

## Ant-associated beetles of Fennoscandia and Denmark

Jussi Päivinen, Petri Ahlroth & Veijo Kaitala

Päivinen, J., Ahlroth, P. & Kaitala, V. 2002: Ant-associated beetles of Fennoscandia and Denmark. — *Entomol. Fennica* 13: 20–40.

Ants have a negative impact on populations of many arthropod species. On the other hand, numerous arthropod species live in association with ants. In this paper we list ant-associated beetles (including myrmecophiles) of Fennoscandia and Denmark. Data is based on a literature survey and new field observations. We list 369 ant-associated beetle species of which 73 are categorized as myrmecophilous. Our data suggests that there might be numerous beetle species associated with ants, which are not generally known to do so. This indicates that ant colonies may be important habitats for a large variety of beetle species.

*Jussi Päivinen, Department of Biological and Environmental Science, University of Jyväskylä, P.O. Box 35, FIN-40351 Jyväskylä, Finland; E-mail: jupepa@dodo.jyu.fi*

*Petri Ahlroth, Jyväskylä University Museum, Section of Natural History, P.O. Box 35, FIN-40351 Jyväskylä, Finland; E-mail: pahl@dodo.jyu.fi*

*Veijo Kaitala, Department of Biological and Environmental Science, University of Jyväskylä, P.O. Box 35, FIN-40351 Jyväskylä, Finland; E-mail: vkaitala@cc.jyu.fi*

*Received 22 March 2001, accepted 24 October 2001*

### 1. Introduction

Several studies suggest that ants, through predation and disturbance, have a negative impact on various arthropods, such as harvestmen (Opiliones), spiders (Araneae) and ground beetles (Carabidae) (Cherix & Bourne 1980, Rosengren & Sundström 1991, Niemelä *et al.* 1992, Laakso & Setälä 2000). Nevertheless, numerous arthropods live in an association with ants (*see* the reviews by Larsson 1943, Kistner 1982, Hölldobler & Wilson 1990). In a recent study in Finland, wood ant mounds (Formicidae, *Formica* spp.) were considered to be hot spots for earthworms and many arthropods that are not usually considered as ant-associated or myrmecophilous species (Laakso & Setälä

1997, 1998). According to Laakso & Setälä (1997), the activity and presence of ants create habitats that have highly different abiotic and biotic conditions compared to the surrounding forest floor. For example, wood ant mounds differ from the surrounding by having a high and regulated temperature, and high input of detritus and arthropod carrion (Rosengren *et al.* 1987). Moreover, the wood ant mounds are actively shielded from various arthropod and vertebrate predators (e.g. ground beetles, spiders, birds and shrews). Based on these assumptions, we predict that ant colonies may also maintain a high species richness of many other arthropod groups.

Ant-associated insects have evolved different types of symbiotic relationships with ants. “Ant

guests”, commonly known as myrmecophiles, are dependent on ant societies at least during part of their life cycles (Hölldobler & Wilson 1990). Other species do so occasionally, functioning as casual predators or temporary nest commensals. Both of these ant-associated insect groups include a great variety of springtails (Collembola), beetles (Coleoptera) and butterflies (Lepidoptera), as well as less abundant representatives of a wide range of other insect groups (Hölldobler & Wilson 1990).

One of the most diverse ant-associated insect taxa are beetles. According to Hölldobler & Wilson (1990), 35 different ant-associated beetle families, consisting of thousands of species, have hitherto been recorded. Although the literature on ant-associated beetle species is enormous, a large part of the available data consists only of incidental observations or ecological studies of individual species. Only a few detailed lists of the host ants and their myrmecophilous beetles have been previously published (e.g. Johansen 1904, Donisthorpe 1927, Larsson 1943, Collingwood 1957, Wilson 1971, Kistner 1982, Hölldobler & Wilson 1990, Wojcik 1990, Franck 1992, Kistner *et al.* 1997), and an updated list on this fauna in Fennoscandia and Denmark is virtually lacking.

In this paper we survey the most comprehensive list of myrmecophilous and other ant-associated beetles in Fennoscandia (Finland, Norway and Sweden) and Denmark. The two groups — myrmecophilous and other ant-associated beetles — will be hereafter referred to by the abbreviation AAB (ant-associated beetles). We also demonstrate that ant colonies are species rich habitats for beetles. This knowledge is based on the present literature of beetles and their ecology. The knowledge is reinforced by our own data, and by field observations of several coleopterologists. Finally, we discuss the previous classifications of myrmecophilous beetles.

## 2. Material and methods

In this study, we collected a list of beetle species, which have been observed with ants according to literature and some field observations. We also collected data on host ants and special requirements of beetle species. We used the following sources of information on ant-associated beetles.

Danmarks Fauna: Hansen & Henriksen (1927), Larsson (1943), Hansen (1950, 1951a, 1951b, 1952, 1954, 1956, 1957, 1958, 1965, 1966a, 1966b, 1968a, 1968b, 1969, 1973a, 1973b, 1973c, 1973d), Die Käfer Mitteleuropas Ökologie: (Koch 1989a, 1989b, 1992) and Svensk Insektfauna: Aurivillius (1917, 1920), Spessittseff (1925), Lindroth (1933, 1961), Palm (1948, 1961, 1963, 1966, 1968, 1970, 1972) and Landin (1957). In addition to these books, we collected data from some periodicals: Acta Entomologica Fennica, Annales Entomologici Fennici, Entomologica Fennica, Entomologica Scandinavica, Entomologisk Tidskrift, Entomologiske Meddelelser, Entomologist's Gazzette, Norwegian Journal of Entomology, Fauna Norvegica, Notulae Entomologicae. From these periodicals we used the following references. Meinert (1887–88a, 1887–88b, 1889–90), Lovendal (1891–92), Johansen (1895–96, 1903, 1904, 1906), Schlick (1895–96, 1897), Holstebro (1910), Adlerz (1911, 1912), Rosenberg (1913, 1914, 1924), West (1913, 1930), Krogerus (1934), Palm (1936, 1943, 1946, 1947, 1954a, 1954b, 1956, 1959, 1979, 1985a, 1985b), Palmén (1936), Kangas (1938, 1951, 1982, 1983), Lindberg (1943), Kryger (1945), Lindgren (1945), Widenfalk, 1954, Kornerup (1960), Collingwood (1957, 1959, 1965), Wegelius (1960), Lundberg (1961, 1972, 1973, 1976, 1977, 1978a, 1978b, 1980, 1981, 1983, 1984, 1993), Hansen (1964, 1967, 1968c, 1970, 1971), Huggert (1967), Skidmore & Johnson (1969), Huggert & Ulefors (1971), Baranowski (1975, 1976, 1979, 1980a, 1980b, 1982), Szymczakowski (1975), Andersson (1977, 1981), Nilssen & Andersen (1977), Rydh (1977), Sörensson (1979, 1996), Bangsholt (1981), Persson (1981), Gillerfors (1982, 1990), Pritzl (1982), Ehnström (1983), Andersen *et al.* (1984), Hansen & Mahler (1985), Mahler (1987), Clayhills (1988), Hansen (1988), Johnson (1988), Martin (1989), Hansen *et al.* (1990, 1991, 1994), Paulsen (1991) and Siitonen (1993). *See also* Douglas (1858), Adlerz (1913), Donisthorpe (1927), Lindroth (1946), Owen (1986, 2000), Vallenduuk (1987), Franc (1992), Völkl (1995), Sagvolden & Hansen (1996), Whitehead (1996), Sloggett *et al.* (1999) and Jorum (2000). Furthermore, our data include field observations from Finland (Päivinen 1999, Mukkala pers. comm., Rutanen pers. comm.). In these field studies, all beetles were captured inside ant mounds and occasional observations were not included in our list.

## 3. Results

Based on the literature survey and field observations a total of 369 ant-associated species of beetles have been recorded in Fennoscandia and Denmark (Table 1). These species numbers include both myrmecophiles and other ant-associated beetles (Table 1). The total number of host ant species was 39. The largest number of beetle species was found

Table 1. List of the ant associated beetle species and their host ants according to the studied literature and new field observations. \* = myrmecophile according to Koch (1989a, 1989b, 1992), and \*\* = myrmecophile according to Szymczakowski (1975). Abbreviations under the column "host ant" are explained in Table 2. Under the column Ref., 1 = Danmarks Fauna (Hansen & Henriksen 1927, Larsson 1943, Hansen 1950, 1951a, 1951b, 1952, 1954, 1956, 1957, 1958, 1965, 1966a, 1966b, 1968a, 1968b, 1969, 1973a, 1973b, 1973c, 1973d), 2 = Die Käfer Mitteleuropas Ökologie (Koch 1989a, 1989b, 1992), 3 = Svensk Insekt Fauna (Spessivtseff 1925, Landin 1957, Lindroth 1933, 1961, Palm 1948, 1961, 1963, 1966, 1968, 1970, 1972), 4 = Päivinen 1999, 5 = Mukkala pers. comm., 6 = Rutanen pers. comm., 7 = Völkl 1995, 8 = Ehnström 1983, 9 = Szymczakowski 1975, 10 = Adlerz 1911, 11 = Adlerz 1912, 12 = Palm 1936, 13 = Palm 1943, 14 = Lindgren 1945, 15 = Palm 1946, 16 = Palm 1947, 17 = Palm 1954a, 18 = Palm 1954b, 19 = Widenfalk 1954, 20 = Palm 1956, 21 = Franc 1992, 22 = Adlerz 1913, 23 = Palm 1959, 24 = Lundberg 1961, 25 = Huggert 1967, 26 = Huggert & Ulefors 1971, 27 = Lundberg 1972, 28 = Lundberg 1973, 29 = Baranowski 1975, 30 = Lundberg 1976, 31 = Baranowski 1976, 32 = Andersson 1977, 33 = Rydh 1977, 34 = Lundberg 1978b, 35 = Lundberg 1978a, 36 = Palm 1979, 37 = Sörenssön 1979, 38 = Baranowski 1979, 39 = Owen 1986, 40 = Baranowski 1980a, 41 = Baranowski 1980b, 42 = Persson 1981, 43 = Lundberg 1981, 44 = Andersson 1981, 45 = Gillerfors 1982, 46 = Baranowski 1982, 47 = Lundberg 1983, 48 = Lundberg 1984, 49 = Palm 1985a, 50 = Palm 1985b, 51 = Gillerfors 1990, 52 = Lundberg 1993, 53 = Sörensson 1996, 54 = Collingwood 1957, 55 = Collingwood 1959, 56 = Collingwood 1965, 57 = Douglas 1858, 58 = Palmen 1936, 59 = Kangas 1938, 60 = Kangas 1951, 61 = Kangas 1982, 63 = Kangas 1983, 64 = Siitonen 1993, 65 = Krogerus 1934, 66 = Lindberg 1943, 67 = Wegelius 1960, 68 = Clayhills 1988, 69 = Donisthorpe 1927, 70 = Lundberg 1980, 71 = Lundberg 1977, 72 = Skidmore & Johnson 1969, 73 = Johnson 1988, 74 = Whitehead 1996, 75 = Sloggett et al. 1999, 76 = Owen 2000, 77 = Nilssen & Andersen 1977, 78 = Andersen et al. 1984, 79 = Paulsen 1991, 80 = Sagvolden & Hansen 1996, 81 = Johansen 1904, 82 = Meinert 1887–88a, 83 = Meinert 1889–90, 84 = Lovendal 1891–92, 85 = Johansen 1895–96, 86 = Schlick 1895–96, 87 = Meinert 1887–88b, 88 = Schlick 1897, 89 = Johansen 1903, 90 = Johansen 1906, 91 = Holstebro 1910, 92 = West 1913, 93 = Rosenberg 1913, 94 = Rosenberg 1914, 95 = West 1930, 96 = Kryger & Sonderup 1945, 97 = Kornerup 1960, 98 = Hansen 1967, 99 = Hansen 1968c, 100 = Hansen 1970, 101 = Hansen 1971, 102 = Bangsholt 1981, 103 = Pritzl & Mahler 1982, 104 = Hansen & Mahler 1985, 105 = Mahler 1987, 106 = Hansen 1988, 107 = Martin 1989, 108 = Hansen et al. 1990, 109 = Hansen et al. 1991, 110 = Hansen et al. 1994, 111 = Jorum 2000, 112 = Lindroth 1946, 113 = Hansen 1964.

