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ECOLOGICAL STRUCTURE OF LEAF-BEETLE ASSEMBLAGES (COLEOPTERA, CHRYSOMELIDAE) OF THE BUG VALLEY PLANT COMMUNITIES IN THE WŁODAWA–KODEŃ SECTION

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Summary. In the years 2005–2007, in the valley of middle Bug, studies on the structure of leaf--beetle assemblages inhabiting, *inter alia*, typical for this area and environmentally valuable moist habitats, were carried out. In total, the occurrence of 114 species was recorded. Most of them inhabited the riparian zone (49) and the least, mesoxerothermic and psammophilous (35). The highest biodiversity was reached in beetle communities of ruderal (2.88), moist meadows (2.59) whereas the smallest in fresh meadow (1.29). A characteristic feature of Chrysomelidae fauna from this section of the river is a high proportion of hydro, hygro-, and mesohygrophilic species in several plant communities and the complete lack of xerothermic species. Beetle assemblages are species-rich here, however dominated primarily by broad range elements (Holarctic, Palaearctic or Euro-Siberian) with a total of 82 species (71.2%) and 2606 specimens (79.91%). The tested segment of the riverbank is inhabited by a typical lowland fauna of Chrysomelidae, with the presence of very few rare species that were not previously listed either in the area of Belarus, or not distant Polesie National Park.

Key words: leaf-beetles, West Polesie, habitat corridor, the Bug Valley, moist biotopes

INTRODUCTION

The valley of the middle Bug, which is a part of the largest unregulated and characterised by the annual flooding river of Europe is under the care of several different forms of nature conservation. This is a specific area where beside natural plant communities, substantially altered by human activity biotopes are met. Currently, the main impact on the habitat have diverse climatic, hydrological and anthropogenic conditions. The entire border segment of the river (with Ukraine and Belarus) has a length of 363 km and is often divided into three sections: Volhynia, Polesie and Podlasie [Dombrowski *et al*. 2002]. According to the physiographic division of Poland, the analysed fragment belongs to West

Polesie, and the river constitutes the western border of two mesoregions: Kodeń Plain in the north and Włodawa Hummock in the south. Flat, partly marshy erosional plains and water-accumulation plains, belonging to the mixed broadleaf forest zone are the dominating landscape [Kondracki 2002].

High diversity of aquatic and terrestrial habitats of the Bug Valley indirectly promotes the richness of invertebrates. This relationship has been noted by many authors, as reflected in numerous publications, either as a larger fauna-ecological study, or the contributions to faunal analyses concerning only determining of the presence of specific taxa. In recent years, a few studies on various groups of arthropods in Polesie section, differing in terms of habitat conditions from Volyn and Podlasie sections have been published. They concerned terrestrial arachnids fauna [Hajdamowicz and Stańska 2006], water mites [Stryjecki 2009], selected groups of aquatic beetles and caddisflies [Buczyńska and Buczyński 2006], dragonflies [Buczyńska and Buczyński 2006, Buczyński 2012], as well as click beetles [Pawlęga 2011]. In 2010, the publication was released, in which the diversity of the Leaf beetle from the Bug River section between Hrubieszów and Drohiczyn was discussed in detail [Kubisz *et al*. 2010]. According to the authors, the total number of leaf-beetles known to inhabit the river valley amounts to 185 species. Volyn section is inhabited respectively by 70 species (15 of which exclusively in this segment of the river), Polesie section – 123 (31 exclusively) and Podlasie section 133 species (39 exclusively). This work is, however, the only one in which the multifaceted ecological analysis of Chrysomelidae assemblages inhabiting several types of riparian habitats in the middle section of the Bug River Valley was conducted and its detailed implementation was the overarching goal of this work. The focal point of the study were representative species of varied, in this area, hygroscopic and mesohygrophilic habitats, which group the river valley into the following communities: riparian, rushes and moist meadows. In addition, beetle assemblages of mesophilic habitats: fresh meadows and ruderal communities, as well as mesothermophilic (for mesoxerothermic and psammophilous) were analysed.

RESEARCH AREA

Chrysomelidae catches were conducted in six most representative plant communities set on a 65 km segment of the Bug River between Włodawa and Kodeń (Fig. 1). The following are all examined types of plant communities in nine villages populated by chrysomelid assemblages, with detailed information on community letter code, GPS coordinates and next station number:

1. riparian forests [le]: Szuminka, 51°35’18.76N 23°33’07.08E (1); 51°35’21.19N 23°33’09.85E (2); 51°35’22.86N 23°33’01.19E (3); Pawluki, 51°39’22.48N 23°32’18.73E (4); Dołhobrody, 51°40’26.24N 23°33’07.54E (5);

Hanna, 51°42’57.42N 23°30’17.98E (6); Sławatycze, 51°46’08.26N 23°34’39.61E (7); 51°45’35.28N 23°35’03.86E (8); Jabłeczna, 51°48’22.83N 23°38’17.61E (9); Szostaki, 51°50’33.98N 23°36’13.62E (10); Kodeń, 51°53’44.97N 23°35’53.91E (11);

2. rushes [sz]: Szuminka, 51°35’28.13N 23°33’00.85E (1); Pawluki, 51°39’27.01N 23°31’56.77E (2); Sławatycze, 51°46’08.78N 23°34’41.87E (3); Kodeń, 51°53’44.06N 23°35’49.12E (4);

3. moist meadows [wl]: Szuminka, 51°35’20.45N 23°32’53.38E (1); Pawluki, 51°39’28.83N 23°31’57.04E (3); Dołhobrody, 51°40’28.88N 23°32’43.31E (4); Jabłeczna, 51°48’23.92N 23°38’07.83E (5);

4. fresh meadows [sl]: Szuminka, 51°35’25.24N 23°33’02.96E (1); Pawluki, 51°39’30.23N 23°31’57.05E (2); 51°39’25.88N 23°32’19.96E (3); Dołhobrody, 51°40’27.05N 23°33’00.92E (4); Hanna, 51°42’28.95N 23°31’13.77E (5); Sławatycze, 51°46’05.61N 23°34’36.52E (6); Jabłeczna, 51°48’25.14N 23°38’13.31E (7); Kodeń, 51°55’02.51N 23°36’32.28E (8);

5. ruderal [ru]: Szuminka, 51°35’17.47N 23°33’05.88E (1); Pawluki, 51°39’28.96N 23°32’19.58E (2); Sławatycze, 51°46’08.32N 23°34’38.94E (3);

6. mesoxerothermic and psammophilous [mp]: 1) Szuminka, 51°35’22.12N 23°33’05.16E (1); Stawki, 51°38’52.19N 23°31’38.10E (2), 51°38’17.41N 23°31’22.32E (3); Dołhobrody, 51°40’28.22N 23°32’28.69E (4); Hanna, 51°42’56.43N 23°30’20.46E (5); Sławatycze, 51°45’37.03N 23°35’02.46E (6); Kodeń, 51°53’46.33N 23°35’51.70E (7).

