The insect fauna associated with carpophores of the fungus *Fomitopsis pinicola* (Fr.) Karst. in a southern Norwegian spruce forest

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The insect fauna of *Fomitopsis pinicola* in three developmental stages was studied in different ways: (1) Rearing; (2) carpophore traps; (3) odour traps with carpophores as the odour source (4) observations and experiments on a common species, *Gyrophaena boleti* (L.).

The rearings yielded 23 species. Few species were reared from more than one of the stages, indicating a pronounced fauna succession in the carpophores. Highest diversity was found in the dead carpophores. Four species seem to be clearly associated with *F. pinicola,* while the majority is described from other habitats. Four Diptera and three Hymenoptera species are new to Norway.

The long species list in the carpophore traps indicate a high activity of insects close to the carpophores. The majority of the species are previously described from fungus or saproxylic habitat, but few were reared from *F. pinicola* in this study. However, some relation to the carpophores is indicated, since most species showed significant difference among the carpophore stages in the traps.

Attraction to carpophore scent was not found for the beetle species tested, but is not excluded as a factor in host selection. However, *Gyrophaena boleti* was exclusively observed under living carpophores with opened hymenium, and moisture of between 28—100%, while this restriction was not demonstrated in the carpophore traps, in which this species also occurred in the other stages of the carpophores. Thus, stimuli from direct or close contact with the substrate appears to be a major factor in the host selection.

Even high densities of spore-eating *G. boleti* had no visible impact on the hymenia of sporulating carpophores. Dissecting a large number of carpophores in different developmental stages revealed relatively few galleries or other traces of insect activity. It is unclear whether the major role in the decomposition of *F. pinicola* Carpophores is played by insects, micro-organisms or these in combination.

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INTRODUCTION

The present article comprises a study of the insect fauna associated with *Fomitopsis pinicola* within a forest reserve, and forms the basis for a later comparative study with managed forests. Generally, polypores are considered to be a habitat for many specialized invertebrates. There are several publications on the fauna and ecology of polypores (Bendick 1952, Nuss 1975, Paviour-Smith 1960, Graves and Graves 1985, Klopfenstein and Graves 1989, Pielou 1966, Pielou and Verma 1968, Klimaszewski and Peck 1987). However, this faunal element is poorly studied in Scandinavia. Our primary goal is to increase the knowledge about saproxylic insect communities in order to achieve species conservation in forestry practices. We chose carpophores of *F. pinicola* as object for our study, because they appear both in managed and less-disturbed forests, and may be used in comparisons between these forest types.

F. pinicola is widely distributed in the

Taiga forests of Europe and North America, and is also reported from South America, Africa, Australia, Central and East Asia, Japan and the Philippine Islands (Perrin 1979, Mounce 1929). This species is reported from more than 100 tree species (Perrin 1979). It grows mainly on coniferous trees, but is common on deciduous trees as well. Experimental logging of Douglas fir in USA showed that *F. pinicola* appeared about 3 years after logging, and gradually came to dominate in the degradation of the wood during the 11-years study (Wright and Harvey 1967). Cracks in the outer bark are assumed to be the major entrance for the fungi. However, *F. pinicola* has been isolated from as many as 39% of in-flight bark beetles *(Ips pini, Dentroctonus brevicomis, D. ponderosae, D. valens),* indicating that such bark beetles may be important in the dissemination of this fungus (Pettey and Shaw 1986).

F. pinicola produces relatively big, perennial carpophores, which represent suitable habitats for many invertebrate species. Midtgaard (1985) presents a list of Teneidae (Lepidoptera) and their polypore hosts, among these *F. pinicola.* In Karelian forests Yakovlev (1986) has reared insects from *F. pinicola,* and Yakovlev and Myttus (1989) have conducted experiments on the attraction of Diptera to aromatic substances from *F. pinicola.*

The essential questions in the present study are:

1. How does the fauna associated with *F. pinicola* differ between the successive stages of the carpophores?
2. What kind of species are trapped, and what relationship do they have to the carpophores?
3. What kind of stimuli are important for host selection?
4. Do insects feeding intensively on the underside of the carpophores effect the vitality of the fungus?

STUDY AREA

The studies were conducted in 1991—92 near Tappenberg lake (UTM: N 636100, E 148000) in the Østmarka Nature Reserve (12.5 km^2) east of Oslo in Norway. The reserve is dominated by old spruce forest (*Picea abies)* with scattered birchs (*Betula verrucosa* and *B. pubescens),* aspens *(Populus tremula,* sallows *(Salix caprea),* rowans *(Sorbus aucuparia),* hoary alders *(Alnus incana)* and bird cherries (*Prunus padus).* Generally, the area has a high density of dead wood and of the dominat polypore species, *Fomitopsis pinicola* (up to 37 cubic meter dead wood and 300 carpophores pr. 1000 m^2).

METHODS

Classification of carpophore stages

The carpophores were classified into three developmental stages: Stage I, small, live capophores with undeveloped hymenium; stage II, live carpophores with open, moist hymenioum; stage III, dead carpophores (Fig. 1). By dissecting a large number of carpophores, we did not find any individual with heavily insect-infested interior parts, which could constitute a separate stage between living and dead carpophores caused by insect penetrations (see Graves 1960). Dry carpophores were not treated as a separate stage (Graves 1960), since they comprised both living and dead fungi in our registrations: We selected 50 dry carpophores (moisture content <20%; moisture content = weight of water/dry weight x 100, Protimeter III) on 11 May 1992, and repeated the measurement of the moisture content and tested for sporulation 11—15 June. At that time half had moisture above 28% (20 carpophores with moisture as

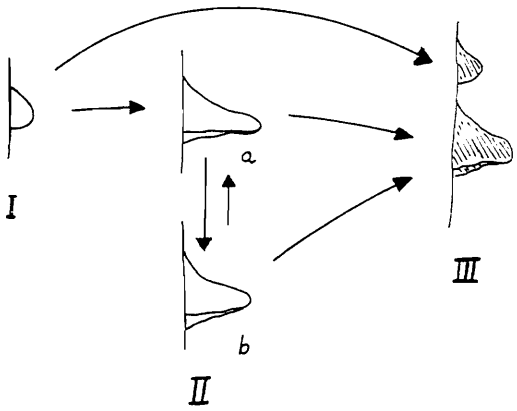

Fig. 1. Schematic representation of the developmental stages of *Fomitopsis pinicola* recognized in our study. I: Carpophores with undeveloped hymenium. II: Living carpophore with opened hymenium (a, moist individual; b, dry individual which is alive and may recover). III: Dead carpophore.

high as 50—80%), and 16 carpophores sporulated (microscope slides with vaseline were mounted 1—2 cm below the hymenia). Clearly, this fungus has a great ability to survive dry periods by stopping spore production and reducing the water content in the carpophore. In our study, stage III comprised only black carpophores which were certainly dead.

Rearing and trapping methods

Insects from each of the three stages of *F. pinicola* were collected with three methods: Rearing from enclosed carpophores, «carpophore traps» close to carpophores in situ, and «odour traps» with carpophores as the odour source. The rearing and trapping periods were (period 1) from 28 April to 30 May, (period 2) from 30 May to 27 June, (period 3) from 27 June to 13 August, and (period 4) from 13 August to 29 September, 1991. Ethylen-glycol was used as a preservation in all trap types.

