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***Coccinellidae* (Coleoptera) of linden-oak-hornbeam and thermophilous oak forests of the Mazovian Lowland**

[With 7 Tables and 3 Figures in the text]

**Abstract.** In 1976–1984 entomofaunistic studies were carried out in linden-oak-hornbeam (*Tilio-Carpinetum*) and thermophilous oak (*Potentillo albae-Quercetum*) forests on the Mazovian Lowland. Species composition, community structure and abundance of *Coccinellidae* were determined in the canopy and herb layer in the studied habitats. Furthermore, the material was subject to zoogeographical and ecological analyses and seasonal dynamics was examined.

INTRODUCTION

Linden-oak-hornbeam forests are fertile deciduous forests of the alliance *Carpinion betuli*, spreading on large areas of Europe and its central part in particular. Due to pronounced geographical differences, several regional variants of the linden-oak-hornbeam associations have been distinguished.

Three basic associations of linden-oak-hornbeam forests may be found on the area of Poland, namely, *Galio silvatici-Carpinetum* in the eastern and southern part of Poland, *Stellarario-Carpinetum* on the Pomerania Lake District and *Tilio-Carpinetum* in the remaining part of the country (MATUSZKIEWICZ 1981).

So far the literature lacks, in substance, works dealing with *Coccinellidae* in linden-oak-hornbeam forests as well as in thermophilous oak forests. Some data may only be found in the papers by BIELAWSKI (1971, 1978), where information was provided on the occurrence of ladybirds in mountain linden-oak-hornbeam forests on the area of the Bieszczady and Pieniny Mountains.

The aim of the present paper was to present the abundance, species composition and community structure of *Coccinellidae* in linden-oak-hornbeam and thermophilous oak forests on the Mazovian Lowland. The present work was preceded by two papers on *Coccinellidae* occurring in the habitats of potential linden-oak-hornbeam forests, i.e. on urban green areas of Warsaw (CZECHOWSKA 1981) and on moist meadows (CZECHOWSKA 1989).

#### TIMING AND STUDY AREA

The studies were carried out in 1976–1984 in four linden-oak-hornbeam and three thermophilous oak forests. The examinations on particular stands lasted usually two years, and only in exceptional cases — a year or three years. All the studied forests are located within the range of 60 km around Warsaw.

##### **Linden-oak-hornbeam forests**

1. Dębina nature reserve (1980–1981). A forest near the locality of Klembów, an oak-hornbeam tree stand with an admixture of lindens. Apart from plots of a typical linden-oak-hornbeam forest, there were also found in places (in land hollows) plots of a low (humid) linden-oak-hornbeam forest.

2. Modrzewina nature reserve (1981–1982). A forest near the locality of Belsk Duży. An oak-linden-hornbeam tree stand with an admixture of larches, their huge specimens towering over the remaining trees.

3. Cyganka nature reserve (1979–1980). Situated on the area of the Kampinos National Park, near the locality of Truskaw. A small plot of a linden-oak-hornbeam forest surrounded with pine woods. An oak-hornbeam tree stand with a slight admixture of birches, elms and lindens.

4. Radziejowice (1976–1978). A forest community in the Jaktorowska Forest, near the locality of Radziejowice. Apart from plant communities typical for linden-oak-hornbeam forests, there also occurred plots with a modified tree stand due to an admixture of pine trees.

##### **Thermophilous oak forests**

1. King Jan III Sobieski nature reserve (1980–1981). A small plot of a thermophilous oak forest, situated at Marysin Wawerski on the suburbs of Warsaw. The tree stand composed mainly of oaks and singular lindens and hornbeams.

2. Bolesław Hryniewiecki nature reserve (1983–1984). A plot of modified thermophilous oak forest at Podkowa Leśna. An oak tree stand with an admixture of pine trees.

3. Radziejowice (1984). A well preserved plot of a thermophilous oak forest in the Jaktorowska Forest, near the locality of Radziejowice. An oak tree stand with a slight admixture of birches, hornbeams and pine trees.

A detailed geobotanical description of the studied forests may be found in the introductory paper (KOTOWSKA, NOWAKOWSKI 1989).

#### METHODS AND MATERIAL

*Coccinellidae* were sampled by means of Moericke traps (MOERICKE 1950) hung in the canopy layer and by entomological sweep net in the herb layer.

Moericke traps were hung (according to the composition of tree stands) on lindens (*Tilia cordata*), hornbeams (*Carpinus betulus*), oaks (*Quercus* sp.), elms (*Ulmus* sp.) and pine trees (*Pinus silvestris*). As a rule nine traps were distributed on particular stand, three on each of the three studied tree species. Only in the Cyganka and Hryniewiecki reserves the traps were placed on four trees. The studies analyzed the material coming from two traps from each tree. Catches were completed over the period since April till the end of November. In 1976–1980 the traps were emptied every 5 and 10 days, to be emptied every 7 days later on. Abundance of *Coccinellidae* was expressed as a number of individuals caught in one trap over 24 hours.

Sampling with a sweep net was performed more than a dozen times in a season. Abundance of *Coccinellidae* in the herb layer was estimated as the number of individuals in one sweep sample (one sample including 25 net sweepings).

A total of 848 *Coccinellidae* was collected on the seven stands under study. In the linden-oak-hornbeam forests 504 individuals were caught, out of which 305 in the canopy and 199 in the herb layer. In the thermophilous oak forests 344 individuals were sampled, i.e. 105 in the canopy and 239 in the herb layer.

*Coccinellidae* were identified by means of the key worked out by BIELAWSKI (1959), applying the nomenclature after KLAUSNITZER (1970, 1979).

#### RESULTS

##### Linden-oak-hornbeam forest (*Tilio-Carpinetum*)

##### Species composition and community abundance

Altogether 19 species of *Coccinellidae* were noted to occur in the studied linden-oak-hornbeam forests, which accounted for  $\frac{1}{3}$  of the coccinellid fauna of the Mazovian Lowland. The number of ladybirds species sampled in particular forests ranged from 9 (Dębina reserve) to 15 (Cyganka reserve, Radziejowice) (Tabs I and II).

Table I. Species composition and abundance of *Coccinellidae* in the canopy layer in the  
(*n* — abundance index,

No.	Species	Tilio-					
		Locality					
		Dębina res.		Modrzewina res.		Cyganka res.	
		<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
1	<i>Stethorus punctillum</i> WSE.	—	—	—	—	0.0011	3.5
2	<i>Scymnus (Pullus) ferrugatus</i> (MOLL)	—	—	—	—	—	—
3	<i>Scymnus (P.) auritus</i> THBG.	0.0008	6.3	—	—	0.0014	4.4
4	<i>Scymnus (P.) suturalis</i> THBG.	—	—	—	—	—	—
5	<i>Scymnus (S.) nigrinus</i> KUGEL.	—	—	—	—	—	—
6	<i>Chilocorus renipustulatus</i> (SCRIBA)	—	—	0.0009	4.8	—	—
7	<i>Exochomus quadripustulatus</i> (L.)	0.0004	3.1	—	—	0.0003	0.9
8	<i>Adalia decempunctata</i> (L.)	0.0044	34.4	0.0094	50.0	0.0069	21.7
9	<i>Adalia bipunctata</i> (L.)	—	—	—	—	0.0009	2.8
10	<i>Coccinella septempunctata</i> L.	—	—	0.0047	25.0	0.0006	1.9
11	<i>Synharmonia conglobata</i> (L.)	0.0008	6.3	—	—	—	—
12	<i>Synharmonia impustulata</i> L.	—	—	—	—	0.0006	1.9
13	<i>Myrrha octodecimguttata</i> (L.)	—	—	—	—	0.0006	1.9
14	<i>Calvia decempunctata</i> (L.)	0.0004	3.1	0.0005	2.7	0.0023	7.2
15	<i>Calvia quatuordecimguttata</i> (L.)	0.0004	3.1	—	—	0.0077	24.2
16	<i>Calvia quatuordecimpunctata</i> (L.)	0.0016	12.5	0.0028	14.8	0.0080	25.2
17	<i>Anatis ocellata</i> L.	0.0040	31.2	0.0005	2.7	0.0014	4.4
In general		0.0128		0.0188		0.0318	
Number of species		8		6		12	

