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Aquatic plant communities in the catchment area of the Ipeľ river in Slovakia and Hungary.

Part I. Classes *Lemnetea* and *Charetea fragilis*

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ABSTRACT: The author reports on the results of the studies on aquatic plant communities of the classes *Lemnetea* and *Charetea fragilis* in the catchment area of Ipeľ river in Slovakia and Hungary. In 1993–2000, thirteen aquatic plant communities were identified in this region. Only the occurrence of *Hydrocharitetum morsus-ranae*, which had been mentioned in the related literature, was not confirmed. The basic synecological, synmorphological and synchorological characteristics are presented for each of the plant communities identified in the studied region. The notes of their occurrence in Slovakia and Hungary are mentioned as well.

Keywords: *Charetea fragilis*, *Lemnetea*, Ipeľ river, synchorology, synecology

Introduction

The Ipeľ river belongs to the important water flows in Slovakia. In the past decades, it was the subject of considerable interventions related to the management of water supplies and an intensive agricultural exploitation of landscape. These interventions have exercised a marked influence on the vegetation of this region, especially, the aquatic and marsh plant communities.

From the viewpoint of floristics, the catchment area of Ipeľ river belongs to the relatively well-investigated regions of Slovakia. On the other hand, the knowledge

of the plant communities occuring in this area is limited. In addition, only few publications contain reliable data about the aquatic vegetation of this region (MÁTHÉ 1956; KÁRPÁTI & KÁRPÁTI 1967; KOVÁCS & MÁTHÉ 1967, DAVID 1987, 1997; DAVID & al. 1995; HRIVNÁK 1997, 1998a, b, c, 1999a, b; HRIVNÁK & al. 1997, 2001a, b; OŤAHEĽOVÁ & al. 1998).

The aims of the current studies were the following ones:

1) to document the recent structure of the aquatic plant communities (classes *Lemnetea* and *Charetea fragilis*) of the catchment area of Ipeľ river, and
2) to complete the information on their ecological and chorological conditions.

Material and methods

Characteristics of the study area

The catchment area of the Ipeľ river is spread from 18° 42′ 2″ to 19° 56′ 15″ East and from 47° 49′ 12″ to 48° 35′ 50″ North. It is located in the southern part of central Slovakia, the south-eastern part of western Slovakia, and the northern part of central Hungary (Fig. 1). The Ipeľ river springs in the orographical unit Veporské vrchy Mts. in the altitude of 1.058 m above sea level and flows into the Danube river near the Szob village in 102 m a. s. l. Its total length is 254.25 km (cf. FEKETE 1972). The essential part of the stream (approximately between the outfall to Danube river and the Ipolytarnóc village) forms a natural border between Slovakia and Hungary. The catchment area of Ipeľ river is shaped as a compressed oblong and includes 5151.044 km^2. Its main part (3648.592 km^2) is located on the territory of Slovakia (FEKETE 1972). The longest tributaries of Ipeľ river are the Štiavnica river, Krupinica river, Tisovník creek and Krivánsky potok creek.

From the phytogeographical viewpoint, the catchment area of Ipeľ river belongs to the region *Carpaticum occidentale*, district *Praecarpaticum* and the region *Pannonicum*, district *Matricum* in Slovakia (cf. FUTÁK 1966), and the region *Pannonicum*, district *Matricum* on the territory of Hungary (cf. MOLNÁR 1999).

Phytosociological studies (methods of recording, processing and evaluation of data)

The phytosociological relevés were made according to the Zürich-Montpellier approach using the adapted Braun-Blanquet's scale (BARKMAN & al. 1964). In the attached tables, the rates of 2m (low abundance and cover about 5 %), 2a (cover 5–12.5 %) and 2b (12.6–25 %) are presented in the abbreviated forms as M, A and B. The data were collected in 1993–2000. All the relevés were stored using the TURBOVEG database software (HENNEKENS 1996a) and the phytosociological tables were processed by MEGATAB (HENNEKENS 1996b). Using the TWINSPAN software (HILL 1979), the divisive polythetic method of classification was carried out in order to detect the natural variability of individual plant communities.

The published and unpublished phytosociological relevés from the catchment area of Ipeľ river are presented in the corresponding tables. Except for the numbers of relevés less than 5, where the absolute values are presented, the data in the synoptic tables are percentages. For the purpose of comparison, the abbreviated synoptic tables from some other parts of Slovakia (OŤAHEĽOVÁ 1995a, 2001) are presented as well. The diagnostic species of individual plant communities are used according to the following authors: ELLMAUER & MUCINA (1993), JAROLÍMEK & al. (1997), OŤAHEĽOVÁ (1995a, 2001) and OŤAHEĽOVÁ & al. (2001).

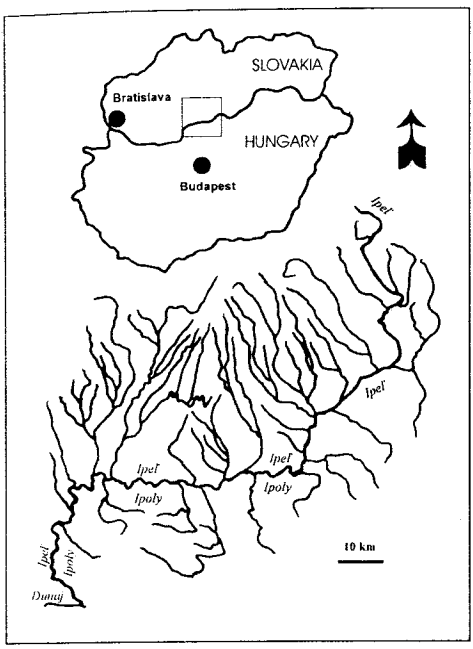

Fig. 1. Map of area studied

Soil and water sampling

The soil samples for analyses were collected from the depth of 10–20 cm. Only the samples from two localities (namely, those with the occurrence of *Lemnetum minoris* and *Ricciocarpetum natantis*), were analysed. The analyses were carried out in the laboratory of the Department of Natural Environment, Forestry Research Institute in Zvolen. The following methods were used in order to determine the corresponding properties of soil:

- texture analysis (clay and silt by sedimentation method, sand was calculated as a complement),
- soil reaction (pH_{H2O}) by electrometric method,
- total organic carbon (C_{OX}) by wet combustion using colorimetry for the Cr^{3+} determination,
- total nitrogen (N_T) by LECO EP 228 analysator,
- available phosphorus (P_M), potassium (K_M), calcium (Ca_M) and magnesium (Mg_M) by Mehlich II method; AES – ICP.

The water reaction (pH) was stated on several chosen localities. The water was sampled in the field using the plastic bottles. The values of pH were measured in the lab by means of WTW 325–B/SET–1 device.

Nomenclature

The names of the non-vascular and vascular plants follow MARHOLD & HINDÁK (1998). The names of individual syntaxa with the name of author and the year of the first valid description are mentioned only once. The names of the aquatic plant communities from the classes *Charetea fragilis* and *Lemnetea* are presented according to the papers of OŤAHEĽOVÁ (1995a, 2001) and SCHRATT (1993a, b).

Results and discussion

Survey of vegetation units

Lemnetea DE BOLÓS et MASCLANS 1955
Lemnetalia minoris DE BOLÓS et MASCLANS 1955
Lemnion minoris DE BOLÓS et MASCLANS 1955
Lemnetum trisulcae KNAPP et STOFFERS 1962
Riccietum fluitantis SLAVNIĆ 1956
Lemnetum minoris OBERD. ex T. MÜLLER et GÖRS 1960
Lemnetum gibbae MIYAWAKI et J. TX. 1960
Lemno minoris-Spirodeletum polyrhizae KOCH 1954
Ricciocarpetum natantis R. TX. 1974
Lemno-Utricularietalia PASSARGE 1978
Utricularion vulgaris PASSARGE 1964
Lemno-Utricularietum vulgaris SOÓ 1947
Utricularietum neglectae T. MÜLLER et GÖRS 1960
Hydrocharitetalia RÜBEL 1933
Hydrocharition RÜBEL 1933
Hydrocharitetum morsus-ranae VAN LANGENDONCK 1935
Ceratophylletum demersi HILD 1956
Ceratophylletum submersi VON SOÓ 1928
Charetea fragilis FUKAREK ex KRAUSCH 1964
Nitelletalia flexilis DĄMBSKA 1966
Nitellion syncarpae-tenuissimae KRAUSE 1969
Nitelletum mucronatae TOMASZEWICZ ex HRIVNÁK et al. 2001
Charetalia hispidae SAUER ex KRAUSCH 1964
Charion vulgaris (KRAUSE et LANG 1977) KRAUSE 1981
Charetum vulgaris CORILLION 1957

Characteristic of vegetation units

Lemnetum trisulcae KNAPP et STOFFERS 1962 (Tab. 3, rels 37–40)

This pleustophyte community belongs to the rare associations in the catchment area of Ipeľ river. It grows in natural as well as artificial biotopes, mostly in deeper river oxbows, canals and artificial gravel or sand ditches. The stands of this community were found in the stagnating, medium deep or deep water with the fluctuating level. The maximum depth of the water was 1 m. Towards the line of the bank, the stands of *Lemnetum trisulcae* interlocked to the marsh plant communities of the class *Phragmito-Magnocaricetea* KLIKA in KLIKA et NOVÁK 1941. In cases of a considerable decline of the water level, *Lemnetum trisulcae* was outgrown by the species of the alliance *Oenanthion aquaticae* HEJNÝ et NEUHÄUSL 1959.

The general appearance of this community is determined by the submerged species *Lemna trisulca*. From among the others, only *Typha latifolia* and *Lemna*

minor are characterised by a higher frequency. Three floristical and ecological variants were detected after the synthesis of data:

– the variant with higher frequencies of *Typha latifolia* and *Lemna minor*, growing on the contact zones with the marsh plant communities of littoral stagnating water (tab. 3, rels 37–38),

– the variant with the presence of additional submerged species, mainly, *Potamogeton trichoides* and *Sparganium emersum* (tab. 3, rel. 39),

– the variant with the presence of the diagnostic species of *Oenanthion aquaticae*, which begins to develop after a considerable decrease of water level (tab. 3, rel. 40).

Up to the present time, the occurrence of this community was reliably confirmed only once in the catchment area of Ipeľ river (OŤAHEĽOVÁ & al. 1998). However, the stands of *Lemnetum minoris* are common on the territory of Slovakia (OŤAHEĽOVÁ 1995a). On the other hand, *Lemnetum minoris* is relatively rare in Hungary (BORHIDI & SÁNTA 1999).

Riccietum fluitantis SLAVNIĆ 1956 (tab. 3, rels 46–47)

This community is very rare in the catchment area of Ipeľ river. In addition to two localities near Pinciná and Zelené villages, the fragments of *Riccietum fluitantis* grow in the pool of the town park in Lučenec. The community grows usually in the upper littoral zone of the localities with stagnating water. Besides the *Riccietum fluitantis*, the dominating species (*Riccia fluitans*) is also relatively frequent in the other aquatic plant communities of the classes *Lemnetea* and *Potametea*. Along with another pleustophytes, it forms the synusia of the reed bed communities of *Phragmition communis* KOCH 1926 and the large sedge communities of *Magnocaricion elatae* KOCH 1926 (e. g. HRIVNÁK 1998b).

