

THE CICADA FAUNA (HOMOPTERA: AUCHENORRHYNCHA) FROM THE “CHEILE TURULUI” AREA AND THE “CHEILE TURZII” NATURE RESERVE, ROMANIA

VALENTIN POPA, ROXANA COJOCNEANU

Abstract. This article represent a faunistic, zoogeographical and biological studies on the cicada species from the “Cheile Turului” and the “Cheile Turzii” areas. These areas are located in the Trascău Mountains, in the central part of Romania. 107 cicada species were identified. These species belong to 9 families and 15 subfamilies. The great majority of species, from the studied areas, are European and Palaearctic. The maximum adult activity was registered in spring and autumn, for the bivoltine species and in summer and autumn for the monovoltine ones. The adult maximum activity varies from a species to another.

Résumé. Cet article représente une étude faunistique, zoogéographique et biologique sur les cicadines de “Cheile Turului” et “Cheile Turzii”, localisés dans la région centrale de la Roumanie. 107 espèces de cicadines ont été identifiées. Ces espèces sont encadrées en 9 familles et 15 sousfamilles. La plupart des espèces sont Européennes et Paléarctiques. L'activité maximale des adultes est enregistrée pendant le printemps et l'automne pour les espèces bivoltines et pendant l'été et l'automne pour les espèces monovoltines. La durée d'activité maximale des adultes est variable d'une espèce à l'autre.

Keywords: cicada, taxonomy, biology, zoogeography, monovoltine and bivoltine species.

In the areas of Trascău Mountains (“Cheile Turului” and “Cheile Turzii”), in the central part of Romania, we made zoogeographical and biological studies on the cicada species. From here, we identified 107 species.

MATERIAL AND METHOD

“Cheile Turului” is the last limestone extension of the Trascău Mountains, the gorges being the result of the erosive action of the “Pârâu Racilor” river. From these gorges we have collected samples from the following stations:

1.a. A coppice along the valley, with shrubs and trees mainly belonging to the species *Salix*, *Alnus*, *Coryllus*, and with herbaceous vegetation dominated by *Petasites hybridus*.

2.a. On the left slope, which has southern aspect, there is a meadow rich in steppe herbaceous species.

3.a. Also on the left slope there is a meadow with *Artemisia* on a nymphyllous substrate, the layer of soil being almost non-existent.

4.a. The Sândulești plateau located on the way out from the Turului gorges towards “Cheile Turzii”, is a pasture *Festucetum sulcatae calcophilum* (Fig. 1).

5.a. We have also collected biological samples from the shrubs alongside the river.

“Cheile Turzii” is a northeastern extension of the Trascău Mountains, located in a hilly area in the northwestern part of Romania. The gorges are the result of the

erosion of the Hășdate river in the Jurassic limestone, and have a length of approximately 3.5 km (Fig. 2). Aside from the Jurassic limestone, here there also are cretaceous layers and pyroclastites. From a geomorphologic point of view, the relief is very varied, which determines a great diversity of habitats, and a great ecologic diversity. The variety of the ecologic factors brings about great floristic and faunal diversity.

Until now, in our country there have never been conducted studies on cicadas in this area, and this determined us to perform studies of fauna, biology and ecology.

In "Cheile Turzii", we collected biological samples from the following stations:

1.b. Spruce forest – it is actually a 70 years old coniferous plantation, located at the lower region of the Mischiu forest (Nyárády, 1930) on the right slope of the gorges. The dominant wooden species are *Pinus nigra*, *Pinus sylvestris* and *Picea excelsa*. The herbaceous layer is weak represented, and the litter layer is very thick.

