

**ORDER TRICHOPTERA (INSECTA)
FROM THE APUSENI NATURE PARK (TRANSYLVANIA, ROMANIA)**

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ABSTRACT

54 caddisfly species (imago) belonging to 12 families were identified during 2006 and 2008 in three sampling sites in the upper Arieş and Someşul Cald catchment areas, representing about one fifth of the Romanian Trichoptera fauna. 23 species were common to the three sites (Gârda Seacă, Vârtop - the upper Arieş catchment area and Ic Ponor - the source of the Someşul Cald River); 15 species were present only in the Someşul Cald, 1 only in Vârtop and 11 only in Gârda Seacă. *Hydroptila taurica* Martinov belonging to Hydroptilidae was recorded for the first time in the Romanian fauna. The following species were cited for the first time for this park: *Lype reducta* Hag., *Hydropsyche botosaneanui* Marink, *Rhadicoleptus alpestris* Kol., *Limnephilus hirsutus* Pictet, *L. rhombicus* Linnaeus, *L. sparsus* Curtis. Other species, like *Hydropsyche tabacarui* Bots. (Family Hydropsychidae), *H. botosaneanui* Marink. and *H. pellucidula* Curtis were identified in the considered sites, even if they are known to occur mostly in submountainous waters in Romania. A high number of species belonged to Limnephilidae (44%) (23 species), Rhyacophilidae and Hydroptilidae (12%) (7 species). High values of Shannon Wiener diversity index showed an increased microhabitat diversity and good water quality. Caddisfly populations recorded a normal distribution along an altitudinal gradient, but there were major human pressures that influenced the diversity of Trichoptera species.

RÉSUMÉ: Les Trichoptères (Insecta) du Parc Naturel d'Apuseni (Transylvanie, Roumanie).

Pendant les années 2006 et 2008, dans trois stations du bassin supérieur de l'Arieş et de Someşul Cald, on a identifié 54 espèces de Trichoptères à l'état d'imagos appartenant à 12 familles, qui représente un peu plus de 1/5ème du total de la faune des Trichoptères de Roumanie. Vingt-trois espèces sont communes pour trois sites: Gârda Seacă, Vârtop - le bassin supérieur de l'Arieş - et Ic Ponor - la source du Someş Cald. Quinze espèces n'ont été trouvées qu'à Someşul Cald, 1 à Vârtop et 11 à Gârda Seacă. Parmi les Hydroptylidae, *Hydroptyla taurica* Martinov est nouvelle pour la faune de Roumanie. On a enregistré pour la première fois sur le territoire du Parc Naturel d'Apuseni les espèces de Trichoptères suivantes: *Lype reducta* Hag., *Hydropsyche botosaneanui* Marink., *Rhadicoleptus alpestris* Kol., *Limnephilus hirsutus* Pictet, *L. rhombicus* Linnaeus, *L. sparsus* Curtis. Cependant, d'autres espèces comme *Hydropsyche tabacarui* Bots., *H. botosaneanui* Marink. et *H. pellucidula* Curtis (Hydropsychidae) y ont été récoltées bien qu'elles soient plus communément présentes dans les eaux du piémont en Roumanie. Nos recherches ont mentionné la présence d'un grand nombre d'espèces appartenant aux Fam. Limnephilidae (23) et Rhyacophilidae (7). Les valeurs élevées des indices de diversité spécifique Shannon Wiener, montrent une diversité élevée des microhabitats et une qualité supérieure de l'eau des deux bassins supérieurs de ces deux rivières. En dehors de la distribution normale des populations par rapport au gradient altitudinal, on constate des influences majeures d'origine anthropique induisant des conséquences sur la diversité spécifique des Trichoptères.

REZUMAT: Ordinul Trichoptera (Insecta) din Parcul Nat. Apuseni (Transilvania, România).

În 2006 și 2008, în trei stații din bazinul superior al Arieșului și Someșului Cald au fost identificate 54 specii de trichoptere (imago), aparținând la 12 familii, ceea ce reprezintă ceva mai mult de 1/5 din totalul faunei de trichoptere a României. 23 specii sunt comune celor trei situri (Gârda Seacă, Vârtop - bazinul superior al Arieșului și Ic Ponor - obârșia Someșului Cald), 15 au fost doar în Someșul Cald, 1 în Vârtop și 11 doar în Gârda Seacă. Dintre Hydroptilidae, *Hydroptila taurica* Martinov este înregistrată prima dată în România. Au fost înregistrate prima dată pe teritoriul PNA speciile de Trichoptere: *Lype reducta* Hag.; *Hydropsyche botosaneanui* Marink; *Rhadicoleptus alpestris* Kol.; *Limnephilus hirsutus* Pictet; *L. rhombicus* Linnaeus; *L. sparsus* Curtis, iar alte specii, *Hydropsyche tabacarii* Bots. (Fam. Hydropsychidae) *H. botosaneanui* Marink. și *H. pellucidula* Curtis au fost identificate ca prezente, deși acestea sunt prezente în general în apele submontane din România. În cercetările noastre, este subliniată prezența unui număr mare de specii, aparținând familiilor Limnephilidae (23) și Rhyacophilidae (7); valorile ridicate ale indicilor de diversitate specifică Shannon Wiener induc ideea unei diversități crescute a microhabitatelor și o calitate superioară a apei celor două bazine superioare ale celor două râuri. În afară de distribuția normală a populațiilor pe gradient altitudinal, există influențe majore de origine antropică cu consecințe asupra diversității specifice a Trichopterenelor.

INTRODUCTION

The diversity of bioindicator species always represented a topic of debate in all research activities of ecosystems. The following aspects represent the framework of previous research of Trichoptera community structure in Apuseni Nature Park: the main challenge of the present study was the existence of previous research studies on Trichoptera communities from the Apuseni Mountains aquatic ecosystems (and not only) (Botoșăneanu, 1952, 1957, 1959, 1966; Botoșăneanu and Por, 1957; Botoșăneanu and Schneider, 1978; Murgoci, 1951; Murgoci and Marcoci, 1955); another challenge was the heterogeneous sampling of Order Trichoptera in these ecosystems along the years. All previous studies were based on individuals collected on different occasions from the caves or the water bodies of the Apuseni Mountains in different expeditions and in different periods of time. Most species cited in these papers and most samplings were described many times by specialists on other macroinvertebrate groups; no previous study described a sampling method with efficient results; at present there is no complete list of caddisfly species from the running waters of the Apuseni Nature Park; after the Apuseni Nature Park was declared a protected area, its administration demanded a database of macroinvertebrate biodiversity from the aquatic and terrestrial ecosystems included in the Park area; nowadays, fewer researchers focus on fauna and flora structure from the Romanian protected areas, thus numerous databases include only historic data; in order to implement the Framework Directive - a request for Romania as new EU member, a complete inventory of bioindicator groups (including numerous Trichoptera from aquatic ecosystems) must be made.

MATERIAL AND METHODS

Three unpolluted aquatic ecosystems were chosen, two in Arieș Basin (Gârda Seacă and Vârtop) and one in Someșul Cald Basin (Fig. 1). The first was located in Vârtop at 1,140 m altitude and the second one in Gârda Seacă at 760 m (near Dobra house in Gârda Seacă), while the third one is near the Ic Ponor locality, in the upper Someșul Cald Basin - near the river source: Vârtop - North 46030' 58'', East 22041' 11'' (1,139 m); Gârda Seacă - North 46027' 54'', East 22049' 35'' (853 m); Someșul Cald - North 46037' 47'', East 22046' 55'' (1,081 m). At the last station, caddisflies were collected from two close sites (100 m distance). Three light traps were used along the Someșul Cald, situated about 50 m from one another. A third light trap was on the Alunul Mic River, 100 m upstream from its junction with the Someșul Cald River.



Figure 1: The location of the following sampling sites: Vârtop, Gârda Seacă (the upper Arieș River) and the Someșul Cald (source).

Light traps are metal cylindrical tools, 30 cm in diameter, having three holes 10 cm in diameter. Inside the traps are 250 W white light bulbs with mercury vapors. The light bulbs were connected to a 3 KW electrical generator. They were on from nine o'clock in the evening till five - five thirty o'clock in the morning the next day. The biological material was collected in plastic recipients with 80% alcohol and a few ml glycerin. After the sampling, the material was sorted, identified up to species level, divided by sex and then preserved in 80% alcohol. The collection is located at the The Bucharest University Zoological Institute of Sinaia.

15 samples were taken from the Someșul Cald Basin (Someșul Cald - River source and Alunul Mic) in July 2008 (between 18th July to 23rd July 2008), while the samples from the Arieș catchment area (Vârtop and Gârda Seacă) were collected from June the 5th till August the 29th 2006. The last samples were collected in two consecutive nights every two weeks. Thus, 13 samples were taken from Gârda Seacă, the Dobra house, and 11 samples from Vârtop. At the three sampling sites the light traps worked with the same type of bulb described above.

Characteristics of aquatic ecosystems considered for the study:

The Arieș River source (Vârtop) was characterized by the presence of bryophytes and mountainous limno- and helocrene springs, with low water flow, benthic substratum with organic load and large stones. The water came from a complex of springs of the Vârtop area, collected by the main river which became larger on going downstream (broader river bed reaching up to 2 - 3 m, increased water flow and water velocity - up to a few m/s). The main characteristic of these springs was the strong human impact coming from numerous buildings located in the area, chalets, local houses, small hotels, access roads, fences etc. The flora was dominated by the spruce forest (*Picea excelsa*), covering the whole upper Arieș Basin area.

Gârda Seacă. (Gârda de Sus - the Dobra house) had a width of 3 - 4 m, increased water flow and a water velocity of 10 - 15 m/s. Pollution sources coming from human settlements were located downstream from the sampling site. The forest growing on the two river terraces included mostly *Fagus sylvatica* and herbaceous flora: *Impatiens nolitangere*, *Epilobium montanum*, *Mercurialis perennis*, *Heleborus purpurascens*, *Alnus viridis*, *Salix* sp., *Sambucus* sp. etc. were found on the river banks. A mountainous meadow of several hundred square meters, with a characteristic herbaceous flora (*Petasites*, *Tusilago farfara* and graminaceous plants) was located upstream from the site, on the left river bank.