RESEARCH METHODS

Detailed studies of leaf-beetles fauna were conducted from early May to late September (monthly on average) in 2005–2007. A scoop was used in order to catch beetles in each stand, additionally a beating tray was used only in willow riparian (*Salicetum triandro-viminalis*), which constituted a unique community covered only with shrubs. For the purpose of analysis of collected material, dominance of beetles in individual communities (D%) (Tab. 1), assemblage biodiversity (Shannon-Wiener index) [Shannon-Weaver 1949], the distribution of species evenness (J') [Pielou 1974], the similarity of the faunal assemblages (Bray-Curtis formula) [Bray and Curtis 1957] were calculated and a zoogeographic analysis was conducted. For a part of the calculation the free version of Biodiversity Pro [McAleece *et al*. 1997] was used. Chrysomelidae systematic arrangement in the summary table at the end of the work (Tab. 1) was adopted from Löbl and Smetana [2010] with minor changes proposed by Borowiec *et al*. [2011]. The division into zoogeographic components was based on the species range characteristics, described in the work of Borowiec [1984], Warchałowski [2003] and Löbl and Smetana [2010], the names and the distribution of range

types were taken from Wąsowska [1994] and Pawłowski *et al*. [1994]. The majority of data of the leaf-beetle species preferences in relation to the degree of humidity of habitats were taken from Kubisz *et al*. [2010].

RESULTS

In particular plant communities of the valley of the middle Bug a total of 3312 specimens of Chrysomelidae were caught, and 114 species distinguished; these represent 23.41% of Polish fauna of leaf-beetles and up to 55.1% of the fauna of Podlasie (Polesie), included in the *Catalogue of Fauna of Poland*. From the quantitative analysis 51 undetectable taxa were excluded: *Altica sp*. (21 ♀), *Chaetocnema concinna / picipes* (28 ♀) and *Longitarsus succineus / noricus* (2♀). In the examined area, assemblages of Chrysomelidae from hygro- and mesohygrophilic habitats: riparian (49 species, 1183 specimens), and subsequently moist meadows (44 species, 337 specimens) and rushes (43 species, 316 specimens) were characterised by the highest number of species. Mesophilic habitats: fresh meadows (42 species, 1004 specimens), ruderal (35 species, 90 specimens) and mesothermophilic: mesoxerothermic and psammophilous (35 species, 331 specimens) were proved slightly poorer (Tab. 1).

The highest biological diversity (H') was characteristic of the following areas of chrysomelid assemblages: ruderal (2.88), moist meadows (2.59), rushes (2.44), riparian forests (2.34), followed by mesoxerothermic and psammophilous communities (1.96) and fresh meadows (1.29). In the case of species evenness indicator (J') the highest value for the actual diversity (0.81) was found in an assemblage of Chrysomelidae ruderal communities, characterised by their relative evenness despite small quantity. In the fresh meadows assemblage, species evenness was the lowest, only 0.35 (Fig. 2). Unquestionable impact on the mentioned fact – in the case of the last plant community – has the presence of a few dominant species and the preying on various species of rumex, eudominant *Gastrophysa viridula* (D = 74.9%) (Tab. 1).

The highest fauna similarity (50%) was characteristic of beetle assemblages of moist meadows and rushes communities. These communities interact (or interweave) with each other in the valley of the river, particularly frequently in places exposed to periodical flooding, therefore moving between these communities does not pose problems for the beetles. For oligophagous species moisture conditions in the plant community are more important than the food base. The biggest difference in fauna composition concerned riparian, mesoxerothermic and psammophilous beetle assemblages. This is understandable due to the fact that these communities are not adjacent to each other in the field and temperature conditions, and indirectly the moisture, gather other species of Chrysomelidae from various environmental groups (Fig. 3).

