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Heteroptera communities of pine forests in Poland

[With 7 tables and 6 figures in the text]

Abstract. The structure of *Heteroptera* communities was studied in two association-types of pine forests: the subcontinental (*Peucedano-Pinetum*) pine forest in Puszcza Białowieska and Puszcza Biała and the suboceanic (*Leucobryo-Pinetum*) pine forest in Bory Tucholskie and Roztocze. In the herb layer of these forests, 119 heteropteran species were registered, eurytopic species being the most abundant. In the canopies of pines, 101 species were found, with forest *Heteroptera*, especially stenotopes, being the most abundant. Euro-Siberian and Palearctic species were dominant in the herb layer, European and Euro-Siberian species – in the tree canopy layer. The greatest numbers of imagines were registered in the early summer (June) – for the heteropterans of tree canopies, and at the turn of summer and autumn - for the heteropterans of the herb layer.

INTRODUCTION

The names of *Heteroptera* species inhabiting coniferous forests are mentioned in many scientific papers, especially in faunistic papers. Data concerning the dominance structure, ecological characteristics and seasonal abundance fluctuations, however, are contained in few publications (FEDORKO 1958, 1961; KARCZEWSKI 1962; STRAWIŃSKI 1956, 1958; SZUJECKI 1980). Most of the data found in these publications pertain to the herb layer fauna, while those concerning the species composition of the tree canopy *Heteroptera* communities usually cover only the lower stratum (less than 3m tall) (KLOMP, TEERINK 1973).

Of the regions mentioned in the present paper, only the forest associations of Puszcza Białowieska have been previously studied. That research was carried out in 1956 and resulted in finding 86 species of *Heteroptera* in moist and mixed coniferous forests (STRAWIŃSKI 1956, SZUJECKI 1980).

STUDY AREAS AND METHODS

The research was carried out in pine forests of four regions of Poland in the years 1986-1988. The pine forests of Puszcza Białowieska and Puszcza Biała

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were representatives of the *Peucedano-Pinetum* association-type. The former belonged to the subboreal variety of this association-type with a large proportion of spruce, while the latter represented the Sarmatian variety with abundant juniper. In these forests, entomological samples were taken in the herb layer and in canopies of pines belonging to three age classes: mature forest (over 90 years of age), pole wood (47–59 years) and young growth (15–25 years).

The forest associations of Bory Tucholskie and Roztocze belonged to the *Leucobryo-Pinetum* association-type. The former were forests of a markedly distorted structure, where *Deschampsia flexuosa* was abundant in the herb layer. The forests of Roztocze, apart from a high proportion of *Leucobryum glaucum* – a typical feature of this association-type, were also characterized by high proportions of fir, spruce and beech in the forest stand. In the above two forest associations, heteropterans were collected in the herb layer and tree crowns of mature forest stands. In Bory Tucholskie, samples also were taken in younger stands (pole wood and young growth).

A detailed description of the pine forests studied in phytosociological terms is contained in the paper by MATUSZKIEWICZ (1993).

The herb layer samples were collected with a sweeping net. The measure of heteropteran abundance in this layer of the pine forest was the average number of specimens collected in 25 sweeps. Heteropterans inhabiting tree crowns were collected by means of Moericke's pitfall traps. Here, the measure of abundance was the average number of specimens caught in one pitfall trap during a twenty-four-hour catch. In Tables III, V and VII and in Figures 5 and 6, the value of this parameter has been multiplied by 1000 in order to make the tables and figures more legible.

SPECIES COMPOSITION

A total of 165 *Heteroptera* species was registered in the pine forests studied. In the herb layer 119 species were found, while 101 species were registered in canopies of pines (see Tab. I).

Of the regions where samples were collected in forest stands of three age classes, Puszcza Białowieska was inhabited by the greatest number of *Heteroptera* species (87), whereas the lowest number of *Heteroptera* species (51) were found in Bory Tucholskie. The forests of Roztocze, with 92 *Heteroptera* species noted in the herb layer, rank higher than Puszcza Białowieska, even though in the former region no samples were drawn in younger pine forest stands. 16 species of *Heteroptera* were found in the herb layer in all the regions (see Tab. II). Only 5 of them are considered forest species. Of the species found in tree canopies of mature forest stands, 8 were registered in all the regions. Only one of these species was not characteristic of pines. The figures for the pole wood stands were: 8 species common to all the regions including two not characteristic of pine, and in the young stands 9 species were registered in all the regions, of which 3 are not species characteristic of pines.

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Table I. Comparison of the number of species and individuals and of the abundance of *Heteroptera* of the studied pine forests; N – the number of species, n – the number of individuals

	Puszcza Białowieska		Puszcza Biała		Bory Tucholskie		Roztocze		Total	
	N	n	N	n	N	n	N	n	N	n
Herbs layer	59	1276	54	2136	38	1473	77	2073	119	6958
Mature forest	41	1189	29	278	21	567	31	409	63	2443
Pole wood	32	474	20	185	28	426	–	–	52	1085
Young stand	35	213	32	137	26	119	–	–	63	469
Total	87	3152	68	2736	51	2585	92	2482	165	10955

ABUNDANCE AND DOMINANCE STRUCTURE

In the pine forests studied, 10,955 *Heteroptera* individuals were collected (Tab. I). The highest average abundance of a heteropteran community was noted for Puszcza Biała – 3.66 individuals/sample, the lowest – for Roztocze (2.17 indiv./sample), the figures for the three forests except Puszcza Biała being quite similar: 2.7 for Puszcza Białowieska and 2.38 for Bory Tucholskie (Tab. II).

Table II. Abundance (n') and percentages (%) of *Heteroptera* species of the herb layer of the studied pine forests; + – abundance lower than 0.1 indiv./sample

Region		Puszcza Białowieska		Puszcza Biała		Bory Tucholskie		Roztocze	
No	Species	n'	%	n'	%	n'	%	n'	%
1	2	3	4	5	6	7	8	9	10
1.	*Sehirus luctuosus* Muls. et R.			0.003	0.1			0.004	0.2
2.	*Adomerus biguttatus* (L.)			0.005	0.1	0.014	0.6	0.013	0.6
3.	*Tritomegas bicolor* (L.)							0.001	+
4.	*Aelia acuminata* (L.)	0.060	2.3	0.010	0.3			0.010	0.5
5.	*Aelia klugi* Hahn			0.003	0.1				
6.	*Eysarcoris aeneus* (Scop.)							0.001	+
7.	*Stagonomus pusillus* (H.-S.)	0.002	+						
8.	Holcostethus vernalis (Wolff).	0.002	+					0.007	0.3
9.	*Palomena prasina* (L.)	0.004	0.1	0.007	0.2	0.002	0.1	0.001	+
10.	*Palomena viridissima* (Poda)							0.002	0.1
11.	*Pitedia juniperina* (L.)							0.001	+
12.	*Pitedia pinicola* (Muls. et R.)			0.002	0.1				
13.	*Carpocoris purpureipennis* (De Geer)	0.004	0.1			0.002	0.1	0.002	0.1
14.	*Carpocoris fuscispinus* (Boh.)	0.004	0.1	0.002	0.1	0.003	0.1	0.004	0.2
15.	*Carpocoris pudicus* (Poda)					0.002	0.1	0.002	0.1
16.	*Dolycoris baccarum* (L.)	0.094	3.5	0.029	0.8	0.002	0.1	0.026	1.2
17.	*Eurydema oleraceum* (L.)	0.008	0.3	0.003	0.1			0.010	0.5
18.	*Piezodorus lituratus* (F.)	0.002	+						
19.	*Picromerus bidens* (L.)			0.010	0.3	0.003	0.1	0.010	0.5
20.	*Troilus luridus* (F.)	0.004	0.1	0.003	0.1			0.001	+
21.	*Rhacognathus punctatus* (L.)							0.001	+
22.	*Acanthosoma haemorrhoidale* (L.)	0.002	+						
23.	*Elastotethus interstinctus* (L.)	0.023	0.9						