Ant associated beetle species	Host ant	Special requirement	Ref.
<b>CARABIDAE</b>			
<i>Dyschirius globosus</i> (Herbst, 1784)	<i>Lfuli, Frufa</i>	hygrophil	81
<i>Porotachys bisulcatus</i> (Nicolai, 1822)	Formicidae		2
<i>Syntomus truncatellus</i> (Linnaeus, 1761)	<i>Lfuli, Frufa</i>	xerophil	81
<b>HYDROPHILIDAE</b>			
<i>Megasternum obscurum</i> (Marsham, 1802)	<i>Mrubr, Ftusc</i>	hygrophil	81
<b>PTILIIDAE</b>			
<i>Ptenidium gressneri</i> Erichson, 1845	<i>Camponotus</i> spp., <i>Lfuli, Ftusc</i>	hygrophil, mycetophil	1, 2, 54, 69, 81, 89, 113
<i>Ptenidium laevigatum</i> Erichson, 1845	<i>Lfuli, Frufa</i>	hygrophil, mycetophil	1, 69
<i>Ptenidium turgidum</i> Thomson, 1855	<i>Lbrun, Frufa</i>	mycetophil	1, 69
<i>Ptenidium formicetorum</i> * Kraatz, 1851	<i>Lbrun, Lfuli, Frufa,</i> <i>Fpoly, Faqui, Fprat</i>	myrmecophil, mycetophil	1, 2, 4, 5, 6, 21, 49, 54, 63, 69, 81, 89, 112, 113
<i>Ptenidium pusillum</i> (Gyllenhal, 1808)	<i>Frufa</i>	mycetophil	81
<i>Micridium halidaj</i> (Matthews, 1868)	<i>Lbrun, Lnige</i>	mycetophil	101, 113
<i>Ptilium myrmecophilum</i> * (Allibert, 1844)	<i>Lasius</i> spp., <i>Fsang, Frufa,</i> <i>Fprat, Ftrun,</i> <i>Faqui</i>	myrmecophil, mycetophil	1, 2, 5, 6, 21, 56, 63, 69, 81, 112, 113
<i>Ptilium modestum</i> Wankowicz, 1869	<i>Lasius</i> spp., <i>Frufa,</i> <i>Fexse</i>	mycetophil	1, 6, 27, 81, 102, 113
<i>Pteryx suturalis</i> (Heer, 1841)	<i>Fsuec</i>	mycetophil	16

Ant associated beetle species	Host ant	Special requirement	Ref.
<i>Acrotrichis montandonii</i> (Allibert, 1844)	<i>Lfuli, Lbrun, Lumbr, Frufa, Fpoly, Fprat, Faqui</i>	mycetophil	1, 2, 5, 6, 56, 63, 69, 113
<i>Acrotrichis dispar</i> (Matthews, 1865)	<i>Frufa</i>	mycetophil	1
<i>Acrotrichis brevipennis</i> (Erichson, 1845)	<i>Frufa</i>	hygrophil, mycetophil	81
<i>Acrotrichis pumila</i> (Erichson, 1845)	<i>Frufa</i>	mycetophil	81
<i>Acrotrichis thoracica</i> (Waltl, 1838)	<i>Frufa</i>	mycetophil	2
<i>Acrotrichis silvatica</i> Rosskothén, 1935	Formicidae	mycetophil	1, 113
<i>Acrotrichis norvegica</i> Strand, 1941	<i>Lbrun</i>	mycetophil	2
<i>Acrotrichis intermedia</i> (Gillmeister, 1845)	<i>Frufa</i>	mycetophil	1, 113
<i>Acrotrichis atomaria</i> (DeGeer, 1774)	<i>Frufa</i>	mycetophil	1, 81, 113
<i>Acrotrichis fascicularis</i> (Herbst, 1793)	<i>Frufa</i>	mycetophil	1, 81, 113
AGYRTIDAE			
<i>Agyrtes bicolor</i> Lap. Cast., 1840	<i>Frufa</i>		1, 2
CHOLEVIDAE			
<i>Ptomaphagus sericatus</i> (Chaudoir, 1845)	Formicidae	necrophil	91
<i>Nemadus colonoides</i> (Kraaz, 1851)	<i>Lnige, Lbrun, Lfuli, Frufa</i>		1, 21, 81, 89, 91, 93
<i>Eocatops lapponicus</i> ** Szymczakowski, 1975	<i>Flema</i>	myrmecophil	9, 30, 35
<i>Dreposcia umbrina</i> (Erichson, 1837)	<i>Lbrun, Lfuli</i>		1, 2, 21, 91
SCYDMAENIDAE			
<i>Euthiconus conicicollis</i> * (Fair. & Lab., 1855)	<i>Lnige, Lbrun, Lfuli, Frufa</i>	myrmecophil	1, 2, 21, 79, 101, 102
<i>Eutheia plicata</i> (Gyllenhal, 1813)	<i>Terra, Lfuli, Fexse, Frufa, Fprat</i>		1, 2, 32, 37, 54, 69, 92, 95, 102, 105, 111
<i>Eutheia linearis</i> Mulsant, 1861	<i>Lbrun, Lnige, Frufa</i>		1, 2, 104
<i>Eutheia scydmaenoides</i> Stephens, 1830	<i>Lfuli, Frufa</i>		1, 2
<i>Nevraphes elongatulus</i> (Müller & Kunze, 1822)	<i>Frufa</i>		1
<i>Nevraphes angulatus</i> (Müller & Kunze, 1822)	Formicidae	hygrophil	1
<i>Nevraphes talparum</i> Lokay, 1924	<i>Lnige, Lfuli, Frufa</i>		1, 17, 95
<i>Nevraphes plicicollis</i> Reitter, 1879	<i>Lnige, Frufa</i>		100, 102, 105
<i>Scydmodigraphes helvolus</i> (Schaum, 1844)	<i>Lnige, Lfuli, Frufa</i>		1
<i>Scydmodorphes minutus</i> * (Chaudoir, 1845)	<i>Cherc, Lbrun, Lnige, Lfuli, Frufa, Fprat</i>	myrmecophil	1, 2, 18, 21, 49, 58
<i>Stenichnus scutellaris</i> (Müller & Kunze, 1822)	<i>Lfuli, Frufa</i>		1
<i>Stenichnus pusillus</i> (Müller & Kunze, 1822)	<i>Lfuli, Frufa</i>		1, 2, 69
<i>Stenichnus godarti</i> * (Latreille, 1806)	<i>Lbrun, Lfuli, Lnige, Frufa</i>	myrmecophil	1, 2, 49, 54, 69, 101, 108
<i>Stenichnus collaris</i> (Mueller & Kunze, 1822)	<i>Lfuli, Frufa</i>		1, 5, 44
<i>Stenichnus bicolor</i> (Denny, 1825)	<i>Lbrun, Lnige, Frufa, Faqui, Fexse</i>		1, 2, 6, 69, 101
<i>Microscydms nanus</i> * (Schaum, 1844)	<i>Lasius</i> spp., <i>Frufa, Fprat</i>	myrmecophil	1, 2, 49, 58
<i>Microscydms minimus</i> * (Chaudoir, 1845)	<i>Lnige, Frufa</i>	myrmecophil	2, 5, 6, 40
<i>Euconnus claviger</i> * Mueller & Kunze, 1822	<i>Lnige, Lfuli, Lbrun, Frufa, Faqui</i>	myrmecophil	1, 2, 4, 6, 21, 69, 81, 95, 105, 106, 111, 112
<i>Euconnus pragensis</i> * (Machulka, 1923)	<i>Clign, Lnige, Lbrun, Frufa</i>	myrmecophil	2, 21, 40, 41, 80

Continued

Table 1. Continued.

Ant associated beetle species	Host ant	Special requirement	Ref.
<i>Euconnus macklini</i> * (Mannerheim, 1844)	<i>Lnige, Lbrun, Lfuli, Frufa</i>	myrmecophil	2, 5, 6, 21, 40, 63, 95, 105, 112
<i>Euconnus wetterhallii</i> (Gyllenhal, 1813)	<i>Myrmica</i> spp.	hygrophil	106
<i>Euconnus denticornis</i> (Mueller & Kunze, 1822)	<i>Frufa</i>	hygrophil	1, 106
<i>Euconnus hirticollis</i> (Illiger, 1798)	<i>Faqui</i>	hygrophil	4
<i>Scydmaenus tarsatus</i> Muller & Kunze, 1822	<i>Lfuli</i>		87
<i>Scydmaenus rufus</i> Müller & Kunze, 1922	<i>Myrmica</i> spp., <i>Lbrun, Frufa</i>		1, 36, 49
<i>Scydmaenus perrisi</i> * (Reitter, 1882)	<i>Lbrun</i>	myrmecophil	2, 19, 21, 52
<i>Scydmaenus hellwigii</i> * (Herbst, 1792)	<i>Lbrun, Lfuli, Frufa, Fpoly</i>	myrmecophil	1, 2, 5, 6, 19, 21, 40, 49, 63, 112
STAPHYLINIDAE			
<i>Gabrius nigrifulus</i> (Gravenhorst, 1802)	<i>Formica</i> spp.	hygrophil	81
<i>Gabrius sphagnicola</i> (Sjöberg, 1950)	<i>Fural</i>		30, 50
<i>Gabrius splendidulus</i> (Gravenhorst, 1802)	<i>Frufa</i>		2, 81, 113
<i>Gabrius osseticus</i> (Kolenati, 1846)	<i>Lfuli, Frufa</i>	hygrophil	81, 113
<i>Bisnius subuliformis</i> (Gravenhorst, 1802)	<i>Lfuli</i>		1, 101
<i>Philonthus ventralis</i> (Gravenhorst, 1802)	<i>Frufa</i>	hygrophil	1
<i>Platydracus fulvipes</i> (Scopoli, 1763)	<i>Mrugi</i>	hygrophil	1, 113
<i>Platydracus stercorarius</i> (Olivier, 1795)	<i>Mrubr, Mrugi, Mscab, Tcaes, Lalie, Lflav, Frufa, Prufe</i>	xerophil	1, 69
<i>Platydracus latebricola</i> (Gravenhorst, 1806)	<i>Mrubr, Mrugi, Lumbr, Lfuli, Frufa</i>	xerophil	1, 69, 105, 113
<i>Staphylinus erythropterus</i> Linnaeus, 1758	<i>Myrmica</i> spp.	hygrophil	1, 2, 42, 113
<i>Heterothops praevius</i> Erichson, 1840	<i>Frufa</i>	pholeophil	81
<i>Heterothops niger</i> Kraaz, 1868	<i>Lfuli, Frufa</i>	pholeophil	1, 69
<i>Heterothops dissimilis</i> (Gravenhorst, 1802)	<i>Frufa</i>		1, 56, 82, 113
<i>Euryporus picipes</i> (Paykull, 1800)	<i>Lfuli</i>	hygrophil	1, 82, 113
<i>Quedius mesomelinus</i> (Marsham, 1802)	<i>Lfuli, Frufa</i>	phloeophil	69, 81
<i>Quedius maurus</i> (Sahlberg, 1830)	<i>Lfuli</i>		1, 113
<i>Quedius invreal</i> Gridelli, 1924	<i>Lfuli</i>	pholeophil	2, 41
<i>Quedius ochripennis</i> (Ménétriés, 1832)	<i>Lfuli</i>		1, 2, 113
<i>Quedius brevicornis</i> Thomson, 1860	<i>Lasius</i> spp.		2
<i>Quedius brevis</i> * Erichson, 1840	<i>Lfuli, Fsang, Frufa, Fexse, Faqui, Flugu</i>	myrmecophil	1, 2, 4, 5, 6, 21, 44, 49, 54, 55, 56, 57, 63, 69, 81, 82, 97, 111, 112, 113
<i>Quedius microps</i> (Gravenhorst, 1847)	<i>Cherc, Lnige, Lfuli</i>		1, 2, 40, 49, 81, 112, 113
<i>Quedius truncicola</i> Fair. & Lab., 1855	<i>Lfuli</i>		2, 53
<i>Quedius scitus</i> (Gravenhorst, 1806)	<i>Lbrun, Frufa</i>		1, 2, 69, 113
<i>Quedius fuliginosus</i> (Gravenhorst, 1802)	<i>Lfuli</i>	hygrophil	81
<i>Quedius boops</i> (Gravenhorst, 1802)	<i>Lfuli</i>	hygrophil, xerophil	81
<i>Leptacinus formicetorum</i> * Märkel, 1841	<i>Lbrun, Frufa, Fprat, Fexse, Fpoly, Faqui, Fural, Frufi</i>	myrmecophil	1, 2, 3, 4, 5, 6, 21, 57, 63, 67, 69, 81, 82, 112, 113
<i>Gyrohypnus scoticus</i> (Joy, 1913)	<i>Lfuli, Frufa</i>	hygrophil	81
<i>Gyrohypnus angustatus</i> (Stephens, 1833)	<i>Lfuli, Frufa</i>	hygrophil	1, 49, 113
<i>Gyrohypnus atratus</i> * (Heer, 1839)	<i>Lfuli, Frufa, Faqui, Fpoly, Fprat</i>	myrmecophil	1, 2, 4, 5, 6, 21, 54, 63, 69, 81, 82, 112, 113
<i>Nudobius lentus</i> (Gravenhorst, 1806)	<i>Fpoly</i>		5
<i>Hypnogyra glabra</i> (Nordmann, 1837)	<i>Lbrun, Lfuli, Frufa</i>		1, 6, 69, 113