2.b. Coppice – located on both sides of the Hășdate river, it also covers the abrupt slopes that flank the riverbanks. The coppice is made up of some important vegetal associations, As. *Salici-Populetum* (Tx. 1931) Meyer-Drus (Bechet, 1980) with an arborescent layer of approximately 20 m in height, with species such as *Populus nigra*, *Acer pseudoplatanus*, *Fraxinus excelsior*, and shrubs like: *Salix alba*, *Salix purpurea*, *Spirea ulmifolia*, *Alnus glutinosa*, *Alnus incana*, *Crataegus monogyna*. The herbaceous layer is represented by *Cherophyllum aromaticum*, *Anthriscus sylvestris*, *Rubus caesius*, *Brachypodium sylvaticum*, *Astragalus glycyphyllos*, association As. *Lolio – Potentilletum anserinae* Knapp, 1946 located on the humide side of the Hășdate river in the form of clusters (Bechet, 1980), association As. *Lolio – Plantaginetum majoris* (Linkola, 1921) Beger, 1930, located on more elevated grounds, and association As. *Calamagrostietum arundinaceae* Soó, 1960, on the abrupt slopes of the valley (Bechet, 1980).

3.b. Oak forest – located on an inclined slope with southern aspect. The forest is composed of young trees, between 10 and 12 m high. The association that characterises this station is *Quercus petrae – Carpinetum* Soó and Pocs, 1957 (Bechet, 1980). The soil layer is very thin, the shrubs are represented by *Crataegus monogyna*, *Acer tataricum*, *Cornus mas*, *Ligustrum vulgare*, and the herbaceous layer is composed of *Convalaria majalis*, *Brachypodium sylvaticum*, *Dactylis glomerata*, *Stelaria holostea*, *Asarum europaeum*, *Galeobdolon luteum*.

4.b. Forest of deciduous trees – located on the right bank of the Hășdate river, on the way out from the gorges towards the Tourist Complex. The forest is mainly composed of oak, hornbeam, maple, alder, the herbaceous layer is well developed, the soil is rich and the humidity is high.

5.b. A pasture called "Coasta Tătălii" – is located at the entrance of the gorges from Petrești village, and has western aspect. This pasture is made up on a very thin layer of soil, pierced here and there by underlying limestone bedrock. In the herbaceous layer, the characteristic association is *Avenastretum decori* Domin, 1932 (Bechet, 1980). The pasture lacks any wooden vegetation, with the exception of the shrubs located on the upper region: *Crataegus monogyna*, *Prunus spinosa*.

6.b. Steppe meadow called "Povârnișul lui Pop" – located at the foot of the plateau on the left slope of the gorges. It has an inclination of 45°, southern aspect, the layer of soil is thin and underneath there are blocks of pyroclastites. The composition of the herbaceous layer proves the steppe-like thermophyllous character of this meadow: *Stipa pulcherrima*, *Botriochloa ischaemum*,

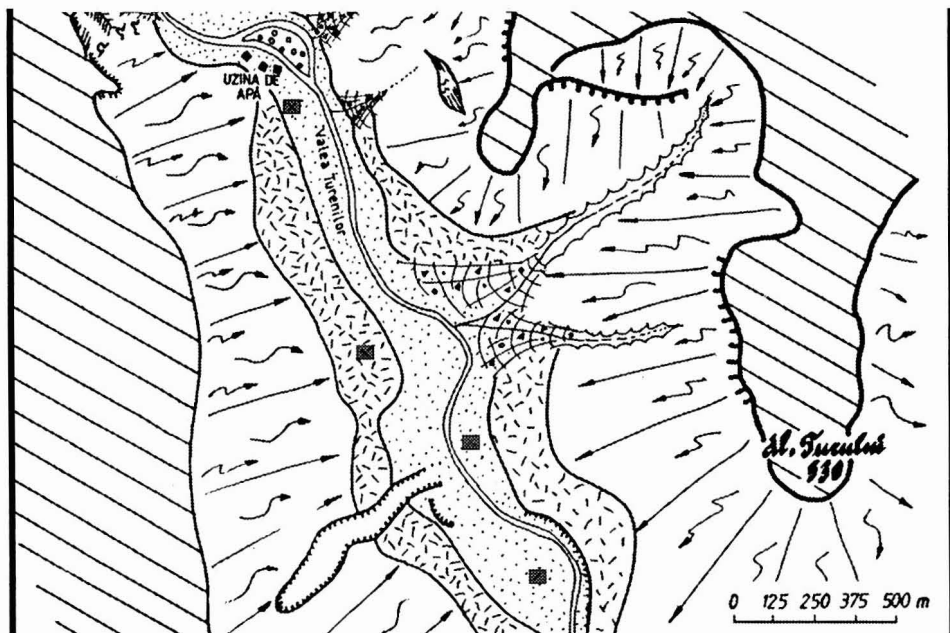


Fig. 1 - The "Cheile Turului" area with the sampling sites (Cocean, 1995)