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1	2	3	4	5	6	7	8	9	10
24.	*Elasmucha ferrugata* (F.)			0.022	0.6	0.087	3.7	0.335	15.7
25.	*Elasmucha fieberi* (JAK.)	0.031	1.2						
26.	*Elasmucha grisea* (L.)	0.048	1.8	0.005	0.1	0.003	0.1		
27.	*Coreus marginatus* (L.)	0.006	0.2	0.002	0.1			0.001	+
28.	*Corizus hyosciyami* (L.)							0.004	0.2
29.	*Rhopalus parumpunctatus* (SCHILL.)	0.171	6.5	0.015	0.4	0.011	0.5	0.021	0.9
30.	*Rhopalus maculatus* (FIEB.)	0.002	+	0.003	0.1	0.002	0.1		
31.	*Myrmus miriformis* (FALL.)	0.010	0.4	0.003	0.1				
32.	*Stictopleurus pictus* (FIEB.)	0.002	+						
33.	*Dicranocephalus agilis* (SCOP.)							0.001	+
34.	*Nithecus jacobeae* (SCHILL.)	0.015	0.6						
35.	*Nysius thymi* (WOLFF)			0.002	0.1				
36.	*Nysius ericae* (SCHILL.)							0.001	+
37.	*Nysius he1veticus* (H.-S.)	0.010	0.4	0.002	0.1				
38.	*Kleidocerys resedae* (PANZ.)	0.062	2.3	0.003	0.1			0.001	+
39.	*Cymus obliquus* HORV.							0.001	+
40.	*Cymus claviculus* (FALL.)	0.006	0.2					0.001	+
41.	*Cymus melanocephalus* FIEB.	0.002	+						
42.	*Geocoris grylloides* (L.)	0.002	+						
43.	*Geocoris ater* (F.)							0.003	0.1
44.	*Stygnocoris pygmaeus* (F. SAHLB.)	0.006	0.2					0.008	0.4
45.	*Stygnocoris pedestris* (FALL.)	0.160	6.0	1.933	53.0	0.763	32.1	0.009	0.4
46.	*Megalonotus chiragra* (F.)	0.002	0.1	0.003	0.1				
47.	*Megalonotus sabulicola* (THOMS.)							0.002	0.1
48.	*Pterotmetus staphyliformis* (SCHILL.)	0.002	+	0.005	0.1				
49.	*Rhyparochromus pini* (L.)			0.002	0.1			0.003	0.1
50.	*Ischnocoris angustulus* (BOH.)					0.002	0.1		
51.	*Drymus ryei* DOUGL. et SC.	0.004	0.1						
52.	*Drymus brunneus* (F. SAHLB.)	0.002	+						
53.	*Eremocoris p1ebejus* (FALL.)			0.005	0.1	0.032	1.3	0.005	0.2
54.	*Eremmcoris abietis* (L.)							0.019	0.9
55.	*Scolopostethus decoratus* (HAHN)					0.002	0.1		
56.	*Pachybrachius fracticol1is* (SCHILL.)			0.002	0.1				
57.	*Neides tipularius* L.			0.002	0.1	0.002	0.1	0.001	+
59.	*Saldula vestita* (DOUGL.)	0.004	0.1						
59.	*Acalypta carinata* (PANZ.)	0.006	0.2					0.002	0.1
60.	*Acalypta nigrina* (FALL.)	0.046	1.7	0.041	1.1	0.048	2.0	0.016	0.8
61.	*Acalypta marginata* (WOLFF)			0.002	0.1	0.002	0.1		
62.	*Acalypta gracilis* (FIEB.)							0.001	+
63.	*Himacerus apterus* (F.)	0.002	+						
64.	*Nabicula limbata* (DAHLB.)	0.042	1.6	0.002	0.1	0.003	0.1	0.008	0.4
65.	*Nabis ferus* (L.)	0.204	7.7	0.074	2.0	0.118	4.9	0.026	1.2
66.	*Nabis pseudoferus* REM.	0.175	6.6	0.076	2.1	0.066	2.8	0.100	4.7
67.	*Nabis punctatus* A. COSTA	0.002	+			0.002	0.0	0.076	3.6
68.	*Nabis ericetorum* SCHOLTZ			0.005	0.1	0.018	0.8		
69.	*Nabis rugosus* (L.)	0.183	6.9	0.188	3.1	0.023	0.9	0.085	3.9
70.	*Myrmedobia exilis* (FALL.)	0.004	0.1	0.028	0.8			0.005	0.2
71.	*Myrmedobia distinguenda* REUT.							0.002	0.1
72.	*Anthocoris nemorum* (L.)	0.004	0.1					0.003	0.1

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1	2	3	4	5	6	7	8	9	10
73.	*Anthocoris confusus* REUT.								
74.	*Acompocoris pygmaeus* (FALL.)					0.005	0.2	0.001	+
75.	*Orius niger* WOLFF			0.002	0.1				
76.	*Orius minutus* (L.)							0.006	0.3
77.	*Orius agilis* (FLOR)							0.001	+
78.	*Monalocoris filicis* (L.)			0.002	0.1	0.002	0.1	0.002	0.1
79.	*Bothynotus pilosus* (BOH.)			0.002	0.1			0.002	0.1
80.	*Deraeocoris ruber* (L.)							0.001	+
81.	*Alloeotomus gothicus* (FALL.)							0.001	+
82.	*Myrmecoris gracilis* (J. SAHLB.)							0.001	+
83.	*Leptoptema dolobrata* (L.)					0.008	0.3		
84.	*Leptoptema ferrugata* (FALL.)			0.015	0.4				
85.	*Stenodema calcaratum* (FALL.))	0.252	9.5	0.020	0.5	0.006	0.3	0.006	0.3
86.	*Stenodema virens* (L.)	0.025	0.9	0.061	1.7	0.053	2.2	0.007	0.3
87.	*Stenodema laevigatum* (L.)	0.223	8.4	0.563	15.4	0.787	33.1	0299	14.0
88.	*Stenodema holsatum* (F.)	0.344	13.0			0.043	1.8	0.018	0.8
89.	*Notostira erratica* (L.)			0.007	0.2				
90.	*Trigonotylus coelestialium* (KIRK.)			0.002	0.1			0.001	+
91.	*Trigonotylus ruficornis* (GEOFFR.)			0.002	0.1				
92.	*Phytocoris longipennis* FLOR	0.004	0.1						
93.	*Phytocoris pini* KIRSCHB.					0.003	0.1		
94.	*Adelphocoris reicheli* (FIEB.)							0.002	0.1
95.	*Calocoris biclavatus* (H.-S.)			0.007	0.2			0.001	+
96.	*Calocoris affinis* (H.-S.)	0.002	+					0.145	6.8
97.	*Calocoris norvegicus* (GMEL.)							0.006	0.3
98.	*Stenotus binotatus* (F.)	0,027	1.0					0.001	+
99.	*Lygocoris pabulinus* (L.)	0.002	+					0.001	+
100.	*Lygus rugulipennis* (POPP.)	0.133	5.0	0.256	7.0	0.205	8.6	0.504	23.7
101.	*Lygus pratensis* (L.)	0.100	3.8	0.029	0.8	0.037	1.6	0.076	3.6
102.	*Lygus punctatus* (ZETT.)	0.067	2.5	0.161	4.4	0.008	0.3	0.234	10.9
103.	*Camptozygum aequale* (VILL.)					0.003	0.1	0.004	0.2
104.	*Charagochilus gyllenhali* (FALL.)	0.004	0.1					0.006	0.3
105.	*Capsus pilifer* REM.	0.002	+						
106.	*Capsodes gothicus* (L.)							0.001	+
107.	*Halticus pusillus* (H.-S.)	0.019	0.7	0.005	0.1				
108.	*Heterotoma meriopterum* (SCOP.)	0.008	0.3	0.017	0.5			0.001	+
109.	*Heterocordylus genistae* (SCOP.)	0.006	0.2	0.003	0.1				
110.	*Orthotylus ericetorum* (FALL.)							0.001	+
111.	*Globiceps flavomaculatus* (F.)	0.008	0.3					0.001	+
112.	*Globiceps cruciatus* REUT.							0.001	+
113.	*Blepharidopterus brevicornis* (WAGN.)					0.002	0.1		
114.	*Phoenicocoris modestus* (MEY.-D.)							0.001	+
115.	*Phoenicocoris obscurellus* (FALL.)			0.002	0.1			0.002	0.1
116.	*Atractotomus mali* (MEY.-D.)	0.002	+						
117.	*Psallus varians* (H.-5.)							0.001	+
118.	*Plesiodema pinetellum* (ZETT.)							0.003	0.1
119.	*Lopus decolor* (FALL.)			0.002	0.1				
Total		2.650		3.662		2.377		2.173	