Ant associated beetle species	Host ant	Special requirement	Ref.
<i>Xantholinus linearis</i> (Olivier, 1795)	<i>Lfuli, Frufa</i>	hygrophil	1, 113
<i>Xantholinus meyeri</i> Drugmand	<i>Lfuli, Frufa</i>	hygrophil	1
<i>Xantholinus tricolor</i> (Fabricius, 1787)	<i>Lfuli, Fsang, Frufa</i>		81, 113
<i>Xantholinus laevigatus</i> Jacobson, 1847	<i>Lfuli, Frufa</i>	hygrophil	1, 81, 113
<i>Othius punctulatus</i> (Goeze, 1777)	Formicidae		81
<i>Othius angustus</i> Stephens, 1833	<i>Lfuli</i>	xerophil	81
<i>Othius myrmecophilus</i> Kiesenwetter, 1843	<i>Mscab, Lfuli, Lbrun, Fexse, Fsang, Frufa</i>		1, 54, 69, 97
<i>Astenus gracilis</i> (Paykull, 1789)	<i>Formica</i> spp.	xerophil	2
<i>Medon apicalis</i> (Kraatz, 1857)	<i>Frufa</i>	pholeophil	1, 2, 113
<i>Medon rufiventris</i> (Nordmann, 1837)	<i>Lfuli</i>	xerophil	71
<i>Medon castaneus</i> (Gravenhorst, 1802)	Formicidae	phloeophil	81
<i>Medon fuscus</i> (Mannerheim, 1830)	Formicidae	pholeophil	2
<i>Sunius melanocephalus</i> (Fabricius, 1792)	<i>Lfuli</i>	xerophil	2, 81
<i>Sunius bicolor</i> (Olivier, 1795)	<i>Mrugi, Lflav</i>	hygrophil, xerophil	1, 69
<i>Scopaeus laevigatus</i> (Gyllenhal, 1827)	<i>Frufa</i>	hygrophil	1
<i>Scopaeus minutus</i> Erichson, 1840	<i>Fural</i>	thermophil, xerophil	1
<i>Scopaeus pusillus</i> Kiesenwetter, 1843	<i>Frufa</i>	thermophil, xerophil	2
<i>Stenus aterrimus</i> * Erichson, 1839	<i>Frufa, Fprat, Fnigr</i>	myrmecophil	1, 2, 21, 25, 37, 70, 81, 102, 112, 113
<i>Stenus crassus</i> Stephens, 1833	<i>Frufa</i>	hygrophil	1
<i>Hapalaraea nigra</i> (Gravenhorst, 1806)	<i>Lfuli</i>		1, 113
<i>Omalium caesum</i> Gravenhorst, 1806	<i>Lfuli, Frufa</i>		81
<i>Xylodromus depressus</i> (Gravenhorst, 1802)	Formicidae		81
<i>Xylodromus affinis</i> (Gerhardt, 1877)	<i>Lfuli</i>		1, 113
<i>Anotylus rugosus</i> (Fabricius, 1775)	<i>Formica</i> spp.	hygrophil	1
<i>Platystethus arenarius</i> (Fourcroy, 1785)	<i>Frufa</i>	coprophil	81
<i>Bledius procerulus</i> Erichson, 1840	<i>Lflav</i>	xerophil, psammophil	2
<i>Trichophya pilicornis</i> Gyllenhal, 1810)	<i>Faqui</i>	pholeophil	4
<i>Mycetoporus lepidus</i> (Gravenhorst, 1806)	<i>Lfuli, Frufa</i>		2, 81
<i>Ischnosoma bergrothi</i> (Hellen, 1925)	<i>Myrmica</i> spp.	tyrrophil	3
<i>Carphacis striatus</i> (Olivier, 1794)	Formicidae	mycetophil	1
<i>Bolitobius cingulatus</i> Mannerheim, 1830	<i>Myrmica</i> spp.	hygrophil	3
<i>Sepedophilus testaceus</i> (Fabricius, 1792)	<i>Lfuli, Frufa</i>	pholeophil, mycetophil	2, 81
<i>Sepedophilus marshami</i> (Stephens, 1832)	<i>Lasius</i> spp., <i>Faqui</i>	mycetophil	4, 6
<i>Sepedophilus immaculatus</i> (Stephens, 1832)	<i>Lfuli, Frufa</i>		81
<i>Tachyporus nitidulus</i> (Fabricius, 1781)	<i>Fpoly</i>		5
<i>Tachyporus obtusus</i> (Linnaeus, 1767)	<i>Frufa</i>		81
<i>Tachyporus hypnorum</i> (Fabricius, 1775)	<i>Fpoly</i>		5
<i>Tachyporus chrysomelinus</i> (Linnaeus, 1758)	<i>Fpoly</i>		5
<i>Tachyporus scitulus</i> (Erichson, 1839)	<i>Fexse</i>	xerophil	2
<i>Tachyporus corpulentus</i> J. Sahlberg, 1876	<i>Frufa</i>	xerophil	1
<i>Tachinus rufipes</i> (Linnaeus, 1758)	<i>Lfuli, Frufa</i>	saprophil	81
<i>Tachinus fimetarius</i> Gravenhorst, 1802	<i>Lfuli, Frufa</i>		81
<i>Tachinus marginellus</i> (Fabricius, 1781)	<i>Lfuli, Frufa</i>	saprophil	81
<i>Lamprinodes saginatus</i> * (Gravenhorst, 1806)	<i>Mrugi, Msabu, Mscab, Mrubr, Lflav, Lfuli, Ftusc, Frufa, Fexse, Fsang</i>	xerophil, myrmecophil	1, 2, 21, 26, 38, 69, 81, 113
<i>Aleochara spissicornis</i> Erichson, 1839	<i>Tcaes</i>	thermophil	2
<i>Aleochara moesta</i> Gravenhorst, 1802	<i>F. rufa</i>		85

*Continued*

Table 1. Continued.

Ant associated beetle species	Host ant	Special requirement	Ref.
<i>Aleochara lanuginosa</i> Gravenhorst, 1802	<i>Frufa</i>	coprophil	81, 85
<i>Aleochara lygaea</i> Kraatz, 1862	<i>Lfuli</i>	coprophil	1, 95, 113
<i>Aleochara villosa</i> Mannerheim, 1830	Formicidae	coprophil	1
<i>Aleochara sanguinea</i> (Linnaeus, 1758)	<i>Lbrun, Lfuli</i>	coprophil	1, 69, 110
<i>Aleochara spadicea</i> (Erichson, 1839)	<i>Lfuli</i>		3
<i>Aleochara ruficornis</i> Gravenhorst, 1802	<i>Lfuli, Frufa, Ffusc</i>		1, 69, 81
<i>Oxypoda opaca</i> (Gravenhorst, 1802)	<i>Lfuli</i>		1, 81, 113
<i>Oxypoda longipes</i> Mulsant & Rey, 1861	<i>Lfuli</i>		1, 113
<i>Oxypoda vittata</i> * Märkel, 1842	<i>Lfuli, Frufa</i>	myrmecophil	1, 2, 13, 21, 32, 44, 49, 69, 81, 85, 95, 101, 112, 113
<i>Oxypoda acuminata</i> (Stephens, 1832)	<i>Lfuli, Lnige</i>	hygrophil	1, 81
<i>Oxypoda spectabilis</i> Märkel, 1844	<i>Lfuli</i>	hygrophil	1
<i>Oxypoda umbrata</i> (Gyllenhal, 1810)	<i>Lfuli</i>	hygrophil	81
<i>Oxypoda hansseni</i> Strand, 1946	<i>Flema</i>		68, 70
<i>Oxypoda abdominalis</i> (Mannerheim, 1830)	Formicidae	xerophil	2
<i>Oxypoda togata</i> Erichson, 1837	<i>Lasius</i> spp.	psammophil	2
<i>Oxypoda exoleta</i> Erichson, 1839	<i>Lfuli</i>	xerophil	105, 106
<i>Oxypoda recondita</i> Kraatz, 1856	<i>Myrmica</i> spp., <i>Lfuli, Lbrun, Frufa,</i> <i>Fsang</i>		1, 2, 3, 69, 81, 113
<i>Oxypoda serpentata</i> Kangas, 1983	<i>Frufa</i> coll.		63
<i>Oxypoda arborea</i> Zerche, 1994	<i>Lfuli</i>		1, 113
<i>Oxypoda testacea</i> Erichson, 1839	<i>Frufa</i>		2
<i>Oxypoda brachyptera</i> (Stephens, 1832)	<i>Frufa, Tcaes</i>	xerophil	2
<i>Oxypoda annularis</i> (Mannerheim, 1830)	<i>Frufa</i>		1, 2, 67, 81, 85, 113
<i>Oxypoda flavicornis</i> Kraatz, 1856	<i>Faqui</i>	hygrophil	4
<i>Oxypoda advena</i> Mäklin, 1846	<i>Lfuli</i>		1
<i>Oxypoda ferruginea</i> Erichson, 1839	<i>F. rufa</i>	hygrophil	85
<i>Oxypoda soror</i> Thomson, 1855	<i>Lfuli</i>	hygrophil	1, 113
<i>Oxypoda formiceticola</i> * Märkel, 1841	<i>Lasius</i> spp., <i>Ffusc,</i> <i>Fpoly, Fexse, Frufa,</i> <i>Faqui, Flugu</i>	myrmecophil	1, 2, 3, 4, 5, 6, 21, 39, 56, 63, 69, 81, 85, 111, 112, 113
<i>Oxypoda pratensiscola</i> * Lohse, 1967	<i>Fexse, Fprat,</i> <i>Fnigr</i>	xerophil, myrmecophil	2, 21, 70
<i>Oxypoda rugicollis</i> * Kraatz, 1856	<i>Lasius</i> spp., <i>Fexse,</i> <i>Frufa, Fprat</i>	myrmecophil	2, 3, 5, 6, 21, 24
<i>Oxypoda haemorrhoea</i> * Mannerheim, 1830	<i>Lfuli, Fpoly,</i> <i>Faqui, Fexse, Fsuec,</i> <i>Fsang, Frufa, Fprat,</i> <i>Ftrun, Flugu, Fnigr</i>	myrmecophil	2, 3, 4, 5, 6, 16, 39, 56, 57, 63, 67, 69, 70, 81, 85, 112
<i>Parocyusa rubicunda</i> (Erichson, 1837)	<i>Lnige</i>	hygrophil	1, 81, 113
<i>Stichoglossa semirufa</i> (Erichson, 1839)	<i>Lfuli</i>		1, 2, 113
<i>Ischnoglossa prolixa</i> (Gravenhorst, 1802)	<i>Lfuli</i>		2
<i>Thiasophila angulata</i> * (Erichson, 1837)	<i>Lfuli, Lbrun, Frufa,</i> <i>Fprat, Faqui, Fpoly,</i> <i>Fsang, Fural, Flugu</i>	myrmecophil	1, 2, 3, 4, 5, 6, 21, 39, 56, 57, 63, 67, 69, 81, 85, 112, 113
<i>Thiasophila canaliculata</i> * Mulsant & Rey, 1874	<i>Frufa, Fexse</i>	myrmecophil	1, 2, 33, 63, 81, 85, 112, 113
<i>Thiasophila wockii</i> * (Schneider, 1862)	<i>Cvagu, Cherc</i>	myrmecophil	2, 3, 15, 18, 21, 40, 98, 105, 112

Ant associated beetle species	Host ant	Special requirement	Ref.
<i>Thiasophila bercionis</i> * Bernhauer, 1926	<i>Fural, Fexse</i>	myrmecophil	2, 23, 27, 65
<i>Thiasophila inquilina</i> * Märkel, 1844	<i>Lfuli, Frufa, Fprat</i>	myrmecophil	1, 2, 3, 21, 43, 44, 49, 69, 81, 85, 95, 101, 102, 105, 112, 113
<i>Thiasophila lohse</i> * Zerche, 1987	<i>Fprat</i>	myrmecophil	2, 21
<i>Crataraea suturalis</i> (Mannerheim, 1830)	<i>Lfuli, Frufa</i>		1, 113
<i>Haploglossa gentilis</i> (Märkel, 1844)	<i>Lbrun, Lfuli</i>		1, 2, 21, 49, 69, 113
<i>Haploglossa villosula</i> (Stephens, 1832)	<i>Myrmica</i> spp., <i>Lbrun, Lfuli, Frufa</i>		1, 2, 3, 21, 49, 69, 81, 85, 105, 113
<i>Haploglossa picipennis</i> (Gyllenhal, 1827)	<i>Lbrun</i>		1, 113
<i>Haploglossa marginalis</i> (Gravenhorst, 1806)	<i>Lbrun, Lfuli</i>		1, 21, 105, 113
<i>Poromniusa prociidua</i> (Erichson, 1837)	<i>Frufa</i>		1, 113
<i>Ocalaea badia</i> Erichson 1837	<i>Lfuli, Frufa</i>	hygrophil	81, 85
<i>Ilyobates subopacus</i> Palm, 1935	<i>Myrmica</i> spp.	hygrophil	1, 3
<i>Ilyobates nigricollis</i> (Paykull, 1800)	<i>Myrmica</i> spp., <i>Lfuli</i>	hygrophil	1, 81
<i>Amarochara umbrosa</i> (Erichson, 1837)	<i>Lasius</i> spp.		1, 113
<i>Amarochara bonnaire</i> * (Fauvel, 1865)	<i>Lbrun, Lfuli</i>	myrmecophil	1, 2, 21, 113
<i>Amarochara forticornis</i> (Lacordaire, 1835)	<i>Lfuli</i>	thermophil	105
<i>Dinarda dentata</i> * (Gravenhorst, 1806)	<i>Ffusc, Fsang, Frufi, Fexse, Fcine, Faqui</i>	myrmecophil	1, 2, 4, 21, 69, 81, 85, 105, 112, 113
<i>Dinarda hagensi</i> * Wasmann, 1889	<i>Fexse, Fprat</i>	myrmecophil	1, 2, 21, 37, 69, 105, 112, 113
<i>Dinarda maerkeli</i> * Kiesenwetter, 1843	<i>Frufa, Fprat, Fpoly, Ftrun, Flugu, Fsang</i>	myrmecophil	1, 2, 3, 5, 21, 37, 54, 56, 69, 81, 112, 113
<i>Meotica exilis</i> (Knoch, 1806)	<i>Formica</i> spp.	hygrophil, pholeophil	2, 85
<i>Ousipalia caesula</i> (Erichson, 1839)	<i>Lfuli, Frufa</i>	psammophil	81
<i>Aloconota sulcifrons</i> (Stephens, 1832)	Formicidae	hygrophil	81
<i>Liogluta micans</i> (Mulsant & Rey, 1852)	<i>Lasius</i> spp.	hygrophil	6
<i>Liogluta longiuscula</i> (Gravenhorst, 1802)	<i>Lbrun, Lfuli, Frufa</i>	hygrophil	1
<i>Liogluta alpestris</i> (Heer, 1839)	<i>Lbrun, Lfuli, Ffusc</i>	hygrophil	1, 69, 81, 113
<i>Geostiba circellaris</i> (Gravenhorst, 1806)	<i>Lfuli, Frufa</i>	hygrophil	1, 2, 85, 93
<i>Callicerus obscurus</i> Gravenhorst, 1802	<i>Lfuli</i>	hygrophil, pholeophil	3
<i>Callicerus rigidicornis</i> Erichson, 1839	<i>Lfuli, Lnige, Frufa</i>		1, 69
<i>Atheta talpa</i> * (Heer, 1841)	<i>Lfuli, Frufa, Fprat, Fpoly, Faqui, Ftrun, Fexse, Flugu</i>	myrmecophil	1, 2, 3, 4, 6, 21, 39, 54, 56, 63, 81, 85, 111, 112, 113
<i>Atheta nigra</i> (Kraatz, 1856)	<i>Frufa</i>		81
<i>Atheta myrmecobia</i> (Kraatz, 1856)	<i>Lasius</i> spp., <i>Frufa</i>	hygrophil	1, 2, 6, 81, 85, 90, 95, 113
<i>Atheta fungi</i> (Gravenhorst, 1806)	Formicidae		81, 85, 113
<i>Atheta scapularis</i> (Sahlberg, 1831)	<i>Mrubr, Frufa</i>	mycetophil	3, 85, 113
<i>Atheta sodalis</i> (Erichson, 1837)	<i>Lfuli, Lbrun, Fexse, Frufa</i>	mycetophil	1, 44, 69, 81, 85, 113
<i>Atheta trinotata</i> (Kraatz, 1856)	<i>Lfuli, Frufa</i>		81
<i>Atheta flavipes</i> * (Gravenhorst, 1806)	<i>Lflav, Fexse, Fsang, Frufa, Fprat, Fpoly, Faqui, Ftrun, Flugu</i>	myrmecophil	1, 2, 3, 4, 5, 6, 21, 42, 56, 63, 69, 81, 85, 93, 112, 113

Continued



Table 1. Continued.

