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Seasonal activity and habitat associations of Silphidae and Leiodidae: Cholevinae (Coleoptera) in central Bohemia

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Abstract. Fourteen species of Silphidae and 20 species of Leiodidae: Cholevinae were collected in the Velký Blaník Protected Landscape Area (central Bohemia) on 4 forest and on 3 field habitats, in 1986 and 1987. Pitfall traps unbaited or baited with fish meat and ripen cheese were used. Seasonal activities, abundance of teneral adults and habitat associations are given for abundant species.

INTRODUCTION

The two groups studied, Silphidae and Leiodidae: Cholevinae, are important members of beetle community on carrion (Shubeck et al. 1981).

The synecology of carrion beetles (Silphidae) was studied by many authors. Some notes about habitat preferences were given by Grinfel'd (1948) from Russia, Kursk region. Succession of burying beetles on carrion in southern Poland was studied by Mroczkowski (1949). Other small papers were summarized in Petruška (1964) and Anderson (1982). Ecology of several central European species were studied in fields of northern Moravia by Novák (1965, 1966), Petruška (1966) and Špicarová (1969). Data on habitat preferences and seasonality in central Europe were also given in the key of Šustek (1981). Colonisation of Silphidae on young dune islands in northern Germany was studied by Plaisier (1988). The occurrence of carrion beetles on crop fields in northwestern Poland and the efficiency of various types of baited pitfall traps was evaluated by Kaminska (1989). Seasonal activity and habitat preferences of North American species were discussed by Anderson (1982) and Anderson & Peck (1985), who also give many references to other papers concerning North American fauna.

On the other hand, there are only few papers dealing with ecology of small carrion beetles (Leiodidae: Cholevinae). Some elementary information was provided by Sokolowski (1942) for species from northern Germany. Seasonal activity and habitat preferences were studied in central Germany (Plath & Witzke 1972) and northern Moravia (Majer 1980). Topp & Engler (1980) and Engler (1982) dealt with the seasonal dynamics of species in a beech forest in northern Germany. The habitat preferences and seasonal dynamics of North American species in southeren Ontario was recently studied by Peck & Anderson (1985) and by Chandler & Peck (1992). The former paper reviews several older papers concerning North America.

The seasonal activity and altitudinal distribution of both Silphidae and Leiodidae: Cholevinae were studied in northern Italy (Zoia 1990) and Japan (Kamimura & al. 1964; Martin 1989, 1992).

AREA OF STUDY

The beetles were collected at several localities in Velký Blaník Protected Landscape Area (central Bohemia), about 20 km SE of Benešov, faunistic grid mapping code 6355 after (Zelený 1972), at 450-630 m a.s.l.

Temperature data for 1986 and 1987 (Fig. 1) were obtained from meteorological station at Čechtice (10 km from Velký Blaník hill), precipitations (Fig. 2) were recorded in Načeradec (4 km from Velký Blaník hill).

In 1986 the material was collected at four forest sites:

(1) **Beech stand** at the top of Velký Blaník hill, dry area with rock field, covered with a layer of dead leaves.

(2) Dense and **dry coniferous forest** (largely *Picea abies*) between Holý vrch and Velký Blaník hills.

(3) **Mixed forest** (*Picea*, *Betula*, and *Larix*) on the northern slope of Velký Blaník hill; moist, with a thick dead leaf layer.

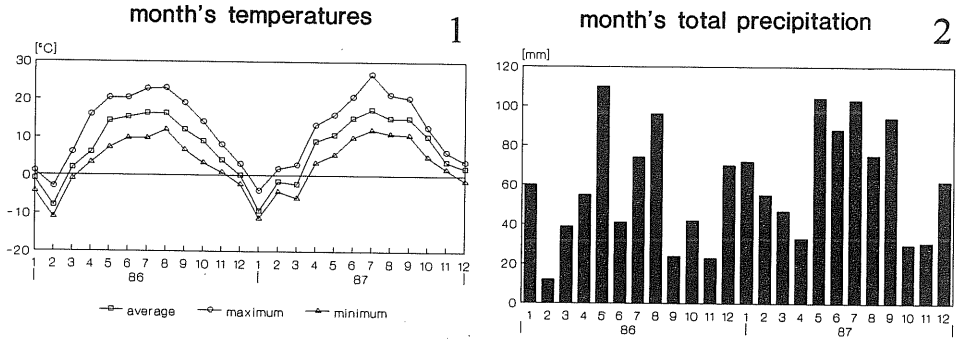
(4) **Moist coniferous forest** at the northern foot of Velký Blaník hill, source area of a small brook with thick moss layer.