Table II. Species composition and abundance of *Coccinellidae* in the herb layer of the  
(*n* — abundance index,

No.	Species	Tilio-					
		Locality					
		Dębina res.		Modrzewina res.		Cyganka res.	
		<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
1	2	3	4	5	6	7	8
1	<i>Rhyzobius litura</i> (FABR.)	—	—	—	—	—	—
2	<i>Chilocorus renipustulatus</i> (SCRIBA)	—	—	—	—	—	—
3	<i>Exochomus quadripustulatus</i> (L.)	—	—	—	—	—	—
4	<i>Adonia variegata</i> (GOEZE)	—	—	—	—	—	—
5	<i>Adalia decempunctata</i> (L.)	0.008	15.4	—	—	0.015	29.4
6	<i>Adalia bipunctata</i> (L.)	0.002	3.8	—	—	—	—
7	<i>Coccinella septempunctata</i> L.	0.002	3.8	0.063	57.2	0.003	5.9
8	<i>Coccinella quinquepunctata</i> L.	0.002	3.8	0.004	3.6	—	—
9	<i>Coccinula quatuordecimpustulata</i> (L.)	—	—	0.001	1.0	0.006	11.8

*Tilio-Carpinetum* and the *Potentillo albae-Quercetum* forests of the Mazovian Lowland data from Moericke traps)

<i>Carpinetum</i>				<i>Potentillo albae-Quercetum</i>							
				Locality							
Radziejowice		In general		King Sobieski res.		Radziejowice		B. Hryniewiecki res.		In general	
n	%	n	%	n	%	n	%	n	%	n	%
0.0019	6.3	0.0008	3.4	—	—	—	—	0.0015	7.0	0.0005	2.7
—	—	—	—	—	—	—	—	0.0026	12.2	0.0009	5.0
0.0074	24.6	0.0024	10.3	—	—	0.0028	11.2	0.0077	36.1	0.0035	19.2
0.0023	7.7	0.0006	2.6	—	—	—	—	0.0009	4.2	0.0003	1.6
—	—	—	—	—	—	—	—	0.0006	2.8	0.0002	1.1
—	—	0.0002	0.9	0.0004	4.4	—	—	—	—	0.0001	0.5
0.0019	6.3	0.0007	3.0	—	—	—	—	0.0014	6.6	0.0003	1.6
0.0119	39.7	0.0081	34.5	0.0031	34.4	0.0055	22.1	0.0017	8.0	0.0034	18.9
0.0002	0.7	0.0007	1.3	0.0004	4.4	0.0028	11.2	—	—	0.0011	6.0
0.0016	5.3	0.0017	7.3	0.0004	4.4	—	—	0.0003	1.4	0.0022	1.1
—	—	0.0002	0.9	—	—	—	—	—	—	—	—
—	—	0.0002	0.9	—	—	—	—	—	—	—	—
—	—	0.0002	0.9	0.0004	4.4	—	—	0.0003	1.4	0.0002	1.1
0.0005	1.7	0.0009	3.8	0.0023	25.6	0.0082	33.0	0.0003	1.4	0.0036	19.9
—	—	0.0020	8.5	0.0004	4.5	0.0028	11.2	—	—	0.0011	6.0
0.0021	7.0	0.0036	15.3	0.0016	17.8	0.0028	11.2	0.0037	17.4	0.0027	14.8
0.0002	0.7	0.0015	6.4	—	—	—	—	0.0003	1.4	0.0001	0.5
0.0300		0.0234		0.0090		0.0249		0.0213		0.0182	
1		15		8		6		12		15	

*Tilio-Carpinetum* and the *Potentillo albae-Quercetum* forests of the Mazovian Lowland data from sweep net)

<i>Carpinetum</i>				<i>Potentillo albae-Quercetum</i>							
				Locality							
Radziejowice		In general		King Sobieski res.		Radziejowice		B. Hryniewiecki res.		In general	
n	%	n	%	n	%	n	%	n	%	n	%
9	10	11	12	13	14	15	16	17	18	19	20
0.003	1.3	0.001	0.9	—	—	—	—	—	—	—	—
0.003	1.3	0.001	0.9	—	—	—	—	0.043	11.3	0.014	8.8
—	—	—	—	0.002	5.0	—	—	—	—	0.001	0.6
—	—	—	—	—	—	0.002	3.3	0.002	0.5	0.001	0.6
0.003	1.3	0.007	6.3	0.002	5.0	—	—	0.005	1.3	0.002	1.2
—	—	0.001	0.9	—	—	—	—	0.002	0.5	0.001	0.6
0.065	28.7	0.033	29.7	0.005	12.5	0.010	16.4	0.031	8.2	0.015	9.3
0.003	1.3	0.002	1.8	—	—	—	—	0.016	4.2	0.005	3.1
0.065	28.7	0.018	16.2	—	—	0.004	6.6	0.004	1.0	0.003	1.9

Tab. II — cont.

1	2	3	4	5	6	7	8
10	<i>Synharmonia conglobata</i> (L.)	—	—	—	—	—	—
11	<i>Calvia decemguttata</i> (L.)	—	—	—	—	—	—
12	<i>Calvia quatuordecimguttata</i> (L.)	—	—	0.001	1.0	0.006	11.8
13	<i>Calvia quatuordecimpunctata</i> (L.)	0.028	53.9	0.041	37.2	0.018	35.3
14	<i>Anatis ocellata</i> (L.)	—	—	—	—	—	—
15	<i>Tytthaspis sedecimpunctata</i> (L.)	—	—	—	—	—	—
16	<i>Psyllobora vigintiduopunctata</i> (L.)	—	—	—	—	—	—
17	<i>Subcoccinella vigintiquatuor-</i> <i>punctata</i> (L.)	0.010	19.2	—	—	0.003	5.9
	In general	0.052		0.110		0.051	
	Number of species	6		5		6	

Table III. Qualitative similarity (after the SÖRENSEN formula) of the communities of *Coccinellidae* in the *Tilio-Carpinetum* and *Potentillo albae-Quercetum* forests of the Mazovian Lowland

		<i>Tilio-Carpinetum</i>				<i>Potentillo albae-Quercetum</i>		
		Dębina res.	Modrzewina res.	Cyganka res.	Radziejowice	King Sobieski res.	Radziejowice	B. Hryniewiecki res.
<i>Tilio-Carpinetum</i>	Dębina res.	—	67	77	74	78	70	63
	Modrzewina res.	67	—	52	67	70	60	55
	Cyganka res.	77	52	—	76	80	64	71
	Radziejowice	74	67	76	—	69	62	74
<i>Potentillo albae-Quercetum</i>	King Sobieski res.	78	70	70	69	—	64	65
	Radziejowice	70	60	64	62	64	—	58
	B. Hryniewiecki res.	63	55	71	74	65	58	—

Similarity of species composition of the coccinellid communities on the studied areas was relatively high, ranging 52–77 % (Tab. III).

In order to determine the degree of constancy in occurrence of particular *Coccinellidae* species in the linden-oak-hornbeam forests, the TISCHLER scale was employed (TROJAN 1975). According to the scale the following categories of species were distinguished: absolutely constant, constant, accessory, and

9	10	11	12	13	14	15	16	17	18	19	20
—	—	—	—	—	—	0.002	3.3	—	—	0.001	0.6
—	—	—	—	0.002	5.0	—	—	—	—	0.001	0.6
0.001	0.4	0.002	1.8	—	—	—	—	—	—	—	—
0.062	27.3	0.037	33.3	0.025	62.5	0.039	63.8	0.071	18.7	0.045	28.0
—	—	—	—	0.002	5.0	—	—	—	—	0.001	0.6
—	—	—	—	—	—	—	—	0.002	0.5	0.001	0.6
—	—	—	—	—	—	—	—	0.202	53.2	0.067	41.6
0.022	9.7	0.009	8.1	0.002	5.0	0.004	6.6	0.002	0.5	0.003	1.9
0.227		0.111		0.040		0.061		0.380		0.161	
9		10		7		6		11		15	

accidental. The species absolutely constant included: *Adalia decempunctata*, *Coccinella septempunctata*, *Calvia quatuordecimpunctata*, *Calvia quatuordecimguttata*, and *Anatis ocellata*. The first three species were also the most numerous and regularly sampled in all the years of the studies. The group of constant species included: *Scymnus auritus*, *Exochomus quadripustulatus*, *Adalia bipunctata*, *Coccinella quinquepunctata*, *Coccinula quatuordecimpustulata*, *Calvia decemguttata*, and *Subcoccinella vigintiquatuordecimpunctata*. There were two accessory species, namely, *Stethorus punctillum* and *Chilocorus renipustulatus*. The accidental species were: *Rhyzobius litura*, *Synharmonia conglobata*, *Synharmonia impustulata*, *Scymnus suturalis* and *Myrrha octodecimguttata*.

