Insects associated with fruit bodies of the wood-decaying fungus Oak mazegill (*Daedalea quercina*) in mixed oak forests in southern Sweden

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Polypores host species rich insect assemblages, but relatively few polypore species have been studied in detail. We investigated insect assemblages associated with the fruit bodies of *Daedalea quercina*, a specialist species on oak in southern Sweden. Fruit bodies (n = 228) were collected from 25 nature reserves and woodland key habitats, and were taken into the laboratory to collect emerging insects. A total of 245 insect individuals were recorded, belonging to at least 45 species. The numerically dominant fungivores were the tineid moths *Montescardia tessulatella* (n = 38 individuals) and *Nemapogon fungivorellus* (n = 10) and the coleopteran *Ennearthron cornutum* (Ciidae) (n = 44). Altogether 40 individuals of hymenopteran parasitoids were recorded, belonging to Braconidae (Exothecinae, Microgastrinae and Rogadinae, altogether 6 spp.), Ichneumonidae (Banchinae, Cryptinae and Orthocentrinae, altogether 4 spp.), Torymidae (1 sp.), Perilampidae (1 sp.) and Scelionidae (1 sp.). Most of the remaining insect species are not specifically associated with fruit bodies, but occupy many types of decaying material. In conclusion, *D. quercina* hosted a low number of insect individuals in general and only a few coleopteran species. The fungus apparently has only one specialist species, *N. fungivorellus*, which is a near-threatened (NT) species on the Swedish red list; the record from Norra Vi is the first from the Jönköping. The overall low number of insect individuals and the dominance of Lepidoptera among the fungivores is possibly explained by the tough fruit bodies of *D. quercina*, which only moths are able to utilize; fruit bodies which had already started to rot were devoid of moths.

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Insect-fungus interactions have received increasing research interest, yet we still lack detailed and systematically obtained information about insect assemblages from most fungal species. Many wood-decaying fungi (polypores) host species rich insect communities, comprising fungivores

Figure 1. *Daedalea quercina* on dead oak branch in Aspanäs, Östergötland. The perennial fruit bodies occur on dead branches on living trees as well as on stumps, snags and logs. Fruit bodies host many insects, including Lepidoptera, Coleoptera, Diptera and Hymenoptera.

Korkmussling på död ekgren vid Aspanäs, Östergötland. Fruktkroppar av korkmussling är fleråriga och förekommer på död ved på levande ekar och på ek-stubbar och lågor. Många arter av fjärilar, skalbaggar, tvåvingar och steklar lever i fruktkropparna. Foto: Atte Komonen.

and their parasitoids and predators (Komonen 2001, 2003). In this paper, we describe the insect species composition in the fruit bodies of the wood-decaying fungus *Daedalea quercina* (L.) Pers. (1801), a specialist species on oak in south Swedish woodlands.

Fungivores can be categorized as obligate or facultative. In polypores, obligate fungivores belong mostly to Coleoptera (Tenebrionoidea, Anobiidae), Lepidoptera (Tineidae) and Diptera (Sciaroidea and Tipuloidea). There are also some species of Staphylinidae (Coleoptera), which feed on spores. Obligate fungivores, however, are rarely specialists in any fungal species, rather they can utilize a few related fungal species (Jonsell & Nordlander 2004). In addition to host identity, many other factors influence insects' occurrence in fruit bodies, such as the successional stage of the fruit body or local environmental conditions (e.g. microclimate, forest characteristics) (Jonsell et al. 2001, Komonen et al. 2004, Komonen & Kouki 2005). Facultative fungivores can be found from all the above-mentioned insect orders. These species are not specifically associated with fungal fruit bodies, but utilize many types of decaying material. Hymenopteran and dipteran parasitoids parasitize eggs, larvae or pupa of the fungivores and are themselves parasitized by hymenopteran hyperparasitoids.