In 1987 the beetles were collected at 3 non-forest sites (further called „fields" sites):

(5) Wet **march** at the edge of a mixed forest, with heavy soil.

(6) Edge of a **maize field**, a dry site with an exuberant stand of *Urtica* and *Cirsium*.

(7) Edge of a **barley field** and a small mixed grove (largely *Carpinus*), dry and warm site.



Figs 1-2. 1 - the course of average, maximum and minimum monthly temperatures and 2 - average of the monthly total precipitation in 1986 and 1987 (for precise location, see text).

MATERIALS AND METHODS

The material was collected using pitfall traps with an outlet of 10 cm diameter, 13 cm deep. The traps were filled with 1:1 solution of water and ethylene glycol (Anderson 1982). Nine traps were placed on each locality; three unbaited, three baited with fish meat and three baited with ripen cheese. The traps were serviced at 2-4 weeks intervals, 15 times (22.iii. - 5.xii.) in 1986, and 12 times (5.iv. - 5.xii.) in 1987. The material was placed into 75 % ethanol or dry mounted and deposited in the author's collection. Classification follows the papers of Szymczakowski (1961, 1971) and Šustek (1981).

RESULTS

In total I collected 9845 individuals of 14 species of Silphidae and 8906 individuals of 20 species of Cholevinae (Table 1).

1. Trap efficiency

The total catch and relative abundance of different taxa in unbaited and baited traps differed largely (Table 2).

Table 1. Relative abundances of individual species of Silphidae and Leiodidae: Cholevinae, trapped in the Velký Blaník Protected Landscape Area (central Bohemia) during 1986 and 1987

species	number of individuals		
	forest sites 1986	field sites 1987	totally 1986 + 1987
Silphidae			
Nicrophorus vespilloides Herbst, 1784	3808	856	4664
Oiceoptoma thoracica (Linneaus, 1758)	1604	313	1917
Nicrophorus investigator Zetterstedt, 1824	1133	130	1263
Nicrophorus fossor fossor Erichson, 1837	494	105	599
Silpha tristis tristis Illiger, 1798	0	573	573
Nicrophorus humator Olivier, 1790	263	83	346
Nicrophorus vespillo (Linneaus, 1758)	92	139	231
Thanatophilus sinuatus (Fabricius, 1775)	18	206	224
Thanatophilus rugosus (Linneaus, 1758)	1	11	12
Phosphuga atrata atrata (Linneaus, 1758)	0	9	9
Nicrophorus sepultor Charpentier, 1825	0	2	2
Necrodes littoralis (Linneaus, 1758)	2	0	2
Aclypea opaca (Linneaus, 1758)	0	1	1
Xylodrepa quadripunctata (Linneaus, 1761)	0	1	1
Leiodidae: Cholevinae			
Catops tristis tristis (Panzer, 1794)	2572	148	2720
Sciodrepoides watsoni watsoni (Spence, 1815)	863	1596	2459
Catops coracinus coracinus Kellner, 1846	1226	45	1271
Sciodrepoides fumatus fumatus (Spence, 1815) and *S. alpestris* Jeannel, 1934, females	675	67	742
Catops picipes (Fabricius, 1792)	452	144	597
Sciodrepoides fumatus fumatus (Spence, 1815), males	199	63	262
Sciodrepoides alpestris Jeannel, 1934, males	179	16	195
Catops fuliginosus fuliginosus Erichson, 1837	59	87	146
Catops grandicollis Erichson, 1837	3	125	128
Catops subfuscus subfuscus Kellner, 1846	125	0	125
Ptomaphagus sericatus (Chaudoir, 1845)	5	110	115
Catops kirbyi kirbyi (Spence, 1815)	55	24	79
Fissocatops morio (Fabricius, 1792)	0	28	28
Catops chrysomeloides (Panzer, 1798)	5	13	18
Catops longulus Kellner, 1846	5	1	6
Catops nigriclavis Gerhardt, 1900	3	2	5
Catops nigricans (Spence, 1815)	0	4	4
Ptomaphagus variicornis (Rosenhauer, 1847)	3	0	3
Ptomaphagus subvillosus (Goeze, 1777)	0	1	1
Catops fuscus fuscus (Panzer, 1794)	0	1	1
Choleva paskoviensis Reitter, 1913	0	1	1

The most effective traps were those baited with fish meat, followed by ripen cheese baited and unbaited traps.

