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LIMONIIDAE AND PEDICIIDAE (INSECTA: DIPTERA) ASSEMBLAGES ALONG MOUNTAINOUS STREAMS: ADDITIONS TO ASSESS THE BIODIVERSITY IN WET HABITATS IN CARPATHIANS, ROMANIA

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HEGYI PATAKOK LIMONIIDAE ÉS PEDICIIDAE EGYÜTTESEI (INSECTA, DIPTERA): NEDVES ÉLŐHELYEK BIODIVERZITÁS-BECSLÉSÉNEK ÚJABB LEHETŐSÉGEI A KÁRPÁTOKBAN, ROMÁNIA

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Kivonat: A romániai Kárpátok különböző forrásainak és patakjainak Limoniidae és Pediciidae (Diptera) együtteseit hasonlítjuk össze a 2000 és 2004 között gyűjtött kifejlett példányok alapján. A nyári gyűjtések élőhelyenkénti taxondiverzitásának és mennyiségi adatainak összehasonlításával a vizsgált folyóvíztípusok minősítésének lehetőségét vizsgáljuk. Összesen 157 faj jelenlétét mutattuk ki a Kárpátok középhegységi régiójában, ebből 19 fajt (1 Pediciidae és 18 Limoniidae) elsőként említünk a hazai faunára. 25 lelőhely esetében a Limoniidae és Pediciidae együttesek diverzitásának, egyenletességének alakulását követjük. A Kárpátok középhegységi régiójában a Limoniidae és Pediciidae együttesek szempontjából a legértékesebb élőhelyeknek erdővel borított nedves-mocsaras élőhelyek és a források minősülnek, előbbieket főként a magas faj- és egyedszámmal, míg utóbbiakat főként az endémikus, ritka fajok jelenlétével tűnnek ki.

Abstract: The adult Limoniidae and Pediciidae (Diptera) communities along mountainous streams from different regions in the Carpathians, Romania are compared based on recent, fresh collected material. The possibility to use crane flies as part of an integrative ecological classification of watercourses in mountainous habitats was evaluated using taxon diversity and quantitative data of the summer-collected species. 157 species were recorded during our investigations, which completed with 19 species (1 Pediciidae and 18 Limoniidae) the number of short-palped crane fly species, previously known from literature data. A comment on the evolution of the species composition and biodiversity of the Limoniidae and Pediciidae fauna at local and regional level are given, using community analyses data and diversity ordering.

Key words: Limoniidae, Pediciidae, adults assemblages, mountainous streams, Carpathians, assessment, biodiversity

Introduction

In general the term “biodiversity” encompasses all level of biological variation, from the level of genes to ecosystems, but is most commonly interpreted at the level of organisms, the number of different kind of animals or plants species, because this is usually the easiest way to measure diversity (MCNAEELY et al. 1989).

If we accept the holistic ecosystem philosophy, each component of this system has equal contribution and loss of any part (species, population, etc.) may lead to instability and collapse of the whole system. In contrast many organisms, like insects (except butterflies, which people generally like) are largely ignored in conservation planning. Limoniidae belong to Diptera take part from this ignored majority.

How can limoniids and pediciids contribute to assessment and classification of the wet habitats in mountainous areas?

1. They are genetically diversified, which is suggested by its great taxonomical diversity: short-palped crane flies are, with around 10 000 described species, among the largest families of Diptera. More than 500 European species have been recognized up to the present (SAVCHENKO, et al.1992). Between the other European countries, the Romanian crane flies fauna is one of the most diverse and reflect the abundance of suitable habitats, but the investigations concerning Limoniidae and Pediciidae were sporadical or superficial from here. No more than 268 species was cited up to the present in few papers. Much more species could be expected from here, if we compare our fauna with the situation with the surroundings, better investigated countries (e.g. Slovakia with 350 species) (STARY and BARTAK 2000).
2. Great diversity of habitats and trophic relationships: Most species of Limoniidae and Pediciidae are associated with moist environment. Adults are ordinarily found in low deciduous vegetation near streams and lakes in forested areas. Many species are very abundant and extensively preyed upon by birds, mammals, fishes and other vertebrates, as well as spiders and insects. Larvae usually are found in various aquatic and semi-aquatic environments during most of their development, moving to margins or dryer places for pupation. Usually they are more frequent in more or less wet organic soils or decaying vegetation in or along the streams, lakes, swamps, marshes, especially in woodlands. Most larvae feed on algae or decaying plant material, and a large majority of Pediciidae species are carnivorous in spring's habitats (REUSCH and OOSTERBROEK 1997).

Data on the ecology of these Diptera families are rather general. The knowledge on the Limoniidae and Pediciidae assemblages in wet area are restricted to more or less updated taxa lists (SAVCHENKO et al. 1992). Only a few exceptions we can mentioned here. In 1978 MENDL published ecological data about 403 species of Limoniidae and Pediciidae from running waters, followed with important distribution data. From the beginning of 1990 BRINKMANN and REUSCH have major contribution on larval ecology and emergence data on some Limoniidae species from running waters in Germany (BRINKMANN 1992, BLANKE and REUSCH 1990, REUSCH 1988, REUSCH and ZIMMERMAN 2000).

Data on the Limoniidae and Pediciidae from the Romanian Carpathians can be found in a few paper published by ASTANEI (1979), ERHAN (1984), ERHAN and CEIANU (1986), MOCZÁR (1952), RIEDEL (1914), THALHAMMER (1900), WEINBERG and ASTANEI (1979), PARVU (2003).

In these publications important new data on the species composition of the Romanian fauna were published. All these papers are important faunistic references, but without any data on ecology of species mentioned. The most intensively investigated region in Romania provided to be the northern part of the Eastern Carpathians with 169 species, without having data on the number of samples or habitats investigated (ERHAN and CEIANU 1986). Other regions have been totally neglected (example the Apuseni Mountains or the so called Romanian Western Carpathians), with important endemic aquatic fauna (ex. Trichoptera) (UJVÁROSI 2002).