The Someșul Cald and Alunul Mic rivers. The river was 8 - 10 m wide; the substratum was made of rock fragments measuring from a few centimeters to 30 - 40 cm. Microhabitats dominated by sand and gravel were located laterally, in the riverbed regions with decreased erosion. Artificial waterfalls made by wood logs were situated every 50 m, causing decreases in water velocity. The aquatic ecosystem had an increased stability in the study area, not only from a hydrological point of view, but also as regards the structure of the adjacent communities. No traces of floods or erosion and sedimentation were found in the riverbed and in the floodplain. Before the junction, both rivers drained a system of caves and gorges that caused an increased stability of hydrological levels, so pluvial waters and those coming from the sudden snow melt had little influence. All these aspects influenced the diversity of aquatic microhabitats, leading to a stable structure of Trichoptera communities. The three light traps from the Someșul Cald catchment area were located at 30 m upstream the river junction with the tributary Alunul Mic, in a forest dominated by *Picea excelsa*. *Alnus viridis*, *Sambucus* sp. and *Salix* sp. were found on the riverbanks, together with shrub species: *Sorbus* sp., *Lonicera* sp., next to characteristic herbaceous flora: *Simphytum* sp., *Aconitum* sp., bryophytes in the shadows etc.

RESULTS AND DISCUSSIONS

There is only one monograph that characterizes caddisfly fauna from the Arieș River catchment area (Gârda Seacă), but the number of taxa identified by the authors was very low - only 6 species (larvae and also adults): *Rhyacophila laevis*, *Wormaldia triangulifera*, *Plectocnemia conspersa*, *Adicella filicornis*, *Potamophylax luctuosus* and *Beraea pullata* (Botoșăneanu and Por, 1957). Only three of these six species were identified in the three sites considered for the present study (*Rhyacophila laevis*, *Plectocnemia conspersa*, *Potamophylax luctuosus*). Other species registered with a very low frequency in our samples (*Drusus tenellus*, *Potamophylax latipennis* and *Rhyacophila nubila*) (Tab. 3) were not identified by the authors even if their research took place in the same region - Gârda Seacă.

From the total of about 113 taxa identified in the Apuseni Mountains area from the beginning of Trichoptera research in Romania (Ciubuc, 1993), only 56 were found in these three sites considered for the present study, representing about 49%. The total number of 113 taxa also includes the ones caught in submountainous and hilly regions of the mountain. Trichoptera species identified in our samples belonged to 12 families. Family Limnephilidae included the highest number of species (23), representing 44% from the taxonomical structure of the community (Fig. 2 and Tab. 1). Other families included less taxa: Families Rhyacophilidae and Hydropsychidae 6 (12%), Glossosomatidae 5 (10%). The rest of the families: Hydroptilidae, Philopotamidae, Polycentropodidae, Psycomyidae, Brachicentridae, Goeridae, Sericostomatidae and Odontoceridae only had 1 - 3 species, representing 2 - 6% (Fig. 2, Tab. 1).

Good water quality from the upper Someșul Cald River and the Alunul Mic River led to the presence of several species with specific ecological requests, like *Rhyacophila polonica*, *Polycentropus excisus*, *Wormaldia pulla*, *Agapetus ochripes*, *Potamophylax latipennis* etc.

For the present study, six Trichoptera species were first cited in the Apuseni Nature Park: *Lype reducta*; *Hydropsyche botosaneanui*; *Rhadicoleptus alpestris*; *Limnephilus hirsutus*; *L. rhombicus*; *L. sparsus*. *Hydroptila taurica* was first identified in our country (Fig. 9). *Synagapetus slavorum*, described by Botoșăneanu on species coming from the former Yugoslavia (Botoșăneanu, 1960) was found in Romania in only a few locations: in Runcu (North Oltenia), Apuseni - in a few sites (Botoșăneanu, 1995) and Plavișevița, The Iron Gates (Ciubuc, 2008, unpublished data). The number of taxa identified in Gârda Seacă and the Someșul Cald source was the same - 38, but the species composition in the two sites was different. Thus, in Gârda Seacă 12 species were identified; in the Someșul Cald - Alunul Mic Rivers 15 species and at the Arieș River source (Vârtope) only one species (*Micropterna nycterobia*) (Tab. 2). The other species included on the list were found at all three sites. The high number of different taxa, especially in Gârda Seacă and in the Someșul Cald was probably due to the following factors: the existence of different microhabitats in the sites, different hydrological characteristics of the rivers, the altitude, the temperature regime and last but not least the flora composition in the adjacent terrestrial ecosystems or the species composition of benthic primary producers. Despite the good water quality in the Someșul Cald and in the Arieș (Gârda Seacă), there were differences between the two rivers. Four species belonging to the *Hydropsyche* genus (*H. botosaneanui*, *H. bulbifera*, *H. pellucidula*, *H. tabacarii*) (Tab. 2) were identified in Gârda Seacă. On the other hand, in the Someșul Cald River dominant species were those belonging to Family Limnephilidae (*Ecclisopteryx madida*, *L. extricatus*, *L. decipiens*, *L. rhombicus*), known to be eurybiont species. However, stenobiont

species were also found: *Potamophylax nigricornis*, *Rhyacophila polonica* or *Philopotamus montanus*, which were rhithrobiont or crenobiont species. Other species, like *Rhyacophila nubila*, *Potamophylax latipennis* or *Limnephilus extricatus*, even if they were known to be mountainous rhithrobiont species, they were identified at all three sampling sites together with eurybiont species (*Limnephilus bipunctatus*, *L. griseus*, *L. lunatus*). *Rhadicoleptus alpestris*, which was an alpine species, was identified at high altitudes exceeding 1000 m, in Vârtop (the Arieş and Someşul Cald source), even if in Vârtop the springs were highly impacted. However, this species was present at lower altitudes as well (in Gârda Seacă).

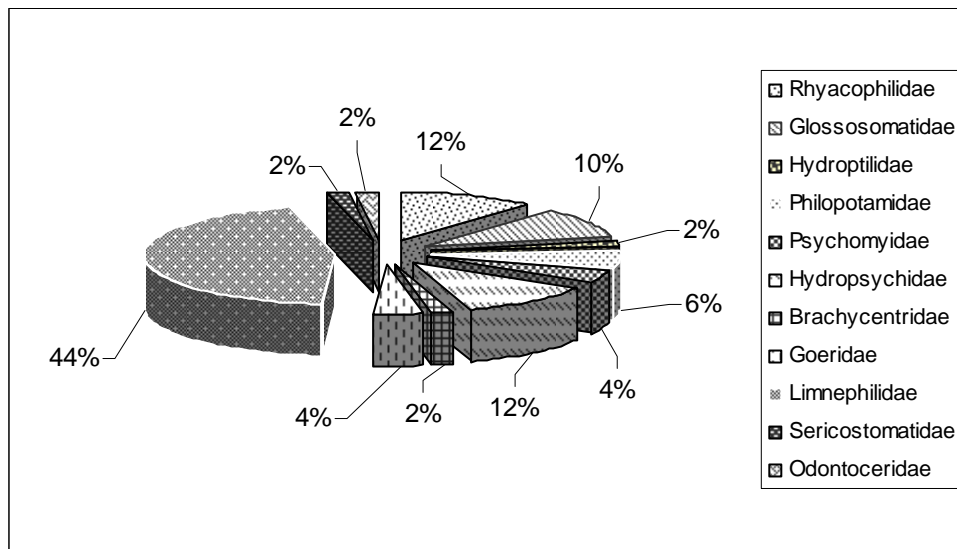


Figure 2: Species percentage belonging to different Trichoptera families from the Apuseni Nature Park area.

The common taxa identified in the Someşul Cald and Vârtop were species that preferred alpine and subalpine regions (*Limnephilus coenosus*, *Rhadicoleptus alpestris*), or rhithrobiont species (*Plectrocnemia conspersa*), together with species with larger ecological requests (*Limnephilus vittatus*). Five common species were found in Gârda Seacă and Vârtop, despite the differences in altitude: *Limnephilus sparsus* (eurybiont), *Potamophylax luctuosus* (mountainous rhithrobiont), *Silo piceus* (rhithrobiont and epi-potamobiont), *Rhadicoleptus alpestris* (alpine and subalpine) and *Stenophylax permistus* (rhithrobiont).

All the examples presented above prove the adaptability of some caddisfly eurybiont species to different ecological conditions but also the high specificity of others to different types of brooks, to a specific temperature regime with or without particulate organic load. Hydropsychidae species were identified in higher numbers in Gârda Seacă compared to the other two sites: the Someşul Cald and Vârtop. Thus, five taxa were found: *Hydropsyche botosaneanui*, *H. bulbifera*, *H. pellucidula*, *H. tabacarui* and *Hydropsyche* sp., compared to only one - *Hydropsyche instabilis* in the Someşul Cald and Vârtop stations. The species belonging to genus *Hydropsyche* did not build cases and they were collectors, feeding on particulate organic matter that was why they were present in higher numbers at the Gârda Seacă site, where leaf fragments were numerous in the riverbed. On the other hand, most species from Family Hydropsychidae were found in plain and hilly regions, up to 600 - 700 meters a.s.l.

The table 3 presents 38 taxa identified in the Gârda de Sus (Dobra house) between June 5th and August 29th 2006. *H. instabilis* and *H. pellucidula* recorded the highest abundance. Sex ratio was in favor of females for both species. *Hydropsyche tabacarii* and *H. botoaneanui* had very low populations (*H. tabacarii* 5 ♂ and 5 ♀; *H. botoaneanui* only 1 ♂). The highest frequency (70 - 80%) was recorded by *Drusus tenellus*; *Potamophylax latipennis* and *Rhyacophila nubila*. The imagoes found throughout the warm season suggested that the emergence took place from June to August-September, leading to numerous populations belonging to the three species. In only three sampling occasions in June no emergence occurred.

Table 1: List of Trichoptera taxa identified in the Apuseni Nature Park area.