Ant associated beetle species	Host ant	Special requirement	Ref.
<i>Atheta confusa</i> * (Märkel, 1844)	<i>Lfuli, Frufa</i>	myrmecophil	1, 2, 3, 21, 41, 44, 49, 69, 81, 85, 95, 101, 102, 113
<i>Atheta longicornis</i> (Gravenhorst, 1802)	Formicidae		81
<i>Atheta subterranea</i> (Mulsant & Rey, 1853)	Formicidae	pholeophil	1, 113
<i>Atheta brunneipennis</i> (Thomson, 1852)	<i>Fexse</i>		3
<i>Atheta castanoptera</i> (Mannerheim, 1830)	<i>Lfuli, Frufa</i>	mycetophil	81
<i>Atheta fungicola</i> (Thomson, 1852)	<i>Lfuli, Frufa</i>	mycetophil	81
<i>Atheta brunnea</i> (Fabricius, 1798)	<i>Lfuli</i>		1, 69
<i>Atheta hepatica</i> (Erichson, 1839)	<i>Lfuli</i>		1, 90, 113
<i>Lyprocorrhe anceps</i> * (Erichson, 1837)	<i>Lfuli, Fexse, Frufa, Fprat, Faqui, Ftrun, Flugu, Fnigr</i>	myrmecophil	1, 2, 4, 5, 6, 21, 39, 42, 56, 69, 70, 81, 85, 112, 113
<i>Acrotona consanguinea</i> (Eppelsheim, 1875)	<i>Lfuli, Lumbr</i>		1
<i>Acrotona aterrima</i> (Gravenhorst, 1802)	Formicidae		81
<i>Acrotona parvula</i> (Mannerheim, 1830)	<i>Lfuli, Frufa</i>		81
<i>Coprothassa melanaria</i> (Mannerheim, 1830)	Formicidae		81
<i>Amischa nigrofusca</i> (Stephens, 1832)	<i>Lfuli</i>		81
<i>Amischa analis</i> (Gravenhorst, 1802)	<i>Mscab, Mrubr, Lfuli, Lbrun, Lflav, Fexse, Frufa</i>		1, 54, 56, 81, 85
<i>Amischa bifoveolata</i> (Mannerheim, 1830)	<i>Lfuli, Frufa</i>		81
<i>Thamiaraea hospita</i> (Märkel, 1844)	<i>Lfuli</i>		81
<i>Drusilla canaliculata</i> * (Fabricius, 1787)	<i>Mscab, Mrugi, Mrubr, Msulc, Tcaes, Lacer, Lnige, Lfuli, Lflav, Lbrun, Lalie, Fsang, Ffusc, Fexse, Frufa</i>	xerophil, myrmecophil	1, 2, 5, 56, 69, 81, 85, 97, 113
<i>Zyras collaris</i> (Paykull, 1800)	<i>Mrubr, Mrugi, Lfuli, Frufa</i>	hygrophil	1, 2, 3, 69, 81, 85, 97, 101, 112, 113
<i>Zyras limbatus</i> * (Paykull, 1789)	<i>Mrubr, Mscab, Lfuli, Lflav, Lbrun, Lnige, Ffusc, Fsang, Fexse</i>	xerophil, myrmecophil	1, 2, 3, 5, 21, 54, 56, 69, 81, 85, 101, 112, 113
<i>Zyras funestus</i> * (Gravenhorst, 1806)	<i>Lfuli</i>	myrmecophil	1, 2, 3, 12, 21, 44, 49, 56, 69, 81, 85, 101, 112, 113
<i>Zyras humeralis</i> * (Gravenhorst, 1802)	<i>Lbrun, Lumbr, Lfuli, Frufa, Fprat, Faqui</i>	myrmecophil	1, 2, 3, 4, 5, 21, 44, 49, 54, 63, 69, 81, 85, 97, 101, 112, 113
<i>Zyras cognatus</i> * (Märkel, 1842)	<i>Lbrun, Lnige, Lfuli, Ffusc, Fexse</i>	myrmecophil	1, 2, 3, 12, 21, 44, 49, 69, 81, 85, 88, 101, 112, 113
<i>Zyras lugens</i> * (Gravenhorst, 1802)	<i>Lbrun, Lfuli</i>	myrmecophil	1, 2, 3, 6, 12, 21, 44, 49, 69, 81, 85, 101, 112, 113
<i>Zyras laticollis</i> * (Märkel, 1844)	<i>Lfuli</i>	myrmecophil	1, 2, 3, 6, 12, 21, 44, 49, 69, 81, 85, 101, 112, 113
<i>Lomechusoides strumosus</i> * (Fabricius, 1792)	<i>Fsang, Frufa, Fprat</i>	xerophil, myrmecophil	1, 2, 3, 21, 69, 78, 81, 85, 90, 95, 105, 109, 112, 113

Ant associated beetle species	Host ant	Special requirement	Ref.
<i>Lomechusoides wellenii</i> (Palm, 1949)	<i>Fural, Flugu, Frufa</i>		3, 28, 30
<i>Lomechusoides inflatus</i> (Zetterstedt, 1828)	<i>Fgaga, Fexse, Fural, Frufa, Fprat</i>		3, 24, 30, 48, 66
<i>Lomechusa emarginata</i> * (Paykull, 1789)	<i>Mrubr, Mrugi, Msabu, Msulc, Mrugu, Mscab, Lasius spp., Ffusc, Frufa, Fsang</i>	myrmecophil	1, 2, 3, 6, 21, 22, 38, 54, 56, 81, 69, 72, 85, 97, 112, 113
<i>Lomechusa paradoxa</i> * Gravenhorst, 1806	<i>Mrubr, Mrugi, Mscab, Mrugu, Ffusc, Frufi, Fcuni, Swest</i>	xerophil, myrmecophil	1, 2, 21, 22, 56, 69, 81, 85, 105, 112, 113
<i>Lomechusa pubicollis</i> * Brisout de B., 1860	<i>Mrubr, Mrugi, Msulc, Tcaes, Lfuli, Lnige, Lalie, Lflav, Lumbr, Ftrun, Frufi, Ffusc, Frufa</i>	myrmecophil	1, 2, 3, 6, 21, 22, 42, 64, 112, 113
<i>Leptusa ruficollis</i> (Erichson, 1839)	<i>Formica spp.</i>		1, 2
<i>Tachyusida gracilis</i> * (Erichson, 1837)	<i>Lbrun, Lnige</i>		2, 69, 113
<i>Euryusa castanoptera</i> Kraatz, 1856	<i>Lbrun, Lfuli</i>		1, 2, 113
<i>Euryusa optabilis</i> * Heer, 1839	<i>Lbrun, Lnige, Lfuli, Frufa</i>	myrmecophil	1, 2, 3, 21, 44, 52, 69, 76, 113
<i>Euryusa sinuata</i> * Erichson, 1837	<i>Lbrun, Lfuli</i>	myrmecophil	1, 2, 17, 21, 45, 52, 69, 74, 113
<i>Euryusa coarctata</i> * Märkel, 1844	<i>Lbrun</i>	myrmecophil	1, 2, 52, 113
<i>Oligota muensteri</i> Bernhauer, 1923	<i>Lasius spp., Frufa</i>		3, 6, 26, 29, 59
<i>Oligota tantilla</i> Mennerheim, 1843	<i>Lasius spp.</i>		6
<i>Oligota pusillima</i> (Gravenhorst, 1806)	<i>Lfuli, Frufa, Fexse</i>		1, 2, 3, 6, 27, 59, 67, 69, 81, 102, 103, 61
<i>Oligota uralensisicola</i> Kangas, 1982	<i>Fural</i>		113
<i>Cypha nitida</i> (Palm, 1935)	<i>Lbrun</i>		Reference missing
<i>Cypha hanseni</i> (Palm, 1949)	<i>Lfuli</i>		Reference missing
<i>Cypha pulicaria</i> (Erichson, 1839)	Formicidae		Reference missing
<b>PSELAPHIDAE</b>			
<i>Meliceria tragardi</i> Palm, 1938	<i>Lbrun</i>		34
<i>Euplectus nanus</i> (Reichhenbach, 1816)	<i>Lnige, Frufa, Fpoly</i>	hygrophil	2, 5, 63, 101
<i>Euplectus kirbii</i> Danny, 1825	<i>Lfuli, Lnige</i>	hygrophil	81, 82, 101
<i>Euplectus piceus</i> Motschulsky, 1835	<i>Lbrun, Frufa</i>	hygrophil	1, 2, 54, 113
<i>Euplectus decipiens</i> Raffray, 1910	<i>Lasius spp.</i>	hygrophil	6
<i>Euplectus infirmus</i> Raffray, 1910	<i>Lbrun, Lnige</i>	hygrophil	99, 101, 105
<i>Euplectus sanguineus</i> Motschulsky, 1835	<i>Lbrun, Lnige, Ffusc, Fsang</i>	hygrophil	1
<i>Euplectus signatus</i> (Reichenbach, 1816)	<i>Lasius spp., Frufa, Faqui</i>	hygrophil	2, 4, 6, 39, 60
<i>Euplectus bonvouloiri</i> ssp. <i>rosae</i> Raffray, 1910	<i>Lfuli</i>	hygrophil	31
<i>Euplectus punctatus</i> Mulsant, 1861	<i>Frufa</i>	hygrophil	5, 60
<i>Euplectus karstenii</i> (Reichhenbach, 1816)	<i>Lfuli, Frufa</i>	hygrophil	1, 2, 5, 6, 81
<i>Euplectus fauveli</i> Guillebeau, 1888	<i>Frufa</i>	hygrophil	5, 60
<i>Euplectus brunneus</i> (Grimmer, 1841)	<i>Formica spp., Lbrun</i>	hygrophil	1, 2, 113
<i>Plectophloeus nitidus</i> (Fairmaire, 1857)	<i>Lbrun, Lfuli</i>	hygrophil	1, 2, 113
<i>Saulcyella schmidtii</i> (Märkel, 1844)	<i>Lbrun, Lfuli, Frufa</i>	hygrophil	2, 21

Continued

Table 1. Continued.