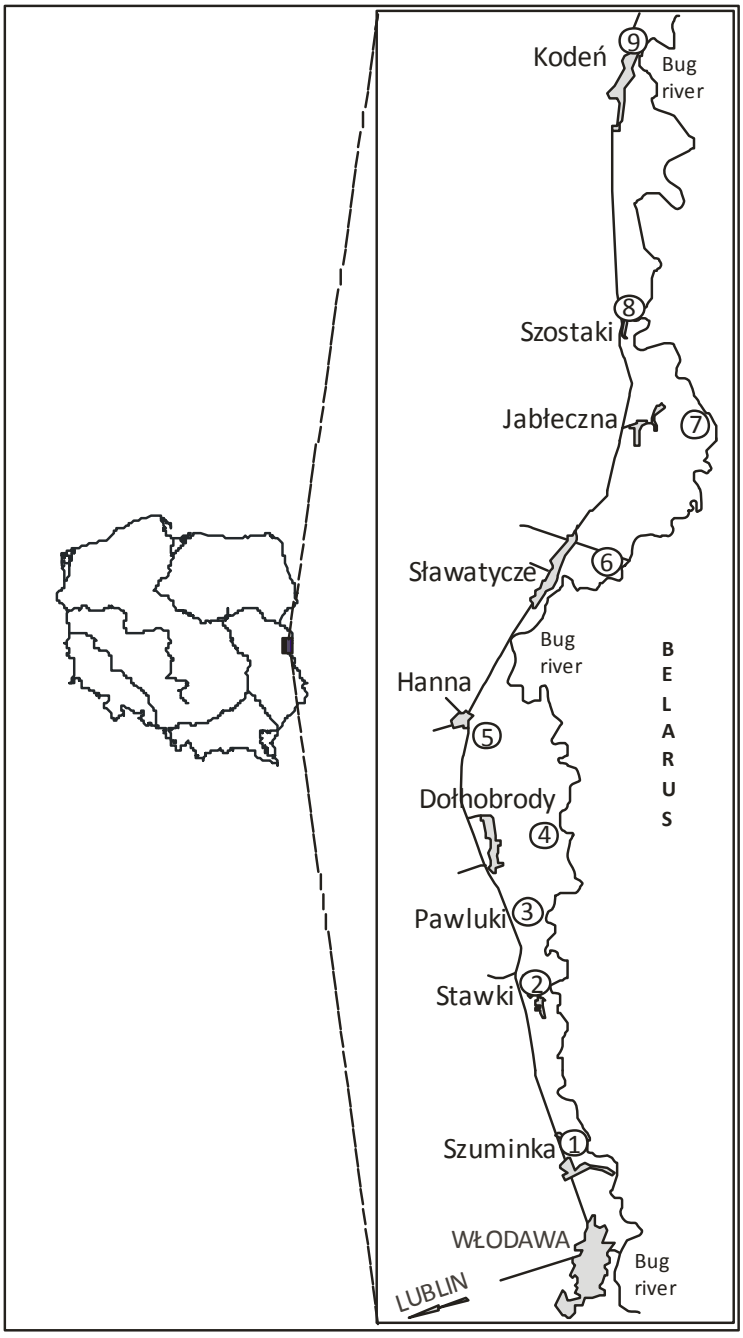

Fig. 1. List of villages in the valley of the Bug River with the research sites

Table 1. List of leaf-beetle species (taxa) collected in plant communities of the Bug river valley. SD – chorotypes (zoogeographical elements); L – total abundance; D% – dominance structure (in per cent); plant communities: le – riparian forests; almond willow-osier scrubs (*Salicetum triandro-viminalis*), sz – rushes, wl – moist meadows, sl – fresh meadows, ru – ruderal communities, mp – mesoxerotermic and psammophilous communities. Designations of chorotypes acc. Fig. 4 (in text)

No.	Species/Taxa	PS	SD	le		sz		wl		sl		ru		mp	
				L	D%	L	D%	L	D%	L	D%	L	D%	L	D%
1	*Donacia bicolora* Zschach, 1788	hd	zP			1	0.32								
2	*Donacia cinerea* Herbst, 1784	hd	zP			1	0.32								
3	*Donacia marginata* Hoppe, 1795	hd	zP			3	0.95								
4	*Donacia semicuprea* Panzer, 1796	hd	E			101	31.96	4	1.19	65	6.47				
5	*Donacia simplex* Fabricius, 1775	hd	P			2	0.63								
6	*Plateumaris sericea* (Linnaeus, 1760)	hg	P			2	0.63								
7	*Lema cyanella* (Linnaeus, 1758)	mh	P									1	1.11		
8	*Oulema duftschmidi* (Redtenbacher, 1874)	m	E					1	0.30					1	0.30
9	*Oulema gallaeciana* (Heyden, 1870)	m	ES	1	0.08					5	0.50	4	4.44		
10	*Oulema melanopus* (Linnaeus, 1758)	m	H					1	0.30	5	0.50	1	1.11	1	0.30
11	*Cassida denticollis* Suffrian, 1844	mt	ES	1	0.08							1	1.11	5	1.51
12	*Cassida flaveola* Thunberg, 1794	mt	H			2	0.63								
13	*Cassida margaritacea* Schaller, 1783	mt	ES											9	2.72
14	*Cassida murraea* Linnaeus, 1767	m	P									2	2.22		
15	*Cassida nebulosa* Linnaeus, 1758	m	H	1	0.08					1	0.10				
16	*Cassida prasina* Illiger, 1798	m	P	1	0.08	1	0.32			2	0.20	1	1.11	11	3.32
17	*Cassida rubiginosa* Müller, 1776	m	H			1	0.32	6	1.78			1	1.11	1	0.30
18	*Cassida rufovirens* Suffrian, 1844	mt	pE											2	0.60
19	*Cassida sanguinolenta* Müller, 1776	mt	P			1	0.32	1	0.30	20	1.99	3	3.33	1	0.30
20	*Cassida sanguinosa* Suffrian, 1844	m	P			1	0.32			1	0.10			1	0.30
21	*Cassida stigmatica* Suffrian, 1844	m	P	1	0.08										
22	*Cassida vibex* Linnaeus, 1767	m	P							1	0.10				
23	*Cassida viridis* Linnaeus, 1758	mh	P	3	0.25	3	0.95	4	1.19	1	0.10				
24	*Cassida vittata* Villers, 1789	m	P	1	0.08							1	1.11	3	0.91
25	*Hypocassida subferruginea* Schrank, 1776	mt	P											1	0.30