Insects were reared from 198 carpophores, 66 for each stage. Ninety carpophores were kept in an outdoor cage house with a natural climate. Each carpophore was placed in a plastic funnel closed with black textile on the top and a collecting vial in the bottom. The remaining 108 carpophores were situated in the boxes of the odour traps (see beneath). Carpophores in the funnels were collected at the beginning of periods 1, 2 and 4, and the collecting vials were emptied in all of the four periods. After rearing had ceased, all carpophores were dissected and inspected for traces of insect activity.

Carpophore traps were mounted on 30 carpophores *in situ,* 10 from each of the three developmental stages. The carpophore trap consisted of a transparent plastic sheet inserted vertically through the carpophore, ending in a plastic funnel with a collecting vial about 5 cm beneath the humenium (Fig. 2A). Volatile insecticide («Vapona strip») was mounted beneath the plastic barrier in order to increase the trapping of insects under the hymenium. The traps did not seem to disturb the growth of the carpophores.

The odour traps were arranged in a regular grid of 6 x 6 traps with 2 m intervals, and the trap categories were alternated in order to avoid clustering effects within the grid. There were nine traps within each carpophore stage, and nine control traps without carpo-

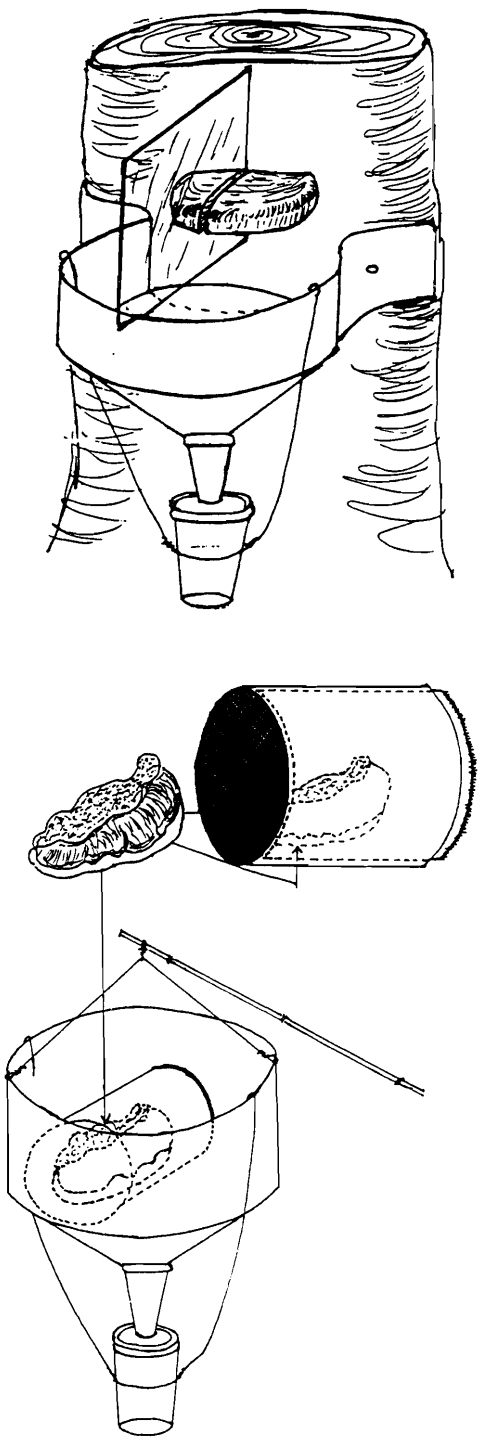

Fig. 2. Traps used in the present study. A: Carpophore trap. B: Odour trap.

Table 1. Insect species reared from carpophores of *Fomitopsis pinicola* (Fr.) Karst in different developmental stages in our study, and habitat references in literature. I: Before development of ripe spores. II: Active production of ripe spores. III: Dead. *New species for Norway.

TAXA	STAGE			HABITAT REFERENCES
	I	II	III	
Cisidae (Coleoptera)				
Cis glabratus Mellie	0	2	75	fungivores, in polypores (Paviour-Smith 1960 etc.)
Cis quadridens Mellie	0	0	18	fungivores, in polypores (Paviour-Smith 1960 etc.)
Cis dentatus Mellie	0	1	0	fungivores, in polypores (Paviour-Smith 1960 etc.)
Ennearthron laricinum (Mellie)	0	0	3	fungivores, in polypores (Paviour-Smith 1960 etc.)
Staphylinidae (Coleoptera)				
Leptusa pulchella (Mannerheim)	0	0	2	stumps, trunks, and polypores (Hansen 1954)
Leptusa fumida (Erichson)	0	0	1	stumps, trunks, and polypores (Hansen 1954)
Gyrophaena boleti (L.)	1	0	0	fungivores, especially spores (Ashe)
Rhizophagidae (Coleoptera)				
Rhizophagus dispar (Paykull)	0	0	1	hunt larvae under bark (Hansen 1950)
Ptinidae (Coleoptera)				
Ptinus fur (L.)	0	3	0	non-saproxilic habitats (Hansen 1951)
Latheridae (Coleoptera)				
Stephostethus rugicollis (Paykul)	1	0	0	non-saproxilic habitats (Hansen 1951)
Microphysidae (Hemiptera)				
Loricula elegantula Bärenspr.?	0	0	4	prey on wood lice and springtails ((Chinery 1973)
Tineidae (Lepidoptera)				
Archinemapogon yildizae Kocak	0	3	0	F.pinicola, and other polypores (Midtgaard 1985)
Cecidomyiidae (Diptera)				
*Winnertzia nigripennis Kieff.?	0	0	9	
Winnertzia Rondani sp.	0	0	1	
*Camptomyia maxima Mamaev	0	9	0	mycelium of F.pinicola (Mamaev 1961)
Camptomyia Kieffer sp.1	0	0	14	fungi/under bark (Panelius 1965)
Lestodiplosis polypori (Loew)	0	44	8	hunt insect larvae (Hingley 1971)
Sciaridae (Diptera)				
*Lycoriella solani (Winnerts)	0	89	0	occurs as "mushroom pest" (Hussey et al.1969)
Lycoriella Frey sp.	0	7	0	
*Corynoptera forcipata (Winnerts)	0	0	1	
Corynoptera Winnerts sp.	0	1	0	
Chloropidae (Diptera)				
*Gaurax dubius (Macquart)	0	0	1	reared from Piptoporus betulinus (Smith 1965)
Encyrtidae (Hyenoptera)				
*Coelopencyrtus araenarius (Erd.)	1	0	0	parasite in wasp larvae (Tryapitsyn 1987)
Ichneumonidae (Hymenoptera)				
*Lissonota deversor (Gravenhorst)	0	0	2	parasite in butterfly larvae (Hedqvist pers.comm.)
Plectiscidea Viereck sp.	0	1	0	unknown (Hedqvist pers.comm.)
Braconidae (Hymenoptera)				
*Bracon atrator Nees	0	0	1	parasite in butterfly larvae (Hedqvist pers.comm.)
SUM SPECIES	3	8	15	
SUMSPECIMENS	3	160	141	

phores. The trap was a hanging plastic funnel with collecting vial (Fig. 2B). The carpophores were placed in a metal box inside the funnel; they were not visible from outside, but the fungal smell could escape through the fine-meshed netting walls of the box. Attracted insects were empied from the collecting vials, and reared insects were collected from the metal box. The traps were operated during periods 1, 2 and 3, and the carpophores were replaced at the beginning of each period.