Fam. Rhyacophilidae	<i>Hydropsyche tabacarii</i> Botoşăneanu, 1960
<i>Rhyacophila fasciata</i> Hagen, 1859	Fam. Brachycentridae
<i>Rhyacophila laevis</i> Pictet, 1834	<i>Micrasema minimum</i> McLachlan, 1876
<i>Rhyacophila mocsaryi</i> Klapalek 1898	Fam. Goeridae
<i>Rhyacophila nubila</i> (Zetterstedt, 1840)	<i>Silo graellsii</i> Pictet, 1865
<i>Rhyacophila torrentium</i> Pictet, 1834	<i>Silo piceus</i> (Brauer, 1857)
<i>Rhyacophila tristis</i> Pictet, 1834	Fam. Limnephilidae
<i>Rhyacophila polonica</i> McLachlan, 1879	<i>Ecclisopetryx dalecarlica</i> Kolenati, 1848
Fam. Glossosomatidae	<i>Ecclisopetryx madida</i> McLachlan, 1867
<i>Glossosoma boltoni</i> Curtis, 1834	<i>Drusus tenellus</i> Klapalek, 1898
<i>Glossosoma conformis</i> Neboiss, 1963	<i>Grammotaulius nigropunctatus</i> (Retzius, 1783)
<i>Glossosoma discophorum</i> Klapalek, 1902	<i>Rhadicleptus alpestris</i> Kolenati, 1848
<i>Agapetus laniger</i> (Pictet, 1834)	<i>Limnephilus auricula</i> Curtis, 1834
<i>Agapetus ochripes</i> Curtis, 1834	<i>Limnephilus bipunctatus</i> Curtis, 1834
<i>Synagapetus slavorum</i> Botoşăneanu, 1960	<i>Limnephilus coenosus</i> Curtis, 1834
Fam. Hydroptilidae	<i>Limnephilus decipiens</i> (Kolenati, 1848)
<i>Hydroptila taurica</i> Martynov, 1934	<i>Limnephilus extricatus</i> McLachlan, 1865
Fam. Philopotamidae	<i>Limnephilus griseus</i> (Linnaeus, 1758)
<i>Philopotamus montanus</i> (Donovan, 1813)	<i>Limnephilus hirsutus</i> (Pictet, 1834)
<i>Wormaldia occipitalis</i> (Pictet, 1834)	<i>Limnephilus ignavus</i> McLachlan, 1865
<i>Wormaldia pulla</i> (McLachlan, 1878)	<i>Limnephilus lunatus</i> Curtis, 1834
Fam. Polycentropodidae	<i>Limnephilus rhombicus</i> (Linnaeus, 1758)
<i>Polycentropus excisus</i> Klapalek, 1894	<i>Limnephilus sparsus</i> Curtis, 1834
<i>Polycentropus flavomaculatus</i> (Pictet, 1834)	<i>Limnephilus vittatus</i> (Fabricius, 1798)
<i>Plectrocnemia conspersa</i> (Curtis, 1834)	<i>Micropterna nycterobia</i> McLachlan, 1875
Fam. Psychomyiidae	<i>Micropterna sequax</i> McLachlan, 1875
<i>Psychomyia pusilla</i> (Fabricius, 1781)	<i>Potamophylax latipennis</i> (Curtis, 1834)
<i>Lype reducta</i> (Hagen, 1868)	<i>Potamophylax luctuosus</i> (Piller and Mitterpacher, 1783)
Fam. Hydropsychidae	<i>Potamophylax nigricornis</i> (Pictet, 1834)
<i>Hydropsyche botoaneanui</i> Marinkovic 1966	<i>Stenophylax permistus</i> McLachlan, 1875
<i>Hydropsyche bulbifera</i> McLachlan, 1878	Fam. Sericostomatidae
<i>Hydropsyche instabilis</i> (Curtis, 1834)	<i>Sericostoma flavicorne</i> Schneider, 1845
<i>Hydropsyche pellucidula</i> (Curtis, 1834)	Fam. Odontoceridae
<i>Hydropsyche</i> sp.	<i>Odontocerum hellenicum</i> Malicky, 1972

Among the six new species from the Apuseni Nature Park, three were identified in Gârda Seacă (*Hydropsyche botosaneanui*, 1♂; *Limnephilus hirsutus* 6♂ and 4♀, *L. sparsus*), 2 were found in Someșul Cald (*Lype reducta* and *L. rhombicus*) and 1 in Vârtoș (*L. sparsus*). (Tabs. 2 - 5). The following species recorded a very low number of individuals: *Agapetus laniger*, 3♀; *Glossosoma conformis*, 3♀; *G. boltoni*, 1♀; *Grammotaulius nigropunctatus*, 4♂ and 1♀; *Limnephilus griseus*, 4♂ and 1♀; *Hydropsyche bulbifera*, 3♀; *Rhyacophila tristis*, 3♂, *R. torrentium* 4♂ and 5♀; *Silo graellsii*, 2♂, 6♀ and *Wormaldia occipitalis*, 1♂, *Micropterna nycterobia*, 1♀ (Tabs. 3 - 5).

Table 2: List of Trichoptera imago instars present in the three stations considered for the present study.

12 species identified only at the Gârda Seacă	16 species identified only in the Someșul Cald
<i>Agapetus laniger</i>	<i>Agapetus ochripes</i>
<i>Hydropsyche botosaneanui</i>	<i>Ecclisopetryx madida</i>
<i>Hydropsyche bulbifera</i>	<i>Hydroptila taurtica</i>
<i>Hydropsyche pellucidula</i>	<i>Limnephilus decipiens</i>
<i>Hydropsyche</i> sp.	<i>Limnephilus extricatus</i>
<i>Hydropsyche tabacarii</i>	<i>Limnephilus griseus</i>
<i>Limnephilus hirsutus</i>	<i>Limnephilus rhombicus</i>
<i>Limnephilus ignavus</i>	<i>Lype reducta</i>
<i>Micropterna sequax</i>	<i>Odontocerum hellenicum</i>
<i>Rhyacophila laevis</i>	<i>Philopotamus montanus</i>
<i>Synagapetus slavorum</i>	<i>Polycentropus excisus</i>
<i>Wormaldia occipitalis</i>	<i>Polycentropus flavomaculatus</i>
	<i>Potamophylax nigricornis</i>
	<i>Rhyacophila polonica</i>
	<i>Sericostoma flavicorne</i>
	<i>Wormaldia pulla</i>
1 sp. identified only in the Vârtoș	
<i>Micropterna nycterobia</i>	
10 common sp. for the three stations	12 sp. common at Gârda Seacă and Someșul Cald
<i>Drusus tenellus</i>	<i>Ecclisopetryx dalecarlica</i>
<i>Glossosoma conformis</i>	<i>Glossosoma discophorum</i>
<i>Hydropsyche instabilis</i>	<i>Grammotaulius nigropunctatus</i>
<i>Limnephilus bipunctatus</i>	<i>Limnephilus auricula</i>
<i>Limnephilus extricatus</i>	<i>Micrasema minimum</i>
<i>Limnephilus griseus</i>	<i>Psychomyia pusilla</i>
<i>Limnephilus lunatus</i>	<i>Rhyacophila fasciata</i>
<i>Potamophylax latipennis</i>	<i>Rhyacophila mocsaryi mocsaryi</i>
<i>Rhadicleptus alpestris</i>	<i>Rhyacophila torrentium</i>
<i>Rhyacophila nubila</i>	<i>Rhyacophila tristis</i>
	<i>Silo graellsii</i>
	<i>Rhadicleptus alpestris</i>
4 sp. comon for Vârtoș and Someșul Cald	5 sp. common for the Gârda Seacă and Vârtoș
<i>Limnephilus coenosus</i>	<i>Limnephilus sparsus</i>
<i>Limnephilus vittatus</i>	<i>Potamophylax luctuosus</i>
<i>Plectrocnemia conspersa</i>	<i>Silo piceus</i>
<i>Rhadicleptus alpestris</i>	<i>Stenophylax permistus</i>
	<i>Rhadicleptus alpestris</i>

The presence of new species of caddisflies in the Apuseni Nature Park, even with low populations, proves that species diversity from these ecosystems is not yet fully discovered.

Table 3a: Caddisfly imago instars caught with light traps at Gârda Seaca (the Dobra house) in 2006.

Taxa	The sampling date						
	sex	05.06.06	06.06.06	19.06.06.	20.06.06	03.07.06	04.07.06
<i>Agapetus laniger</i>	♀						
<i>Drusus tenellus</i>	♂				3		49
	♀			1	12	1	12
<i>Ecclisopetryx dalecarlica</i>	♂	22	14	39	40	3	
	♀		1	20	431		
<i>Glossosoma boltoni</i>	♀						1
<i>Glossosoma conformis</i>	♀						2
<i>Glossosoma discophorum</i>	♂						3
	♀						2
<i>Grammotaulius nigropunctatus</i>	♂	1	1	1			1
	♀	1					
<i>Hydropsyche botosaneanui</i>	♂				1		
<i>Hydropsyche bulbifera</i>	♀						
<i>Hydropsyche instabilis</i>	♂						74
	♀						5
<i>Hydropsyche pellucidula</i>	♂						37
	♀				1	4	
<i>Hydropsyche</i> sp.	♀				1		
<i>Hydropsyche tabacarui</i>	♂			5	1		
	♀			5			
<i>Limnephilus auricula</i>	♀				1		1
<i>Limnephilus bipunctatus</i>	♂				1		
<i>Limnephilus extricatus</i>	♂						11
	♀						
<i>Limnephilus griseus</i>	♂		1				1
	♀						
<i>Limnephilus hirsutus</i>	♂						6
	♀					3	

Taxa	The sampling date						
	sex	05.06.06	06.06.06	19.06.06.	20.06.06	03.07.06	04.07.06
<i>Limnephilus ignavus</i>	♂						
<i>Limnephilus lunatus</i>	♀	1					
<i>Limnephilus sparsus</i>	♀				1		
<i>Micrasema minimum</i>	♀			1	1		
<i>Micropterna sequax</i>	♂						
<i>Potamophylax latipennis</i>	♂		1			1	34
	♀		1	1		1	26
<i>Potamophylax luctuosus</i>	♂	5	1	5	7		
	♀	4	4	26	42		
<i>Psychomyia pusilla</i>	♂						
	♀						10
<i>Rhadicleptus alpestris</i>	♂			4	2		
<i>Rhyacophila fasciata</i>	♂			1			
<i>Rhyacophila laevis</i>	♂			2	2		
<i>Rhyacophila mocsaryi mocsaryi</i>	♂	1		49	18	3	
	♀				8		
<i>Rhyacophila nubila</i>	♂				4	4	72
	♀			1	5	2	40
<i>Rhyacophila torrentium</i>	♂						1
	♀						
<i>Rhyacophila tristis</i>	♂			1	2		
<i>Silo graellsii</i>	♂				2		
	♀				4		1
<i>Silo piceus</i>	♂			1	5		
	♀			1	10		
<i>Stenophylax permistus</i>	♂	1			1		
	♀	2	2		1		
<i>Synagapetus slavorum</i>	♂						
<i>Wormaldia occipitalis</i>	♂		1				

Table 3b: List of caddisfly imago instars caught with light traps at the Gârda Seacă sampling site (the Dobra house) in 2006.

