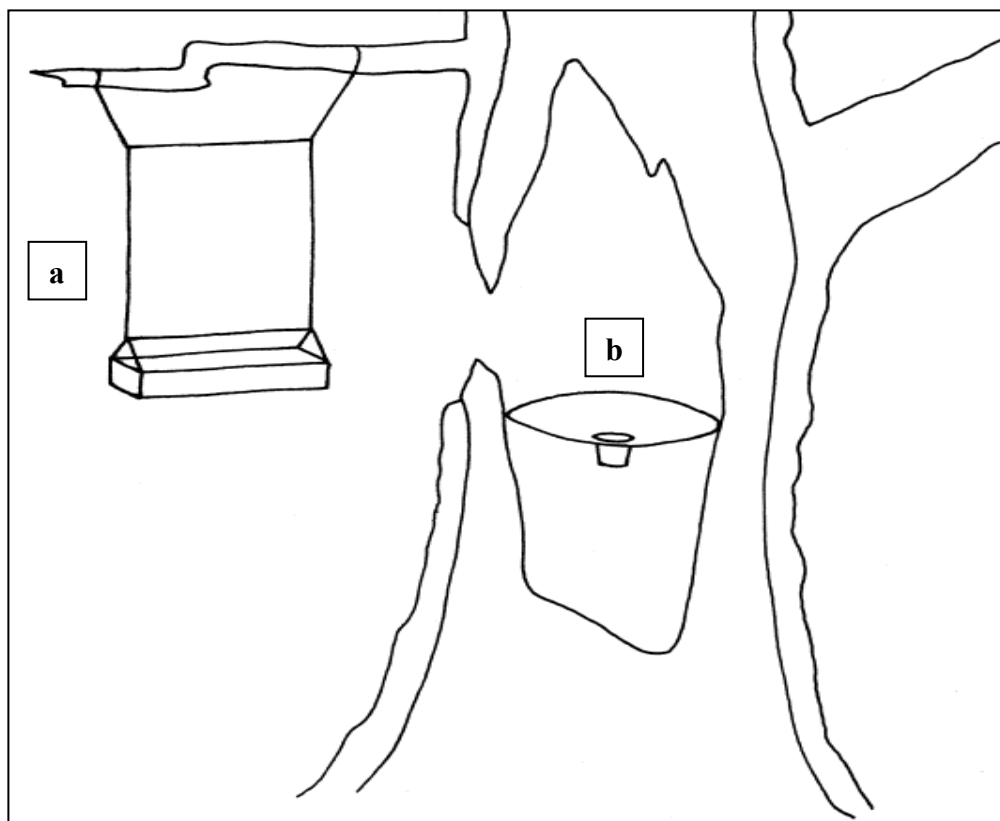


Figure 3. The two type of traps used in the beetle studies in Kiel region 2022 a: window trap b: pitfall trap in a hollow tree.

Table 1. The trap effort used at the beetle inventory in Kiel region, Germany 2022 (number of traps per tree species).

	Stodthagen		Wulfshagen	
	<u>Window traps</u>	<u>Pitfall traps</u>	<u>Window traps</u>	<u>Pitfall traps</u>
oak	7	8	9	8
beech	3	3	2	2
birch	1	1	-	-
alder	2	1	-	-

In this study the traps were mounted in field in 27-28 April and taken in 15-22 August 2022.

The studied trees can be found in Appendix 3.

4. Result

In total 6990 beetle individuals were identified from 422 species and of these 307 are classified as saproxylic. From these 43 are on the German national Red List.

At Stodthagen we found 244 saproxylic beetle species and of these 36 species (6 from the higher categories) are on the German national Red List. Of the saproxylic species 120 were found in Gürlich studies in Stodthagen in 2005. This means 124 new saproxylic species were found in the present study.

At Wulfshagen 205 saproxylic beetle species were found and of these 32 species (6 from the higher categories) are on the Red List. From the traps on oaks (*Quercus*) 29 red listed species was found in Wulfshagen and 27 in Stodthagen and from the traps on beeches 23 red listed was found in Wulfshagen and 17 in Stodthagen. The traps on birch and alder trees in Stodthagen gave 9 and 11 red listed species respectively. The two traps who caught most red listed species are both from Wulfshagen: the window trap on a hollow beech (9W = window trap no 9, see Appendix) caught 19 red listed species and the window trap (2W) on a hollow oak caught 18 red listed species.

The three window traps that caught the most saproxylic species were mounted on a dead birch in Stodthagen (10W), on a hollow beech tree in Wulfshagen (9W) and on a hollow beech in Stodthagen (13W) with 78, 71 and 68 species respectively. The richest pit fall traps were placed in a hollow beech in Wulfshagen (9P), a hollow oak in Wulfshagen (4P) and a hollow oak in Stodthagen (11P) with 40, 38 and 27 species respectively.

Among the saproxylic beetles 45 can be identified as developing in nests (like birds, ants, bees and wasps) or wood mould in trunk cavities (hollows). Of these 38 were found in Wulfshagen and 36 in Stodthagen (Table 3).

The most threatened species found is the death watch beetle (Ptinidae, Anobiinae) *Cacotemnus thomsoni* caught in Stodthagen. Other rare species found from the category “highly threatened” are the hermit beetle *Osmoderma eremita*, the click beetle (Elateridae) *Ampedus rufipennis*, the hairy fungus beetle (Mycetophagidae) *Mycethophagus decempunctatus*, the darkling beetles (Tenebrionidae) *Corticeus fasciatus* and *Allecula rhenana* (Appendix 1)

Table 2 (following page). The saproxylic species on the German Red List found in a study of old deciduous trees in Stodthagen and Wulfshagen in Kiel region, Germany in 2022.