### The canopy layer

Fifteen species of ladybirds were recorded to occur in the canopy layer of the studied linden-oak-hornbeam forests, the number of species found in particular forests ranging from 6 (Modrzewina reserve) to 12 (Cyganka reserve).

An average index of community abundance in the canopy layer amounted to 0.0234. The least abundant was the community of the Dębina reserve (0.0128), whereas the most abundant — that at Radziejowice (0.0300) and in the Cyganka reserve (0.0318) (Tab. I).

The poorest *Coccinellidae* communities, both as regards quantity and quality, occurred in the typical, homogeneous in respect of habitat conditions, linden-oak-hornbeam forest of the Dębina reserve. The communities of the forests having more mosaic habitats, i.e. in the Cyganka reserve and at Radziejowice, were approximately two times more abundant and richer in species.

The species most numerous occurring in the canopy layer was *Adalia decempunctata* (accounting for 34.5% of the whole material). The species less numerous were respectively: *Calvia quatuordecimpunctata* (15.3%), *Scymnus*

*auritus* (10.3%), *Calvia quatuordecimguttata* (8.5%), and *Coccinella septempunctata* (7.3%) (Fig. 1A). The contribution of the remaining species ranged from 0.5 to 6.4%.

As regards their structure, *Coccinellidae* communities of the canopy layer in the particular linden-oak-hornbeam forests were fairly similar, especially those from the forest of the Dębina reserve, Modrzewina reserve and at Radziejowice. The dominating species in all the three stands was *Adalia decempunctata*, which accounted for 34–50% of the community (Tab. I). The contribution of subdominants was fairly alike, ranging from 25 to 31%, though subdominants themselves were different in each of the three communities (namely: *Anatis ocellata*, *Coccinella septempunctata* and *Scymnus auritus*, respectively). The contribution of the remaining species amounted from 0.7 to 15%. The community structure of *Coccinellidae* in the Cyganka reserve was slightly different. Three species co-dominated there, their contribution being approximately the same, namely, *Calvia quatuordecimpunctata* (25.2%), *C. quatuordecimguttata* (24.2%), and *Adalia decempunctata* (21.7%). The contribution of the remaining species ranged from 0.9 to 7.2%.

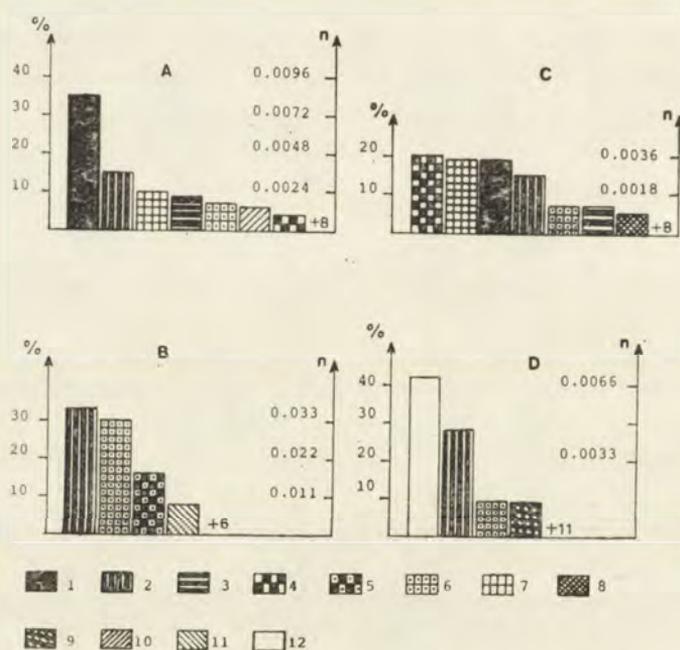


Fig. 1. Dominance structure of the *Coccinellidae* communities in the linden-oak-hornbeam forests (A – the canopy layer, B – the herb layer) and in the thermophilous oak forests (C – the canopy layer, D – the herb layer); 1 – *Adalia decempunctata*, 2 – *Calvia quatuordecimpunctata*, 3 – *Calvia quatuordecimguttata*, 4 – *Calvia decempunctata*, 5 – *Coccinella quatuordecimpustulata*, 6 – *Coccinella septempunctata*, 7 – *Scymnus auritus*, 8 – *Scymnus ferrugatus*, 9 – *Chilocorus renipustulatus*, 10 – *Anatis ocellata*, 11 – *Subcoccinella viginti-quatuor-punctata*, 12 – *Psyllobora vigintiduopunctata*.

Table IV. Similarity of dominance structure (the MORISITA index) of the communities of *Coccinellidae* in the canopy layer from the *Tilio-Carpinetum* and the *Potentillo albae-Quercetum* forests of the Mazovian Lowland

		<i>Tilio-Carpinetum</i>				<i>Potentillo albae-Quercetum</i>		
		Dębina res.	Modrzewina res.	Cyganka res.	Radziejowice	King Sobieski res.	Radziejowice	B. Hryniewiecki res.
<i>Tilio-Carpinetum</i>	Dębina res.	—	0.69	0.62	0.69	0.56	0.49	0.36
	Modrzewina res.	0.69	—	0.59	0.77	0.78	0.50	0.26
	Cyganka res.	0.62	0.59	—	0.57	0.75	0.67	0.42
	Radziejowice	0.69	0.77	0.57	—	0.67	0.58	0.41
<i>Potentillo albae-Quercetum</i>	King Sobieski res.	0.56	0.78	0.75	0.67	—	0.88	0.30
	Radziejowice	0.49	0.50	0.67	0.58	0.88	—	0.41
	B. Hryniewiecki res.	0.36	0.26	0.42	0.41	0.30	0.41	—

The differences in dominance structure of the studied communities were expressed in the values of the MORISITA index (after HORN 1966). The values estimated for the *Coccinellidae* communities of the Dębina reserve, Modrzewina reserve and at Radziejowice were fairly high, amounting to 0.69–0.77. On the other hand, lower values of the similarity index were obtained while comparing these three communities to that of the Cyganka reserve (Tab. IV). This apparent dissimilarity resulted from a very numerous occurrence of *Calvia quatuordecimguttata* at the Cyganka reserve, whose tree stand included several elms (*Ulmus* sp.). According to BIELAWSKI (1959), *C. quatuordecimguttata* most preferably occurs on this tree species.

#### The herb layer

In the herb layer of the studied linden-oak-hornbeam forests 10 species of *Coccinellidae* were found (Tab. II). On the particular stands there occurred from 5 (Modrzewina reserve) to 9 species (Radziejowice) of *Coccinellidae*. An average abundance index amounted to 0.111. Particular values differed fairly significantly. The communities of the smallest and almost equal abundance occurred in the reserves of Cyganka and Dębina. The community of the Modrzewina reserve was two times more numerous, whereas that at Radziejowice — four times more abundant (Tab. II).