Taxa	The sampling date							
	sex	18.07.06	31.07.06	01.08.06	14.08.06	15.08.06	28.08.06	29.08.06
<i>Agapetus laniger</i>	♀		3					
<i>Drusus tenellus</i>	♂	12	74	7	24		4	6
	♀	3	52	12	12	1	4	6
<i>Ecclisopetryx dalecarlica</i>	♂		1					
	♀	1						
<i>Glossosoma boltoni</i>	♀							
<i>Glossosoma conformis</i>	♀							1
<i>Glossosoma discophorum</i>	♂	1	1				1	
	♀		2					
<i>Grammotaulius nigropunctatus</i>	♂							
	♀							
<i>Hydropsyche botosaneanui</i>	♂							
<i>Hydropsyche bulbifera</i>	♀		1		2			
<i>Hydropsyche instabilis</i>	♂			1	1			
	♀		27		2			5
<i>Hydropsyche pellucidula</i>	♂		1					
	♀		22					5
<i>Hydropsyche</i> sp.	♀							
<i>Hydropsyche tabacarui</i>	♂							
	♀							
<i>Limnephilus auricula</i>	♀							
<i>Limnephilus bipunctatus</i>	♂		2					
<i>Limnephilus extricatus</i>	♂	2	4					1
	♀							
<i>Limnephilus griseus</i>	♂						1	
	♀		2					
<i>Limnephilus hirsutus</i>	♂							
	♀		1					
<i>Limnephilus ignavus</i>	♂						1	

Taxa	The sampling date							
	sex	18.07.06	31.07.06	01.08.06	14.08.06	15.08.06	28.08.06	29.08.06
<i>Limnephilus lunatus</i>	♀							
<i>Limnephilus sparsus</i>	♀							
<i>Micrasema minimum</i>	♀							
<i>Micropterna sequax</i>	♂						1	
<i>Potamophylax latipennis</i>	♂	9	38	6	2		9	9
	♀	7	47	7	11	1	3	7
<i>Potamophylax luctuosus</i>	♂							
	♀							
<i>Psychomyia pusilla</i>	♂				2			
	♀		10					9
<i>Rhadicoleptus alpestris</i>	♂							
<i>Rhyacophila fasciata</i>	♂							
<i>Rhyacophila laevis</i>	♂							
<i>Rhyacophila mocsaryi mocsaryi</i>	♂							
	♀							
<i>Rhyacophila nubila</i>	♂	10	53	2	2		2	9
	♀	1	101	4	6		2	15
<i>Rhyacophila torrentium</i>	♂							1
	♀	1	1					1
<i>Rhyacophila tristis</i>	♂							
<i>Silo graellsii</i>	♂							
	♀		1					
<i>Silo piceus</i>	♂							
	♀							
<i>Stenophylax permistus</i>	♂							
	♀							
<i>Synagapetus slavorum</i>	♂				1			1
<i>Wormaldia occipitalis</i>	♂							

1	2	3	4	5	6	7	8	9	10	11	12
Micrasema minimum	♂							1	1		
Odontocerum hellenicum	♀			4					2	4	
	♂										
Philopotamus montanus	♀										
Plectrocnemia conspersa	♂			1	1					2	
	♀	2	1			1			1		
Polycentropus excisus	♂	1						1			
Polycentropus flavomaculatus	♀		1								
Potamophylax latipennis	♂	15	8	11	1	1	1	8	6	3	
	♀	2	4	2	2	1		2			1
Potamophylax nigricornis	♂		2								
Psychomyia pusilla	♂								1		
	♀		7	1			2	10	8	4	1
Rhadicoleptus alpestris	♂										
Rhyacophila fasciata	♂										
Rhyacophila m. mocsaryi	♂	2								2	
Rhyacophila nubila	♂	10	12	14	1			1			1
	♀	2	3	3	1	1				1	2
Rhyacophila polonica	♂			1							
Rhyacophila torrentium	♂		2								
	♀										
Rhyacophila tristis	♂		1						2		
	♀							1	1		1
Sericostoma flavicorne	♂	1		1		1		1			
	♀	1						1	2	1	
Silo graellsii	♂	4	4	1	2			5	5		2
	♀	1	7	2				1	3	1	
Wormaldia pulla	♂		1								
	♀							1			

At the Arieş River source (Vârtoș), all species were represented by populations with very low number of individuals. Only one species recorded higher values from this point of view: *Rhadicoleptus alpestris* - an alpine species, having 5♂ and 16♀, cumulative values for the whole summer (Tab. 4). The main cause for the decreased number of individuals was the alteration of microhabitats from the area due to the human impacts (buildings near or in the spring complex).

Table 5: Trichoptera imago instars collected with light traps at Vârtop (the Arieș source), 2006.

Taxa	sex	The sampling date										
		05.06.06	19.06.06	20.06.06	03.07.06	04.07.06	31.07.06	01.08.06	14.08.06	15.08.06	25.08.06	29.08.06
<i>Drusus tenellus</i>	♂							1				
	♀							1				
<i>Glossosoma conformis</i>	♀									1		
<i>Hydropsyche instabilis</i>	♂							1				
<i>Limnephilus bipunctatus</i>	♂		2								1	
<i>Limnephilus coenosus</i>	♂				1							
<i>Limnephilus extricatus</i>	♂	2	1									
	♀		1			1	2		1			
<i>Limnephilus griseus</i>	♂		1									
	♀		1									
<i>Limnephilus lunatus</i>	♂						1					1
<i>Limnephilus sparsus</i>	♀			1							1	
<i>Limnephilus vittatus</i>	♂										2	
<i>Micropterna nycterobia</i>	♀		1									
<i>Plectrocnemia conspersa</i>	♀		1									
<i>Potamophylax latipennis</i>	♂	5			1		3					1
	♀							3				
<i>Potamophylax luctuosus</i>	♀		1								1	
<i>Rhadicoleptus alpestris</i>	♂		2							2	1	
	♀		7								14	
<i>Rhyacophila nubila</i>	♂							1				
	♀							1				
<i>Silo piceus</i>	♀							1				
<i>Stenophylax permistus</i>	♂									1		

Regarding the number of taxa, in Ic Ponor (the Someșul Cald-Source and the Alunul Mic) a similar status was recorded, compared to the Gârda Seacă sampling site (the same number of taxa in the two sites - 38) (Tab. 5). However, the species composition of caddisfly communities was different. Thus, six populations had high number of individuals, compared to three in Gârda Seacă. Next to the species identified in Gârda Seacă (*Drusus tenellus*; *Potamophylax latipennis*, *Rhyacophila nubila*), other species were found: *Ecclisopteryx madida*, *Hydropsyche instabilis* and *Silo graellsii* (the last one with highest frequency: 70 - 80%). The microhabitats from the Someșul Cald - source were more diverse, but also more stable, that is why the number of species with high populations was double compared to the Gârda Seacă area. However, due to the short sampling period which was happened in 18th to 23rd July 2008, changes might occur in the numerical dynamics or even in the species structure of the caddisfly communities in other sampling periods. The sampling surface was 200 m river length, thus there was no doubt that Trichoptera communities from the Someșul Cald - source had an increased stability (Tabs. 3 and 5).

Rhadicleptus alpestris, even if is alpine species, could be found at 700 - 800 m altitude and could dwell microhabitats strongly impacted by human activities (such Vârtop and Gârda Seacă).

Few species new for the Apuseni Nature Park were present in only one or two sampling sites: *Lype reducta*; *Hydropsyche botosaneanui*; *Limnephilus hirsutus*; *L. rhombicus*; *L. sparsus*. Their geographical distribution should be studied more accurately. The reason why these species were not found in previous samplings might be related also to the sampling method. The use of a high power light source (250W) led to a more efficient capture of imago instars.

Species diversity

For the calculation of the Shannon diversity index, not only the number of species but also the distribution of individuals in each species was considered. The values calculated for the present study expressed the dynamics throughout the year, even if they were low. The fact that the index equally considered all the species, without identifying the specificity or the characteristics of each species represented a drawback of the method.

Diversity indices calculated for caddis fly populations from Gârda Seacă ranged between 0.7 to 1.9, which represent a low to medium diversity, but constant throughout the sampling months (Fig. 3). The lowest values were recorded in August 15th 2006 and corresponded to the period when temperature dropped with 6 - 8^oC. Only three individuals were collected on that sampling date, belonging to the following species: *Drusus tenellus*, *Potamophylax latipennis* and *Synagapetus slavorum*. The highest values of diversity indices were recorded in June the 19th 2006 (1.70), July the 4th 2006 (1.80) and August the 29th 2006 (1.90). At these sampling dates the caddisfly community recorded the highest values of species richness (Tab. 6).