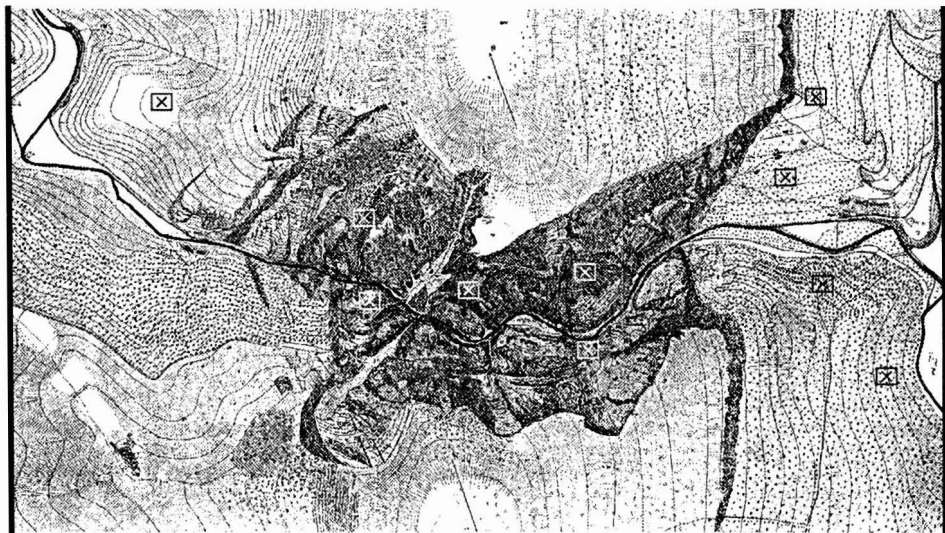


Fig. 2 - The "Cheile Turzii" Nature Reserve area with the sampling sites (Nyárády, 1939)

Brachypodium pinnatum. The shrubs that are located on the upper part of the meadow are represented by *Cornus mas* and *Prunus tenella*. We have also taken quantitative samples from these shrubs.

7.b. Meadow on plateau on the left slope– located at an altitude of 706 m and an inclination of 4-8°. The underlying limestone rocks pierce the thin soil layer. The sunstroke is high, during summer the temperature at the soil level is often above 30°C and the humidity is very low. In the herbaceous layer we found a great floral associations diversity, located on limited areas: As. *Stipetum pulcherrimae calcicolum* Pop and Hodişan, 1960 (Bechet, 1980), located on the edge of the “Marginea Ercsei” plateau (Nyárady, 1939), As. *Stipetum joannis calcicolum* Pop, Csürös et al., 1964 (Bechet, 1980), situated on the upper part of the ridge, the herbaceous layer is represented by *Carex humilis*, *Potentilla arenaria*, *Alyssum alyssoides*, *Stipa joannis*, *Inula ulmifolia*; As. *Caricetum humilis transsylvanicum* Zalyamy, 1939 (Bechet, 1980) on the edge and on the upper part of the plateau, and association *Carici humilis – Brachypodietum pinnati transsylvanicum* Soó, 1942 (Bechet, 1980) located on the upper region of the plateau, in the form of small clusters.

8.b. Shrubs located on the plateau, on the left slope – form a vegetable association *Pruno spinosae – Crataegetum* Hueck, 1931 (Bechet, 1980), which develops on a layer of soil with low alkalinity or poorly eroded slopes. From this association we have taken quantitative samples.

From the biotops mentioned above we have taken quantitative and qualitative biological samples, using the entomological net for the herbaceous layer and shrubbery, and the umbrella net for the tree canopies. The sampling of biological material was performed between May and September 1999. The collected biological material was preserved in alcohol 80% and identified in the laboratory using specific literature (Ossiannilsson, 1978, 1981; Ribaut, 1936, 1952; Della Giustina, 1989). We have performed faunistic, ecological and biological studies. In this paper we present the faunistic, zoogeographic and biological results of our studies.

