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Neuropterans (*Neuropteroidea*) of linden-oak-hornbeam and thermophilous oak forests of the Mazovian Lowland

[With 6 tables and 7 figures in the text]

Abstract. In 1976–1984 entomofaunistic studies were carried out in linden-oak-hornbeam forests (*Tilio-Carpinetum*) and thermophilous oak forests (*Potentillo albae-Quercetum*) on the Mazovian Lowland. The habitats were examined with regard to species compositon, phenology, abundance, and community structure of neuropterans. Moreover the material was subject to zoogeographical and ecological analysis.

INTRODUCTION

Fertile linden-oak-hornbeam forests and thermophilous oak forests covered in the past vast area of the Mazovian Lowland. Presently they have been limited to small enclaves amidst ploughlands and pine forests. The aim of the present work was to study the fauna of *Neuropteroidea* in some preserved plots of these habitats with respect to its number of species, phenology, abundance, community structure, and ecological requirements.

The paper is a successive work dealing with neuropterans of the Mazovian Lowland. The former studies (CZECHOWSKA 1981, 1986) concerned neuropterans of the Warsaw urban greens spreading in habitats of potential linden-oak-hornbeam forest (*Tilio-Carpinetum*).

TIME AND AREAS OF STUDIES

Sampling was carried out in four linden-oak-hornbeam forests and three thermophilous oak forests in 1976–1984. The examination period of particular forests totalled two years, only in exceptional cases it was shortened to one year or prolonged to three years (Radziejowice).

Linden-oak-hornbeam forests

1. Dębina reserve (1980–1981). The forest spread near the locality of Klembów. An oak-hornbeam three stand. A peculiar trait of the tree stand layer was almost a complete absence of lindens. Apart from patches of a typical linden-oak-hornbeam forest there also occurred in places (in land hollows) plots of a low (humid) linden-oak-hornbeam forest (*Tilio-Carpinetum stachyetosum*).

2. Cyganka reserve (1979–1980). Located on the area of the Kampinoski National Park near the locality of Truskaw. A small plot of a linden-oak-hornbeam forest surrounded with pine forests. An oak-hornbeam tree stand with a slight admixture of birches, elms, and lindens. The studied site bordered on the north on a marshy land depression, grown with a small transition bog.

3. Modrzewina reserve (1981–1982). The forest situated near the locality of Belsk Duży. A linden-oak-hornbeam tree stand with an admixture of larches (*Larix polonica*), their huge specimens towering over the other trees.

4. Radziejowice (1976–1978). A forest complex within the Jaktorowska Forest near the locality of Radziejowice. Apart from plots of plant composition typical of a linden-oak-hornbeam forest, the studied forest also included patches of tree stand with an admixture of pine trees. The examined site was located about 250 m from the river bed of a small rivulet Pisia-Gągolina, separated from it by a narrow strip of a low humid linden-oak-hornbeam forest.

Thermophilous oak forests

1. King Jan III Sobieski reserve (1980–1981). The small plot of an oak forest located on Warsaw suburbs in the locality of Marysin Wawerski. The tree stand was composed mainly of oaks and individual lindens and hornbeams.

2. Bolesław Hryniewiecki reserve (1983–1984). The plot of an oak forest in Podkowa Leśna. The oak tree stand with an admixture of pine trees.

3. Radziejowice (1984). The well preserved plot of an oak forest within the Jaktorowska Forest near the locality of Radziejowice. The oak tree stand with a slight admixture of birches, lindens, hornbeams, and pine trees.

A detailed geobotanical description of the examined forests is supplied in the introductory paper (Kotowska, Nowakowski 1989).

METHODS AND MATERIAL

The main sampling method were Moericke yellow pan traps (Moericke 1950) hung in the canopy layer. Moreover, supplementary sampling methods were also applied, such as shaking of tree branches and net-sweeping in the herb layer (Bańkowska, Garbarczyk 1989).

The Moericke traps were hung, according to the species composition of the three stand, on lindens (*Tilia cordata*), hornbeams (*Carpinus betulus*), oaks (*Quercus* sp.), elms (*Ulmus* sp.), and pine trees (*Pinus silvestris*). In particular forests usually 9 traps were hung, three at each of the three previously appointed tree species; only in the Cyganka and B. Hryniewiecki reserves the traps were placed on trees of four species. The material assigned for analyses came from two traps from every tree species. Sampling was performed since April till November. In 1976–1980 the traps were emptied every five and ten days; later on — every seven days. A total of 4419 imagines of *Neuropteroidea* was trapped; 3511 in the linden-oak-hornbeam forests and 908 in the thermophilous oak forests.

The method of tree branch shaking was applied in the Dębina, Modrzewina and Kind Sobieski reserves in 1981. This method turned out in total 179 larvae and 32 mature individuals. Among larvae the dominating was *Chrysotropia ciliata*, while imagines belonged to 6 species: *Chrysoperla carnea* (8 individuals), *Hemerobius humulinus* (8 individuals), *H. micans* (7 individuals), *Micromus angulatus* (4 individuals), *Chrysotropia ciliata* (4 individuals), and *Nineta flava* (1 individual).

Net-sweeping in the herb layer was performed in the same plots and in the same year as tree branch shaking. The swept samples yielded a total of 38 individuals identified to 6 species. The species most frequently netted in the herb layer were *Chrysoperla carnea* (16 individuals) and *Micromus angulatus* (9 individuals); the remaining were singular individuals of *Hemerobius humulinus, H. micans, Nineta flava,* and *Chrysopa perla*.

Since the material of imagines acquired by the supplementary methods was quantitatively and qualitatively scanty, it was disregarded in subsequent analyses. Thus the characteristic of neuropteran communities in the examined habitats was based solely on the material turned out by the Moericke yellow pan traps. The community abundance was expressed by the number of individuals trapped in 1 pan in 24 h. Insects were determined after the key provided by Aspöck, Aspöck and Hölzel (1980).

RESULTS

Linden-oak-hornbeam forests

Species composition, abundance and structure of communities

In this habitat a total of 28 species of *Neuropteroidea* was sampled (Tab. I). In particular forests 10–19 species were trapped. The smallest number of species was noted in the community of the Dębina reserve. The tree stand of this forest, composed mainly of oaks and hornbeams, provided fairly homogeneous habitat conditions in the canopy layer. Furthermore, a part of this forest was constitued of

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

No	Species \ Habitats / Plots	Linden-oak-hornbeam forests (*Tilio-*					
		Dębina res.		Cyganka res.		Modrzewina res.	
		n	%	*n*	%	*n*	%
	Raphidiidae						
1	*Raphidia notata* FABR.	—	—	+	+	0.005	1.2
2	*Raphidia major* BURM.	—	—	—	—	0.002	0.5
3	*Raphidia flavipes* STEIN	—	—	—	—	—	—
4	*Raphidia xanthostigma* SCHUMM.	—	—	+	+	—	—
	Coniopterygidae						
5	*Coniopteryx tineiformis* CURT.	—	—	+	+	0.001	0.2
6	*Coniopteryx borealis* TJED.	—	—	—	—	—	—
7	*Coniopteryx parthenia* NAVAS et MARCET	—	—	—	—	—	—
8	*Coniopteryx haematica* MCLACHLAN	—	—	—	—	—	—
9	*Semidalis aleyrodiformis* STEPH.	—	—	—	—	—	—
10	*Conventzia psociformis* CURT.	—	—	—	—	0.002	0.5
	Hemerobiidae						
11	*Drepanopteryx phalaenoides* L.	—	—	—	—	+	+
12	*Wesmaelius concinnus* (STEPH.)	—	—	—	—	+	+
13	*Wesmaelius quadrifasciatus* (REUT.)	—	—	—	—	0.003	0.7
14	*Wesmaelius nervosus* (FABR.)	—	—	—	—	—	—
15	*Hemerobius humulinus* L.	0.007	3.2	0.020	10.3	0.010	2.3
16	*Hemerobius stigma* STEPH.	—	—	—	—	—	—
17	*Hemerobius atrifronts* MCLACHLAN	—	—	—	—	0.003	0.7
18	*Hemerobius nitidulus* FABR.	—	—	—	—	—	—
19	*Hemerobius micans* OLIV.	0.002	0.9	0.001	0.5	0.003	0.7
20	*Hemerobius marginatus* STEPH.	—	—	+	+	—	—
21	*Micromus angulatus* (STEPH.)	—	—	+	+	+	+
22	*Sympherobius pygmaeus* (RAMB.)	—	—	—	—	—	—
23	*Sympherobius klapaleki* ZEL.	0.001	0.5	+	+	—	—
	Chrysopidae						
24	*Nineta flava* (SCOP.)	0.056	25.7	0.040	20.6	0.185	42.7
25	*Nineta vittata* (WESM.)	0.004	1.8	0.003	1.5	0.019	4.4
26	*Nineta inpunctata* (REUT.)	—	—	0.001	0.5	—	—
27	*Chrysotropia ciliata* (WESM.)	0.089	40.8	0.073	37.6	0.116	26.8
28	*Chrysopa perla* (L.)	+	+	—	—	—	—
29	*Chrysopa septempunctata* WESM.	0.003	1.4	0.003	1.5	0.029	6.7
30	*Anisochrysa flavifrons* (BRAU.)	—	—	—	—	—	—
31	*Anisochrysa prasina* (BURM.)	0.006	2.8	0.011	5.7	0.008	1.9
32	*Anisochrysa ventralis* (CURT.)	—	—	+	+	0.001	0.2
33	*Chrysoperla carnea* (STEPH.)	0.050	22.9	0.042	21.6	0.046	10.6
34	*Cunctochrysa albolineata* (KILL.)	—	—	—	—	—	—
	Total	0.218		0.194		0.433	

the *Tilio-Carpinetum* and the *Potentillo albae-Quercetum* forests of the Mazovian Lowland
+ — $n<0.001$)