Even if the species diversity of caddisfly communities from Ic Ponor (Someșul Cald and Alunul Mic) was calculated only for five sampling nights, it brought new information on population dynamics on short periods. Diversity indices ranged according to diel variations of microclimate parameters, not only in aquatic ecosystems but also in the atmosphere. At all four sites where light traps were used, higher diversity values were recorded at the beginning and at the end of the sampling period. These values represented the response of caddisfly populations to water temperature but also to the air temperature and humidity for the sampling period and for the period prior to the sampling. At site I (pb. 1) the index recorded 1.99 in the first day (18th - 19th July 2008), and 2.11 in the last night (22nd - 23rd July 2008); all the intermediate values were lower. A similar situation was recorded at sites 2 and 3 and at the Alunul Mic. A slight decrease in temperature and in air pressure (to 740 mm Hg) was recorded during the days that followed the trap installation, on 15th - 17th July 2008, similar to the values recorded in the last sampling night. The first and the last sampling night were accompanied by heavy rains and increases in air humidity. Between 19th and 22nd July the air temperature increased to 27 - 28^oC. Caddisflies were sensitive to temperature, wind and air humidity changes, responding with an increased activity at dawn, when breeding took place. At the last sampling (22nd - 23rd July 2008) intermittent rains occurred all night long and diversity indices recorded the highest values (over 2) at all sites. At site 1 (pb. 1) diversity index recorded 2.11 (Fig. 4); at site 2 (pb. 2) 2.06 (Fig. 5); at site 3 (pb. 3) 2.33 (Fig. 6) and at the Alunul Mic 2.33 - the highest value (Fig. 7). In dry, sunny days, with temperatures exceeding 25 - 30^oC, the adults hide under the vegetation, waiting for the humidity to increase during the evening to resume activity. The figures 8 to 14 present the species new for Romania and Apuseni Nature caddisfly fauna.

Table 6: Diversity index Shannon-Wiener (H') for the Gârda Seacă and Vârtop samples.

The sampling sites	5 th 07. 2006	6 th 07. 2006	9 th 07. 2006	10 th 07. 2006	3 rd 07. 2006	4 th 07. 2006	18 th 07. 2006	31 st 07. 2006	1 st 07. 2006	14 th 08. 2006	15 th 08. 2006	28 th 08. 2006	29 th 08. 2006
Gârda Seacă	1.204	1.39	1.7	1.03	1.84	1.9	1.5	1.8	1.1	1.3	0.7	1.5	1.9
Vârtop	0.598	0	1.56	0	0.69	0	0	1	1.52	0	1	0.9	0.7

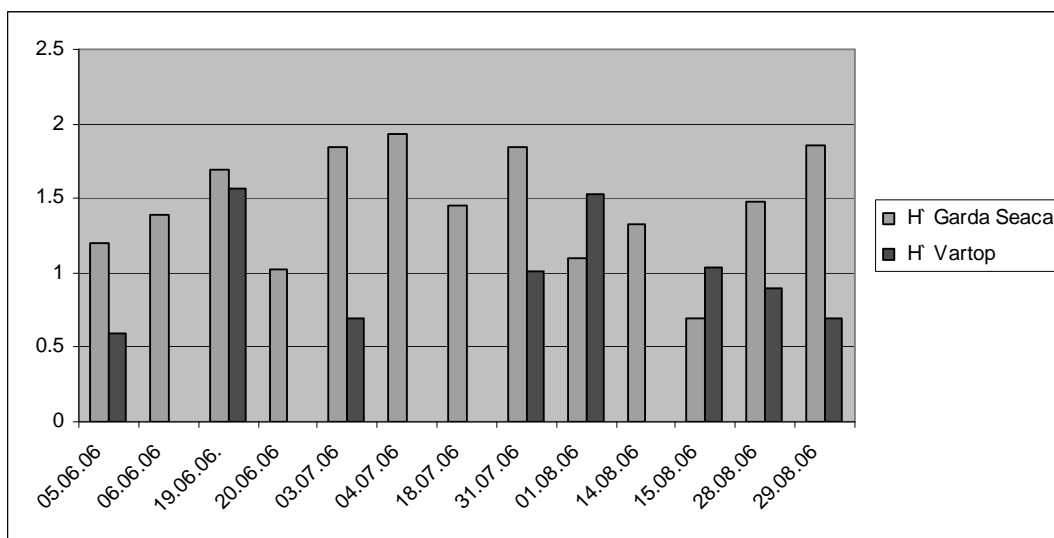


Figure 3: Shannon diversity indices (H') for Gârda Seacă and Vârtop samples, June-September 2006.

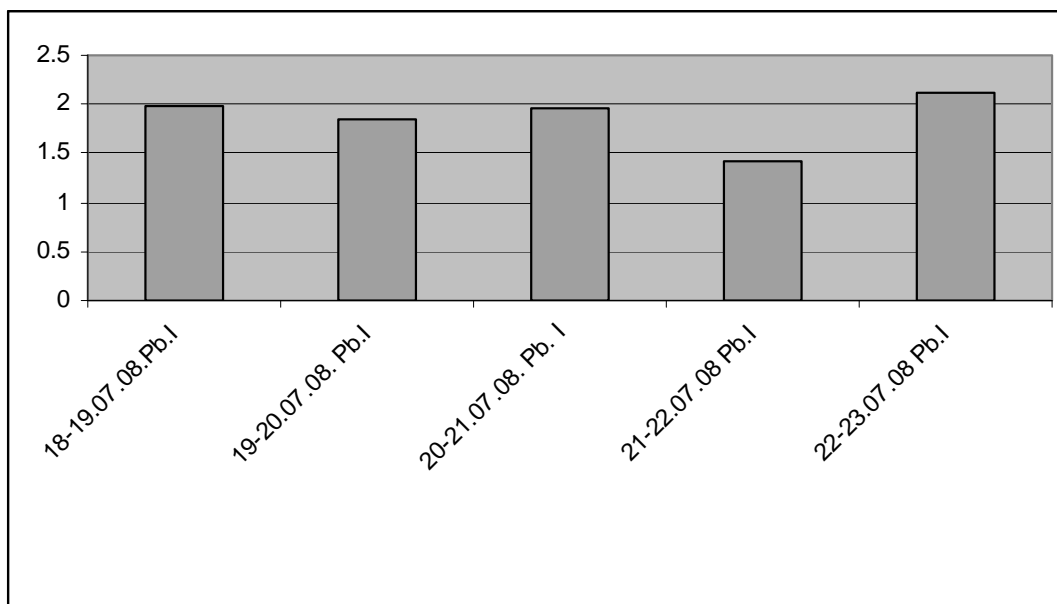


Figure 4: Species diversity indices (H') calculated at the sampling site 1 (Pb 1), for five sampling nights.

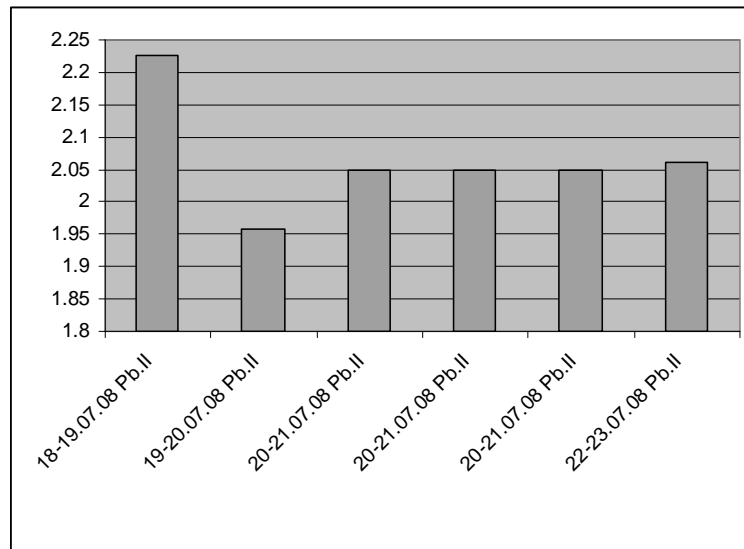


Figure 5: Species diversity indices (H') calculated at the sampling site 2 (Pb. 2) for five sampling nights.

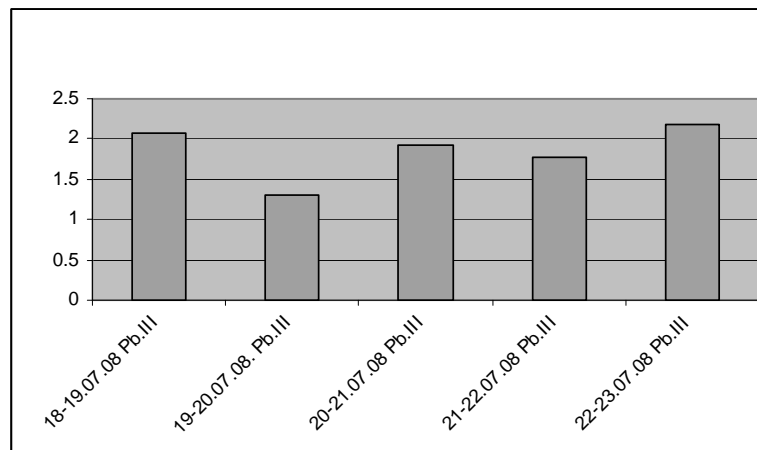


Figure 6: Species diversity indices (H') calculated at the sampling site 3 (Pb. 3) for five sampling nights.

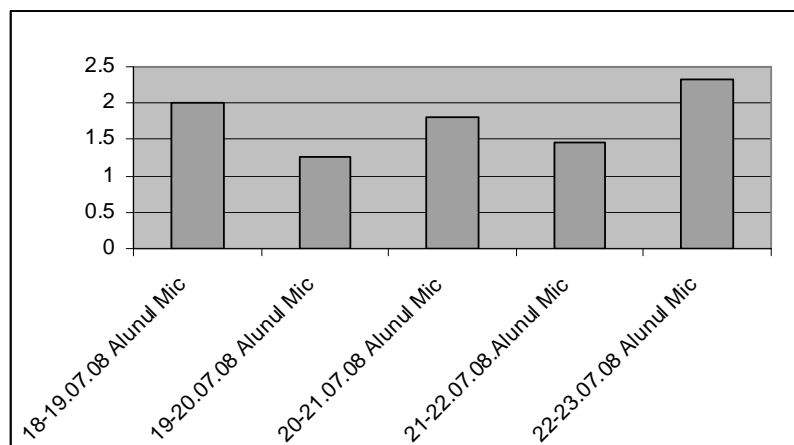


Figure 7: Species diversity indices (H') calculated at the Alunul Mic for five sampling nights.

