

BIODIVERSITY OF THE HETEROPTERA OF SERBIA

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The paper offers a brief survey of the history of research on Heteroptera in Serbia in the last 150 years. A total of 855 Heteroptera species are known from Serbia today. The fauna of Serbia, or rather FR Yugoslavia has been compared to the fauna of other Balkan countries. The specific features of the Heteroptera fauna in Serbia have been underlined, and in respect of these, the national, endemic, relict and endangered Heteroptera species were cited.

KEY WORDS: Heteroptera, Biodiversity, Serbia, Yugoslavia.

INTRODUCTION

The research of Heteroptera in Serbia boasts a 150 year long history. Five stages of that history have been recognized, related to the scientists who worked in that period. In the beginning those were random investigations of certain foreign collectors who visited Serbia in order to collect some other more attractive groups of insects and who in the course of their work collected a few bugs as well. The first stage begins with Franc FIEBER, who in his classic work on European bugs (1861) cited eight bug species for Serbia, five of which were new for science. Those were: *Catoplatus crassipes* (Fieber, 1861), *Kalama lugubris* Fieber, 1861, *Tingis elongata* (Fieber, 1861), *Macropternella inermis* (Fieber, 1861), and *Crocistethus waltlianus* (Fieber, 1861).

The second stage is related to the work of Geza HORVÁTH and comprises some 30 years. In this period, the collection and investigation of Heteroptera in Serbia were systematic. This stage has seen the first fauna of Heteroptera of Serbia (HORVÁTH, 1903) which contained 334 species.

The third stage is related to Nicholas KORMILEV, who worked in Yugoslavia in the period 1927 - 1945. He conducted some more extensive research in the area

of Macedonia, where his posts were in Skopje and Tetovo. He spent the World War II in Belgrade and collected Heteroptera in its vicinity (PROTIĆ, 1987a). KORMILEV has considerably furthered our knowledge on the diversity of Heteroptera of Serbia and Yugoslavia. His doctoral thesis which should have been taken before the outbreak of the World War II cited 450 and 900 Heteroptera species for Serbia and Yugoslavia respectively.

The fourth stage comprises the period following the World War II and lasts until the eighties. The Heteroptera were in the post-war period treated only in certain ecological investigations, along with other insect orders. The most important works are those by GRADOJEVIĆ (1963) and JANKOVIĆ (1963). In the sixties in Vojvodina there appeared successions of grain bugs of the *Eurygaster* spp. genus, and a number of experts on protection in agronomy began to collect and investigate these harmful species (JOVANIĆ 1959, 1965, 1972; JOVANIĆ, BJEGOVIĆ 1966). This period also saw the master and doctoral degrees on grain bugs, those by BALARIN (1966) and STAMENKOVIĆ (1975) deserve a special mention.

The fifth stage occupies the last twenty years. It coincides with the beginning of my work at the Department of Entomology in the Natural History Museum. The investigations in this period have been twofold: systematic taxonomic research with the aim of forming study collection of Natural History Museum Heteroptera, and simultaneously with this basic research, investigations of Heteroptera fauna in certain agrocenoses: agricultural fields and orchards (PROTIĆ, 1987, 1993).

Table I
Number of Heteroptera species classified into families established in Serbia

No	FAMILIA	Species	No	FAMILIA	Species
1	CORIXIDAE	15	18	REDUVIIDAE	20
2	NAUCORIDAE	1	19	MIRIDAE	252
3	NOTONECTIDAE	4	20	ARADIDAE	16
4	PLEIDAE	1	21	PIESMATIDAE	7
5	NEPIDAE	2	22	BERYTIDAE	17
6	BELOSTOMATIDAE	1	23	LYGAEIDAE	155
7	HEBRIDAE	2	24	PYRRHOCORIDAE	6
8	HYDROMETRIDAE	1	25	STENOCEPHALIDAE	3
9	VELIIDAE	4	26	COREIDAE	34
10	GERRIDAE	10	27	ALYDIDAE	4
11	LEPTOPODIDAE	1	28	RHOPALIDAE	19
12	SALDIDAE	18	29	SCUTELLERIDAE	28
13	NABIDAE	17	30	PENTATOMIDAE	103
14	MICROPHISIDAE	1	31	ACANTHOSOMATIDAE	5
15	ANTHOCORIDAE	32	32	CYDNIDAE	25
16	CIMICIDAE	2	33	PLATASPIDAE	1
17	TINGIDAE	48			855

RESULTS

According to the latest investigations a total of 855 Heteroptera species, classified into 33 families (Tab I), is known from Serbia.

