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CONTRIBUTION TO THE LARVAL NET-SPINNING CADDISFLY (TRICHOPTERA: HYDROPSYCHIDAE) FAUNA OF NORTHERN HUNGARY AND THE NORTHERN GREAT PLAIN WITH NOTES ON THEIR DISTRIBUTION PATTERNS

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ADATOK ÉSZAK-MAGYARORSZÁG ÉS AZ ÉSZAK-ALFÖLD SZÖVŐTEGZES-FAUNÁJÁHOZ (TRICHOPTERA: HYDROPSYCHIDAE) A FAJOK ELTERJEDÉSI MINTÁZATÁNAK VIZSGÁLATÁVAL LÁRVAADATOK ALAPJÁN

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ABSTRACT: Aquatic macroinvertebrate communities are regularly investigated by the North Hungarian National Inspectorate for Environmental Protection and Nature Conservation (ÉMI-KTF) since 2005 in Northern Hungary and since 2007 in the Northern Great Plain region as a part of the monitoring program connected to the Hungarian inplementation of the European Union's Water Framework Directive. Due to their regularity and extensive spatial coverage these investigations provide valuable faunistical data, few of which have been published up to now. In this paper the faunistical data of net-spinning caddisfly larvae investigations at 87 sampling sites are shown that arisen from collectings between 2009 and 2013. New occurrence data are given for 10 species. Results of statistical analyses show significant differences among the hydropsychid faunas of watercourses with different hydrogeochemical character, altitude, substrate particle size and catchment area. Larvae of three species (*Hydropsyche fulvipes, H. Instabilis* and *H. saxonica*) appears to be characteristic of some mountainous streams and smaller watercourses in hilly regions, one (*H. contubernalis*) to be that of larger watercourses in hilly regions and another (*H. bulgaromanorum*) to be typical of large lowland rivers.

Key words: net-spinning caddisflies, faunistical data, new occurences, distribution patterns, Northern Hungary, Northern Great Plain

KIVONAT: Az Észak-magyarországi Környezetvédelmi és Természetvédelmi Felügyelőség (ÉMI-KTF) az Észak-magyarországi régióban 2005, az Észak-alföldi régióban pedig 2007 óta végzi a vízi makrogerinctelen élőlényközösségek vizsgálatát az Európai Unió Víz Keretirányelvének végrehajtásához kapcsolódóan. Rendszerességük és széles területi

lefedettségük okán ezek a vizsgálatok nagy mennyiségű, értékes faunisztikai adattal is szolgálnak, melyek közül ezidáig csak kevés került publikálásra. Jelen dolgozatban az említett területek 87 mintavételi helyén, 2009 és 2013 között végzett gyűjtések szövőtegzes-lárvákra vonatkozó faunisztikai adatai, valamint elterjedési mintázatuk statisztikai analízissel történő vizsgálatának eredményei kerülnek bemutatásra. A vizsgálatok során 10 hazai szövőtegzes-faj került elő új, eddig nem közölt lelőhelyekről. A statisztikai analízis eredményei szerint szignifikáns különbség mutatkozik a különböző tengerszint feletti magasságú, eltérő hidrogeokémiájú, különböző szubsztrát-szemcseméretű és különbőző nagyságú vízgyűjtőterületű víztípusok szövőtegzes-faunájában. Három faj, a *Hydropsyche fulvipes,* a *H. instabilis* és a *H. saxonica* a hegyvidéki patakok és egyes dombvidéki kisvízfolyások, a *H. contubernalis* a nagyobb dombvidéki patakok és folyók, míg a *H. bulgaromanorum* a síkvidéki nagy és nagyon nagy folyók karakterisztikus faja.

Kulcsszavak: szövőtegzesek, faunisztikai adatok, új lelőhelyek, elterjedési mintázat, Észak-Magyarország, Észak-Alföld

Introduction

The National Inspectorate for Environmental Protection and Nature Conservation (Northern Hungary) (ÉMI-KTF) takes part in the biological monitoring of surface waters specified by the EU's Water Framework Directive (WFD) (2000/60/EC) since 2005. As a part of the monitoring program aquatic macroinvertebrate communities are regularly investigated since 2005 in Northern Hungary and since 2007 in the Northern Great Plain region. Between 2009 and 2013 samplings were made at 202 sites on running and stagnant waters that are considered as water bodies according to the WFD and located in the above mentioned areas. Although the primary aim of these investigations is water quality assessment, they provide large amount of faunistical data.

Net-spinning larvae of the world's third largest caddisfly family (MORSE 1997), Hydropsychidae, can be found in all types of running waters and some of them in lakes. They are among the best indicator groups of macroinvertebrates for assessing water quality, as they have limited mobility and a relatively long life span (DOHET 2002). Investigations have already shown that species of the family occur in more or less restricted parts of watersystems, so much so that a watercourse can be divided in stretches from source to mouth by characteristic species and their combinations (HIGLER and TOLKAMP 1983).

According to NÓGRÁDI and UHERKOVICH (2002) 15 species of Hydropsychidae occur in Hungary, all of which live in running waters. The nationwide distribution of these species is relatively well known (NÓGRÁDI and UHERKOVICH 2002), as well as the hydropsychid fauna of the investigated area (NÓGRÁDI and UHERKOVICH 2002, MÓRA and CSABAI 2002a, 2002b, 2003, KISS et al. 2006, MÓRA et al. 2004a, 2004b, 2005, 2006, SZITTA et al. 2009, FICSÓR and NAGY 2009, FICSÓR and SZABÓ 2011, POLYÁK et al. 2013).

This paper presents the yet unpublished occurrence data of larval hydropsychids arisen from collectings at 87 sites of the WFD water bodies in Northern Hungary and in the Northern Great Plain between 2009 and 2013. Results of some preliminary investigations on the species' preferred types of water bodies in the studied area are also discussed.

Materials and methods

Sampling

Samplings were carried out as the part of the biological monitoring program of surface waters fulfilled by ÉMI-KTF. In accordance, an AQEM-based, WFD-compatible sampling method described by CSÁNYI et al. (2012) was applied. In cases of large rivers (e.g. Bodrog and Tisza) or bigger, hardly wadable watercourses (e.g. Rima) samples were collected from every littoral habitat which was accessible on foot.

Samples were collected with standard pond net (0.25 × 0.25 m frame, 1 mm mesh size) or by hand from larger stones, larger pieces of wood or the elements of vegetation taking into account the size of the pond net frame as a spatial unit. Samples were preserved with 75 V/V% ethanol right after being taken and were sorted in the laboratory. In most cases samples were subsampled due to the large number of specimens. Sorted specimens were stored in 75 V/V% ethanol and were identified according to WARINGER and GRAF (1997) and NEU and TOBIAS (2004).