26	*Chrysomela saliceti* Weise, 1884	mh	zP	66	5.58										
27	*Chrysomela vigintipunctata* (Scopoli, 1763)	m	P	2	0.17										
28	*Plagiodera versicolora* (Laicharting, 1781)	mh	H	28	2.37										
29	*Plagiosterna aenea* (Linnaeus, 1758)	mh	P	3	0.25										
30	*Phratora vulgatissima* (Linnaeus, 1758)	m	P	173	14.62					1	0.10	1	1.11		
31	*Phratora tibialis* (Suffrian, 1851)	m	E	266	22.49	1	0.32					5	5.56		
32	*Gastrophysa polygoni* (Linnaeus, 1758)	m	H	2	0.17	1	0.32	1	0.30	1	0.10	1	1.11	1	0.30
33	*Gastrophysa viridula* (De Geer, 1775)	m	H	41	3.47	28	8.86	51	15.13	752	74.90	29	32.22	6	1.81
34	*Phaedon armoraciae* (Linnaeus, 1758)	m	H									1	1.11		
35	*Phaedon cochleariae* (Fabricius, 1792)	m	zP	5	0.42	8	2.53	8	2.37						
36	*Prasocuris junci* (Brahm, 1790)	hg	E							1	0.10				
37	*Prasocuris marginella* (Linnaeus, 1758)	hg	b	1	0.08	2	0.63								
38	*Prasocuris phellandrii* (Linnaeus, 1758)	hg	H			2	0.63	65	19.29						
39	*Chrysolina graminis* (Linnaeus, 1758)	m	ES	2	0.17	2	0.63	6	1.78	5	0.50				
40	*Chrysolina herbacea* (Duftschmid, 1825)	mh	pES					1	0.30						
41	*Chrysolina polita* (Linnaeus, 1758)	mh	P	2	0.17	2	0.63	1	0.30	1	0.10	1	1.11		
42	*Chrysolina varians* (Schaller, 1783)	mt	H											6	1.81
43	*Gonioctena quinquepunctata* (Fabricius, 1787)	m	E	12	1.01										
44	*Galeruca pomonae* (Scopoli, 1763)	mt	H											1	0.30
45	*Galeruca tanaceti* (Linnaeus, 1758)	mt	P							2	0.20				
46	*Galerucella calmariensis* (Linnaeus, 1767)	hg	P			26	8.23	39	11.57	6	0.60				
47	*Galerucella grisescens* (Joannis, 1865)	hg	P	1	0.08	1	0.32	1	0.30						
48	*Galerucella lineola* (Fabricius, 1781)	mh	P	24	2.03					1	0.10				
49	*Galerucella pusilla* (Duftschmid, 1825)	mh	ES			8	2.53	2	0.59						
50	*Galerucella tenella* (Linnaeus, 1760)	hg	ES			5	1.58	1	0.30	11	1.10				
51	*Lochmaea caprea* (Linnaeus, 1758)	m	P			1	0.32								
52	*Lochmaea crataegi* (Forster, 1771)	mt	zP											2	0.60
53	*Agelastica alni* (Linnaeus, 1758)	mh	H	83	7.02	3	0.95	2	0.59	7	0.70				
54	*Phyllobrotica quadrimaculata* (Linnaeus, 1758)	hg	E					1	0.30						
-	*Altica* n, det ♀ (females)	-													
55	*Altica oleracea* (Linnaeus, 1758)	m	P											1	0.30

56	*Altica tamaricis* Schrank, 1785	mh	ES	1	0.08										
57	*Aphthona euphorbiae* (Schrank, 1781)	mt	zP					1	0.30						
58	*Aphthona lutescens* (Gyllenhal, 1813)	hg	zP	2	0.17	1	0.32	5	1.48			2	2.22	1	0.30
59	*Aphthona nonstriata* (Goeze, 1777)	mh	ES	1	1.08	70	22.15	75	22.26	3	0.30				
-	*Chaetocnema concinna/picipes* ♀ (females)	-													
60	*Chaetocnema aridula* (Gyllenhal, 1827)	m	P							2	0.20	2	2.22	6	1.81
61	*Chaetocnema concinna* (Marsham, 1802)	m	H					1	0.30			1	1.11		
62	*Chaetocnema hortensis* (Geoffroy, 1785)	m	P			1	0.32			3	0.30	1	1.11		
63	*Chaetocnema mannerheimii* (Gyllenhal, 1827)	mt	ES	1	0.08	3	0.95	11	3.26						
64	*Chaetocnema semicoerulea* (Koch, 1803)	mh	P	45	3.80	1	0.32								
65	*Crepidodera aurata* (Marsham, 1802)	m	P	297	25.11	1	0.32	1	0.30	3	0.30	2	2.22		
66	*Crepidodera fulvicornis* (Fabricius, 1792)	m	P	65	5.49			1	0.30			1	1.11		
67	*Crepidodera plutus* (Latreille, 1804)	mh	P	9	0.76					2	0.20				
68	*Epitrix pubescens* (Koch, 1803)	mh	ES	7	0.59	1	0.32	3	0.89			1	1.11		
69	*Hippuriphila modeeri* (Linnaeus, 1760)	hg	P			12	3.80			7	0.70				
-	*Longitarsus succineus/noricus* ♀ (females)	-													
70	*Longitarsus brunneus* (Duftschmid, 1825)	mh	P					1	0.30						
71	*Longitarsus kutscherai* (Rye, 1872)	m	P							1	0.10				
72	*Longitarsus longiseta* Weise, 1889	m	P							2	0.20				
73	*Longitarsus luridus* (Scopoli, 1763)	m	H					2	0.59	13	1.29	3	3.33		
74	*Longitarsus lycopi* (Foudras, 1860)	mh	zP									1	1.11		
75	*Longitarsus melanocephalus* (De Geer, 1775)	m	zP			1	0.32	1	0.30	22	2.19	4	4.44	2	0.60
76	*Longitarsus nasturtii* (Fabricius, 1792)	m	ES	2	0.17										
77	*Longitarsus parvulus* (Paykull, 1799)	mh	zP							1	0.10				
78	*Longitarsus pratensis* (Panzer, 1794)	m	H					2	0.59	5	0.50	1	1.11		
79	*Longitarsus rubiginosus* (Foudras, 1860)	m	H											4	1.21
80	*Longitarsus succineus* (Foudras, 1860)	m	P							1	0.10				
81	*Longitarsus tabidus* (Fabricius, 1775)	mt	zP											2	0.60
82	*Lythraria salicariae* (Paykull, 1800)	hg	P	1	0.08			15	4.45			2	2.22		
83	*Neocrepidodera ferruginea* (Scopoli, 1763)	m	ES			3	0.95	1	0.30	4	0.40				
84	*Neocrepidodera motschulskii* Konstantinov, 1991	mh	bg							1	0.10				
85	*Neocrepidodera transversa* (Marsham, 1802)	m	ES	1	0.08	1	0.32	2	0.59	1	0.10				