Oaks *Quercus robur* and *Q. petraea* may be considered keystone species for biodiversity in mixed-species temperate broadleaved forest, because they host a large number of rare and red-listed species, of which many are not found on any other tree species (Palm 1959, Berg et al. 1994, Gärdenfors 1994, Dahlberg & Stokland 2004, Nordén et al. 2007, 2008, Jansson 2009). Particularly, large-diameter hollow oaks host a high number of specialized insect species. Such trees are scarce across Europe, occurring mostly in nature reserves and other set-aside areas, as well as in some parks. Large oaks have been strongly disfavored in Sweden after their legal protection ceased in 1830. Oaks have been cut, traditional woodland pastures have been abandoned, and silviculture has favored conifers. (Eliasson 2002, Götmark et al. 2005). Consequently, the range of many oak dependent species has declined (Lindhe et al. 2010) and many species have become more or less threatened (i.e. red-listed; see Gärdenfors 2005). In this context it is interesting to document if there are any specialist fungivores on *D. quercina*, what type of fruit bodies and forests they prefer, and to assess their conservation status in Sweden.

Material and Methods

The study fungus

The wood-decaying fungus Oak mazegill (Sw: korkmussling) *Daedalea quercina* (Basidiomycota: Polyporales) is a specialist species on oaks (*Quercus* spp.), although occasionally known to occur on other trees (Niemelä, 2005; Fig. 1). This perennial brown-rot causing species is the only representative of the genus in Europe, and has a wide global distribution, following that of oaks. The fruit bodies are very tough with a cork-like texture, and typically 10-20 cm x 5-10 cm and 3-8 cm thick. The fruit bodies occur singly or in small clusters on dead branches of living oaks, or on logs, stumps, snags and fallen branches.

Study sites and sampling

The study sites (n = 25; Fig. 2, Table 1) were former woodland pastures, which have been aban-

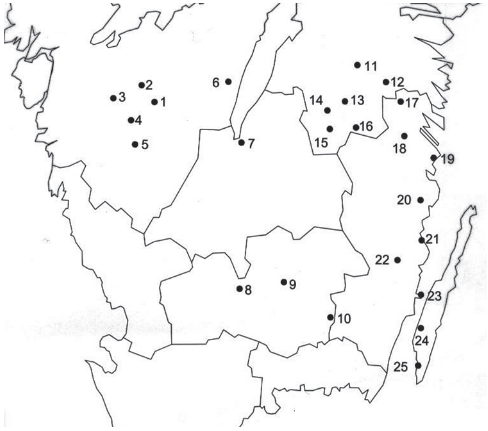

Figure 2. *Daedalea quercina* fruit bodies were collected from 25 sites (nature reserves or woodland key habitats) in southern Sweden. All sites are mixed-species oak-rich broad-leaved woodland. Numbers refer to Table 1.

Fruktkropparna av korkmussling insamlades från 25 naturreservat/nyckelbiotoper i Götaland. Alla lokaler är ek-rika blandskogar. Numren på kartan refererar till Tabell 1.

Table 1. Study sites, dead wood (CWD, > 10 cm diameter), living oaks, woody debris objects with *Daedalea quercina* (Dq objects), and fruit bodies recorded and collected.

Lokaler, dödved (> 10 cm diameter), ekar (grundyta), objekt (ek) med korkmussling (Dq objects), samt fruktkroppar inventerade och insamlade (=collected).