The list of sampling sites is shown in Table 1. In cases of many geographical terms the original Hungarian form were left for the localities being more identifiable: övcsatorna = channel; ér = brooklet; felett = over; ipari tározó = industrial reservoir; közúti híd = road bridge; papírgyár = paper mill; patak = stream; torkolat = mouth; után, alatt = under; vízmű = waterworks.

Table 1. List of sampling sites with administration units, exact geographical coordinates (EOV) and 10 × 10 UTM grid codes

No.	Name of sampling site (administration unit)	EOVX	EOVY	UTM grid code
1.	Ágói-patak (Hort)	260396	704108	DT08
2.	Bábony-patak (Sajókeresztúr)	317257	778511	DU83
3.	Balla-patak (Mátraballa)	292562	724078	DU21
4.	Bán-patak (Vadna)	326278	761152	DU64
5.	Bene-patak, Mátrafüred után (Gyöngyös)	275609	719607	DT29
6.	Bene-patak (Halmajugra)	269214	726353	DT39
7.	Bodrog, Felsőberecki rév (Sátoraljaújhely)	337276	845155	EU55
8.	Bódva (Hídvégardó)	359643	782719	DU87
9.	Bódva, Borsodszirák vízmű (Sajószentpéter)	324223	776314	DU84
10.	Boldogkőváraljai-patak (Boldogkőváralja)	333369	810839	EU15
11.	Bózsva-patak (Alsóregmec)	347622	840764	EU46
12.	Ceredi-Tarna (Sirok)	287811	735653	DU30
13.	Csenkő-patak (Zsujta)	353175	814661	EU27
14.	Csernely-patak (Uppony)	319903	753211	DU54
15.	Csincse-övcsatorna (Gelej)	277674	779343	DT89
16.	Csincse-patak (Csincse)	282665	777933	DU80
17.	Eger-patak (Eger)	281134	751228	DU50
18.	Gilip-patak (Bekecs)	313390	807141	EU13
19.	Gönci-patak, Potacs-ház után (Gönc)	351255	818003	EU26
20.	Gönci-patak, Göncruszka közúti híd (Gönc)	348299	812537	EU16
21.	Gyöngyös-patak, Lajosháza (Gyöngyössolymos)	279667	716689	DU20
22.	Gyöngyös-patak, Gyöngyös észak (Gyöngyös)	272174	715748	DT19
23.	Gyöngyös-patak (Gyöngyöshalász)	266246	714813	DT18
24.	Hangony-patak, Ózd-Center (Ózd)	324876	747546	DU54

No.	Name of sampling site (administration unit)	EOVX	EOVY	UTM grid code
25.	Hangony-patak, Ózd felett (Ózd)	321369	740262	DU44
26.	Hejő-patak (Nyékládháza)	296034	784574	DU81
27.	Hejő-Szarda-övcsatorna (Nagycsécs)	293275	790880	DU91
28.	Hercegkúti-patak, 37-es út közúti híd (Sárospatak)	332177	835936	EU45
29.	Hernád (Zsujta)	353589	813793	EU17
30.	Hernád (Gesztely)	308605	792490	DU92
31.	Hódos-patak, Ózd-Hódoscsépány (Ózd)	318535	740195	DU43
32.	Hór-patak (Cserépfalu)	288427	761095	DU60
33.	Hór-patak (Mezőkövesd)	272714	765145	DT69
34.	Jósva-patak (Szinpetri)	349582	765470	DU76
35.	Kácsi-patak (Mezőkeresztes)	277606	772613	DT79
36.	Kánya-patak, Szemerei dűlő (Mezőkövesd)	274259	762910	DT69
37.	Kánya-patak (Egerlövő)	264887	769451	DT78
38.	Keleméri-patak (Hét)	328095	749141	DU54
39.	Kígyós-patak (Feldebrő)	277610	742183	DT49
40.	Kis-Csincse (Csincse)	283111	778313	DU80
41.	Körös-ér (Tiszajenő)	185989	732113	DT30
42.	Kulcsár-völgyi-patak (Emőd)	289101	782091	DU80
43.	Külső-Mérges-patak (Adács)	261235	718496	DT28
44.	Laskó-patak, Egerbakta felett (Egerbakta)	290286	741823	DU41
45.	Laskó-patak (Demjén)	278890	745915	DT49
46.	Laskó-patak alsó (Besenyőtelek-Poroszló)	259536	763613	DT67
47.	Leleszi-Tarna-patak (Pétervására)	298190	729191	DU31
48.	Nyiget-patak (Markaz)	274178	727582	DT39
49.	Nyögő-patak (Sajószentpéter)	319585	773007	DU73
50.	Ostoros-patak (Ostoros)	279928	755242	DU50
51.	Ostoros-patak, Zsóry-fürdő alatt (Mezőkövesd)	273031	760316	DT69
52.	Parádi-Tarna Recsk bányatelep felett (Recsk)	287517	727676	DU30
53.	Parádi-Tarna, Recsk bányatelep alatt (Recsk)	288078	728057	DU30
54.	Parádi-Tarna (Sirok)	286463	734453	DU30
55.	Rakaca-patak (Szalonna)	345258	775352	DU86
56.	Rédei-patak (Gyöngyöspata)	273907	705805	DT09
57.	Rédei-patak (Vámosgyörk)	260480	716983	DT28
58.	Rima, Ostoros-patak torkolata felett (Mezőszemere)	266764	761978	DT68
59.	Rima, Ostoros-patak torkolata alatt (Mezőszemere)	266498	762178	DT68
60.	Ronyva-patak, Sátoraljaújhely felett (Sátoraljaújhely)	343861	843690	EU46
61.	Ronyva-patak, Sátoraljaújhely alatt (Sátoraljaújhely)	341206	844244	EU45
62.	Sajó (Sajópüspöki)	327405	745909	DU54
63.	Sajó (Sajókaza)	327589	763926	DU64
64.	Sajó (Sajószentpéter)	321049	774288	DU74
65.	Sajó (Sajólád)	300438	787954	DU91
66.	Sajó (Kesznyéten)	293336	799504	EU01
67.	Sas-patak (Hídvégardó)	357500	781418	DU87
68.	Szartos (Tornyosnémeti)	354512	813250	EU17
69.	Szerencs-patak, Rátka közúti híd (Szerencs)	320248	810916	EU13
70.	Szinva-patak, Hűtőházi út (Miskolc)	307952	782338	DU82
71.	Szinva-patak, Papírgyár felett (Miskolc)	309083	769604	DU72
72.	Szóláti-patak (Egerszólát)	278440	742791	DT49