The recent finished Fauna Europaea Project, which aims to provide a species inventory of all European Country, initiated us to gather together all the published information concerning the Limoniidae and Pediciidae from Romania. Besides this inventory the research of this insect in the field was more intensified and an electronically database of the Romanian Tipuloidea was elaborated (UJVÁROSI 2005b). Between 2000 and 2004 a large material of about 3 000 individuals were collected by us, together 181 species of Limoniidae and 24 species of Pediciidae, mostly from the mountainous regions of Romania (UJVÁROSI 2005b). These numbers represent about 70 % of the entire country's fauna. Between important new data on some rare limoniids and pediciids flies, other 19 species (18 Limoniidae and 1 Pediciidae) were recorded for the first time to the Romanian fauna. These species will be enumerated in the Appendix of this paper, but details on distribution and collection conditions will be published later (UJVÁROSI 2005a) These important new records lead us to intensify not only the species inventory in this area, but also to contribute with new data on the habitat requirement and community structure of limoniids and pediciids from here.

Material and methods

Sampling method

Adult crane flies were collected between 2000 and 2004 by lamping and by sweeping adult insects among vegetation with a sweep net. For lamping a 250 W halogen bulb was used, which was positioned 2 m above ground level, placed close to the water. Insects were preserved in 70% alcohol. The sampling intensity varied between watercourses: some were investigated only once, using daytime collection, while in 25 collecting sites mentioned in the Table 1 daytime sweeping as well as night collecting were used. In these sites the collecting period covered the summer time, from June to August.

The species was identified using dissecting microscope with 100x magnification. All identification was made on male genitalia. Nomenclature and order use in the present paper largely followed SAVCHENKO et al. 1992, REUSCH and OOSTERBROEK 1997 and STARY 2003, 2004.

Statistical method

The traditional diversity index of Shannon (H) and evenness (E) were used to calculate the species diversity of the short-palped crane-flies assemblages. Diversity profiled was used for scale dependent diversity characterization. We used the Rényi scale dependent diversity, which is sensitive for the rare species for small values of the scale parameter using the DivOrd.1 computer program (TÓTHMÉRÉSZ 1995, 1997, MAGURA and TÓTHMÉRÉSZ 1998). The species composition similarity was calculated by the help of the Jaccard index.

Habitat investigated

The Carpathians region is characterized with an abundant freshwater network, crucial for maintenance a high level of biodiversity from here, with various types of springs and streams, natural and more or less modified by human interventions. In general the Romanian Carpathians could be divided in three major regions, based on geological and zoogeographical considerations: Eastern Carpathians (from Maramures-region to Ciucas Mountains), Southern Carpathians (from Bucegi to Retezat Mountains) and the Apuseni Mountains or the Romanian Western Carpathians) (Fig. 1).

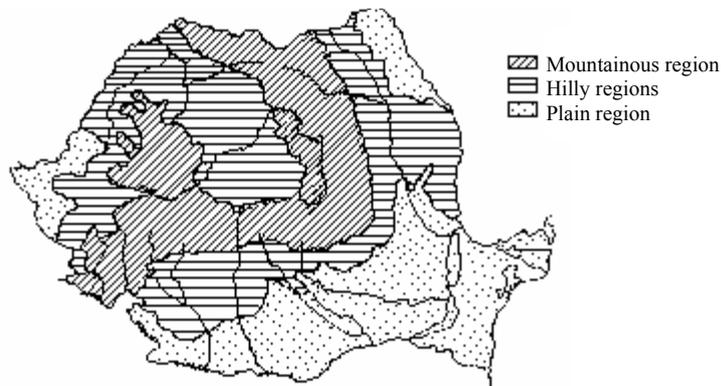


Figure 1. The mountainous area represented the Carpathians in Romania (after GODEANU 2002).

During our investigation carried out from 2000 to date different springs, spring brooks and streams of second and third order in the mountainous area were observed occasionally. Between them 25 habitats were investigated systematically in summer period between June and August, where 157 species were identified.

Results

Taxa diversity

Altogether 157 species of Limoniidae and Pediciidae was identified from 25 collecting sites in the Carpathians. Most species (40-50) were found in the second and third order streams in the well forested swampy area in Eastern Carpathians (Table 1). Only a few species (5-7) were identified along small brooks in open damp meadows, where intensive sheep grazing activity were observed (Piatra Craiului at Plaiul Foi, Valea Caprei at Fagaras Mts. and Arieseni at Bihor Mts). The highest number of species (59) was in Oituz, Nemira Mountains, at 750 m in mixed spruce fir and beech forest, followed by the Voslobeni (Gheorgheni Depression) at 680 m altitude, in a swampy area (44 species) and Valea Ierii (Gilau Mountains) (36 species) at 700 m altitude. Species rich sites were also at Lacul Rosu (Cupas Valley in Hasmas Mountains), in peat bogs from the Harghita Mountains, at 1000 m altitude (Sancraieni), in the swamp area at Siculeni (Ciuc Depression), at Babarunca (Ciucas Mountains) and at Stanisara (Cozia Mountains) with more than 20 species. The Limoniidae and Pediciidae fauna around springs was poor in species, slightly

more than 10 each site, but some important rare species were identified only from here (especially from karstic springs at Bihor and Gilau Mountains).