Tree species: Q=Quercus, F=Fagus, B=Betula, A=Alnus									
NT = Near threatened, T = Threatened, HT = Highly threatened, NE = Near extinction, DD = Data deficient									
Family	Spec name	Cat Col	Red list	S-Q	S-F	S-B	S-A	W-Q	W-F
Staphylinidae	Quedius truncicola	1115	NT	3	49			1	2
	Trichonyx sulcicollis	1368	NT					1	
Scarabaeidae	Osmoderma eremita	2293	HT					1	2
Elateridae	Stenagostus rhombeus	2408	NT	5				1	
	Hypoganus inunctus	2431	NT	1			1	2	1
	Calambus bipustulatus	2432	NT	1				3	
	Procræus tibialis	2434	T	2				52	7
	Ampedus rufipennis	2435	HT						8
	Ampedus hjorti	2443	T	1				10	3
Eucnemidae	Microrhagus pygmaeus	2479	T	1	1	1	1		
	Hylis cariniceps	2484	T				1		
	Hylis foveicollis	2485	NT				3	1	1
	Hylis olexai	2486	NT	3	6	1		2	2
	Eucnemis capucina	2487	T	6	5		3	5	7
Ptinidae	Xestobium rufovillosum	2628	NT	18				20	4
	Gastrallus immarginatus	2640	NT					1	
	Cacotemnus thomsoni	2646	NE		1				
	Priobium carpini	2650	T		3				
	Dorcatoma flavicornis	2665	T	73	3	1		60	9
	Dorcatoma chrysomelina	2667	NT	73	7		1	227	20
	Dorcatoma robusta	2671	T		2				
Lymexylidae	Lymexylon navale	2675	T	10	6	1		29	8
Cryptophagidae	Cryptophagus quercinus	2911	T			5			
	Cryptophagus badius	2912	T	23	4	1	6	88	2
Erotylidae	Triplax aenea	3010	T	1					
	Triplax rufipes	3013	NT	3				1	
	Colydium elongatum	3246	T						
Colydidae/Zophorid	Colydium elongatum	3246	T	6		1			1
Mycetophagidae	Mycetophagus piceus	3261	NT	16	1		1	87	9
	Mycetophagus 10-punctatus	3262	HT	11			1		
	Mycetophagus populi	3267	T		1				
Aderidae	Euglenes pygmaeus	3313	T	10	1	3	1	13	
	Euglenes oculatus	3314	T	3				54	3
Tenebrionidae	Pentaphyllus testaceus	3361	T					6	2
	Corticeus fasciatus	3395	HT	1				5	
	Allecula morio	3397	T		1			21	4
	Allecula rhenana	3398	HT		1			1	7
	Prionychus ater	3400	NT	5				13	5
	Pseudocistela ceramboides	3403	T	1				6	7
Melandryidae	Orchesia micans	3459	NT	1	1	3	7		
Cerambycidae	Rhagium sycophanta	3497	T					1	
	Stictoleptura scutellata	3520	T	1					
Curculionidae	Euophryum confine	4291	DD					1	
	Phloeophagus lignarius	4299	NT						2
	Acalles misellus	4337	T	1					
No of beetle species				27	17	9	11	29	23
No of beetle individuals				280	93	17	26	713	116

Table 3. Species living in tree hollows found in the study of saproxylic beetles on old deciduous trees in Stodthagen and Wulfshagen, Kiel, Germany, in 2022. (Saprox: O = obligate saproxylic F = facultative saproxylic).

Family	Spec name	Cat Col	Saprox	Red list	Stodthagen	Wulfshagen
Histeridae	<i>Abraeus granulum</i>	646	O			1
	<i>Abraeus perpusillus</i>	647	O		1	1
	<i>Plegaderus dissectus</i>	653	O		1	1
	<i>Gnathoncus nannetensis</i>	672	F		1	
	<i>Gnathoncus buyssoni</i>	674	F		1	
	<i>Dendrophilus corticalis</i>	677	F		1	1
	<i>Paromalus flavicornis</i>	680	O		1	1
	<i>Margarinotus striola</i>	684	F		1	1
	<i>Margarinotus merdarius</i>	685	F		1	1
Leiodidae	<i>Nemadus colonoides</i>	888	O		1	1
Staphylinidae	<i>Velleius dilatatus</i>	1101	F		1	1
	<i>Quedius maurus</i>	1106	O		1	
	<i>Quedius brevicornis</i>	1109	O		1	1
	<i>Quedius truncicola</i>	1115	O	NT	1	1
	<i>Quedius scitus</i>	1117	F		1	1
	<i>Euplectus brunneus</i>	1351	O		1	
	<i>Batrisodes delaporti</i>	1358	O			1
	<i>Batrisodes venustus</i>	1359	O		1	1
	<i>Prionocyphon serricornis</i>	2197	O		1	1
Trogidae	<i>Trox scaber</i>	2203	F		1	1
Scarabaeidae	<i>Osmoderma eremita</i>	2293	O	HT		1
Elateridae	<i>Procræus tibialis</i>	2434	O	T	1	1
	<i>Ampedus rufipennis</i>	2435	O	HT		1
	<i>Ampedus hjorti</i>	2443	O	T	1	1
Eucnemidae	<i>Eucnemis capucina</i>	2487	O	T	1	1
Dermestidae	<i>Dermestes lardarius</i>	2562	F			1
Ptinidae	<i>Ptinus fur</i>	2619	F		1	1
	<i>Ptinus subpilosus</i>	2622	O			1
Cryptophagidae	<i>Cryptophagus badius</i>	2912	O	T	1	1
	<i>Cryptophagus micaceus</i>	2922	O		1	1
	<i>Cryptophagus saginatus</i>	2923	F		1	1
	<i>Cryptophagus pilosus</i>	2939	F		1	1
	<i>Atomaria morio</i>	2953	F	T	1	
Mycetophagidae	<i>Triphyllus bicolor</i>	3256	F		1	1
	<i>Mycetophagus quadriguttatus</i>	3264	F		1	1
Tenebrionidae	<i>Pentaphyllus testaceus</i>	3361	O	T		1
	<i>Palorus depressus</i>	3364	F		1	1
	<i>Tenebrio molitor</i>	3385	F			1
	<i>Allecula morio</i>	3397	O	T	1	1
	<i>Allecula rhenana</i>	3398	O	HT	1	1
	<i>Prionychus ater</i>	3400	O	NT	1	1
	<i>Pseudocistela ceramoides</i>	3403	O	T	1	1
	<i>Mycetochara maura (linearis)</i>	3410	O		1	1
	<i>Cossonus linearis</i>	4292	O		1	
No of beetle species					36	38