	Site area/ Areal	Oak CWD/ Död ekved	Basal area living oaks	Sampled area/ Provtagen yta	Dq objects/ Vedbitar med Dq		Fruiting bodies/Fruktkroppar		
Name/Namn	(ha)	(m^3/ha)	(m^2/ha)	(ha)	No	(ha^{-1})	No/antal	(ha^{-1})	No. collected
1 Skölvene	7	2.3	18.2	5.3	3	0.57	14	3	4
2 Karla	4	0.9	13.1	5.1	3	0.59	15	3	5
3 Östadkulle	4	1.0	15.1	4.0	3	0.75	18	5	6
4 Sandviksås	9	5.4	10.2	6.3	6	0.95	58	9	15
5 Rya åsar	60	5.9	22.8	7.0	6	0.86	150	21	30
6 Strakaskogen	11	1.4	4.2	6.2	0	0.00	0	0	0
7 Bondberget	104	9.9	11.6	7.5	10	1.33	97	13	7
8 Långhult	22	1.5	11.8	6.6	4	0.61	7	1	5
9 Bokhultet	150	10.1	16.2	6.4	14	2.19	122	19	9
10 Kråksjöby	6	1.1	20.3	3.5	0	0.00	0	0	0
11 Stavsäter	18	0.8	6.0	8.5	6	0.71	16	2	3
12 Åtvidaberg	7	5.7	17.2	6.6	5	0.76	21	3	13
13 Fagerhult	20	0.7	7.2	7.7	3	0.39	15	2	4
14 Aspernäs	28	5.9	14.0	11.4	8	0.70	30	3	8
15 Norra Vi	8	8.1	18.8	5.0	14	2.80	126	25	19
16 Fröåsa	6	1.7	15.8	5.9	11	1.86	85	14	14
17 Ulvsdal	12	8.6	10.1	8.0	25	3.13	82	10	14
18 Hallingeberg	7	6.2	18.3	5.3	8	1.51	16	3	7
19 Ytterhult	15	4.1	14.4	7.9	5	0.63	23	3	5
20 Fårbo	17	18.9	17.1	7.7	6	0.78	10	1	7
21 Emsfors	8	6.9	10.6	6.5	3	0.46	8	1	2
22 Getebro	15	2.4	16.8	7.5	11	1.47	70	9	13
23 Lindö	13	1.6	8.5	5.6	10	1.79	56	10	11
24 Vickleby	7	2.5	26.5	6.5	40	6.15	304	47	14
25 Albrunna	25	11.5	11.9	11.0	3	0.27	31	3	13
Overall/Totalt					207	1.25	1374	8	228

doned 50-80 years ago. Currently, the sites are nature reserves (12) or woodland key habitats (13), which have been set-aside from commercial forestry and contain many large oaks (oldest trees at each site about 80-250 years old). The mean area of the sites is 23 ha (SD = 34 ha). These sites are used in the Swedish Oak Project to study forest landscape values, and experimental conservation thinning (see Götmark 2010, 2012). At www.bioenv.gu.se/personal/Gotmark_Frank/ there are seven newsletters from the project in Swedish, with many articles and site photos.

In smaller sites, the entire area was searched for fruit bodies, whereas in larger sites the sampling was restricted to the core area of the site (i.e. surrounding the area where the dead wood measurements and thinnings had been done; Table 1). All living and dead oak trees, branches and stumps were surveyed for fruiting bodies. Because the field work was done before the green vegetation emerged, fallen branches, stumps and oak trees were easily visible. Also, the pale colored fruiting bodies could be easily spotted high up on oak trees. In smaller stands, all fruiting bodies that were found, that could be reached from the ground and that had traces of moth feeding were collected, whereas at larger stands a sample was collected from many scattered wood pieces. Feeding by moths leaves conspicuous frass, which allows identifying previously or currently occupied fruit bodies (Fig. 3). As other insect taxa do not leave conspicuous feeding traces and there were no published studies of the insect fauna in *D. quercina*, fruit bodies of different decay stages were also collected. Altogether 1374 fruit bodies were recorded, of which 228 were collected for insect rearings. Field work was conducted from 23 March to 12 April 2009.

In the laboratory, fruit bodies were divided in 5 decay classes (1 = living, no traces of moth feeding (3% of the collected fruit bodies), 2 = partly living (or recently dead), but no traces of moth feeding (14%), 3 = recently dead with traces of moth feeding (57%), 4 = starting to rot, but no traces of moth feeding (6%), 5 = rotten with traces of moth feeding (20%). Because substrate size influences animal density in general, the dry weight of each fruit body was measured with 2 g accuracy after the rearings to examine the relationship between insect density and resource size. Most of the collected fruit bodies were small: the median dry weight was 20 g (min-max = 2-680 g).