Ant associated beetle species	Host ant	Special requirement	Ref.
<i>Trimium brevicorne</i> (Reichenbach, 1816)	<i>Lasius</i> spp., <i>Fsuec</i> , <i>Frufa</i>	hygrophil	1, 2, 16, 81
<i>Batrisodes delaportii</i> * (Aubé, 1833)	<i>Lbrun</i> , <i>Lfuli</i>	myrmecophil	1, 2, 19, 21, 52, 69, 113
<i>Batrisodes venustus</i> * (Reichenbach, 1816)	<i>Mscab</i> , <i>Clign</i> , <i>Lbrun</i> , <i>Lfuli</i> , <i>Lnige</i> , <i>Frufa</i> , <i>Ffusc</i>	myrmecophil	1, 2, 19, 21, 54, 69, 81, 96, 113
<i>Batrisodes hubenthalii</i> * Reitter, 1913	<i>Lbrun</i> , <i>Lnige</i>	myrmecophil	2, 21, 29
<i>Batrisodes adnexus</i> * (Hampe, 1863)	<i>Myrmica</i> spp., <i>Camponotus</i> spp., <i>Lbrun</i>	myrmecophil	1, 2, 21, 51, 69, 81, 105, 113
<i>Bryaxis curtisii</i> (Leach, 1817)	<i>Lfuli</i>	hygrophil	1, 113
<i>Trichonyx sulcicollis</i> (Reichenbach, 1816)	<i>Myrmica</i> spp., <i>Lbrun</i> , <i>Lfuli</i>	hygrophil	1, 2, 21, 69, 81, 90, 113
<i>Amauronyx maerkeli</i> (Aubé, 1844)	<i>Myrmica</i> spp., <i>Lbrun</i> , <i>Lflav</i> , <i>Lfuli</i> , <i>Ffusc</i> , <i>Tcaes</i>	hygrophil	1, 2, 21, 54, 69, 81, 113
<i>Tychus niger</i> (Paykull, 1800)	<i>Lfuli</i>	hygrophil	1, 81, 113
<i>Brachygluta fossulata</i> (Reichenbach, 1816)	<i>Frufa</i>	hygrophil	5
<i>Chennium bituberculatum</i> * Latreille, 1807	<i>Tcaes</i>	xerophil, myrmecophil	2, 21, 47
<i>Tyrus mucronatus</i> (Panzer, 1803)	<i>Lbrun</i> , <i>Lnige</i> , <i>Ffusc</i> , <i>Frufa</i> , <i>Fsang</i>	hygrophil	2, 102, 113
<i>Claviger testaceus</i> * Preysslér, 1790	<i>Mrubr</i> , <i>Mscab</i> , <i>Tcaes</i> , <i>Lbrun</i> , <i>Lumbr</i> , <i>Lmixt</i> , <i>Lalie</i> , <i>Lfuli</i> , <i>Lnige</i> , <i>Lflav</i>	xerophil, myrmecophil	1, 2, 6, 12, 21, 22, 54, 69, 72, 81, 105, 112, 113
<i>Claviger longicornis</i> * Müller, 1818	<i>Lumbr</i> , <i>Lnige</i> , <i>Lfuli</i> , <i>Lbrun</i> , <i>Lflav</i> , <i>Lmixt</i>	myrmecophil	1, 2, 14, 21, 46, 69, 81, 94, 95, 105, 112, 113
HISTERIDAE			
<i>Abraeus granulum</i> Erichson, 1839	<i>Lasius</i> spp.		2
<i>Abraeus perpusillus</i> (Marsham, 1802)	<i>Lfuli</i> , <i>Lbrun</i> , <i>Frufa</i>		1, 2, 81, 113
<i>Abraeus parvulus</i> * Aubé, 1842	<i>Lasius</i> spp.	myrmecophil	2
<i>Plegaderus caesus</i> (Herbst, 1792)	<i>Lfuli</i>		1, 113
<i>Plegaderus dissectus</i> Erichson, 1839	Formicidae		2
<i>Acritus minutus</i> (Herbst, 1792)	<i>Lasius</i> spp.		2
<i>Acritus homoeopathicus</i> Wollaston, 1857	<i>Fprat</i>		2
<i>Aeletes atomarius</i> * (Aubé, 1842)	<i>Lnige</i> , <i>Formica</i> spp.	myrmecophil	2, 100
<i>Gnathonchus rotundatus</i> (Kugelann, 1792)	<i>Lfuli</i>		1, 81
<i>Myrmetes paykullii</i> * Kanaar, 1979	<i>Lasius</i> spp., <i>Frufa</i> , <i>Fprat</i> , <i>Fpoly</i> , <i>Faqui</i>	myrmecophil	1, 2, 4, 6, 21, 54, 69, 77, 95, 112, 113
<i>Dendrophilus corticalis</i> (Paykull, 1798)	<i>Lfuli</i> , <i>Lbrun</i> , <i>Fexec</i> , <i>Frufa</i>		1, 2, 69, 81, 113
<i>Dendrophilus pygmaeus</i> * (Linnaeus, 1758)	<i>Lfuli</i> , <i>Fpoly</i> , <i>Frufa</i> , <i>Fprat</i> , <i>Fexse</i> , <i>Fpoly</i> , <i>Faqui</i>	myrmecophil	1, 2, 4, 5, 6, 21, 54, 56, 57, 69, 78, 81, 111, 112, 113
<i>Paromalus flavicornis</i> (Herbst, 1792)	<i>Lbrun</i> , <i>Lfuli</i>		1, 113
<i>Margarinotus merdarius</i> (Hoffmann, 1803)	<i>Lnige</i> , <i>Lfuli</i>		1, 12, 81
<i>Hister unicolor</i> Linnaeus, 1758	<i>Lfuli</i>	saprophil	1, 81
<i>Hister helluo</i> Truqui, 1852	Formicidae		2
<i>Atholus corvinus</i> (Germar, 1817)	Formicidae	xerophil	2

Ant associated beetle species	Host ant	Special requirement	Ref.
<i>Hetaerius ferrugineus</i> * (Olivier, 1789)	<i>Mscab, Lacer, Terra, Lfuli, Lnige, Lflav, Ffusc, Fprat, Frufi, Fsang, Frufa, Fcine, Fexse</i>	myrmecophil, xerophil	1, 2, 21, 37, 38, 69, 81, 105, 113
CLAMBIDAE			
<i>Clambus minutus</i>	<i>Frufa</i>	hygrophil, mycetophil	1
SCARABAEIDAE			
<i>Diastictus vulneratus</i> (Sturm, 1805)	<i>Ffusc</i>	psammophil, pholeophil	2
<i>Cetonia aurata</i> (Linnaeus, 1758)	<i>Cherc, Frufa</i>	thermophil	3, 10, 11, 69, 81, 86
<i>Liocola marmorata</i> (Fabricius, 1792)	<i>Lfuli</i>		3, 11
<i>Trichius fasciatus</i> (Linnaeus, 1758)	<i>Mrugi</i>		3, 10, 11
<i>Potosia cuprea</i> * (Fabricius, 1775)	<i>Frufa, Fprat, Fural</i>	myrmecophil	2, 3, 69, 97, 111, 113
LYCIDAE			
<i>Platycis minuta</i> (Fabricius, 1787)	<i>Lfuli</i>		1
<i>Platycis cosnardi</i> (Chevrolat, 1829)	<i>Lfuli</i>		113
CANTHARIDAE			
<i>Cantharis livida</i> Linnaeus, 1758	Formicidae	xerophil	1
ELATERIDAE			
<i>Ampedus rufipennis</i> (Stephens, 1830)	<i>Lnige</i>		1, 17, 113
<i>Ampedus cinnabarinus</i> (Eschscholtz, 1829)	<i>Lasius</i> spp.		107
<i>Ampedus pomorum</i> (Herbst, 1784)	<i>Lnige</i>		96
<i>Ampedus hjorti</i> (Rye, 1905)	<i>Lbrun</i>		2, 17
<i>Ampedus balteatus</i> (Linnaeus, 1758)	<i>Lnige</i>		96, 107
<i>Cardiophorus asellus</i> Erichson, 1840	<i>Frufa</i>	psammophil, pholeophil	1
DERMESTIDAE			
<i>Dermestes palmi</i> Sjöberg, 1950	<i>Cherc</i>		8, 18
<i>Globicornis emarginata</i> (Gyllenhal, 1808)	<i>Camponotus</i> spp.		15
LYCTIDAE			
<i>Lyctus linearis</i> (Goeze, 1777)	<i>Lbrun</i>		2
ANOBIIDAE			
<i>Ptinus subpilosus</i> Sturm, 1837	<i>Lbrun, Lfuli</i>		69
NITIDULIDAE			
<i>Eपुरaea terminalis</i> (Mannerheim, 1843)	<i>Lasius</i> spp.	saprophil	2
<i>Amphotis marginata</i> * (Fabricius, 1781)	<i>Lfuli</i>	myrmecophil	1, 21, 44, 54, 81, 113
MONOTOMIDAE			
<i>Monotoma quadrioveolata</i> Aubé, 1837	<i>Formica</i> spp.		2
<i>Monotoma conicicollis</i> * Aube, 1837	<i>Frufa, Fpoly, Faqui, Fprat, Fural, Flugu</i>	myrmecophil	1, 2, 4, 5, 6, 21, 39, 54, 56, 57, 69, 77, 81, 82, 111, 112, 113

Continued

Table 1. Continued.

Ant associated beetle species	Host ant	Special requirement	Ref.
<i>Monotoma angusticollis</i> * (Gyllenhal, 1827)	<i>Frufa</i> , <i>Fpoly</i> , <i>Fprat</i> , <i>Flugu</i> , <i>Faqui</i>	myrmecophil	1, 2, 5, 6, 21, 54, 55, 56, 57, 63, 77, 81, 82, 111, 112, 113
<i>Monotoma picipes</i> Herbst, 1793	Formicidae		2
<i>Monotoma longicollis</i> (Gyllenhal, 1827)	Formicidae		2
CRYPTOPHAGIDAE			
<i>Hypocopus lathridioides</i> Motschulsky, 1839	<i>Fexse</i>	xerophil	2, 24, 27
<i>Micrambe abietis</i> (Paykull, 1798)	<i>Frufa</i>	mycetophil	81
<i>Cryptophagus acutangulus</i> Gyllenhal, 1827	Formicidae	mycetophil	1
<i>Cryptophagus fallax</i> Balfour-Browne, 1953	Formicidae	mycetophil	1, 113
<i>Cryptophagus badius</i> Sturm, 1845	<i>Lfuli</i>	mycetophil	1, 82, 113
<i>Cryptophagus fuscicornis</i> Sturm, 1845	<i>Lfuli</i>	mycetophil	1
<i>Cryptophagus labilis</i> Erichson, 1846	<i>Mrugi</i> , <i>Lbrun</i>	mycetophil	2, 113
<i>Cryptophagus confusus</i> Bruce, 1934	<i>Lbrun</i>	mycetophil	2, 73
<i>Cryptophagus intermedius</i> Bruce, 1934	<i>Lbrun</i>	mycetophil	113
<i>Cryptophagus distinguendus</i> Sturm, 1845	<i>Frufa</i>	mycetophil	1, 2, 81
<i>Cryptophagus scutellatus</i> Newman, 1834	<i>Formica</i> spp.	mycetophil	2, 6
<i>Spavius glaber</i> * (Gyllenhal, 1808)	<i>Frufa</i> , <i>Fpoly</i> , <i>Faqui</i> , <i>Fural</i>	myrmecophil, mycetophil	2, 4, 5, 6, 21, 63, 67, 81, 82, 112, 113
<i>Caenoscelis ferruginea</i> (Sahlberg, 1820)	<i>Frufa</i>	mycetophil	1, 94, 113
<i>Caenoscelis sibirica</i> Reitter, 1889	<i>Lnige</i>	mycetophil	113
<i>Atomaria peltata</i> Kraatz, 1853	<i>Formica</i> spp.	mycetophil	6
<i>Atomaria nigriventris</i> Stephens, 1830	<i>Lfuli</i>	mycetophil	1, 113
<i>Atomaria procerula</i> Erichson, 1846	<i>Lbrun</i>	mycetophil	105
CERYLONIDAE			
<i>Cerylon histerooides</i> (Fabricius, 1792)	<i>Lbrun</i> , <i>Lfuli</i> , <i>Frufa</i>		2, 5, 81
<i>Cerylon ferrugineum</i> Stephens, 1830	<i>Formica rufa</i> coll.		63
BOTHRIDERIDAE			
<i>Teredus cylindricus</i> (Olivier, 1790)	<i>Lbrun</i>		1, 2
<i>Oxytaemus variolosus</i> * (Dufour, 1843)	<i>Lfuli</i>	myrmecophil	2
ENDOMYCHIDAE			
<i>Mycetaea subterranea</i> (Fabricius, 1801)	<i>Lfuli</i>		81, 113
<i>Symbiotes latus</i> Redtenbacher, 1849	<i>Lbrun</i> , <i>Lflav</i>	mycetophil	1, 2, 113
<i>Symbiotes gibberosus</i> (Lucas, 1849)	<i>Lbrun</i> , <i>Lfuli</i>	mycetophil	1, 2, 113
<i>Leiestes seminigra</i> (Gyllenhal, 1808)	<i>Lnige</i>		1, 2
COCCINELLIDAE			
<i>Platynaspis luteorubra</i> (Goeze, 1777)	<i>Lnige</i>	xerophil	7
<i>Coccinella magnifica</i> Redtenbacher, 1843	<i>Ffusc</i> , <i>Frufa</i>	thermophil	1, 2, 54, 69, 75, 95, 113
CORYLOPHIDAE			
<i>Orthoperus punctulatus</i> Reitter, 1876	<i>Frufa</i>	mycetophil	5
LATRIDIIDAE			
<i>Enicmus transversus</i> (Olivier, 1790)	<i>Frufa</i>	mycetophil	5
<i>Dienerella elongata</i> (Curtis, 1830)	<i>Frufa</i>	mycetophil	1, 113
<i>Dienerella clathrata</i> (Mannerheim, 1844)	<i>Frufa</i>	mycetophil	6
<i>Dienerella ruficollis</i> (Marshall, 1802)	<i>Frufa</i>	mycetophil	1, 81, 113
<i>Stephotethus rugicollis</i> (Olivier, 1790)	<i>Frufa</i>	mycetophil	1, 113
<i>Corticaria longicollis</i> * (Zetterstedt, 1838)	<i>Lnige</i> , <i>Frufa</i> , <i>Fprat</i> , <i>Fpoly</i> , <i>Faqui</i>	myrmecophil, mycetophil	1, 2, 4, 5, 6, 21, 81, 95, 105, 113
<i>Corticaria crenicollis</i> Mannerheim, 1844	<i>Frufa</i>		1, 81

Ant associated beetle species	Host ant	Special requirement	Ref.
<i>Corticaria inconspicua</i> * Wollaston, 1860	<i>Frufa, Fprat</i>	myrmecophil, mycetophil	1, 2, 113
<i>Corticarina fuscula</i> (Gyllenhal, 1827)	<i>Frufa</i>	mycetophil	5
MYCETOPHAGIDAE			
<i>Mycetophagus quadriguttatus</i> Mueller, 1821	<i>Lfuli</i>	mycetophil	1, 113
ADERIDAE			
<i>Aderus populneus</i> (Creutzer, 1796)	<i>Lfuli</i>		113
TENEBRIONIDAE			
<i>Myrmecixenus subterraneus</i> * Chevrolat, 1835	<i>Lnige, Lfuli, Fexse, Ffusc, Frufa, Fprat, Fpoly, Faqui</i>	myrmecophil	1, 2, 3, 4, 5, 21, 38, 81, 82, 97, 112, 113
<i>Opatrum sabulosum</i> (Linnaeus, 1761)	<i>Lnige, Ffusc</i>		69
<i>Pentaphyllus testaceus</i> (Hellwig, 1792)	<i>Lbrun</i>	mycetophil	113
<i>Palorus depressus</i> (Fabricius, 1790)	<i>Frufa, Fpoly</i>		3, 5, 6, 113
LAGRIDIIDAE			
<i>Scraptia fuscula</i> Mueller, 1821	<i>Lfuli, Lbrun, Fsang</i>		1, 20, 113
CHRYSOMELIDAE			
<i>Clytra quadripunctata</i> * (Linnaeus, 1758)	<i>Ffusc, Fexse, Frufa, Fprat, Fsang, Faqui, Flugu</i>	myrmecophil, xerophil	1, 2, 3, 4, 21, 55, 56, 69, 81, 111
CURCULIONIDAE			
<i>Dryophthorus corticalis</i> (Paykull, 1792)	<i>Lbrun, Lnige</i>		1, 69, 113
<i>Cossonus linearis</i> (Fabricius, 1775)	<i>Lfuli</i>	hygrophil	1, 113

with the host ant *Formica rufa* (166) and *Lasius fuliginosus* (156) (Table 2). The largest number of the host ant species (15) was found for a staphylinid beetle *Drusilla canaliculata* (Staphylinidae).