The greatest contribution to the sampled material had *Calvia quatuordecimpunctata* (33.3%) and *Coccinella septempunctata* (29.7%). As regards the remaining species, also considerably numerous was *Coccinula quatuordecimpustulata* (16.2%) and *Subcoccinella vigintiquatuorruptata* (8.1%) (Fig. 1B). In the particular forests the contribution of *Calvia quatuordecimpunctata* ranged from 27 to 54%, which made this species either a dominant or a subdominant in the studied communities. *Coccinella septempunctata* occurred numerously only in the Modrzewina reserve and at Radziejowice, while in the reserves of Dębina and Cyganka it was inabundant. However, in the herb layer of the two latter forests a considerable number of *Adalia decempunctata* was collected. The most even contribution of particular species to the community was observed in the Cyganka reserve, whereas elsewhere the communities were in about 90% made up of two or three species (Tab. II).

The index of similarity in dominance structure (the MORISITA index) was noted for a wide value range. The most similar in their structure were the *Coccinellidae* communities in the Cyganka and Dębina reserves (0.82) as well as in the Modrzewina reserve and at Radziejowice (0.75), while the least similar were the communities in the Cyganka and Modrzewina reserves (0.47) (Tab. V).

On the basis of analyses of species composition and community structure of *Coccinellidae* in the linden-oak-hornbeam forests on Mazovia it may be assumed

Table V. Similarity of dominance structure (the MORISITA index) of the communities of *Coccinellidae* in the herb layer from the *Tilio-Carpinetum* and *Potentillo albae-Quercetum* forests of the Mazovian Lowland

		<i>Tilio-Carpinetum</i>				<i>Potentillo albae-Quercetum</i>		
		Dębina res.	Modrzewina res.	Cyganka res.	Radziejowice	King Sobieski res.	Radziejowice	B. Hryniewiecki res.
<i>Tilio-Carpinetum</i>	Dębina res.	—	0.54	0.82	0.50	0.92	0.90	0.31
	Modrzewina res.	0.54	—	0.47	0.75	0.69	0.73	0.29
	Cyganka res.	0.82	0.47	—	0.63	0.70	0.70	0.25
	Radziejowice	0.50	0.75	0.63	—	0.62	0.70	0.27
<i>Potentillo albae-Quercetum</i>	King Sobieski res.	0.92	0.69	0.70	0.62	—	0.99	0.33
	Radziejowice	0.90	0.73	0.70	0.70	0.99	—	0.34
	B. Hryniewiecki res.	0.31	0.29	0.25	0.27	0.33	0.34	—

that a typical feature of the studied habitat was abundance of *Adalia decempunctata* in the canopy and of *Calvia quatuordecimpunctata* in the herb layer. The occurrence and abundance of the remaining species seemed, in a greater degree, to depend on local differences in site conditions as well as on the vicinity of other habitats (pine forests in particular), from where ladybirds could spread.

### Zoogeographical analysis

*Coccinellidae* sampled in the studied linden-oak-hornbeam forests on Mazovia represented the following zoogeographical elements: cosmopolitan, Holarctic, Palaearctic, Euro-Siberian and European. The largest group (similarly as on the whole Mazovian Lowland) was made up of Palaearctic species. The group included 13 species and 82% of the sampled individuals, the most abundant species being *Adalia decempunctata* and *Calvia quatuordecimpunctata*.

The remaining zoogeographical elements included 1–2 species. The European element was represented by *Rhyzobius litura* and *Synharmonia impustulata*, Euro-Siberian — by *Stethorus punctillum* and *Scymnus auritus*, Holarctic — by *Calvia quatuordecimguttata*, and cosmopolitan — by *Adalia decempunctata*. Among these species fairly abundant were Euro-Siberian (9.3%) and Holarctic forms (6.7%) (Tab. VI).

Palaearctic species were the essential part of all the communities, contributing from 67 to 99% to the community abundance. This element prevailed almost exclusively in the Modrzewina and Dębina reserves, i.e. on areas where the studied plots were most similar to the community of *Tilio-Carpinetum typicum*. On the other hand, in forests bearing certain features of pine wood

Table VI. Contribution of zoogeographical elements to the *Coccinellidae* communities in the *Tilio-Carpinetum* and *Potentillo albae-Quercetum* forests on the Mazovian Lowland (*S* — number of species, *N* — number of individuals)

Element	Habitat					
	<i>Tilio-Carpinetum</i>			<i>Potentillo albae-Quercetum</i>		
	<i>S</i>	<i>N</i>	%	<i>S</i>	<i>N</i>	%
Cosmopolitic	1	6	1.2	2	5	1.5
Holarctic	1	34	6.7	1	2	0.5
Palaearctic	13	414	82.1	14	293	85.4
Euro-Siberian	2	47	9.3	4	42	12.0
European	2	3	0.6	1	2	0.6
Total	19	504		22	344	

habitats, the *Coccinellidae* communities were more zoogeographically diversified and the contribution of Palaearctic forms dwindled on account of Holarctic (Cyganka reserve) or Euro-Siberian element (at Radziejowice).

### Ecological analysis

#### Habitat preferences and plasticity

The family *Coccinellidae* is characteristic for a remarkable adaptability, both as regards habitat requirements and ecological plasticity. These insects inhabit almost all types of land plant communities and all their layers.

Among *Coccinellidae* of the Mazovian Lowland, the prevailing (60%) are the species living in forested habitats. Open areas are inhabited by 29% of species, while 11% is attributed by ubiquitous species, which can occur in both the types of habitats.

*Coccinellidae* communities of the studied Mazovian linden-oak-hornbeam forests were mainly made up of forest (12 species and 50.4% of individuals) and ubiquitous forms (5 species and 48% of individuals) (Tab. VII). Among the exclusively forest species of *Coccinellidae* the most numerous was *Adalia*

Table VII. Contribution of ecological elements to the *Coccinellidae* communities in the *Tilio-Carpinetum* and *Potentillo albae-Quercetum* forests in the Mazovian Lowland (S — number of species, N — number of individuals)

Criterion	Element	Habitat					
		<i>Tilio-Carpinetum</i>			<i>Potentillo albae-Quercetum</i>		
		S	N	%	S	N	%
Habitat	Ubiquitous	5	243	48.2	6	213	61.9
	Forests areas	12	254	50.4	13	119	34.6
	Open areas	2	7	1.4	3	12	3.5
Ecological amplitude	Eurytopic	3	202	40.1	3	105	30.5
	Poliotopic	14	261	51.7	16	131	38.1
	Oligotopic	2	41	8.1	3	108	31.4
Stratification	Canopy of trees and shrubs	11	250	49.6	12	94	27.3
	Herbous plants	4	48	9.5	6	120	34.9
	Both levels	4	206	40.9	4	130	37.8
Moisture requirement	Hygrophilous	5	357	70.8	5	137	39.8
	Mesohygrophilous	6	42	8.3	6	31	9.0
	Xerophilous	8	105	20.8	11	176	51.1
Trophic type	Acarids	1	9	1.8	1	5	1.5
	Coccids and aphids	2	14	2.8	3	40	11.6
	Aphids	15	464	92.0	15	193	56.1
	Fungi	—	—	—	2	102	29.6
	Herbous plants	1	17	3.4	1	4	1.2

*decempunctata*, while among the ubiquitous species — *Calvia quatuordecimpunctata* and *Coccinella septempunctata*. Individuals of the two groups occurred in a fairly steady quantitative proportion. In the reserves of Cyganka and Dębina and at Radziejowice the forest species accounted for 55–66%, while ubiquitous — for 34–43% of the collected material. An inverse quantitative ratio was noted only in the community of the Modrzewina reserve, where ubiquitous Coccinellidae were 3.5 times more numerous than the forest ones.

As regards ecological plasticity, the richest group, both with respect to quantity and quality, were politopes of forested areas, comprising 14 species and 51.7% of the collected individuals. The dominating species in this group was *Adalia decempunctata*. Eurytopes were represented by *Coccinella septempunctata*, *Calvia quatuordecimpunctata* and *Adalia bipunctata*, and accounted jointly for 40% of the sampled individuals. The group of oligotopes included *Coccinula quatuordecimpustulata* and *Subcoccinella vigintiquatuorpunctata*. The contribution of individuals of these species amounted to 8%, the highest being recorded at Radziejowice and the smallest in the Modrzewina reserve. Any stenotopic species of the occurrence solely bound to the studied habitats were not recorded to be present in the Mazovian linden-oak-hornbeam forests.