All fruiting bodies were placed individually in plywood boxes (10 x 28 x 28 cm and 15 x 28 x 28 cm) or in 10 dl plastic boxes, and were kept in room temperature (18°C) to allow the emergence of insects. Most emerged individuals entered a glass vial, which was inserted into the side of the box during rearing. Boxes were opened 16-20 August 2009 to collect the remaining insects and to weigh the fruit bodies. Moths have generally one-year development in southern Sweden (Bengtsson et al. 2008), and because of the high constant temperature at the laboratory, it is likely that all moths completed their development by the time rearing boxes were opened; fruiting bodies were not dissected. The focus of the present study was on the fungivorous insects, so not all accidental or low-abundance taxa were identified to species level. The nomenclature of Coleoptera follows Silfverberg (2010), Lepidoptera Bengtsson et al. (2008) and Hymenoptera Gauld & Bolton (1988) and Goulet & Huber (1993).

Results

The mean density of wood pieces with *D. quercina* was 1.3 per ha (including also few fruit bodies high up in trees) and density of fruit bodies 8 per ha (Table 1). A total of 245 insect individuals belonging to at least 45 species emerged from the *D. quercina* fruit bodies. Of the fungivorous species, Lepidoptera (5 spp., 55 exx.) and Coleoptera (at least 15 spp., 120 exx.) were numerically dominant (Table 2); 40 parasitoids were also reared (at least 13 spp.). Living or partly living fruit bodies without moth frass (n = 37), as well as very decayed ones (n = 42) apparently did not host any fungivorous Tineidae or Ciidae. The dry weight of the fruit bodies did not correlate with the number of insect individuals ($r_s = 0.20$, $n = 88$, $p = 0.07$; only fruit bodies that hosted insect individuals were included). Even very small (6 g) fruit bodies hosted tineid moths.

Table 2. At least 45 insect species emerged from *Daedalea quercina* fruit bodies from nature reserves and woodland key habitats from southern Sweden.

Minst 45 insektsarter kom fram från fruktkroppar av korkmussling *Daedalea quercina*, insamlade från naturreservat och nyckelbiotoper i södra Sverige.

Family/ Familj	Species/ Art	# of individuals/ Antal individer	# of sites/ Ant.lokaler
Lepidoptera			
Tineidae	*Montescardia tessulatella*	38	12
Tineidae	*Nemapogon fungivorellus*	10	3
Tineidae	*Agnathosia mendicella*	3	3
Tineidae	*Nemapogon cloacellus*	2	2
Tineidae	*Morophaga choragella*	1	1
Coleoptera			
Dytiscidae	*Hydroporus sp.*	2	2
Carabidae	*Agonum obscurum*	1	1
Carabidae	*Harpalus sp.*	1	1
Staphylinidae	*Aleocharinae spp.*	42	
Staphylinidae	*Staphylininae sp. 1*	1	1
Staphylinidae	*Staphylininae sp. 2*	1	1
Staphylinidae	*Quedius sp.*	1	1
Staphylinidae	*Sepedophilus sp.*	1	1
Malachiidae	*Malachius bipustulatus*	2	2
Cryptophagidae	*Cryptophagus sp.*	1	1
Latridiidae	*Dieneralle sp.*	1	1
Latridiidae	*Corticaria sp.*	9	3
Latridiidae	*Corticarina sp.*	5	1
Ciidae	*Ennearthron cornutum*	44	8
Ciidae	*Cis bidentatus*	1	1
Ciidae	*Orthocis sp.*	1	1
Cantharidae	*Malthodes sp.*	1	1
Scraptiidae	*Anaspis thoracica*	2	2
Apionidae	*Apion sp.*	1	1
Curculionidae	*Rhyncolus ater*	2	2
Diptera			
Nematocera	*Nematocera spp.*	18	
Table 2 continued			
Anthomyiidae	*Anthomyiidae sp.*	2	1
Agromyziidae	*Agromyzidae sp.*	1	1
Anthomyzidae	*Anthomyzidae sp.*	2	1
Hymenoptera			
Ichneumonidae	*Banchinae*		
Ichneumonidae	*Lissonota sp. 1*	3	3
Ichneumonidae	*Lissonota sp. 2*	2	1
Ichneumonidae	*Orthocentrinae*		
Ichneumonidae	*Symplecis sp. 1*	4	1
Ichneumonidae	*Cryptinae*		
Ichneumonidae	*Uchidella sp. 1*	1	1
Braconidae	*Exothecinae*		
Braconidae	*Colastes sp. 1*	2	1
Braconidae	*Colastes sp. 2*	3	3
Braconidae	*Colastes sp. 3*	2	2
Braconidae	*Microgastrinae*		
Braconidae	*Apanteles sp. 1*	11	5
Braconidae	*Rogadinae*		
Braconidae	*Rogas sp. 1*	2	1
Braconidae	*Braconidae sp.*	1	1
Scelionidae	*Trissolcus sp. 1*	2	2
Perilampidae	*Perilampus sp. 1*	6	1
Torymidae	*Torymidae sp. 1*	1	1
Heteroptera			
Piesmatidae	*Piesma maculatum*	1	1
Anthocoridae	*Anthocoris confusus*	4	1
Mecoptera			
Raphidiidae	*Raphidia notata*	3	1
TOTAL		245	