Limoniidae

Altogether 136 (53% of the Romanian species) Limoniidae species were recorded. The large majority of species was caught in low number of individuals from only few sites. It is important to mention that 18 species are recorded for the first time for the Romanian fauna, which occurs only in few habitats, but never in large number of individuals. Between others some valuable findings were *Antocha (O.) alpigena* (Mik.), *Cheilotrichia (E.) caerulea* Stary, *Hexatoma (E.) grisea* (Riedel), *H. (H.) fuscipennis* (Curtis), *Hoplolabis (P.) spinosa* (Nielsen), *Limonia dilutior* (Edw.), *Molophilus zetterstedti* (Tjeder), *Molophilus (M.) ermolenkoi* Savch., *M. (M.) priapoides* Stary, *Ormosia (O.) egena* (Bergroth). They have limited distribution all over Europe, sometimes the area of distribution cover only the Carpathians (*Molophilus ermolenkoi*, *Ormosia egena*, etc.), while *Dicranomyia (D.) omissinervis* Meij., *Idiocera (I.) punctata* (Edw.), *Idioptera macropteryx* (Tjeder), *Lipsothrix errans* (Walker), *Molophilus brevihammatus* Bang., *Orimarga juvenilis* (Zetterstedt), *Phylidorea (P.) abdominalis* (Staeger) are widely distributed in Europe (SAVCHENKO et al. 1992). Their presence along the mountainous streams has been expected.

Limoniidae species are important components of the aquatic ecosystems, where in a large variety of habitats occurs. From 157 species identified during the recent investigation the large majority of species (104) are close related to the ecoton characterized by swampy, moist soil on the bank of the rivers. Some of the species were captured close to the water on the low vegetation, which are terrestrial (only 13). For a number of 40 species the ecology are not satisfactorily known, their larvae may dwell in terrestrial, semiaquatic or hygropteretic habitats as well (MENDL 1978, BRINKMANN 1992).

The highest number of species were identified on the shores of the brooks in the Eastern Carpathians, with luxurious riparian vegetation, like the brooks in the Dupa Lunca marsh, Voslobeni, Gheorgheni Depression with 44 species and the swampy valley at Oituz in Nemira Mts. with 55 species. These situations reflect a strong preference of the majority of Limoniidae species to damp humid area in well-forested areas.

Pediciidae

Pediciids were present in the collected material with only 21 species, but this number represents 62% of the known Romanian pediciids. They are important components of the cold spring ecosystems, where the majority of species occurs. Only the *Ula* genus is terrestrial, the larvae frequently were found in fleshy fungi. Some species, like *Dicranota (P.) pallens* Lacksch., *D. (P.) simulans* Lacksch., *Pedicia (A.) occulta* (Meig.), *P. (C.) littoralis* (Meig.), *P. (C.) straminea* (Meig.), *P. (P.) rivosa* (L.), *T. immaculata* (Meig.) frequently occurs along streams and springbrooks all over Europe. *P. straminea* and *P. rivosa* are very common predators in springs, but could also occur in a large variety of habitats, from aquatic to more or less terrestrial (SALMELA 2001). It is important to mention that the Pediciidae fauna of Romania is very poor known. From 2000 to date important new species to the science and to the country's fauna were identified from the mountainous regions (UJVÁROSI and STARY 2002). These species are: *Dicranota (P.) brevicornis* Bergr., *D. (P.) gracilipes* Wahlengren, *D. (P.) martynovscki* Stary, *Pedicia (C.) apusenica* Ujvárosi et Stary, *P. (C.) stary* Savch., *Ula mixta* Stary.

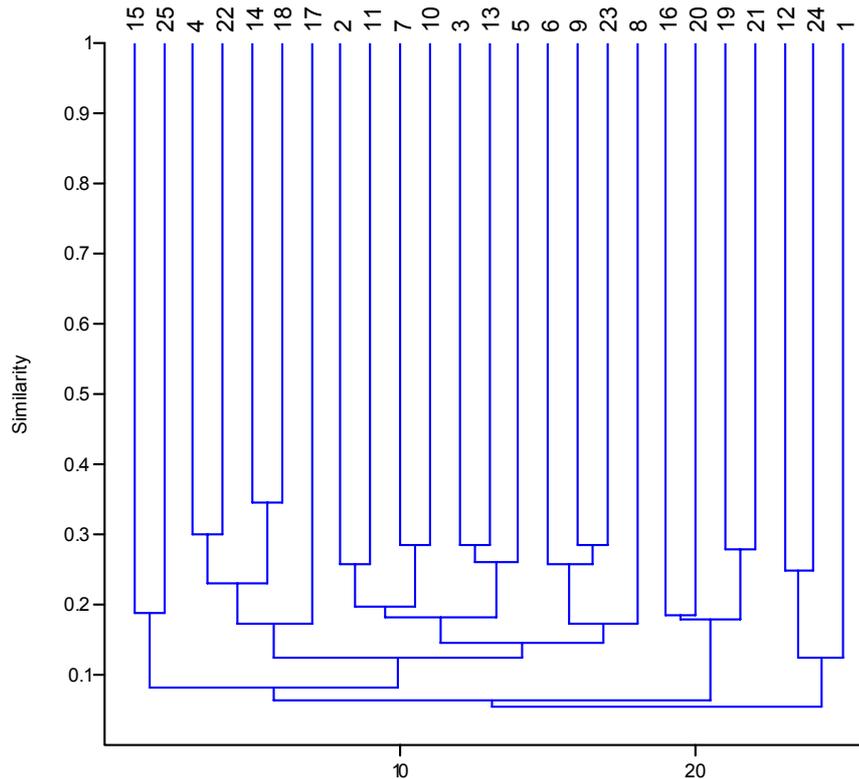


Figure 2. The clustering of the Limoniidae and Pediciidae assemblages from 25 aquatic ecosystems investigated in the Carpathians, using the Jaccard index.