In the catchment area of Ipeľ river, *Riccietum fluitantis* was previously mentioned by HRIVNÁK (1997) and OŤAHEĽOVÁ & al. (1998) – however, without the corresponding phytosociological relevés. From among the other Slovak localities, this community is known from Východoslovenská rovina lowland (OŤAHEĽOVÁ & HUSÁK 1982, 1985), Podunajská rovina lowland (OŤAHEĽOVÁ & HUSÁK in OŤAHEĽOVÁ 1995a) and Borská nížina lowland (ZLINSKÁ & al. 1997). The stands with the dominance of *Riccia fluitans* and its coodominance with other aquatic macrophtytes were published from the vicinity of Čuňovo village in Podunajská rovina lowland KUBALOVÁ (2000).

Lemnetum minoris OBERD. ex T. MÜLLER et GÖRS 1960 (Tab. 1, rels 1–24)

The ass. *Lemnetum minoris* belongs to the most frequent aquatic communities in the studied area. It grows in natural biotopes (river oxbows, natural terrain depressions) or, more frequently, in artificial ditches, pools and canals. The fragments of this community may also grow in the littoral of the artificial water reservoirs. *Lemnetum minoris* prefers the shallow and medium deep, stagnating or slowly flowing water with the depth of 10–50 (max. 100) cm. The bottom is formed of organic material or silt that cover frequently the gravely or sandy sediments. The results of the soil analysis from a locality near Nitra nad

Ipľom village (tab. 1, rel. 8) are presented in Table 2. As it was demonstrated by the fractional analysis, the soil has been characterised as a clayey sand with the neutral reaction. The reaction of water from the Cerovo fishpond (tab. 1, rel. 15) was moderately acid (pH 6.32) and in case of the gravel ditch near Nitra nad Ipľom village (tab. 1, rel. 24), it was moderately alkaline (pH 7.24).

In general, the stands of *Lemnetum minoris* are very poor in species. Only three species per one relevé were formed on average. The natant species *Lemna minor* creates the general appearance of community, whereas the others occur only infrequently and reflect the particular environmental conditions. Based on a relatively rich phytosociological data, three floristical and ecological variants of this community were defined:

the variant with the presence of eutrophic helophytes, demanding the high content of the nutrients in soil (*Typha latifolia*, *Carex riparia*, *Sparganium erectum*). This variant grows in shallow water, which is gradually out grown by the marsh vegetation (tab. 1, rels 6–9),

– the variant of very eutrophic water, attacked by human activity, with a higher frequency of *Lemna gibba* (tab. 1, rels 10–12),

– the variant with the presence of the diagnostic species of wet meadows from the order *Molinietalia* KOCH 1926 (tab. 1, rel. 13),

– the variant of the shallow and drying biotopes with the presence of the diagnostic species of the alliance *Oenanthion aquaticae* (e.g. *Phellandrium aquaticum* or *Ranunculus sceleratus*, tab. 1, rels 14–18),

– the variant with the submerged layer of *Lemna trisulca* and *Ceratophyllum demersum* (tab. 1, rels 19–21),

– the variant of the euthropic shallow and drying biotopes (tab. 1, rels 22–24).

The relevés Nr. 1–5 (tab. 1) give evidence of the very poor stands with the almost absolute dominance of *Lemna minor* and only occasional occurrence of additional species.

The ass. *Lemnetum minoris* occurs very frequently in the catchment area of Ipeľ river. This fact is confirmed by many published literature data (DAVID & al. 1995; HRIVNÁK 1998b, c, 1999a, b; HRIVNÁK & al. 1997, 2001b; OŤAHEĽOVÁ & al. 1998).

Despite a few relevés published (cf. OŤAHEĽOVÁ 1995a: tab. 10, column 4), ass. *Lemnetum minoris* belongs to the most frequent aquatic plant communities in Slovakia. However, this association is relatively rare on the territory of Hungary (BORHIDI & SÁNTA 1999).

Lemnetum gibbae MIYAWAKI et J. TX. 1960 (Tab. 3, rels 41–44)

This community is typical of artificial biotopes. It grows in canals and artificial ditches with stagnating, eutrophic or hyperthrophic water with the depth of about 10–60 cm. The fluctuation of water level is more marked in the second half of summer. The community is poor in species, the cover of natant layer is almost continual. Besides the dominant species, *Lemna gibba*, only *L. minor* occurs in a higher constancy. Four floristical and ecological variants are separated in Tab. 3:

– the typical variant, poor in species (tab. 3, rel. 41),

– the variant with the species of *Oenanthion aquaticae* alliance, fixed on eutrophic biotopes with a fluctuating water level. The stands of this variant grow in contact zones with the other marsh plant communities (tab. 3, rel. 42),

– the variant with the presence of ruderal species. It grows in eutrophic and hypertrophic biotopes with a fluctuating water level in contact with the synantropic vegetation (tab. 3, rels 43–44).

In Slovakia, *Lemnetum gibbae* occurs mainly in lowlands. Nevertheless, on suitable biotopes, its presence is possible on the localities at a higher altitude as well (cf. OŤAHEĽOVÁ 1995a, HEJNÝ & HUSÁK 1978). OŤAHEĽOVÁ (1995a) presented detailed data about the occurrence of this community on the territory of Slovakia. In the catchment area of the Ipeľ river, the presence of *Lemnetum gibbae* was previously mentioned by HRIVNÁK & al. (1997) and OŤAHEĽOVÁ & al. (1998).