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The abundance of the tree crowns *Heteroptera* communities is different in each region and in forest stands representing various age classes. However, the figures are always the highest for the tree crown communities of mature forest stands, and decrease with the descending age of the stand in all the regions studied (Tab. III).

In the herb layer, a total of 12 *Heteroptera* species were considered dominant (i.e. they accounted for at least 5 per cent of a community). *Stenodema laevigatum* was found in all the forests studied, *Lygus rugulipennis* and *Stygnocoris pedestris* were noted in three of them (Tab. II). Only the last one is a forest species.

As far as the herb layer communities are concerned, the *Heteroptera* communities from Puszcza Biała and Bory Tucholskie show the most similar dominance structures. In both regions, the same species are dominant and the curve of dominance follows a characteristic steep pattern. This testifies to the degeneration of the forests studied (this finding is further confirmed by phytosociological data). The structure of dominance of the herb layer *Heteroptera* communities in the two other regions studied is more diversified and the curve is easier. Of 8 dominant species in Puszcza Białowieska, 5 are dominants only in this region. Similarly, 3 out of 5 dominant species in Roztocze reach such high proportions in the community in no other region (Tab. II, Fig. 1).

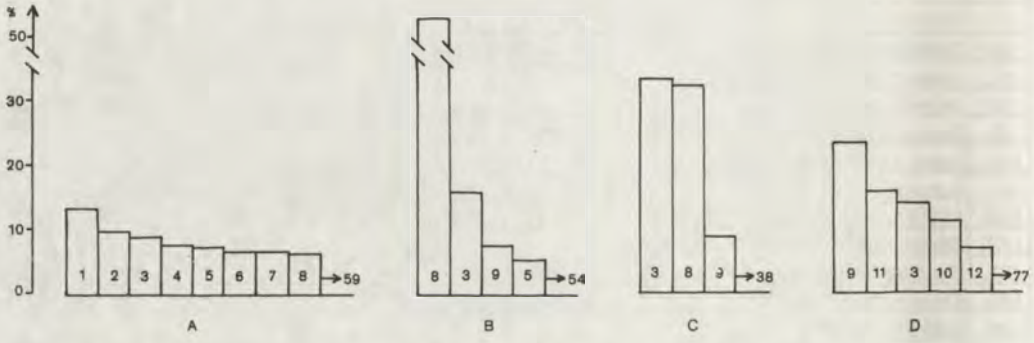

Fig. 1. Structure of dominance of *Heteroptera* communities in the herb layer of pine forests: A – Puszcza Białowieska, B – Puszcza Biała, C – Bory Tucholskie, D – Roztocze; Species: 1 – *Stenodema holsatum*, 2 – *S. calcaratum*, 3 – *S. laevigatum*, 4 – *Nabis ferus*, 5 – *N. rugosus*, 6 – *Stygnocoris pedoferus*, 7 – *Rhopalus parumpunctatus*, 8 – *Stygocoris pedestris*, 9 – *Lygus rugulipennis*, 10 – *L. punctatus*, 11 – *Elasmucha ferrugata*, 12 – *Calocoris affinis*.

In the tree crowns communities, 12 species were considered dominant (5 in mature stands and in middle age stands, and 11 in young stands) (Tab. III, Fig. 2). The species most abundant in all the age classes of pine forest stands were: *Phoenicocoris obscurellus* and *Phytocoris pini*; *Plesiodema pinetellum* was the most abundant species at the majority of stands. The composition of the dominant species group in the oldest forest stands does not show regional differences; in the pole wood communities such differences exist, but they concern single species only. The lowest degrees of similarity between *Heteroptera* communities were noted for young stands heteropterans.

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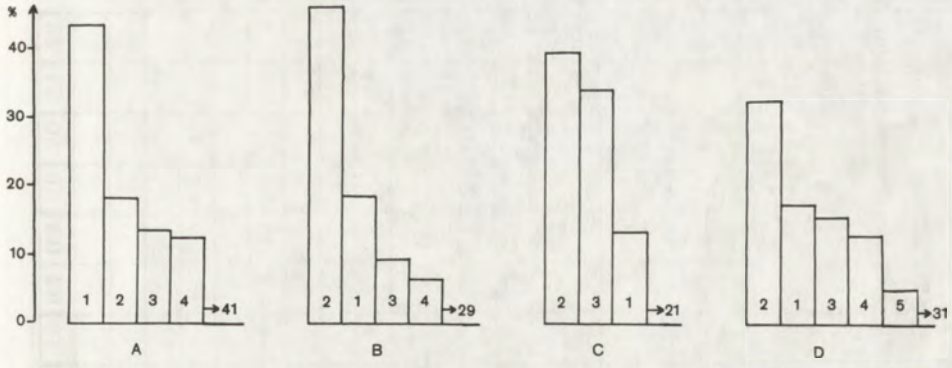