All reared adult insects were determined to species except Collembola. *Corynoptera sp.* (Diptera) were not determined to species due to the lack of male individuals. In the carpophore and odour traps only Cisidae, Staphylinidae and Ptilidae (Coleoptera) were determined to species.

Gyrophaena boleti

On 4 June 1991, we counted the number of *Gyrophaena boleti* and measured the moisture content under 100 carpophores in a locality with a high density of *F. pinicola.* Further, the feeding damage of the hymenium was tested in a small experiment. On the 8 June 1991, 12 pairs of test chambers were mounted under sporulating carpophores. One chamber confined feeding beetles within a small area of the hymenium, while the other was kept empty (control). Three densities of beetles were tested (3.5, 7.0 and 14.0 beetles pr. cm^2). The hymenia in all of the chambers were inspected under a stereo microscope after 24 days. Séveral *G. boleti* were collected in order to check if other species of *Gyrophaena* were represented.

RESULTS

Rearing from carpophores

Rearing from 198 carpophores yielded totally 23 species representing five orders: Diptera, Coleoptera, Hemiptera, Lepidoptera and Hymenoptera (Table 1). The majority of the species belonged to Diptera and Coleoptera, and the highest species number was found in the families Cecidomyidae (Dipt.) and Cisidae (Col.). The species numbers increased with the stage number; three species in stage I, eight in stage II and 15 in stage III. Only three individuals were reared from stage I, while stage II and III yielded 159 and 141 specimens respectively. Only two species were reared from more than one carpophores stage.

Carpophore traps

The total capture in the carpophore traps comprised 96 Staphylinidae species, 12 Cisidae and three Ptilidae species (Appendix 1). Most frequent staphylinids were *Lordithon lunulatus, Gyrophaena boleti* and *Oxypoda alternans,* which all were most numerous in stage II. *Cis glabratus* and *Cis quadridens* were the most abundant species in Cisidae, and *Acrotrichis intermedia* in Ptilidae. These three species appeared most often in the stage III traps. Table 2 shows the test results for the difference between the carpophore stages. Significant differences were found in 11 of the 16 individually tested species, and also between the sums of the less numerous species ($n<15$).

An analysis of the habitat requirements of the trapped species is given in Table 3. The majority of the species, including species with few individuals, have been reported from saproxylic and fungal habitats (Newton 1984, Lawrence 1973, Sundt 1958). By and large, frequent capture and clear significance between stages corresponded with species described as obligatory fungi or dead wood inhabitants. Few of the trapped species were reared in this study. The three most frequently reared species showed a significant difference between the stages in the carpophore traps, while four species reared in low numbers were also seldom trapped.

Odour traps

The odour traps captured 55 Staphylinidae species, three Cisidae species and six Ptilidae species. Most species were few in numbers, and seemed to occur just as often in the control (Appendix 2). Generally, the tests showed no significant difference between the carpophore-containing traps and the control (Table 4). Only four species were numerous enough to be tested indicidually, of which two species showed a significant difference between traps with and without carpophores (Table 4).

Table 2. The results of chi-square test on the distribution of the species among the developmental stages of the carpophores in the traps under carpophores of *Fometopsis pinicola* (Fr.) Karst. I: Undeveloped humenium. II: Opened hymenium. III: Dead. ***p<0.001, **p<001, *p<0.05, ns p>0.05.

		main test	a posteriori test	
Species	Max.in stage	Chi-square	I=II,III?	II=III?
Lordithon lunulatus (L.)	II	94,0625 ***	ns	***
Gyrophaena boleti (L.)	II	41,54688 ***	**	***
Oxypoda alternans (Gravenhorst	II	89,18 ***	**	***
Acrotrichis intermedia (Gillmeister	I	32,46667 ***	***	**
Cis glabratus Mellie	I	44,93103 ***	***	***
Quedius plagiatus (Mannerheim)		3,875 ns		
Cis quadridens Mellie	I	51,31818 ***	**	***
Ischnoglossa prolixa (Gravenhorst)		1,1875 ns		
Placusa tachyporoides Waltl	I	13,46154 **	**	ns
Phloeonomus sjoebergi Strand		3,714286 ns		
Placusa incompleta Sjöberg	I	31,14286 ***	***	***
Anthophagus omalinus Zetterstedt		3,1 ns		
Sepedophilus littoreus (L.)		1,6 ns		
Acrotrichis insularis (Mäklin)	I	10,84211 **	ns	**
Lordithon thoracicus (Fabricius)	II	15,64706 ***	**	*
Mniusa incrassata (Mulsant&Rey)	II,III	8,375 *	**	ns
Other species		17,73214 ***	***	ns
SUM TOTAL		92,8045 ***	***	**

Table 3. Distribution of species number among ecological groups, and among the levels of significance of the difference between carpophore stages in the traps under *Fomitopsis pinicola.* The differences between the stages were chi-square tested in species with a mean number of specimens at least 5 in each stage. ***p<0.001, **p<0.01, *p<0.05, ns p>0.05. The ecological categories are judged from hatching results and literate descriptions.

	Total	<5 in stage	>5 in stage			
			Difference between stages			
			ns	*	**	***
Frequently hatched from F.pinicola	3	0	0	0	0	3
Few hatched from F.pinicola	4	4	0	0	0	0
Obligatory saproxylic	38	30	2	1	1	4
Facultative saproxylic	74	58	5	1	2	8
Obligatory in fungi	22	16	0	0	0	6
Facultative in fungi	55	44	1	0	2	8
Not saproxylic or in fungi	33	33	0	0	0	0

Table 4. The result of chi-squre test on the distribution of the species among the developmental stages of the carpophores and the control in the odour traps. I: Undeveloped hymenium. II: Opened hymenium. III: Dead. C: Control (without carpophore). ***p<0.001, **p<0.01, *p<0.05, ns p>0.05.

		main test	a posteriori test		
Species	Max.in stage	Chi-square	I-III=C?	I=II&III?	II=III?
Acrotrichis intermedia (Gillmeister)	II	13,36 **	*	ns	*
Acrotrichis insularis (Mäklin)		7,740741 ns			
Placusa tachyporoides Waltl	I	39,75 ***	*	***	***
Atheta (Microdota) nesslingi Bernhauer	I	17,14493 ***	ns	**	**
Other species		5,777251 ns			
SUM TOTAL		5,380261 ns			

Gyrophaena boleti

The staphylinid *Gyrophaena boleti* occurred in large numbers under stage II carpophores from spring to mid summer (up to 160 under one carpophore) (Fig. 3). It was represented in carpophore traps of all three stages, but was significantly most numerous in the stage II (Table 2, Appendix 1). By counting beetles and measuring moisture under the hymenia of 100 carpophores on 4 June, we found this species restricted to stage II hymenia with at least 28% moisture. It occurred in large numbers and almost independently of moisture in the interval 28—100% (Kendall Rank corr = 0.04, p = 0.65) (Fig. 4) Our registrations on 15 June showed that sporulation intensity (No. of spores pr. area) was correlated with hymenium moisture (Kendall Rank corr = 0.60, p<0.0004), but was not correlated for carpophores above 28% (Kendall Rank corr = 0.18, p = 0.27).