According to Koch (1989a, 1989b and 1992) the listed beetle species can be classified in 10 different groups by their ecological requirements (Table 1). In our data, 73 out of 369 beetles can be classified as myrmecophilous. Most of the other listed AAB species are hygrophilous (require moisture) and mycetophilous (require fungi) (Table 3).

There were 162 beetle species, which had been observed with ants only according to one reference (see Table 1). The largest number of references (20) was found for a staphylinid beetle *Quedius brevis*.

#### 4. Discussion

In this study, we encountered a total of 369 AAB species in Fennoscandia and Denmark, and 73

species of them are classified as myrmecophilous according to Szymczakowski (1975) and Koch (1989a, 1989b and 1992). The total number of beetle species in Fennoscandia and Denmark is about 5000 (Lundberg & Gustafsson 1995). Thus, we can conclude that more than 7% of the beetle fauna of Fennoscandia and Denmark can be found with ants and may belong to the ant-associated species. However, 162 species have only one observation (reference) in our list (see Table 1). This may indicate that the total number of beetle species, which are able to live with ants, would be even higher if more information was available. On the other hand, this may indicate that many beetle species may occur with ants accidentally.

There is evidence that suggests that ants reduce the numbers of other arthropods, e.g. spiders (Araneae) and harvestmen (Opiliones) (Cherix & Bourne 1980, Skinner & Whittaker 1981, Niemelä *et al.* 1992 and Laakso & Setälä 2000). However, only a few detailed investigations or experiments

have been published concerning the ants' impact on beetle species occurrence (*see* Laakso & Setälä 1998, 2000). Laakso & Setälä (2000) concluded that biomasses of large predatory arthropods were considerably smaller in the areas of high ant density than in the areas with few ants. However, the density of ants did not affect the total species richness of arthropods. In our opinion this is not surprising because many arthropod species in the study of Laakso & Setälä's (2000) study seems to be ant-

associated. We propose that in these kinds of studies arthropod species should be categorized to ant-associated and other species, and these two groups should be dealt with separately. After this categorization it would be possible to find out whether ants affect other arthropods. Furthermore, Laakso & Setälä (1998) noticed that, based on surface area, ant mounds harboured an order of magnitude more abundant insect fauna than the surrounding soil, the typical Coleoptera taxa in the

Table 2. List of the host ant species with the abbreviations and the numbers of the ant-associated beetle species observed with them.

Host ant species	Abbreviations used in Table 1	Number of ant-associated beetle species
<i>Tapinoma erraticum</i> Latreille, 1798	<i>Terra</i>	4
<i>Myrmica rubra</i> (Linnaeus, 1758)	<i>Mrubr</i>	12
<i>M. ruginodis</i> Nylander, 1846	<i>Mrugi</i>	12
<i>M. rugulosa</i> Nylander, 1849	<i>Mrugu</i>	2
<i>M. sabuleti</i> Meinert, 1861	<i>Msabu</i>	2
<i>M. scabrinodis</i> Nylander, 1846	<i>Mscab</i>	11
<i>M. sulcinodis</i> Nylander, 1846	<i>Msulc</i>	3
<i>Stenamma westwoodii</i> , Westwood, 1840	<i>Swest</i>	1
<i>Leptothorax acervorum</i> , (Fabricius, 1793)	<i>Lacer</i>	2
<i>Tetramorium caespitum</i> (Linnaeus, 1758)	<i>Tcaes</i>	8
<i>Camponotus vagus</i> (Scopoli, 1763)	<i>Cvagu</i>	1
<i>C. herculeanus</i> (Linnaeus, 1758)	<i>Cherc</i>	4
<i>C. ligniperda</i> (Latreille, 1802)	<i>Cligh</i>	2
<i>Lasius flavus</i> (Fabricius, 1781)	<i>Lflav</i>	14
<i>L. alienus</i> (Förster, 1850)	<i>Lalie</i>	4
<i>L. brunneus</i> (Latreille, 1798)	<i>Lbrun</i>	77
<i>L. niger</i> (Linnaeus, 1758)	<i>Lnige</i>	42
<i>L. fuliginosus</i> (Latreille, 1798)	<i>Lfuli</i>	156
<i>L. umbratus</i> (Nylander, 1846)	<i>Lumbr</i>	7
<i>L. mixtus</i> (Nylander, 1846)	<i>Lmixt</i>	2
<i>Formica fusca</i> (Linnaeus, 1758)	<i>Ffusc</i>	23
<i>F. gagatooides</i> Ruzsky, 1904	<i>Fgaga</i>	1
<i>F. lemani</i> Bondroit, 1917	<i>Flema</i>	2
<i>F. cinerea</i> Mayr, 1853	<i>Fcine</i>	2
<i>F. cunicularia</i> , Latreille, 1798	<i>Fcuni</i>	1
<i>F. rufibarbis</i> Fabricius, 1793	<i>Frufi</i>	5
<i>F. exsecta</i> Nylander, 1846	<i>Fexse</i>	31
<i>F. suecica</i> Adlerz, 1902	<i>Fsuec</i>	3
<i>F. uralensis</i> Ruzsky, 1895	<i>Fural</i>	11
<i>F. sanguinea</i> Latreille, 1798	<i>Fsang</i>	20
<i>F. truncorum</i> Fabricius, 1804	<i>Ftrun</i>	7
<i>F. rufa</i> Linnaeus, 1761	<i>Frufa</i>	166
<i>F. polycтена</i> Förster, 1850	<i>Fpoly</i>	25
<i>F. aquilonia</i> Yarrow, 1955	<i>Faqui</i>	29
<i>F. lugubris</i> Zetterstedt, 1840	<i>Flugu</i>	12
<i>F. pratensis</i> Retzius, 1783	<i>Fprat</i>	34
<i>F. nigricans</i> Emery, 1909	<i>Fnige</i>	4
<i>Polyergus rufescens</i> (Latreille, 1798)	<i>Prufe</i>	1

mounds being Ptilidae and Staphylinidae. As many of the listed AAB species belong to these two families, our study provides some support for this finding (see Table 1).

Koch (1989a, 1989b and 1992) has categorized beetle species according to their ecological requirements. Based on this classification, we divided ant-associated beetles into two groups: myrmecophilous species and other ant-associated species. Other ant-associated species are regularly found with ants, but based on Koch (1989a, 1989b, 1992) they are not necessarily dependent on ants. Koch (1989a, 1989b, 1992) has also categorized some beetle species as myrmeco- or mycetophagous (feed upon ants or fungus). We have categorized these species as myrmeco- or mycetophilous species, since they are clearly dependent on ants or fungus as a food resource. Also one mycetobiont (bounded to fungus) species is classified as mycetophilous. Furthermore, according to Szymczakowski (1975) the endemic Nordic beetle species *Eocatops lapponicus* is classified as myrmecophilous too.

Vaz-De-Mello *et al.* (1998) have studied rare or poorly known beetle species of the family Scaradaeidae and propose that myrmecophilous interactions between beetles and ants are possibly more common than has been thought previously. We agree with Vaz-De-Mello *et al.* (1998) and state that many beetles, which are not previously known to benefit from ants, do so, however. According to present knowledge, it is difficult to specify which listed AAB species could be myrmecophiles.

A generally accepted classification of myrmecophilous arthropods is based on a series of works by Wasmann (e.g. Wasmann 1910, translated into English by Wheeler in 1910). Wasmann devised 5 behavioural categories: (1) synechthrans (persecuted guests), (2) synoeketes (indifferently tolerated guests), (3) symphiles (true guests), (4) ectoparasites and endoparasites and (5) trophobionts (provide secretions to the ants). In the current study, we list beetle species that are classified as myrmecophilous according to Szymczakowski (1975) and Koch (1989a, 1989b, 1992). As the ecology of these species is poorly known, we did not classify the species into the appropriate behavioural categories. Correspondingly, Larsson (1943) has classified ant-associated species by their behaviour to three categories; synechthrans, synoeketes and symphiles. All the beetle species belonging to these behavioural categories are myrmecophilous according to Hölldobler and Wilson's (1990) definition. Thus, there are many myrmecophilous beetles in Larsson's (1943) list that are not classified myrmecophilous according to Koch (1989a, 1989b, 1992). It seems that at least both Larsson's (1943) and Johansen's (1904) description of myrmecophilous beetles is probably different from Koch's (1989a, 1989b, 1992) and Hölldobler & Wilson's (1990). We propose that when a beetle species is found to associate with ants but knowledge of its basic ecology is lacking, the term ant-associated beetle (AAB) species should be used instead of the term myrmecophilous.

Table 3. The number of AAB species found with each host ant genus. AAB species are classified according to their ecological requirements. The same AAB species can have zero, one or two special requirements.

Host ant genus	AAB species' special requirement				
	Hygrophil	Mycetophil	Myrmecophil	Xerophil	Other groups
<i>Tapinoma</i> spp.	0	0	1	1	0
<i>Myrmica</i> spp.	9	2	10	8	0
<i>Stenamma</i> spp.	0	0	1	1	0
<i>Leptothorax</i> spp.	0	0	2	2	0
<i>Tetramorium</i> spp.	1	0	4	5	1
<i>Camponotus</i> spp.	1	1	5	0	1
<i>Lasius</i> spp.	45	25	54	12	15
<i>Formica</i> spp.	37	36	56	15	14
<i>Polyergus</i> spp.	0	0	0	1	0
Total	93	64	133	45	31



Both AAB and most of the host-ant species are often difficult to identify. The largest number of listed AAB species exists with *Formica rufa*. Probably, at least in some older studies, most of the so-called *F. rufa*-group species (*F. rufa*, *F. polyctena*, *F. aquilonia*, *F. lugubris* and *F. pratensis*) have been incorrectly identified as *F. rufa*. Moreover the species *F. aquilonia* was not described until 1955 by Yarrow. This may partly explain why six times more AAB-species have been observed with *F. rufa* than with *F. aquilonia*, although the latter probably is the most common mound-building wood ant in Fennoscandia. Indeed, Päivinen (1999) found in *Formica aquilonia* mounds 20 ant-associated beetle species not previously recorded for *F. aquilonia*. In total, only 10% of AAB-species that Päivinen (1999) found in *F. aquilonia*'s mounds were earlier observed with this species.

64 ant species have been recorded in Fennoscandia and Denmark (Collingwood 1979). According to our study, AAB species were found with only 2/3 of them. Due to the poor knowledge of AAB species living with ants (*see* Päivinen 1999), we assume that clearly more AAB species could further be found with most of the ant species. To find more AAB species in the future, research should be focused on those ant species that do not exist on the present list.

Finally, we conclude that ant colonies are species rich habitats for many beetles in Fennoscandia and Denmark. In addition, myrmecophilous interactions between beetles and ants can be more frequent than previously thought. Despite the fact that ants have been shown to have negative association with many arthropods, ants seem to have an important role in maintaining beetle species diversity. We recommend the use of the term ant-associated beetle (AAB) for beetles, which are found to live with ants. More detailed studies on the basic ecology of ant-beetle interactions should be done to determine which species are true myrmecophiles.

*Acknowledgements.* Special thanks to Veli-Matti Mukkala and Ilpo Rutanen, who gave us their valuable field observations concerning about ants and beetles. We are also grateful to Teija Virola, Esko Hyvärinen, Jouni Laakso, Heikki Setälä, Jouni Sorvari, Lotta Sundström and Tero Toivanen for improving the manuscript. Special thanks also to Tom Clayhills, Jyrki Muona and Juha Siitonen who helped

us to solve many taxonomical problems and Pekka Punttila for helping us in the literature survey. The study was financed by the Jenny and Antti Wihuri Foundation, University of Jyväskylä, Otto A. Malm Foundation, the Societas pro Fauna et Flora Fennica and the Entomological Society of Finland.