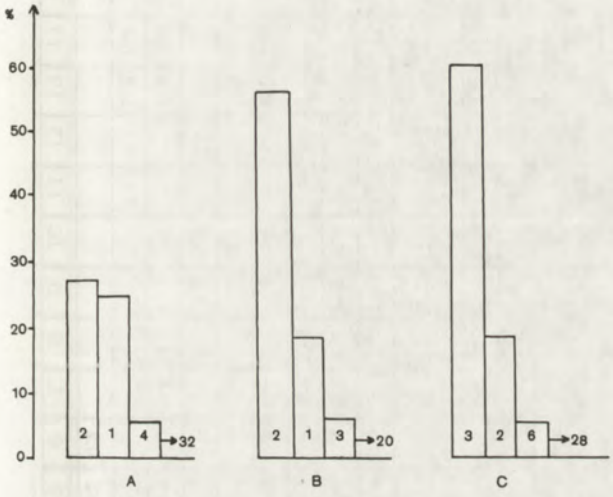

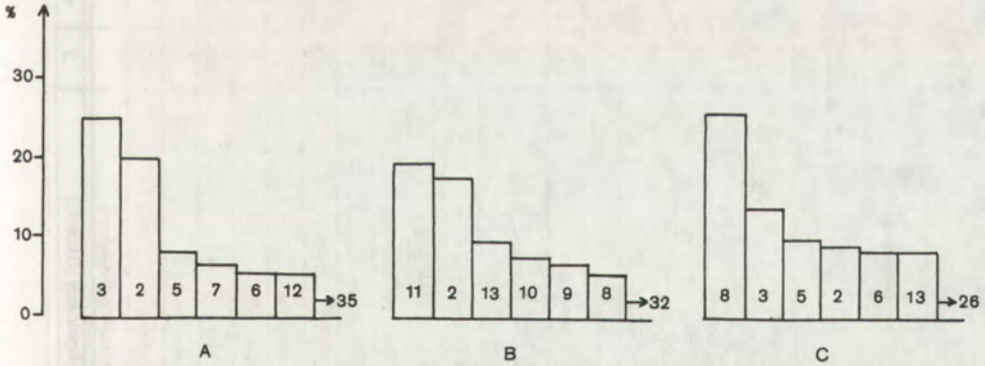

Fig. 2. Structure of dominance of the heteropterans of the canopies of pines a – mature forest, b – pole wood, c – young stand; A-D – see Fig. 1. Species: 1 – *Plesiodema pinetellum*, 2 – *Phoenicocoris obscurellus*, 3 – *Phytocoris pini*, 4 – *Phoenicocoris modestus*, 5 – *Captozygum aequale*, 6 – *Alloeotomus germanicus*, 7 – *Phytocoris intricatus*, 8 – *Aradus cinnamomeus*, 9 – *Phytocoris longipennis*, 10 – *Philophorus cinnamopterus*, 11 – *Lygus rugulipennis*, 12 – *Nabis pseudoferus*, 13 – *N. ferus*.

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Table III. Abundance (n') and percentages (%) of *Heteroptera* species of the canopies of pines in the studied pine forests

Region		Puszcza Białowieska						Puszcza Biała						Bory Tucholskie						Roztocze	
forest stand age class		mature forest		pole wood		young stand		mature forest		pole wood		young stand		mature forest		pole wood		young stand		mature forest	
No	Species	n'	%	n'	%	n'	%	n'	%	n'	%	n'	%	n'	%	n'	%	n'	%	n'	%
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1.	*Palomena prasina* (L.)					0.4	1.0	0.4	0.7												
2.	*Palomena viridissima* (Poda)											0.2	0.8								
3.	*Pitedia pinicola* (Muls. et Rey)	0.2	0.1	0.2	0.2			0.4	0.7												
4.	*Carpocoris purpureipennis* (De Geer)											0.2	0.8								
5.	*Carpocoris fuscispinus* (Boh.)							0.2	0.4												
6.	*Dolycoris baccarum* (L.)	0.2	0.1	0.4	0.4	0.7	1.7	1.6	2.9	0.2	0.5	0.2	0.8							0.4	0.3
7.	*Eurydema oleraceum* (F.)			0.2	0.2																
8.	*Piezodorus lituratus* (F.)															0.2	0.3				
9.	*Pentatoma rufipes* (L.)					0.4	1.0														
10.	*Troilus luridus* (F.)	0.2	0.1					0.4	0.7	0.6	1.6										
11.	*Rhacognathus punctatus* (L.)	0.2	0.1																	0.4	0.3
12.	*Acanthosoma haemorrhoidale* (L.)	0.2	0.1	0.4	0.4															0.4	0.3
13.	*Elasmostethus interstinctus* (L.)	1.0	0.4	0.4	0.4	0.2	0.5	0.2	0.4												
14.	*Elasmucha fieberi* (Jak.)	0.8	0.3	0.4	0.4	0.2	0.5														
15.	*Elasmucha grisea* (L.)	1.2	0.5	0.4	0.4	0.4	1.0					0.2	0.8	0.2	0.2	0.2	0.3				
16.	*Coreus marginatus* (L.)							0.2	0.4												
17.	*Kleidocerys resedae* (Panz.)	0.8	0.3					0.4	0.7									0.2	1.0		
18.	*Cymus claviculus* (Fall.)			0.2	0.2	0.4	1.0					0.2	0.8								
19.	*Stygnocoris pygmaeus* (F. Sahlb.)											0.2	0.8								
20.	*Stygnocoris pedestris* (Fall.)			0.2	0.2																
21.	*Stygnocoris fuliginaeus* (Geoffr.)															0.2	0.3				

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
22.	*Sphragisticus nebulosus* (FALL.)															0.2	0.3				
23.	*Pterotmetus staphyliniformis* (SCHILL.)					0.6	1.5														
24.	*Rhyparochromus pini* (L.)																			0.2	1.0
25.	*Drymus sylvaticus* (F.)	0.2	0.1									0.2	0.8							0.2	1.0
26.	*Eremocoris plebejus* (FALL.)															0.7	0.7	0.2	0.3	0.3	1.4
27.	*Scolopostethus thomsoni* REUT.																	0.2	0.3		
28.	*Scolopostethus decoratus* (HAHN)											0.2	0.8								
29.	*Scolopostethus pilosus* (REUT.)					0.2	0.5														
30.	*Gastrodes abietum* (BERGR.)	0.2	0.1																		
31.	*Gastrodes grossipes* (De GEER)	1.6	0.7													0.8	1.1			0.4	0.3
32.	*Piesma capitatum* (WOLF)					0.2	0.2														
33.	*Piesma maculatum* (LAP.)													0.5	0.5			0.7	3.5		
34.	*Aradus cinnamomeus* (PANZ.)					0.2	0.5					1.3	5.1					5.1	25.4		
35.	*Saldula saltatoria* (L.)																	0.3	1.4		
36.	*Derephysia foliacea* (FALL.)	0.2	0.1																		
37.	*Rhinocoris annulatus* (L.)					0.4	1.0														
38.	*Himacerus apterus* (L.)	0.2	0.1	0.2	0.2	0.2	0.5													0.4	0.3
39.	*Nabis ferus* (L.)	0.6	0.3			1.1	2.7	0.8	1.4	0.2	0.5	2.4	9.4	0.2	1.0	1.4	1.7	8.5	0.4	0.3	
40.	*Nabis paeudaferus* REM.	0.2	0.1	0.4	0.4	2.3	5.7			0.2	0.5	0.7	2.8	0.2	0.2	0.3	0.4	0.2	1.0	0.4	0.3
41.	*Nabis punctatus* A. COSTA																			0.4	0.3
42.	*Nabis ericetorum* SCHOLTZ.							0.2	0.4									0.3	1.4		
43.	*Nabis rugosus* (L.)	0.2	0.2							0.2	0.5					0.2	0.3	0.2	1.0		
44.	*Myrmedobia exilis* (FALL.)					0.2	0.5					0.5	1.9				0.3	1.4	0.7		
45.	*Temnostethus pusillus* (H.-S.)	0.2	0.1	0.2	0.2			0.2	0.4					0.7	0.7						
46.	*Elatophilus nigricornis* (ZETT.)													0.50	0.5	0.7	0.7				
47.	*Elatophilus stigmatellus* (ZETT.)	1.2	0.5			0.7	1.7	0.4	0.7	0.6	1.6	0.4	1.6			0.5	0.7	0.3	1.4	0.4	0.3