No.	Name of sampling site (administration unit)	EOVX	EOVY	UTM grid code
73.	Szuha-patak (Múcsony)	327002	770170	DU74
74.	Tarján-patak, Delitanya (Gyöngyöstarján)	271430	713548	DT19
75.	Tarna középső (Verpelét)	279572	737506	DU40
76.	Telekes-patak (Alsótelekes)	341997	769468	DU76
77.	Tisza (Kisköre)	238450	760501	DT65
78.	Tisza (Szolnok)	203925	738525	DT42
79.	Tisza (Tiszaug)	169665	726260	DS29
80.	Tisza (Tiszaújváros)	286954	801839	EU00
81.	Tisza (Zemplénagárd)	338045	876517	EU85
82.	Toka-patak (Gyöngyös)	272149	714819	DT19
83.	Toka-patak, ipari tározó alatt (Gyönygösoroszi)	277233	712686	DT19
84.	Tolcsva-patak (Erdőhorváti)	332408	826748	EU35
85.	Vasonca-patak (Halmaj)	324587	794387	DU94
86.	Zagyva (Jásztelek)	237931	721679	DT25
87.	Zagyva (Újszász)	216962	729050	DT33

Statistical analyses

One-way non-parametric multivariate analysis of variance (PERMANOVA, permutation N=10000) was used with Bray-Curtis distance measure to detect significant difference among predefined groups of sampling sites. Groups were created according to (1) the type features defined by the WFD: based on the geology, altitude and the size of catchment area; (2) other characters: sampled mineral substrate size type recorded at the time of sampling, alteration status and (3) types indirectly defined by the current Hungarian water quality assessment method (HMMI) based on macroinvertebrates (see CSÁNYI et al. 2012). The groups and the number of sites therein are listed in Table 2.

Relative species abundance data (individuals/m^2) were box plotted against categories of type features with the highest F-values during PERMANOVA to detect general preferences of species.

Since relatively large set of data obtained from samplings in different seasons of five consecutive years were available, raw abundance data of species were transformed into frequency of occurrence (P) before principal components analysis (PCA) by the evaluation below.

$$P_{ts} = \frac{n_t}{n_s}$$

where

n_t is the number of occasions *t* species occurred at sampling site *s*

n_s is the number of occasions sampling site *s* was sampled.

Subsequently, relative frequency of occurrence was calculated for each species at each site, and PCA (boot N=1000) was run using these values. All statistical analyses were done using the PAST software version 2.17 (HAMMER et al. 2001).

Table 2. Numbers of samplings at sites in groups created for statistical analyses and the results of PERMANOVA based on abundance of hydropsychid species (i/m^2)

Type feature	Categories	Nr. of samplings at sites	PERMANOVA	
			F	p
Geology	siliceous	27	7.905	<0.0001
	calcareous	160		
Altitude	high (>350 m)	32	6.636	<0.0001
	mid-altitude (200-350 m)	103		
	lowland (<200 m)	52		
Size of catchment area	small (10-100 km^2)	83	7.636	<0.0001
	medium (100-1000 km^2)	46		
	large (1000-10 000 km^2)	43		
	very large (>10 000 km^2)	15		
Sampled substrate size type*	coarse	69	3.874	<0.0001
	medium fine	68		
	fine	50		
Alteration	near pristine	135	1.562	0.0079
	heavily modified	51		
	artificial	1		
HMMI type**	HMMI_m	32	8.815	<0.0001
	HMMI_sc	87		
	HMMI_lc	39		
	HMMI_sl	10		
	HMMI_ll	19		

*Groups of sampled substrate size type were defined using the sampled percentage of 3 substrate particle size categories: (1) >6 cm; (2) 2 mm – 6 cm and (3) <2 mm. The size type was defined as „fine" if the percentage of (3) was >50%, „medium fine" if the percentage of (3) was <50% and that of (2) was higher than (1), and „coarse" if (3) was <50% and (1) was higher than (2).

**HMMI types are actually different types of quality assessment methods however, a certain HMMI type corresponds to a certain group of Hungarian water body types characterized by altitude, geology, substrate size and catchment area together (m = mountainous streams, sc = small watercourses of hilly regions, lc = large watercourses of hilly regions, sl = small lowland rivers, ll = large lowland rivers – see CSÁNYI et al. 2012, VÁRBÍRÓ et al. 2010, 2011)

Results and discussion

Faunistical results

Samplings at 87 sites resulted in the occurrences of 11691 specimens of 11 species. In the following list and in the subsequent statistical calculations only the results of successful identification at species level were included. New occurrences were recorded for 10 species, which are indicated in the list with an asterisk (*) before the name of the sampling site. The names of collectors are indicated by abbreviations as follows: NK = Katalin Nagy, IZs = Zsuzsanna Imri, FM = Márk Ficsór. Nomenclature follows MALICKY and DE JONG (2013).

List of records

Cheumatopsyche lepida (Pictet, 1834) – Hernád (Zsujta): 2010.10.13., 1, FM; 2011.04.11.,3, NK-IZs; 2011.09.13., 3, NK-FM – *Tolcsva-patak (Erdőhorváti): 2012.08.02., 3, NK-FM.