The following Tables show the Heteroptera species globally significant for the fauna of Serbia.

Table II
Wealth and diversity of Heteroptera fauna in FR Yugoslavia, ex-Yugoslav and Balkan countries

Country/ Republic	Area (km ²) ¹	No Species ²	Log(S)/Log(A) ³
ALBANIA	28.748	505	0,606
BOSNIA & HERZEGOVINA	51.129	657	0,598
BULGARIA	110.912	1020	0,592
CROATIA	56.538	858	0,617
GREECE	131.957	647	0,548
MACEDONIA	25.713	851	0,644
SLOVENIA	20.251	691	0,659
YUGOSLAVIA	102.173	970	0,596
Serbia	88.361	855	0,592
Montenegro	13.812	371	0,620

¹ area of specific countries in km², data taken over from geographic atlas

² data on the number of established species in specific countries taken over from different papers

³ S= Number of species, A= Area

Table III
The Heteroptera species described from the territory of Serbia (national species)

No	Species	Locus typicus	Reference
1.	<i>Aradus serbicus</i> Horváth	Negotin	Horváth, 1888
2.	<i>Calisius salicis</i> Horváth	Ruma	Horváth, 1913
3.	<i>Catoplatus crassipes</i> (Fieber)	“Serbien”	Fieber, 1861
4.	<i>Crocistethus waltlianus</i> (Fieber)	“Serbien”	Fieber, 1861
5.	<i>Hyalochiton syrmensis</i> (Horváth)	Vrdnik	Horváth, 1897
6.	<i>Kalama lugubris</i> Fieber	“Serbien”	Fieber, 1861
7.	<i>Macropternella inermis</i> (Fieber)	“Serbien”	Fieber, 1852
8.	<i>Tingis angusata</i> (Herrich-Schaeffer)	“Serbien”	Horváth, 1881
9.	<i>Tingis elongata</i> (Fieber)	“Serbien”	Fieber, 1861

Table IV
Endemic Heteroptera species in the fauna of Serbia

No	Species	Locality with UTM code	
1.	<i>Adelphocoris insignis</i> Horváth	Suva Planina	EN98
2.	<i>Adelphophylus balcanicus</i> (Kormilev)	Vlasina	FN02
3.	<i>Calocoris princeps</i> Reuter	Bor: Stol	EP99
4.	<i>Dicyphus digitalidis</i> Josifov	Vlasina	FN02
5.	<i>Sciocoris pentheri</i> Wagner	Prokletije	DN21
6.	<i>Thyreocoris balcanicus</i> Schumacher	Vratna	FQ01

Table V
Relict Heteroptera species in the fauna of Serbia

PN = Pannonian Serbia, PP = Peri-Pannonian Serbia, MV = Mountains and Valleys of Serbia.

No	Species	Region Serbia	in Distribution
1	<i>Saldula orthochila</i> (Fieber)	PK	Euro-Siberian/BMo
2	<i>Monalocoris filicis</i> (Linnaeus)	PK	Euro-Siberian
3	<i>Dicyphus pallidus</i> (Herrich-Schaeffer)	PP,PK	Euro-Siberian
4	<i>Phytocoris longipennis</i> Flor	PK	Euro-Siberian
5	<i>Orthops montanus</i> (Schilling)	PK	Euro-Siberian/BMo
6	<i>Gryposoris sexguttatus</i> (Fabricius)	PN,PK	Euro-Siberian/BMo
7	<i>Plagiognathus arbustorum</i> (Fabricius)	PP,PK	Euro-Siberian
8	<i>Compsidolon salicellum</i> (Herrich-Schaeffer)	PK	Euro-Siberian
9	<i>Nithecus jacobae</i> (Schilling)	PP,PK	Euro-Siberian/BMo
10	<i>Nysius thymi</i> (Wolff)	PN,PK	Euro-Siberian/BMo
11	<i>Geocoris grylloides</i> Linnaeus	PN	Euro-Siberian
12	<i>Megalonotus dilatatus</i> (Herrich-Schaeffer)	PK	Euro-Siberian/BMo
13	<i>Dicranocephalus medius</i> (Mulsant & Rey)	PK	Euro-Siberian
14	<i>Pitedia juniperina</i> (Linnaeus)	PK	Euro-Siberian/BMo
15	<i>Aelia klugi</i> Hahn	PK	Euro-Siberian/BMo
16	<i>Carpocoris melanocerus</i> (Mulsant & Rey)	PK	Euro-Siberian/BMo
17	<i>Picromerus bidens</i> (Linnaeus)	PN,PK	Euro-Siberian
18	<i>Trolius luridus</i> (Fabricius)	PK	Euro-Siberian/BMo
19	<i>Canthophorus impressus</i> (Horváth)	PK	Euro-Siberian/BMo
20	<i>Adomerus biguttatus</i> (Linnaeus)	PK	Euro-Siberian