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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
48.	*Elatophilus pini* (Bärenspr.)	0.4	0.2													0.2	0.3			0.4	0.3
49.	*Anthocoris nemorum* (L.)			0.2	0.2															0.4	0.3
50.	*Anthocoris confusus* Reut.	0.2	0.1												0.2	0.2					
51.	*Acompocoris pygmaeus* (Fall.)	1.2	0.5	0.8	0.9	0.2	0.5	0.4	0.7	0.4	1.0			2.9	2.8	1.2	1.6			1.1	0.7
52.	*Orius niger* Wolff					0.4	1.0							0.5	0.5					0.4	0.3
53.	*Orius minutus* (L.)																			3.0	1.9
54.	*Orius majusculus* (Reut.)	0.2	0.1									0.4	1.6								
55.	*Lyctocoris campestris* (F.)																	0.2	1.0		
56.	*Monalocoris filicis* (L.)					0.2	0.5														
57.	*Alloeotomus gothicus* (Fall.)	0.4	0.2			0.4	1.0	0.6	1.1											3.4	2.2
58.	*Alloeotomus germanicus* Wagn.	3.0	1.2	0.4	0.4	2.3	5.7	0.6	1.1	0.4	1.0					4.0	5.5	1.7	8.5	0.7	0.4
59.	*Stenodema calcaratum* (Fall.)							0.2	0.4			0.4	1.6			0.2	0.3	0.2	1.0		
60.	*Stenodema virens* (L.)	0.2	0.1	0.2	0.2			0.8	1.4	0.6	1.6	0.4	1.6	0.7	0.7	0.3	0.4	0.3	1.4	0.4	0.3
61.	*Stenodema laevigatum* (L.)											0.2	0.8					0.2	1.0		
62.	*Notostira elongata* (Geoffr.)									0.2	0.5							0.2	1.0		
63.	*Trigonotylus coelestialium* (Kirk.)					0.4	1.0														
64.	*Phytocoris longipennis* Flor					0.4	1.0					1.6	6.3	0.2	0.2						
65.	*Phytocoris dimidiatus* Kirschb.							0.2	0.4	0.4	1.0	0.2	0.8								
66.	*Phytocoris intricatus* Flor	0.4	0.2	0.4	0.4	2.6	6.4	0.2	0.4			0.2	0.8	0.9	0.9	0.2	0.3				
67.	*Phytocoris pini* Kirschb.	31.6	13.4	13.4	14.3	10.0	24.7	5.0	9.0	2.3	6.0	0.7	2.7	34.6	34.1	43.5	60.0	2.7	13.4	23.9	15.6
68.	*Phytocoris varipes* Boh.																			0.7	0.4
69.	*Adelphocoris lineolatus* (Goeze)																	0.2	1.0		
70.	*Calocoris biclavatus* (H.-S.)											0.2	0.8								
71.	*Calocoris fulvornaculatus* (De Geer)											0.2	0.8								
72.	*Calocoris affinis* (H.-S.)																			1.1	0.7
73.	*Stenotus binotatus* (F.)			0.2	0.2																
74.	*Dichrooscytus rufipennis* (fall.)			0.6	0.6	0.6	1.5							0.2	0.2					0.4	0.3
75.	*Lygus rugulipennis* (Popp.)	0.8	0.3	0.2	0.2	0.6	1.5	0.2	0.4	0.2	0.5	4.8	18.9			0.8	1.1	0.2	1.0		

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
76.	*Lygus pratensis* (L.)					0.4	1.0			0.4	1.0	0.2	0.7								
77.	*Lygus punctatus* (Zett.)									0.2	0.5					0.2	0.3				
78.	*Orthops cervinus* (H.-S.)													0.2	0.2	0.2	0.3				
79.	*Orthops rubricatus* (Fall.)			0.2	0.2																
80.	*Orthops viscicola* (Put.)	0.2	0.1																		
81.	*Carnpto zygum aequale* (Vill.)	10.8	4.6	3.9	4.2	3.2	7.9	1.8	3.2	1.5	3.9	1.1	4.3	0.9	0.9	0.8	1.1	2.0	9.9	8.2	5.3
82.	*Capsus ater* (L.)																			0.4	0.3
83.	*Halticus apterus* (L.)	0.2	0.1															0.2	1.0		
84.	*Orthotylus fuscescens* (Kirschb.)	1.2	0.5	0.2	0.2			0.2	0.4	0.6	1.6			2.9	2.8	0.3	0.4	0.3	1.4	1.9	1.2
85.	*Globiceps flavomaculatus* (F.)					0.7	1.7														
86.	*Blepharidopterus angulatus* (Fall.)	0.2	0.1													0.5	0.7			0.4	0.3
87.	*Dryophilocoloris flavoquadrimaculatus* (De Geer)							0.2	0.4												
88.	*Pilophorus cinnamopterus* (Kirschb.)											1.8	7.1								
89.	*Cremnocephalus albolineatus* Reut.							0.8	1.4	0.2	0.5	0.2	0.8								
90.	*Harpocera thoracica* (Fall.)			0.2	0.2							0.2	0.8								
91.	*Campylomma verbasci* (Mey. -D.)											0.2	0.8								
92.	*Chlamydatus pulicarius* (Fall.)	0.2	0.1																		
93.	*Chlamydatus pullus* (Reut.)	0.2	0.1																		
94.	*Phoenicocoris modestus* (Mey.-D.)	29.2	12.4	6.4	6.8	0.6	1.5	3.4	6.1					0.4						20.2	13.2
95.	*Phoenicocoris obscurellus* (Fall.)	42.6	18.0	32.9	35.1	8.1	20.0	25.4	45.7	22.0	57.1	4.4	17.3	40.2	39.6	13.6	18.7	1.8	9.0	49.6	32.4
96.	*Atractotómus mali* (Mey.-D.(					0.2	0.5														
97.	*Atractotomus magnicornis* (Fall.)	0.2	0.1	0.2	0.2			0.2	0.4											4.5	2.9
98.	*Psallus betu3eti* (Fall.)	0.2	0.1																		
99.	*Psallus perrisi* Muls	0.4	0.2	0.2	0.2	0.2	0.5														
100.	*Psallus* alnicola Dougl et Sc.															0.2	0.3				
101.	*Plesiodema pinetellum* (Zett.)	102.9	43.5	29.2	31.1	0.4	1.0	10.0	18.0	7.1	18.4	1.1	4.3	13.6	13.4	1.7	2.3			26.9	17.6
	Total	236.3		98.8		40.5		55.6		38.5		25.4		101.4		72.4		20.1		153.0	

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ZOOGEOGRAPHICAL ANALYSIS

In the herb layer of Polish pine forests, Euro-Siberian and Palearctic zoogeographical elements are abundant and occur in greater numbers than European and Holarctic elements (Tab. IV). This tendency is also shown in the *Heteroptera* communities in Puszcza Białowieska and Puszcza Biała. In Bory Tucholskie and Puszcza Biała, where fewer *Heteroptera* species are found, Holarctic elements are more than three times as abundant as all the remaining elements taken together (Tab. IV).