Discussion

The insect assemblage on *D. quercina* was numerically dominated by two fungivorous species, the moth *Montescardia tessulatella* and the coleopteran *Ennearthron cornutum*. Similar high relative abundance of Lepidoptera among the fungivores and lack of numerically dominant specialist or semi-specialist Coleoptera, were observed for spruce-growing *Fomitopsis rosea* (Komonen 2001). It is also interesting that both *D. quercina* and *F. rosea* share two Lepidoptera species, namely *Agnathosia mendicella* and *Montescardia tessulatella* (Komonen & Mutanen 1999, Komonen 2001); the latter has also been reared from several other polypores. These host use patterns might be explained by the very close phylogenetic relatedness of *Daedalea* and *Fomitopsis* (Hibbett & Donoghue 2001). *Agnathosia mendicella* has a southern distribution in Scandinavia but occurs quite far north in Finland, whereas *M. tessulatella* occurs throughout Fennoscandia (Bengtsson et al. 2008).

Nemapogon fungivorellus is a red-listed species (near-threatened, NT) in Sweden and considered a specialist in *D. quercina* (Fig. 4). In Scandinavia, the species has a rather limited distribution in southern coastal regions (Bengtsson et al. 2008). In this study, 6 specimens were re-

Figure 3. Moth larvae develop inside *D. quercina* fruit bodies and their feeding leaves conspicuous frass. In this example, the large diameter frass indicates that the larvae are near pupation or have already left the fruit body.

Larver av malfjärilar utvecklas i fruktkroppar av korkmussling och de efterlämnar tydliga exkrementer. I denna fruktkropp, indikerar stor diameter på exkrementerna att larverna antingen är redo att förpuppa sig eller har lämnat fruktkroppen. Foto: Atte Komonen.

corded from coastal Albrunna (southern Öland), but also 2 specimens from Rya åsar (Borås) and 2 specimens from Norra Vi (ca. 20 km southwest from Kisa), which are both located more inland; the record from Norra Vi is the first from Jönköping. *Nemapogon cloacellus* has been reared from many polypore species and genera in Sweden and has a wide distribution across Fennoscandia (Jonsell & Nordlander 2004, Bengtsson et al. 2008). The documented moth species composition is in accordance with previous observations (Bengtsson et al. 2008).