86	*Phyllotreta armoraciae* (Koch, 1803)	m	H					1	0.30						
87	*Phyllotreta atra* (Fabricius, 1775)	m	zP			2	0.63	1	0.30						
88	*Phyllotreta cruciferae* (Goeze, 1777)	m	H	1	0.08					1	0.10				
89	*Phyllotreta dilatata* Thamson, 1866	mh	ES	2	0.17			1	0.30						
90	*Phyllotreta nemorum* (Linnaeus, 1758)	m	P	1	0.08	3	0.95					6	6.67	1	0.30
91	*Phyllotreta ochripes* (Curtis, 1837)	m	ES			3	0.95	1	0.30						
92	*Phyllotreta striolata* (Illiger, 1803)	m	H	1	0.08	1	0.32	4	1.19			1	1.11		
93	*Phyllotreta tetrastigma* (Comolli, 1837)	hg	ES	1	0.08										
94	*Phyllotreta undulata* (Kutschera, 1860)	m	H	1	0.08			4	1.19						
95	*Phyllotreta vittula* (Redtenbacher, 1849)	m	H	3	0.08	2	0.63	1	0.30	9	0.90	1	1.11	1	0.30
96	*Psylliodes affinis* (Paykull, 1799)	mh	H	8	0.68			1	0.30						
97	*Psylliodes cucullata* (Illiger, 1807)	mt	P	1	0.08							2	2.22	23	6.95
98	*Psylliodes dulcamarae* (Koch, 1803)	mh	ES	2	0.17										
99	*Psylliodes picina* (Marsham, 1802)	mh	E			1	0.32								
100	*Sphaeroderma testaceum* (Fabricius, 1775)	m	H	1	0.08			3	0.89			1	1.11		
101	*Coptocephala unifasciata* (Scopoli, 1763)	mt	pES											5	1.51
102	*Labidostomis longimana* (Linnaeus, 1760)	mt	pES							2	0.20			3	0.91
103	*Labidostomis tridentata* (Linnaeus, 1758)	mt	ES											3	0.91
104	*Cryptocephalus aureolus* Suffrian, 1847	mt	ES	1	0.08					1	0.10			3	0.91
105	*Cryptocephalus bilineatus* (Linnaeus, 1767)	mt	P							6	0.60				
106	*Cryptocephalus chrysopus* Gmelin, 1790	mt	pE											2	0.60
107	*Cryptocephalus frenatus* Laicharting, 1781	mh	pE	1	0.08										
108	*Cryptocephalus fulvus* (Goeze, 1777)	mt	P							25	2.49	3	3.33	191	57.70
109	*Cryptocephalus janthinus* Germar, 1824	hg	pES					2	0.59						
110	*Cryptocephalus labiatus* (Linnaeus, 1760)	m	E											1	0.30
111	*Cryptocephalus moraei* (Linnaeus, 1758)	mt	ES											1	0.30
112	*Cryptocephalus ocellatus* Drapiez, 1819	m	P	7	0.59							1	1.11		
113	*Cryptocephalus pygmaeus* Fabricius, 1792	mt	pE											15	4.53
114	*Cryptocephalus sericeus* (Linnaeus, 1758)	mt	pES									1	1.11	14	4.23
	Total		-	1183		316		337		1004		90		331	

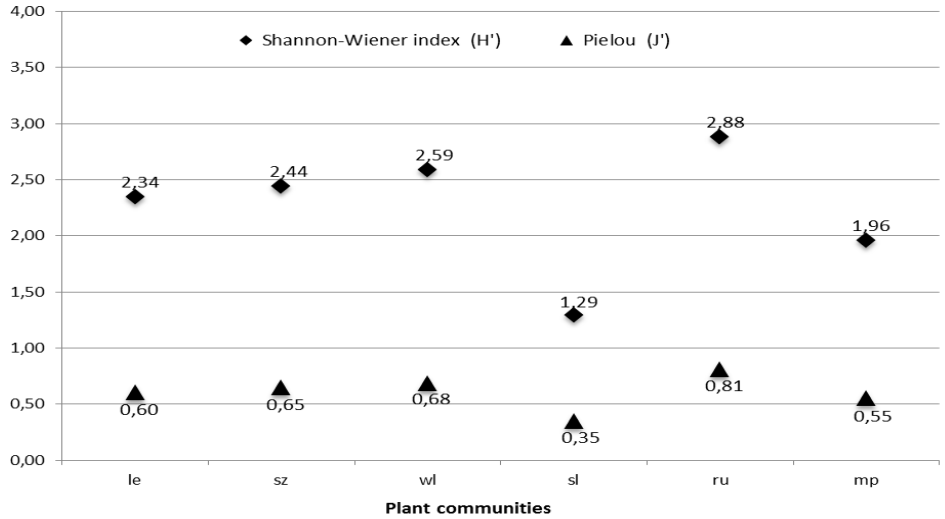

Fig. 2. Comparison of diversity of species assemblages (Coleoptera, Chrysomelidae) in studied plant communities using the Shannon-Wiener index (H') and Pielou formula (J'); le – marshy meadow, sz – rushes, wl – moist meadows, sl – fresh meadows, ru – ruderal communities, mp – mezoxerothermic and psammophilous communities

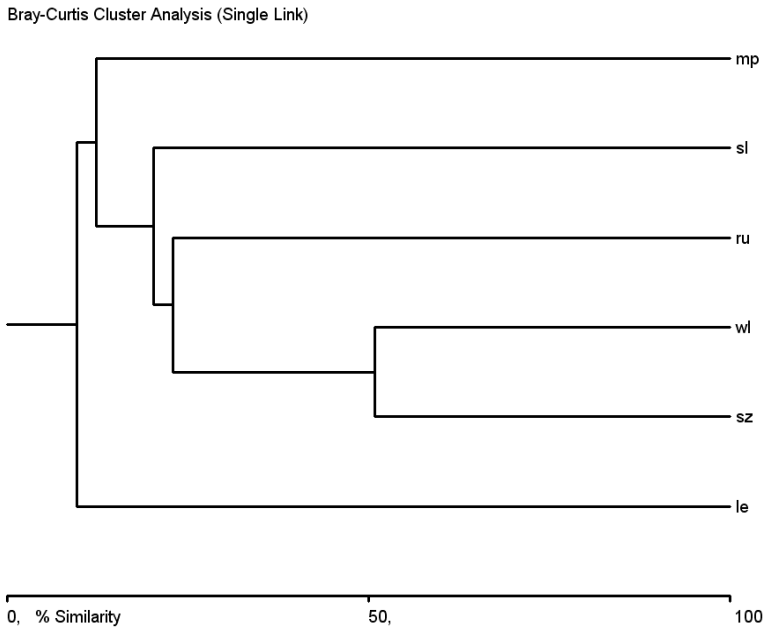

Fig. 3. Faunistic similarity of Chrysomelidae assemblages in Bug river valley among studied plant communities based on Bray-Curtis formula (grouping object, the method of individual connections). Designation of plant communities acc. Fig. 2