Oak (*Quercus*)

The oaks were studied with a greater and similar effort (Tab 1) at both sites so a comparison is possible to make. In total the number of red listed saproxylic beetles are in the same level for the two studied sites: 29 species for Wulfshagen and 27 species from Stodthagen (Tab 2). If looking only at the result from the pitfall traps in the hollow oaks Wulfshagen gave 13 red listed saproxylic beetles in comparison with 11 at Stodthagen

The species found from the higher red list category (Highly threatened = HT) are: the darkling beetle (Tenebrionidae) *Corticeus fasciatus* found at both sites and the darkling beetle *Allecula rhenana* and the hermit beetle (*Osmoderma eremita*) only found in Wulfshagen and the hairy fungus beetle (Mycetophagidae) *Mycetophagus decempunctatus* only found in Stodthagen.

For more information about the species see Appendix 2.

Beech (*Fagus sylvatica*)

The beech trees were studied with a smaller but similar effort (Tab 1) at both sites so a comparison is possible to make even less fair. In total the number of red listed saproxylic beetles were higher for Wulfshagen with 23 found species in comparison with 17 for Stodthagen. This is despite Wulfshagen had less traps (Tab 1): 29 species for Wulfshagen and 27 species from Stodthagen.

The species found from the higher red list category (Highly threatened = HT) are: the darkling beetle (Tenebrionidae) *Allecula rhenana* at Stodthagen, the hermit beetle (*Osmoderma eremita*) and the click beetle (Elateridae) *Ampedus rufipennis* only found in Wulfshagen.

Birch (*Betula* sp)

Only one birch was studied in Stodthagen. One trap of each type was used and gave still a good result with 9 red listed species (Tab 2). For example: the false click beetle (Eucnemidae) *Microrhagus pygmaeus*, the silken fungus beetles (Cryptophagidae) *Cryptophagus quercinus* and *Cryptophagus badius* and the ant-like leaf beetle (Aderidae) *Euglenes pygmeus*. Some of the species caught originate from other trees nearby like the Timberworm beetle (Lymexylidae) *Lymexylon navale* (from an oak tree) and probably the Death watch beetle *Dorcatoma flavicornis* and *Colydium elongatum* as well.

Alder (*Alnus glutinosa*)

The alder trees were only studied in Stodthagen. The traps were placed on two old hollow alders and caught 11 red listed species. Some examples of nice species are: the false click beetles (Eucnemidae) *Microrhagus pygmeus*, *Eucnemis capucina* and *Hylis cariniceps*, but also the rare hairy fungus beetle (Mycetophagidae) *Mycetophagus decempunctatus* is worth mentioning.

5. Discussion

This study has given a first overview of the richness of beetles living in the hollow trees in both areas. To be able to say if species have been translocated by the wood mould boxes that will be moved from Wulfshagen to Stodthagen, a very good picture of the species composition are needed from both areas. A lot of studies are needed to have the full picture of the species diversity of saproxylic beetles in areas of these sizes. In studies during one season of the capture efficiency of the window traps (Jansson & Antonsson, unpublished data), results indicate that 6-

10 window traps (size of the transparent plastic sheet 50x30 cm) on one and same tree species (oak – *Quercus robur*) capture 50-70% of (but not all of the hollow living species) species in smaller areas (5-10ha). This means that the effort used on oaks in this study (7 and 9 window traps) is not enough to get the full picture of all the species living on oaks in the studied areas. For a full picture 15-20 traps per tree species is needed. But it depends of how rich the fauna is in an area and how big variation it is between the trees. Another sign of that a large effort is needed to catch a large part of the saproxylic beetles in an area is that this study increased the number of known saproxylic beetle species known from Stodthagen (from the result from the study of Gürlich in 2005) from 191 to 312.

As the effort in Wulfshagen was only concentrated to hollow oaks and beeches it has not given the full picture of the wood living species in the area. A study of other tree species like ash and lime tree would give some more species. The studied trees in Wulfshagen were also in medium stages of the hollow tree succession (Fig 3) so further studies of weak or dead trees, fallen trees or high stumps or dead wood with bracket fungus would for sure give many other species. For Stodthagen the traps covered a larger range of tree species and to some extent a wider range of succession stages of the trees but studies of some more birches, some aspens and coniferous trees would complement and give a lot of valuable information especially for a comparison with the study Stephan Gürlich (2005) made in the area.

6. Acknowledgement

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7. Disclaimer:

This publication and any communication or publication reported in it reflects only the author's view and the Commission is not responsible for any use that may be made of the information it contains.

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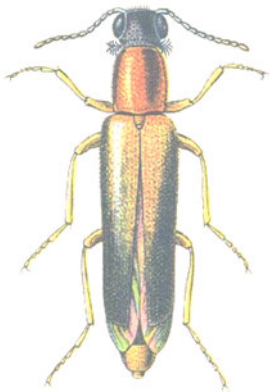
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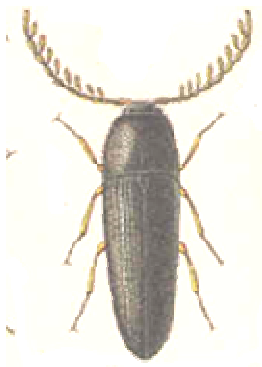
Appendix 1 - Description of some of the red listed and interesting saproxylic beetle species found in Stodthagen and Wulfshagen in Kiel region in 2022.



***Cacotemnus thomsoni* (ER – Nearly extinct)** – This beetle belongs to the family Ptinidae that today also includes the Death watch beetles like this species. The beetle is grey-brown and 3mm long. It was found in a window trap on an old beech tree in Stodthagen. The larval development take place under the bark of old spruces like *Picea abies* so this individual has just passed the beech tree.