Most Silphinae in forest habitats were caught with fish-baited traps while catches with other traps were low. In field habitats, more Silphinae were trapped also with cheese-baited and unbaited traps. Most Nicrophorinae in both forest and field sites were captured with fish-baited traps.

Table 2. The efficiency of differently baited traps in Silphidae: Silphinae and Nicrophorinae, and Leiodidae: Cholevinae, in the Velký Blaník Protected Landscape Area (central Bohemia) on forest sites in 1986 and field sites in 1987

	forest sites (1986)				field sites (1987)			
	total number of specimens	per-cent of total catch			total number of specimens	per-cent of total catch		
		fish meat	ripen cheese	un-baited		fish meat	ripen cheese	un-baited
Silphinae	1709	97.2	2.6	0.2	1115	70.1	18.1	11.8
Nicrophorinae	5790	84.3	14.1	1.6	1315	89.2	3.6	7.2
Cholevinae	6427	68.6	28.7	2.7	2477	54.3	34.1	11.6
total	13926	78.7	19.4	1.9	4907	67.4	22.2	10.4

Cheese baited traps were slightly more efficient than unbaited traps, at forest sites. The distribution of catches of Leiodidae: Cholevinae was different. The highest numbers were trapped with fish-baited traps, but catches with cheese-baited traps were also high in both forest and field habitats. At field sites also unbaited traps catched significant members of cholevine beetles.

2. Seasonal activity

Among **carrion beetles**, *Thanatophilus sinuatus* was found early in the season, from April to August (Fig. 3). *Oiceoptoma thoracica* adults were trapped from April to October, with two peaks of activity in May-June and August (Fig. 4). Larvae were captured mainly in May-June (Fig. 5), first tenerals in July to August. *Silpha tristis tristis* adults were captured from June to October (Fig. 6). Larvae were captured in June to October (Fig. 7), the tenerals appeared in August to October.

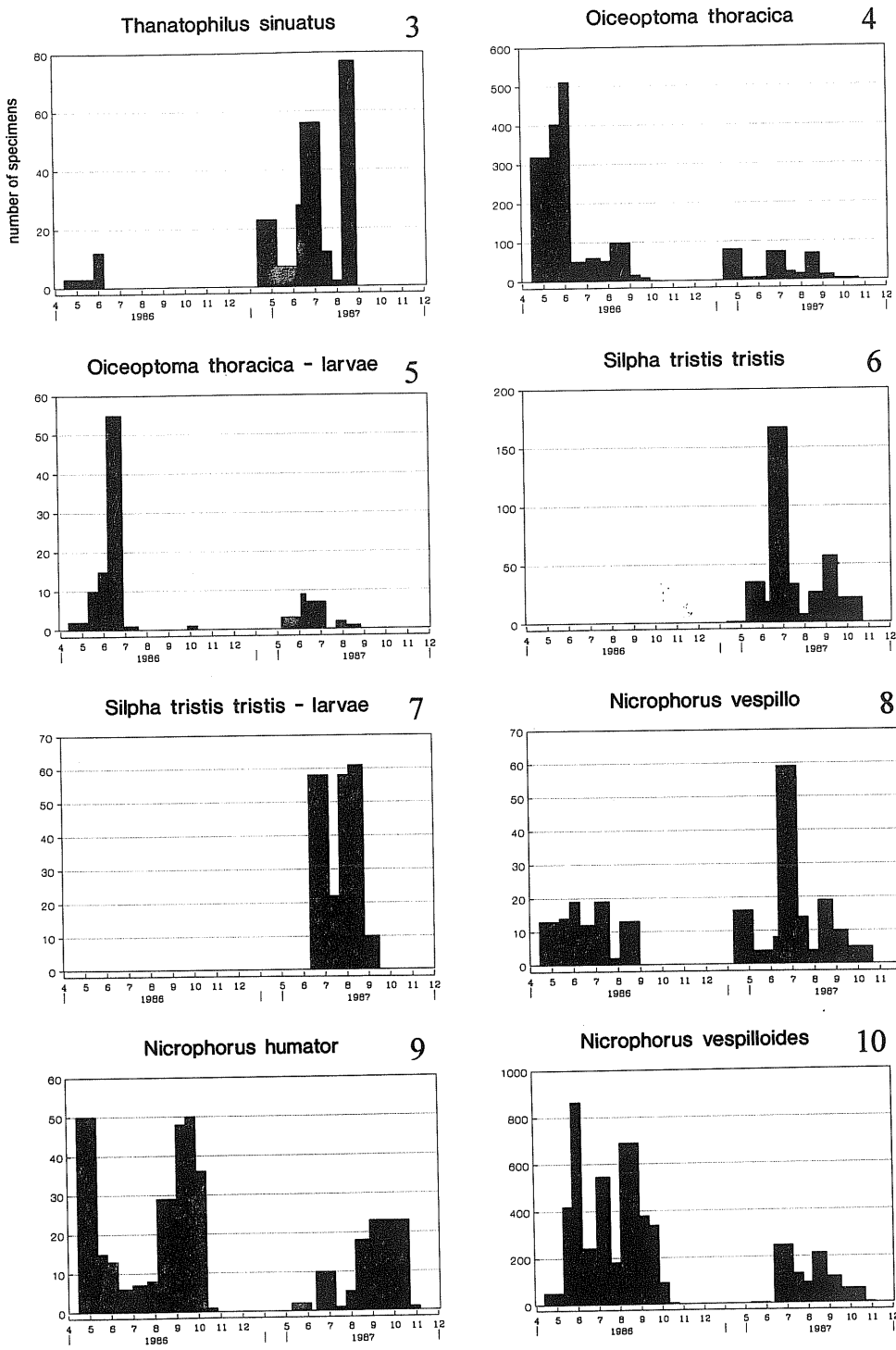
Nicrophorus vespillo and *N. humator* were trapped from April to October, with peak activity in July (Fig. 8), and April to May and August to October (Fig. 9), respectively. *N. vespilloides* was captured from April to December, with a weak peak from May to mid-October (Fig. 10). *N. investigator* and *N. fossor fossor* overwinter as larvae. The adults appear late in the season, from May to October (Fig. 11), and from June to October (Fig. 12), respectively. The peak catches were attained in July to August.