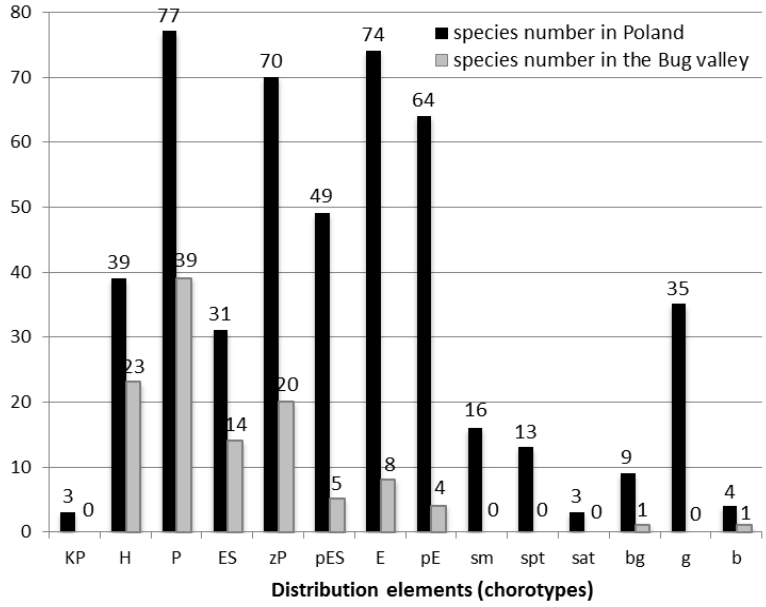

Fig. 4. Number of Chrysomelidae species representing different range of distribution in the Bug river valley (B) against the Polish fauna of Chrysomelidae (A). Designations of the reach: KP – Cosmopolitan, H – Holarctic, P – Palaearctic, zP – western Palaearctic, ES – Eurosiberian, pES – South-Eurosiberian, E – European, pE – South-European, sm – Submediterranean, spt – Subpontic, sat – Subatlantic, bg – Boreo-mountain, g – Mountain, b – Boreal

The number of caught taxa should be considered high comparing to national Chrysomelidae fauna, especially given the absence of bioindicator species: mountain, subpontic and submediterranean, with a total share in Poland of over 13%. Leaf-beetles fauna in the middle Bug Valley is dominated by widely spread species (H, P, ES), whose percentage of qualitative share against Polish fauna was equal to 58.97%, 50.65% and 28.57% respectively (Fig. 4). 82 eurytopic species belonging to this range group (wide), constitute in total – qualitatively 71.92% and quantitatively 79.91% of caught up taxa (Fig. 5).

A vast majority of leaf beetle species present in Poland are mesophiles, with the preference for medium-moist and open biotopes [Warchałowski 1975, Borowiec 1987]. The studied middle section of the Bug Valley is, in addition to mesophilic, home to hydrophilic, hygrophylic, and mesohygrophilic species, which results from its higher diversity as compared to Volhynia or Podlasie sections of the river. After mesophiles, these constitute the second most numerous group in the region (42.11% of caught species and 61.45% of specimens) to have found optimum living conditions in the studied riparian assemblages, significantly increasing their biodiversity. The total percentage of hygrophylic species in the studied area was equal to 36.84%, whereas the quantitative – 26.94% (Fig. 7).

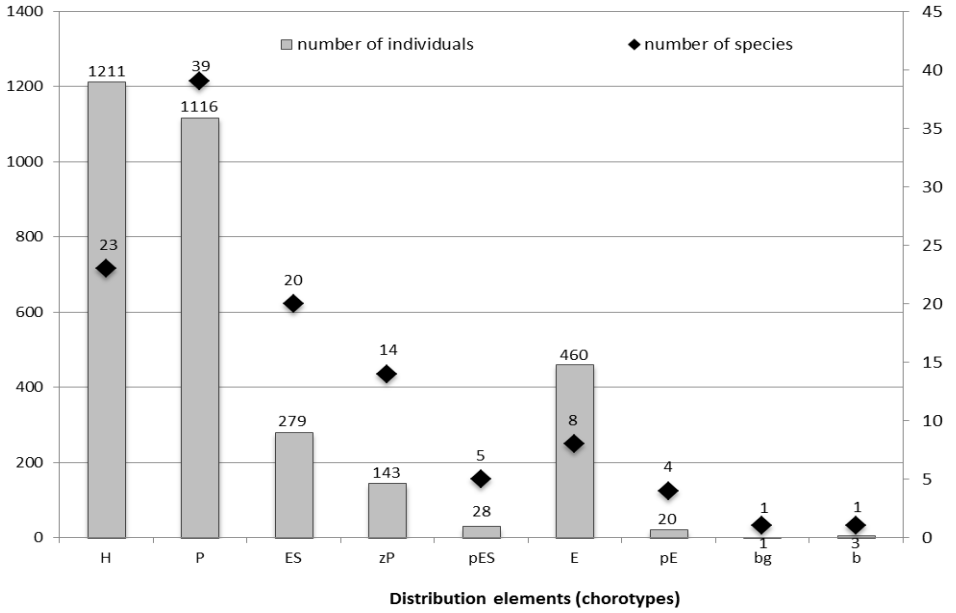

Fig. 5. Zoogeography of Chrysomelidae in investigated area. Designation of zoogeographical elements acc. Fig. 2

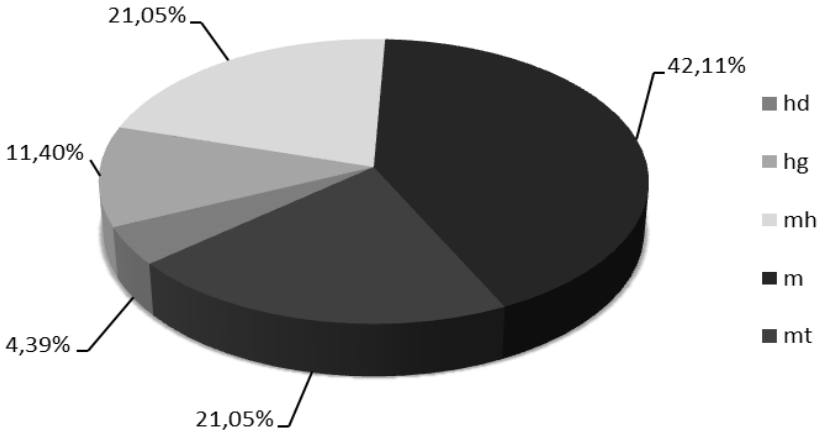

Fig. 6. The quantitative share of Chrysomelidae species with particular habitat preferences