Table IV. Number (N) and abundance (n') of *Heteroptera* species representing the following zoogeographical elements found in the herb layer of pine forests.

Zoogeographical elements	Puszcza Białowieska		Puszcza Biała		Bory Tucholskie		Roztocze	
	N	n'	N	n'	N	n'	N	n'
Cosmopolitan			1	0.002			1	0.001
Holarctic	7	0.593	10	2.611	6	1.615	11	0.356
Palearctic	17	1.010	17	0.452	9	0.428	24	0.700
Euro-Siberian	20	0.719	14	0.259	12	0.148	22	0.584
European	6	0.195	7	0.100	7	0.126	10	0.125
Boreal	3	0.117	3	0.233	2	0.056	5	0.258
Sub-Mediterranean	6	0.016	2	0.005	2	0.004	4	0.149
Total	59	2.650	54	3.662	38	2.377	77	2.173

In the mature forest and pole wood tree canopy communities, European and Euro-Siberian elements have the greatest numbers of species, while in the canopies of young pines Palearctic and Holarctic elements are equally abundant (Tab. V). In older stands (mature forest, pole wood), Euro-Siberian elements are the most abundant; they constitute up to 77 per cent of a community. Only in pole wood communities of Bory Tucholskie is the abundance of European elements equally high. In young forest stands, the abundance of the above elements varies significantly; it is different in each region (Tab. V).

ECOLOGICAL ANALYSIS

In the herb layer of two pine forests – Roztocze and Bory Tucholskie – forest species of *Heteroptera* account for 54 per cent and 49.5 per cent, respectively, of all the species found there. The majority of the forest species are oligotopic. These reach particularly high abundance in Roztocze. In Bory Tucholskie, forest polytopes are a group of equally high abundance (Tab.VI).

In the other forests studied (Puszcza Białowieska and Puszcza Biała), forest species are less abundant (44 per cent and 43 per cent respectively), oligotopic forms being even less frequent. In Puszcza Białowieska, there are many dominant species that are not associated with coniferous forests, and because of this forest species' abundance is the lowest in this region (24 per cent).

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Table V. Number (N) and abundance (n') of *Heteroptera* species of the canopies of pines

Zoogeographical elements	Puszcza Białowieska						Puszcza Biała						Bory Tucholskie						Roztocze	
	mature forest		pole wood		young stand		mature forest		pole wood		pole wood		mature orest		pole wood		pole wood		mature forest	
	N	n'	N	n'	N	n'	N	n'	N	n'	N	n'	N	n'	N	n'	N	n'	N	n'
Cosmopolitan																	1	0.2		
Holarctic	6	1.8	3	0.8	4	1.5	3	2.8	2	0.4	7	4.3	1	0.7	3	0.9	8	6.7	4	1.6
Palearctic	5	2.0	6	1.2	8	3.9	5	1.8	4	1.4	7	8.4	4	1.4	4	2.2	5	3.0	4	4.2
Euro-Siberian	14	182.0	10	71.3	13	12.9	7	39.8	5	30.3	6	6.5	6	57.5	7	18.2	4	2.4	10	100.2
European	16	50.1	12	20.3	9	22.0	14	11.2	8	6.2	10	5.5	9	41.3	11	50.2	7	7.5	10	44.5
Boreal					1	0.2			1	0.2	1	0.5	1	0.5	2	0.7	1	0.3	1	0.7
Sub-Mediterranean			1	0.2							1	0.2			1	0.2			2	1.8
Total	41	236.3	32	93.8	35	40.5	29	55.6	20	38.5	32	25.4	21	101.4	28	72.4	26	20.1	31	153

Table VI. Number (N) and abundance (n') of *Heteroptera* species representing the following groups of environmental flexibility registered in the herb layer of pine forests

	Puszcza Białowieska		Puszcza Biała		Bory Tucholskie		Roztocze	
	N	n'	N	n'	N	n'	N	n'
Eurytopes	7	0.862	6	1.059	6	1.266	8	1.021
Polytopes:								
open areas	17	0.992	16	0.117	8.	0.078	15	0.112
forest areas	16	0.589	9	2.205	4	0.837	16	0.287
Oligotopes:								
open areas	6	0.100	7	0.024	4	0.010	11	0.033
forest areas	9	0.099	10	0.236	14	0.181	19	0.699
Stenotopes:								
open areas	3	0.006	2	0.005	1	0.002	1	0.001
forest areas	1	0.002	4	0.016	1	0.003	7	0.020
Total	59	2.650	54	3.662	38	2.377	77	2.173

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As far as the fauna of the herb layer is concerned, only 17 species can be associated with some particular coniferous forest plant species. Species typical of the forests studied are: *Elasmucha ferrugata, Stygnocoris pedestris, Lygus punctatus, Acalypta nigrina, Nabis ericetorum, Orthotylus ericetorum & Adelphocoris reicheli.* Only the first four species have high abundance indices, the remaining ones are not abundant or were only registered at some of the stands.

In the canopies of pines representing the two older age classes (mature forest and pole wood), forest species account for 80–65 per cent (forest stenotopes 35–26 per cent) of a community. Forest *Heteroptera* constitute 98–95 per cent of the total heteropteran fauna here. The abundance of these species, and especially of stenotopes, falls beneath this limit only in Bory Tucholskie.

The following species should be considered characteristic of – and most of them exclusive for – the canopies of pines: *Alloeotomus germanicus, A. gothicus, Phytocoris pini, Camptozygum aequale, Orthotylus fuscescens, Phoenicocoris obscurellus, Ph. modestus, Plesiodema pinetellum, Dichrooscytus rufipennis* as well as *Eremocoris abietis, E. plebejus & Gastrodes grossipes.* Some other species which are rare and not abundant in this layer and therefore not well-known also seem to be characteristic, but not necessarily exclusive. These are: *Pitedia pinicola, Elatophilus pini, E. nigricirnis, E. stigmatellus, Phytocoris intricatus & Cremnocephalus albolineatus.*

In the non-stable fauna of young pine forest stands, the contributions of the above stenotopic species vary and are lower in comparison with the tree crowns communities of older pine forests. Here, *Aradus cinnamoneus* is found to live on trunks of pines between 10 and 20 years of age. According to STRAWIŃSKI (1956), this is the only species that is characteristic of and exclusive for young stands.

ABUNDANCE FLUCTUATIONS

It is common for the herb layer communities in all the studied forests that their abundance is low or changes very little until mid-July or even until the end of this month (Fig. 3, 4). Sporadic rises in abundance noted in this period are due to the appearance of single species: the eurytopic *Stenodema laevigatum* in Puszcza Biała; *Elasmucha ferrugata* and *Lygus punctatus*, both characteristic of coniferous forests, in Roztocze. The season of high occurrence of heteropterans starts in August and ends in October. This is the season when the greatest numbers of species are found, including most of the dominants and especially their second generation which is more abundant than the first one.