As we can see in the Fig. 2 the three major regions from the Carpathians, the Eastern Carpathians, the Southern Carpathians and the Apuseni Mountains are not well separate in respect of their short-palped crane flies species. A well separate group is represented by spring's habitats in open meadow (Plaiul Foi, Piatra Craiului, Arieseni, Bihor Mountains, Valea Neagra, Gutin Mountains), where only a few common species was collected, but where intensive grazing and manure enrichment of the water was always evident. The species composition of springs and springbrooks at similar altitude has high number of common species, like springs and springbrooks in the Rodna Mountains and in the Gilau Mountains, around 1100 and 1500 m. A same situation were observed at Obarsia Ialomitei, in the Bucegi Mountains and in the Raul Barbat valley, in the Retezat Mountains, at 1000-1300 m, in the case of second and third order mountainous brooks.

Limoniidae and Pediciidae assemblages' diversity in the Carpathians

In the light of the Shannon indices, the Limoniidae and Pediciidae assemblages along Oituz stream in a damp mixed forest at 780 m in the Eastern Carpathians were the most diverse, followed by the by Valea Ierii, Gilau, Apuseni Mts. (700 m), Stanisoara, Cozia Mts., Southern Carpathians (800 m), the Luci peat bog in spruce-fir forest at Sanraieni, Harghita Mountains (1000 m) and at Valea

Blidari, Gutin Mountains (900 m), both from the Eastern Carpathians. The diversity varied extremely, because the number of species and individuals caught per sites were also very different.

Table 1. Number of species and individuals identified from the 25 habitats investigated in the Romanian Carpathians

Region	Habitat	nr. sp.	nr. ind.	H	E
Eastern	1. Gutin Mts., Valea Neagra, 800 m	13	52	1.673	0.4097
Carpathians	2. Gutin Mts., Valea Blidari, 900 m	14	42	2.16	0.6197
	3. Rodna Mts., Sesuri, Bistrita Aurie, 800 m	11	45	1.699	0.497
	4. Rodna Mts., Sesuri, Valea Lala, 1000 m	10	15	2.079	0.7998
	5. Calimani Mts., Toplita, Lomas, 1000 m	13	132	1.387	0.308
	6. Gheorgheni Depression, Voslabeni, 680 m	44	303	2.484	0.2724
	7. Haghimas Mts., Lacul Rosu, Cupas, 900 m	27	142	2.392	0.4051
	8. Harghita Mts., Sanraineni, Lucs, 1000 m	28	204	2.636	0.4983
	9. Ciuc Depression, Siculeni, 680 m	28	162	1.797	0.2153
	10. Nemira Mts., Oituz, Oituz valley, 780 m	55	284	2.838	0.3107
	11. Ciucas Mts., Babarunca, 900 m	25	128	2.625	0.5524
	Southern	12. Piatra Craiului, Plaiul Foi, 900 m	5	31	1.029
Carpathians	13. Bucegi Mts., Valea lui Stan, 900 m	16	78	2.187	0.557
	14. Bucegi Mts., Obarsia Ialomitei, 1500 m	20	154	2.276	0.4867
	15. Fagaras Mts., Valea Caprei, 1690 m	7	45	1.267	0.5072
	16. Cozia Mts., Stanisoara, 800 m	20	49	2.669	0.7215
	17. Retezat Mts., Gura Zlata, 700 m,	11	16	2.183	0.8066
	18. Retezat Mts., Raul Barbat, 1500 m,	15	59	1.774	0.3928
Apuseni Mts.	19. Trascaunlui Mts., Cheile Turzii, 450 m	18	56	2.504	0.6797
(Western	20. Trascaunlui Mts., Cheile Berchisului, 450 m	12	30	1.929	0.5736
Carpathians)	21. Padurea Craiului Mts., Lorau, Valea Boiului, 700 m	14	69	2.148	0.6119
	22. Gilau Mts., Muntele Baisorii, Buscat, 1500 m	16	114	1.688	0.3379
	23. Gilau Mts., Valea Ierii, 700 m	36	147	2.728	0.425
	24. Bihor Mts., Arieseni, 1000 m	5	13	1.413	0.8214
	25. Bihor Mts., Padis, Cetatea Radesii, 1230 m	12	29	2.339	0.8643
Median		15	59	2.16	0.5072
Minimum		5	13	1.029	0.2153
Maximum		55	303	2.838	0.8643
Total nr. of habitat					25
Total nr. of individuals					2399
Total nr. of species					157

The distribution of the number of individuals between the species identified per habitat was calculated using evenness (E). The majority of rare or new species to the Romanian Carpathians were present in the collected material in low number of individuals, while the wide spread species in the Carpathians has frequently high

number of individuals. Based on the evenness values, the most diverse habitats were the springs and first order streams, where important rare and endemic species occur in low number of individuals. One of the most valuable habitat were the karstic spring at Cetatea Radesi, Padis, Bihar Mts, at 1350 m, were quite recently a new species to the science was described (*Pedicia C. apusenica*), together with a number of other rare species and new records and the Lala valley in the Rodna Mts (UJVÁROSI and STARY 2002). These species has important conservations status for the aquatic ecosystems where they were collected.

Due to the Rényi entropy values (Fig. 3) we can separate at least three groups, one with high number of species. The number of individuals from each species varied extremly from one site to onother, which reflect some particularity of the local conditions. This is the case of the majority of larger springs in the mountainous regions. The second group has a high value of the Rényi entropy, and here a high number of species were represented by more or less equal number of individuals (springs and first order streams). The third group is represented by a low number of habitats where the entropy value is low, with a low number of species with low number of individuals, mostly streams flow in open meadow, with no developed riparian vegetation.