According to seasonal changes in activity, **cholevine beetles** can be sorted to four groups:

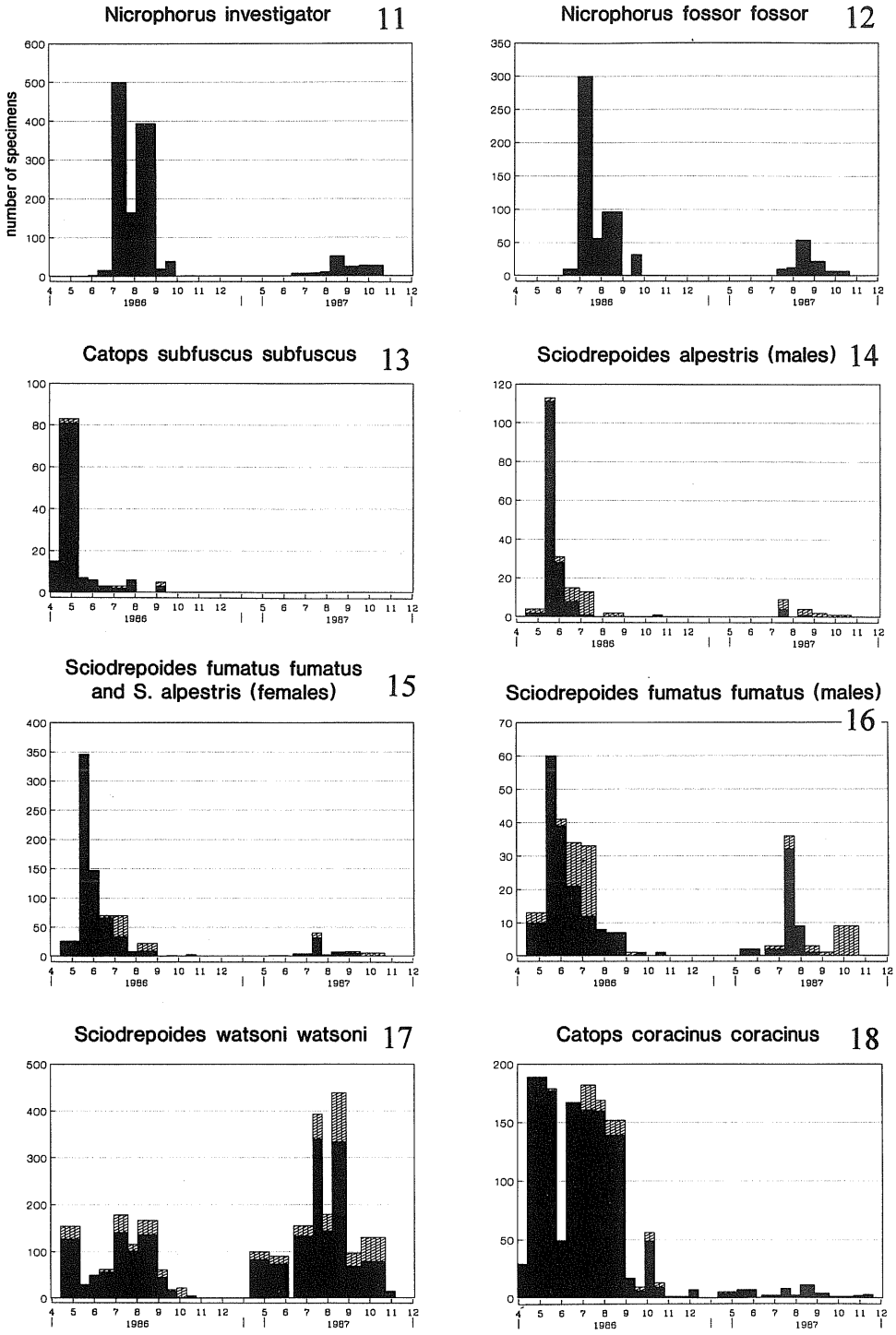
(a) *Catops subfuscus subfuscus* (captured from March to mid-September, peak activity in April, Fig. 13), *Sciodrepoides fumatus fumatus* and *S. alpestris* (both found from April to November, peak activity in May to July, with more tenerals in June, Figs 14-16) have an unimodal activity with a spring peak.