Hydropsyche angustipennis angustipennis (Curtis, 1834) – *Ágói-patak (Hort): 2011.03.30., 159, IZs-FM – *Bábony-patak (Sajókeresztúr): 2009.05.21., 1, NK – *Balla-patak (Mátraballa): 2011.03.28., 15, NK-IZs – Bódva, Borsodszirák vízmű (Sajószentpéter): 2010.10.14., 1, NK – *Bózsva-patak (Alsóregmec): 2012.07.31., 3, NK-FM – Csincse-övcsatorna (Gelej): 2011.04.07., 78, NK-FM – Eger-patak (Andornaktálya): 2009.04.09., 162, NK-IZs; 2012.08.08., 12, NK-FM – *Gilip-patak (Bekecs): 2010.08.18., 1, NK-IZs – *Hangony-patak, Ózd-Center (Ózd): 2009.04.23., 33, NK-IZs; 2012.06.28., 18, NK-FM – *Hercegkúti-patak, 37-es út közúti híd (Sárospatak): 2012.08.01., 9, NK-FM – Hernád (Zsujta): 2011.04.11., 3, NK-IZs – *Hódos-patak, Ózd-Hódoscsépány (Ózd): 2013.06.24., 18, NK-FM – *Hór-patak (Cserépfalu): 2011.03.31., 4, NK-FM – *Hór-patak (Mezőkövesd): 2011.04.05., 17, NK-FM – *Kánya-patak (Egerlövő): 2011.04.05., 15, IZs-FM – *Kígyós-patak (Feldebrő): 2011.03.29., 126, NK-FM – Kis-Csincse (Csincse): 2011.04.07., 126, IZs-FM – *Kulcsár-völgyi-patak (Emőd): 2009.04.09., 1, NK-IZs; 2013.08.01., 15, NK-FM – *Külső-Mérges-patak (Adács): 2011.03.30., 45, NK-IZs – Laskó-patak (Demjén): 2011.03.29., 120, IZs-FM – Laskó-patak (Besenyőtelek-Poroszló): 2009.05.19., 1, FM; 2011.05.30., 36, NK – *Nyiget-patak (Markaz): 2011.03.23., 9, NK-FM – *Nyögő-patak (Sajószentpéter): 2010.05.05., 13, FM – *Ostoros-patak (Ostoros): 2011.04.04., 214, IZs-FM – *Ostoros-patak, Zsóry-fürdő alatt (Mezőkövesd): 2011.04.04., 90, NK-IZs – Parádi-Tarna (Sirok): 2011.03.24., 1, NK-FM – *Rédei-patak (Vámosgyörk): 2011.03.30., 6, IZs-FM – Rima, Ostoros-patak torkolata felett (Mezőszemere): 2011.04.04., 19,5, FM – Rima, Ostoros-patak torkolata alatt (Mezőszemere): 2011.04.04., 21, NK-IZs – *Ronyva, Sátoraljaújhely felett (Sátoraljaújhely): 2010.08.11., 5, FM; 2011.09.12., 5, FM – Sas-patak (Hídvégardó): 2013.07.02., 4, NK-FM – *Szartos (Tornyosnémeti): 2009.05.13., 1, NK-FM; 2010.04.12., 2, FM; 2010.10.13., 9, FM; 2013.05.23., 33, IZs-FM; 2013.08.05., 9, NK-FM – *Szerencs-patak, Rátka közúti híd (Szerencs): 2010.08.18., 1, NK-IZs – Szinva-patak, Hűtőházi út (Miskolc): 2010.08.02., 1, FM; 2013.08.08., 3, NK-FM – *Szóláti-patak (Egerszólát): 2011.03.29., 9, NK-IZs – Szuha-patak (Múcsony): 2013.07.04., 48, NK-FM – *Tarján-patak, Delitanya (Gyöngyös): 2011.03.22., 1,5, NK – Telekes-patak (Alsótelekes): 2010.07.15., 2, IZs-FM; 2010.10.14., 82, NK; 2011.04.11., 90, NK-FM; 2011.09.14., 1,5, NK-FM; 2012.04.19., 147, NK-FM; 2013.05.21., 24, IZs-FM; 2013.07.03., 3, NK-FM – Vasonca-patak (Halmaj): 2012.07.04., 3, FM – Zagyva (Jásztelek): 2009.04.29., 2, NK-IZs; 2011.06.01., 15, FM; 2011.08.18., 36, NK-FM – Zagyva (Újszász): 2011.08.18., 30, NK-FM; 2012.04.25., 6, NK-FM.

Hydropsyche bulbifera McLachlan, 1878 – *Balla-patak (Mátraballa): 2011.03.28., 114, NK-IZs – *Bán-patak (Vadna): 2010.04.07., 1, IZs – *Bene-patak (Halmajugra): 2011.03.23., 39, IZs-FM – Bódva (Hídvégardó): 2009.10.08., 1, NK-IZs – Bódva, Borsodszirák vízmű (Sajószentpéter): 2010.10.14., 1, NK – *Boldogkőváraljai-patak (Boldogkőváralja): 2010.08.09., 2, FM – Ceredi-Tarna (Sirok): 2011.03.24., 18, NK-IZs – *Csincse-patak (Csincse): 2011.04.06., 15, NK-FM – Eger-patak (Andornaktálya): 2009.04.09., 234, NK-IZs; 2012.08.08., 63, NK-FM – Gönci-patak, Potacs-ház után (Gönc): 2009.04.16., 3, NK-IZs; 2010.10.13., 7, FM; 2012.07.03., 3, FM – Gönci-patak, Göncruszka felett (Gönc): 2010.04.12., 18, FM – Gyöngyös-patak, Gyöngyös észak (Gyöngyös): 2009.04.15., 6, NK-IZs; 2009.10.14., 3, NK-IZs; 2010.10.27., 8, NK; 2011.03.23., 9, FM; 2011.09.15., 1, IZs-FM; 2012.04.16., 6, NK-FM; 2013.05.13., 3, IZs-FM – Gyöngyös-patak (Gyöngyöshalász): 2009.04.15., 2, NK-IZs – *Hejő-patak (Nyékládháza): 2013.09.17., 3, NK-FM – Hernád (Zsujta): 2009.05.13., 3, NK-FM; 2010.10.13., 1, FM – Hernád (Gesztely): 2011.04.12., 1, NK-IZs; 2011.09.13., 1, NK-FM – *Hór-patak (Mezőkövesd): 2011.04.05., 75, NK-FM – *Kánya-patak (Mezőkövesd): 2011.04.05., 6, NK-IZs – *Keleméri-patak (Hét): 2012.06.28., 3, NK-FM – *Kis-Csincse (Csincse): 2011.04.07., 144, IZs-FM – *Körös-ér (Tiszajenő): 2011.06.08., 3, NK-FM – Laskó-patak (Demjén): 2011.03.29., 6, IZs-FM – *Leleszi-Tarna (Pétervására): 2011.03.24., 9, NK-FM – *Nyögő-patak (Sajószentpéter): 2013.06.26., 39, NK-FM – *Ostoros-patak (Ostoros): 2011.04.04., 28, IZs-FM – *Ostoros-patak, Zsóry-fürdő

alatt (Mezőkövesd): 2011.04.04., 15, NK-IZs – Parádi-Tarna, bányatelep felett (Recsk): 2011.03.28., 10, NK-FM – Parádi-Tarna, bányatelep alatt (Recsk): 2011.03.28., 17, IZs-FM – Parádi-Tarna (Sirok): 2011.03.24., 30, NK-FM – *Rédei-patak (Gyöngyöspata): 2011.03.22., 3, FM – *Rédei-patak (Vámosgyörk): 2011.03.30., 3, IZs-FM – *Rima, Ostoros-patak torkolata felett (Mezőszemere): 2011.04.04., 36, FM – *Rima, Ostoros-patak torkolata alatt (Mezőszemere): 2011.04.04., 45, NK-IZs – *Ronyva, Sátoraljaújhely felett (Sátoraljaújhey): 2011.09.12., 10, FM; 2013.09.05., 36, NK-FM – *Ronyva, Sátoraljaújhely alatt (Sátoraljaújhely): 2009.05.21., 1, FM – Sajó (Sajópüspöki): 2009.04.23., 1, NK-IZs – Sajó (Sajólád): 2009.05.06., 14, FM; 2013.08.08., 108, NK-FM – *Szartos (Tornyosnémeti): 2013.05.23., 3, IZs-FM – Szinva-patak, Hűtőházi út (Miskolc): 2013.08.08., 69, NK-FM – Tarna (Verpelét): 2011.03.29., 18, IZs-FM – Toka-patak, ipari tározó alatt (Gyöngyösoroszi): 2011.03.22., 153, IZs – Toka-patak (Gyöngyös): 2011.03.22., 42, IZs-FM – Tolcsva-patak (Erdőhorváti): 2012.08.02., 15, NK-FM.