## References

- Adlerz, G. 1911: *Cetonia aurata* och *Trichius fasciatus* i myrbon. — Ent. Tidskr. 32: 43–46.
- Adlerz, G. 1912: Resa till Öland sommaren. — Ent. Tidskr. 33: 43–46.
- Adlerz, G. 1913: Myrornas liv. — Ljus, Stockholm. 243 p.
- Andersen, J., Nielsen, T. R. & Zachariassen, K. E. 1984: Nye funn av biller i Norge. — Fauna Norv. Ser. B. 31: 59–60.
- Andersson, B. 1977: Notiser om svenska skalbaggar. — Ent. Tidskr. 98: 97–102.
- Andersson, B. 1981: Notiser om svenska skalbaggar 3. — Ent. Tidskr. 102: 141–146.
- Aurivillius, C. 1917: Skalbaggar I. Coleoptera. Växtbaggar. Phytophaga. — Svensk Insektfauna 9. Almqvist & Wiksells Boktryckeri-A-B, Uppsala. 119 pp.
- Aurivillius, C. 1920: Skalbaggar II. Coleoptera. Snytbaggar. Rhynchopora. — Svensk Insektfauna 9. Almqvist & Wiksells Boktryckeri-A-B, Uppsala. 64 pp.
- Bangsholt, F. 1981: Femte tillæg til "Fortegnelse over Danmarks biller" (Coleoptera). — Ent. Medd. 48: 49–103.
- Baranowski, R. 1975: Några bidrag till kännedomen om coleopterfaunan vid nedre Dalälven. — Ent. Tidskr. 96: 97–115.
- Baranowski, R. 1976: Några för Sverige nya skalbaggar (Coleoptera). — Ent. Tidskr. 97: 117–123.
- Baranowski, R. 1979: Intressanta skalbaggsfynd 4. — Ent. Tidskr. 100: 71–80.
- Baranowski, R. 1980a: Några bidrag till kännedomen om coleopterfaunan vid nedre Dalälven. 2. — Ent. Tidskr. 101: 29–42.
- Baranowski, R. 1980b: Intressanta skalbaggsfynd 5. — Ent. Tidskr. 101: 99–106.
- Baranowski, R. 1982: Intressanta skalbaggsfynd 6. — Ent. Tidskr. 103: 130–136.
- Cherix, D. & Bourne, J. D. 1980: A field study on a supercolony of the Red wood ant *Formica lugubris* Zett. in relation to other predatory arthropods (spiders, harvestman and ants). — Rev. Suisse. Zool. 87: 955–973.
- Clayhills, T. 1988: Tiedonantoja; *Oxypoda lapponica* tavattu Suomesta (Staphylinidae). — Not. Entomol. 68: 151.
- Collingwood, C. A. 1957: Myrmecophilous beetles in the Midlands. — Entomol. Rec. J. Var. 69: 9–14.
- Collingwood, C. A. 1959: Notes on Irish Coleoptera. — Ent. Gaz. 10: 39–42.
- Collingwood, C. A. 1965: Myrmecophilous Beetles in Ireland, Scotland and Wales. — Entomol. Rec. J. Var. 77: 45–47.

- Collingwood, C. A. 1979: The Formicidae (Hymenoptera) of Fennoscandia and Denmark. — *Fauna Ent. Scand.* 8: 1–175.
- Donisthorpe, H. 1927: The guests of British ants, their habits and life-histories. — George Routledge and Sons, London. 244 pp.
- Douglas, J. W. 1858: Ants' nest beetles. — *Zoologist* 16: 6067–6068.
- Ehnström, B. 1983: Faunistiska anteckningar om trädskalbaggar. — *Ent. Tidskr.* 104: 76–79.
- Franc, V. 1992: Myrmecophilous beetles of Slovakia with special reference to their endangerment and perspectives for protection. — *Acta Universitatis Carolinae Biologica* 36: 299–324.
- Gillerfors, G. 1982: Anteckningar om svenska coleoptera 2. — *Ent. Tidskr.* 103: 73–77.
- Gillerfors, G. 1990: Anteckningar om svenska coleoptera 3. — *Ent. Tidskr.* 111: 87–89.
- Hansen, M. 1988: Syvende tillage til "Fortegnelse over Danmarks biller" (Coleoptera). — *Ent. Medd.* 56: 131–155.
- Hansen, M. & Mahler, V. 1985: Nogle billearter, nye for den danske fauna (Coleoptera). — *Ent. Medd.* 53: 1–23.
- Hansen, M., Mahler, V., Palm, E. & Vagtholm-Jensen, O. 1990: Ottende tillæg til "Fortegnelse over Danmarks Biller" (Coleoptera). — *Ent. Medd.* 58: 11–29.
- Hansen, M., Mahler, V., Palm, E. & Vagtholm-Jensen, O. 1991: Niende tillæg til "Fortegnelse over Danmarks Biller" (Coleoptera). — *Ent. Medd.* 59: 5–21.
- Hansen, M., Mahler, V., Pritzl, G. & Runge, J. B. 1994: 13. tillæg til "Fortegnelse over Danmarks Biller" (Coleoptera). — *Ent. Medd.* 62: 65–89.
- Hansen, V. 1950: Biller XIII. Clavicornia 1. — *Danmarks Fauna* 55. G. E. C. Gads Forlag, København. 278 pp.
- Hansen, V. 1951a: Biller XIV. Clavicornia 2. — *Danmarks Fauna* 56. G. E. C. Gads Forlag, København. 253 pp.
- Hansen, V. 1951b: Biller XV. Rovbiller 1. — *Danmarks Fauna* 57. G. E. C. Gads Forlag, København. 274 pp.
- Hansen, V. 1952: Biller XVI. Rovbiller 2. — *Danmarks Fauna* 58. G. E. C. Gads Forlag, København. 251 pp.
- Hansen, V. 1954: Biller XVII. Rovbiller 3. — *Danmarks Fauna* 59. G. E. C. Gads Forlag, København. 499 pp.
- Hansen, V. 1956: Biller XVIII. Barkbiller. — *Danmarks Fauna* 62. G. E. C. Gads Forlag, København. 196 pp.
- Hansen, V. 1957: Biller XIX. Almindelig del. — *Danmarks Fauna* 63. G. E. C. Gads Forlag, København. 248 pp.
- Hansen, V. 1958: Biller XX. Tilleagsbind. — *Danmarks Fauna* 64. G. E. C. Gads Forlag, København. 244 pp.
- Hansen, V. 1964: Fortegnelse over Danmarks biller (Coleoptera). — *Ent. Medd.* 33: 1–507.
- Hansen, V. 1965: Biller XXI. Snudebiller. — *Danmarks Fauna* 69. G. E. C. Gads Forlag, København. 524 pp.
- Hansen, V. 1966a: Biller XXII. Traebukke. — *Danmarks Fauna* 73. G. E. C. Gads Forlag, København. 228 pp.
- Hansen, V. 1966b: Biller XXIII. Smaeldere og Praktbiller. — *Danmarks Fauna* 74. G. E. C. Gads Forlag, København. 179 pp.
- Hansen, V. 1967: Nye danske biller (Coleoptera) 1966. — *Ent. Medd.* 35: 218–222.
- Hansen, V. 1968a: Biller XXIV. Sandspringere og Lobe-biller. — *Danmarks Fauna* 76. G. E. C. Gads Forlag, København. 451 pp.
- Hansen, V. 1968b: Biller XXV. Ådselbiller og Stunpbiller. — *Danmarks Fauna* 77. G. E. C. Gads Forlag, København. 353 pp.
- Hansen, V. 1968c: Nye danske biller (Coleoptera) 1967. — *Ent. Medd.* 36: 409–413.
- Hansen, V. 1969: Biller XXVI. Andet tillægsbind. — *Danmarks Fauna* 78. G. E. C. Gads Forlag — København. 128 pp.
- Hansen, V. 1970: Nye danske biller (Coleoptera) 1969. — *Ent. Medd.* 38: 165–169.
- Hansen, V. 1971: Billefaunan i Jaegersborg Dyrehave (Coleoptera). — *Ent. Medd.* 39: 161–200.
- Hansen, V. 1973a: Biller VIII. Vandkalve. — *Danmarks Fauna* 34. G. E. C. Gads Forlag, København. 248 pp.
- Hansen, V. 1973b: Biller IX. Vandkaerer. — *Danmarks Fauna* 36. G. E. C. Gads Forlag, København. 172 pp.
- Hansen, V. 1973c: Biller X. Blödvinger. — *Danmarks Fauna* 44. G. E. C. Gads Forlag, København. 344 pp.
- Hansen, V. 1973d: Biller XII. Heteromerer. — *Danmarks Fauna* 50. G. E. C. Gads Forlag, København. 307 pp.
- Hansen, V. & Henriksen, K. 1927: Biller VII. Bladbiller og Bonnebiller. — *Danmarks Fauna* 31. G. E. C. Gads Forlag, København. 401 pp.
- Holstebro, H. O. 1910: De danske Arter af Slaegten *Choleva* Latreille. — *Ent. Medd.* 2(3–4): 377–403.
- Huggert, L. 1967: Några sällsyntare Coleoptera. — *Ent. Tidskr.* 88: 170–173.
- Huggert, L. & Ulefors, S.-O. 1971: Anteckningar om svenska Coleoptera. — *Ent. Tidskr.* 92: 54–65.
- Hölldobler, B. & Wilson, E. O. 1990: The Ants. — Springer-Verlag, Berlin, Heidelberg. 732 pp.
- Johansen, J. P. 1895–96: Catalogus Coleopterorum Danicorum Fam. Staphylinidae. Pars 4. — *Ent. Medd.* 3: 235–276.
- Johansen, J. P. 1903: Meddelelse af Fund av adskillige for Faunaen nye og af nogle kjendte, sjældne Biller. — *Ent. Medd.* 2(3–4): 180–138.
- Johansen, J. P. 1904: Om Undersøgelse af Myretuer samt fortegnelse over de i Danmark fundne, saakaldte myrmecophile Biller. — *Ent. Medd.* 2: 217–265.
- Johansen, J. P. 1906: Meddelelse om Fund av adskillige for Faunaen nye og af nogle kjendte, sjældne Billeder. 3. — *Ent. Medd.* 2(3–4): 65–84.
- Johnson, C. 1988: Notes on some British *Cryptophagus* Herbst (Coleoptera: Cryptophagidae), including *con-fusus* bruce new to Britain. — *Ent. Gaz.* 329–335.
- Jorum, P. 2000: Billefaunaen i Hald Egeskov (Coleoptera). — *Ent. Medd.* 68: 1–46.
- Kangas, E. 1938: Revision der finnischen Arten der Gattung *Oligota* Mann. (Col., Staphylinidae). — *Ann. Ent. Fenn.* 4: 201–212.
- Kangas, E. 1951: Die finnischen *Euplectus*-Arten (Col., Pselaphidae). — *Ann. Ent. Fenn.* 17: 136–148.
- Kangas, E. 1982: Über einige Arten der *Oligota pusillima*

- (Gravenhorst) — Gruppe (Coleoptera, Staphylinidae). — Ann. Ent. Fenn. 48: 65–70.
- Kangas, E. 1983: Eine neue *Oxyroda*-Art (Coleoptera, Staphylinidae) aus Finnland. — Ann. Ent. Fenn. 49: 54–56.
- Kistner, D. H. 1982: The social insects' bestiary. — In: Hermann, H. R. (ed.), Social Insects. Academic Press, New York. 1–244 pp.
- Kistner, D. H., Weissflog, A., Rosciszewski, K. & Maschwitz, U. 1997: New species, new genera, and new records of myrmecophiles associated with army ants (*Aenictus* sp.) with the description of a new subtribe of Staphylinidae (Coleoptera; Formicidae: Aenictinae). — Sociobiology 29: 121–221.
- Koch, K. 1989a: Ökologie 1. — Die Käfer Mitteleuropas E1. 440 pp.
- Koch, K. 1989b: Ökologie 2. — Die Käfer Mitteleuropas E2. 382 pp.
- Koch, K. 1992: Ökologie 3. — Die Käfer Mitteleuropas E3. 389 pp.
- Kornerup, U. 1960: 5. Coleoptera — Biller. — Ent. Medd. 30: 59–104.
- Krogerus, R. 1934: Tiedonantoja yhdistyksistä; *Thiasophila bercionis*. — Not. Entomol. 14: 115.
- Kryger, J. P. & Sonderup, H. P. S. 1945: Biologiske iagttagelser over 200 Arten af danske Billelarven. 2. — Ent. Medd. 24: 175–261.
- Laakso, J. & Setälä, H. 1997: Nest mounds of red wood ant (*Formica aquilonia*): hot spots for litter-dwelling earthworms. — Oecologia 111: 565–569.
- Laakso, J. & Setälä, H. 1998: Composition and trophic structure of detrital food web in ant nest mounds of *Formica aquilonia* and in the surrounding forest soil. — Oikos 81: 266–278.
- Laakso, J. & Setälä, H. 2000: Impacts of wood ants (*Formica aquilonia* Yarr.) on the invertebrate food web of the boreal forest floor. — Ann. Zool. Fennici 37: 93–100.
- Landin, B.-O. 1957: Skalbaggar (Coleoptera). Bladhorningar (Lamellicornia). Fam. Scarabaeidae. — Svensk Insektfauna 46. Almqvist & Wiksells Boktryckeri-A-B, Uppsala. 155 pp.
- Larsson, S. G. 1943: Myrer. — Danmarks Fauna 49. G. E. C. Gads Forlag, København. 190 pp.
- Lindberg, H. 1943: Nykomlingar till Finlands skalbaggsfauna. — Not. Entomol. 23: 50–58.
- Lindgren, L. A. H. 1945: Entomologiska notiser 2. — Ent. Tidskr. 66: 73–78.
- Lindroth, C. H. 1933: Skalbaggar (Coleoptera). Oligfotade baggar. Heteromera. — Svensk Insektfauna 27. Almqvist & Wiksells Boktryckeri AB, Uppsala. 158 pp.
- Lindroth, C. H. 1946: Våra skalbaggar och hur man känner igen dem. Del 1. Markens och vattnets skalbaggar jordlöpare, vattenbaggar och kortvingar. — Albert Bonniers Förlag, Stockholm. 81 pp.
- Lindroth, C. H. 1961: Skalbaggar (Coleoptera). Sandjägare och Jordjöpore. Fam. Carabidae. — Svensk Insektfauna 46. Almqvist & Wiksells Boktryckeri AB, Uppsala. 155 pp.
- Lovedal, E. A. 1891–92: Fortegnelse over de I Danmark levande Cryptophagidae og Lathridiidae. — Ent. Medd. 3: 235–276.
- Lundberg, S. 1961: Bidrag till kännedom om svenska Coleoptera. 4. — Ent. Tidskr. 82: 64–68.
- Lundberg, S. 1972: Bidrag till kännedom om svenska skalbaggar. 13. — Ent. Tidskr. 93: 42–56.
- Lundberg, S. 1973: Bidrag till kännedom om svenska skalbaggar. 14. — Ent. Tidskr. 94: 28–33.
- Lundberg, S. 1976: Bidrag till kännedom om svenska skalbaggar. 16 (Coleoptera). — Ent. Tidskr. 97: 15–20.
- Lundberg, S. 1977: Fynd av två Norden nya skalbaggsarter (Coleoptera). — Ent. Tidskr. 98: 5–6.
- Lundberg, S. 1978a: Bidrag till kännedom om svenska skalbaggar. 17 (Coleoptera). — Ent. Tidskr. 99: 31–34.
- Lundberg, S. 1978b: Skalbaggsarter, som inte återfunnits i Sverige på lång tid — några tips (Coleoptera). — Ent. Tidskr. 99: 121–126.
- Lundberg, S. 1980: *Oxyroda scanica* n.sp. and *O. lapponica* n. sp. from Sweden (Coleoptera: Staphylinidae). — Ent. Scand. 11: 348–352.
- Lundberg, S. 1981: Sällsynta skalbaggar i Halltorps hage. — Ent. Tidskr. 102: 134–135.
- Lundberg, S. 1983: Skalbaggar på Ölands Stora alvar. — Ent. Tidskr. 104: 121–126.
- Lundberg, S. 1984: Bidrag till kännedom om svenska skalbaggar 22. — Ent. Tidskr. 105: 107–108.
- Lundberg, S. 1993: Sällsynta och hotade skalbaggar i Hornsö- och Strömsrumstrakten i östra Småland. — Ent. Tidskr. 114: 83–96.
- Lundberg, S. & Gustafsson, B. 1995: Catalogus Coleopterorum Sueciae. — Naturhistoriska riksmuseet & Entomologiska föreningen i Stockholm.
- Mahler, V. 1987: Sjette tillæd til "Fortegnelse over Danmarks biller" (Coleoptera). — Ent. Medd. 54: 181–235.
- Martin, O. 1989: Smældere (Coleoptera, Elateridae) fra gammel lovskov i Danmark. — Ent. Medd. 57:1–110.
- Meinert, F. 1887–88a: *Scydmaenus* — Larven. — Ent. Medd. 1: 144–150.
- Meinert, F. 1887–88b: Catalogus Coleopterorum Danicorum Fam. Staphylinidae. Pars 1. — Ent. Medd. 1: 215–284.
- Meinert, F. 1889–90: Catalogus Coleopterorum Danicorum Fam. Staphylinidae. Pars 2. — Ent. Medd. 2: 227–279.
- Niemelä, J., Haila, Y., Halme, E., Pajunen, T. & Punttila, P. 1992: Small-scale heterogeneity in the spatial distribution of Carabid beetles in the Southern Finnish taiga. — J. Biogeogr. 19: 173–181.
- Nilssen, A. C. and Andersen, J. 1977: Funn av Coleoptera fra Nord-Norge. — Norw. J. Entomol. 24: 7–9.
- Owen, J. A. 1986: *Formica aquilonia* Yarrow (Hym. Formicidae) and some beetle associates in the Isle of Skye. — Entomol. Mon. Mag. 122: 120.
- Owen, J. A. 2000: Coleoptera occurring underground at the roots of old trees. — Ent. Gaz. 51: 239–256.
- Päivinen, J. 1999: Effects of selective logging on beetles living in ant nests. — M.Sc. thesis, University of Jyväskylä, Jyväskylä. 24 pp. [In Finnish with English abstract].