(b) *Sciodrepoides watsoni watsoni* and *Catops coracinus coracinus* have unimodal activity with a summer peak. The former species was captured from April to October, with peak activity in June to August (Fig. 17). High numbers of tenerals were captured in April and in July to October. The latter species was captured from April to December. Its activity was increased from April to August, with tenerals in July-August (Fig. 18).

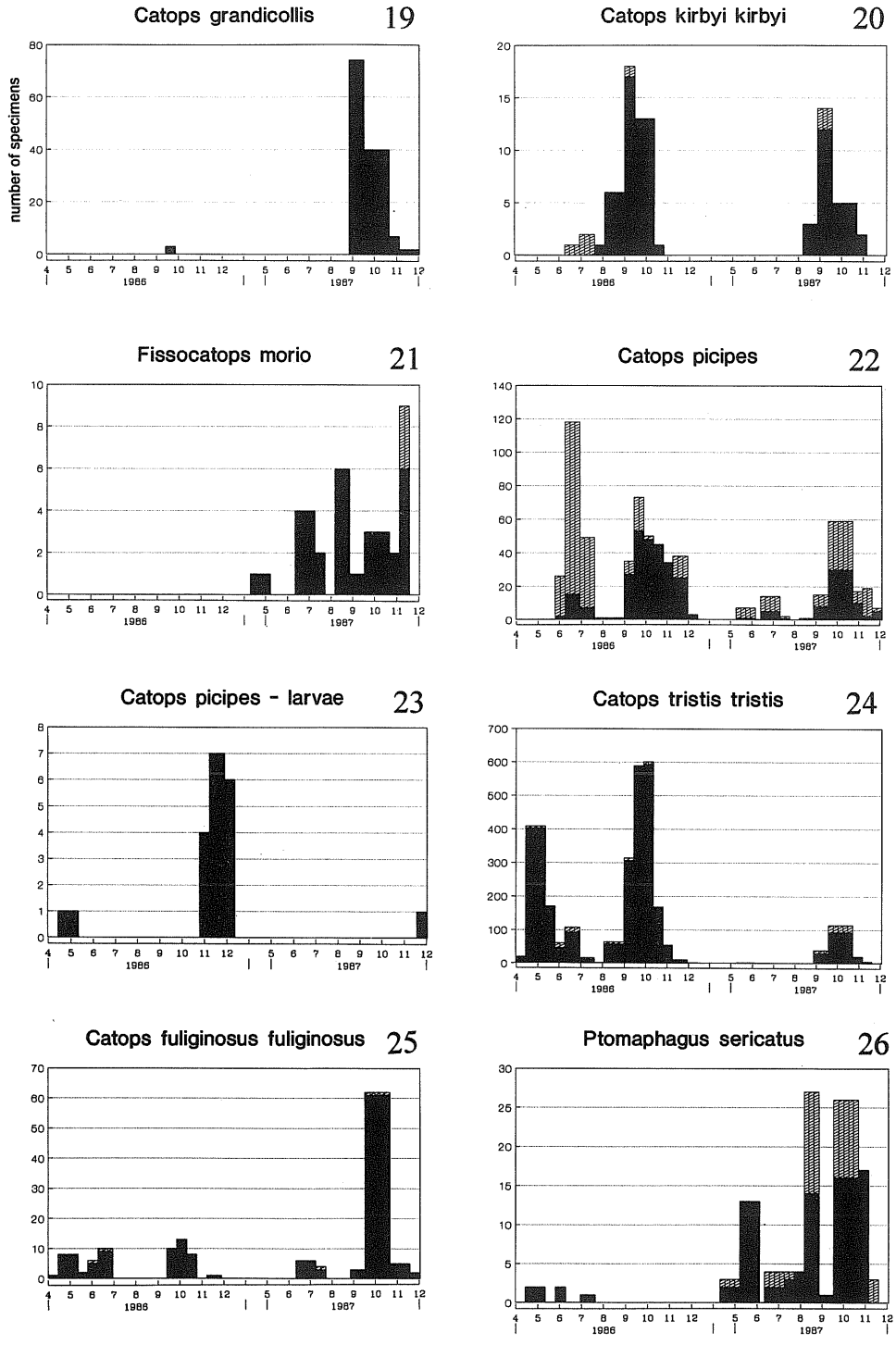
(c) *Catops grandicollis* (captured from September to December, peak abundance in September to October, Fig. 19), *C. kirbyi kirbyi* (captured from June to October, with peak activity in September to mid-October, Fig. 20), and *Fissocatops morio* (captured from April to October,