Table VI
Endangered Heteroptera species in Serbia

No	Species	Locality	Last Found	Distribution
1	<i>Calisius salicis</i> (Horváth)	Ruma	1904	Mediterranean
2	<i>Kalama lugubris</i> (Fieber)	"Serbia"	1861.	Mediterranean
3	<i>Tingis elongata</i> (Fieber)	"Serbia"	1861.	Mediterranean
4	<i>Hyalochiton syrmensis</i> (Horváth)	"Serbia"	1897	Mediterranean
5	<i>Calocoris reuteri</i> (Horváth)	Beograd	1882	Mediterranean
6	<i>Pinalitus coccineus</i> (Horváth)	Požarevac	1894	Mediterranean
7	<i>Paredrocoris pectoralis</i> Reuter	Dupljaja, Niš	1897	South Euro-Siberian
8	<i>Psallus syriacus</i> (Reuter)	Požarevac	1894	Mediterranean
9	<i>Neotiglossa flavomarginata</i> (Lucas)	Dobričevo	1907	Mediterranean

Table VII
Occurrence of Heteroptera species in Serbia with respect to bio-geographical regions

Bio-Geographical Distribution	No Species	Occurrence in %
1. Mediterranean	248	29,005%
2. Palearctic	164	19,181%
3. Euro-Siberian	150	17,543%
4. Euro-Asian	113	13,216%
5. European	66	7,719%
6. Euro-Mediterranean	45	5,263%
7. Holarctic	44	5,146%
8. Euro-Siberian Mediteranean	12	1,403%
9. Cosmopolite	7	0,818%
10. Endemic	6	0,701%
	855	99,995%

DISCUSSION AND CONCLUSIONS

According to the latest investigations, a total of 855 Heteroptera species are known from Serbia. The established species are classified into 33 families (Tab I). In the past period of 150 years, throughout the history of research on the territory of Serbia, neither the researchers nor the collectors have systematically caught aquatic and semi-aquatic bugs. This is the reason for a small number of the established species in the first 10 families from the Table I.

The results of previous investigations of Heteroptera in Serbia and neighbouring, ex-Yugoslav countries were published in the Catalogue of the Heteroptera fauna of Yugoslav countries (PROTIĆ, 1998, 2001). The data from the

Catalogue are the best witness to the biodiversity of the Heteroptera fauna in Serbia, or rather in Yugoslav countries. The Catalogue compiled for the first time all the data on Heteroptera inhabiting the area from Slovenia to Macedonia. Preceding the publication of the Catalogue were numerous works on the similar topic, the most important of which are: HORVÁTH (1903), KORMILEV (1928/1929, 1936, 1943), PROTIĆ (1988/1989, 1993/1994). A total of 1387 species have been so far established in the area of Yugoslav countries, collected at 1243 localities. The Catalogue comprises the list of localities with UTM codes, plant index and about two hundred references.

In comparison with the neighbouring ex-Yugoslav countries, the Heteroptera fauna of Serbia is investigated just as well or even better. The greatest number of data pertains to Croatia, which is understandable, since Croatia, particularly Dalmatia, was a very attractive area of research for foreign collectors. This year in Serbia we celebrate 150 years of Heteroptera investigations, while the history of Heteroptera investigations in Dalmatia is more than 180 years long. The species *Apodiphus amygdali* (Germar, 1817) is the oldest record of bugs in Dalmatia. However, in Croatia as a whole, Heteroptera have been neither caught nor investigated systematically for decades now and we suppose that the number of species established in that area is far from realistic, based as it is on the results of investigations in Dalmatia conducted some 60 and more years ago. Slovenia is very well investigated, owing to the work of father and son (GOGALA & GOGALA, 1986, 1989, 1996). The research of the Heteroptera fauna in Bosnia and Herzegovina are incomplete and after APFELBECK (1891) field investigations were few. Macedonia is comparatively well researched, above all owing to KORMILEV, but also as a result of the years of work of a curator of Berlin Museum, Ursula GÖLLNER-SCHAEIDING (1978, 1982). Montenegro is the least investigated. The fauna of Durmitor Mts. is partly researched (PROTIĆ *et al.*, 1990), but the rest of the area was treated very randomly; only several sites along the coast.