#### Vertical distribution and trophic guilds

Vertical distribution of Coccinellidae is to a great degree conditioned by nutrition requirements of particular species. In this respect, more than a half (53%) of the species reported from Mazovia is bound to the shrub and canopy layers. The second comes the group of Coccinellidae inhabiting solely the herb layer (29%). About 18% is made up of species of a very wide range of ecological plasticity and nutrition requirements, inhabiting all the plant layers.

In the studied linden-oak-hornbeam forests the contribution of species bound to the herb layer was small and the two other group prevailed. Out of 11 species bound to the canopy layer, the most numerous were *Adalia decempunctata*, *Scymnus auritus*, *Calvia quatuordecimguttata*, and *C. decempunctata*. Ladybirds of this group made up almost a half of the collected material. Coccinellids of a wide vertical distribution, i.e. *Calvia quatuordecimpunctata*, *Coccinella septempunctata*, *Adalia bipunctata* and *Chilocorus renipustulatus*, together accounted for about 42% of the sampled individuals. The genuinely herb layer species, i.e. *Coccinula quatuordecimpustulata* and *Subcoccinella vigintiquatuorpunctata*, contributed less than 10% to the sampled material (Tab VII).

*Calvia quatuordecimpunctata* and *Coccinella septempunctata* dominated in the group of species of potentially the greatest vertical distribution range. Their contribution was greater to the material collected in the herb layer than to that trapped in the canopy, especially in case of *Coccinella septempunctata*. This species accounted for 7.6% of the material sampled on trees and for 29.7% of the material swept in the herb layer. *Coccinella septempunctata* was parti-

cularly abundant in the herb layer at the stand of Radziejowice and the Morzewina reserve, and only there it numerously occurred also on trees. In the reserves of Dębina and Cyganka only single individuals of *Coccinella septempunctata* were in samples from the herb layer and, consequently, it was equally scarce, if ever occurred, on trees. Hence *Coccinella septempunctata* should be regarded as primarily a herbal species. It is only in time of its numerous occurrence (following the period of wintering and reproduction) when several imagines of this species may be found also on shrubs and trees.

Almost all the ladybirds collected in the linden-oak-hornbeam forests were aphidophages. This trophic group included 15 species and 92% of the sampled individuals. The two species, i.e. *Chilocorus renipustulatus* and *Exochomus quadripustulatus*, feeding, apart from aphids, also on coccids, jointly accounted for 2.8% of the sampled material. These ladybirds, *Exochomus quadripustulatus* in particular, are associated with coniferous forests. In the studied linden-oak-hornbeam forests they occurred on stands with an admixture of pine trees or in the vicinity of mixed deciduous-coniferous forests (Radziejowice, the Cyganka reserve). *Stethorus punctillum*, feeding on mites, occurred rarely and inabundantly in the studied forests. Its contribution to the collected material did not exceed 2%. Phytophagous *Subcoccinella vigintiquatuor-punctata* accounted for 3.4% of the sampled individuals. The species was most abundant in the Dębina reserve and at Radziejowice (Tabs II and III).

Aphidophagous species of *Coccinellidae* bound to shrubs and deciduous trees do not, on the whole, include monophages, nevertheless some of them are more frequently and abundantly found on certain plant species.

In the studied linden-oak-hornbeam forests, 17 *Coccinellidae* species occurred on oaks, the same number on lindens and 12 on hornbeams. The greatest number of individuals was caught on oaks (140), then on hornbeams (81) and, finally, on lindens (60). The species which were pronouncedly more numerous on oaks than on other trees, were *Scymnus auritus* and *Adalia decempunctata*. The number of individuals of *S. auritus* sampled on oaks was 5 times greater than on hornbeams and 2.5 times greater than on lindens. The number of individuals of *Adalia decempunctata* was 3 times greater on oaks than on hornbeams and lindens. Furthermore, individuals of species trophically bound to aphids of coniferous trees were caught primarily on oaks and then on lindens. Since these ladybirds were collected mainly in spring it may be assumed that their occurrence on deciduous trees was merely temporary. Mass occurrence of aphids on certain species of trees or shrubs in spring time may bring about the occurrence of many species of *Coccinellidae* which are usually not associated with a given habitat. An evidence of this is the occurrence of many *Coccinellidae* species on blooming bird cherries (*Prunus padus* L.) in time of aphid mass development. When the period of occurrence of aphids is over, ladybirds migrate onto other plants or to other habitats (BIELAWSKI 1971).

Apart from particular nutritive preferences of certain species, it may also be assumed that a more numerous occurrence of *Coccinellidae* on oaks results from a greater nutritional value of these trees, which is of vital importance to those ladybirds which are exclusively bound to the canopy layer of the forest. On the two species of oak trees growing in Poland (*Quercus robur* and *Q. sessilis*), 11 species of aphids occur, most of them in great numbers at that. All these species are monophagous and they do not migrating. On the other hand, only one species of aphids lives on hornbeams and two — on lindens, out of which one occurs very rarely (SZELEGIEWICZ 1968).

#### Moisture requirements

Linden-oak-hornbeam forests, shady and humid, are inhabited by species adapted to specific climatic conditions. The essential part of the *Coccinellidae* fauna was composed of *Adalia decempunctata*, *Calvia quatuordecimpunctata* and *Coccinella septempunctata*. These species were also reported as dominating in *Coccinellidae* communities of mountain oak-hornbeam and hornbeam forests in the Bieszczady and Pieniny Mountains (BIELAWSKI 1971, 1978). The three species mentioned above, along with locally abundant *Calvia quatuordecimguttata* and *C. decemguttata*, represented the shado- and higrophilous element. The species preferring warm and dry habitats included *Scymnus auritus* and *Coccinula quatuordecimpustulata* as well as generally all the species bound to coniferous trees.

The prevailing in the most typical *Tilio-Carpinetum* forests in the Dębina and Modrzewina reserves, were higrophilous species (and individuals). On the other hand, a relatively large contribution of thermophilous species was observed to the communities of the stands in the vicinity of coniferous forests or with an admixture of pine trees (Radziejowice, the Cyganka reserve).

#### Seasonal dynamics

On the basis of the sampled imagines of *Coccinellidae* the analyses were carried out of changes in the community abundance over a vegetative season. Both in the herb and canopy layers ladybirds occurred since April till October. However the course of seasonal dynamics in the two plant layers was totally different (Fig. 2A, B).

In the canopy layer the greatest amounts of ladybirds were collected in spring. Their abundance peak fell on May and June and their abundance declined later on. In the herb layer the greatest abundance of the community was recorded in August and September. The course of changes in abundance of *Coccinellidae* communities over a season was determined primarily by the occurrence pattern of the most numerous species, i.e. *Adalia decempunctata*, *Scy-*

*mnus auritus*, *Calvia quatuordecimpunctata*, and *Coccinella septempunctata* (Fig. 2).