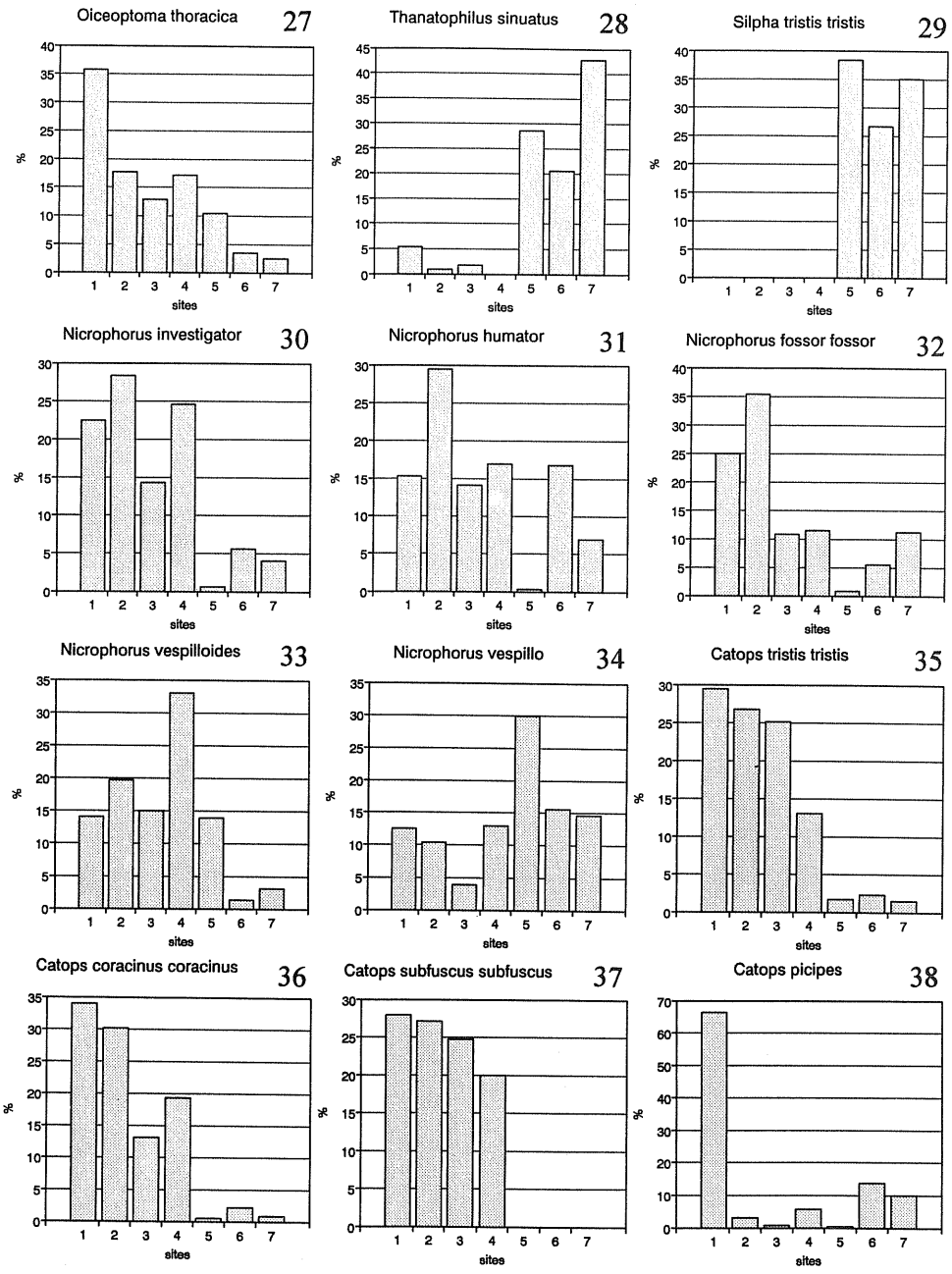
Figs 3-10. Seasonal activities of individual species of Silphidae, trapped in the Velký Blaník Protected Landscape Area (central Bohemia) on forest sites in 1986 and field sites in 1987.