Although Coleoptera were numerically dominant, the lepidopteran larvae are capable of utilizing living fruit bodies and thus are mainly responsible for modifying the physical structure and contributing to the destruction of fruit bodies. Based on the laboratory observations, Lepidoptera pupate close to the surface of the fruit body, and the empty pupal skins remain attached on the surface when the adult emerges from the fruit body. The larvae of fungivorous Tineidae readily developed in very small and apparently living fruit bodies, whereas too decayed fruit bodies seem to be unsuitable. No adults emerged from the fruit bodies without visible frass (Fig. 3), indicating that no lepidopteran individual was missed by preferably collecting those with frass.

Ennearthron cornutum was the most abundant fungivorous beetle in our material. The fact that *E. cornutum* was very abundant in some fruiting bodies, while absent from most fruit bodies, suggests that – if conditions are suitable – the species can complete its development in the fruit bodies of *D. quercina* (see also Reibnitz 1999). Similar opportunism has also been observed for *Cis glabratus* in *Amylocystis lappon-*

Figure 4. The near-threatened *Nemapogon fungivorellus* is a specialist species on *Daedalea quercina*. Ten individuals of the species were documented from three areas: Borås, Öland and for the first time from Jönköping.

Den hänsynskrävande (NT) korkmusslingsmalen är specialist på korkmussling. Sammanlagt tio individer dokumenterades från Borås, Öland och för första gången från Jönköping. Foto: Marko Mutanen.

ica (Komonen 2001). *Ennearthron cornutum* is a generalist species known to develop in many polypore species, from various tree species and habitats (Reibnitz 1999, Jonsell et al. 2001), and is rarely encountered in many individuals. The coleopteran fauna of *D. quercina* has previously been studied in Britain, but no Ciidae was reported (Paviour-Smith 1960). The German data compiled by Reibnitz (1999) indicate *D. quercina* as one host for *Ennearthron cornutum*, the species being the only Ciidae utilizing this fungus.

The parasitoid wasps were represented by 5 families. The most numerous species was *Apanteles* sp. 1. (Braconidae: Microgastrinae), which was recorded from 5 localities (altogether 11 specimens). Microgastrines are koinobiont endoparasitoids of Lepidoptera (Wharton et al. 1997); koinobionts are parasitoids, which allow the host to continue its development while feeding upon it. The other Braconidae subfamilies were Exothecinae (3 species of *Colastes* altogether 7 specimens) and Rogadinae (1 species and 2 specimens of *Rogas*) being idiobiont ectoparasitoids of concealed hosts (idiobionts are parasitoids, which prevent further development of the host after initially immobilizing it) and koinobiont endoparasitoids of Lepidoptera, respectively. In addition, there is one unidentified braconid wasp represented by 1 specimen.

The family Ichneumonidae was represented by the subfamilies Banchinae (2 species of the genus *Lissonota*, in total 5 specimens), Orthocentrinae (1 species of the genus *Symplecis*, 3 specimens) and Cryptinae (1 species of the genus *Uchidella*, 1 specimen). Banchines are koinobiont endoparasitoids of Lepidoptera, and previously *Lissonota* have been reared from several polypore species (Jonsell et al. 2001). The orthocentrines have been reared reliably only from larval fungus gnats (Diptera: Sciaroidea) and most cryptines are idiobiont ectoparasitoids of various insect orders (Gauld & Bolton 1988). In addition to Ichneumonoidea, we identified three morphospecies of microhymenopterans from the samples. One rearing produced 6 specimens of Perilampidae (1 species of *Perilampus*), which have been recorded as parasitoids or hyperparasitoids from several insect orders (Gibson et al. 1997), also from polypores (Jonsell et al. 2001). The other chalcidoidean species was represented by a single female specimen of Torymidae. The rearings also resulted in 2 specimens of Scelionidae belonging to one morphospecies of the genus *Trissolcus*, which are generally egg parasitoids of insects