Figures 5 and 6 show the abundance fluctuations of heteropterans inhabiting the crowns of the oldest pines.The abundance of these communities has a climax which lasts about 6 weeks. In 1986, this climax began at the turn of May and June, and in 1987 it started about two weeks later. The climax is mainly due to rises in the abundance of the four characteristic species. The earliest species appearing in all the four regions is *Plesiodema pinetellum* which appears at the beginning of June. The next species are *Phoenicocoris obscurellus* and sometimes *Ph. modestus.* The latest species of the four is *Phytocoris pini*, and this is usually the only species that is caught in greater numbers during the second half of

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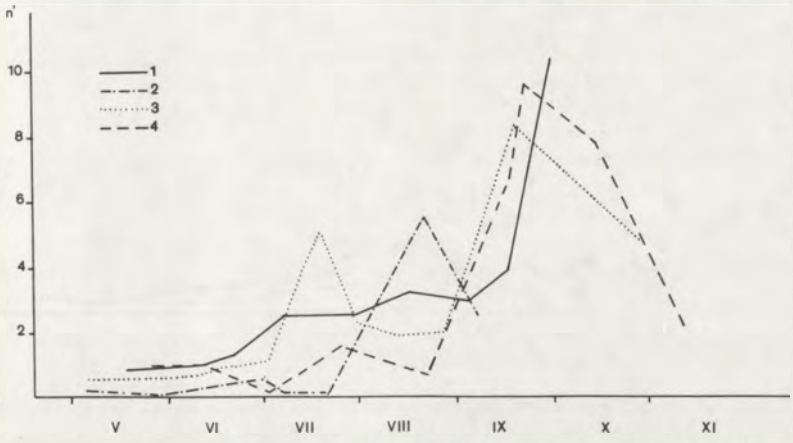

Fig. 3. Abundance fluctuations in the herb layer *Heteroptera* communities in 1986. n' – the index of abundance; 1 – Roztocze, 2 – Puszcza Białowieska, 3 – Puszcza Biała, 4 – Bory Tucholskie.

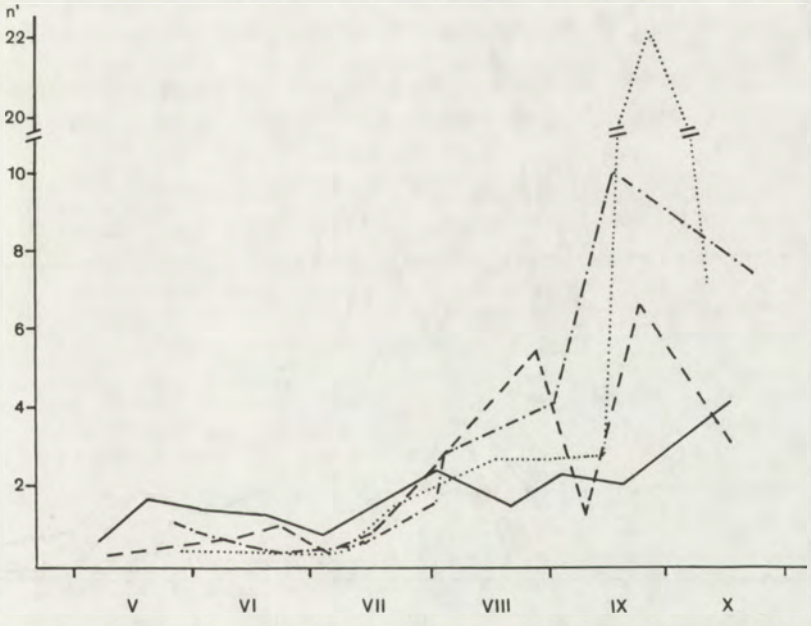

Fig. 4. Abundance fluctuations in the herb layer *Heteroptera* communities in 1987; denotation as in Fig. 3.

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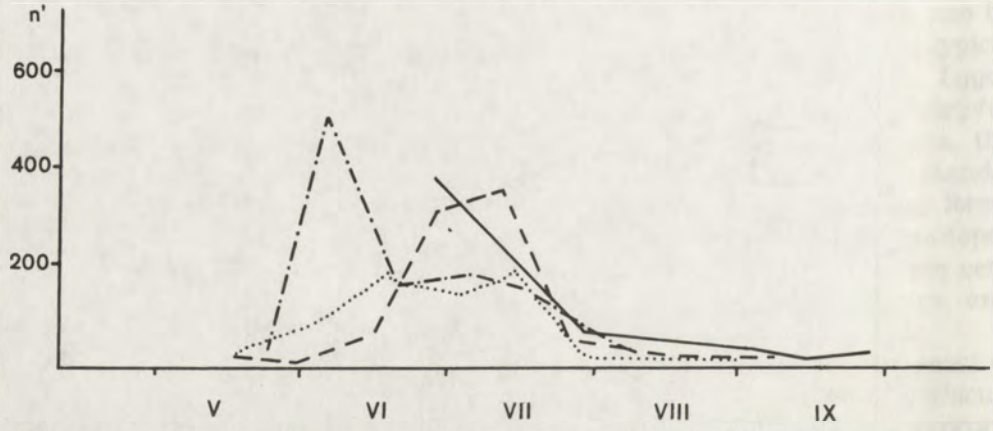

Fig. 5. Abundance fluctuations in the mature forest tree canopies communities of heteropterans in 1986; denotation as in Fig. 3.

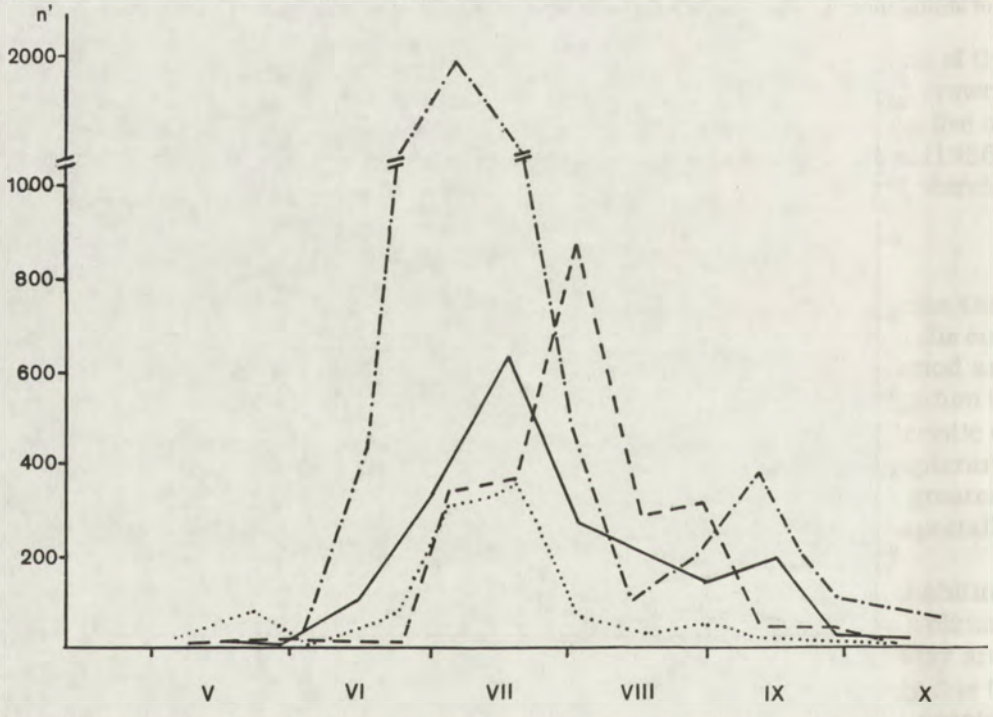

Fig. 6. Abundance fluctuations in the herb layer *Heteroptera* communities in 1987; denotation as in Fig. 3.