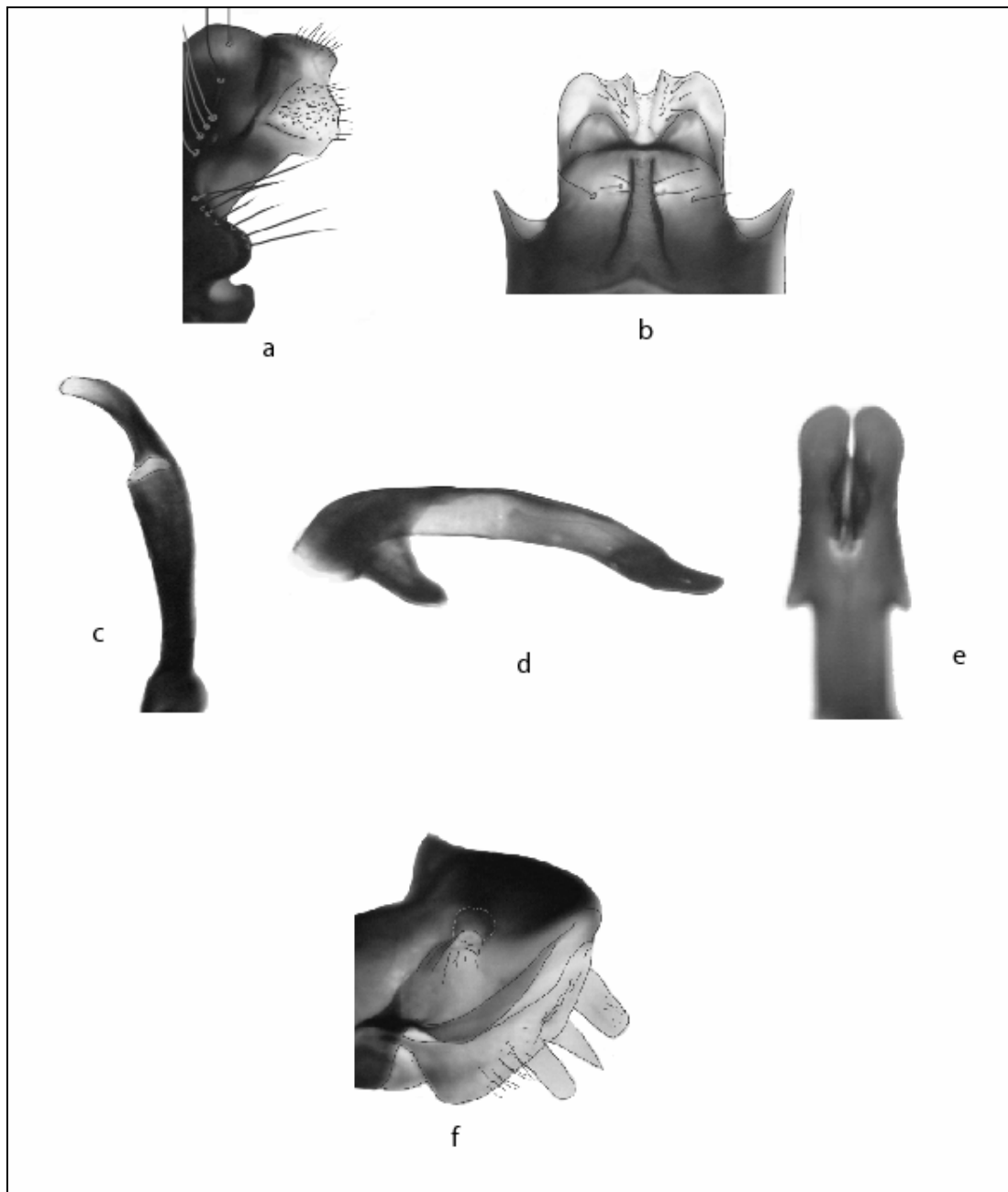


Figure 8: *Hydropsyche botosaneanui* Marinkovic. Male: a - abdominal segments 9 - 10, lateral view; b - abdominal segments 9 - 10, dorsal view; c - harpago, ventral view; d - aedeagus, lateral view; e - aedeagus, apex, dorsal view. Female: f - genitalia, lateral view.

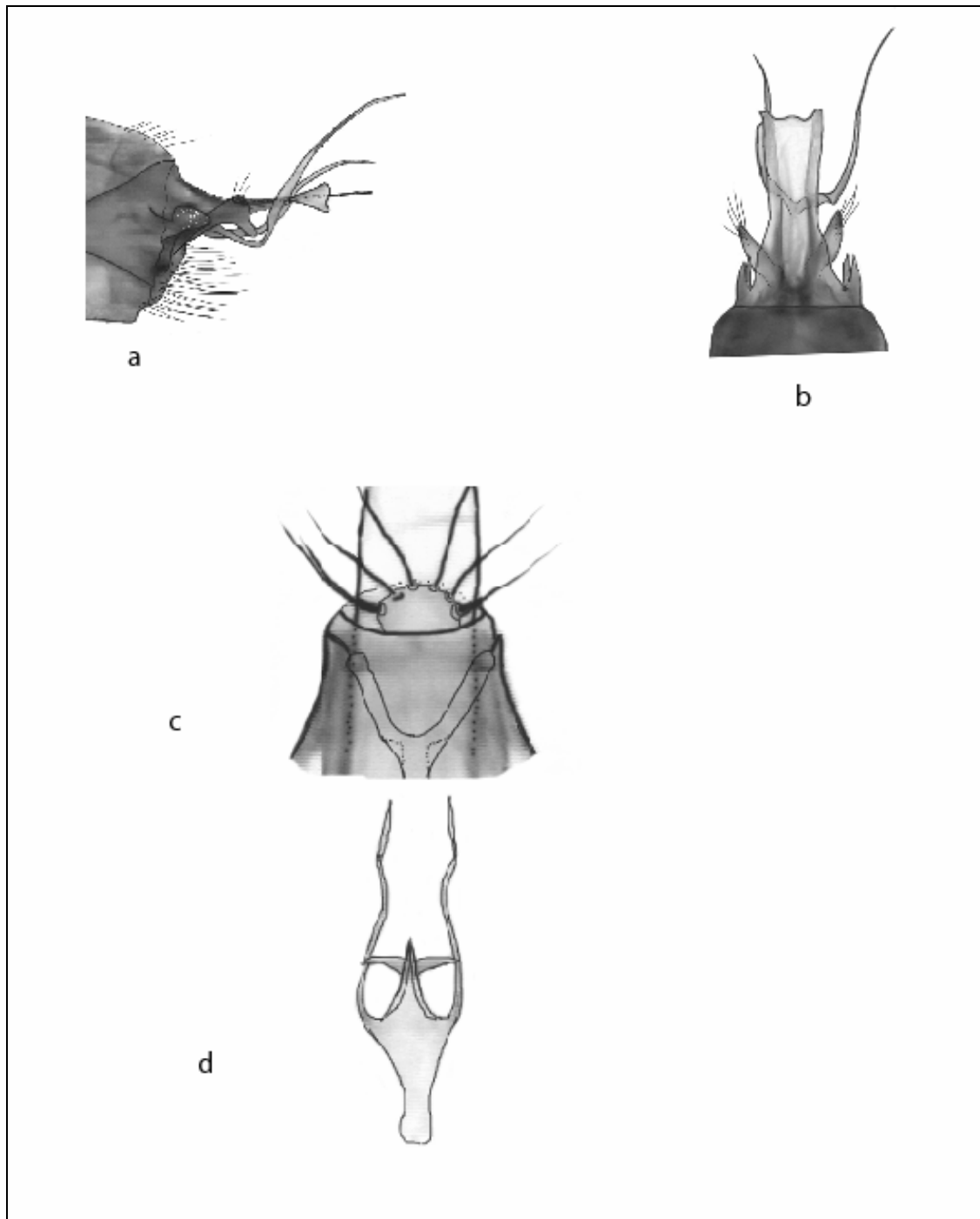


Figure 9: *Hydroptila taurica* Martynov. Male: a - genitalia, lateral view; b - genitalia, dorsal view; Female: c - genitalia, ventral view; d - spermatheca, ventral view.