Conclusions

Daedalea quercina is one of the most common polypore species on oak. Yet, it had a relatively low density in the study sites in comparison to many other polypore species on other tree species. It also hosted a low number of insect fungivores which are specialists on this fungus, compared to some other (but not all) well-studied polypore species. The overall low number of insect individuals and the dominance of Lepidoptera among the fungivores is possibly explained by the tough fruit bodies of *D. quercina*, which only moths may be able to utilize. The fungus itself apparently has a very broad environmental tolerance (occurs in sunny and shady places, as well as near ground and up in the canopy), which in theory should increase the number of associated insect species. However, the low density of fruit bodies possibly makes it challenging for any specialized insect to maintain viable populations in habitats, which have been heavily altered by humans. In past decades, there have been many extensive and systematic studies on fungal-insect communities. These studies have confirmed previous anecdotal observations or revealed many new insect-fungus-parasitoid associations. The present study is one new piece in this myco-entomological puzzle.

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References

Bengtsson, B.Å., Johansson, R. & Palmqvist, G. 2008. Nationalnyckeln till Sveriges flora och fauna. Fjärilar: käkmalar-säckspinnare. Lepidoptera: Micropterigidae-Psychidae. –ArtDatabanken, SLU, Uppsala.

Berg, Å., Ehnström, B., Gustafsson, L., Hallingbäck, T., Jonsell, M. & Weslien, J. 1994. Threatened plant, animal, and fungus species in Swedish forests. Distribution and habitat associations. – Conservation Biology 8: 718-731.

Dahlberg, A. & Stokland, J.N. 2004. Vedlevande arters krav på substrat - sammanställning och analys av 3 600 arter. – Skogsstyrelsen Rapport 7/2004.

Eliasson, P. 2002. Skog, makt och människor. En miljöhistoria om svensk skog 1800–1875. – Kungliga Skogs- och Lantbruksakademien, Stockholm.

Gauld, I.D. & Bolton, B. 1988. The Hymenoptera. – Oxford University Press, Oxford.

Gibson, G.A.P., Huber, J.T. & Woolley, J.B. 1997. Annotated Keys to the Genera of Nearctic Chalcidoidea (Hymenoptera). – The National Research Council Research Press, Ottawa, Ontario.

Goulet, H. & Huber, J.T. (eds.) 1993. Hymenoptera of the World: An Identification Guide to Families. – Agriculture Canada Publications, Ottawa.

Gärdenfors U. 1994. Eken - utnyttjad av tusentals organismer. – I: *Ekfrämjandet 50 år.* s. 77–82. Ekfrämjandet, Lund.

Gärdenfors, U. (ed.) 2005. The 2005 Red List of Swedish species. – ArtDatabanken, Uppsala.

Götmark, F., Fridman, J., Kempe, G. & Nordén, B. 2005. Broadleaved tree species in conifer-dominated forestry: regeneration and limitation of saplings in southern Sweden. – Forest Ecology and Management 214: 142-157.

Götmark, F. 2010. Skötsel av skogar med höga naturvärden – en kunskapsöversikt. –Svensk Botanisk Tidskrift 104, Supplement 1, pp. 1-88.

Götmark, F. 2012. Habitat management alternatives for conservation forests in the temperate zone: a review. – Biological Conservation, under review.

Hibbett, D.S. & Donoghue, M.J. 2001. Analysis of character correlations among wood decay mechanisms, mating systems, and substrate ranges in Homobasidiomycetes. – Systematic Biology 50: 215-242.

Jansson, N. 2009. Habitat requirements and preservation of the beetle assemblages associated with hollow oaks. – Ph.D. thesis, Linköping University, Sweden.

Jonsell, M., Nordlander, G. & Ehnström, B. 2001. Substrate associations of insects breeding in fruiting bodies of wood-decaying fungi. – Ecological Bulletins 49: 173-194.

Jonsell, M. & Nordlander, G. 2004. Host selection patterns in insects breeding in bracket fungi. – Ecological Entomology 29: 697-705.

Komonen, A. & Mutanen, M. 1999. The biology and distribution of Agnathosia mendicella (Tineidae) in Finland. – Baptria 24(4): 201-207.

Komonen, A. 2001. Structure of insect communities inhabiting two old-growth forest specialist bracket fungi. – Ecological Entomology 26: 63-75.