***Lymexylon navale* (T - Threatened)** – A beetle belonging to the family Lymexylidae. The size of this beetle can vary a lot, between 8-15mm. Its yellow with black head and orange pronotum. The larval development take place in fresh oak wood in parts lost the bark. In this study it was found in several window traps in both Stodthagen and Wulfshagen.



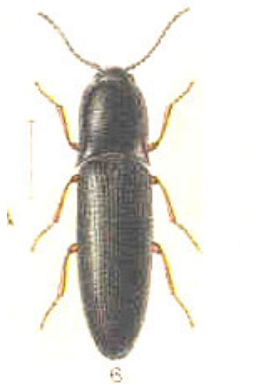
***Mycrorhagus pygmaeus* (T – Threatened).** A beetle from the family False click beetles (Eucnemidae). It's a 3mm long black and slender beetle were the male has comb shaped antennae. The larval development take place in white rooted deciduous thinner wood. In this study all the individuals were found in traps on several tree species in Stodthagen.



***Eucnemis capucina* (T – Threatened).** Another beetle from the family False click beetles (Eucnemidae). It's a 3-5mm long black and slender beetle. The larval development take place in white rooted wood in hollow deciduous trees. In this study all the individuals were found in traps on several tree species in both Stodthagen and Wulfshagen.



***Osmoderma eremita* (HT – Highly Threatened)** – A large (25-30mm) shiny dark brown beetle belonging to the family Scarabaeidae. The larvae develop in the wood mould (wood compost) in the bottom of hollow deciduous trees. It's a protected species in the European Union. The individuals found in this study were caught in two window traps on an oak and a beech tree. The picture is made by Kenneth Claesson.



***Procraerus tibialis* (T - Threatened)**. A 8mm long, slender shiny black beetle from the family Click beetle (Elateridae). 8 mm lång. The larvae develop in the rotten wood on the inside of hollow trunks (preferably oaks). In this study most of the individuals were found in the hollow oaks in Wulfshagen but two were also found in a hollow oak in a short distance from Stodthagen.

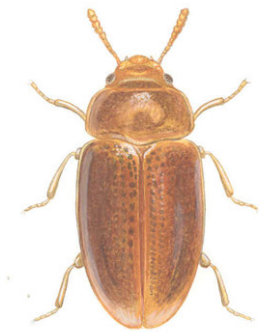


***Ampedus rufipennis* (HT – Highly Threatened)**. A beetle from the family Click beetles (Elateridae). Its black with red elytra and 12-15mm long. The larva live in the rotten wood of old beech trees. In this study some individuals were found in window traps on two hollow beeches in Wulfshagen.

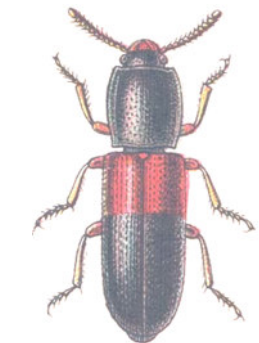


***Mycetophagus decempunctatus* (HT – Highly Threatened)** – Belong to the family hairy fungus beetles (Mycetophagidae). The species is dark brown with light yellow spots on the elytra and 3-4mm long.

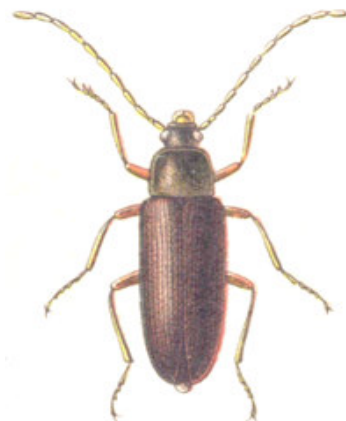
In this study most of the individuals were found in a window trap on an old dead hollow oak a short distance outside Stodthagen but also on a window trap on an old hollow black alder (*Alnus glutinosa*). The beetle in the picture is the close relative *M. 4-punctatus*.



***Pentaphyllus testaceus* (T - Threatened)** Belong to the family darkling beetles (Tenebrionidae) and with 1.5mm in length it is one of the smallest species in the family. The beetle is light brown yellowish. The larvae develop in red rot in dead standing large trees, preferably oaks (*Quercus* spp). The eight individuals found in this study were found in both window and pitfall traps on oaks and beeches in Wulfshagen. The picture is made by Kenneth Claesson.



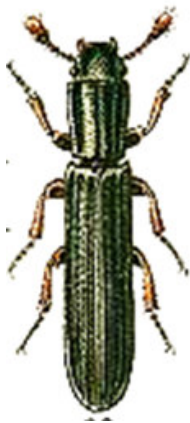
***Corticeus fasciatus* (HT – Highly Threatened)** – Belong to the family darkling beetles (Tenebrionidae). The beetle has a slender body, black with a yellow section in the front of the elytra and 3mm long. The larvae develop of wood dust and remnants in the tracks of the beetle *Lymexylon navale* in dead standing large trees, preferably oaks (*Quercus* spp). In this study most of the individuals were found in four window traps on oaks in Wulfshagen and on an old dead hollow oak a short distance outside Stodthagen.



***Allecula rhenana* (HT – Highly threatened)** – This species belong to the family darkling beetles (but former it belonged Alleculidae). The beetle is 8-10mm, with slender dark brown body and long antennae. The larval development take place in the dead wood of large standing living deciduous trees. Most often other trees than oak. But in this study the individuals were found in window traps on both beech and oaks in Wulfshagen and in a pitfall trap in a hollow beech in Stodthagen.



***Prionychus ater* (NT – Near threatened)** - This species belong to the family darkling beetles (but former it belonged Alleculidae). It is 10-13mm long and the whole beetle is black. The larval development take place in the cavities of standing hollow deciduous trees. Can be found in most deciduous tree species. In this study the individuals were found in both window- and pitfall traps on both beech and oaks in Wulfshagen and Stodthagen.