Carpinetum				Light oak forests (*Potentillo albae-Quercetum*)							
Radziejowice		Total		King Sobieski res.		B. Hryniewiecki res.		Radziejowice		Total	
n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
0.002	0.3	0.002	0.5	0.001	0.6	0.002	1.3	—	—	0.001	0.7
—	—	+	+	+	+	—	—	—	—	+	+
—	—	—	—	—	—	+	+	—	—	+	+
—	—	+	+	—	—	+	+	—	—	+	+
0.004	0.6	0.001	0.3	—	—	—	—	—	—	—	—
+	+	+	+	—	—	—	—	—	—	—	—
+	+	—	—	—	—	+	+	—	—	+	+
0.002	0.3	+	+	—	—	+	+	—	—	+	+
+	+	+	+	+	+	0.004	2.5	—	—	0.002	1.4
—	—	+	+	+	+	0.004	2.5	—	—	0.002	1.4
0.001	0.2	+	+	—	—	+	+	—	—	+	+
0.002	0.3	+	+	+	+	0.006	3.8	—	—	0.002	1.4
—	—	0.001	0.3	—	—	—	—	—	—	—	—
+	+	+	+	—	—	—	—	0.001	0.8	+	+
0.009	1.4	0.012	3.2	0.016	10.2	0.003	1.9	0.005	4.1	0.008	5.5
—	—	—	—	—	—	+	+	—	—	+	+
—	—	0.001	0.3	—	—	—	—	—	—	—	—
—	—	—	—	—	—	+	+	—	—	+	+
—	—	0.001	0.3	0.003	1.9	+	+	—	—	0.001	0.7
—	—	+	+	—	—	—	—	—	—	—	—
0.005	0.8	0.001	0.3	—	—	—	—	—	—	—	—
—	—	—	—	+	+	—	—	—	—	+	+
+	+	+	+	0.001	0.6	0.003	1.9	—	—	0.001	0.7
0.016	2.4	0.074	19.6	0.103	65.6	0.026	16.6	0.015	12.4	0.048	33.1
0.009	1.4	0.009	2.4	0.004	2.5	0.004	2.5	0.013	10.7	0.007	4.8
—	—	+	+	—	—	—	—	—	—	—	—
0.156	23.7	0.109	29.0	0.018	11.4	0.025	15.9	0.012	10.0	0.018	12.4
—	—	+	+	—	—	—	—	—	—	—	—
0.002	0.3	0.009	2.4	+	+	0.001	0.6	0.001	0.8	0.001	0.7
—	—	—	—	—	—	+	+	—	—	+	+
0.194	29.4	0.055	14.6	+	+	0.042	26.8	0.012	10.0	0.018	12.4
—	—	+	+	—	—	0.004	2.5	0.001	0.8	0.002	1.4
0.232	35.2	0.093	24.7	0.011	7.0	0.029	18.5	0.060	49.6	0.033	22.7
0.024	3.6	0.008	2.1	—	—	0.003	1.9	0.001	0.8	0.001	0.7
0.659		0.376		0.157		0.157		0.121		0.145	

a low (humid) linden-oak-hornbeam forest growing in a trough-shaped land hollow, whose cool and humid microclimate was propitious only to few neuropteran species. Although very similar climatic conditions prevailed in the plot of the linden-oak-hornbeam forest in the Cyganka reserve, yet more species (16) were recorded to occur there, which, most likely, resulted from a peculiar location of the studied site. The examined forest plot grew on a dune slope, bordering on a marshy bog at the foot of the dune and on pine forests at the top, the warm microclimate of the latter affecting, to a certain degree, the adjacent linden-oak-hornbeam forest. Most likely it was the neighbourhood of pine forests that favoured the occurrence of a very rare species *Nineta inpunctata*, reported from this plot. The Cyganka reserve is the second place in Poland from where this species has been reported. It was first recorded to occur in the presently discussed linden-oak-hornbeam forest at Radziejowice[1], which also bordered on coniferous forests and was conspicuous for an admixture of pine trees. *Nineta inpunctata* was reported from few sites in Europe and its ecology is little known. It was always sampled in warm habitats, among others, in warm oak-pine forests (Aspöck, Aspöck, Hölzel 1980).

Table II. Qualitative similarity (after the Sörensen formula) and similarity of dominance structure (the Morisita index) of the communities of *Neuropteroidea* in the *Tilio-Carpinetum* and *Potentillo albae-Quercetum* forests of the Mazovian Lowland

		Tilio-Carpinetum				*Potentillo albae-Quercetum*		
		Dębina res.	Cyganka res.	Modrzewina res.	Radziejowice	King Sobieski res.	B. Hryniewiecki res.	Radziejowice
Tilio-Carpinetum	Dębina res.	—	0.98	0.89	0.69	0.63	0.70	0.61
	Cyganka res.	72	—	0.84	0.73	0.58	0.74	0.67
	Modrzewina res.	60	70	—	0.43	0.88	0.64	0.49
	Radziejowice	57	68	65	—	0.19	0.86	0.83
Potentillo albae-Quercetum	King Sobieski res.	72	65	73	65	—	0.47	0.59
	B. Hryniewiecki res.	55	62	63	67	63	—	0.69
	Radziejowice	70	62	57	62	56	55	—

Relatively the greatest numbers of neuropteran species were noted to occur in the Modrzewina reserve and in Radziejowice, i.e., in the forests of more diversified habitat conditions owing to an admixture of coniferous trees. Due to the presence of

[1] It was described in a former paper (Czechowska 1986); the stand where the species was found was called Hamernia.

larches or pine trees, fauna of these plots was enriched by such species as *Hemerobius atrifrons* and *Wesmaelius quadrifaciatus* (in the Modrzewina reserve) and *Wesmaelius concinnus* (in Radziejowice). Moreover, coniferous trees improve thermic conditions of these habitats as their light-pervious canopies let more sunshine in the forest, what, in turn, promotes the occurrence of thermophilous species. Thus abundance of the communities of *Neuropteroidea* in these forests was considerably greater.

Qualitative similarity of particular communities was fairly high. The values of the Sörensen index ranged from 57 to 72% (Tab. II). The least similar were the neuropteran communities of the Dębina reserve and Radziejowice, i.e., from the forests extremely different in their habitat diversity and, consequently, in a species richness of neuropterans. The pairs of the communities of *Neuropteroidea* from the other plots were marked for resembling values of the qualitative similarity index.

In order to estimate constancy of occurrence of particular species, the use was made of the Tischler's scale (Trojan 1975), according to which the following groups of species were distinguished: absolutely constant species of frequency (C) amounting to 100–76%, constant species ($C=75$–51%), accessorial species ($C=50$–26%), and accidental ones ($C=25$–0%).

In the examined forests the absolutely constant species ($C=100\%$) included: *Hemerobius humulinus, Nineta flava, N. vittata, Chrysotropia ciliata, Chrysopa septempunctata, Anisochrysa prasina*, and *Chrysoperla carnea*. The constant elements of fauna were *Raphidia notata, Coniopteryx tineiformis, Hemerobius micans, Micromus angulatus*, and *Sympherobius klapaleki*. The group of accessorial species was made up of *Wesmaelius concinnus, Drepanopteryx phalaenoides, Nineta inpunctata*, and *Anisochrysa ventralis*. The remaining 12 species ranked among the accidental element.

The mean index of neuropteran abundance in the linden-oak-hornbeam forests amounted to 0.376 (Tab. I). The least abundant were the communities from the Dębina and Cyganka reserves (0.194 and 0.218, respectively). About twice more abundant was the community from the Modrzewina reserve, while that from Radziejowice — three times more abundant.