Hydropsyche bulgaromanorum Malicky, 1977 – Bodrog (Sátoraljaújhely): 2010.10.27., 1, FM – Tisza (Zemplénagárd): 2010.08.25., 7, FM; 2011.09.12, 1, FM; 2012.08.01., 63, NK-FM – Tisza (Tiszaújváros): 2011.04.07., 4,5, NK-IZs; 2011.09.08., 6, NK-FM – Tisza (Kisköre): 2011.08.16., 18, NK-FM – Tisza (Szolnok): 2011.06.02., 426, FM; 2011.08.17., 7,33, NK-FM; 2013.08.06., 24, NK-FM – Tisza (Tiszaug): 2011.06.07., 3, NK-IZs; 2013.07.30., 6, IZs-FM – Zagyva (Jásztelek): 2011.06.01., 3, FM; 2011.08.18., 3, NK-FM – Zagyva (Újszász): 2012.04.25., 12, NK-FM.

Hydropsyche contubernalis McLachlan, 1865 – Bódva, Borsodszirák vízmű (Sajószentpéter): 2010.10.14., 8, NK; 2012.04.19., 6, NK-FM – *Hejő-patak (Nyékládháza): 2010.09.01., 2, FM – Hernád (Zsujta): 2009.05.13., 8, NK-FM; 2009.10.07., 5, NK; 2010.08.25., 4, IZs-FM; 2010.10.13., 28, FM; 2011.04.11., 30, NK-IZs; 2011.09.13., 48, NK-FM; 2012.04.17., 9, NK-FM; 2012.07.03., 23, FM; 2013.05.23., 6, NK-IZs; 2013.08.05., 9, NK-FM – Hernád (Gesztely): 2010.10.13., 1, FM; 2011.04.12., 20, NK-IZs; 2011.09.13, 15, NK-FM; 2012.04.17., 9, NK-FM; 2012.07.30., 3, NK-FM; 2013.05.23., 6, IZs-FM; 2013.08.05., 18, NK-FM – Sajó (Sajópüspöki): 2009.10.06., 38, FM; 2010.08.04., 1, FM; 2011.09.14., 3, NK-FM; 2012.04.20., 63, NK-FM; 2012.06.28., 114, NK-FM – Sajó (Sajókaza): 2012.06.28., 51, NK-FM – Sajó (Sajószentpéter): 2009.04.23., 2, NK; 2010.08.04., 5, FM; 2013.09.04., 66, NK-FM – Sajó (Sajólád): 2011.05.25., 7, NK-FM; 2013.08.08., 56, NK-FM – Sajó (Kesznyéten): 2013.09.12., 48, NK-FM.

Hydropsyche fulvipes Curtis, 1834 – *Bózsva-patak (Alsóregmec): 2012.07.31., 15, NK-FM – *Csenkő-patak (Zsujta): 2012.07.03., 3, FM – Gönci-patak, Potacs-ház után (Gönc): 2011.09.13., 1, NK-FM; 2012.04.17., 3, NK-FM; 2013.08.05., 6, NK-FM – *Gyöngyös-patak, Lajosháza (Gyöngyössolymos): 2009.07.09., 14, FM; 2010.08.17., 4, FM; 2011.03.23., 3, NK-FM; 2012.08.07., 27, NK-FM – *Hór-patak (Cserépfalu): 2011.03.31., 3, NK-FM – *Parádi-Tarna, bányatelep felett (Recsk): 2011.03.28., 2, NK-FM – *Sas-patak (Hídvégardó): 2013.07.02., 8, NK-FM – *Telekes-patak (Alsótelekes): 2010.07.15., 3, IZs-FM; 2013.07.03., 12, NK-FM – *Tolcsva-patak (Erdőhorváti): 2012.08.02., 18, NK-FM.

Hydropsyche incognita Pitsch, 1993 – *Bódva (Hídvégardó): 2012.04.19., 6, NK-FM – *Bódva, Borsodszirák vízmű (Sajószentpéter): 2010.07.15., 1, IZs-FM – *Bózsva-patak (Alsóregmec): 2012.07.31., 18, NK-FM – *Ceredi-Tarna (Sirok): 2011.03.24., 9, NK-IZs – Gyöngyös-patak, Gyöngyös észak (Gyöngyös): 2009.10.14., 2, NK-IZs; 2011.03.23., 3, FM; 2011.09.15., 3, IZs-FM – Hernád (Zsujta): 2012.04.17., 12, NK-FM; 2012.07.03., 2, FM – *Nyögő-patak (Sajószentpéter): 2010.05.05., 1, FM – *Ronyva, Sátoraljaújhely felett (Sátoraljaújhely), 2010.08.11., 3, FM – Sajó (Sajópüspöki): 2012.04.20., 3, NK-FM – *Szinva-patak, Hűtőházi út (Miskolc): 2013.08.08., 3, NK-FM – *Toka-patak (Gyöngyös): 2011.03.22., 24, IZs-FM.

Hydropsyche instabilis (Curtis, 1834) – *Balla-patak (Mátraballa): 2011.03.28., 6, NK-IZs – Csernely-patak (Uppony): 2010.05.05., 5, NK – Bódva, Borsodszirák vízmű (Sajószentpéter): 2011.04.11., 1,5, NK-IZs – Gönci-patak, Potacs-ház után (Gönc): 2009.04.16., 1, NK-IZs; 2010.04.12., 4, FM; 2010.07.07., 4, FM; 2011.07.06., 78, FM; 2011.09.13., 8, NK-FM; 2012.07.03., 12, FM; 2013.05.23., 171, IZs-FM – Gyöngyös-patak, Lajosháza (Gyöngyössolymos): 2009.07.09., 4, FM; 2010.06.28., 52, FM; 2011.07.07., 43, FM – Gyöngyös-patak, Gyöngyös észak (Gyöngyös): 2010.06.28., 6, FM; 2010.10.27., 8,

NK; 2011.03.23., 3, FM – *Laskó-patak, Egerbakta felett (Egerbakta): 2011.07.07., 5, FM – *Leleszi-Tarna (Pétervására): 2011.03.24., 6, NK-FM – *Rédei-patak (Gyöngyöspata): 2011.03.22., 3, FM – *Ronyva, Sátoraljaújhely felett (Sátoraljaújhely): 2009.04.14., 1, NK-IZs; 2009.10.19., 5, NK-IZs – Szinva-patak, Hűtőházi út (Miskolc): 2010.08.02., 1, FM.