Lemno minoris-Spirodeletum polyrhizae KOCH 1954 (Tab. 2, rels 25–36)

This community grows in river oxbows, natural terrain depressions, artificial ditches and canals with a muddy, weakly translucent, stagnating or (more rarely) slowly flowing water, which is usually 20–50 (100) cm deep. The community occurs mainly in eutrophic biotopes with the fluctuating water regime, where the water is drying after a longer period with the lack of precipitation.

Besides the natant layer of *Lemna minor* and *Spirodella polyrhiza*, this pleustophyte community is also characterised by the presence of submerged layer. In the catchment area of Ipeľ river, the following floristical and ecological variants were defined:

– the typical variant, poor in species (tab. 2, rel. 25),

– the variant with a higher frequency of *Lemna trisulca* in the submerged layer (tab. 2, rels 26–29),

– the variant with a higher frequency of submerged macrophytes, especially *Ceratophyllum demersum* and, more rarely, *Lemna trisulca* and *Batrachium trichophyllum* (tab. 2, rels 33–35),

– the variant of intensively eutrophic biotopes with a higher frequency of *Lemna gibba* (tab. 2, rel. 36).

In the catchment area of Ipeľ river, the occurrence of this community was previously confirmed by several authors (DAVID & al. 1995; HRIVNÁK & al. 1997, 2001b; KOVÁCS & MÁTHÉ 1967; OŤAHEĽOVÁ & al. 1998). In some cases, their data are even illustrated by phytosociological relevés.

In Slovakia, the ass. *Lemno minoris-Spirodelletum polyrhizae* belongs to the common and frequent communities (cf. OŤAHEĽOVÁ 1995a). However, it was not included into any review of the vegetation of Hungary (SOÓ 1957, BORHIDI 1996, BORHIDI & SÁNTA 1999). The phytosociological relevés with *Salvinia natans* (besides the diagnostic species of ass. *Lemno minoris-Spirodelletum polyrhizae*) were classified as ass. *Salvinio-Spirodeletum* SLAVNIĆ 1956 (cf. BORHIDI & SÁNTA 1999). Nevertheless, it is evident that the relevés from the Hungarian part of the Ipeľ river catchment area are related to ass. *Lemno minoris-Spirodelletum*

polyrhizae. These relevés were published by HRIVNÁK & al. (2001b) and have been included into this paper (tab. 2, rels 25, 29, 34–35).

***Ricciocarpetum natantis* R. Tx. 1974 (tab. 3, rel. 45)**

This community was recorded only on one locality in a terrain depression near the railway line in the northern part of Rapovce village (HRIVNÁK 1998a). The water regime of this locality is markedly fluctuating. The spring period and early summer are characterised by the prevalence of the stagnant water with a depth of 5–50 cm. Later, however, the water level decreases below the surface of soil. The soil was characterised as a sandy clay and its reaction (pH) is near the upper limit of the range of acid soils. From among the detected accessible mineral nutrients, the relatively high values of calcium and magnesium are especially interesting (tab. 8).

The dominant species, *Ricciocarpos natans*, grows in the littoral and limosal ecophases. The terrestrial ecomorpha appears as early as in the limosal ecophase but in the long-time terrestrial ecophase it ceases to develop and dies. Besides *Ricciocarpetum natantis*, this species is also a component of the community *Galio palustris-Caricetum ripariae* BALÁTOVÁ-TULÁČKOVÁ et al. 1993 (HRIVNÁK 1998a). When the water level decreases to the surface of soil, the group of dominating hydrophytes (e. g. *Ricciocarpos natans*, *Lemna minor*) is replaced by common hygrophytes (e. g. *Lythrum salicaria*, *Phellandrium aquaticum*, *Rorippa amphibia*). After that, the stands of *Oenantho aquaticae-Rorippetum amphibiae* LOHMEYER 1950 become dominating.

On the territory of Slovakia, the community with the dominance of *Ricciocarpos natans* were previously mentioned only by OŤAHEĽOVÁ & HUSÁK (1982) from Vojka village in Východoslovenská rovina lowland.

***Lemno-Utricularietum vulgaris* Soó 1947 (Tab. 4, rels 48–52)**

This community grows in the river oxbows, artificial ditches and canals with the stagnating, eutrophic and shallow water. The maximum water level is approximately 50 cm. The bed is created by gravel river deposit or clayey soils, which are frequently covered by a layer of organic materials. The neutral water reaction (pH 6.85) was recorded in the gravel ditches in the floodplain of Ipeľ river between Zelené and Rovňany villages.

The submerged macrophytes are dominating in this community (e.g. *Utricularia vulgaris*, *Lemna trisulca*, *Riccia fluitans*). The natant layer is very contiguous, formed mainly of *Lemna minor*. Two floristical and ecological variants were defined using a relatively poor phytosociological material:

– the variant with the occurrence of submerged aquatic and emerged marsh species, typical for more eutrophic biotopes (tab. 4, rels 48),

– the variant with a frequent occurrence of the submerged pleustophyte, *Lemna trisulca*, which grows in the biotopes with a fluctuating water regime (tab. 4, rels 51–52).

The other phytosociological relevés (tab. 4, rels 49–50) are poor in species and floristically unclear.

From the catchment area of Ipeľ river, the occurrence of this community was previously mentioned by KÁRPÁTI & KÁRPÁTI (1967), HRIVNÁK (1997, 1998c, 1999a) and HRIVNÁK & al. (1997, 2001b). In Hungary, the general data about the occurrence of *Lemno-Utricularietum vulgaris* were published by MÁTHÉ (1956) from the Nógrádi administrative district.

From the other regions of Slovakia, the occurrence of this community was documented by OŤAHEĽOVÁ (1995a). In addition, *Lemno-Utricularietum vulgaris* was also included into the several Slovak reviews (HEJNÝ & HUSÁK 1978, OŤAHEĽOVÁ in MUCINA & MAGLOCKÝ 1985).