***Colydium elongatum* (T - Threatened)** - Belong to the family darkling beetles (Tenebrionidae). The beetle has a slender body, black with a yellow section in the front of the elytra and 3mm long. The larvae develop of wood dust and remnants in the tracks of the beetle *Lymexylon navale* in dead standing large trees, preferably oaks (*Quercus* spp). In this study most of the individuals were found in four window traps on oaks in Wulfshagen and on an old dead hollow oak a short distance outside Stodthagen.

Appendix 2 - The total species list of the saproxylic beetle species found in the studies in Stodthagen and Wulfshagen in the Kiel region in 2022.

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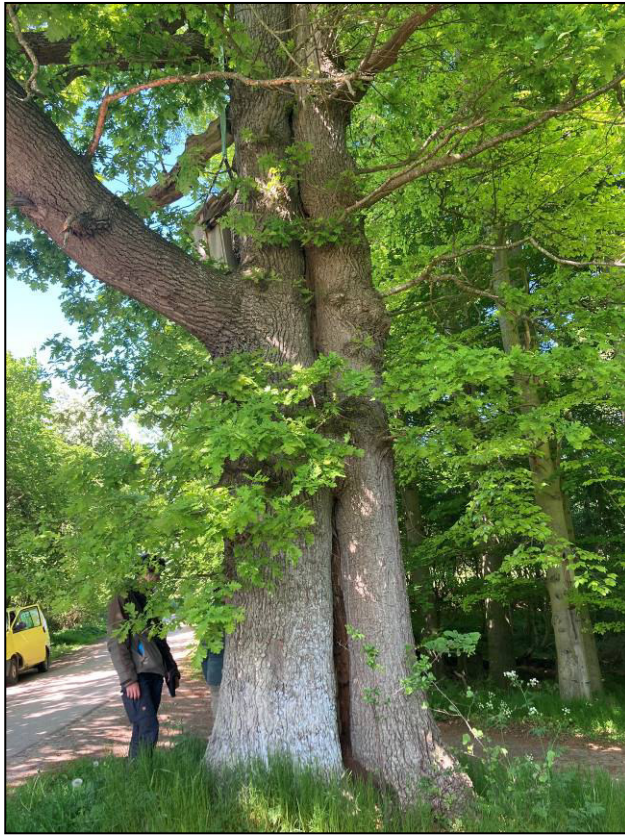
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Beetles in and on old trees in Kiel 2022									
Tree species		Q=Quercus, F=Fagus, B=Betula, A=Alnus		Stodthagen		Gürlich		Wulfshagen	
Family	Spec name	Cat Col	Saprox	Red list	Gürlich 2005	Q	Q	Q	Q
	Dorcatoia chrysomelina	2667	O	NT		2	8	4	17
	Dorcatoia dresdensis	2670	O						
	Dorcatoia robusta	2671	O	T					
Lymexylidae	Hylocetes dermestoides	2674	O		1				
	Lymexylon navale	2675	O	T					
Cleridae	Tillus elongatus	2687	O		1	3	1	2	1
	Opilo mollis	2689	O						
	Thanasimus formicarius	2691	O						
Melyridae	Korynetes caeruleus	2696	F						
	Dasytes cyaneus	2709	O			1			
	Dasytes aeneus	2711	O		1				
	Dasytes plumbeus	2712	O		1	2	2	3	
	Dasytes virens?	2714	O						
	Charopus graminicola (flavipes)	2717							
	Malachius bipustulatus	2725	O		1				
	Anthrenus rufus	2728	F			3			
	Anthrenus fasciatus	2729	F						
Kateridae	Kateretes pedicularius	2731							
	Carpophilus marginellus	2742	O						
Nitidulidae	Epuraea melanocephala	2745	O		1				
	Epuraea guttata	2746	O		1	7			
	Epuraea marseuli	2759	O		1				
	Epuraea longula	2761	O						
	Epuraea terminalis	2764	O		1				
	Epuraea biguttata	2768	O						
	Epuraea unicolor	2769	O		1	1	1	1	
	Epuraea variegata	2770	O		1				
	Epuraea aestiva	2774	O		1				
	Epuraea melina	2775	O						
	Omosita depressa	2818	O						
	Omosita discoidea	2819	O						
	Soronia punctatissima	2825	O						
	Soronia grisea	2826	O		1				
	Cryptacha strigata	2834	O		1				
	Cryptacha undata	2835	O		1				
	Gliastrochilus quadriguttatus	2836	O		1				
	Gliastrochilus hortensis	2837	O		1				
	Sphindus dubius	2841	F						
Sphindidae	Apidophorus orbicollis	2842	F		1				
	Rhizophagus depressus	2846	O		1				
Monotomidae	Rhizophagus ferrugineus	2847	O		1				
	Rhizophagus parallelocollis	2848	F						
	Rhizophagus perforatus	2849	O		1				
	Rhizophagus picipes	2850	O						
	Rhizophagus dispar	2851	F		1				
	Rhizophagus bipustulatus	2852	O		1	3	1		
	Rhizophagus nitidulus	2853	O		1				

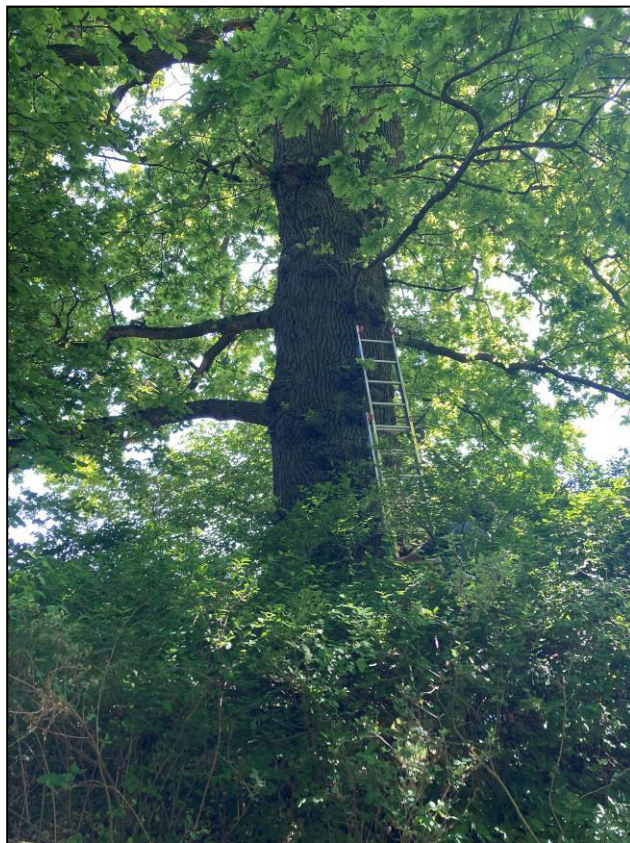
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Appendix 3 – A description of the studied trees in Stodthagen and Wulfshagen in Kiel region in 2022.