Hydropsyche modesta Navàs, 1925 – Bódva (Hídvégardó): 2011.09.14., 6, NK-FM – Bódva, Borsodszirák vízmű (Sajószentpéter): 2010.10.14., 1, NK; 2012.04.19., 6, NK-FM – *Csincse-övcsatorna (Gelej): 2011.04.07., 189, NK-FM – *Csincse-patak (Csincse): 2011.04.06., 15, NK-FM – *Eger-patak (Andornaktálya): 2012.08.08., 3, NK-FM – Gönci-patak, Potacs-ház után (Gönc): 2012.04.17., 3, NK-FM – *Gyöngyös-patak (Gyöngyöshalász): 2012.08.07., 15, NK-FM – *Hejő-Szarda-övcsatorna (Nagycsécs): 2013.08.08., 6, NK-FM – Hernád (Zsujta): 2009.05.13., 1, NK-FM; 2009.10.07., 7, NK; 2010.08.25., 4, IZs; 2010.10.13., 49, FM; 2011.04.11., 18, NK-IZs; 2011.09.13., 60, NK-FM; 2012.04.17., 30, NK-FM; 2012.07.03., 11, FM; 2013.05.23., 33, NK-IZs; 2013.08.05., 12, NK-FM – Hernád (Gesztely): 2009.10.07., 1, NK-IZs; 2010.10.13., 6, FM; 2011.04.12., 9, NK-IZs; 2011.09.13., 15, NK-FM; 2012.04.17., 6, NK-FM; 2013.05.23., 6, IZs-FM; 2013.08.05., 3, NK-FM – *Hór-patak (Mezőkövesd): 2011.04.05., 3, NK-FM – *Kánya-patak (Mezőkövesd): 2011.04.05., 3, NK-IZs – *Kánya-patak (Egerlövő): 2011.04.05., 66, IZs-FM – *Laskó-patak (Besenyőtelek-Poroszló): 2011.05.30., 3, NK – *Ostoros-patak (Ostoros): 2011.04.04., 1, IZs-FM – *Rima, Ostoros-patak torkolata felett (Mezőszemere): 2011.04.04., 88,5, FM – *Rima, Ostoros-patak torkolata alatt (Mezőszemere): 2011.04.04., 213, NK-IZs – *Ronyva, Sátoraljaújhely felett (Sátoraljaújhely): 2010.08.11., 5, FM; 2010.10.27., 7 – Sajó (Sajókaza): 2012.06.28., 12, NK-FM – Sajó (Sajószentpéter): 2009.04.23., 1, NK – Sajó (Sajólád): 2011.05.25., 1, NK-FM; 2013.08.08., 124, NK-FM – Sajó (Kesznyéten): 2013.09.12., 3, NK-FM – Szartos (Tornyosnémeti): 2009.10.07., 9, NK-IZs; 2010.10.13., 34, FM; 2011.09.13., 6, NK-FM; 2013.08.05., 3, NK-FM – *Szinva-patak, Hűtőházi út (Miskolc): 2013.08.08., 21, NK-FM – Tisza (Zemplénagárd): 2010.08.25., 2, FM; 2012.08.01., 3, NK-FM – Zagyva (Jásztelek): 2009.08.03., 1, FM; 2011.06.01., 45, FM; 2011.08.18., 132, NK-FM; 2013.09.03., 6, NK-FM – Zagyva (Újszász): 2012.04.25., 3, NK-FM.

Hydropsyche pellucidula (Curtis, 1834) – *Bábony-patak (Sajókeresztúr): 2013.09.11., 3, NK-FM – Bódva (Hídvégardó): 2011.04.11., 9, IZs-FM; 2011.09.14., 120, NK-FM – Bódva, Borsodszirák vízmű (Sajószentpéter): 2011.04.11., 1,5, NK-IZs – *Gyöngyös-patak, Gyöngyös észak (Gyöngyös): 2010.10.27., 25, NK; 2011.03.23., 9, FM – *Hejő-patak (Nyékládháza): 2010.09.01., 2, FM – *Hejő-Szarda-övcsatorna (Nagycsécs): 2013.08.08., 3, NK-FM – Hernád (Zsujta): 2010.08.25., 3, IZs-FM; 2010.10.13., 45, FM; 2011.04.11., 90, NK-IZs; 2011.09.13., 87, NK-FM; 2013.05.23., 54, NK-IZs; 2013.08.05., 3, NK-FM – Hernád (Gesztely): 2010.10.13., 2, FM; 2011.09.13., 3, NK-FM – *Hódos-patak, Ózd-Hódoscsépány (Ózd): 2010.04.07., 7, IZs – *Jósva-patak (Szinpetri): 2012.04.19., 3, NK-FM – *Kácsi-patak (Mezőkeresztes): 2011.04.05., 9, NK-IZs – *Parádi-Tarna, bányatelep felett (Recsk): 2011.03.28., 3, NK-FM – *Parádi-Tarna (Sirok): 2011.03.24., 29, NK-FM – *Rédei-patak (Gyöngyöspata): 2011.03.22., 3, FM – *Ronyva, Sátoraljaújhely felett (Sátoraljaújhely): 2010.10.27., 7, FM; 2011.05.25., 15, NK-FM; 2011.09.12., 6, FM – Sajó (Sajópüspöki): 2010.08.04., 1, FM; 2010.10.20., 61, NK; 2011.05.26., 3, NK-FM; 2011.07.11., 3, NK; 2012.04.20., 105, NK-FM; 2012.06.28., 3, NK-FM – *Szartos (Tornyosnémeti): 2010.10.13., 1, FM; 2011.09.13., 1, NK-FM – Tarna (Verpelét): 2011.03.29., 30, IZs-FM – *Telekes-patak (Alsótelekes): 2010.07.15., 10, IZs-FM; 2011.04.11., 9, NK-FM – Toka-patak, ipari tározó alatt (Gyöngyösoroszi): 2011.03.22., 72, IZs.