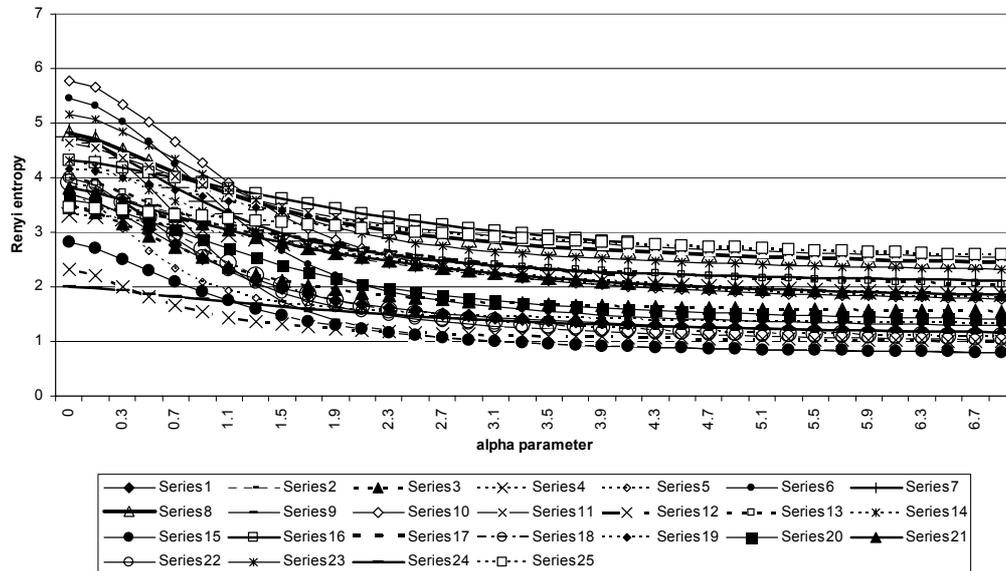


Figure 3. The Rényi entropy of the 25 habitat investigated in the Carpathians (series 1 to 25 correspond with the number of habitats from the Table 1).

Discussion

The high number of species (157) collected during our investigation along mountainous spring and brook in the Romanian Carpathians demonstrated again the conservation status of the aquatic habitats from here. The majority of the species was identified from the well forested damp areas, like the Oituz Valley, Nemira Mts., at 780 m, with 55 species, the well conserved swamp near by Voslobeni in the

Gheorgheni Depression at 680 m with 44 species and Iara Valley, Gilau Mts., with 36 species. In contrast along springs and streams, situated in open meadows, where an intensive sheep grazing activity was observed, it was captured only a few species with broad ecological demand. We can mention here the habitat at Plaiul Fcii, Piatra Craiului, at 900 m, with only 5 species, Valea Capra, Retezat Mts, at 1690 m, 7 species and Arieseni, Bihor Mts, 1000 m, with 5 species. Probably, due to the intensive grazing the lack of the riparian vegetation have a major effect for the extremely low species diversity from here. The knowledge on the fauna from the Carpathians is still very poor, during our investigation a number of 19 species were recorded for the first time from here. The clustering indicates no well separate fauna from the three major regions in the Romanian Carpathians.

Only a few numbers of species has large number of individuals. They has a general distribution, being collected in almost all habitat investigated by us. We can mention here *Erioptera (E.) lutea*, with 512 individuals, present in 20 habitats, missing only from the fauna of springs; *Molophilus (M.) ater*, always present in the assemblages found in swamp area around springs and brooks, with 174 individuals. Surprisingly, the newly recorded species, *Molophilus (M.) brevihammatus* were collected frequently, with 111 individuals in all major region from the Carpathians.

The majority of the species (104) are close related to the aquatic environment; most probably they represent an important part of the fauna of the shore of the rivers and lakes (see Appendix). Limoniids and pediciids inhabit a large variety of aquatic ecosystems, like springs, brooks, lakes to swamps, moist soils. Only a few species identified by us are terrestrial, resting on the luxuriant riparian vegetation close to the water.

The most species rich sites have the highest value of the Shannon indexes. The distribution of the total number of individuals between species varied very much between habitats. In the case of the species rich habitats, like streams from well forested damp areas the number of rare species was high, but always present with low number of individuals. These aquatic ecosystems offer good conditions for high number of ecologically different species. These habitats have important species concentrations from local to widely distributed species. Springs are more selective. Following the evolution of the evenness values among the 25 habitats investigated, the most equilibrated situation was registered along springs, with a low number of species and low number of individuals, but the spring assemblages of Limoniidae and Pediciidae always reflects a high conservation status from here, with a number of endemic or rare species. Due to the Rényi entropy value the most diverse aquatic ecosystems are springs and first order streams in well forested areas, with a moderate number of species with appropriate number of individuals. Large brooks from the Carpathians varied extremely in species composition and number of individuals, because of the complexity of the aquatic environment from here, and due to the local conditions (altitude, water chemistry, etc.).

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Appendix. List of Limoniidae and Pediciidae from the Romanian Carpathians, based on personal data (2000-2004). The symbols in the last column indicate the ecological valence of each species found, based on MENDL (1978) categories. New species to the Romanian fauna are marked with bold.