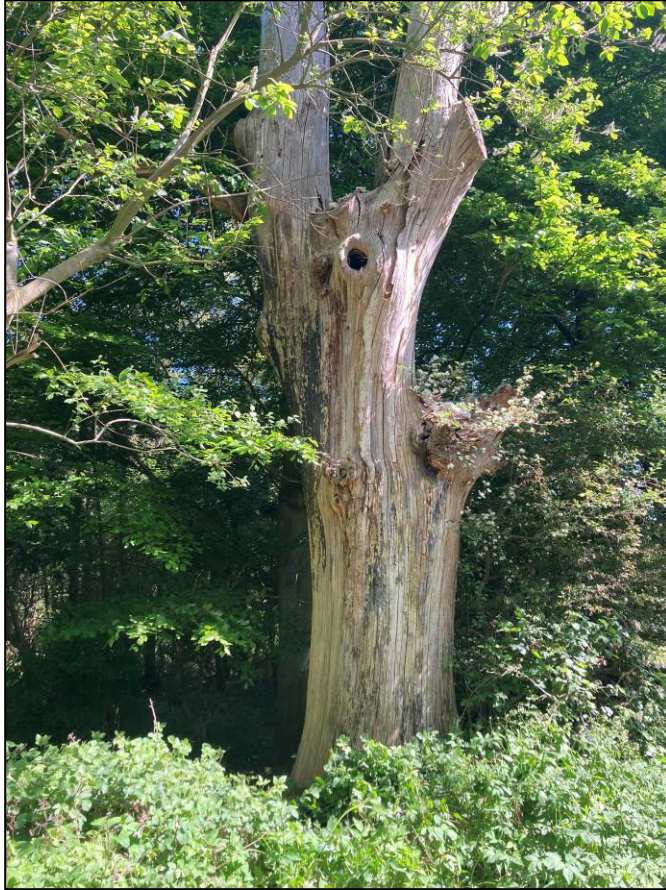
Studied trees in Stodthagen



No 1. A big (4.20cm in circumference in breast height) hollow oak (*Quercus robur*) standing in an open and sunny condition along the road some hundreds of meters before the Stodthagen area. It has a long cavity entrance (15x210cm) running from the ground up to three meters height with a lot of red rotted wood but just a small amount of wood mould. The pitfall (1P) was placed in ground level and the window trap (1W) 4.6m above the ground.



No 2. A big (4.22cm in circumference in breast height) hollow oak (*Quercus robur*) also situated beside the road leading to Stodthagen some hundred meters before the area. The lower part of the trunk has a dense bush layer reaching 2.5m up the trunk. The tree has a small (4x4cm) cavity entrance at 4m height so it was not possible to use a pitfall trap. The window trap (2W) were placed just outside the cavity entrance at 4.5m above the ground.



No 3. A big (3.79cm in circumference in breast height) dead hollow oak (*Quercus robur*) also situated beside the road leading to Stodthagen some hundred meters before the area. Its standing in half shadow in a forest edge. The tree has a large cavity but a rather small entrance (17x20cm) at 4m height but wide enough to place a pitfall trap (3P). The window trap (3W) were placed just outside the cavity entrance at 4.4m above the ground.



No 4. A big (5.20cm in circumference in breast height) hollow oak (*Quercus robur*) standing in an open and sunny condition in a large pasture grazed by horses and cattle in the Stodthagen area. The tree has a small cavity with a medium sized entrance at ground level with just a small amount of wood mould mixed with clay soil. The pitfall (4P) was placed in ground level but no window trap was used.





No 5. A big (6.79cm in circumference in breast height) hollow oak (*Quercus robur*) standing in an open and sunny condition in a large pasture grazed by horses and cattle in the Stodthagen area. The tree has a small cavity with a medium sized entrance at ground level with just a small amount of wood mould mixed with clay soil. The pitfall trap (5P) was placed in ground level but no window trap was used.



No 6. A large (6.56cm in circumference in breast height) hollow oak (*Quercus robur*) standing in an open and sunny condition in a large pasture grazed by horses and cattle in the Stodthagen area. The tree has a medium sized cavity with a large entrance (50x60cm) at ground level with just a small amount of wood mould mixed with clay soil. The pitfall trap (6P) was placed in ground level but no window trap was used.



No 7. A small (2.10cm in circumference in breast height) hollow oak (*Quercus robur*) standing in an open and sunny condition in a large pasture grazed by horses and cattle in the Stodthagen area. The tree has several entrances but the tree is very hollow a forming a tube. The entrance at ground level hade 10 liter of wood mould (red rot type). The pitfall trap (7P) was placed in ground level and the window trap (7W) was placed on the trunk near the other entrances at 2.1m height.



No 8. A large (4.34cm in circumference in breast height) hollow black alder (*Alnus glutinosa*) standing in an semi open and rather sunny condition in a forest glade in the Stodthagen area. The tree has several entrances but it was hard to reach the wood mould. The pitfall trap (8P) was placed in a cavity at 1m level and the window trap (8W) was placed on the trunk near the other entrances at 2.8m height.