Hydropsyche saxonica McLachlan, 1884 – *Balla-patak (Mátraballa): 2011.03.28., 9, NK-IZs – *Bene-patak, Mátrafüred után (Gyöngyös): 2011.03.23., 18, IZs-FM – *Bódva (Hídvégardó): 2011.09.14., 3, NK-FM – Csernely-patak (Uppony): 2010.05.05., 13, NK – Gönci-patak, Potacs-ház után (Gönc): 2009.04.16., 13, NK-IZs; 2009.10.07., 11, NK-IZs; 2010.04.12., 4, FM; 2010.07.07., 9, FM; 2011.04.12., 9, IZs-FM; 2011.07.06., 1,5, FM; 2011.09.13., 11, NK-FM – Gyöngyös-patak, Lajosháza (Gyöngyössolymos): 2009.04.15., 1, NK-IZs; 2010.06.28., 1, FM; 2010.10.27., 11, FM; 2011.03.23., 12, NK-FM; 2011.07.07., 1, FM; 2012.04.16., 5, NK-FM – Gyöngyös-patak, Gyöngyös észak (Gyöngyös): 2009.10.14., 1, NK-IZs; 2010.10.27., 4, NK; 2011.03.23., 3, FM; 2011.09.15., 3, IZs-FM; 2012.04.16., 6, NK-FM –*Hangony-patak, Ózd felett (Ózd): 2013.06.24., 3, NK-FM – *Hódos-patak, Ózd-

Hódoscsépány (Ózd): 2013.06.24., 33, NK-FM – *Hór-patak (Cserépfalu): 2011.03.31., 62, NK-FM – *Keleméri-patak (Hét): 2013.09.04., 6, NK-FM – *Nyiget-patak (Markaz): 2011.03.23., 3, NK-FM – *Nyögő-patak (Sajószentpéter): 2010.05.05., 11, FM – Parádi-Tarna (Sirok): 2011.03.24., 2, NK-FM – Rakaca-patak (Szalonna): 2013.07.02., 9, NK-FM – *Rédei-patak (Gyöngyöspata): 2011.03.22., 96, FM – *Sajó (Sajópüspöki): 2012.06.28., 9, NK-FM – *Szinva-patak, Papírgyár felett (Miskolc): 2010.08.02., 2, FM.

Patterns of distribution

The results of PERMANOVA (Table 2) show that the among-groups differences of hydropsychid species composition were significant ($p<0.05$) in case of all type features, with the highest shown up between groups based on geology ($F=7.905$), the size of catchment area ($F=7.636$) and the HMMI type ($F= 8.815$). In comparison, surprisingly low difference ($F=1.562$) has been detected between groups based on the alteration status of the water bodies, which suggests that distribution of net-spinning caddisfly larvae depends rather on the factors mentioned above and e.g. altitude ($F=6.636$) or mineral substrate composition ($F=3.874$) than on overall hydromorphological departures from natural or near-natural conditions. Large F-value for HMMI types shows that the difference among hydropsychid faunas of the groups is large enough to suggest valid type categories.

Logarithmic species abudanace data (ind/m^2) are boxplotted to depict differences in the occurence of the 11 species for the four type features with the highest F-values (Figure 1). Distinct preferences are shown by five species.

Hydropsche bulgaromanorum (Figure 1A) was found only in large (Bodrog, Zagyva) and very large lowland rivers (Tisza) with fine mineral substrates, while *H. contubernalis* (Figure 1B) seems to prefer somewhat similar conditions as for the size of water bodies, but it was also found 21 times (65,6%) at mid-altitudes and 29 times (90,6%) in rivers with bigger mineral substrate particle size out of total 32 findings. The pattern is even more interesting considering that they were not found together at any site in a five year period and that *H. contubernalis* was recorded from Bódva, Hernád and Sajó, the first two of which are 2nd order and the last one is a main tributary of Tisza (ICPDR 2007), the major locality of *H. bulgaromanorum* in Northern Hungary. The results show conspicuously clear separation in the investigated watercourses, however, they do have been found coexisting in the area (MÓRA and CSABAI 2003).

Hydropsyche fulvipes, H. instabilis and *H. saxonica* (Figure 1C-E) were found at higher altitudes in smaller streams with mineral substrates of larger particle size. *H. fulvipes* seems to inhabit stretches closest to springs since from all of its 15 findings it occurred 11 times (73,3%) in the high and 4 times (26,6%) at sites in the mid-altitude category. These numbers are 18 (54,5%) and 15 (45,5%) for *H. saxonica* and 13 (59,1%) and 7 (31,8%) for *H. instabilis* with the latter found sporadically at lower altitudes (9,1%). All three of them were present at sites with siliceous and calcareous hydrogeochemical characteristics as well, but mainly in coarse particle sized habitats (*H. fulvipes:* 66,7%, *H. saxonica:* 75,8%, *H. instabilis:* 77,3%). These results are in accordance with the fact that these species are known to inhabit smaller streams of mountainous and hilly regions (HIGLER and TOLKAMP 1982, WARINGER and GRAF 1997).