The wealth and diversity of flora and fauna can be quantitatively demonstrated by a relation of the number of species to the area of the territory where they were established. In effect, a great number of species on a small area best testifies to the fauna diversity of a region, whether it is considered from the viewpoint of biogeography and faunistics, as in our case, or with regard to the number of species (population parameters) and the number of representatives of the given species on the unit area in the ecosystem. In our case, then, the biogeographical and faunal diversity of the territory of Serbia, FR Yugoslavia and the neighbouring Balkan countries can be shown through a relation of the logarithm of the entire number of species to the area of the country (Table II).

Of the eight countries, Yugoslavia is placed the second in the number of species, and the sixth in respect of diversity. Despite lasting investigations of more

than a century, some sites inhabited by specific Heteroptera populations have remained uninvestigated. Those are chiefly high mountains, boreal regions, where many still unrecorded species for Serbia are expected to be found. Likewise inadequately investigated are the marshes of Serbia, characterized by specific flora, and therefore possibly harbouring specific entomofauna. The aquatic habitats in Serbia are numerous and diverse and when we become better acquainted with them, a greater diversity of the Heteroptera fauna is certain to be established. Our future work will be directed at the so far uninvestigated habitats and we expect to establish a greater number of species, and therefore a greater diversity index. Natural habitats can change significantly, as is best illustrated by the neighbourhood of Belgrade. Investigations of Heteroptera of Belgrade and its vicinity started around the middle of the 19th century. Since then, and particularly during the World War II, the Heteroptera fauna has been intermittently observed. During the last twenty years Heteroptera have again been collected systematically, and interestingly, we always find some new species not only for the vicinity of Belgrade, but also for Serbia and Yugoslavia. This shows that it is impossible to establish and research the fauna of a region once for all. The changes in nature are huge and are reflected on the quantity and quality, i.e. diversity of plant and animal species.

By comparing faunas, in this case the Heteroptera fauna of Serbia with the Heteroptera faunas of the neighbouring countries, we have established not only the qualitative data on the number of recorded species, degree of diversity, but also the index of faunal similarity (IFS). While estimating the index of faunal similarity, we have compared the Heteroptera fauna of Serbia with that of Croatia, Macedonia, and Slovenia. According to the IFS, the Heteroptera fauna of Serbia shows most similarity to the Heteroptera fauna of Croatia (0,658), then Macedonia (0,633), and finally Slovenia (0,587). The order of the countries compared depends on the parameters estimated.

Serbia lies in the northern-central part of the Balkan Peninsula. According to MARKOVIĆ (1980) the territory of Serbia can in respect of orography and geography be broadly divided into three parts: Pannonian Serbia (PN), valleys of the Pannonian Lowlands in Vojvodina; Peri-Pannonian Serbia (PP), hills and valleys (Posavina, Podrinje, Šumadija, Pomoravlje, Stig, and Braničevo); Serbia of mountains and valleys (MV), belonging to the Carpathian-Balkan, Rhodopian, Šar-Pindic, and Dinaric mountain system. These basic geological, and at the same time ecological units have determined the character of the flora and vegetation of Serbia and the mutual differences in the plant world occurring in these macro-regions of Serbia, as well as the specific entomofauna.

Unlike with other insect orders, a small number of Heteroptera species was described from Serbia (Tab III). A total of nine Heteroptera species new for science have been described. Interestingly, eight of those were described in the 19th century, and only one in 1913.

From the data on the distribution of endemic Heteroptera species in Serbia (Tab IV) we can infer that the centers of endemism are the eastern and south-eastern Serbia, i.e. Carpathian-Balkan Serbia, Vlasina, and Krajište. Prokletije are also a center of endemism.

The relict Heteroptera species have been found in certain sites in Serbia, where they have been preserved until today (Tab V). In view of the number of the established relict Heteroptera species in Serbia, most were found in Carpathian Serbia - as many as 12 species, followed by Ibar region and Kopaonik by eight species, and Metohija with seven relict species. Characteristically, all relict species have Euro-Siberian distribution. As many as 11 of the 20 relict species are Boreo-Montane i.e. 55% relict species in Serbia are alpine species.