The experimental feeding experiment showed that even a high density of *G. boleti* confined to a small area of sporulating hymenium for 24 days did not make any visible impact on the hymenium.

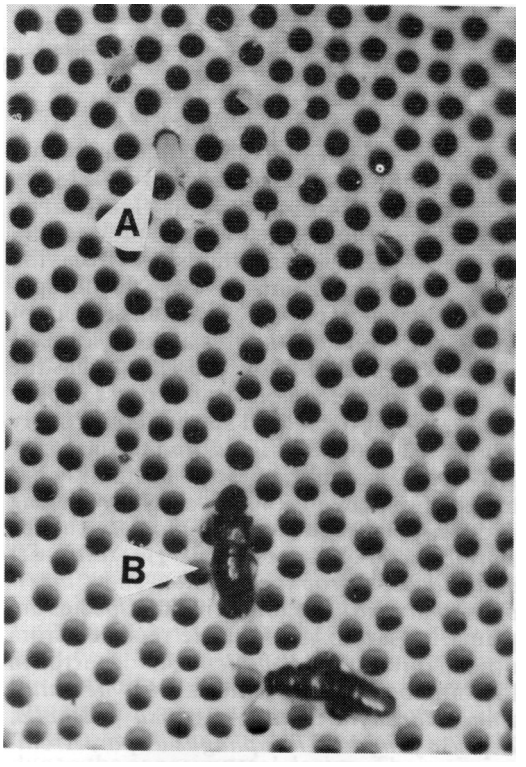

Fig. 3. Photos from the hymenium of living carpophores of *Fomitopsis pinicola.* Invertebrates moving from pore to pore under a fresh sporulating carpophore of *Fomitopsis pinicola.* A: Porricondylinae larva on its way up from a pore. B: Staphylinid beetles of the species *Gyrophaena boleti,* visiting pores and feeding on spores (body length about 1 mm).

DISCUSSION

Rearing from carpophores

As most of the species were only reared from one stage, there seems to be a pronouced succession of the fauna during the life of the carpophore. Stage I had few species, and seems to be too early a stage for most of the insect species. However, it cannot be excluded that certain species oviposit in stage I carpophores and hatch in a later stage. The

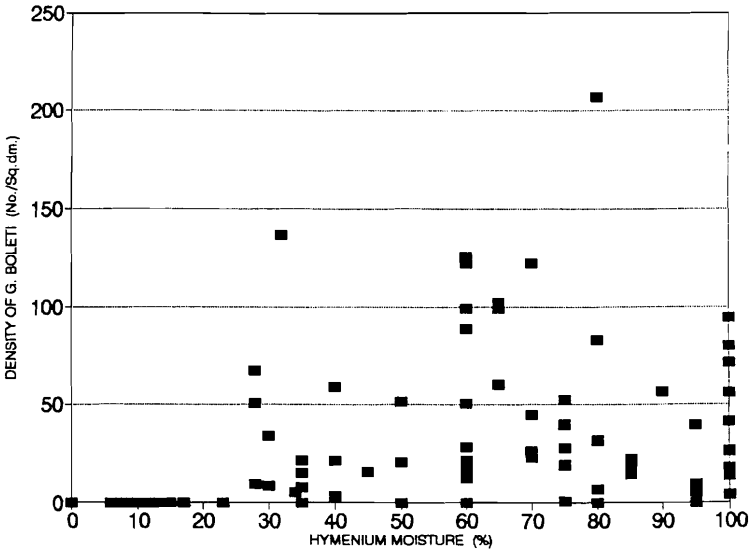

Fig. 4. Density of *Gyrophaena boleti* under the hymenium of 100 different carpophores of *Fomitopsis pinicola* plotted against the percent moisture in the hymenium.

death of the host fungi is certainly an important change for many species, and was clearly demonstrated in our study of *Gyrophaena boleti.* Dead fungi have no spore production, they no longer extract moisture from the wood and may become quite dry. While species on living carpophores can take favour of living mycelium and spores as food sources, the activity within dead carpophores has the character of a decomposition process. Apparently, few of the reared species are strongly associated with *F. pinicola,* and the majority also occur in other habitats. Considering habitat references (Table 1), and our rearing and trapping frequencies, *F. pinicola* may be a preferred host species for *Cis glabratus, Cis quadridens, Gyrophaena boleti* and *Camptomyia maxima.* The following ten species are primarily saproxylic, but are reported from other habitats than *F. pinicola,* or occurred in low numbers in our material: *Cis dentatus, Ennearthron laricinum, Leptusa pulchella, Leptusa fumida, Rhizophagus dispar, Archinemapogon yildizae, Winnertzia nigripennis (?), Camptomyia sp. 2, Lestodiplosis polypori* and *Gaurax dubius.* The remaining 12 species (Table 1) are not mentioned as primarily saproxylic, and their relationships to *F. pinicola* are quite unclear. Generally, sciarid species are associated with a wide range of decaying organic matter, including rotten wood and fungi (Freeman 1983), but we have not found specific literature information about our reared species. Of four parasitic wasp species, only two are described with hosts which occurred in our rearings (Table 1). There appears to be considerable regional variation in the faunal composition in *F. pinicola.* Rearings from *F. pinicola* in Karelian forests gave the follwing Diptera: *Mycetophila laeta* Walk., *M. signatoides* Dz., *Dynatosoma fuscicorne* Mg., *Sciophila buxtoni* Edw., *Scaptosciara calamophila* Frey, *Sc. nacta* Joh., *Lestodiplosis* sp. (Yakovlev 1986): None of these Diptera taxa were reared in our study, except for the genus *Lestodiplosis.* However, the rearing methods must have contributed to the difference. Some species (*Mycetophila sp.)* require access to earth or sand for pupation, and were probably lost with our rearing method.

Carpophore traps

The carpophore traps proved to be very effective and captured a large number of species. Even though few of the species have been reared from *Fomitopsis pinicola* in the present study, both the tests and the descriptions in literature indicate that the majority of the species have a connection with the carpophores. The frequently reared species were all numerous ($n>15$) and showed a marked difference among the carpophore stages in the traps. All species which were numerously trapped and significantly different among the carpophore stages, have been described as

obligatory inhabitants of fungi or saproxylic habitats. The majority of the less numerous species are at least facultatively saproxylic. Therefore, the carpophore traps seem to be rather effective in capturing saproxylic fauna in general. Further, it can be concluded that comparative studies by means of this trap should take into consideration the developmental stage of the carpophores.

Staphylinid beetles dominated in the carpophore traps. Members of this family are generally considered to be predatory or mycophagous, but feeding habits have not been observed in many of the species (Newton 1984). In our carpophore traps, the strongest indication on active host preference was found in species described from fungal and saproxylic habitats. These species were the most numerous and showed the clearest difference among the carpophore stages. E. g. *Oxypoda alternans* was numerous and showed a significant preference for living carpophores, while the other six *Oxypoda* species were few in the traps. In literature, *O. alternans* is said to be especially associated with fungus, while fungus is only one of many habitats for the other species (Hansen 1954).