Utricularietum neglectae T. MÜLLER et GÖRS 1960 (Tab. 4, rels 53–55)

The stands with the dominance of *Utricularia australis* are rare in the studied area. By now, the *Utricularietum neglectae* community has been found only in a fishpond and in a river oxbow near Zelené and Vyškovce nad Ipľom villages, respectively. This community grows in the shallow stagnating water with the maximum depth of 80 cm. In a deeper water (e.g. fishpond near Zelené village), it grows only in the littoral zone. The dominant species, *Utricularia australis*, also grows as a synusia in the reed bed communities of the alliance *Phragmition communis* KOCH 1926. The stands of *Utricularia australis* are submerged, but the natant layer is always present. This layer is mainly composed of *Lemna minor*, but *Spirodella polyrhiza* is relatively frequent as well.

Utricularietum neglectae is not mentioned in the review of the aquatic vegetation of Slovakia (OŤAHEĽOVÁ 1995a). HEJNÝ & HUSÁK (1978) and OŤAHEĽOVÁ (in MUCINA & MAGLOCKÝ 1985) classified this community as subass. *utricularietosum neglectae* SOÓ 1971 within ass. *Lemno-Utricularietum vulgaris*. The relevés of this community from Borská nížina lowland were published by ZLINSKÁ & al. (1997) and MALOVCOVÁ-STANÍKOVÁ (2000) as *Lemno-Utricularietum vulgaris*. In the former paper, *Utricularia australis* dominates in three relevés, but both species of the aggregate taxon, *Utricularia vulgaris* agg., are present in other two ones. On the other hand, only *U. australis* is present in the relevé from Jasenácky fishpond (MALOVCOVÁ-STANÍKOVÁ 2000).

From the catchment area of Ipeľ river, the ass. *Utricularietum neglectae* was previously mentioned by HRIVNÁK (1997) without detailed data about its regional distribution. Later, the occurrence of this community was reported by OŤAHEĽOVÁ & al. (1998) from a fishpond and sand ditch near Zelené and Tešmak villages, respectively – however, without the corresponding phytosociological relevés. The unpublished relevé with the both species of the aggregate taxon (*Utricularia australis*, *U. vulgaris*) was made on the locality Lion near the Čičov village (OŤAHEĽOVÁ ined.). In Slovakia, *Utricularia australis* is considered an insufficiently mapped species with the centre of occurrence in Panonia (ŠÍPOŠOVÁ & OŤAHEĽOVÁ 1997).

From the neighbouring countries, *Utricularietum neglectae* is known from Austria (SCHRATT 1993a) and Czech Republic (HEJNÝ 1995). On the other hand, this community has not been mentioned from Hungary (BORHIDI 1996, BORHIDI &

SÁNTA 1999), Ukraine (SOLOMACHA 1995) and Poland (TOMASZEWICZ 1979, MATUSZKIEWICZ 1982).

Hydrocharitetum morsus-ranae VAN LANGENDONCK 1935

KOVÁCS & MÁTHÉ (1967) found this community between Drégelypalánk a Ipolyvece villages in Hungary in the sixties. Since that time, *Hydrocharitetum morsus-ranae* community has not been detected in the catchment area of Ipeľ river. Therefore, it is considered an extremely rare and endangered community in this area.

In Slovakia, *Hydrocharitetum morsus-ranae* occurs in Podunajská nížina lowland and Borská nížina lowlands (OŤAHEĽOVÁ 1980, 1995a; OŤAHEĽOVÁ & al. 1994). On the territory of Hungary, this association occupies the localities with stagnating and slowly flowing water around the large rivers – Danube, Tisza and Dráva (BORHIDI & SÁNTA 1999).

Syntaxonomical note: In the review of the aquatic vegetation of Slovakia, OŤAHEĽOVÁ (1995a) presented two subassociations of *Hydrocharito-Stratiotetum* KRUSEMAN et VLIEGER 1937: *typicum* V. KÁRPÁTI 1963 and *hydrocharitetosum* SOÓ 1964. The name of this association was used, above all, because of the absence of the data, which would be necessary for an eventual separation of two associations – *Hydrocharitetum morsus-ranae* and *Stratiotetum aloidis* NOWIŃSKI 1930. SCHRATT (1993a) mentioned the name *Hydrocharito-Stratiotetum* only as a synomym of the former two plant communities (pro parte). In the review of the plant communities of Hungary, BORHIDI (1996) presented two separate plant communities as well.

Ceratophylletum demersi HILD 1956 (Tab. 5, rels 56–71)

The stands of *Ceratophylletum demersi* occur frequently in the catchment area of Ipeľ river. They grow in river oxbows, sand or gravel ditches, sluice ways, seepage canals or eventually, in artificial water courses of rivers or creeks. The stands of this community were found on the localities with the stagnating or (rarely) slowly flowing water, which was 20–100 cm deep. The water level is usually very fluctuating during the vegetation period. The results of analyses demonstrated the moderate alkaline reaction of water (pH 7.35 – tab. 5, rel. 66). On the bed, the gravely or sandy sediments were overlaid by a layer of organic materials with a changing thickness. The dominating submerged pleustophyte, *Ceratophyllum demersum*, covers usually the entire water level. From among the other species, only the natant ones occur with a higher frequency. An occasional increased shading by the individuals of the natant layer may therefore cause the decrease of the frequency of *Ceratophyllum demersum* as a consequence of its insufficient sunlight illumination.