No 9. A big (3.53cm in circumference in breast height) dead oak (*Quercus robur*) standing in an open and sunny condition in a large forest glade in the Stodthagen area. The tree has no visible cavities entrances so no pitfall trap was used. Most of the thick bark were loose and was not attached to the trunk creating interesting microhabitats. The window trap (9W) was placed on the south side of the trunk at 2m height.



No 10. A dead smaller birch (*Betula sp.*, 1.10m in circumference in breast height) standing in a shady part of the forest in the Stodthagen area. The tree had a lot of visible cavities entrances and the pitfall trap (10P) was placed in one of them. The window trap (10W) was placed on the trunk near the other entrances at 2m height.



No 11. A large (2.96cm in circumference in breast high) dying hollow oak (*Quercus robur*) standing in a shady condition in the forest in the Stodthagen area. The tree has a medium sized cavity with a small (8x8cm) entrance at 2.6m high with just a small amount of wood mould. The pitfall trap (11P) was placed in ground level and the windowtrap was placed at 2.6m high..



No 12. A hollow beech (*Fagus sylvatica*) (1.55cm in circumference in breast height) standing in a shady part of the forest in the Stodthagen area. The tree has a medium sized cavity with a large entrance at ground level with just a small amount of wood mould mixed with leaves. The pitfall trap (12P) was placed in ground level but no window trap were used.



No 13. A high beech stump (*Fagus sylvatica*) standing in a shady part of the forest in the Stodthagen area. The trunk is full with old fruitbodies of the polypore mushroom *Fomes fomentarius*. The trunk has small cavities in the bottom of the trunk entrances and the pitfall trap (11P) was placed near the rotten roots. The window trap (11W) was placed on the trunk at 2m height.

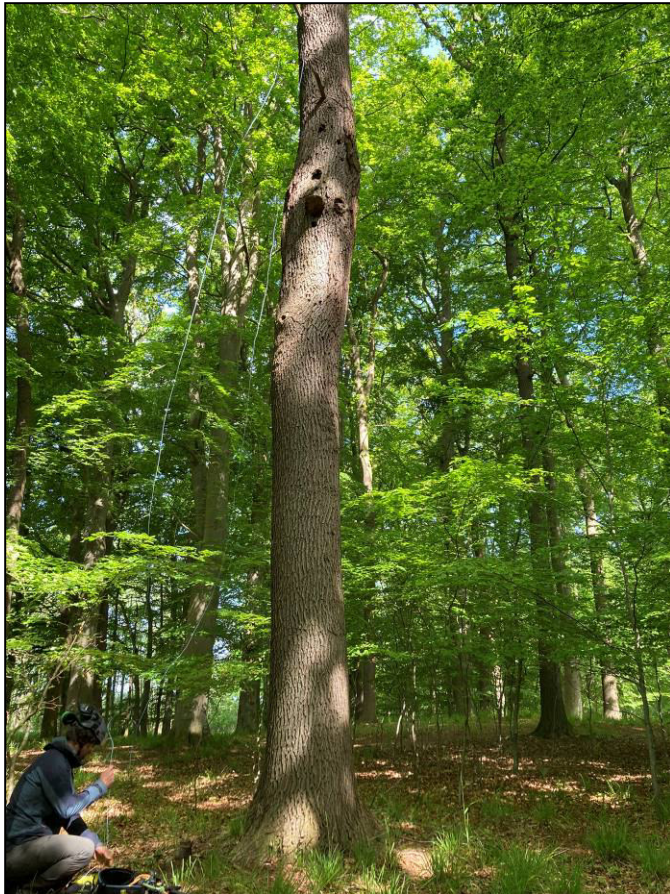


No 14. A hollow beech (*Fagus sylvatica*) standing near the forest edge in a shady part of the forest in the Stodthagen area. The tree has a medium sized cavity with a medium sized entrance (18x39cm) at 2.5m height with white rot and just a lot of wood mould. A pitfall trap (14P) could be placed in the hollow and a window trap (14W) was mounted just in front the cavity entrance.





No 15. A large (2.53m in circumference in breast height) hollow black alder (*Alnus glutinosa*) standing in a semi open and rather sunny condition in a forest glade in the Stodthagen area. The tree has several entrances but it was hard to reach the wood mould so no pitfall trap was used. The window trap (15W) was placed on the trunk near the entrances (15x20cm) at 4m height.



No 16. A tall and slender (2.15m in circumference in breast height) hollow oak (*Quercus robur*) with a *Phellinus robustus* bracket colonized the stem standing in a shady part of the forest in the Stodthagen area. The tree has a small sized cavity with a small entrance (6x6cm) at 6m height. No pitfall trap could be placed but a window trap (16W) was mounted just in front of the entrance.





No 17. A hollow beech (*Fagus sylvatica*) standing near the forest edge in a semi shady part of the forest in the Stodthagen area. The tree has a medium sized cavity with a medium sized entrance (9x45cm) at 2.5m height with white rot and just a small amount of wood mould mixed with leaves. No pitfall trap could be placed but a window trap (17W) was mounted just in front the cavity entrance.



Studied trees in Wulfshagen



No 1. A dead big (Circumference: 4.76cm at breast height) hollow oak (*Quercus robur*) situated in a light situation in a pasture, grazed by horses, with scattered large oaks. The tree has a large cavity (with a lot of wood mould of red rot type) at 6m height and a medium sized entrance but wide enough (30x30cm) to place a pitfall trap (1P) and another pitfall trap was placed in a smaller cavity in ground level. The window trap (1W) was placed just outside the cavity entrance at 6.5m above the ground.