*Adalia decempunctata*, the species bound to the canopy layer, was sampled since April till October. The greatest numbers of individuals were collected in May, i.e. after the wintering period. In June abundance of this species decreased to increase in July due to appearance of the new generation. After this period an abrupt decrease in the species abundance followed (Fig. 2C). *Scymnus auritus* was another species numerous sampled in the canopy layer, yet on

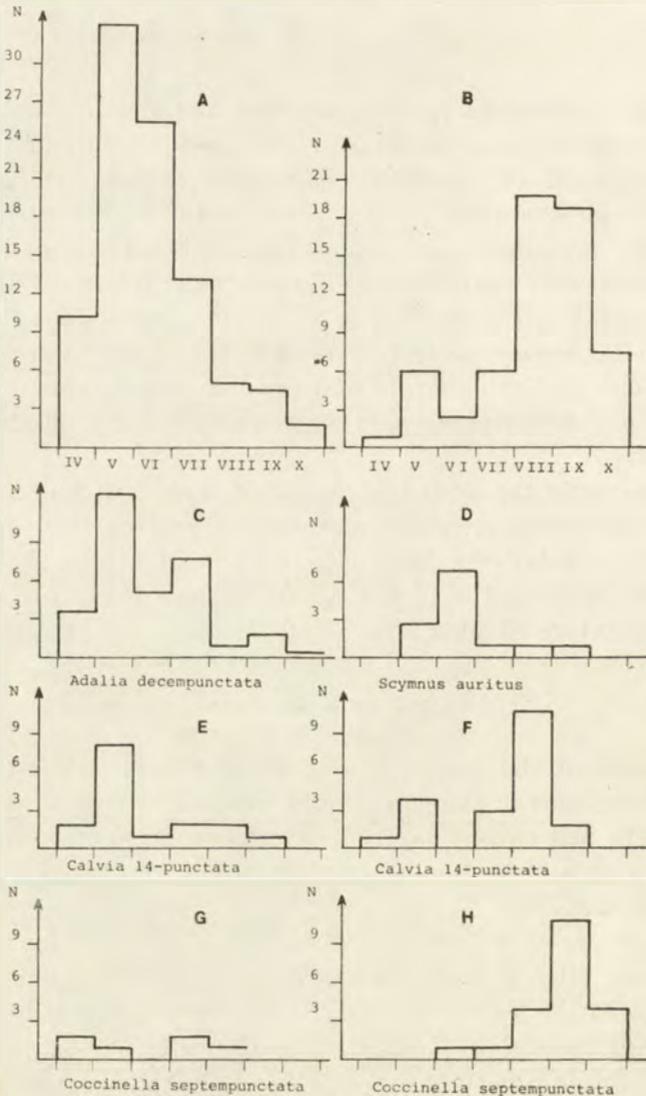


Fig. 2. Seasonal changes in *Coccinellidae* abundance in the linden-oak-hornbeam forests; A – totally in the canopy layer, B – totally in the herb layer, C – abundance dynamics of the dominating species; N – number of individuals.

certain stands only. The species appeared in samples relatively late, i.e. in May. The greatest number of individuals was recorded in the first half of June; later only single individuals were sampled (Fig. 2D). The abundance peak of the new generation wanting, it may be assumed that this thermophilous species does not complete a full development cycle in linden-oak-hornbeam forests. The species was most numerous in the Cyganka reserve and at Radziejowice, i.e. in the vicinity of mixed pine forests, where *Scymnus auritus* frequently is the dominant of communities (CZECHOWSKA 1981).

An interesting course of seasonal dynamics was observed in the cases of *Calvia quatuordecimpunctata* and *Coccinella septempunctata*, i.e. the species occurring both in the canopy as well as in the herb layer. As regards the samples from the canopy layer, *Calvia quatuordecimpunctata* appeared since April till September. However, an overwhelming majority of individuals were sampled in May only; either earlier or later they appeared sporadically (Fig. 2E). In the herb layer two abundance peaks of this species were noted. Similarly as in the canopy layer, an increased appearance of the wintering generation was observed in May. In June, however, no imagines of this species were found in the samples, as this is the usual time of *Coccinellidae* hatching and the occurrence of larval stages. The abundance peak of the new generation fell on July and August (Fig. 2F).

*Coccinella septempunctata* occurred in the canopy layer since April till August, ever in very small numbers (Fig. 2G). In the herb layer the species in question occurred not earlier than in June. A notable increase in its abundance was observed in August to be followed by an abundance peak in September (Fig. 2H).

Changes in abundance of *Coccinellidae* communities during a vegetative season are conditioned, apart from the development cycle, also by seasonal migrations in search for food (BIELAWSKI 1961, 1971). Ladybirds concentrate in large numbers at places where food abounds. When food resources are depleted, ladybirds disperse, seeking new feeding grounds. The abundance peak of *Coccinellidae* in the canopy layer falls in spring time. Then several species move over onto the herb layer while certain other species migrate in search for food most likely onto other species of trees or shrubs (excluded from the studies), or to other habitats.

#### Thermophilous oak forests (*Potentillo albae-Quercetum*)

The studies conducted in thermophilous oak forests were shorter and were carried out on fewer stands than in the linden-oak-hornbeam forests. Moreover, the obtained data on species and community abundance significantly varied from those estimated for the linden-oak-hornbeam communities. Hence the presented characteristics of *Coccinellidae* fauna in thermophilous oak forests should be regarded as merely a preliminary one.

## Species composition and abundance of communities

In the studied Mazovian thermophilous oak forests a total of 22 *Coccinellidae* species was recorded. In the King Sobieski reserve and at Radziejowice 11 species were collected, whereas in the Hryniewiecki reserve — 20 species of *Coccinellidae* (Tabs III and IV). Similarity of species composition of particular communities was moderate, ranging from 58 to 65% (Tab. III).

Fifteen ladybirds species in total occurred in the canopy layer, their smallest number being recorded at Radziejowice (6) and the highest in the Hryniewiecki reserve (12). An average community abundance index amounted to 0.0182. The least numerous was the community in the King Sobieski reserve (0.0090). Almost twice as numerous were the *Coccinellidae* communities at Radziejowice and in the Hryniewiecki reserve (Tab. I). On the whole, the species which had in the sampled material the greatest contribution to the communities in the canopy layer were: *Calvia decempunctata* (19.9%), *Scymnus auritus* (19.2%), *Adalia decempunctata* (18.9%), and *Calvia quatuordecimpunctata* (14.8%) (Fig. 1C). Except for *Scymnus auritus* all the aforementioned species occurred in all the studied forests.

As regards community structure, a close similarity was noted of the *Coccinellidae* communities from the King Sobieski reserve and at Radziejowice. In these two oak forests the same species dominated, namely, *Adalia decempunctata* and *Calvia decempunctata*. The community in the Hryniewiecki reserve varied in its dominance structure, as the most numerous species there were: *Scymnus ferrugatus*, *S. auritus* and *Calvia quatuordecimpunctata* (Tab. I). Differences among the studied communities have reflected in the values of the MORISITA index (Tab. IV).

A total of 15 *Coccinellidae* species was reported to occur in the herb layer of the studied forests. In particular stands there were found from 6 to 11 species. An average abundance index amounted to 0.161. Abundance of ladybirds at Radziejowice and in the King Sobieski reserve was small, the abundance index amounting to 0.0040 and 0.0061, respectively. The community in the Hryniewiecki reserve was several times more numerous (Tab. II). On the whole, the greatest contribution to the communities had successively: *Psyllobora vigintiduopunctata* (41.6%), *Calvia quatuordecimpunctata* (28.0%), *Coccinella septempunctata* (9.3%) and *Chilocorus renipustulatus* (8.8%) (Fig. 1D). The species common for all the studied oak forests were: *Calvia quatuordecimpunctata*, *Coccinella septempunctata* and *Subcoccinella vigintiquatuordecimpunctata*. *Psyllobora vigintiduopunctata* and *Chilocorus renipustulatus* had large shares in the communities due to their unusually abundant occurrence on one stand only, i.e. in the Hryniewiecki reserve.

The *Coccinellidae* communities in the King Sobieski reserve and at Radziejowice were markedly similar to each other in their dominance structures, the number of species and community abundance (Tabs II and IV). They were

also similar in this respect to communities of certain linden-oak-hornbeam forests, especially to that from the Dębina reserve. The *Coccinellidae* community in the Hryniewiecki reserve was distinctly different from all the other examined communities.

### Zoogeographical and ecological remarks

Among 22 species of *Coccinellidae* caught in the Mazovian thermophilous oak forests the following zoogeographical elements were distinguished: cosmopolitan, Holarctic, Palaearctic, Euro-Siberian and European. The group quantitatively and qualitatively richest were Palaearctic ladybirds and, secondly, European ones. The remaining elements were represented by single species, the total contribution of their individuals to the collected material did not exceed 3% (Tab. VI).

As regards ecology ubiquitous *Coccinellidae* were most abundant in the studied thermophilous oak forests. The group of *Coccinellidae* species associated with forested areas was by half less numerous, though more than twice as rich in species. The species typical for open areas accounted merely for a minute part of the collected individuals (Tab. VII).