The stands of ass. *Ceratophylletum demersi* are very poor in species. Besides *Ceratophyllum demersum*, only one or two additional species are present in some cases. However, the monodominant stands were observed only relatively rarely. The floristic variability of this community is in a close relationship with the ecological conditions of biotop. Based on the achieved phytosociolgical material

from the catchment area of Ipeľ river, the following floristical and ecological variants were defined:

– the variant with the presence of submerged species of mesotrophic biotopes (tab. 5, rel 56),

– the variant with a higher frequency of the natant species, *Lemna minor* (tab. 5, rels 57–59),

– the variant with the presence of *Myriophyllum spicatum* and *Potamogeton natans*, occurring in the ditches, which had been created after the mining of gravel (tab. 5, rels 69–71).

In addition, the last group of phytosociological relevés represents the stands, where *Ceratophyllum demersum* is dominating and the occurrence of other species is more or less occasional (tab. 5, rels 60–68). In a part of relevés, a more frequent occurrence of *Lemna minor* and *Spirodella polyrhiza* is presented (tab. 5, 60–62).

From the catchment area of Ipeľ river, the ass. *Ceratophylletum demersi* was previously mentioned by HRIVNÁK & al. (1997), HRIVNÁK (1998b), OŤAHEĽOVÁ & al. (1998), HRIVNÁK (1999b) and HRIVNÁK & al. (2001b). The data about the occurrence of this community in Slovakia and Hungary were compiled by SOÓ (1957) and OŤAHEĽOVÁ (1980, 1995a). In a review of Hungarian plant communities, the ass. *Ceratophylletum demersi* was mentioned by BORHIDI (1996) and BORHIDI & SÁNTA (1999).

Ceratophylletum submersi VON SOÓ 1928 (Tab. 6, rels 72–77)

The stands of this community grow in the stagnating, eutrophic, shallow and medium deep water, mainly in the central part of the catchment area of Ipeľ river. It occurs in artificial or (less frequently) natural, warm biotopes with the fluctuating water level. *Ceratophyllum submersum* is dominant, whereas the other submerged pleustophytes occur only rarely. The most favourable period for the development of the community is late summer. On the locality Biel in Východoslovenská nížina lowland, the results of the soil analysis demonstrated the high content of salts (OŤAHEĽOVÁ 1995a). HRIVNÁK & UJHÁZY (1998) detected a higher content of nitrogen in the soil samples from the vicinity of Lieskovec village in Zvolenská kotlina basin. In both localities, the stands of *Ceratophylletum submersi* grow on the soils with a moderate alkaline or neutral reaction (OŤAHEĽOVÁ 1995a, HRIVNÁK & UJHÁZY 1998). In table 6, three different variants of the community are presented:

– the variant with a considerable occurrence of natant species (mainly *Lemna minor*) and other lemnids (tab. 6, rels 72–74),

– the variant with the presence of the submerged species *Ceratophyllum demersum* and *Myriophyllum spicatum* (tab. 6, rels 75–76),

– the variant with a higher frequency of *Potamogeton pectinatus* (tab. 6, rel 77).

From Slovakia, *Ceratophylletum submersi* was originally mentioned, above all, from Východoslovenská nížina lowland (HEJNÝ 1960; OŤAHEĽOVÁ & HUSÁK 1982, 1985). Later, the stands of this community were also found in Lučenská kotlina

basin and Ipeľská kotlina basin (HRIVNÁK 1998b, 1999b; HRIVNÁK & al. 2001b; OŤAHEĽOVÁ & al. 1998). SOÓ (1957), BORHIDI (1996) and BORHIDI & SÁNTA (1999) included *Ceratophylletum submersi* into the reviews of the plant communities of Hungary.

***Nitelletum mucronatae* TOMASZEWICZ ex HRIVNÁK et al. 2001 (Tab. 7, rel. 81)**

The occurrence of this community near the Zelené village was published by HRIVNÁK & al. (2001a). This was the first information about the occurrence of a macroscopic alga, *Nitella mucronata*, and a community with its dominance on the territory of Slovakia. In the mentioned paper, the synecological and synchorological notes *Nitelletum mucronatae* in Slovakia and Europe are presented as well.

***Charetum vulgaris* CORILLION 1957 (Tab. 7, rels 78–80)**

This community forms submerged stands, that are poor in species. They grow in the stagnating and slowly flowing, eutrophic, shallow and medium deep water bodies. Within the family *Characeae*, KRAUSE (1997) regards *Chara foetida* as the most resistant species to euthrophication.

In the catchment area of Ipeľ river, this community occurs only very rarely. The species appears periodically on various localities, where, under the favourable conditions, it forms the contiguous stands.

There is only one reference (HRIVNÁK 1997) supporting the presence of *Charetum vulgaris* in the catchment area of Ipeľ river. From among the other regions of Slovakia, a single phytosociological relevé has been so far published from Podunnajská rovina lowland (OŤAHEĽOVÁ & HUSÁK 1992). Besides this relevé, two unpublished ones from Podunajská rovina lowland and Borská nížina lowland (Oťaheľová ined.) and two relevés from the Lučenská kotlina basin (tab. 7, rels 78–79) were included into the synoptic table of *Charetum vulgaris* from Slovakia (OŤAHEĽOVÁ 2001).