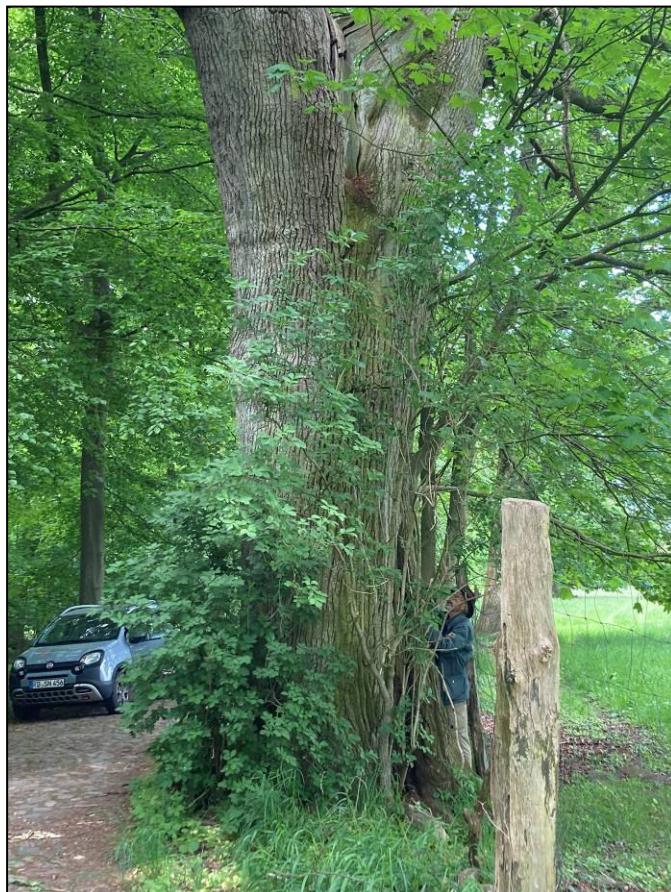


No 2. A big (Circumference: 4.53cm at breast height) hollow oak (*Quercus robur*) situated in a light situation in a pasture, grazed by horses, with scattered large oaks. The tree has a large cavity (with a lot of wood mould of red rot type with a lot of remnants from an owl nest) at 5m height and a large entrance (50x100cm) where we placed a pitfall trap (2P). The window trap (2W) was placed just outside the cavity entrance at 5m above the ground.





No 3. A big (Circumference: 5.08cm at breast height) hollow oak (*Quercus robur*) situated in a light situation in a pasture, grazed by horses, with scattered large oaks. The tree has a large cavity (with a lot of wood mould of red rot type) at 6m height and a large entrance (65x40cm) where we placed a pitfall trap (3P). The window trap (3W) was placed just outside the cavity entrance at 6m above the ground.



No 4. A big (Circumference: 4.84cm at breast height) hollow oak (*Quercus robur*) situated in a semi light situation in a pasture, grazed by horses, with scattered large oaks. The tree has a small and slender cavity (with a little amount of wood mould of red rot type) at ground level there is a small entrance (5x30cm) where we placed a pitfall trap (4P). The window trap (4W) was placed above the cavity entrance at 2.5m above the ground.





No 5. A big (Circumference: 6.02cm at breast height) hollow oak (*Quercus robur*) situated in a light situation in a pasture, grazed by horses, with scattered large oaks. The tree has a large cavity at 4.5m height and a large entrance (70x45cm) where placed a pitfall trap was placed (5P). The window trap (5W) was placed just outside the cavity entrance at 5m above the ground.



No 6. A big (Circumference: 5.30cm at breast height) hollow oak (*Quercus robur*) situated in a light situation in a pasture, grazed by horses, with scattered large oaks. The tree has a very large cavity (with wood mould of red rot type) at 5.3m height and a small entrance (6x10cm) so it was not possible to place any pitfall trap. The window trap (6W) was placed just outside the cavity entrance at 6m above the ground. The rare beetle *Tillus elongatus* was seen during the work.





No 7. A big (Circumference: 6.50cm at breast height) hollow oak (*Quercus robur*) situated in a light situation in a pasture, grazed by horses, with scattered large oaks. The tree has a small cavity (with a little amount of wood mould of red rot type) at ground level and there is a small entrance (20x30cm) where we placed a pitfall trap (7P). No window trap was placed.



No 8. A big (Circumference: 5.58cm at breast height) hollow oak (*Quercus robur*) situated in a light situation in a pasture, grazed by horses, with scattered large oaks. The tree has a large cavity (with a lot of wood mould of red rot type) starting from ground level. The entrance is long and slender (30x400cm) where we placed a pitfall trap in the bottom (8P). The window tran (8W) was placed just outside the



No 9. A big (Circumference: 4.38cm at breast height) hollow beech (*Fagus sylvatica*) situated in the forest edge but in a shady situation. The tree has a medium sized cavity (with a lot of wood mould of white rot type) at 6.2m height. The entrance is small (12x25cm) but enough for place a pitfall trap (9P). The window trap (9W) was placed just outside the cavity entrance at 6m above the ground.



No 10. A big (Circumference: 4.51cm at breast height) hollow beech (*Fagus sylvatica*) situated in the forest in a semi shady situation. The tree has a medium sized cavity (with a lot of white rotted wood but not so much wood mould (of white rot type) at 8.4m height. The entrance is large (30x500cm) but it was not possible to place a trap. The window trap (10W) was placed just outside the cavity entrance at 8m above the ground.



No 11. A big (Circumference: 5.60cm at breast height) hollow beech (*Fagus sylvatica*) situated at the forest edge in a semi shady situation. The tree has a large cavity with a lot of white rotted wood at ground level. The entrance is large (90x170cm) where a pitfall trap (11P) was placed. No window trap was placed. The rare click beetle *Ampedus rufipennis* was seen during the tran work.



No 12. A big (Circumference: 4.26cm at breast height) hollow oak (*Quercus robur*) situated along a road in a semi light situation. The tree has a medium sized cavity (with wood mould of red rot type) at 7.2m height and a small entrance (16x16cm) so it was possible to place pitfall trap (12P). The window trap (12W) was placed just outside the cavity entrance at 6m above the ground.



No 13. A big (Circumference: 5.60cm at breast height) hollow oak (*Quercus robur*) situated along a road in a light situation. The tree has a large cavity (with wood mould of red rot type) and a small entrance (16x16cm) at 4m height. But the pitfall trap (13P) was placed in another entrance near ground level. The window trap (13W) was placed just outside the cavity entrance at 4m above the ground.