RESULTS AND DISCUSSIONS

In the biocoenoses from “Cheile Turului” and “Cheile Turzii” we have identified 107 cicada species, which belong to 9 families and 15 subfamilies (Tab. 1). It is an extremely rich fauna, if we relate it to the entire cicada fauna of our country, which is represented by 512 species (Cantoreanu, 1970).

The 9 families and 15 subfamilies are represented by an unequal number of species. If we analyse the distribution of species in families, we find out that 78 of species belong to family Cicadellidae, 12 species belong to family Delphacidae, 8 species to family Cercopidae, 4 species to family Issidae, the other families Cixiidae, Dictyopharidae, Tettigometridae and Tropiduchidae with only one species. The differences between the families are in relation to the size of the families in Romanian and European fauna (Nast, 1987).

In this paper, we make a second mention in the Romania fauna of a species from the Tropiduchidae family (*Trypetimorpha fenestrata* Costa) in a new locality, “Cheile Turzii”, the first sighting being in the southeastern region of Romania, near the city of Galaţi (Cantoreanu, 1967). In fig. 3 we present the taxonomic spectrum of family Cicadellidae in the studied areas, compared to the Cicadellidae fauna in Europe (Nast, 1987).

Table 1

Cicada species identified in the "Cheile Turului" area and "Cheile Turzii" Nature Reserve

Crt nr.	Taxa	Data of caught	Studied area												Z**		
			Cheile Turului					Cheile Turzii									
			1a*	2a	3a	4a	5a	1b	2b	3b	4b	5b	6b	7b		8b	
	Infraorder Fulgoromorpha Evans, 1946																
	Family Cixiidae Spinola, 1839																
1	<i>Pentastiridius pallens</i> (Germar, 1821)	28.08.1999													1		ES
	Family Delphacidae Leach, 1865																
	Subfamily Stenocraninae Wagner, 1963																
2	<i>Stenocranus major</i> (Kirschbaum, 1868)	17.09.1999							3								E
	Subfamily Delphacinae Wagner, 1963																
3	<i>Euryssa lineata</i> (Perris, 1857)	10.07.1999							1								PAL
4	<i>Metropis mayri</i> Fieber, 1866	16.05.1999											1				ES
		10.07.1999													1		
5	<i>Laodelphax striatellus</i> (Fallen, 1826)	15.05.1999													1		PAL
		28.08.1999									1				3		
		17.09.1999													1		
6	<i>Muirodelpfax aubei</i> (Perris, 1857)	28.08.1999													2		ES
		17.09.1999															
7	<i>Dicranotropis</i> (s. str.) <i>hamata</i> (Boheman, 1847)	09.06.1999				1				1							ES
		28.08.1999													1		
8	<i>Xanthodelphax flaveolus</i> (Flor, 1861)	10.07.1999													2		ES
9	<i>Criomorpha albomarginatus</i> Curtis, 1833	09.06.1999				1											E
10	<i>Javesella pellucida</i> (Fabricius, 1794)	28.08.1999													1		HOL
11	<i>Javesella dubia</i> (Kirschbaum, 1868)	28.08.1999							1								PAL
12	<i>Ribautodelphax albostratus</i> (Fieber, 1866)	16.05.1999											4				T
13	<i>Ribautodelphax angulosus</i> (Ribaut, 1953)	16.05.1999											1				PAL
	Family Dictyopharidae Spinola, 1839																
	Subfamily Dictyopharinae Spinola, 1839																
14	<i>Dictyophara europaea</i> (Linnaeus, 1767)	28.08.1999							1								PAL
	Family Tettigometridae Germar, 1821																
15	<i>Tettigometra griseola</i> Fieber, 1865	28.08.1999								1							PAL
	Family Issidae Spinola, 1839																
	Subfamily Issinae Spinola, 1803																
16	<i>Issus coleoptratus</i> (Fabricius, 1781)	15.05.1999						2					1	2	4		PAL
		10.07.1999												1	7		
17	<i>Issus muscaeformis</i> (Schränk, 1781)	10.07.1999								1				1			E
18	<i>Dalmatium maculiceps</i> (Melichar, 1906)	09.06.1999				2											MED
19	<i>Agalmatium flavescens</i> (Olivier, 1791)	10.07.1999													3		MED
	Family Tropiduchidae Stål, 1866																
20	<i>Trypetimorpha fenestrata</i> A. Costa, 1862	28.08.1999													7		E
		17.09.1999													23		
	Infraorder Cicadomorpha Evans, 1947																
	Family Cercopidae Leach, 1815																
	Subfamily Cercopinae Leach, 1815																
21	<i>Cercopis sanguinolenta</i> (Scopoli, 1763)	15.05.1999												13	3		MED
		09.06.1999	1		5				1				2	2			
		10.07.1999			1				1					9	9		
	Subfamily Aphrophorinae Amyot&Serville, 1843																
22	<i>Lepyronia coleoptrata</i> (Linnaeus, 1758)	09.06.1999				7								10			HOL
		10.07.1999			1										73	1	
		28.08.1999													12	5	
		17.09.1999													1		
23	<i>Neophilaenus albipennis</i> (Fabricius, 1798)	10.07.1999														5	E
24	<i>Neophilaenus campestris</i> (Fallen, 1805)	09.06.1999					4							10			E
		10.07.1999			1										6	41	
		28.08.1999												1	3	13	
		17.09.1999											1	1	3		
25	<i>Neophilaenus exclamationis</i> (Thunberg, 1784)	28.08.1999												2			PAL
26	<i>Neophilaenus minor</i> (Kirschbaum, 1868)	10.07.1999			16										2		MED
27	<i>Aphrophora alni</i> (Fallen, 1805)	09.06.1999	2		1		1										PAL
		10.07.1999								1					10		
		28.08.1999								5	15	4		2	1	4	
		17.09.1999									2						
28	<i>Philaenus spumarius</i> (Linnaeus, 1758)	09.06.1999				15								1			HOL
		10.07.1999													1	11	
		28.08.1999								2	1			1	7	1	
	<i>var. lateralis</i>	09.06.1999												1			
		10.07.1999													1		
		28.08.1999													1	3	