	Ecological categories (after MENDL, 1978, REUSH, 1988, 1989, BRINKMANN, 1991)	Total specimens	Occurrence
LIMONIIDAE			
1	<i>Antocha</i> (A.) <i>vitripennis</i> (Meig.)	brooks and rivers	39 4
2	<i>Antocha</i> (O.) <i>alpigena</i> (Mik)	brooks, hygroperic zone	7 2
3	<i>Atypophthalmus</i> (A.) <i>inustus</i> (Meig.)	?	2 2
4	<i>Atypophthalmus</i> (M.) <i>machidai</i> (Alex.)	?	3 3
5	<i>Austrolimnophila</i> (A.) <i>ochracea</i> (Meig.)	?	6 2
6	<i>Austrolimnophila</i> (A.) <i>unica</i> (O.-S.)	?	2 1
7	<i>Cheilotrichia</i> (C.) <i>cinerea</i> (Strobl)	brook, small river, swamp, moist soil	1 1
8	<i>Cheilotrichia</i> (C.) <i>imbuta</i> (Meig.)	brook, small river, swamp, moist soil	3 3
9	<i>Cheilotrichia</i> (E.) <i>cinerascens</i> (Meig.)	brook, small river, swamp, moist soil	10 3
10	<i>Cheilotrichia</i> (E.) <i>caerulea</i> Stary	?	1 1
11	<i>Cheilotrichia</i> (E.) <i>divisa</i> (Meig.)	?	1 1
12	<i>Cheilotrichia</i> (E.) <i>minima</i> (Strobl.)	?	3 1
13	<i>Cheilotrichia</i> (E.) <i>stary</i> Mendl	brook, small river, swamp, moist soil	1 1
14	<i>Dactylolabis</i> <i>sexmaculata</i> (Macq.)	hygropter zone	1 1
15	<i>Dactylolabis</i> <i>transversa</i> (Meig.)	underground water, caves, psamon	13 5
16	<i>Dicranomyia</i> (D.) <i>chorea</i> (Meig.)	swamps, moist soil	4 1
17	<i>Dicranomyia</i> (D.) <i>distendens</i> (Lundstr.)	peat bogs, swamps, moist soil	9 3
18	<i>Dicranomyia</i> (D.) <i>dydima</i> (Meig.)	springs, swamps, moist soil	5 4
19	<i>Dicranomyia</i> (D.) <i>frontalis</i> (Staeger)	springs, swamps, moist soil	1 1
20	<i>Dicranomyia</i> (D.) <i>mitis</i> (Meig.)	hygropter zone, swamps, moist soil	39 9
21	<i>Dicranomyia</i> (D.) <i>modesta</i> (Meig.)	?	43 9
22	<i>Dicranomyia</i> (D.) <i>omissinervis</i> Meij.	springs, swamps, moist soil	7 2
23	<i>Dicranomyia</i> (G.) <i>transsylvanica</i> Lack.	?	3 2
24	<i>Dicranomyia</i> (G.) <i>tristis</i> (Schumm.)	?	7 6
25	<i>Dicranomyia</i> (M.) <i>morio</i> (Fabr.)	swamps, moist soil	2 1
26	<i>Dicranomyia</i> (M.) <i>occidua</i> Edw.	springs, swamps, moist soil	1 1
27	<i>Dicranomyia</i> (N.) <i>fusca</i> (Meig.)	?	5 3
28	<i>Dicranoptycha</i> <i>fuscescens</i> (Schumm)	?	11 5
29	<i>Dicranoptycha</i> <i>livescens</i> Loew	?	1 1
30	<i>Dicranoptycha</i> <i>paralivescens</i> Stary	?	31 4
31	<i>Discobola</i> <i>annulata</i> (L.)	?	1 1
32	<i>Elephantomyia</i> <i>edwardsi</i> Lack.	?	1 1
33	<i>Elliptera</i> <i>omissa</i> Schiner	brook, small river, hygropter zone	2 1
34	<i>Eloeophila</i> <i>apicata</i> (Loew)	brook, small river, swamp, moist soil	1 1
35	<i>Eloeophila</i> <i>maculata</i> (Meig.)	brook, small river, swamp, moist soil	65 14

36	<i>Eloeophila miliaria</i> (Egger)	brook, small river, swamp, moist soil	5	3
37	<i>Eloeophila submarmorata</i> (Verall)	brook, small river, swamp, moist soil	1	1
38	<i>Epiphragma</i> (E.) <i>ocellare</i> (L.)	moist soil	17	5
39	<i>Eriocnopa trivialis</i> (Meig.)	hot springs, swamps, moist soil	2	1
40	<i>Erioptera</i> (E.) <i>divisa</i> (Walker)	swamps, moist soil	3	2
41	<i>Erioptera</i> (E.) <i>flavata</i> (Westhoff)	?	5	4
42	<i>Erioptera</i> (E.) <i>fusculenta</i> Edw.	swamps, moist soil	1	1
43	<i>Erioptera</i> (E.) <i>lutea</i> Meig.	freshwater, no specialization	512	20
44	<i>Erioptera</i> (E.) <i>sordida</i> Zett.	brooks, small river, swamp, moist soil	1	1
45	<i>Erioptera</i> (M.) <i>fossarum</i> (Loew)	swamp, moist soil,	7	2
46	<i>Euphyllidorea aperta</i> (Verall)	swamp, moist soil,	1	1
47	<i>Euphyllidorea dispar</i> (Meig.)	?	5	2
48	<i>Euphyllidorea phaeostigma</i> (Schumm.)	?	25	3
49	<i>Gnophomyia viridipennis</i> Gimmerth.	?	2	1
50	<i>Gonempeda flava</i> (Schumm.)	?	2	2
51	<i>Gonomyia</i> (G.) <i>conoviensis</i> Barnes	brooks, small river, swamp, moist soil	3	2
52	<i>Gonomyia</i> (G.) <i>lucidula</i> Meijere	brooks, small river, swamp, moist soil	22	9
53	<i>Gonomyia</i> (G.) <i>simplex</i> Tonnoir	brooks, small river, swamp, moist soil	8	5
54	<i>Gonomyia</i> (G.) <i>tenella</i> (Meig.)	brooks, small river, swamp, moist soil	4	3
55	<i>Heliopsis longirostris</i> (Meig.)	swamps, moist soil, standing water	2	1
56	<i>Hexatoma</i> (E.) <i>grisea</i> (Riedel)	brooks, small river, swamp, moist soil	4	2
57	<i>Hexatoma</i> (H.) <i>fuscipes</i> (Curtis)	?	2	2
58	<i>Hoplolabis</i> (P.) <i>areolata</i> (Siebke)	swamps, moist soil	4	2
59	<i>Hoplolabis</i> (P.) <i>mannheimisi</i> (Meig.)	brooks, small river, swamp, moist soil	5	2
60	<i>Hoplolabis</i> (P.) p. <i>punctigera</i> (Lack.)	brooks, small river, swamp, moist soil	2	2
61	<i>Hoplolabis</i> (P.) <i>sorocula</i> (Lack.)	brooks, small river, swamp, moist soil	2	2
62	<i>Hoplolabis</i> (P.) <i>spinosa</i> (Nielsen)	brooks, small river, swamp, moist soil	1	1
63	<i>Hoplolabis</i> (H.) <i>subalpina</i> (Bangerter)	brooks, small river, swamp, moist soil	8	1
64	<i>Hoplolabis</i> (P.) <i>vicina</i> (Tonnoir)	brooks, small river, swamp, moist soil	11	5
65	<i>Hoplolabis</i> (P.) <i>yezoana</i> (Alex.)	brooks, small river, swamp, moist soil	34	7
66	<i>Idiocera</i> (E.) <i>paulsi</i> Stary & Ujv.	brooks, small river, swamp, moist soil	16	2
67	<i>Idiocera</i> (E.) <i>jucunda</i> (Loew)	brooks, small river, swamp, moist soil	43	8
68	<i>Idiocera</i> (I.) <i>punctata</i> (Edw.)	brooks, small river, swamp, moist soil	2	2
69	<i>Idioptera macropteryx</i> (Tjeder)	peat bog	3	1
70	<i>Ilisia maculata</i> (Meig.)	swamps, moist soil	2	2
71	<i>Limnophila pictipennis</i> (Meig.)	brooks, small river, swamp, moist soil	23	3
72	<i>Limnophila schranki</i> Oosterbroek	brooks, small river, swamp, moist soil	73	8