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Table. VII. Number (N) and abundance (n') of *Heteroptera* species representing the following zoogeographical elements found in the canopies of pines

	Puszcza Białowieska						Puszcza Biała						Bory Tucholskie						Roztocze	
	mature forest		pole wood		young stand		mature forest		pole wood		young stand		mature forest		pole wood		young stand		mature forest	
	N	n'	N	n'	N	n'	N	n'	N	n'	N	n'	N	n'	N	n'	N	n'	N	n'
Eurytopes	6	2.2	4	1.0	6	5.0	3	1.8	4	1.0	6	8.7	3	1.1	3	2.1	6	2.8	6	5.0
Polytopes:																				
open areas	4	0.8	3	0.8	4	2.4	4	2.2	2	0.4	4	1.0	1	0.5	3	0.6	5	1.6	3	1.2
forest areas	10	5.2	7	2.0	8	2.0	4	1.2	2	0.8	6	2.8	3	1.4	2	0.4	6	6.2	3	2.2
Oligotopes:																				
open areas			2	0.4	3	4.0	1	0.2	1	0.4	2	1.3					2	2.2	1	0.7
forest areas	10	46.4	6	18.9	6	13.6	7	8.2	4	4.4	9	5.3	7	39.7	11	48.0	3	3.3	7	38.9
Stenotopes:																				
forest areas	11	181.7	10	70.7	8	13.5	10	42.0	7	31.5	5	6.3	7	58.7	9	21.3	4	4.0	11	10.0
Total	41	236.3	32	93.8	35	40.5	29	55.6	20	38.5	32	25.4	21	101.4	28	72.4	26	20.1	31	153.0

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summer. The above species seldom co-occur (except *Phoenicocoris modestus*) and if so, they co-occur for a very short time.

In the first year of the research (1986), the abundance of heteropterans in the tree canopies was much lower than in the following year (1987). The low abundance of the *Heteroptera* fauna observed in 1986 could be partly due to the very severe winter of 1984/85. No signs of unfavourable influence of that winter can be seen as far as the abundance of the herb layer communities is concerned, but it must be noted that the number of *Heteroptera* species caught in each forest division of the studied coniferous forests was higher in 1987 than in 986.

SUMMARY

The heteropteran fauna of the herb layer of the studied pine forests has two radically distinct characteristics. On one hand, it is characterized by similarly high abundance indices of eurytopes and species widely distributed in a geographical sense. On the other hand, the structure of dominance differs in each region. Due to lack of data concerning the quantitative structure of *Heteroptera* communities of pine forests in the available literature, it is impossible to give a precise explanation for the data obtained. Further research and more data will possibly allow for the determination of the most important factors influencing the formation of a particular dominance structure of the herb layer heteropteran communities in pine forests.

The heteropteran fauna of the canopies of pines displays a similar structure in all the forests studied. In this layer of forest, oligotopes and forest stenotopes account for more than 95 per cent of the communities both in mature forest and pole wood communities. In young pine forest stands, the dominant species are eurytopes and polytopes as well as the same stenotopic species which are found to be dominant in older stands. Thus, the contribution of forest-characteristic species does not exceed 50 per cent of these communities.

Our findings show that the formation of the typical pine canopy fauna starts when the trees are still young, or even earlier (there are no data on the *Heteroptera* of pine shoots). Species characteristic of the canopies of pines may settle in young stands, although they seldom find favourable living conditions (presumably climatic), i.e. conditions similar to those present in the canopies of older trees. Therefore, the characteristic species are not abundant in the canopies of young pines. In addition, young pines are often inhabited by eurytopic and polytopic species which basically live in the herb layer. The older the forest stand, the higher is the abundance of the species typical of pines, the abundance of other species being constant. The structure of *Heteroptera* communities that is characteristic of the tree canopy layer is almost complete in 50-year-old forest stands and the only change observed in older stands is the rise in abundance of these insects.

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STRESZCZENIE

[Tytuł: Zgrupowania *Heteroptera* borów świeżych Polski]

W pracy przedstawiono wyniki badań jakościowych i ilościowych nad fauną pluskwiaków różnoskrzydłych *Heteroptera* borów świeżych (*Pseucedano-Pinetum* i *Leucobryo-Pinetum*) z czterech regionów Polski. Uwzględniono w nich owady zasiedlające warstwę runa oraz koron sosen z trzech klas wieku drzewostanu (starodrzew, drągowina, młodnik).

Ogółem, metodami dostosowanymi do odpowiedniego piętra lasu (czerpak entomologiczny w runie, pułapki Moericke'go w koronach), zebrano 10 955 osobników Heteroptera wśród których wyróżniono 165 gatunków. W runie stwierdzono 119 gatunków, w piętrze koron 101 (Tab. I, II, II). Dwa gatunki, *Elatophilus nigricornis* i *Orthops viscicola*, nie były dotychczas wykazywane z Polski.

W runie do dominantów (gatunki o udziale powyżej 5% liczebności zgrupowania) zaliczono 12 gatunków. Struktury dominacyjne zgrupowań występujących w Puszczy Białowieskiej i na Roztoczu charakteryzują się kilkoma gatunkami dominującymi. W zgrupowaniach z Puszczy Białej i z Borów Tucholskich pozycję dominantów zajmuje niewielka liczba gatunków, z nich jeden lub dwa stanowią ponad 50% liczebności całego zgrupowania (rys. 1). W runie stwierdzono największy udział gatunków eurosyberyjskich i palearktycznych. Również pod względem liczebności przeważają te same elementy w Puszczy Białowieskiej i na Roztoczu, natomiast w dwu pozostałych regionach (Puszcza

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Biała i Bory Tucholskie) zdecydowanie najwyższa jest liczebność gatunków o zasięgu holarktycznym (tab. IV). Strukturę ekologiczną zgrupowań pluskwiaków różnoskrzydłych runa cechuje wysoki udział eurytopów a minimalny – specyficznych gatunków borowych (stenotopów) (tab. VI).

Fauna *Hetroptera* koron sosen ma zbliżony charakter we wszystkich regionach. Dominują, zwłaszcza w starszych drzewostanach (starodrzew, drągowina), te same charakterystyczne dla piętra koron gatunki pluskwiaków (rys. 2).

W koronach sosen zarówno pod względem liczby gatunków jak i liczebności przeważają elementy europejskie przed eurosyberyjskimi oraz gatunki o wąskiej amplitudzie wymagań – stenotopy i oligotopy leśne (Tab. V, VII). Zgrupowania *Heteroptera* młodników mają, pod względem wszystkich uwzględnionych parametrów, charakter pośredni pomiędzy fauną runa i koron starszych wiekiem sosen (rys. 2, tab. V, VII). Wspólną cechą wszystkich badanych borów jest stopniowy wzrost liczebności pluskwiaków koron wraz ze wzrostem wieku drzewostanu.

Sezonowe zmiany liczebności mają odmienny charakter w odniesieniu do *Heteroptera* runa i koron sosen. W runie okres najwyższej liczebności przypada na przełom lata i jesieni, natomiast w koronach w okresie wczesnego lata (rys. 3, 4, 5, 6).

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