Considering the whole material, the most numerous species were: *Chrysotropia ciliata* (29.0%), *Chrysoperla carnea* (24.7%), *Nineta flava* (19.7%), and *Anisochrysa prasina* (14.6%). The first three species usually ranked among dominants or subdominants of particular communities. *A. prasina*, however, occurred numerously only in Radziejowice, i.e., in the forest, which, in places, betrayed features of a pine forest habitat. As regards the remaining species, a slightly more numerous occurrence was locally recorded of *Hemerobius humulinus* (in the Cyganka reserve) as well as of *Nineta vittata* and *Chrysopa septempunctata* (in the Modrzewina reserve) (Tab. I).

It was observed in the neuropteran communities of the examined forests that 3–4 species (usually the same) considerably outnumbered the others in the association. Therefore the degree of dominance structure similarity (according to the Morisita formula) of the examined communities was, in most cases, very high. The greatest values of the index (from 0.84 to 0.98) were estimated for the communities of the

Dębina, Cyganka, and Modrzewina reserves. Their dominating species were: *Chrysotropia ciliata*, *Nineta flava* and *Chrysoperla carnea* (Tab. II). Less similar were the dominance structures of the communities of the three above mentioned plots and that of the community from Radziejowice. The essential difference between them was the absence of mesohygrophilous and shade-loving *Nineta flava* among the dominants in Radziejowice, whose place was taken by the photo- and thermophilous *Anisochrysa prasina* (Tabs I, II).

The dominance structures of the neuropteran communities of the Dębina, Cyganka, and Modrzewina reserves may be considered as typical of linden-oak-hornbeam forest on the Mazovian Lowland. Their characteristic trait was a large contribution of megahygrophilous *Chrysotropia ciliata* and mesohygrophilous *Nineta flava*, i.e., the species best adopted to the climatic conditions of this habitat. The plot at Radziejowice had features of a linden-oak-hornbeam forest and a mixed coniferous forest at the same time. It was reflected in a large contribution of *Chr. ciliata* to the community of this plot, i.e., of a stenotopic species bound to humid forests, as well as in an equally high contribution of *A. prasina* and an almost complete absence of *N. flava*, which, in turn, was characteristic of neuropteran communities from warm and dry coniferous forests (Czechowska 1985).

Thermophilous oak forests

Species composition, abundance, and structure of communities

In this habitat the studies were conducted for a shorter time and at a smaller number of plots. Moreover, one of the study seasons (in 1984) was particularly disadvantageous due to unfavourable weather conditions, and, therefore, samplings performed then (in the B. Hryniewiecki reserve and at Radziejowice) turned out very scanty material. For this reason the obtained picture of *Neuropteroidea* communities may be slightly impoverished in its quantitative and qualitative aspect, as compared to the potential of the habitat.

Twenty six neuropteran species were distinguished in the sampled material. The greatest number of species (23) occured in the community from the B. Hryniewiecki reserve, the communities from the King Sobieski reserve and at Radziejowice being much poorer in this respect (15 and 10 species, respectively) (Tab. I). The degree of qualitative similarity of the communities ranged from 55 to 63%. The common and absolutely constant species included, similarly as in the linden-oak-hornbeam forests, *Hemerobius humulinus, Nineta flava, N. vittata, Chrysotropia ciliata, Chrysopa septempunctata, Anisochrysa prasina, and Chrysoperla carnea.*

The mean index of neuropteran abundance in thermophilous oak forests was rather low, amounting to 0.145. Abundance of particular communities approximated the index mean value (Tab. I). On the whole, the dominating species were: *Nineta flava* (33.1%), *Chrysoperla carnea* (22.7%), *Chrysotropia ciliata* (12.4%), and *Anisochrysa prasina* (12.4%). Among the remaining species only *H. humulinus* and *N. vittata* had a slightly greater contribution (Tab. I).

The contribution of the first four neuropteran species to the communities in particular plots differed markedly. In the King Sobieski reserve of almost a homogeneous oak tree stand, *Nineta flava* prevailed, accounting for as much as 65.6% of the sampled individuals. The B. Hryniewiecki reserve, marked for a greater habitat mosaic, was noted for a more even structure of the neuropteran community, the prevailing species being: *Anisochrysa prasina, Chrysoperla carnea, Nineta flava,* and *Chrysotropia ciliata* (Tab. I). Also the same species made up the dominant group in the oak forest at Radziejowice, however, the most numerous there was *Chr. carnea.* As a rule this eurytopic species prevailed among neuropterans of the studied oak forests (and linden-oak-hornbeam forests as well) in years of unfavourable weather conditions. In the cool season of 1984, *Chrysoperla carnea* dominated also in the community from the B. Hryniewiecki reserve.

From the comparison of neuropteran dominance structures in particular linden-oak-hornbeam forests and thermophilous oak forests it follows that in a great deal of instances they were very similar. Particularly high values of the Morisita index were estimated for the communities of the oak forest in the King Sobieski reserve and the linden-oak-hornbeam forest in the Modrzewina reserve (0.88), the oak forest in the B. Hryniewiecki reserve and the linden-oak-hornbeam forest at Radziejowice (0.86), and the oak and linden-oak-hornbeam forests at Radziejowice (0.83). The first pair of communities was conspicuous for a notable contribution of *Nineta flava*, the other two were marked for a large contribution of *Anisochrysa prasina, Chrysoperla carnea* and *Chrysotropia ciliata.*

Generally, among the analyzed communities of *Neuropteroidea* of the linden-oak-hornbeam and the thermophilous oak forests there may be distinguished three variants of dominance structures. Each of these variants was noted for a large contribution of a different species which had specific thermic and humidity requirements. These species were at the same time indicators of habitat conditions in a given site. In the most humid linden-oak-hornbeam forests (Dębina, Cyganka reserves) *Chrysotropia ciliata* dominated, in shady yet little humid forests—*Nineta flava* (Modrzewina and King Sobieski reserves), in light-penetrated, dry forests with an admixture of pine trees—*Anisochrysa prasina* prevailed (linden-oak-hornbeam forest at Radziejowice, oak forest in the B. Hryniewiecki reserve).

Zoogeographical notes

The neuropteran species of the examined linden-oak-hornbeam and thermophilous oak forests on the Mazovian Lowland were identified to represent the following zoogeographical elements: cosmopolitan, Holarctic, Palaearctic, Euro-Siberian, European, and Mediterranean (according to Czechowski and Mikołajczyk 1981) (Tab. III).

A general outline of zoogeographical structure of *Neuropteroidea* fauna of the two habitats was much the same. The richest with species and the most numerous was the Euro-Siberian element, which constituted the core of all the communities.

A large quantitative contribution of this group, accounting for over 50% of mean abundance of communities from the examined habitats, resulted from the attachment to this group of *Chrysotropia ciliata* and *Nineta flava.* The second abundant was the cosmopolitan element, represented solely by *Chrysoperla carnea.* The contribution of this species to the communities in the linden-oak-hornbeam and the oak forests accounted for 23–25% of mean abundance. Palaearctic species, the most abundant being *Anisochrysa prasina*, averaged 17% of the individuals sampled in the linden-oak-hornbeam forests and 14.5% in the thermophilous oak forests. Relatively a little quantitative contribution was noted of neuropterans of Holarctic range (on the average 3.7% in the linden-oak-hornbeam forests and 6.9% in the oak forests), the prevailing species being *Hemerobius humulinus.*

The contribution of European and Mediterranean species in the two habitats was little with respect to the total material, however, it was slightly higher in the oak forests than in the linden-oak-hornbeam forests. As regards the Mediterranean element, the most frequently sampled species was *Sympherobius klapaleki.* It occurred

Table III. Zoogeographical and ecological composition of the *Neuropteroidea* fauna of the *Tilio-Carpinetum* and the *Potentillo albae-Quercetum* forests of the Mazovian Lowland. (N — number of species; *n* — abundance index; % — percentage share in the total abundance of the community)

Criterion	Element	*Tilio-Carpinetum*			*Potentillo albae-Quercetum*		
		N	*n*	%	N	*n*	%
Zoogeography	Cosmopolitan	1	0.093	24.7	1	0.033	22.7
	Holarctic	4	0.014	3.7	3	0.010	6.9
	Palaearctic	3	0.064	17.0	4	0.021	14.5
	Euro-Siberian	13	0.203	54.0	10	0.077	53.1
	European	4	0.002	0.5	2	0.003	2.1
	Mediterranean	3	+	+	6	0.001	0.7
Ecological amplitude	Eurytopic	1	0.093	24.7	1	0.033	22.7
	Polytopic	20	0.171	45.5	19	0.092	63.5
	Oligotopic	1	0.001	0.3	—	—	—
	Stenotopic	6	0.111	29.5	6	0.020	13.8
Plant type	Species associated with deciduous tress	18	0.212	56.4	14	0.081	55.9
	Species associated with deciduous and coniferous trees	7	0.162	43.1	7	0.062	42.8
	Species associated with coniferous tres	3	0.002	0.5	5	0.002	1.3
Moisture requirements	Hygrophilous	4	0.111	29.5	1	0.018	12.4
	Mesohygrophilous	23	0.265	70.5	21	0.125	86.2
	Xerophilous	1	+	+	4	0.002	1.4
Thermal requirements	Termophilous	11	0.072	19.1	15	0.029	20.1
	Others	17	0.304	80.9	11	0.116	79.9

almost in every plot, yet it was most numerous in the oak forest in the B. Hryniewiecki reserve. This oak forest as well as the linden-oak-hornbeam forest in Radziejowice were marked for the most numerous occurrence of the greatest number of small-range species (European and Mediterranean).