73	<i>Limonia alpicola</i> (Lack.)	terrestrial	15	7
74	<i>Limonia dilutior</i> (Edw.)	terrestrial	8	2
75	<i>Limonia flavipes</i> ((Fabricius)	terrestrial	3	2
76	<i>Limonia macrostigma</i> (Schumm.)	terrestrial	12	1
77	<i>Limonia nigropunctata</i> (Schumm.)	terrestrial	8	3
78	<i>Limonia nubeculosa</i> Meigen	terrestrial	4	3
79	<i>Limonia pannonica</i> (Kowitz)	terrestrial	5	4
80	<i>Limonia phragmitidis</i> (Schränk)	terrestrial	36	7
81	<i>Limonia sylvicola</i> (Schummel)	terrestrial	2	1
82	<i>Lipsothryx ecucculata</i> Edwards	springs, moist soil	4	1
83	<i>Lipsothrix errans</i> (Walker)	springs, moist soil	1	1
84	<i>Lipsothrix remota</i> (Walker)	springs, moist soil	13	4
85	<i>Metalimnobia bifasciata</i> (Schränk)	flesy fungi	9	2
86	<i>Metalimnobia quadrimaculata</i> (L.)	flesy fungi	1	1
87	<i>Metalimnobia quadrinotata</i> (Meig.)	flesy fungi	8	6
88	<i>Metalimnobia zetterstedti</i> (Tjeder)	flesy fungi	10	5
89	<i>Molophilus</i> (M.) <i>appendiculatus</i> (Staeg)	brooks, small river, swamp, moist soil	3	2
90	<i>Molophilus</i> (M.) <i>ater</i> (Meig.)	swamp, moist soil,	174	4
91	<i>Molophilus</i> (M.) <i>bifidus</i> Goethg.	hygropterid zone, swamps, moist soil	3	3
92	<i>Moloph. (M.) brevihammatus</i> Bang.	brooks, small river, swamp, moist soil	111	7
93	<i>Molophilus</i> (M.) <i>cinereifrons</i> Meijere	brooks, small river, swamp, moist soil	8	3
94	<i>Molophilus</i> (M.) <i>corniger</i> Meijere	brooks, small river, swamp, moist soil	1	1
95	<i>Molophilus</i> (M.) <i>crassypigus</i> Meijere	?	80	10
96	<i>Molophilus</i> (M.) <i>curvatus</i> Tonnoir	hygropterid zone, brooks, moist soil	11	4
97	<i>Molophilus</i> (M.) <i>cizeki</i> Lacksch.	brooks, small river, swamp, moist soil	2	2
98	<i>Molophilus (M.) ermolenkoi</i> Savch.	brooks, small river, swamp, moist soil	1	1
99	<i>Molophilus</i> (M.) <i>flavus</i> Goethg.	brooks, small river, swamp, moist soil	10	4
100	<i>Molophilus</i> (M.) <i>medius</i> Meijere	?	7	4
101	<i>Molophilus</i> (M.) <i>ochraceus</i> (Meig.)	brooks, small river, swamp, moist soil	2	2
102	<i>Molophilus (M.) priapoides</i> Stary	brooks, small river, swamp, moist soil	3	2
103	<i>Molophilus</i> (M.) <i>propinquus</i> (Egger)	brooks, small river, swamp, moist soil	19	6
104	<i>Molophilus</i> (M.) <i>serpentiger</i> Edwards	brooks, small river, swamp, moist soil	1	1
105	<i>Molophilus</i> (M.) <i>vafer</i> Lacksch.	brooks, small river, swamp, moist soil	3	3
106	<i>Neolimnomyia</i> (B.) <i>nemoralis</i> (Meig.)	brooks, swamps, moist soil	82	15
107	<i>Neolimnomyia</i> (N.) <i>batava</i> (Edw.)	standing water, swamps, moist soil	6	3
108	<i>Neolimnomyia</i> (N.) <i>filata</i> (Walker)	brooks, small river, swamp, moist soil	1	1
109	<i>Neolimnophila bergrothi</i> (Kuntze)	?	12	1
110	<i>Neolimnophila carteri</i> (Tonnoir)	brooks, small river, swamp, moist soil	29	10