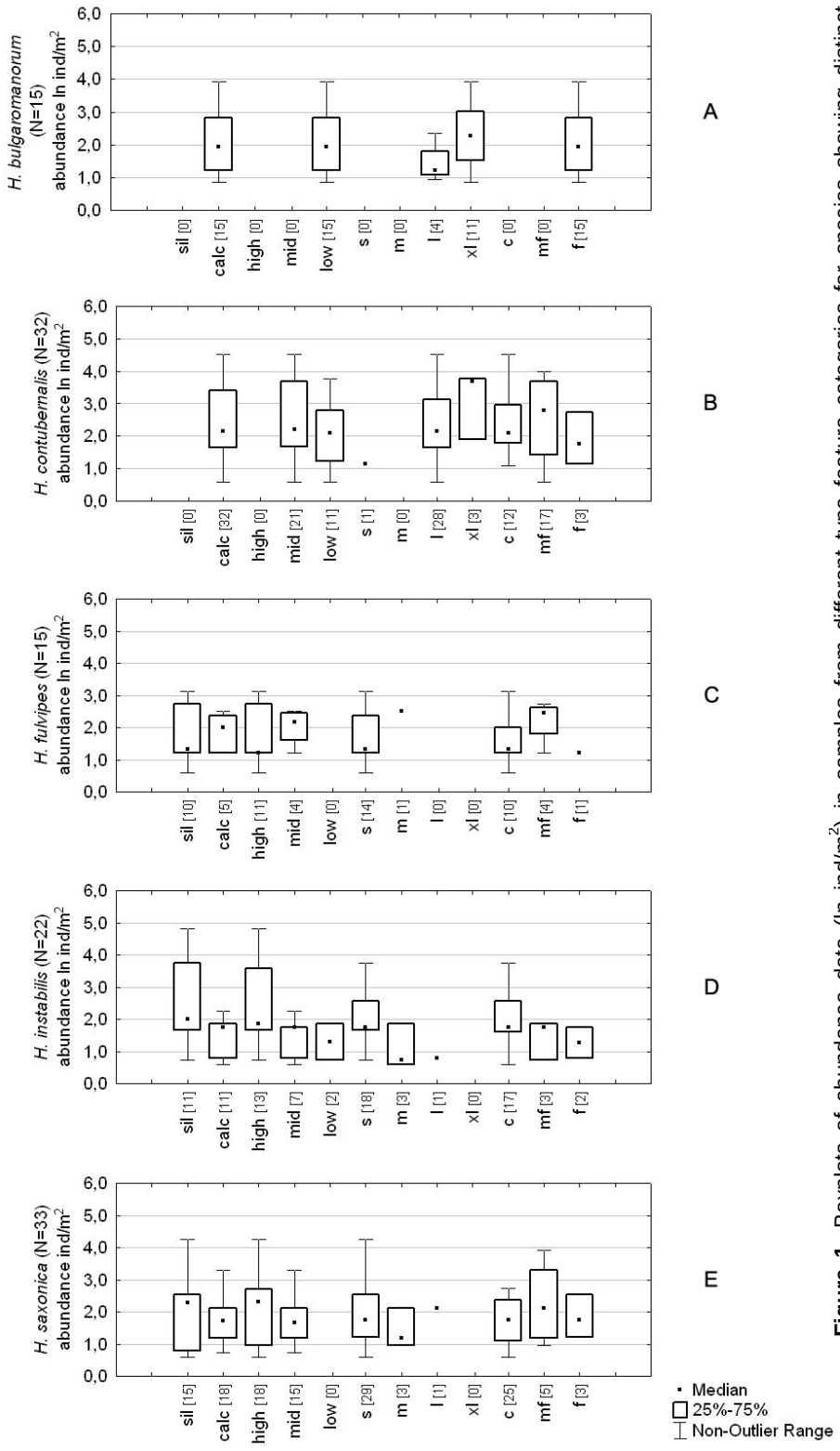

Figure 1. Boxplots of abundance data (ln ind/m^2) in samples from different type feature categories for species showing distinct distribution patterns (N = total number of samples in which the species was found, the numbers in [brackets] indicate the number of cases the species was found in the particular category, sil = siliceous, calc = calcareous, s = small, m = medium, l = large, xl = very large, c = coarse, mf = medium fine, f = fine – see Table 2)

Less distinct patterns can be observed in the case of *H. angustipennis, H. bulbifera, H. incognita* and *H. pellucidula.* All of them tend to occur in the middle section of the stream-river continuum with *H. bulbifera* most likely to be found in substrates with larger particle size (coarse and medium fine – 82.1%) while *H. angustipennis* in those with smaller one (medium fine and fine – 79.7%). No obvious differences were found between the preferred type features of *H. incognita* and *H. pellucidula* at this scale.

Hydropsyche modesta was found mainly in medium sized and large watercourses (80.8% together) with various substrate sizes, and predominantly at mid-altitude or in the lowlands (98.1% together). It was one of the most frequently found species with a seemingly wide range of preferred feature types, however, often co-occurring with *H. contubernalis* in Bódva, Hernád and Sajó.

Larvae of *Cheumatopsyche lepida* were caught only four times during the indicated period – three times at the same, mid-altitude site on the river Hernád with calcareous hydrogeochemical characteristic and medium fine substrates.

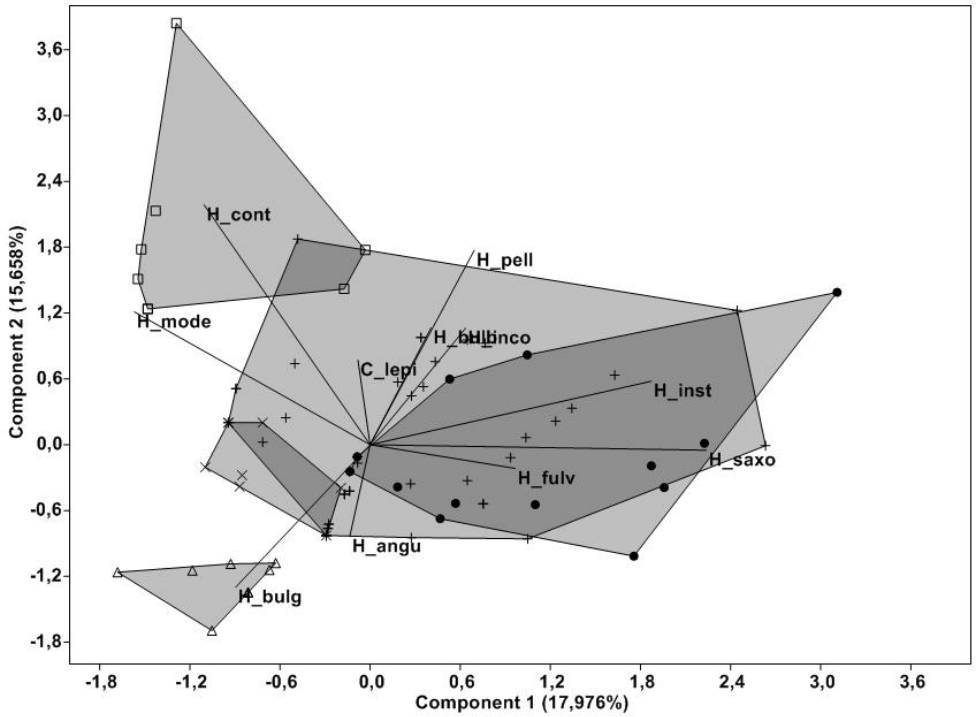

Figure 2. Principal Components Analysis biplot of sampling sites and hydropsychid species. (Sampling sites were grouped according to the HMMI types, for which the highest F-value was calculated during PERMANOVA: • = mountainous streams, + = small watercourses of hilly regions, □ = larger watercourses of hilly regions, x = small lowland rivers, Δ = large lowland rivers)

In the PCA bipot figure three different types – large watercourses of hilly regions, small lowland rivers and large lowland rivers – are separated from each other by their net-spinning caddisfly fauna with the first two having overlaps with that of small watercourses of hilly regions. *Hydropsyche bulgaromanorum* characterise

large lowland rivers while *H. contubernalis* and *H. modesta* seems to be typical for larger watercourses of hilly regions. The similarity of preferences of the last two species is more obvious here than boxplots suggested, leaving the reason for *H. modesta* being also found in smaller watercourses like Csincse-patak, Kánya-patak, Hór-patak or Laskó-patak still to be explained. Although the similar distribution tendencies of three mountainous species *H. fulvipes, H instabilis* and *H. saxonica* are also detectable, no separation of the mountainous streams and/or the small watercourses of hilly regions appears, presumably due to larger number of sampling sites in these categories (see Table 2) representing streams with the same type features but with different degrees of hydromorphological degradation, anthropogenic impact, water quality or other stressors which were out of the aim and sight of the present study.

Further investigations are planned to determine what environmental factors or combination of them could be responsible for the actual distribution of hydropsychid species in the investigated area, particularly in cases of water body types and species that could not be obviously characterized in the present study.

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