Ecological notes

A majority of species of *Neuropteroidea* is habitationally bound to forest areas, where they occur mainly in the bush and canopy layer. With regard to ecological plasticity, the sampled neuropterans were classified as eurytopes, polytopes, oligotopes, and stenotopes (according to Czechowski and Mikołajczyk 1981).

The group of eurytopes, which may occur in various afforested or open habitats, was represented only by *Chrysoperla carnea*. In the examined habitats it accounted, on the average, for 20% in the oak forests and 25% of the whole material in the linden-oak-hornbeam forests (Tab. III). A majority of species sampled in the linden-oak-hornbeam forests and the thermophilous oak forests (over 70%) ranked among polytopes, which may dwell apart from forests, also any other type of afforested areas. These species dominated quantitatively, accounting for 45.5% of individuals trapped in the linden-oak-hornbeam forests and 63.5% in the oak forests. The most abundant species in this group were *Nineta flava, Anisochrysa prasina* and *Hemerobius humulinus*.

The group of oligotopes includes species dwelling open and afforested habitats providing they fulfil certain conditions concerning temperature, humidity, vegetation or others. This element was represented by *Micromus angulatus* sampled in linden-oak-hornbeam forests as well as on moist meadows (*Arrhenatheretum medioeuropaeum*) located in habitats of linden-oak-hornbeam forest on Mazovia.

Stenotopes comprise species characteristic of a certain habitat. In case of humid and cool linden-oak-hornbeam forests such a species was *Chrysotropia ciliata*. Other psychrophilic species were (according to Aspöck, Aspöck, Hölzel 1980) *Hemerobius atrifrons* and *H. marginatus*, yet, contrary to *Chr. ciliata*, they were sampled in the studied linden-oak-hornbeam forests only sporadically.

Species typical of coniferous habitats, namely, *Raphidia flavipes, Coniopteryx parthenia, Wesmaelius concinnus, Hemerobius stigma, H. nitidulus* and, most probably, *Nineta inpunctata* were also included to the group of stenotopes. All these neuropterans occurred only locally, in forests with an admixture of pine trees. Relatively the greatest number of individuals of the above species came from the B. Hryniewiecki reserve, which would imply that it was the site of the warmest microclimate.

As regards moisture requirements, a majority of the sampled species ranked among mesohygrophilous insects. Both in the linden-oak-hornbeam and the oak forests, they accounted for about a half individuals sampled there (Tab. III). Also the hygrophilous element, most abundantly represented by *Chrysotropia ciliata*, contributed highly to the sampled individuals. Other species of this group (i.e., *Hemerobius atrifrons, H. marginatus* and *Micromus angulatus*) were less numerous. On the whole, thermophilous oak forests are a warmer and drier habitat than linden-oak-hornbeam forests. The contribution of *Chr. ciliata* to communities from the oak forests was two times smaller than to those from the linden-oak-hornbeam forests, while the contribution of the less demanding in this respect, mesohygrophilous *Nineta flava* was greater (also about two-fold) in the former habitat.

As to thermic requirements, a broad group was made up of thermophilous species (*Raphidia major, R. flavipes, Coniopteryx haematica, Sympherobius pygmaeus, S. klapaleki*, and *Anisochrysa flavifrons*) and a good deal of wide-range species, yet clearly preferring warmer sites. They included species bound to pine trees (*Wesmaelius concinnus, Hemerobius stigma* and *H. nitidulus*) as well as *Chrysopa septempunctata, Cunctochrysa albolineata, Anisochrysa prasina*, and *A. ventralis*. As to thermic and moisture requirements of *A. ventralis*, it was observed that it occured relatively most frequently (yet never very abundantly) in warm yet not too dry habitats. In the linden-oak-hornbeam forests it was sporadically sampled. A greater number of individuals of this species came from the oak forests, from the B. Hryniewiecki reserve in particular (Tab. I). Ealier studies conducted in coniferous forests (Czechowska 1985) revealed that *A. ventralis* was the most abundant in mixed pine forests (*Pino-Quercetum*), similarly to the related *A. prasina*. In dry pine forests (*Peucedano-Pinetum*) the species was as scarce as in linden-oak-hornbeam forests.

In both examined habitats the thermophilous element accounted for about 20% of the whole material. In the linden-oak-hornbeam forests the greatest number and abundance of thermophilous species was recorded in the plot at Radziejowice, while in the thermophilous oak forests — at the B. Hryniewiecki reserve.

Trophic specialization of *Neuropteroidea* results in the fact that several species are bound to certain plant biotopes or even to specific tree or bush species.

The examined habitats were dwelled mainly by neuropterans feeding on phytophages of deciduous trees and bushes. Fauna of *Neuropteroidea* of the linden-oak-hornbeam forests included 18 species of this category, while that of the thermophilous oak forests — 14 species. In both habitats quantitative contribution of this group was alike and accounted, on the average, for 56% of the sampled individuals, the most abundant species being *Chrysotropia ciliata* and *Nineta flava*.

A large quantitative contribution, in spite of a smaller number of species, was also noted of neuropterans of a wide trophic spectrum, comprising phytophages of coniferous and deciduous trees. The communities from the linden-oak-hornbeam forests as well the thermophilous oak forests comprised 7 species of this trophic guild each, which accounted for 43% individuals. The most abundant neuropterans of this group were *Chrysoperla carnea, Anisochrysa prasina*, and *Hemerobius humulinus*.

Quantitative contribution of species living on coniferous trees was marginal, accounting, on the average, for 0.5% of the whole material from the linden-oak-hornbeam forests and for 1.5% from the oak forests. Neuropterans belonging to this guild were: *Raphidia flavipes, Coniopteryx parthenia, Wesmaelius* *concinnus, W. quadrifasciatus, Hemerobius stigma, H. atrifrons,* and *H. nitidulus.* Relatively the most frequent species from among them, was *W. concinnus.*

Wesmaelius quadrifascius and *Hemerobius atrifrons*, i.e., the species biologically bound to larch tree, should be considered as typical of linden-oak-hornbeam forests as larches are natural constituents of the tree stand in this habitat. An alien element of the fauna of *Neuropteroidea* of these forests, on the other hand, are all the species bound to pine trees, such as *Wesmaelius concinnus, Hemerobius stigma* or *H. nitidulus.*

Table IV. List of species and number of individualis of *Neutopteroidea* caught in habitat studied on three main tree species

No	Species	Species of trees: *Quercus* sp.	*Tilia cordata*	*Carpinus betulus*
		Number of samples		
		5664	5523	5272
1	*Raphidia notata*	7	2	—
2	*Raphidia major*	—	2	—
3	*Raphidia xanthostigma*	1	1	—
4	*Coniopteryx tineiformis*	2	6	1
5	*Coniopteryx borealis*	—	—	1
6	*Coniopteryx parthenia*	—	—	1
7	*Coniopteryx haematica*	2	—	—
8	*Semidalis aleyrodiformis*	3	6	6
9	*Conventzia psociformis*	16	1	—
10	*Drepanopteryx phalaenoides*	—	—	2
11	*Wesmaelius concinnus*	1	—	—
12	*Wesmaelius quadrifasciatus*	—	—	3
13	*Wesmaelius nervosus*	—	2	—
14	*Hemerobius humulinus*	29	51	58
15	*Hemerobius micans*	2	8	15
16	*Micromus angulatus*	1	1	2
17	*Sympherobius pygmaeus*	1	—	—
18	*Sympherobius klapaleki*	13	13	7
19	*Nineta flava*	466	193	236
20	*Nineta vittata*	51	12	20
21	*Nineta inpunctata*	—	2	1
22	*Chrysotropia ciliata*	513	243	341
23	*Chrysopa perla*	—	—	1
24	*Chrysopa septempunctata*	37	6	6
25	*Anisochrysa flavifrons*	2	—	—
26	*Anisochrysa prasina*	548	50	51
27	*Anisochrysa ventralis*	21	—	2
28	*Chrysoperla carnea*	462	188	202
29	*Cunctochrysa albolineata*	14	3	1
	Total	2192	790	957

The presence of these neuropterans characteristic of pine forests was, to a certain degree, justified in case of the thermophilous oak forests. This habitat being an intermediate link between linden-oak-hornbeam forests and coniferous forests, occupies sites drier than the former and has an admixture of pine trees in its tree stand (Matuszkiewicz 1981).