The most frequent staphylinids in the carpophore traps comprised both fungivorous and predatory species. *Lordithon lunulatus* and *L. thoracicus* showed a strong preferance for living carpophores. According to Hansen (1952), *Lordithon* species prey on other invertebrates in fungal fruiting bodies and in rotten wood, and the imago feeds on mycetophilid larvae. In our study area, the hymenia of *F. pinicola* often contained cecidomyiid larvae, which are likely to be the food source of this predator. *Gyrophaena boleti* was also frequent and preferred living carpophores. However, *Gyrophaena* belongs to the few staphylinid genera feeding exclusively on fungus both as larva and imago (Ashe 1984). Our studies indicate that *G. boleti* mainly feed on spores, and fresh and sporulating carpophores could harbour large numbers of this species (up to 160 individuals on the underside of one fruiting body).

Only three ptilid species were trapped. Most *Acrotrichis* species live in decaying, organic matter, such as litter, decaying herbs and excrement, and some of the species (e.g. *A. insularis)* are known to be attracted in large numbers to sites with large amounts of fungi and decaying, organic matter (Michael Sørensen pers. comm., Sundt 1958). The present species must probably be considered as facultative visitores to *F. pinicola.*

Thus, carpophores may serve serveral ecological functions beyond being the substrate for larval development of certain species. The high number of saproxylic and/or fungi-dependant species in the carpophore traps may indicate that the carpophores function as «attraction centres». Some species lay their eggs there, some are spore feeders, some may be visiting predators, and some might utilize the presence of carpophores in their orientation towards another saproxylic habitat.

Host attraction and selection

Yakovlev and Myttus (1989) have tested odour attraction to *Fomitopsis pinicola* in Karelian forests with a different method. They applied both ether- and water extracts of *F. pinicola* as bait in a type of sticky trap («atracon»). The ether solution seemed attractive to fungus gnats such as *Cordyla murina* and *Allodia* spp. (among them *A. pyxidiiformis* Zaitzev), and to *Megaselia* sp. (Phoridae) and *Fannia* sp. (Fanniidae). The function of the attraction seems unclear, since none of these taxa have been reared from *F. pinicola.* Only a few individuals of beetles (mainly Staphylinidae) were captured in these traps (not determined, Yakovlev pers. comm.).

Little attractive response in our experiments does not imply that attraction by fungal odour can be excluded for the beetles. A bigger part of the polypore fungi is mycelium inside the wood, and this fungal component was not involved in our experiment. Another explaination may be that the fungal odour from many fungi or fungi-infected pieces of wood within a site may have a common attractive effect on saproxylic insect species, but that olfactory responses may be less important for many species during short distance orientation. Further, our results may be due to the experimental design. The emission of odour from the dispensers may have been insufficient compared to the natural habitats. However, the majority of species develop in dead and dry carpophores, and these carpophores should not be drastically changed when they are removed from the trees.

Our results suggest that selection of host fungi does not take place in a directed determined movement, but rather the insects seem to be clustered in a sort of cloud around fungi

and rotten wood, and that the final choice is made very close to, or in direct contact with the substrate. Our carpophore traps yielded a long list of species, but quite many of the species are associated with other habitats than *F. pinicola* in literature. A similar effect was observed in an experiment with sticky traps placed vertically near living sporophores (Agaricales) on the ground (Yakovlev and Myttus 1989). Many of the trapped species have not been reared from the respective fungi species. *Gyrophaena boleti* illustrates how a species depending on one specific microhabitat (the underside of spore-producing *F. pinicola,* stage II) also occurred in the «swarming clouds» around young and dead carpophores in the present study.

Apparently, many cisid species are active around polypores and dead wood if their search for food and breeding places, while only certain species prefer carpophores of *F. pinincola.* Of 12 cisid species in the carpophore traps, eight species were not reared in the present study. Paviour-Smith (1960) and Lawrence (1973) made groups of polypore and cisid species, in which certain cisids were associated with certain polypores. Paviour-Smith (1960) distinguished two groups («headquarters») in her study from Wytham Woods in England, and Lawrence (1973) ended up with four «host preference groups» in cisids of North America. Probably, corresponding groups may be found in Scandinavia. In our study, two cisid species (*Cis glabratus* and *C. quadridens)* were numerous both in the traps and the rearings from *Fomitopsis pinicola.* Secondly, some of our trapped but not reared species *(Cis nitidus, C. boleti, C. hispidus* and *Ennearthron cornutum)* have been associated with other polypore species by other authors (Paviour-Smith 1960, Nuss 1975, Klimaszevski and Peck 1987). Many of these popypore species are also present in our study area, and their fauna will be compared in a later publication (Økland in prep.).

The mechanism of host selection in Cisidae has been discussed by several authors, and here the general conslusion seems to be that the final host selection demands direct contact with the substrate. Paviour-Smith's (1960) and Lawrence's (1973) results indicate that the structure of the sporephore is the decisive factor in host selection. Paviour-Smith (1960) reasoned that the composition of mono-, di-or trimitic hyphal cells is important. The nutritive value may be of some importance, since *Hadraule blaisdelli* (Cisidae) showed preferences between fungal species even though the fungal tissue had been powdered (Klopfenstein 1971). Furthermore, the comsumption and survival rate of this species increased when the tissue was powdered, indicating that the hardness of the carpophore is important as well (Klopfenstein and Graves 1989). Paviour-Smith (1960) argued that olfaction must be less important, since so many cisids occur in dry and dead carpophores. However, we do not know to what extent cisids colonize carpophores before they die. Similar to results of many other authors (Klimaszewski and Peck 1987, Graves 1960, Lawrence 1973), most of our cisids were reared from dead carpophores. However, a considerable part of the cisids were captured in carpophore traps at living fungi.

Impact on the vitality of the carpophores

Spore-producing carpophores of *F. pinicola* clearly tolerate a very high grazing pressure by spore-eaters on the underside (e.g. by *G. boleti).* At the same time, the spore-eaters probably contribute in the spread of fungi to new sites.

Generally, cisid beetle have been described as a «major force »in the degradation of the host fungi (Klopfenstein and Graves 1989). Contrary to *Fomes fomentarius* in the same area, we did not find extensive penetration by insects inside the carpophores of *F. pinicola.* Apparently, the main degradation of the *F. pinicola* carpophores starts after the death of the carpophores. It is not yet clear wether the major role in the decomposition of *F. pinicola* carpophores is played by insects, microorganisms or these in combination.

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SAMMENDRAG

Insektfauna i fruktlegemer av rødrandkjuke *(Fomitopsis pinicola* (Fr.) Karst.) i en sørnorsk granskog

Insektfauna i rødrandkjuke *(Fomitopsis pinicola)* i tre utviklingsstadier er studert på forskjellige måter: (1) Klekking; (2) kjukefeller; (3) duftfeller med fruktlegemer som dispenser; (4) registreringer og eksperimenter med en vanlig art, *Gyrophaena boleti* (L.).