Table 1(continued)

Crt nr.	Taxa	Data of caught	Studied area														Z			
			Tureni Gorges					Turda's Gorges												
			1a	2a	3a	4a	5a	1b	2b	3b	4b	5b	6b	7b	8b					
97	<i>Turrutus socialis</i> (Flor, 1861)	09.06.1999				8													PAL	
		10.07.1999															249			
		28.08.1999															6	23		
		17.09.1999														44	193			
98	<i>Jassargus (Obtujargus) obtusivalvis</i> (Kirschbaum, 1868)	09.06.1999				1			1										MED	
		17.09.1999														21	1			
		15.05.1999									2						2			
99	<i>Jassargus (Aurkius) repletus</i> (Fieber, 1869)	10.07.1999															9		MED	
		28.08.1999																1		
		17.09.1999																6		
		10.07.1999																2		
101	<i>Mendraus pauxillus</i> (Fieber, 1869)	10.07.1999															2	E		
102	<i>Verdanus abdominalis</i> (Fabricius, 1803)	10.07.1999															14	PAL		
103	<i>Verdanus nigrifrons</i> (Kirschbaum, 1868)	10.07.1999															6	6	E	
		28.08.1999															6			
104	<i>Rhoananus hypochlorus</i> (Fieber, 1869)	10.07.1999															4		E	
105	<i>Enantiocephalus comutus</i> (Herrich-Schaffer, 1838)	28.08.1999										1							ES	
106	<i>Mocuellus</i> (s. str.) <i>collinus</i> (Boheman, 1850)	17.09.1999																2	E	
107	<i>Mocuellus</i> (s. str.) <i>quadricornis</i> Diabola, 1949	10.07.1999																9	E	
		28.08.1999																2		
		17.09.1999																1		

* The symbols 1a, 1b... are identical with symbols from the Introductory part of article

** Zoogeographical characteristics of species

E-european

ES-eurosiberian

MED-mediterranean

PAL-palaearctic

HOL-holarctic

U-ubiquist

It can be observed in both cases the fact that the majority of species (over 50%) belong to subfamily Deltocephalinae, followed by subfamily Typhlocybae. The other subfamilies are more weakly represented, both in the studied area and in European fauna. Only the Macropsinae subfamily are less represented in the studied areas.