111	<i>Neolimonia dumetorum</i> (Meig.)	?	5	2
112	<i>Orimarga attenuata</i> (Walk.)	hygropter zone	14	5
113	<i>Orimarga juvenilis</i> (Zetterstedt)	hygropter zone	5	2
114	<i>Ormosia baldensis</i> Mendl	brooks, small river, swamp, moist soil	3	1
115	<i>Ormosia fascipennis</i> (Zetterstedt)	brooks, small river, swamp, moist soil	5	5
116	<i>Ormosia egena</i> (Bergroth)	swamps, moist soil	3	2
117	<i>Ormosia ruficauda</i> (Zetterstedt)	brooks, small river, swamp, moist soil	3	1
118	<i>Paradelphomyia fuscata</i> (Loew)	brooks, hygropter zone, swamps	1	1
119	<i>Paradelphomyia senilis</i> (Haliday)	hygropter zone swamps, moist soil	1	1
120	<i>Phylidorea</i> (P.) <i>abdominalis</i> (Staeger)	swamps, moist soil	1	1
121	<i>Phylidorea</i> (P.) <i>ferruginea</i> (Meig.)	standing water, peat bog, swamps	3	2
122	<i>Phylidorea</i> (P.) <i>fulvonervosa</i> (Schumm)	?	21	4
123	<i>Phylidorea</i> (P.) <i>longicornis</i> (Schumm)	?	5	2
124	<i>Phylidorea</i> (P.) <i>nervosa</i> (Schumm.)	?	2	1
125	<i>Phylidorea</i> (P.) <i>squalens</i> (Zetterst.)	peat bog, brooks, small rivers, swamps	20	3
126	<i>Pilaria discicollis</i> (Meig.)	brooks, small river, swamp, moist soil	3	2
127	<i>Prionolabis hospes</i> (Egger)	brooks, small river, swamps	57	4
128	<i>Rhabdomastix</i> (R.) <i>lurida</i> Loew	brooks, small river, swamp, moist soil	4	2
129	<i>Rhabdomastix</i> (R.) <i>subparva</i> Stary	brooks, small river, swamp, moist soil	1	1
130	<i>Rhypholophus phryganoptera</i> Kolenati	brooks, small river, swamp, moist soil	1	1
131	<i>Rhyphidia ctenophora</i> Loew	?	4	3
132	<i>Rhyphidia maculata</i> Meigen	?	3	2
133	<i>Rhyphidia punctiplenna</i> Mik	?	4	2
134	<i>Rhyphidia uniserata</i> Schiner	?	1	1
135	<i>Symplecta</i> (S.) <i>hybrida</i> (Meig.)	brooks, small river, swamp, moist soil	8	1
136	<i>Tasiocera</i> (D.) <i>murina</i> Meigen	swamps, moist soil	8	4
PEDICIIDAE				
1	<i>Dicranota</i> (L.) <i>lucidipennis</i> (Edw.)	brooks, small rivers, hygropter zone	2	2
2	<i>Dicranota</i> (P.) <i>brevicornis</i> Bergroth	brooks, small rivers, swamps, moist soil	1	1
3	<i>Dicranota</i> (P.) <i>candelisequa</i> Stary	?	3	3
4	<i>Dicranota</i> (P.) <i>gracilipes</i> Wahlengren	brooks, small rivers	1	1
5	<i>Dicranota</i> (P.) <i>landrocki</i> Czizek	brooks, small rivers	2	1
6	<i>Dicranota</i> (P.) <i>martynovski</i> Stary	brooks, small rivers, swamps, moist soil	2	1
7	<i>Dicranota</i> (P.) <i>pallens</i> Lacksch.	brook, small river, hygropter zone	84	4
8	<i>Dicranota</i> (P.) <i>simulans</i> Lacksch.	brooks, small rivers, swamps, moist soil	36	2
9	<i>Dicranota</i> (P.) <i>subtilis</i> Loew	brooks, small rivers, swamps, moist soil	1	1
10	<i>Pedicia</i> (A.) <i>occulta</i> (Meig.)	brook, small river, hygropter zone	34	5
11	<i>Pedicia</i> (C.) <i>apusenica</i> Ujv. & Stary	springs, brooks, moist soil	7	2

12	<i>Pedicia</i> (C.) <i>littoralis</i> (Meig.)	brook, small rivers, swamps, moist soil	11	1
13	<i>Pedicia</i> (C.) <i>stary</i> Savchenko	springs, brooks, moist soil	4	1
14	<i>Pedicia</i> (C.) <i>straminea</i> (Meigen)	brooks, springs, swamp, moist soil	17	5
15	<i>Pedicia</i> (P.) <i>rivosa</i> (L.)	springs, swamps, peat bog, moist soil	15	7
16	<i>Pedicia</i> <i>zernyi pallens</i> Savchenko	brooks, small rivers, swamps, moist soil	5	1
17	<i>Tricyphona</i> <i>immaculata</i> (Meig.)	brooks, springs, swamp, moist soil	25	5
18	<i>Tricyphona</i> <i>schummeli</i> Edw.	springs, swamps, moist soil	21	3
19	<i>Trichyphona</i> <i>unicolor</i> (Schumm.)	peat bogs, brooks, swamps, moist soil	20	1
20	<i>Ula</i> <i>mixta</i> Stary	not aquatic, fleshy fungi	1	1
21	<i>Ula</i> <i>sylvatica</i> (Meig.)	not aquatic, fleshy fungi	18	7
	Total nr. of species		157	