Klekking ga totalt 23 arter. Det synes å være en markert fauna-suksesjon i fruktlegemene, ettersom få arter klekket fra mer enn et stadium. Flest arter ble funnet i de døde fruktlegemene. Fire arter synes å være spesielt knyttet til rødrandkjuke, mens majoriteten er også beskrevet fra andre habitater. Fire arter av tovinger og tre arter av årevinger er nye for Norge.

Den lange artslisten fra kjukefellene tyder på en høy aktivitet av insekter nær kjukene. De fleste av artene er tidligere beskrevet fra sopp- og dødvedhabitater, men få ble klekket fra rødrandkjuke i dette studiet. De fleste synes imidlertid å være relatert til fruktlegemene, ettersom deres kjukefelle-fangster var signifikant forskjellig mellom kjukestadiene.

Det ble ikke påvist tiltrekning til duft fra fruktlegemene for de testede billeartene (Staphylinidae, Cisidae og Ptilidae).

Gyrophaena boleti ble bare funnet under levende fruktlegemer med åpent hymenium og fuktighet i intervallet 28—100%, mens denne begrensningen ikke gjorde seg gjeldende i kjukefellefangstene, hvor arten også ble fanget fra andre stadier av kjukene. Dette tyder på at stimuli ved direkte substratkontakt er en avgjørende faktor ved vertsvalg for denne arten.

Selv store tettheter av sporespisene *G. boleti* hadde ingen synlig virkning på hymenitet av de sporulerende kjukene. Gjennomskjæring av et stort antall fruktlegemer viste relativt få ganger og spor etter insektaktivitet. Det er uklart om den viktigste nedbrytningen av fruktlegemene hos rødrandkjuke besørges av insekter, mikroorganismer eller en kombinasjon av disse.

REFERENCES

Ackerman, J. K. and Shenefeldt, R. D. (1973) Organisms, especially insect, associated with wood rotting higher fungi (Basidiomycetes in Wisconsin forests. Trans. Wis. Acad. Sci. Arts Lett. 61, 185—206.

Ashe, J. S. (1984) Major features in the evolution of relationship between gyrophaenine staphylinid beetles (Coleoptera: Staphylinidae: Aleocharinae) and fresh mushrooms. Pp. 227—255 in: Wheeler, Q, and Blackwell, M. (eds.) Fungus-insect relationships. Columbia University Press, New York.

Benick, L. (1952) Pilzkäfer und Käferpilze. Acta zool. fenn. 70 1—250.

Chinery, M. (1973) A field guide to the insects of Britain and Northern Europe. William Collins Sons & Co. Ltd., London, pp. 1—352.

Freeman, P. (1983) Sciarid flies. Handbooks for the identification of British insects Vol 9, Part 6, 1—68.

Graves, R. C. (1960) Ecological observations on the insects and other inhabitants of woody shelf fungi (Basidiomycetes: Polyporaceae) in the Chicago area. Ann. Entomol. Soc. Am. 53, 61—68.

Graves, R. C. and Graves, A. C. F. (1985) Diptera associated with shelf fungi and certain other micro-habitats in the highlands area of western North Carolina. Entomol. News 96, 87—92.

Hansen, V. (1950) Clavicornia 1. del. Danmarks Fauna. 55, 1—278. Gads forlag, København.

Hansen, V. (1951) Clavicornia 2. del og Bostrychoidea. Danmarks Fauna 56, 1—253. Gads forlag, København.

Hansen, V. (1952) Rovbiller 2. del. Danmarks fauna 58, 1—251. Gads forlag, København.

Hansen, V. (1954) Rovbiller 3. del. Danmarks Fauna 59, 1—499. Gads forlag, København.

Hanski, I. (1989) Fungivory: Fungi, Insects and Ecology. Pp. 25—68 in: Wilding et al. (eds.) Insect-fungus interactions. Academic Press, London.

Hingley, M. R. (1971) The ascomycete fungus Daldinia concentrica, as a habitat for animals. J. Anim. Ecol. 40, 17—32.

Hussey, N. W., Read, W. H. and Hesling, J. J. (1969) The pests of protected cultivation. The biology and control of glasshouse and mushroom pests. London.

Klimaszewski, J. and Peck, S. B. Succession and phenology of beetle faunas (Coleoptera) in the fungus Polyporellus squamosus (Huds.:Fr.) Karst. (Polyporaceae) in Silesia, Poland. Can. J. Zool. 65, 542—550.

Klopfenstein, P. C. (1971) The ecology, behaviour, and life cycle of the mycetophilous beetles, Hadraule blaisdelli (Casey) (Insecta: Coleoptera: Ciidae). Thesis, Bowling Green State Univ., Ohio.

Klopfenstein, P. C. and Graves, R. C. (1989) Feeding preference and adult survival of Hadraule

blaisdelli (Coleoptera: Ciidae) on different host fungi (Polyporaceae) Ent. News 100 (4), 157—164.
Lawrence, J. F. (1973) Host preference in ciid beetles (Coleoptera: Ciidae) inhabiting the fruting bodies of Basidiomycetes in North America. Bull. Mus. Comp. Zool. 145, 163—212.
Mamaev, B. M. (1961) Gall midges of the USSR. New species of the genus Camptomyia Kieffer (Itonididae, Diptera). Zool. Zh. 40, 1677—1690 (in Russian).
Mamaev, B. M. (1964) Gall midges of the USSR 6. New species of the tribe Porricondylini (Diptera, Cecidomyiidae). Entomologiceskoe Obozrenie 43, 894—913 (in Russian).
Midtgaard, F. (1985) Kjukelevende sommerfugler. Fauna 38, 50—52 (in Norwegian with English abstract).
Mounce, I. (1929) Studies in forest pathology II. Dominion of Canada, Department of agriculture Bulletin No. 111, Ottawa.
Newton, A. F. JR. (1984) Mycophagy in Staphyloidea (Coleoptera). Pp. 302—353 in: Wheeler, Q. and Blackwell, M. (eds.) Fungus — insect relationships. Comumbia University Press, New York.
Nuss, I. (1975) Zur Ökologie der Porlinge. Biblotheca Mycologica 45, 1—263.
Panelius, S. A. revision of the European gall midges of the subfamily Porricondylinae (Diptera: Itonodidae). Acta Zoologica Fennica 113, 1—157.
Paviour-Smith, K. (1960) The fruiting-bodies of macrofungi as habitats for beetles of the family Ciidae (Coleoptera). Oikos 11, 43—71.
Perrin, P. W. (1979) First draft on a monographic card for Fometopsis pinicola (Fr.) Karst. Western forest products laboratory, document no: IRG/WP/196, Vancouver, Canada.
Pettey, T. M. and Shaw, C. G. (1986) Isolation of Fomitopsis pinicola from in-flight bark beetles (Coleoptera: Scolytidae). Can. J. Bot. 64, 1507—1509.
Pielou, D. P. (1966) The fauna of Polyporus betulinus (Bulliard) Fries (Basidiomycetes: Polyporaceae) in Gatineau Park, Quebec. Can. Ent. 98, 1233—1237.
Pielou, D. P. and Verma, A. N. (1968) The arthropod fauna associated with the birch bracket fungus, Polyporus betulinus, in Eastern Canada. Can. Ent. 100, 1179—1199.
Pritchard, A. E. and Felt, E. P. (1958) March flies and gall-midges. Guide to the insects of Connecticut Part VI, 1—218. State library, Hartford.
Rehfous, M. (1955) Contribution à l'étude des insectes des champignons. Mitt. Schweitz. Entomol. Ges. 28, 1—106.
Smith, K. G. V. (1965) The immature stages of Gaurax (=Botanobia) dubius (Macquart) (Ditp., Chloropidae) with notes on the specific status of G. fascipes Becker. Entomologist's mon. Mag. 100 (1964), 237—239.
Soós, A. and Papp, L. (1984—1986) Cataloque of Palaearctic Diptera. Vol. 4: Sciaridae - Anisopodidae and Vol. 10: Clusiidae - Chloropidae. Akadémiai Kiadó, Budapest.
Sundt, E. (1958) Revision of the Fenno-Scandian species of the genus Acrotrichis Motsch. Norsk Entomologisk Tidsskrift Bd. X, h. 4—5, 241—281.
Tryapitsyn, V. A. (1987) Family Encyrtidae. Pp. 427—594 in: Medvedev, G. S. (ed.) Keys to the Insects of the European part of the USSR. III, Part 2, 427—594. Oxonian Press Ltd., New Dehli.
Wright, K. H. and Harvey, G. M. (1967) The deterioration of beetle-killed douglas-fir in Western Oregon and Washington. U.S. Department of Agriculture, Portland, Oregon.
Yakovlev, E. (1986) Fauna and ecology of arthropods in Karelia. Karelian centre of Russian Academy Sci., Forest Research Institute, Petrozavodsk, pp. 83—123 (in Russian).
Yakovlev, E. B. and Myttus, E. R. (1986) On the attraction of insects by the fungal sporophores and by some fungal smell constituents. Karelian centre of Russian Academy Sci., Forest Research Institute, Petrozavodsk, pp. 1—47 (in Russian with English abstract).