A zoogeographic analysis of the cicada species from "Cheile Turului" and "Cheile Turzii" shows that most of the species are European (40%) and Palaearctic (26%). The rest of the species belong to other zoogeographic categories (Fig. 4).

We notice a significant infusion of euro-siberian and turanic species. From the analysis of the zoogeographic spectrum, we can conclude that the studied areas are located in a place at the interference of species with different origin and distribution. This spectrum that mostly contains species with broad distribution reflects the great diversity of the biotops in the studied areas. It is also observed the existence of a high percentage of species with euro-siberian distribution, which are found in xero-thermophyllous biotops with a strong steppe-like character.

The rich biological material collected in the field allowed us to also perform studies concerning the adults activity periods of some species (Tab. 2), in relation to the number of generations per year.

Given the ecological conditions in the researched area, *Laodelphax striatellus* and *Rhopalopyx vitripennis* are bivoltine. Species like *Stenocranus major*, *Muirodelphax aubei*, *Ribautodelphax albostriatus*, *Trypetimorpha fenestrata*, *Handianus limonii*, *Mendraus pauxillus*, *Verdanus nigrifrons* and *Rhoananus hypochlorus* are monovoltine. For *Ribautodelphax albostriatus*, the flight period

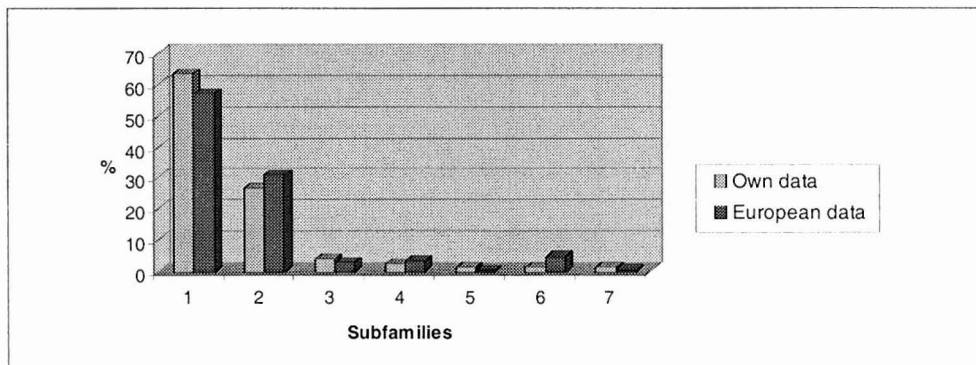


Fig. 3 - Histogram showing the comparison between the percent of species of the subfamilies of the family Cicadellidae from the studied areas with european reports
 1 - Deltocephalinae, 2 - Typhlocybinae, 3 - Aphrodinae, 4 - Agalliinae,
 5 - Dorycephalinae, 6 - Macropsinae, 7 - Ulopinae