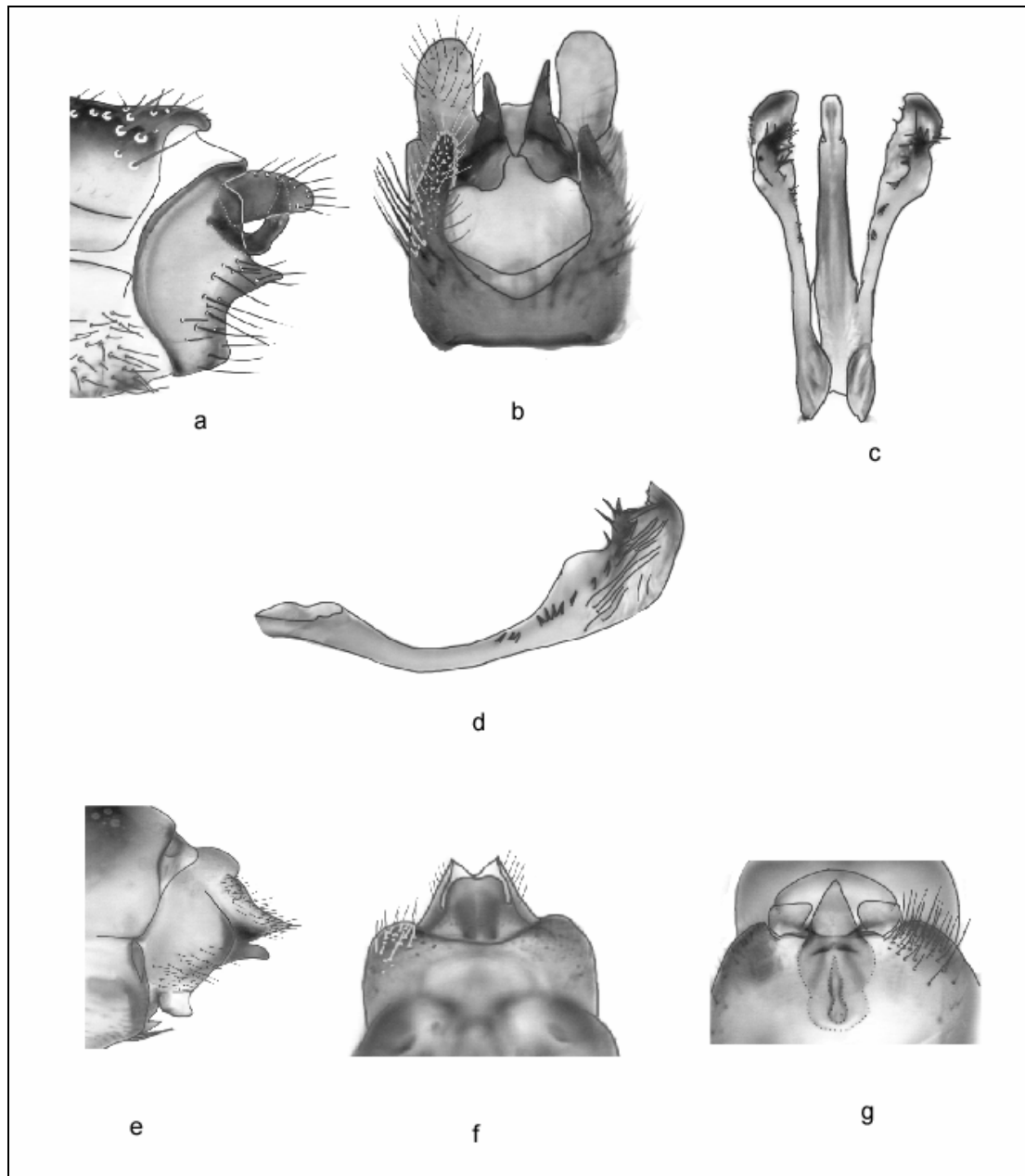


Figure 10: *Limnephilus hirsutus* (Pictet) Male: a - genitalia, lateral view; b - genitalia, ventral view; c - aedeagus with parameres, ventral view; d - parameres, lateral view; Female: e - genitalia, lateral view; f - genitalia, dorsal view; g - genitalia, ventral view, detail.

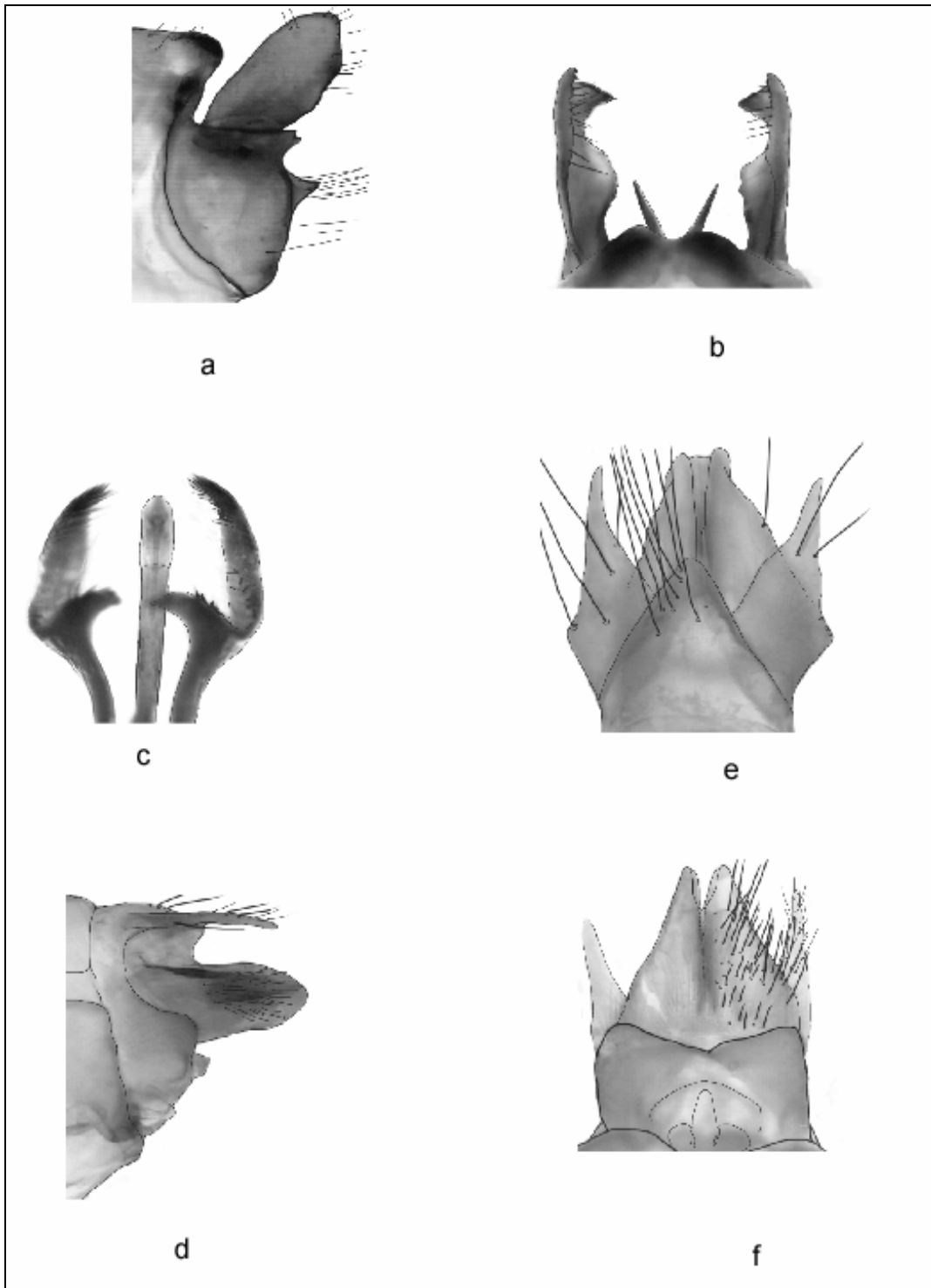


Figure 11: *Limnephilus rhombicus* (Linnaeus). Male: a - genitalia without aedeagus and parameres, lateral view; b - genitalia, dorsal view; c - aedeagus and parameres, dorsal view. Female: d - genitalia, lateral view; e - genitalia, dorsal view; f - genitalia, ventral view.

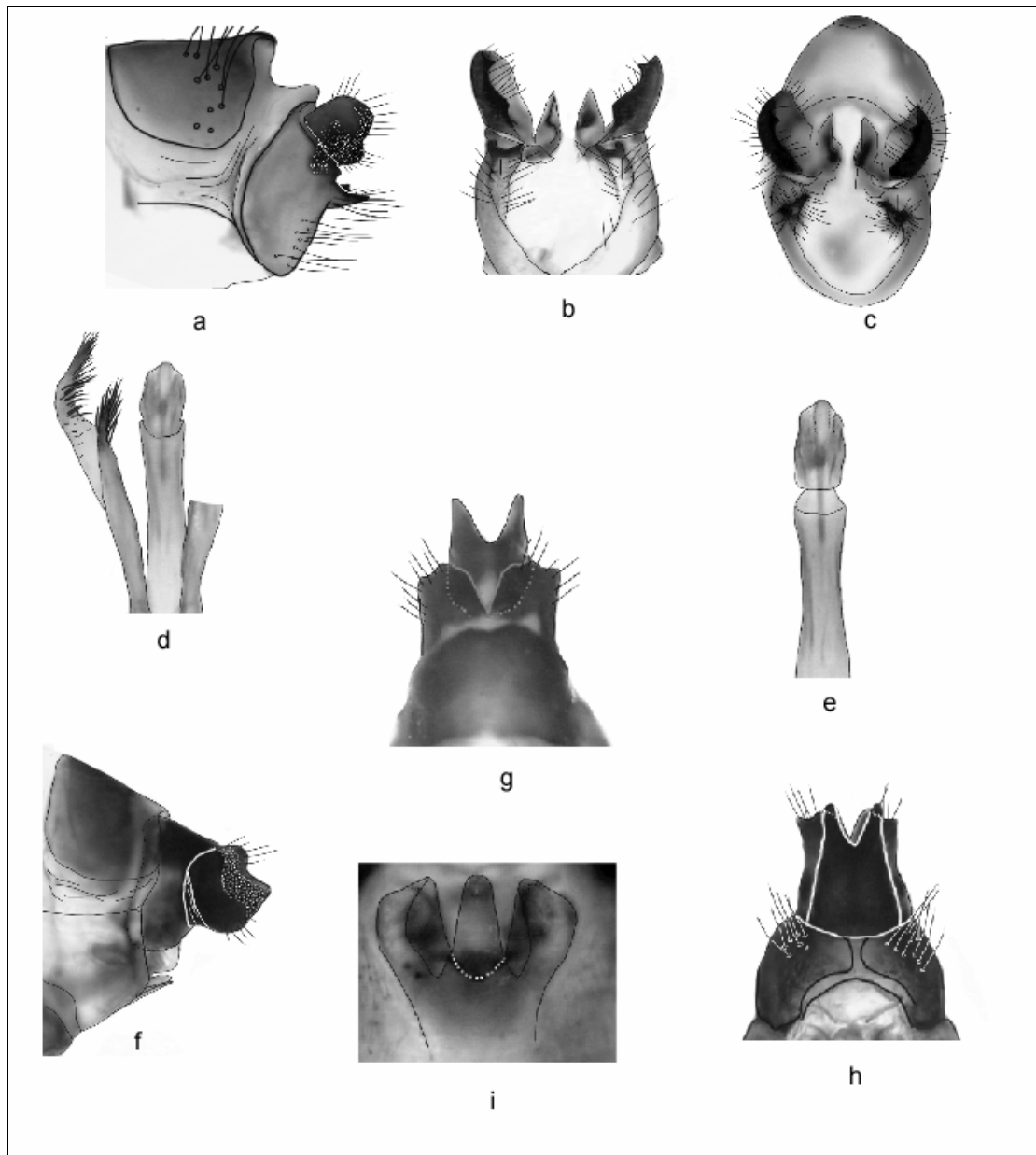


Figure 12: *Limnephilus sparsus* Curtis. Male: a - genitalia without aedeagus and parameres, lateral view; b - genitalia, ventral view; c - genitalia, caudal view; d - aedeagus with the right paramere, dorsal view; e - aedeagus, dorsal view. Female: f - genitalia, lateral view; g - genitalia, dorsal view; h - genitalia, ventral view; i - genitalia, detail, ventral view.