According to ecological plasticity 3 groups were distinguished in the sampled ladybirds, namely, eurytopes, politopes and oligotopes. The eurytopic and oligotopic elements were represented by an equal number of species and individuals (3 species and approximately 31% of the sampled individuals each). The remaining 16 species and 38% of material belonged to the group of politopes (Tab. VII).

As regards vertical distribution, 12 species were bound exclusively to the canopy layer and shrubs, 6 — to the herb layer and 4 species could occur in all the forest layers. Species abundance was inversely proportional to the number of species representing the given type of distribution. The greatest amount of individuals (37.8%) represented the species of the widest range of vertical distribution, 35% of individuals were the herb ladybirds and 27% of individuals — ladybirds of the canopy layer (Tab. VII).

Considering thermic and moisture requirements, *Coccinellidae* preferring warm and dry habitats were the group including the greatest number of both species and individuals. The group consisted of 11 species and accounted for 51% of the collected individuals. Ladybirds preferring shady and humid habitats were represented by 5 species and about 40% of individuals. Six species and 9% of the collected material were classified as euryhigrophilous elements (Tab. VII).

Five trophic guilds were distinguished in the *Coccinellidae* fauna on the thermophilous oak forests (Tab. VII). The majority was made up of aphidophagous ladybirds (15 species and 56% of individuals). The species feeding on

mixed food of aphids and coccids (*Scymnus ferrugatus*, *Chilocorus renipustulatus* and *Exochomus quadripustulatus*) totally accounted for 11.6% of the sampled material. A minute contribution (1.5%) was observed of *Stethorus punctillum*, the only *Coccinellidae* species feeding on mites. Both in the linden-oak-hornbeam forests as well as in the thermophilous oak forests the latter species occurred solely on stands in the vicinity of mixed pine forests or on stands bearing traits of such a habitat (the Cyganka reserve, the linden-oak-hornbeam forest at Radziejowice, the Hryniewiecki reserve). As regards phyto-

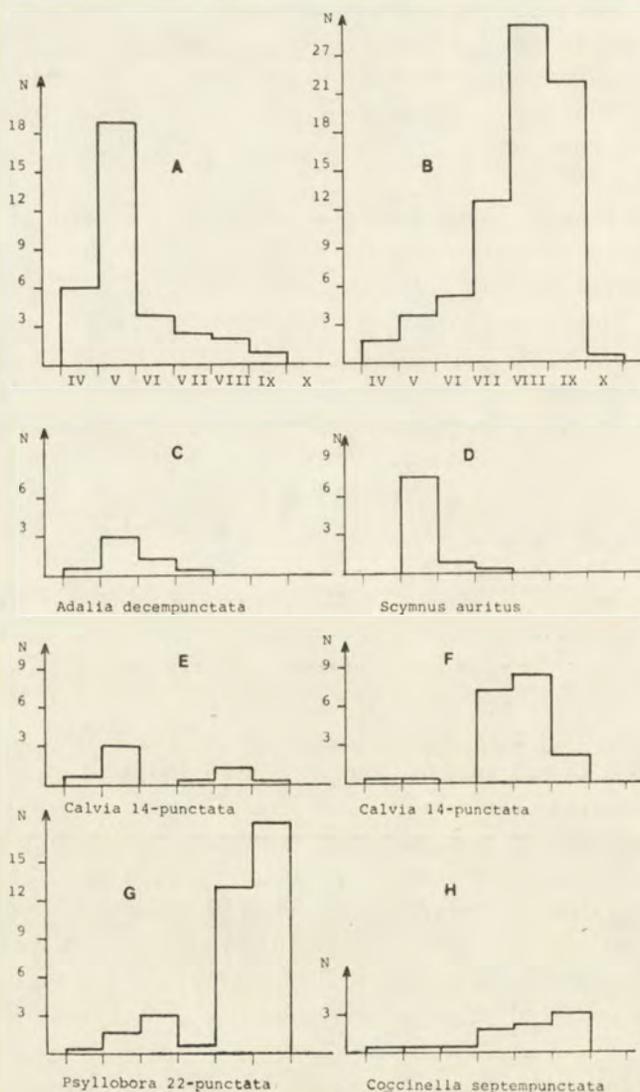


Fig. 3. Seasonal changes in *Coccinellidae* abundance in the thermophilous oak forests. Symbols as in Fig. 2.

phagous ladybirds the species noted to occur in the studied oak forests included *Subcoccinella vigintiquatuorpunctata* feeding on plants of the families *Papilionaceae*, *Caryophyllaceae*, *Asteraceae*, and *Chenopodiaceae* (TANASIJEVIC 1958, KLAUSNITZER, KLAUSNITZER 1979), and mycophagous *Tytthaspis sedecimpunctata* and *Psyllobora vigintiduopunctata* (TURIAN 1969). The only species abounding in the studied oak forests was *Psyllobora vigintiduopunctata*. These ladybirds (both imagines and larvae) occurred numerously in the Hryniewiecki reserve, yet only in the first season of studies, which was exceptionally dry and hot. In the next year, which had a greater amount of precipitation, only single individuals were sampled. The oak forest in the Hryniewiecki reserve is situated on an area of a low level of ground water. A period of drought bringing about an additional loss of water and causing plant weakness, seems to cause favourable conditions for a mass development of the powdery mildews and, consequently, mycophagous *Coccinellidae*. Under similar conditions an unusually abundant occurrence of *Tytthaspis sedecimpunctata* was observed on a moist meadow (*Arrhenatheretum medioeuropaeum*) located on an area of a low level of ground water during a hot and dry summer (CZECZOWSKA in press).

Seasonal changes in *Coccinellidae* abundance in the thermophilous oak forests had, on the whole, a course much resembling that in the linden-oak-hornbeam forests. In the canopy layer the most numerous occurrence of ladybirds was observed in May, while in the herb layer their greatest abundance was recorded in August and September (Fig. 3).

#### RECAPITULATION

In the studied linden-oak-hornbeam and the thermophilous oak forests on Mazovia, a total of 24 *Coccinellidae* species was recorded, including 16 species common to both habitats. The index of qualitative similarity of the *Coccinellidae* fauna in the linden-oak-hornbeam forests and the thermophilous oak forests was high and amounted to 80%. A strikingly close similarity was observed of communities in the canopy layers. In both types of the studied habitats a similar number of species as well as a mean community abundance was recorded. Qualitative similarity of the communities in the canopy layers of the linden-oak-hornbeam and the thermophilous oak forests amounted to 86%, while the index of similarity in dominance structures of communities — to 0.78. Both in the linden-oak-hornbeam and the oak forests the species most numerous in the communities were *Adalia decempunctata*, *Calvia quatuordecimpunctata* and *Scymnus auritus*. As compared to the linden-oak-hornbeam forests, the *Coccinellidae* communities of the thermophilous oak forests were distinct for a smaller average abundance of *Adalia decempunctata* and greater

of *Scymnus auritus* and *Calvia decempunctata*. Average abundance of *Calvia quatuordecimpunctata* was the same in the two habitats.

In the herb layer of the thermophilous oak forests there were recorded 5 *Coccinellidae* species more than in the linden-oak-hornbeam forests. Also the mean abundance of the former communities was slightly higher than in the linden-oak-hornbeam forests. Qualitative similarity of communities of the two habitats amounted to 64 %, while the index of similarity of community dominance structure — 0.50. In the herb layer of the linden-oak-hornbeam forests the greatest mean abundance was recorded of *Calvia quatuordecimpunctata* and *Coccinella septempunctata*, while in the thermophilous oak forests — of *Psyllobora vigintiduopunctata* and *Calvia quatuordecimpunctata* (Tab. II). Both in the linden-oak-hornbeam forests and the thermophilous oak forests the greatest number of species and individuals belonged to the Palaearctic element. The contribution of the remaining elements (cosmopolitan, Holarctic, Euro-Siberian and European) was small.