The analysis of the sampled material with respect to the frequency of trapping neuropteran imagines on the main tree species revealed that the greatest number of individuals was caught on oaks. In an approximate number of samples 49.6% of the sampled insects came from oaks, 21.7% — from hornbeams and 17.9% — from lindens. Almost all the species of the most abundant family *Chrysopidae* occurred more numerously on oaks than on hornbeams or lindens. The greatest quantitative disproportion, however, was observed in case of *Anisochrysa prasina*, whose 80% of imagines came from oaks. (Tab. IV).

As an alike tendency for occurring on oaks had also been noted in case of *Coccinellidae* (Czechowska 1989), its reasons seem likely to spring from trophic aspects. Both groups of insects, i.e., *Neuropteroidea* and *Coccinellidae*, rank among predators, mostly aphidophages, while mature *Chrysopidae*, especially of the genus *Anisochrysa*, are melitophages, benefiting by honey-dew.

On the two species of oak growing in Poland (*Quercus robur* and *Q. sessilis*) 11 species of aphids occur, including *Tuberculoides annulatus* (Hgt.) marked for the greatest honey-dew production. On the other hand, only 1 aphid species lives on hornbeams and 2 species — on lindens, including one very rare (Szelęgiewicz 1968). Hence food abundance of oaks is far move than that of hornbeams and lindens, what is of a decisive significance for insects living exclusively in this forest layer and may result in their great abundance there.

Phenology and seasonal changes in abundance

Seasonal dynamics of *Neuropteroidea* of the studied linden-oak-hornbeam forests and the thermophilous oak forests was observed to progress in two periods — the spring and summer one. Since April till the end of June neuropteran communities were not abundant. Samplings performed at that time turned out, apart from common *Chrysoperla carnea*, several rare species, scanty in abundance, of the families *Raphidiidae*, *Coniopterygidae* and *Hemerobiidae*. The summer period, lasting since July till mid-September, brought a vehement abundance increase due to the appearance of numerous species of the family *Chrysopidae* (Figs. 1–4, Tab. V).

The date of appearance of spring and summer generations of neuropterans was subject to certain variations in time due to weather conditions in a given season. As a rule the first species appeared not sooner than in mid-May, i.e., when it warmed up for good. In particularly cool years the date of appearance was noted to depend on microclimatic conditions of a site. It was most palpable in case of the community from the thermophilous oak forest (in the King Sobieski reserve) and the communities from the two linden-oak-hornbeam forests (in the Cyganka and Dębina reserves) in the cool season of 1980. In the oak forest, which was the warmest of these plots, the spring abundance peak of *Neuropteroidea* fell in May, in the Cyganka reserve — in the beginning of June, while in the coldest forest in the Dębina reserve a very small abundance increase was observed only by the end of June (Fig. 1). Consequently, the appearance of summer species was first noted in the oak forest and lastly — in the Dębina reserve.

The neuropteran communities from these three plots were in their greater part constituted by *Nineta flava*. The date of appearance of this species and the length of

Table V. List of species and number of individuals of *Neuropteroidea* caught in particular months

No	Species / Months	IV	V	VI	VII	VIII	IX	X	Total
1	*Raphidia notata*	—	7	17	—	—	—	—	24
2	*Raphidia major*	—	1	3	1	—	—	—	5
3	*Raphidia flavipes*	—	—	1	—	—	—	—	1
4	*Raphidia xanthostigma*	—	2	1	—	—	—	—	3
5	*Coniopteryx tineiformis*	—	6	1	—	2	—	—	9
6	*Coniopteryx borealis*	–	1	—	—	—	—	—	1
7	*Coniopteryx parthenia*	—	1	—	—	—	—	—	1
8	*Coniopteryx haematica*	—	2	—	1	—	—	—	3
9	*Semidalis aleyrodiformis*	—	8	1	1	5	—	—	15
10	*Conventzia psociformis*	—	—	2	3	11	1	—	17
11	*Drepanopteryx phalaenoides*	–	1	—	—	—	—	1	2
12	*Wesmaelius concinnus*	—	—	22	1	—	—	—	23
13	*Wesmaelius quadrifasciatus*	—	—	3	1	2	—	—	6
14	*Wesmaelius nervosus*	—	—	1	1	—	—	—	2
15	*Hemerobius humulinus*	1	94	23	30	12	4	—	164
16	*Hemerobius stigma*	—	—	3	—	—	—	—	3
17	*Hemerobius atrifrons*	—	1	—	1	3	1	—	6
18	*Hemerobius nitidulus*	—	1	—	1	—	—	—	2
19	*Hemerobius micans*	—	12	1	4	6	3	1	27
20	*Hemerobius marginatus*	—	—	—	—	1	—	—	1
21	*Micromus angulatus*	—	—	2	—	1	—	1	4
22	*Sympherobius pygmaeus*	—	—	1	—	—	—	—	1
23	*Sympherobius klapaleki*	—	18	10	3	2	—	—	33
24	*Nineta flava*	—	3	68	649	309	6	—	1035
25	*Nineta vittata*	—	—	37	40	18	—	—	95
26	*Nineta inpunctata*	—	—	3	—	—	—	—	3
27	*Chrysotropia ciliata*	—	5	379	502	278	8	—	1172
28	*Chrysopa perla*	—	1	—	—	—	—	—	1
29	*Chrysopa septempunctata*	—	—	2	25	58	—	—	85
30	*Anisochrysa flavifrons*	—	—	—	1	—	1	—	2
31	*Anisochrysa prasina*	—	—	42	330	293	22	—	687
32	*Anisochrysa ventralis*	—	1	15	6	2	—	—	24
33	*Chrysoperla carnea*	49	166	54	60	425	150	37	941
34	*Cunctochrysa albolineata*	—	—	9	7	5	—	—	21
	Total	50	331	701	1668	1433	196	40	4419
	Number of species	2	19	25	21	18	9	4	

its occurrence pronouncedly varied in particular forests. The species appeared most early and occurred for the longest time in the thermophilous oak forest; it appeared the most late and occurred for the shortest time in the Dębina reserve (Fig. 5).

In the following, very warm season, microclimatic differences between particular plots were not of much significance. The optimal conditions for the appearance of neuropterans were met everywhere almost at the same time, so both in the oak forest and in the two linden-oak-hornbeam forests changes in neuropteran abundance coincided (Fig. 2).

Notwithstanding certain seasonal changes in the date of appearance and the length and abundance of neuropteran occurrence, it was possible to define, on the basis of many years' data, precise periods of occurrence and abundance peaks of many species (Tab. V).

Chrysoperla carnea was noted to occur for the longest period of time. The species was recorded to occur as early as in April, its abundance peak, however, fell in the second half of May. In June and July the species was sporadically sampled and in certain seasons it was completely absent. A successive abundance peak fell on the turn of August and September (Tab. V). The period of occurrence of *Hemerobius humulinus* and *H. micans* was only slightly shorter. *H. humulinus* was most abundant in May and in the beginning of June. It occurred rather scarcely throughout summer, relatively the greatest number of individuals being sampled in July. In case of *H. micans* any distinctive abundance peak was not observed, only single individuals of the species being sampled troughout the season (Tab. V).

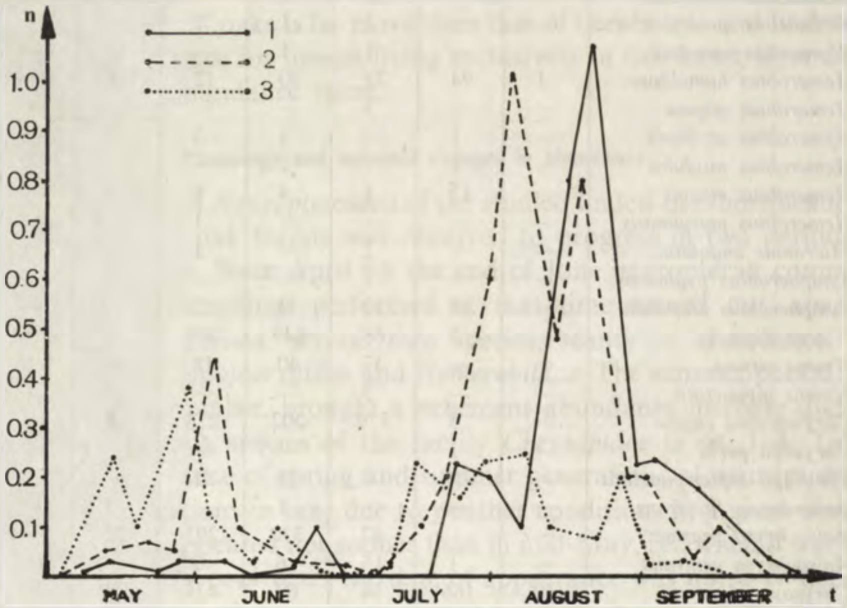

Fig. 1. Seasonal changes in abundance of *Neuropteroidea* in 1980 in linden-oak-hornbeam forests (1 — Dębina res., 2 — Cyganka res.) and in thermophilous oak forest (3 — King Jan III Sobieski res.): *n* — abundance index.