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Appendix 1. Staphylinidae, Cisidae and Ptilidae beetles trapped under carpophores of *Fometopsis pinicola* in different successional stages. I: Carpophores with undeveloped hymenium. II: Carpophorus with open hymenium. III: Dead carpophores. C: Control (without carpophores). * = species hatched from *F. pinicola* in this study.

	I	II	III	SUM
STAPHYLINIDAE:				
Acidota crenata (Fabricius)	0	1	2	3
Acrulia inflata (Gyllenhal)	1	1	2	4
Amischa analis (Gravenhorst)	4	4	4	12
Anomognathus cuspidatus (Erichson)	2	0	0	2
Anthobium melanocephalum (Illiger)	0	0	1	1
Anthophagus omalinus Zetterstedt	3	9	8	20
Atheta (Amidobia) talpa (Heer)	1	0	0	1
Atheta (Anopleta) picipes (Thomson)	1	2	8	11
Atheta (Atheta) incognita (Sharp)	0	0	1	1
Atheta (Atheta) crassicornis (Fabricius)	0	0	6	6
Atheta (Atheta) nigricornis (Thomson)	0	2	1	3
Atheta (Atheta) castanoptera (Mannerh.)	0	3	0	3
Atheta (Atheta) fungicola (Thomson)	0	2	1	3
Atheta (Atheta) pilicornis (Thomson)	0	0	1	1
Atheta (Megacrotona) lateralis (Mannerh.)	0	0	1	1
Atheta (Microdota) subtilis (Scriba)	1	1	5	7
Atheta (Microdota) atomaria (Kraatz)	1	0	0	1
Atheta (Notothecta) sodalis (Erichson)	3	1	3	7
Atheta (Notothecta) flavipes (Gravenh.)	3	2	0	5
Atheta (Notothecta) pallidicornis (Thoms.)	0	1	0	1
Atheta (Xenota) myrmecobia (Kraatz)	1	3	4	8
Atrecus pilicornis (Paykull)	3	6	5	14
Autalia Samouelle sp.	1	0	0	1
Bolitobius cingulatus Mannerheim	0	4	2	6
Bolitochara mulsanti Sharp	0	2	0	2
Bolitochara lucida (gravenhorst)	0	1	0	1
Coryphium angusticolle Stephens	0	0	1	1
Dadobia immersa (Erichson)	1	0	0	1
Deliphrum tectum (Paykull)	0	0	1	1
Dinaraea arcana (Erichson)	2	1	1	4
Dinaraea aequata (Erichson)	0	1	0	1
Elonium striatulum (Fabricius)	2	3	2	7
Euryusa castanoptera Kraatz	0	1	0	1
Gabrius splendidulus (Gravenhorst)	2	2	1	5
Gabrius astutoides (Strand)	0	0	1	1
Geostiba circellaris (Gravenhorst)	0	1	0	1
Gyrohypnus angustatus Stephens	2	0	0	2
*Gyrophaena boleti (L.)	24	77	27	128
Gyrophaena strictula Erichson	0	2	0	2
Gyrophaena bihamata Thomson	0	0	1	1
Hapalarea linearis (Zetterstedt)	4	5	4	13
Haploglossa villosula (Stephens)	6	3	2	11
Ischnoglossa prolixa (Gravenhorst)	8	11	13	32
Lathrobium brunnipes (Fabricius)	1	2	2	5
Lathrobium fulvipenne Gravenhorst	0	1	0	1
*Leptusa pulchella (Mannerheim)	2	2	4	8
*Leptusa fumida (Erichson)	0	2	0	2
Liogluta letzneri (Eppelsheim)	0	1	7	8
Liogluta alpestris (Heer)	0	1	0	1
Lordithon lunulatus (L.)	50	105	5	160
Lordithon thoracicus (Fabricius)	0	13	4	17
Lordithon speciosus (Erichson)	2	1	5	8
Megarthrus sinuatocollis (Lacordaire)	0	1	0	1
Mniusa incrassata (Mulsant&Rey)	0	7	9	16
Mycetoporus punctus (Gravenhorst)	1	0	3	4
Mycetoporus lepidus (Gravenhorst)	2	1	0	3
Mycetoporus clavicornis (Stephens)	0	0	2	2
Mycetoporus rufescens (Stephens)	0	0	1	1
Mycetoporus splendidus (Gravenh.)	0	1	0	1
Nudobius lentus (Gravenhorst)	0	0	2	2
Olophrum fuscum (Gravenhorst)	1	1	0	2
Omalium rugatum Mulsant&Rey	1	0	3	4
Othius angustus Stephens	0	0	1	1
Oxypoda alternans (Gravenhorst)	19	77	4	100
Oxypoda skalitzkyi Bernhauer	0	8	4	12
Oxypoda umbrata (Gyllenhal)	0	0	2	2
Oxypoda amoena Fairmaire&Laboul.	0	1	0	1
Oxypoda annularis Mannerheim	0	0	1	1
Oxypoda lividipennis Mannerheim	0	1	0	1
Pachygluta ruficollis (Erichson)	1	0	0	1
Phloeonomus sjoebergi Strand	3	8	10	21
Phloeonomus punctipennis Thoms.	2	1	4	7
Phloeonomus monilicornis (Gyllen.)	1	3	2	6
Phloeonomus pusillus (Gravenhorst)	0	0	2	2
Phloeopora angustiformis Baudi	0	0	1	1
Phymatura brevicollis (Kraatz)	1	0	0	1
Placusa tachyporoides Waltl	17	7	2	26
Placusa incompleta Sjöberg	0	2	19	21
Placusa depressa Mäklin	0	2	0	2
Quedius plagiatus (Mannerheim)	10	21	17	48
Quedius xanthopus Erichson	1	4	2	7
Quedius fulvicollis (Stephens)	1	3	0	4
Quedius tenellus (Gravenhorst)	0	1	0	1
Quedius brevis Erichson	2	1	0	3
Quedius mesomelinus (Marsham)	0	0	1	1
Quedius fellmani (Zetterstedt)	0	1	0	1
Quedius molochinus (Gravenhorst)	0	1	0	1
Sepedophilus littoreus (L.)	8	8	4	20
Stenus argus Gravenhorst	0	1	0	1
Stenus bifoveolatus Gyllenhal	0	1	0	1
Syntomium aenum (Müller)	1	4	1	6
Tachinus pallipes Gravenhorst	0	2	1	3
Tachinus marginatus Gyllenhal	0	1	1	2
Tachinus marginellus (Fabricius)	1	0	0	1
Thyasophila inquilina (Märkel)	2	2	0	4
Zyras cognatus (Märkel)	2	1	11	14
CISIDAE:				
*Cis glabratus Mellie	1	15	42	58
*Cis quadridens Mellie	5	2	37	44
Cis boleti (Scopoli)	7	1	2	10
Cis lineatocribratus Mellie	2	0	4	6
*Cis dentatus Mellie	0	0	4	4
Cis nitidus (Fabricius)	0	0	2	2
Cis bidentatus (Olivier)	1	0	0	1
Cis hispidus (Paykull)	0	1	0	1
Cis punctulatus Gyllenhal	0	0	1	1
Cis sp.	1	0	0	1
*Ennearthron laricinum (Mellie)	1	0	3	4
Ennearthron cornutum (Gyllenhal)	2	0	2	4
PTILIDAE:				
Acrotrichis intermedia (Gillmeister)	9	28	53	90
Acrotrichis insularis (Mäklin)	4	2	13	19
Acrotrichis rugulosa Rosskothen	0	1	0	1