Among *Coccinellidae* inhabiting the linden-oak-hornbeam forests politopes of forested areas prevailed. These ladybirds inhabiting mainly the canopy and shrub layers, accounted for a half of the sampled material. Poorer in species though equally numerous was the group of ubiquitous species. The species bound to the herb layer had merely a slight share in the studied communities. In the *Coccinellidae* communities of the linden-oak-hornbeam forests, the most abundant were the species shade-loving and hygrophilous (Tab. VII).

Also a majority of species living in the canopy and shrub layers of the thermophilous oak forests belonged to the group of politopes inhabiting forested areas. However the abundance of this group was two times smaller than that of ubiquitous *Coccinellidae*. As compared to the linden-oak-hornbeam forests, in the thermophilous oak forests a greater number of individuals belonged to oligotopic group and species bound to the herb layer. Also thermophilous and xerophilous species were more abundant both as regards the number of species and the number of individuals. Among the represented trophic groups, both in the linden-oak-hornbeam and oak forests, a majority of species (and individuals) ranked among aphidophages. Locally in the oak forests one mycophagous species (*Psyllobora vigintiduopunctata*) occurred numerously (Tab. VII).

While analyzing the *Coccinellidae* material sampled in the linden-oak-hornbeam forests attention should be paid to the effect of the vicinity of pine forests on the species composition of the communities. Vast and well preserved stands of linden-oak-hornbeam forests are hardly to be found on the Mazovian Lowland nowadays. The areas once overgrown with these fertile forests have, in most cases, been turned into ploughland. The preserved patches of linden-oak-hornbeam forests on Mazovia frequently neighbour upon pine forests, which develop on less fertile types of soil. It happens that the former, due to man's activity, become modified toward pine forests.

The presence of pine trees enriches *Coccinellidae* fauna in species biologically bound to this species of tree. Hence the collected material comprised *Myrrha octodecimguttata* and particularly numerous *Anatis ocellata*. The effect of adjacent pine forests was also seen in the occurrence in the studied communities of thermophilous and xerophilous *Coccinellidae*, such as *Scymnus auritus* and *Coccinula quatuordecimpustulata*.

Thermophilous oak forests are habitats which are a transition link between linden-oak-hornbeam forests and coniferous forests (MATUSZKIEWICZ 1981). Since they occupy areas drier than linden-oak-hornbeam forests, and, moreover, their tree stand may contain an admixture of pine trees, hence the recorded occurrence in these forests of *Coccinellidae* characteristic for pine forests is well accounted for.

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## STRESZCZENIE

[Tytuł: *Coccinellidae* (*Coleoptera*) grądów i dąbrów świetlistych Mazowsza]

W czterech zbadanych lasach grądowych (*Tilio-Carpinetum*) Mazowsza stwierdzono łącznie 19 gatunków biedronek (od 9 do 15 w poszczególnych lasach). Podobieństwo jakościowe zgrupowań (wg SÖRENSENA) wynosiło od 52 do 77%. W warstwie koron drzew dominował na ogół *Adalia decempunctata*. Współdominantami lub subdominantami były *Coccinella septempunctata*, *Calvia quatuordecimpunctata*, *C. quatuordecimguttata*, *Scymnus auritus* i, wyjątkowo, *Anatis ocellata*. W warstwie runi do najliczniejszych gatunków należały *Calvia quatuordecimpunctata* i *Coccinella septempunctata*. Biedronki te były dominantami lub współdominantami zgrupowań we wszystkich badanych lasach. Na niektórych stanowiskach liczniej występowały ponadto *Coccinula quatuordecimpustulata* i *Subcoccinella vigintiquatuorpunctata*, a także zalatujący z koron drzew — *Adalia decempunctata*. Wskaźniki podobieństwa struktur dominacyjnych (wg MORISITY) zgrupowań z poszczególnych lasów były dość zróżnicowane. Dla koron drzew wynosiły 0,57-0,77, a w warstwie runi 0,47-0,82.

W trzech zbadanych dąbrowach świetlistych (*Potentillo albae-Quercetum*) odłowiono ogółem 22 gatunki *Coccinellidae* (od 11 do 20 na poszczególnych stanowiskach). W koronach drzew do gatunków dominujących należały *Scymnus auritus*, *Adalia decempunctata*, *Calvia decemguttata* i *C. quatuordecimpunctata*. W runi dominantami o przeważającej liczebności były *Calvia quatuordecimpunctata* lub *Psyllobora vigintiduopunctata*. Wśród pozostałych gatunków do liczebniejszych należały *Coccinella septempunctata* i, lokalnie, *Chilocorus renipustulatus*. Wskaźniki podobieństwa struktur dominacyjnych porównywanych zgrupowań w koronach drzew wynosiły 0,30-0,88, a w runi 0,33-0,99.

Średnie wskaźniki liczebności zgrupowań biedronek w lasach grądowych wynosiły 0,0234 (korony drzew) i 0,111 (runi), a w dąbrowach świetlistych 0,0182 (korony drzew) i 0,161 (runi).

Lasy grądowe i dąbrowy świetliste zasiedlał w zasadzie ten sam zespół gatunków. Wskaźnik podobieństwa całkowitych składów gatunkowych tych

środowisk wynosił 80%. Również pod względem struktury zoogeograficznej i ekologicznej zgrupowania *Coccinellidae* z obu zespołów leśnych miały wiele cech wspólnych. Główną część zgrupowań stanowiły gatunki (i osobniki) palearktyczne, politopowe leśne oraz ubikwistyczne o szerokim rozmieszczeniu poziomym i pionowym.

## РЕЗЮМЕ

[Заглавие: *Coccinellidae* (Coleoptera) грудов и дубрав Мазовии]

В четырех исследованных лесах типа гряда (*Tilio-Carpinetum*) констатировано всего 19 видов божьих коровок (с 9 до 15 в отдельных лесах). Качественное сходство сообществ (по Серенсену) составляло от 52 до 77%. В ярусе крон деревьев обычно доминировал *Adalia decempunctata*. Субдоминантами были *Coccinella septempunctata*, *Calvia quatuordecimpunctata*, *C. quatuordecimguttata*, *Scymnus auritus* и, в виде исключения, *Anatis ocellata*. В ярусе травянистого покрова к наиболее многочисленным принадлежали *Calvia quatuordecimpunctata* и *Coccinella septempunctata*. Эти виды были доминантами или субдоминантами сообществ во всех исследованных лесах. Кроме того на некоторых станциях более многочисленно встречались *Coccinula quatuordecimpustulata* и *Subcoccinella vigintiquatuorruptata*, а также залетающий из крон деревьев *Adalia decempunctata*. Показатели сходства структуры доминации (по Морисити) сообществ из отдельных лесов были довольно дифференцированы. Для крон деревьев составляли 0,57–0,77, в травянистом покрове 0,47–0,82.

В трех исследованных дубравах (*Potentillo albae-Quercetum*) отловлено в общем 22 вида *Coccinellidae* (от 11 до 20 на отдельных станциях). В кронах деревьев к доминирующим видам относились *Scymnus auritus*, *Adalia decempunctata*, *Calvia decemguttata* и *C. quatuordecimpunctata*. В травянистом покрове доминантами были *Calvia quatuordecimpunctata* или *Psyllobora vigintiduorruptata*. Среди остальных видов к более многочисленным принадлежали *Coccinella septempunctata* и местами *Chilocerus renipustulatus*. Показатели сходства структуры доминации сравниваемых сообществ в кронах деревьев составляли 0,30–0,88; в травянистом покрове 0,33–0,99.

Средние показатели численности сообществ божьих коровок в липово-грабовых лесах составляли 0,0234 (кроны деревьев) и 0,111 (травянистый покров); в дубравах — 0,0182 (кроны деревьев) и 0,161 (травянистый покров).

Как леса типа гряда, так и дубравы населяло в принципе одно и то же сообщество видов. Показатель сходства всего видового состава этих био-

топов составлял 80%. С точки зрения зоогеографической и экологической структуры *Coccinellidae* из обеих лесных ассоциаций имели много общих признаков. Основную часть сообществ составляли палеарктические виды (и особи), политопные лесные или убиквисты характеризующиеся широким горизонтальным и вертикальным размещением.

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