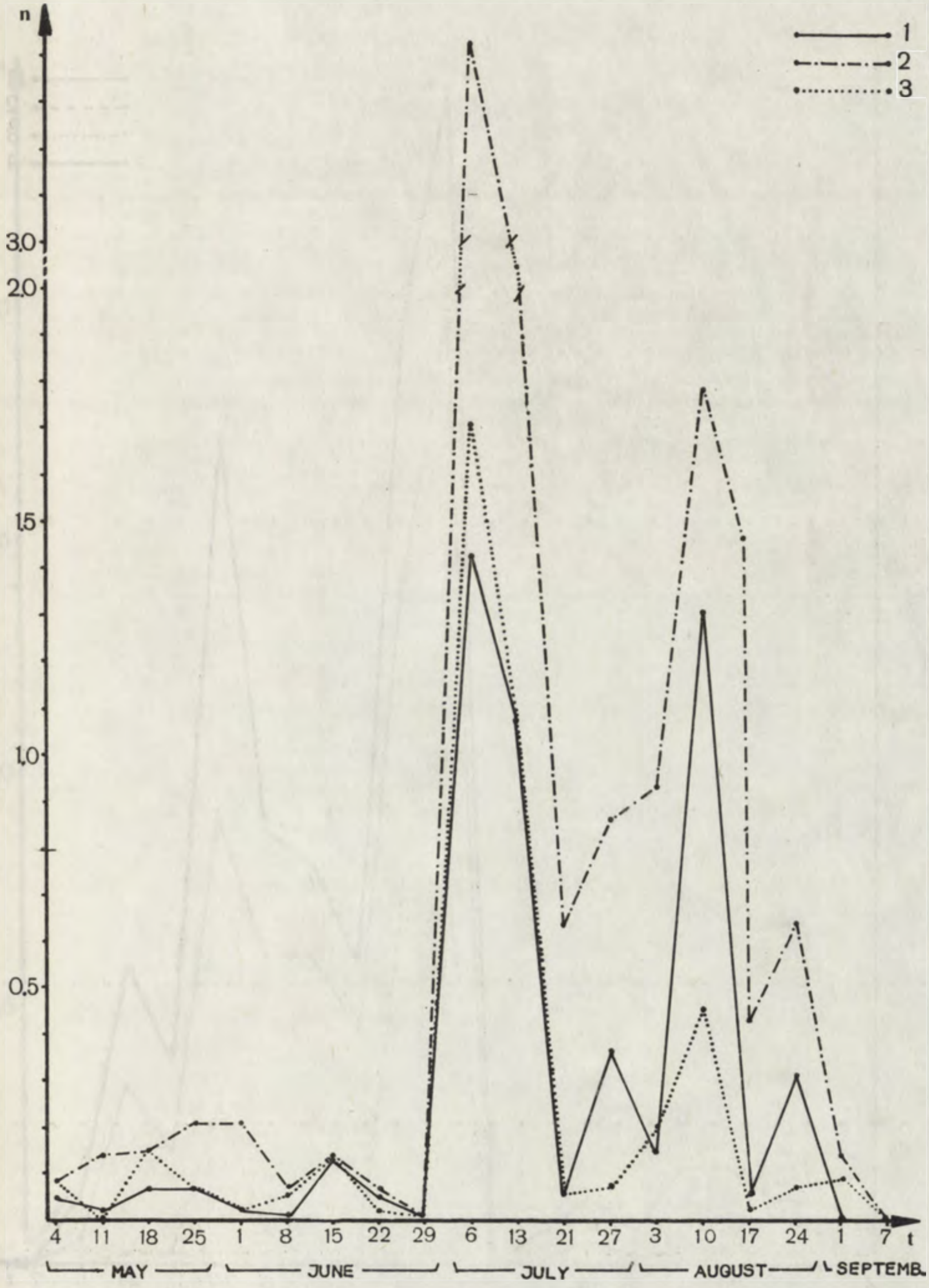

Fig. 2. Seasonal changes in abundance of *Neuropteroidea* in 1981 in two linden-oak-hornbeam forests (1 — Dębina res., 2 — Modrzewina res.) and in thermophilous oak forest (3 — King Sobieski res.): *n* — abundance index.

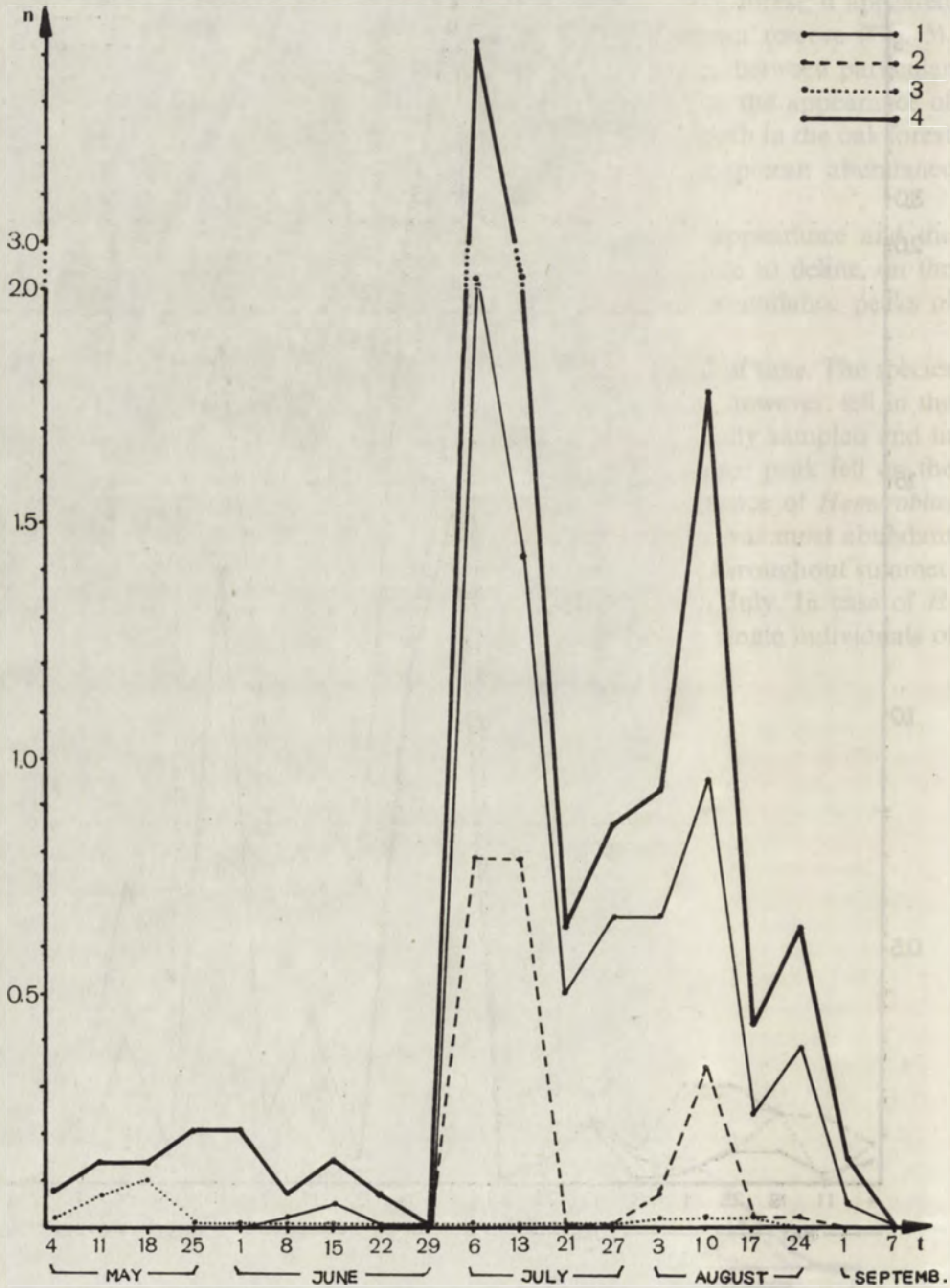

Fig. 3. Seasonal changes in abundance of *Neuropteroidea* in Modrzewina reserve in 1981; *n* — abundance index, 1 — *Nineta flava*, 2 — *Chrysotropia ciliata*, 3 — *Chrysoperla carnea*, 4 — total *Neuropteroidea*.