Komonen, A. 2003. Hotspots of insect diversity in boreal forests. – Conservation Biology 17: 976-981.

Komonen, A. & Kouki, J. 2005. Occurrence and abundance of fungus-dwelling beetles (Ciidae) in boreal forests and clearcuts: habitat associations at two spatial scales. – Animal Biodiversity and Conservation 28: 137-147.

Komonen, A., Jonsell, M., Økland, B., Sverdrup-Thygeson, A. & Thunes, K. 2004. Insect assemblage associated with the polypore *Fomitopsis pinicola*: a comparison across Fennoscandia. – Entomologica Fennica 15: 102-112.

Lindhe, A., Jeppsson, T. & Ehnström, B. 2010. Longhorn beetles in Sweden – changes in distribution and abundance over the last two hundred years. – Entomologisk Tidskrift 131(4): 241-508.

Niemelä, T. 2005. Käävät – puiden sienet. – Norrlinia, Helsinki.

Nordén, B., Götmark, F., Ryberg, M., Paltto, H. & Allmér, J. 2008. Partial cutting reduces species richness of fungi on woody debris in oak-rich forests. – Canadian Journal of Forest Research 38: 1807-1816.

Nordén, B., Paltto, H., Götmark, F. & Wallin, K. 2007. Species indicators of biodiversity, what do they indicate? - Lessons for conservation of cryptogams in oak-rich forest. – Biological Conservation 135: 369–379.

Palm, T. 1959. Die Holz- und Rindenkäfer der süd- und mittelschwedischen Laubbäume. – Opuscula Entomologica Supplementum 16: 1-374.

Paviour-Smith, K. 1960. The fruiting bodies of macrofungi as habitats for beetles of the family Ciidae (Coleoptera). – Oikos 11: 43-71.

Reibnitz, J. 1999. Verbreitung und Lebensräume der Baumschwammfresser Südwestdeutschlands (Coleoptera: Cisidae). – Mitteilungen Entomologischer Verein Stuttgart 34.

Silfverberg, H. 2010. Enumeratio renovata Coleopterorum Fennoscandiae, Daniae et Baltiae. – Sahlbergia 16(2): 1-144.

Wharton, R.A., Marsh, P.M. & Sharkey, M.J. (eds.) 1997. Manual of the New World Genera of the Family Braconidae (Hymenoptera). – The International Society of Hymenopterists, Washington, DC.

Sammanfattning

Tickor och andra vedsvampar är ofta värdar för många olika insektsarter, men för ganska få svampar har samhällena beskrivits i detalj. Vi undersökte insektssamhällen i eksvampen korkmussling *Daedalea quercina* i södra Sverige. Från 228 fruktkroppar insamlade i 25 reservat och nyckelbiotoper i Götaland kläcktes 245 insektsindivider. Minst 45 arter identifierades, varav de vanligaste var de svampätande fjärilarna *Montescardia tessulatella* (n = 38) och *Nemapogon fungivorellus* (n = 10, Fig. 4) (Tineidae), samt skalbaggen *Ennearthron cornutum* (Ciidae) (n = 44). 40 individer av parasitsteklar noterades: Braconidae (underfamilj Exothecinae, Microgastrinae och Rogadinae, totalt 6 arter), Ichneumonidae (underfamilj Banchinae, Cryptinae och Orthocentrinae, totalt 4 arter), Torymidae (1 art), Perilampidae (1 art) och Scelionidae (1 art). De flesta övriga insektsarterna var inte svampspecialister. Få insektsarter förutom den hänsynskrävande (NT) korkmusslingsmalen (*N. fungivorellus*) verkar vara specialiserade på korkmussling, vilket är lite i jämförelse med vissa andra tickor. Korkmusslingsmal (2 individer) från Norra Vi är den första observationen i Jönköping. En förklaring till det låga art- och individantalet av insekter samt till dominansen av fjärilar i korkmusslingen kan vara de hårda fruktkropparna i kombination med att de sällan finns i stora tätheter.