Conclusion

During the period of 1993–2000, eleven plant communities of the class *Lemnetea* and two of the class *Charetea fragilis* were documented in the catchment area of Ipeľ river. The occurrence of *Hydrocharitetum morsus-ranae* community, which had been mentioned from the vicinity of Drégelypalánk village in Hungary (KOVÁCS & MÁTHÉ 1967), was not confirmed at this time. Twelve plant communities were identified in the Slovak part of the catchment area of Ipeľ river, but only five of them in the Hungarian part (*Lemnetum trisulcae*, *Lemnetum minoris*, *Lemno minoris-Spirodelletum polyrhizae*, *Ceratophylletum demersi* and *C. submersi*). While the Hungarian part of the catchment has so far been investigated only occasionally, the number of the reliably documented plant communities from the Hungarian side is perhaps still not definite. For the territory of Slovakia, the finding of *Ricciocarpetum natantis* (HRIVNÁK 1998a) seems to be the most considerable. Up to the present time, this plant community was

mentioned only from Východoslovenská rovina lowland (OŤAHEĽOVÁ & HUSÁK 1982). The finding of *Utricularietum neglectae* is appreciable as well, because this community was not sufficiently documented by phytosociological relevés from Slovakia. Besides that, the illustration of *Lemno minoris-Spirodelletum polyrhizae* (HRIVNÁK & al. 2001b) by phytosociological relevés seems to be important for the territory of Hungary.

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Tab. 1. *Lemnetum minoris*

*	Number of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	C	Ca
	Number of species	2	1	2	4	1	3	2	6	5	2	2	2	3	2	4	5	2	2	2	3	7	8	4	5		
LE	*Lemna minor*	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**4**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**4**	**5**	**5**	100	100
	Diagnostic species of the floristical and ecological variants																										
PM	*Typha latifolia*	.	.	.	.	.	+	+	+	A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	17	-
PM	*Carex riparia*	.	.	.	.	.	A	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8.3	-
LE	*Lemna gibba*	.	.	.	.	.	.	.	.	.	B	1	A	.	.	.	.	.	.	.	.	.	.	.	.	13	11
MA	*Scirpus sylvaticus*	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	4.2	-
MA	*Equisetum palustre*	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	4.2	-
PM	*Phallandrium aquaticum*	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	r	.	+	.	.	.	.	.	.	17	-
BI	*Ranunculus sceleratus*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	4.2	-
O	*Solanum dulcamara*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	4.2	-
PO	*Potamogeton natans*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	4.2	-
O	*Persicaria amphibia*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	4.2	-
PM	*Iris pseudacorus*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	r	.	.	.	.	.	.	.	8.3	-
LE	*Lemna trisulca*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	B	A	B	.	.	.	.	13	44
LE	*Ceratophyllum demersum*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	A	.	.	.	.	.	4.2	33
PM	*Alisma plantago-aqutica*	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	A	.	+	.	13	-
BI	*Persicaria hydropiper*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	M	.	.	.	4.2	-
PM	*Lycopus europaeus*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	8.3	-
BI	*Bidens frondosa*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	r	.	.	8.3	-
O	*Echinochloa crus-galli*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	4.2	-
MA	*Elytrigia repens*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	4.2	-
BI	*Rumex crispus*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	4.2	-
	Other species																										
PM	*Butomus umbellatus*	.	.	.	A	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8.3	-
PM	*Glyceria fluitans*	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	8.3	-
PM	*Sparganium erectum*	.	.	.	.	.	.	.	A	.	.	.	.	.	.	.	.	.	.	.	.	r	.	r	.	13	-
PM	*Lythrum salicaria*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	+	.	.	8.3	-

C – constancy, Ca – constancy according to OŤAHEĽOVÁ (1995a)

* BI – *Bidentetea tripartitae*, LE – *Lemnetea*, MA – *Molinio-Arrhenatheretea*, O – Others, PM – *Phragmito-Magnocaricetea*, PO – *Potametea*

Tab. 2. *Lemno minoris-Spirodelletum polyrhizae*

*	Number of relevé	2 5	2 6	2 7	2 8	2 9	3 0	3 1	3 2	3 3	3 4	3 5	3 6	C	Ca
	Number of species	2	3	5	6	4	5	3	3	5	6	3	4		
	Dominant species														
LE	*Spirodela polyrhiza*	**5**	**4**	**4**	**4**	**3**	**A**	**B**	**1**	**3**	**3**	**3**	**+**	100	94
LE	*Lemna minor*	**1**	**B**	**A**	**B**	**4**	**5**	**4**	**5**	**4**	**4**	**5**	**4**	100	100
	Diagnostic species of the floristical and ecological variants														
LE	*Lemna trisulca*	.	3	4	3	B	.	.	.	1	.	.	.	42	41
PO	*Persicaria amphibia* f. *natans*	.	.	+	r	.	.	.	.	.	+	.	.	25	-
PM	*Phragmites australis*	.	.	.	.	.	r	.	.	.	1	.	.	17	-
PM	*Sparganium emersum*	.	.	.	.	.	.	r	.	.	.	.	.	8	-
PM	*Typha latifolia*	.	.	.	.	.	.	.	r	.	.	.	.	8	-
PO	*Batrachium trichophyllum*	.	.	.	.	.	.	.	.	+	.	.	.	8	2
LE	*Ceratophyllum demersum*	.	.	.	.	.	.	.	.	+	B	A	.	25	29
LE	*Lemna gibba*	.	.	.	.	.	.	.	.	.	.	.	B	8	11
	Other species														
PM	*Glyceria maxima*	.	.	.	.	.	.	.	.	.	+	.	+	17	2

C – constancy, Ca – constancy according to OŤAHEĽOVÁ (1995a)
* LE – *Lemnetea*, PM – *Phragmito-Magnocaricetea*, PO – *Potametea*