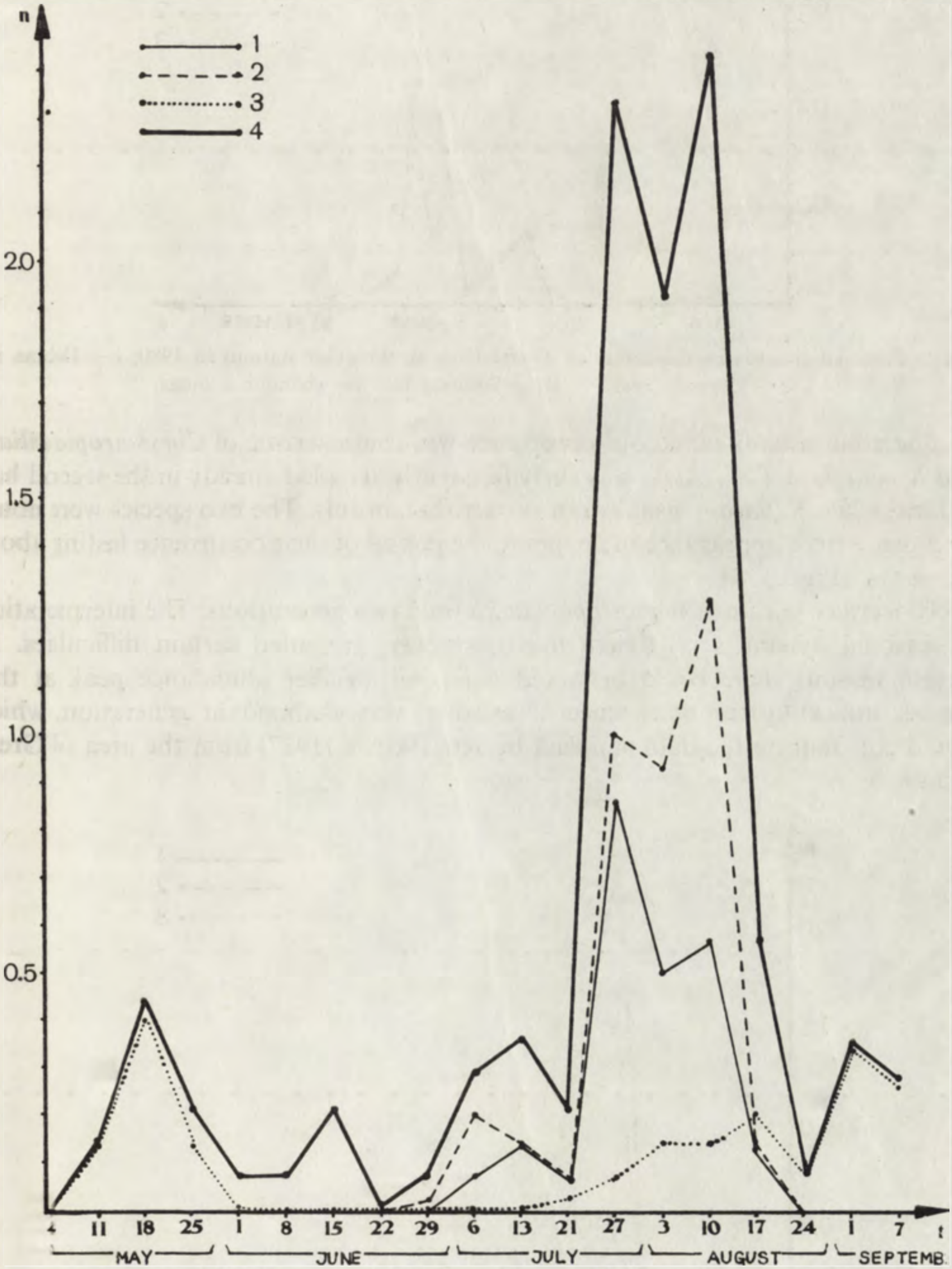

Fig. 4. Seasonal changes in abundance of *Neuropteroidea* in Modrzewina reserve in 1982; denotations — see Fig. 3.

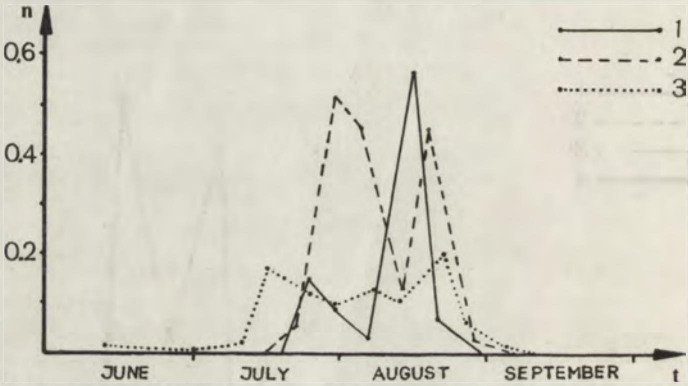

Fig. 5. Seasonal changes in abundance of *Nineta flava* at particular stations in 1980; 1 — Dębina res; 2 — Cyganka res; 3 — King Sobieski res; *n* — abundance index.

Short but usually numerous occurrence was characteristic of *Chrysotropia ciliata* and *Nineta flava*. *Chr. ciliata* was fairly frequently sampled already in the second half of June, while *N. flava* — usually not sooner than in July. The two species were noted for a concurrent appearance of imagines, the period of their occurrence lasting about 2 months (Figs 3, 4).

In warmer seasons *Chrysotropia ciliata* bred two generations. The interpretation of seasonal dynamics of *Nineta flava*, however, presented certain difficulties. In certain seasons there could be noted a second, smaller abundance peak at this species, indicating the occurrence of another, very inabundant generation, which would corroborate the data supplied by Killington (1937) from the area of Great Britain.

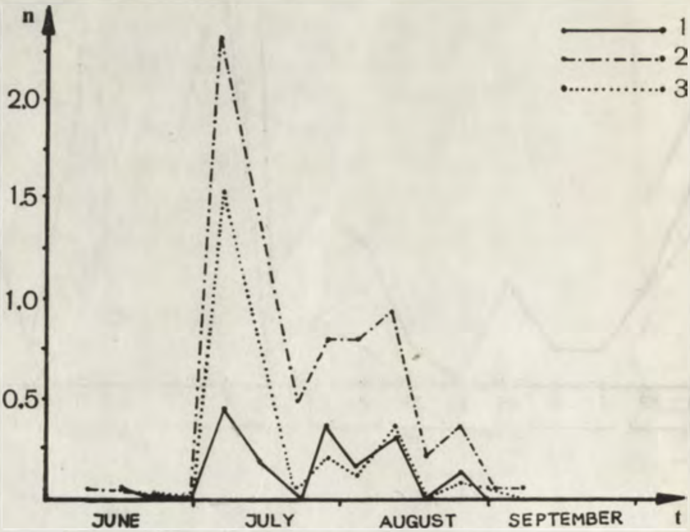

Fig. 6. Seasonal changes in abundance of *Nineta flava* at particular stations in 1981; denotations — see Fig. 5.

Table VI. Mean day air temperatures

Location of weather stations	Years	Months											
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Świder near Warsaw	1980	−6.5	−1.6	−0.6	6.2	9.7	16.0	17.0	16.5	12.2	8.2	1.8	−0.9
	1981	−3.4	−1.0	3.6	5.6	14.4	17.4	18.2	16.4	13.5	8.6	3.3	−3.3
Warsaw-Okęcie (city outskirts)	mean from years 1881–1960	−3.1	−2.2	1.6	7.6	13.7	16.9	18.5	17.4	13.4	7.8	2.5	−1.1
Centre of Warsaw	1975	2.8	−0.2	4.8	7.4	15.4	17.0	20.2	19.4	16.1	8.2	1.7	1.2
Centre of Warsaw	mean from years 1946–1960	−2.6	−2.5	1.1	8.3	14.1	17.3	19.1	18.2	13.9	7.9	3.1	0.3

The studies in the annual development cycle of *Nineta flava* conducted recently in France revealed, however, that certain females underwent imaginal diapause due to long daytime, which prolonged their life span and egg-laying period. *N. flava* was observed to breed only one generation in its southern range of occurrence, although imagines were present since May till October (CANARD 1982, 1983, 1986).

Many years' observations conducted in natural habitats as well as in habitats of Warsaw urban green areas revealed that on the area of the Mazovian Lowland *Nineta flava* occurred over a much shorter period of time. Climatic conditions restrict the occurrence time of imagines of this species down to two warmest months, i.e., July and August. The abundance peak usually falls in July, which has the highest mean 24 hour air temperature (Tab. VI).