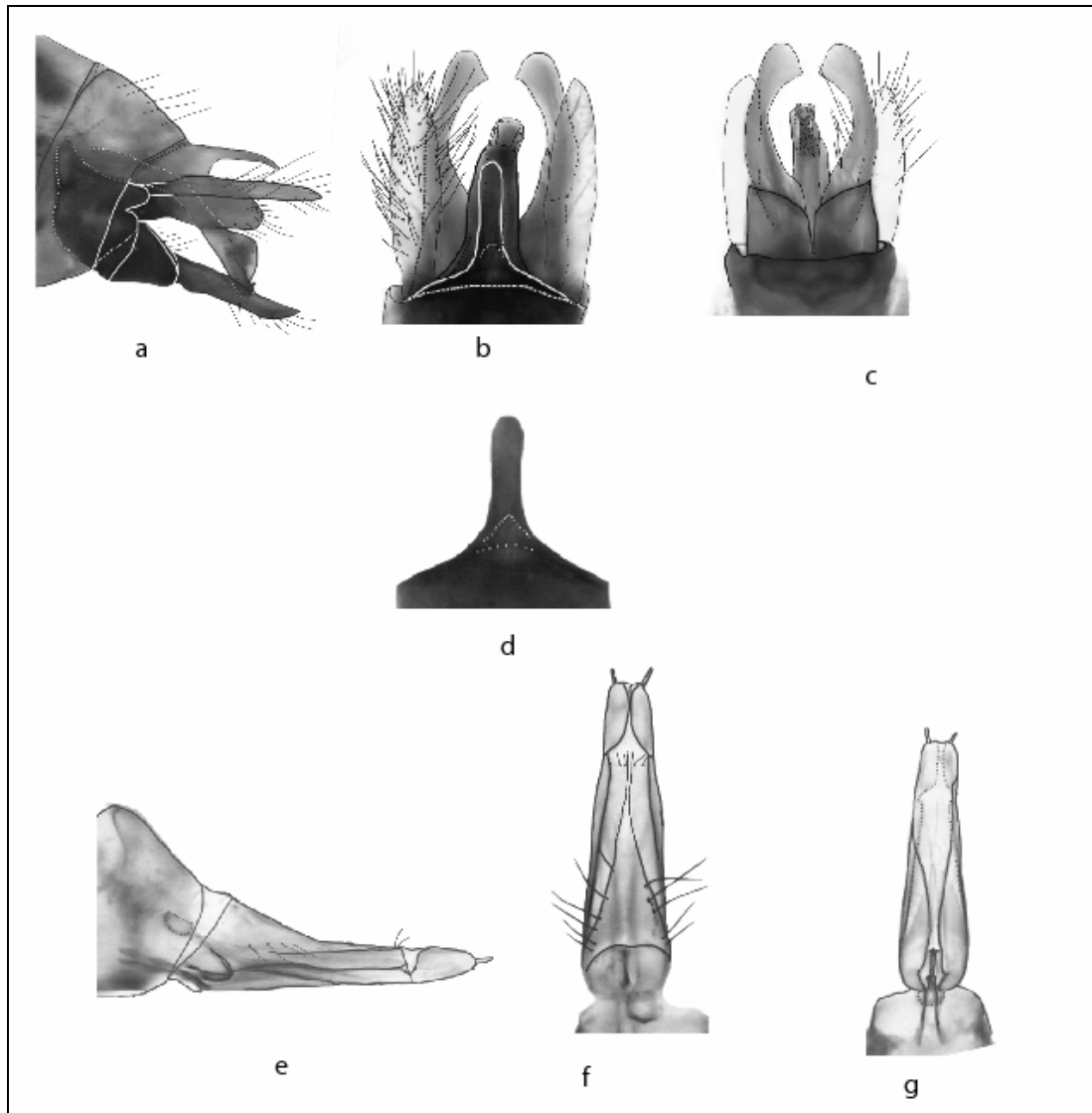


Figure 13: *Lype reducta* (Hagen). Male: a - genitalia with aedeagus, lateral view; b - genitalia, dorsal view; c - genitalia, ventral view; d - abdominal segment 9, dorsal view. Female: e - genitalia, lateral view; f - genitalia, dorsal view; g - genitalia, ventral view.

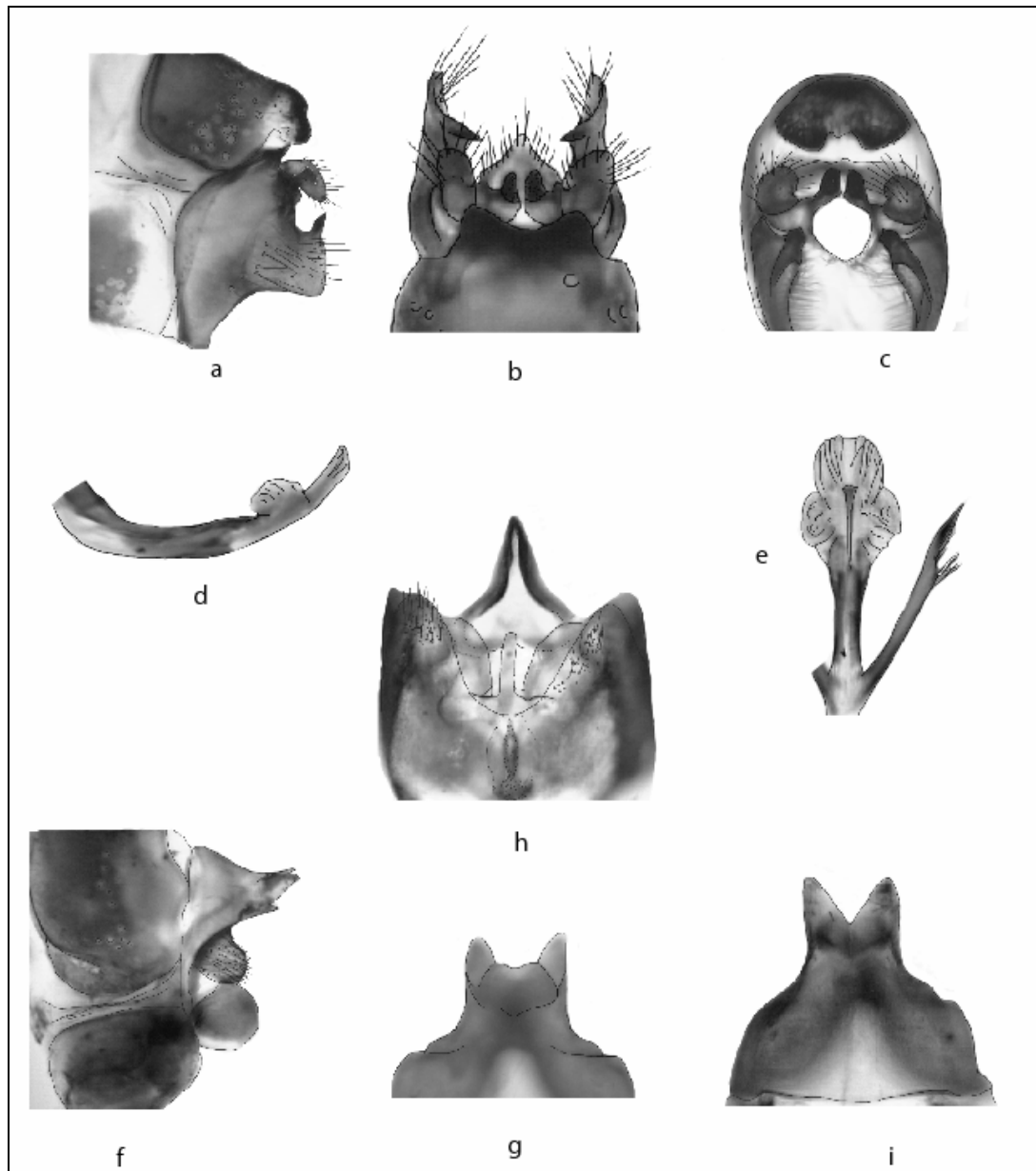


Figure 14: *Rhadicoleptus alpestris* Kolenati. Male: genitalia, lateral view; b - genitalia, dorsal view; c - genitalia, caudal view; d - aedeagus, lateral view; e - aedeagus with left paramere, ventral view. Female: f - genitalia, lateral view, g - genitalia, segment X, ventral view; h - genitalia, segment IX, ventral view; i - genitalia, segment X, dorsal view.

CONCLUSIONS

The present study added a new caddisfly species for Romania and six new species for the Apuseni Mountains, to complete the list of Trichoptera fauna. The distribution of caddisfly communities was influenced by human activities in aquatic habitats (springs, brooks, rivers, lakes) but also by human impacts on adjacent ecosystems (forests, meadows). The impact of human factors overlapped on natural environmental parameters, like rainfall, erosion, sedimentation - that caused changes in structure parameters of biotic communities (abundance, species diversity and richness, spatial distribution on an altitude gradient). The diel activity of imagoes was increased in days with heavy rainfall, high air humidity and low air pressure. On the other hand, they became inactive during sunny days with high temperature, these weather conditions causing them to seek shelter underneath the vegetation. Even if the diversity indices were calculated for short periods of time (one sampling night), they brought precious data on the intensity of emergence process of adults related to the dynamics of water physical and chemical parameters, temperature, air humidity, rainfall, wind. The sampling method used for the present study - white light trap with mercury vapors - was very efficient, leading to accurate results concerning species diversity of caddisfly community. However, the method should not be used excessively, over longer periods of time, to prevent the elimination of large numbers of individuals from the populations, thus affecting their balance.

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