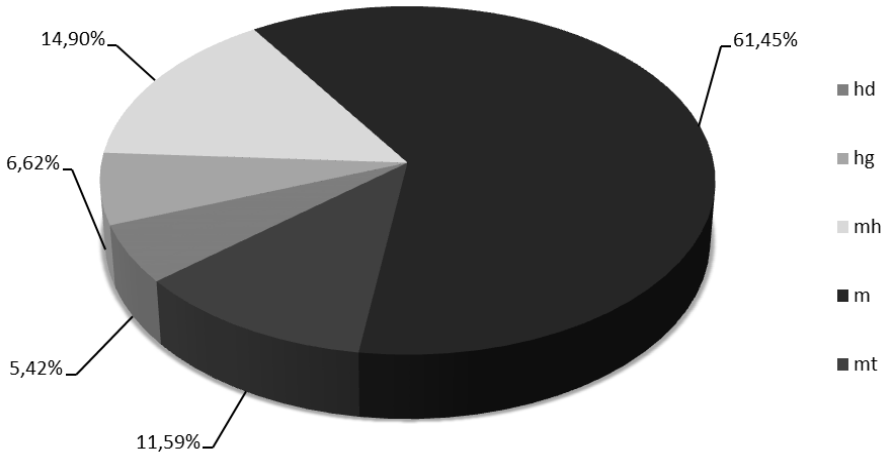

Fig. 7. The qualitative share of Chrysomelidae species with particular habitat preferences

DISCUSSION

The species-rich beetle family, Chrysomelidae constitutes an important source of biocenological research. The species representatives demonstrate significant affiliation to certain types of biotopes, usually on the level of higher phytosociological units (order and higher), and reflect changes within them [Borowiec 1987]. It is for that reason that this species can be used in evaluation of negative developments in both predominantly natural and man-made habitats (*e.g.* meadows) [Wąsowska 1989], thus providing an invaluable tool for preliminary assessment of habitat quality, and consequently the suitability of whole areas.

According to *Catalogue of Fauna of Poland* [Burakowski *et al*. 1990, 1991], the chrysomelid fauna of the Podlasie and Polesie regions, is well-known. Until recently, however, they were among the least-studied zoographical regions in Poland. Up until the 1990s there were only 47 species of Chrysomelidae recorded in the area, with the exclusion of Bruchidae, a former family and at present a subfamily of Chrysomelidae. Recent faunistic works have introduced 160 new species into the region [Pietrykowska and Staniec 1997] – 13 species, [Borowiec 2003] – 12 species, [Ścibior and Pietrykowska-Tudruj 2008] – 8 species, [Ścibior *et al*. 2008] – 1 species, [Ścibior and Pietrykowska-Tudruj 2010] – 77 species, and [Ścibior 2010] – 49 species, which accounts for 207 species (42.5% Chrysomelidae fauna in Poland). The last of the cited studies has proved 9 new species to be ecdemic to the Podlasie/Polesie region, and originating precisely in the middle section of the Bug Valley, which comprise the following: *Donacia bicolora, Cryptocephalus chrysopus, Prasocuris junci, Lochmaea crataegi, Phyllotreta armoraciae, P. tetrastigma, Crepidodera plutus, Chaetocnema semicoerulea*

and *Cassida stigmatica*. Virtually all of the aforementioned taxa are Chrysomelidae of moist biotopes, typical of the studied river section.

Ecological studies of open-biotope leaf-beetles assemblages have been developing since the 1960s, with a few researchers involved: Stypa-Mirek [1960], Żurańska [1962], Warchałowski [1975], Borowiec [1987], Wąsowska [1989, 1994], Ścibior [2003, 2004a, 2004b, 2010] and Ścibior and Dunus [2006]. The Chrysomelidae zoocenoses of Lubelszczyzna region are to a certain extent identified, particularly in the following regions: Roztocze [Wąsowska 1994], „Lasy Janowskie" Landscape Park [Ścibior 2003, 2004a, 2004b], Kozłowiecki Landscape Park [Ścibior and Dunus 2006] and Poleski National Park [Ścibior 2010].

The majority of present research regarding chrysomelid fauna in the Bug Valley focused on two sections of the river, Volhynia and Podlasie, with banks of limestone substrate and xerothermic flora (*e.g.* Czumów, Gródek, Mielnik). The middle region has thus far been disregarded in entomological studies due to a scant percentage of thermophile environments, which are characterised by high focus of stenotopic species of southern distribution and in Poland frequently reach their northern or north-western range [Kubisz *et al*. 2010]. Such biotopes are virtually nonexistent in the Polesie section, therefore this study failed to report any catchment of typically xerothermophilic species of sub-Pontian and sub--Mediterranean distribution. Species characterised by higher thermal optima (thermophilic and mesothermophilic) representing Euro-Siberian and southern--European elements (Fig. 4, Table 1) are found in sunlit and warm psammophile associations formed in the riparian and forest dunes. The Chrysomelidae of the moist biotope fauna demonstrates marked resemblance to the fauna of Poleski National Park [Ścibior 2010], which can be attributed to a small distance between both regions and unconfined latitudinal spread of the species.

Ruderal communities in the area in question display certain biodiversity, are found in areas subject to synatropisation and are commonly of mosaic structure [Dombrowski 2002]. The highest index of Chrysomelidae species biodiversity observed in the present study in the unnatural biotope is a consequence of a marked presence of numerous mesophiles, typical of the biotope, on the one hand, and migration from adjacent biotopes of other heliophilous and oligophagous eurytopic species, which find here favourable conditions, on the other hand.