- Palm, T. 1936: Coleoptera i bivråk- och ormvråkbon. — Ent. Tidskr. 57: 84–96.
- Palm, T. 1943: Anteckningar om svenska skalbaggar. — Ent. Tidskr. 64: 74–85.
- Palm, T. 1946: Coleopterfaunan i jämtländsk lavgranskog. — Ent. Tidskr. 67: 109–139.
- Palm, T. 1947: Anteckningar om svenska skalbaggar. III. — Ent. Tidskr. 68: 171–178.
- Palm, T. 1948: Skalbaggar (Coleoptera). Kortvingar: Fam. Staphylinidae. Underfam. (Micropeplinae, Phloeocharinae, Olisthaerinae, Proteininae, Omaliinae). — Svensk Insektfauna 38. Almqvist & Wiksells Boktryckeri AB, Uppsala. 209 pp.
- Palm, T. 1954a: Anteckningar om svenska skalbaggar. IX. — Ent. Tidskr. 75: 13–28.
- Palm, T. 1954b: Bidrag till kännedomen om svenska skalbaggars biologi och systematik. — Ent. Tidskr. 75: 151–161.
- Palm, T. 1956: Anteckningar om svenska skalbaggar. XI. — Ent. Tidskr. 77: 56–63.
- Palm, T. 1959: Bidrag till kännedomen om svenska skalbaggars biologi och systematik. 28–35. — Ent. Tidskr. 80: 22–32.
- Palm, T. 1961: Skalbaggar. Coleoptera. Kortvingar: Fam. Staphylinidae. Underfam. Oxytelinae, Oxyporinae, Steninae, Euaesthetinae. Häfte 2. — Svensk Insektfauna 48. Almqvist & Wiksells Boktryckeri AB, Uppsala. 126 pp.
- Palm, T. 1963: Skalbaggar. Coleoptera. Kortvingar: Fam. Staphylinidae. Underfam. Paederinae, Staphylininae. Häfte 3. — Svensk Insektfauna 49. Almqvist & Wiksells Boktryckeri AB, Uppsala. 168 pp.
- Palm, T. 1966: Skalbaggar. Coleoptera. Kortvingar: Fam. Staphylinidae. Underfam. Habrocerinae, Trichophyinae, Tachyporinae. Häfte 4. — Svensk Insektfauna 50. Almqvist & Wiksells Boktryckeri AB, Uppsala. 93 pp.
- Palm, T. 1968: Skalbaggar. Coleoptera. Kortvingar: Fam. Staphylinidae. Underfam. Aleocharinae (Deinopsis-Trichomicra). Häfte 5. — Svensk Insektfauna 51. Almqvist & Wiksells Boktryckeri AB, Uppsala. 112 pp.
- Palm, T. 1970: Skalbaggar. Coleoptera. Kortvingar: Fam. Staphylinidae. Underfam. Aleocharinae (Atheta). — Svensk Insektfauna 52. Almqvist & Wiksells Boktryckeri AB, Uppsala. 215 pp.
- Palm, T. 1972: Skalbaggar. Coleoptera. Kortvingar: Fam. Staphylinidae. Underfam. Aleocharinae (Aleuonotatintotus). — Svensk Insektfauna 55. Almqvist & Wiksells Boktryckeri AB, Uppsala. 148 pp.
- Palm, T. 1979: Om skalbaggsfaunan i komposthögar vid Uppsala. — Ent. Tidskr. 100: 33–36.
- Palm, T. 1985a: Skalbaggar i en gammal tallskog i Uppsala. — Ent. Tidskr. 106: 107–112.
- Palm, T. 1985b: Skalbaggsstudier på en uppländsk mosse. — Ent. Tidskr. 106: 138–143.
- Palmen, E. 1936: Pikkutietoja; eräitä mielenkiintoisia kovakuoriaislöytöjä. — Ann. Ent. Fenn. 2: 149–151. [In Finnish].
- Paulsen, O. 1991: *Euthiconus conicicollis* (Fairm. & Laboulbene, 1855) (Col., Scydmaenidae) og *Anitys rubens* (Hoffmann, 1803) (Col., Anobiidae) nye arter i Norge. — Fauna Norv. Ser. B. 38: 31.
- Persson, B. 1981: Nya landskapsfynd av skalbaggar. — Ent. Tidskr. 102: 43–45.
- Pritzl, G. & Mahler, J. 1982: De danske *Oligota* — arter (Coleoptera: Staphylinidae). — Ent. Medd. 49: 107–112.
- Rosenberg, E. C. 1913: Bidrag til Kundskaben om Billernes Levevis, Udvikling og Systematic. 3. Undersogelser over Danmarks Billefauna I Dyreboer, saerlig underjordiske. — Ent. Medd. 2(5): 37–76.
- Rosenberg, E. C. 1914: Mindre Meddelelser. Nye og sjældne danske Biller. — Ent. Medd. 2(5): 118–123.
- Rosenberg, E. C. 1924: Contributions to the knowledge of the life-habits, development and systematics of the Coleoptera. 4. On the larva *Batrissodes venustus* Reichenb., with remarks on the life-habits of other so-called myrmecophile Coleoptera. — Ent. Medd. 14: 374–388.
- Rosengren, R., Fortelius, W., Lindström, K. and Luther, A. 1987: Phenology and causation of nest heating and thermoregulation in red wood ants of the *Formica rufa* group studied in coniferous forest habitats in southern Finland. — Ann. Zool. Fenn. 24: 147–155.
- Rosengren, R. & Sundström, L. 1991: The interaction between red wood ants, *Cinara* aphids, and pines. A ghost of mutualism past? — In: Huxley, C. R. & Cutler, D. F. (eds.), *Ant-Plant Interactions*. Oxford University Press, Oxford. 80–91 pp.
- Rydh, I. 1977: Nyfynd av skalbaggar i Blekinge och Småland 2 (Coleoptera). — Ent. Tidskr. 98: 141–142.
- Sagvolden, B. A. and Hansen, L. O. 1996: Notes on Norwegian Coleoptera. 3. — Fauna Norv. Ser. B. 43: 89–94.
- Schlick, W. 1895–96: Biologiske Bidrag. — Ent. Medd. 5: 110–138.
- Schlick, W. 1897: Biologiske Bidrag. Coleoptera 3. Fortsaettelse. — Ent. Medd. 2(1): 49–67.
- Siitonen, J. 1993: Faunistic records of Carabidae and Staphylinidae (Coleoptera) caught by pitfall trapping in western Finnish Lapland. — Ent. Fenn. 4: 225–231.
- Skidmore, P. and Johnson, C. 1969: A preliminary list of the Coleoptera of Merioneth, North Wales. — Ent. Gaz. 20: 139–225.
- Skinner, G. J. and Whittaker, J. B. 1981: An experimental investigation of interrelationship between the wood-ant (*Formica rufa*) and some tree-canopy herbivores. — J. Anim. Ecol. 50: 313–326.
- Sloggett, J. J., Manica, A., Day, M. J. and Majerus, M. E. N. 1999: Predation of ladybirds (Coleoptera: Coccinellidae) by wood ants, *Formica rufa* L. (Hymenoptera: Formicidae). — Ent. Gaz. 50: 217–221.
- Spessivtseff, P. 1925: Andra familjegruppen snytbaggar (Rhynchophora). Skalbaggar (Coleoptera). Barkborrar (Scolytidae). — Svensk Insektfauna 28: 194 pp. Almqvist & Wiksells Boktryckeri-A-B, Uppsala.
- Szymczakowski, Von W. 1975: Unerwarteter Fund einer neuen *Eocatops*-Art in Schweden und Finnland (Col. Catopidae). — Ent. Tidskr. 96: 3–7.

- Sörensson, M. 1979: Uppgifter om svenska skalbaggar. — Ent. Tidskr. 100: 67–69.
- Sörensson, M. 1996: Sydsvenska kortvingar (Coleoptera: Staphylinidae) ur ett naturvårdsperspektiv: 1. *Quedius truncicola*. — Ent. Tidskr. 117: 11–22.
- Vallenduuk, H. J. 1987: Faunistics and biology of myrmecophilous Histeridae in the Netherlands (Coleoptera). Greater than or equal to. — Entomol. Ber. (Amst.) 47: 53–59.
- Vaz-De-Mello, F. Z., Louzada, J. N. C & Schoederer, J. H. 1998: New Data and Comments on Scarabaeidae (Coleoptera: Scarabaeoidea) Associated with Attini (Hymenoptera: Formicidae). — Coleopt. Bull. 52: 209–216.
- Völkl, W. 1995: Behavioural and morphological adaptations of the coccinellid, *Platynaspis luteorubra* for exploiting ant-attended resources (Coleoptera: Coccinellidae). — J. Insect Behav. 8: 653–670.
- Wasmann, E. 1910: Die Ameisen und ihre Gäste. — Memoires 2: 209–232.
- Wegelius, A. 1960: Bidrag till kännedomen om skalbaggsfaunan inom Pallas-Ounastunturi nationalpark. — Not. Entomol. 40: 86–107.
- West, A. 1913: Mindre meddelelser. — Ent. Medd. 2(5): 29–32.
- West, A. 1930: Tillaeg og Rettelser til Fortegnelserne over de danske Coleoptera. — Ent. Medd. 16: 441–492.
- Wheeler, W. M., 1910: Ants, their structure, development and behaviour. — Columbia Univ. Press, New York. 663 pp.
- Whitehead, P. F. 1996: The northernmost British record of *Euryusa sinuata* Erichsin, 1837 (Coleoptera: Staphylinidae). — Ent. Gaz. 47: 255–256.
- Widenfalk, T. 1954: Smärre meddelanden och notiser. Fynd av några sällsyntare eller Sverige nya skalbaggar. — Ent. Tidskr. 75: 61–62.
- Wilson, E. O. 1971: The insect societies. — Belknap Press of Harvard University Press, Cambridge, Mass. 548 pp.
- Wojcik, D. P. 1990: Behavioral interactions of fire ants and their parasites, predators and inquilines. — In: Van der Meer, R. K., Jaffe, K. & Cedeno, A (eds.), Applied Myrmecology: A World Perspective. Westview Press, Boulder, San Francisco & Oxford. 329–344 pp.