Appendix 2. Staphylinidae, Cisidae and Ptilidae beetles captured in traps with odour from carpophores of *Fometopsis pinicola* in different successional stages. I: Carpophores with undeveloped hymenium. II: Carpophorus with open hymenium. III: Dead carpophores. C: Control (without carpophores). * = species hatched from *F. pinicola* in this study.

	I	II	III	C	SUM
STAPHYLINIDAE:					
Acidota crenata (Fabricius)	2	0	0	5	7
Acrulia inflata (Gyllenhal)	4	0	0	1	5
Aloconota gregaria (Erichson)	1	1	0	2	4
Amischa analis (Gravenhorst)	2	0	0	2	4
Amischa bifoveolata Mannerheim	0	0	2	0	2
Amischa nigrofusca Stephens	0	0	0	1	1
Anomognathus cuspidatus (Erichson)	0	2	0	1	3
Anthophagus omalinus Zetterstedt	3	2	1	2	8
Atheta (Anopleta) picipes (Thomson)	0	0	1	0	1
Atheta (Atheta) incognita (Sharp)	0	1	2	7	10
Atheta (Atheta) nigricornis (Thomson)	0	2	0	0	2
Atheta (Atheta) castanoptera (Mannerh.)	0	1	0	0	1
Atheta (Atheta) pilicornis (Thomson)	0	0	1	0	1
Atheta (Dimetrota) cinnamoptera (Thoms.)	2	0	1	0	3
Atheta (Megacrotona) lateralis (Mannerh.)	0	3	0	0	3
Atheta (Microdota) nesslingi Bernhauer	0	2	14	7	23
Atheta (Microdota) subtilis (Scriba)	4	2	1	0	7
Atheta (Nototheta) sodalis (Erichson)	0	0	1	1	2
Atheta (Nototheta) flavipes (Gravenh.)	0	0	1	0	1
Atheta (Xenota) myrmecobia (Kraatz)	2	0	2	3	7
Atrecus pilicornis (Paykull)	2	1	1	1	5
Dadobia immersa (Erichson)	0	2	2	2	6
Deliphrum tectum (Paykull)	0	0	0	0	0
Dinaraea arcana (Erichson)	1	0	2	0	3
Dinaraea aequata (Erichson)	0	0	0	2	2
Elonium striatulum (Fabricius)	0	0	0	1	1
Gabrius splendidulus (Gravenhorst)	1	0	0	0	1
*Gyrophaena boleti (L.)	1	0	0	1	2
Hapalarea linearis (Zetterstedt)	2	0	0	2	4
Ischnoglossa prolixa (Gravenhorst)	7	2	0	4	13
*Leptusa pulchella (Mannerheim)	2	2	0	3	7
Lordithon lunulatus (L.)	6	6	0	0	12
Megarthrus fennicus Lahtinen	1	0	0	0	1
Megarthrus nitidulus Kraatz	0	0	0	1	1
Oxypoda alternans (Gravenhorst)	1	0	0	0	1
Oxypoda skalitzkyi Bernhauer	0	0	1	2	3
Oxypoda nigicornis Motschulsky	0	0	1	0	1
Phloeonomus lapponicus (Zett.)	0	3	1	2	6
Phloeopora angustiformis Baudi	0	0	0	1	1
Phloeopora testacea (Mannerheim)	1	0	0	0	1
Placusa tachyporoides Waltl	0	1	21	2	24
Placusa incompleta Sjöberg	0	0	1	1	2
Placusa depressa Mäklin	0	3	9	4	16
Quedius plagiatus (Mannerheim)	3	0	0	0	3
Quedius xanthopus Erichson	4	1	0	2	7
Quedius fulvicollis (Stephens)	0	0	1	0	1
Quedius tenellus (Gravenhorst)	1	0	0	3	4
Quedius maurus (Sahlberg)	0	0	4	0	4
Quedius mesomelinus (Marsham)	0	0	1	0	1
Sepedophilus littoreus (L.)	1	1	2	1	5
Tachinus pallipes Gravenhorst	1	1	0	1	3
Tachinus laticollis Gravenhorst	0	0	1	3	4
Tachinus proximus Kraatz	0	2	0	0	2
Tachinus elegans Eppelsheim	0	0	0	1	1
Tachinus subterraneus (L.)	0	0	1	0	1
CISIDAE:					
*Cis glabratus Mellie	0	0*	0	1	1
Cis boleti (Scopoli)	3	2	4	2	11
Cis lineatocribratus Mellie	0	0	1	0	1
PTILIDAE:					
Acrotrichis intermedia (Gillmeister)	88	113	84	65	350
Acrotrichis insularis (Mäklin)	26	14	27	14	81
Acrotrichis rugulosa Rosskothen	1	0	0	1	2
Acrotrichis parva Rosskothen	0	1	0	1	2
Acrotrichis silvatica Rosskothen	0	0	1	0	1
Ptenidium nitidum (Heer)	0	0	1	0	1