A previous paper (PROTIĆ, 1993/94) considered the threats to the species and suggested that 57 Heteroptera species should be entered in the Red Book of Yugoslavia. The list of species of global importance includes all national, endemic, and relict species. This paper cited as the endangered species only those not found on a certain site for over 100 years (Tab VI). We established that the habitats of the foregoing nine species had changed, and that their populations are either very small or have disappeared from the sites where they were caught by the foreign collectors. It is interesting that eight of the nine species on the list of endangered species have a Mediterranean distribution. This suggests that greater efforts should be made to protect Mediterranean and sub-Mediterranean habitats in Serbia which are numerous. The investigation of biodiversity of a group of animals is important because it establishes not only their numbers, but also the changes in the numbers of species in certain habitats. Natural habitats, particularly those around settlements and tourist centers have been changing fast during the last decades, and the living world was decimated as a result.

An analysis of the biogeographical distribution of the Heteroptera of Serbia (Tab VII) shows at the first glance that the species with great ranges (Palearctic, Euro-Siberian, and Euro-Asian), comprise 428 species, or 50,05% of the total Heteroptera fauna of Serbia. Also typical of the Heteroptera fauna of Serbia is a great number of the Mediterranean species, which comprise both exclusively Mediterranean species, and those whose ranges include a Mediterranean element. A total number of "Mediterraneans" in Serbia is estimated at 305 species, or 35,67% of the total Heteroptera fauna of Serbia.

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БИОДИВЕРЗИТЕТ НЕТЕРОПТЕРА СРБИЈЕ

ЉИЉАНА ПРОТИЋ

И з в о д

Од првих истраживања Heteroptera у Србији прошло је 150 година. Протекли период подељен је на пет етапа истраживања. Поједине етапе везивали смо за име стручњака који је радио у том периоду. Тако прва етапа почиње са Франц Фибером (FIEBER), који је у класичном делу о европским стеницама (1861) навео осам врста стеница за Србију. Другу етапу представља рад Гезе Хорвата (HORVÁTH) и обухвата преко 30 година. Из тог периода потиче и прва фауна Хетероптера Србије из 1903. у којој су обрађене 334 врсте. Трећу етапу везујемо за рад Николе КОРМИЛЕВА, који је радио у Србији и знатно дуже у Македонији. Кормилев је веома много унапредио дотадашње знање о разноврсности Heteroptera Србије, јер је у докторској дисертацији обрадио фауну Heteroptera Југославије (територија СФРЈ), која је по његовој процени обухватала око 900 врста. За Србију је наводио око 450 врста. Четврта етапа обухвата период после Другог светског рата до осамдесетих година. У том периоду Heteroptera су обрађиване само у оквиру појединих еколошких истраживања са осталим инсекатским редовима или су истраживане актуелне штетне врсте, као на пример житне стенице из рода *Eurygaster* Laporte. Пета етапа траје последњих двадесет година. Истраживања у овом периоду одвијала су се у два правца. Прво вршена су систематско-таксономска истраживања у циљу формирања студијске збирке Heteroptera Природњачког музеја, а паралелно са овим основним истраживањима текла су проучавања фауне Heteroptera у појединим агроценозама. У Србији је према последњим подацима о истраживању Heteroptera познато 855 врста.

Богатство и диверзитет фауне Heteroptera може се квантитативно исказати односом броја врста према површини територије на којој су оне констатоване. Дакле овако разматрано, биогеографско-фаунистички диверзитет територије Србије, СР Југославије и суседних балканских држава (Албанија, Босна и Херцеговина, Бугарска, Грчка, Хрватска, Македонија) може се исказати као однос логаритама укупног броја врста

према површини државне територије. Према истражености на првом месту је Бугарска, а највећи диверзитет је у Македонији. У оквиру Србије највећи диверзитет Heteroptera забележен је у источној и централној Србији. Према индексу фаунистичке сличности фауна Heteroptera Србије је најсличнија са фауном Heteroptera Хрватске, затим Македоније, а потом Словеније.

На територији Србије до сада смо забележили 20 реликтних и шест ендемичних врста Heteroptera. Анализирајући локалитете на којима су нађене поједине реликтне врсте Heteroptera, можемо извести закључак да постоје одређени центри где су се сачувале ове врсте до данас. Према броју утврђених врста предпостављамо да постоје три основне географске групације распрострањености реликтних врста Heteroptera у Србији. То су: Карпатска Србија са највећим бројем, затим подрегион Ибар и Копаоник и Метохија, а нешто мањи број у Балканској Србији и Старом Влаху и Рашкој. Од 20 реликтних врста до сада утврђених у Србији 45% су борео-монтанске врсте. Према биогеографској заступљености у Србији су најзаступљеније медитеранске врсте са 35,6%.

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