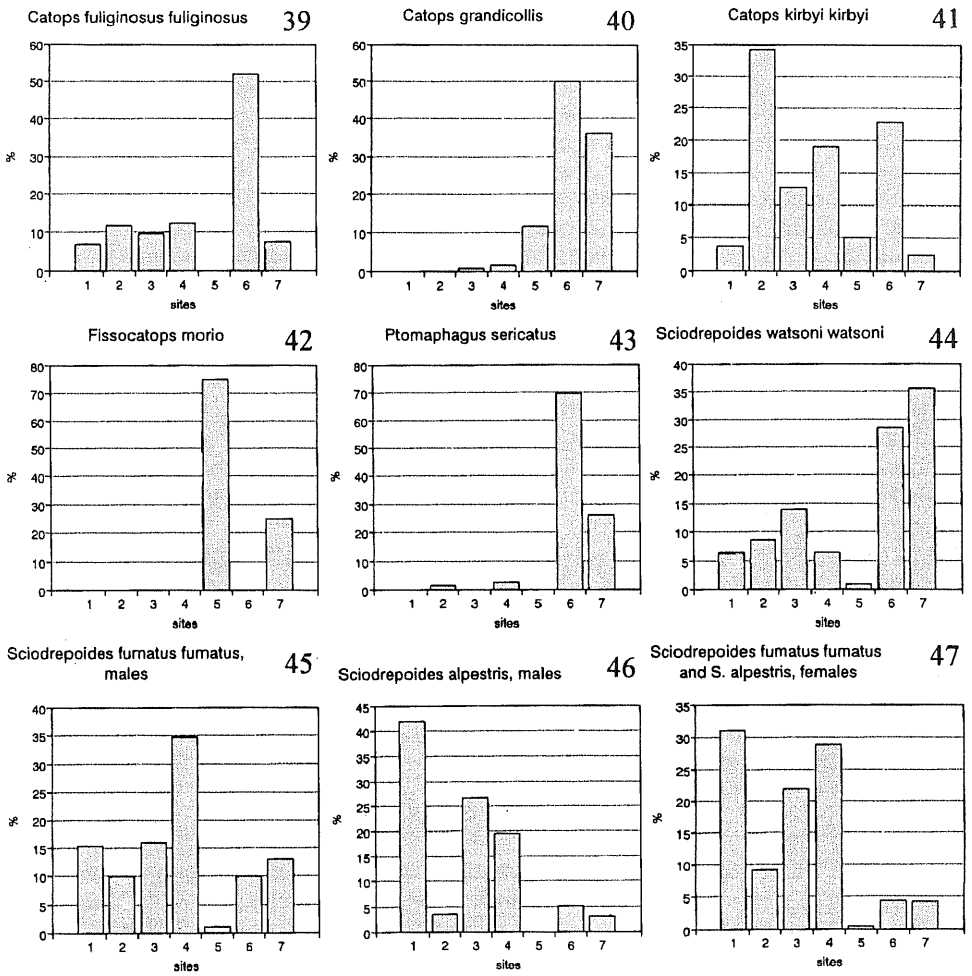
Figs 11-18. Seasonal activities of individual species of Silphidae and Leiodidae: Cholevinae, trapped in the Velký Blaník Protected Landscape Area (central Bohemia) on forest sites in 1986 and field sites in 1987. Black boxes - mature specimens, hatched boxes - teneral specimens.