112 out of 114 leaf-beetles species (98.24%) can be found in Belarus [Aleksandrovich *et al*. 1996]. The remaining two mesothermophilic *Cassida rufovirens* and *Cryptocephalus pygmaea ab. vittula*, although their presence in Belarusian habitats is certain, based on the species distribution, are yet to be found [Warchałowski 1991, 2000].

Similar studies of Chrysomelidae assemblages, characteristic of the middle Bug Valley moist and meadow biotopes, have been carried out in other regions of Poland [Warchałowski 1975, Borowiec 1987, Wąsowska 1989, 1994, Ścibior 2003, 2004a, 2004b, 2010, Ścibior and Dunus 2006]. Depending on the area, its floral structure

and soil moist levels, the habitats demonstrate characteristic structure and quantity of beetle species, sharing, however, the constant and typical group of dominant species. To compare the results with other studies is difficult due to several reasons, such as the discrepancy in the study area size in the terrain, as well as in the regions, and secondly, for the fact that frequently, particular meadow catchments (fresh or moist) are differently grouped and divided by individual entomofauna researchers. In the case of riparian forests (*Salicetum triandro-viminalis*) the number of Chrysomelidae specimens outweighs the results obtained in the former study (33) in the Polesie National Park [Ścibior 2010]. An analogous number of species (49) was observed in „Lasy Janowskie" Landscape Park [Ścibior 2004a], nevertheless, the catchment area additionally included the *Circaeo-Alnetum*.

In comparison, the number of species (44) from the present study of *Chrysomelidae* assemblage of moist meadows in Poland should be regarded as high. The highest quantitative result thus far (97) was noted by Warchałowski [1975] in the vicinity of Muszkowicki Las Bukowy Nature Reserve, nevertheless, the researcher combined, instead of approaching separately, the area's fresh and moist meadows and a plant community surrounding one of the reservoirs. Similarly in the Chrysomelidae studies of Wąsowska [1994] and Ścibior [2003] conducted in the similar biotope of Roztocze and Lasy Janowskie region, the results were grouped for moist meadows and mud sedges, with the total amount of 85 and 77 species respectively. Furthermore, 55 species found by Borowiec [1987] in Łąka Sulistrowicka Nature Reserve were caught at unspecified locations of *Molinietalia caerulae* plant communities in both moist meadows and of variable moisture content. Moist meadow catchment had thus far produced weaker results in comparison to the present Bug Valley study, *i.e.* 35 in Polesie National Park [Ścibior 2010] and 20 in Kozłowiecki Landscape Park [Ścibior and Dunus 2006].

The number of species inhabiting rushes of the Bug River (43) is comparable to other areas of Lubelszczyzna region, outweighing however the Lasy Janowskie and Kozłowiecki Park, 40 and 33 respectively, [Ścibior 2004a, 2010], yet lower than in Polesie National Park [Ścibior 2010], where it was equal to 51. Warchałowski [1975] indeed proved the finding of 68 species in the neighbouring Muszkowicki Las Bukowy Nature Reserve, nevertheless, the description of the catchment area in general terms of „a stretch of bushes on the Cienkówka River" can denote even a number of separate plant communities in different biotopes. Nevertheless, at least to a certain extent the catch was apparently conducted in the *Phragmition*, as suggested by the biology and ecology of taxa comprised in the summary table in the aforementioned paper.

Interestingly, the study of fresh meadow assemblage of Chrysomelidae, in comparison with studies conducted in other parts of Poland, demonstrates high species diversity (42), as it is second only to Lasy Janowskie, with 68 species [Ścibior 2004b] and dominates over other analysed areas of: five Mazowsze

towns (18–33 recorded species) [Wąsowska 1989] or Łąka Sulistrowicka Nature Reserve with 21 species [Borowiec 1987].

CONCLUSION

The chrysomelid fauna of the middle section of the Bug River demonstrates typical features of lowland fauna shaped by physiogeographical conditions, offered by the studied section of the river valley. Dominant are mesophilic species inhabiting predominantly fresh meadows and ruderal biotopes.

Riparian plant communities should be considered as valuable and important for the development of numerous moist biotope beetles, which are a prevailing species. The presence of dune vegetation, *e.g. Spergulo-Corynephoretum*, *Cytisus scoparius*, dry pasture lands or moors, creates conditions for mesoxerothermic species, with the preference for high sun exposure and rapid soil temperature rise. Unfortunately, no xerothermic species were recorded in the analysed section of the Bug River, with their biotope limited to the Volyn (Gródek, Czumów) and Podlasie (Mielnik) sections of the river.

Although dominated by eurytopic species of a wide habitat range, the numbers of taxa recorded on such a limited area is definitely significant. In addition, 9 previously unrecorded species originating from other regions of Polesie were observed. The species composition of the Chrysomelidae shows little discrepancy from the Belarusian fauna, which indicates the similarity between Polish and Belarusian biotopes and shows that the river does not hinder the migration of species.

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STRUKTURA EKOLOGICZNA ZGRUPOWAŃ CHRZĄSZCZY STONKOWATYCH (COLEOPTERA, CHRYSOMELIDAE) ZBIOROWISK ROŚLINNYCH DOLINY BUGU NA ODCINKU WŁODAWA–KODEŃ

Streszczenie. W latach 2005–2007 chrząszcze stonkowate zbierane były w 9 miejscowościach zlokalizowanych w dolinie środkowego Bugu pomiędzy Włodawą i Kodniem. Odławiano je w 6 typach zbiorowisk roślinnych o różnej wilgotności: w łęgach (głównie *Salicetum triandro-viminalis*), szuwarach, łąkach wilgotnych, świeżych, w zbiorowiskach ruderalnych oraz mezokserotermicznych/psammofilnych. Ogółem we wszystkich tych biotopach stwierdzono 3312 osobników reprezentujących 114 gatunków. Zgrupowania chrząszczy tego fragmentu doliny rzeki okazały się często bogatsze w gatunki niż analogiczne zgrupowania w innych rejonach naszego kraju. Spośród wszystkich zebranych taksonów tylko dwa (*Cassida rufovirens*, *Cryptocephalus pygmaea*) nie zostały dotychczas stwierdzone na przyległym obszarze Białorusi.

Słowa kluczowe: stonkowate, Polesie Zachodnie, korytarz ekologiczny, dolina Bugu, siedliska wilgotne