As compared to natural habitats more favourable conditions for the development of *Nineta flava* prevail in large towns, where the mean 24 hour air temperatures are

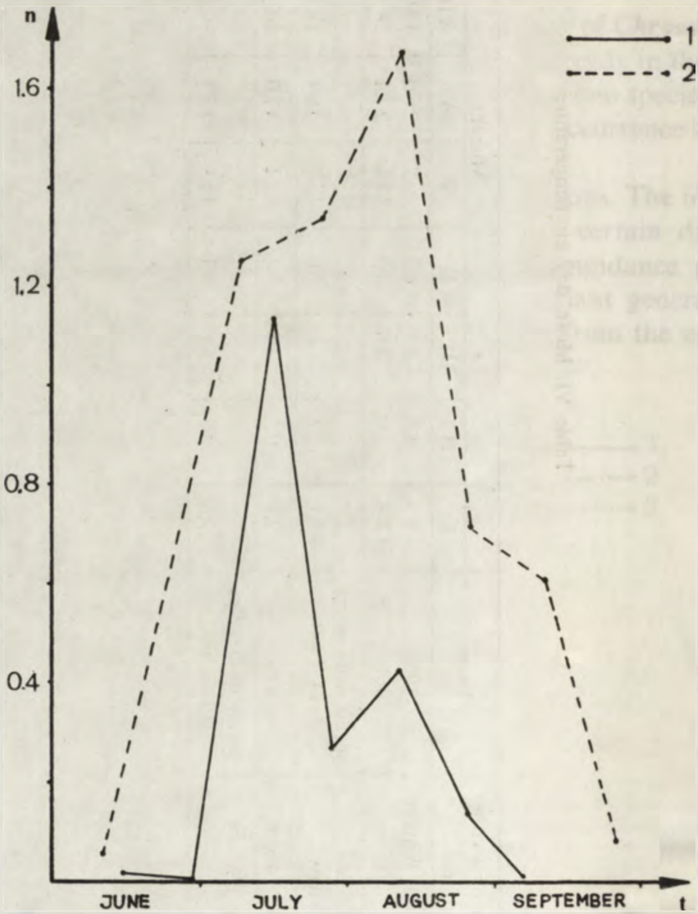

Fig. 7. Seasonal changes in abundance of *Nineta flava* in natural habitats of linden-oak-hornbeam forests (mean from three sites examined in 1981) — 1, and in city lawns of Warsaw (mean from two park sites examined in 1975) — 2.

slightly higher throughout the whole year (Tab. VI). However, also in this habitat *N. flava* occurred for about 2 months, yet in certain years imagines appeared earlier, i.e., in the second half of June. An exceptionally long period of occurrence of these insects, lasting since June 10 till September 15, was recorded in Warsaw in 1975 (Fig. 7). That year, however, was noted for exceptionally high mean 24 hour air temperatures, exceeding the many years' means (Tab. VI).

It may be assumed, therefore, that apart from long daytime, also the air temperature must be sufficiently high so as to produce imaginal diapause at *N. flava*. On the Mazovian Lowland, where the mean 24 hour air temperature in summer months does not exceed 20°C, it is a rule that only one generation of this species develops, marked for a short time of occurrence of imagines.

As to the other species, distinct occurrence periods were recorded for *Anisochrysa prasina* and *Chrysopa septempunctata*. *A. prasina* appeared in the beginning of June to reach its abundance peak on the turn of July and August. Later on the insects were sampled till the end of September. A very late and short occurrence span was noted of *Chr. septempunctata*. Individuals of this species were sampled in late July and August (Tab. V).

RECAPITULATION

A total of 34 species of *Neuropteroidea* was reported from the linden-oak-hornbeam forests and the thermophilous oak forests of the Mazovian Lowland. The record included three species new to the fauna of this region, namely, *Raphidia flavipes*, *Wesmaelius quadrifascius* and *Hemerobius atrifrons*.The total number of *Neuropteroidea* species reported from the Mazovian Lowland amounted presently to 59.

Neuropteran communities of the Mazovian linden-oak-hornbeam and thermophilous oak forests are, in broad terms, similar with respect to their abundance, and in zoogeographical and ecological aspect.

Similarity of total species make-up in the two habitats was high and amounted to 74% (according to Sörensen formula). Among 20 species common for the two habitats, the absolutely constant were: *Hemerobius humulinus*, *Chrysotropia ciliata*, *Nineta flava*, *N. vittata*, *Chrysopa septempunctata*, *Anisochrysa prasina*, and *Chrysoperla carnea*. Also the group of dominating species was common for the two habitats and it included: *Chrysotropia ciliata*, *Nineta flava*, *Anisochrysa prasina*, and *Chrysoperla carnea*. All this resulted in a high value of the structural similarity index (0.88; according to Morisita formula).

As to the zoogeographical aspect, both in the linden-oak-hornbeam as well as in the thermophilous oak forests, the qualitatively and quantitatively richest group was made up of Euro-Siberian species. Southern, thermophilous species contributed very scantily to the neuropteran communities of the studied habitats. They were found to occur locally in warmer sites.

Considering the ecological requirements, neuropterans dwelling the examined forests ranked mainly among polytopic forest species. As to the trophic aspect, about

Particular plots in the studied linden-oak-hornbeam forests and the thermophilous oak forests differed in their thermic and humidity conditions. The forests arranged in the order: low (humid) linden-oak-hornbeam forest, high (dry) linden-oak-hornbeam forest, thermophilous oak forest, from a series of habitats of decreasing humidity. The extremes are: the linden-oak-hornbeam forest in the Dębina reserve on one side and the oak forest in the B. Hryniewiecki reserve on the other. The intermediary links are the forests in the Cyganka reserve, Modrzewina reserve, at Radziejowice, and in the King Sobieski reserve. The analysis of neuropteran communities of these plots enabled to capture within the same group species, changes in dominance structures due to thermic and humidity conditions of each plot. Along with a diminishing humidity and improving thermic conditions of the habitat, there decreased the contribution of hygrophilous and psychrophilous *Chrysotropia ciliata*, dominating in the linden-oak-hornbeam forests and, consequently, an increase was noted in the contribution of mesohygrophilous and thermophilous species — *Nineta flava* and *Anisochrysa prasina*.

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STRESZCZENIE

[Tytuł: Siatkoskrzydłe (*Neuropteroidea*) grądów i dąbrów świetlistych Niziny Mazowieckiej]

Na podstawie materiału liczącego 4428 osobników imagines *Neuropteroidea* określono skład gatunkowy, strukturę zgrupowań, wymagania ekologiczne oraz dynamikę sezonową siatkoskrzydłych żyjących w tych lasach.

W czterech zbadanych lasach grądowych (*Tilio-Carpinetum*) Niziny Mazowieckiej stwierdzono łącznie 28 gatunków *Neuropteroidea*. Na poszczególnych stanowiskach odławiano od 10 do 19 gatunków siatkoskrzydłych. Wskaźniki podobieństwa jakościowego zgrupowań wynosiły (wg SÖRENSENA) od 57 do 72%. Średni wskaźnik liczebności zgrupowań w tym środowisku wynosi 0,357. Zespół dominujących sieciarek składa się z *Chrysotropia ciliata*, *Chrysoperla carnea*, *Nineta flava* i *Anisochrysa prasina*. Ponadto, lokalnie, nieco liczebniej występują *Hemerobius humulinus*, *Nineta vittata* i *Chrysopa septempunctata*. Wskaźniki podobieństwa struktur dominacyjnych (wg MORISITY) są zawarte w granicach 0,49–0,98.

W trzech zbadanych dąbrowach świetlistych (*Potentillo albae-Quercetum*) odłowiono ogółem 26 gatunków *Neuropteroidea*, na poszczególnych stanowiskach od 10 do 22 gatunków. Stopień podobieństwa jakościowego zgrupowań wynosi od 55 do 63%. Przeciętny wskaźnik liczebności zgrupowań ma wartość 0,157. Do najliczebniejszych gatunków w tym środowisku należą *Nineta flava*, *Chrysoperla carnea*, *Anisochrysa prasina* i *Chrysotropia ciliata*. Wskaźniki podobieństwa struktur dominacyjnych między poszczególnymi zgrupowaniami *Neuropteroidea* wynoszą od 0,47 do 0,69.

Łącznie w zbadanych środowiskach stwierdzono 34 gatunki siatkoskrzydłych, w tym trzy gatunki (*Raphidia flavipes*, *Wesmaelius quadrifasciatus* i *Hemerobius atrifrons*) nowe dla fauny tego regionu. Wskaźnik podobieństwa jakościowego między całkowitymi składami gatunkowymi *Neuropteroidea* obu środowisk wynosi 74% a podobieństwa struktur dominacyjnych 0,88.

Również pod względem struktury zoogeograficznej i ekologicznej siatkoskrzydłe zbadanych środowisk mają wiele cech wspólnych. Główną część zgrupowań stanowią gatunki (i osobniki) eurosyberyjskie, politopowe, związane troficznie z fitofagami drzew i krzewów liściastych.

Dla zgrupowań siatkoskrzydłych lasów grądowych charakterystyczny jest duży udział stenotopowego, wilgociolubnego *Chrysotropia ciliata*. Gatunek ten jest dominantem lub subdominantem zgrupowań z poszczególnych stanowisk. W dąbrowach świetlistych udział *Chrysotropia ciliata* jest około 2-krotnie mniejszy. Jego miejsce zajmują mniej pod tym względem wymagające mezohigrofilne — *Nineta flava* i *Anisochrysa prasina*.

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