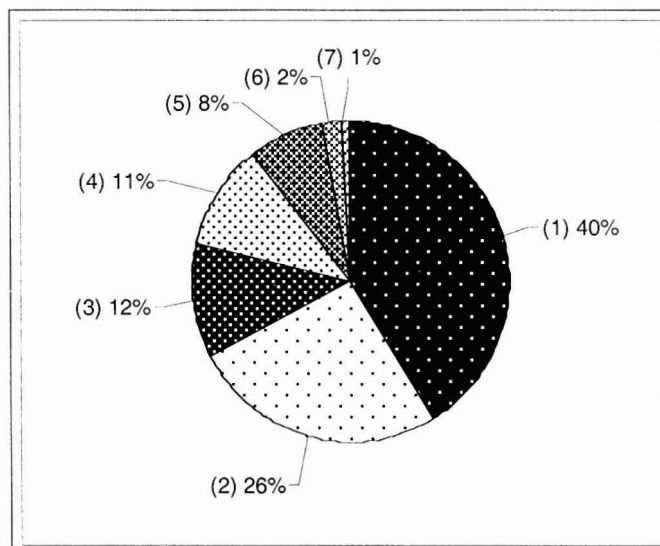


Fig. 4 - Zoogeographical spectrum of the cicada species from the studied areas
 1 - European, 2 - Palearctic, 3 - Mediterranean, 4 - Eurosiberian,
 5 - Holarctic, 6 - Turanic, 7 - Ubiquist

takes place in May and the beginning of June; for *Rhopalopyx vitripennis*, *Handianus limonii*, *Mendrausus pauxillus*, *Verdanus nigrifrons* and *Rhoananus hypochlorus* during the summer months June and July, and for *Trypetimorpha fenestrata*, *Muirodelphax aubei* and *Stenocranus major* during the autumn months. The different flight periods suggest that the biological cycle of these species does not overlap in time and differs in length. For instance, for *Verdanus nigrifrons* the duration of the summer flight is longer than in other species. Also, for *Trypetimorpha fenestrata* the duration of the autumn flight is longer than for

Table 2

The adults maximum activity in the studied areas

Nr. crt.	Species	Months				
		V	VI	VII	VIII	IX
1	<i>Stenocranus major</i>					■
2	<i>Laodelphax striatellus</i>	■			■	■
3	<i>Muirodelphax aubei</i>				■	■
4	<i>Ribautodelphax albostriatum</i>	■				
5	<i>Trypetimorpha fenestrata</i>				■	■
6	<i>Rhopalopyx vitripennis</i>			■		■
7	<i>Handianus limonii</i>			■		
8	<i>Mendrausus pauxillus</i>			■		
9	<i>Verdanus nigrifrons</i>			■	■	
10	<i>Rhoanans hypochlorus</i>			■		

Stenocranus major. The results of our studies coincide in most aspects with the results of other researchers (Schiemenz, 1987, 1996). For *Muirodelphax aubei*, in the researched area there is only one generation per year, while in Germany (Schiemenz, 1987) there are two generations per year. It is possible that the different number of generation be determined by the climatic differences.

Conclusions

1. In the studied biocoenoses from “Cheile Turului” and “Cheile Turzii” there are a number of 107 cicada species, number that indicates an extremely rich fauna compared to other similar areas in Romania and even in Europe.
2. The taxonomic spectrum of the Cicadellidae family shows a great concentration of the species belonging to subfamily Deltocephalinae in the researched area, and a weak representation of subfamily Macropsinae, compared to the European fauna.
3. The zoogeographic spectrum of the cicada species in the researched areas shows the existence of a great number of European and Palearctic species.
4. The cicada fauna from “Cheile Turului” and “Cheile Turzii” contains bivoltine species with two flight periods, during spring and autumn, and also monovoltine species with flight periods mostly during summer and autumn.
5. For the monovoltine species, the flight period differs both in time and length.

FAUNA DE CICADINE (HOMOPTERA: AUCHENORRHYNCHA) DIN ZONA CHEILE TURULUI ȘI REZERVAȚIA NATURALĂ CHEILE TURZII, ROMÂNIA

REZUMAT

Această lucrare reprezintă un studiu faunistic, biologic și zoogeografic asupra cicadinelor din zona Cheile Turului și Rezervația Naturală Cheile Turzii din Munții Trascău, România. Au fost identificate un număr total de 107 specii de cicadine, care aparțin la 9 familii și 15 subfamilii. Majoritatea speciilor sunt europene sau palearticte. Perioada de activitate a adulților este mai intensă primăvara și toamna pentru speciile bivoltine, vara și toamna pentru cele monovoltine. Durata perioadei de zbor variază de la o specie la alta.

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"Babeș-Bolyai" University – Department of Zoology
3400 – Cluj-Napoca, Romania
e-mail: valentin@hasdeu.ubbcluj.ro