Figs 19-26. Seasonal activities of individual species of Leiodidae: Cholevinae, trapped in the Velký Blaník Protected Landscape Area (central Bohemia) on forest sites in 1986 and field sites in 1987. Black boxes - mature specimens, hatched boxes - teneral specimens.



Figs 27-38. Habitat associations of individual species of Silphidae and Leiodidae: Cholevinae, trapped in the Velký Blaník Protected Landscape Area (central Bohemia) in 1986 and 1987. Sites selected: 1 - top beech stand; 2 - dry coniferous forest; 3 - mixed forest; 4 - moist coniferous forest; 5 - wet march; 6 - edge of a maize field; 7 - edge of a barley field. For total numbers of specimens, see Table 1.



Figs 39-47. Habitat associations of individual species of Leiodidae: Cholevinae, trapped in the Velký Blaník Protected Landscape Area (central Bohemia) in 1986 and 1987. Sites selected: 1 - top beech stand; 2 - dry coniferous forest; 3 - mixed forest; 4 - moist coniferous forest; 5 - wet march; 6 - edge of a maize field; 7 - edge of a barley field. For total numbers of specimens, see Table 1.

with presence of tenerals in October, Fig. 21) have unimodal autumnal activity.

(d) Species with bimodal adult activity. *Catops picipes* was found from mid-May to December, with peaks in June and September to November, and high number of tenerals in May to June and September to October (Fig. 22). Larvae were captured in November to December and May (Fig. 23). *C. tristis tristis* was collected from March to December, with peak activity in April to May and September to October. Tenerals appeared in June to October (Fig. 24). *C. fuliginosus fuliginosus* was captured in March to June and September to December, with a weak peak in June and a high peak in October (Fig. 25). *Ptomaphagus sericatus* was captured from April to November, with a weak peak of abundance in June and a high one in August to November. Tenerals were found in August to November (Fig. 26).

3. Habitat associations

Among **carrion beetles**, *Oiceoptoma thoracica* was found at all habitats, but was more abundant in forest (Fig. 27). *Thanatophilus sinuatus* was collected mostly in the field sites (Fig. 28), and *Silpha tristis tristis* was restricted exclusively to the field areas (Fig. 29).

Species of the genus *Nicrophorus* were found in all habitats. All but *N. vespillo* were more common in forest habitats. This is true for *N. investigator* (Fig. 30). *N. humator* was more common in the dry coniferous forest (Fig. 31), *N. fossor fossor* in the beech forest and dry coniferous forest (Fig. 32), and *N. vespilloides* in moist coniferous forest (Fig. 33). *N. vespillo* was more common in field rather than forest habitats, particularly at the moist march (Fig. 34).

Among **cholevine beetles**, *Catops tristis tristis* and *C. coracinus coracinus* were more common in forest than open habitats (Figs 35,36), and *C. subfuscus subfuscus* was found at forest habitats only (Fig. 37). *C. picipes* was most common in the beech forest (Fig. 38).

C. fuliginosus fuliginosus was most abundant near a maize field (Fig. 39). *C. grandicollis* was abundant in the field habitats, particularly near barley field (Fig. 40). *Fissocatops morio* was captured only near a barley field and at moist march (Fig. 42). *Catops kirbyi kirbyi* had no habitat preference (Fig. 41).

Sciodrepoides watsoni watsoni was omnipresent, most common being on dry field habitats (Fig. 44). *S. fumatus fumatus* and *S. alpestris* were common in the forest habitats (Figs 45-47); males of the former species were most abundant in the moist coniferous forest (Fig. 45), males of the latter species in the beech forest (Fig. 46), females of these two species were not distinguished. *Ptomaphagus sericatus* was abundant in the dry field habitats, particularly near the edge of maize field (Fig. 43).

Other species were scarce.

DISCUSSION

Leiodidae: Cholevinae are attracted to various baits. This supports the meaning of Peck & Anderson (1985), that small bodied Cholevinae are generalist scavengers while large Silphidae are restricted to carrion. High preference of carrion beetles for traps baited with meat was also noted by Kaminska (1989).

Both Silphidae and Leiodidae: Cholevinae exhibit different patterns of seasonal activity and/or habitat association. Our data are similar to the results of Novák (1965,1966), Šustek (1982) and Kamimura et al. (1964) in Silphidae, and Topp & Engler (1980), Engler (1980), Majer (1980) and Zoia (1990) in Leiodidae: Cholevinae. The data for Nearctic species of Cholevinae are different (Peck & Anderson 1985).

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