Tab. 3. Other communities from the alliance *Lemnion minoris*

*	Number of relevé	3	3	3	4	C	Ca	4	4	4	4	C	Ca	4	4	4	C	Ca
		7	8	9	0			1	2	3	4			5	6	7		
	Number of species	5	4	5	8			2	4	8	3			6	3	8		
	Dominant and diagnostic species of the floristical and ecological variants																	
LE	*Lemna trisulca*	**5**	**5**	**5**	**3**	4	100	.	.	.	.	-	16	.	.	.	-	57
PM	*Typha latifolia*	1	A	r	.	3	-	.	.	1	.	1	-	.	.	.	-	-
PO	*Potamogeton trichoides*	.	.	1	.	1	-	.	.	.	.	-	-	.	.	.	-	-
PM	*Sparganium emersum*	.	.	+	.	1	-	.	.	.	.	-	-	.	.	.	-	-
PM	*Rorippa amphibia*	.	.	.	A	1	22	.	.	.	.	-	-	.	.	.	-	22
O	*Persicaria amphibia*	.	.	.	1	1	11	.	.	.	.	-	16	1	.	.	-	11
PM	*Phellandrium aquaticum*	.	.	.	+	1	11	.	.	.	.	-	16	r	.	.	-	11
LE	*Hydrocharis morsus-ranae*	.	.	.	r	1	44	.	.	.	.	-	-	.	.	.	-	44
PO	*Batrachium circinatum*	.	.	.	1	1	-	.	.	.	.	-	-	.	.	.	-	-
LE	*Lemna gibba*	.	.	.	.	-	-	**4**	**5**	**5**	**4**	4	100	.	.	.	-	-
PM	*Alisma plantago-aquatica*	.	.	+	.	1	-	.	+	.	.	1	-	.	.	.	-	-
PM	*Rumex maritimus*	.	.	.	+	1	-	.	+	.	.	1	-	.	.	.	-	-
BI	*Bidens cernuus*	.	.	.	.	-	-	.	.	1	.	1	-	.	.	.	-	-
PM	*Veronica anagallis-aqautica*	.	.	.	.	-	-	.	.	+	.	1	-	.	.	.	-	-
BI	*Persicaria lapathifolia*	.	.	.	.	-	-	.	.	r	.	1	-	.	.	.	-	-
O	*Juncus articulatus*	.	.	.	.	-	-	.	.	+	.	1	-	.	.	.	-	-
MA	*Agrostis stolonifera*	.	.	.	.	-	-	.	.	1	+	2	-	.	.	.	-	-
LE	*Ricciocarpos natans*	.	.	.	.	-	11	.	.	.	.	-	-	**5**	.	.	-	11
LE	*Riccia fluitans*	.	.	.	.	-	11	.	.	.	.	-	-	.	**5**	**5**	2	100
	Other species																	-
LE	*Lemna minor*	3	A	.	.	2	77	B	.	A	3	3	75	3	A	1	2	77
BI	*Bidens frondosa*	r	.	.	.	1	-	.	.	.	.	-	-	.	.	+	1	-
LE	*Spirodela polyrhiza*	.	.	.	1	1	44	.	.	.	.	-	25	.	+	+	2	44
PM	*Glyceria maxima*	.	.	.	.	-	11	.	+	.	.	1	-	r	.	A	1	11

C – constancy, Ca – constancy according to OŤAHEĽOVÁ (1995a)

* BI – *Bidentetea tripartitae*, LE – *Lemnetea*, MA – *Molinio-Arrhenatheretea*, O – Others, PM – *Phragmito-Magnocaricetea*, PO – *Potametea*

Tab. 4. Plant communities of *Utricularion vulgaris*

*	Number of relevé	4	4	5	5	5	C	Ca	5	5	5	C
		8	9	0	1	2			3	4	5	
	Number of species	11	5	5	8	8			7	3	10	
	Dominant and diagnostic species of the floristical and ecological variants											
LE	*Lemna minor*	**3**	**B**	**3**	**4**	**3**	100	66	**4**	**A**	**+**	3
LE	*Utricularia vulgaris* agg.	**4**	**5**	**3**	**+**	**B**	100	100	.	.	.	-
LE	*Ceratophyllum demersum*	A	1	.	.	.	40	8	.	.	.	-
LE	*Callitriche palustris* agg.	B	.	.	.	.	20	-	.	.	.	-
PM	*Typha latifolia*	1	.	.	.	.	20	-	.	.	.	-
PM	*Lythrum salicaria*	+	.	.	.	.	20	-	.	.	.	-
O	*Juncus effusus*	+	.	.	.	.	20	-	.	.	.	-
PM	*Lycopus europaeus*	+	.	.	.	.	20	-	.	.	.	-
PM	*Stachys palustris*	r	.	.	.	.	20	-	.	.	.	-
LE	*Lemna trisulca*	.	1	.	3	4	60	75	.	.	.	-
PO	*Persicaria amphibia* f. *natans*	.	.	.	+	+	40	8	.	.	.	-
PM	*Sparganium erectum*	.	.	.	+	+	40	-	.	.	.	-
PM	*Phellandrium aquaticum*	.	.	.	+	+	40	-	.	.	.	-
LE	*Utricularia australis*	.	.	.	.	.	-	-	**5**	**5**	**5**	3
PM	*Iris pseudacorus*	.	.	r	.	.	20	-	r	.	.	1
PM	*Glyceria maxima*	.	.	+	.	.	20	16	1	.	.	1
LE	*Riccia fluitans*	1	.	.	A	A	60	16	.	3	B	2
	Others											
BI	*Persicaria hydropiper*	r	.	.	.	.	20	-	.	.	+	1
LE	*Spirodela polyrhiza*	.	+	.	.	.	20	-	B	.	+	2
PO	*Batrachium trichophyllum*	.	.	.	1	.	20	-	.	.	+	1

C – constancy, Ca – constancy according to OŤAHEĽOVÁ (1995a)

* BI – *Bidentetea tripartitae*, LE – *Lemnetea*, O – Others, PM – *Phragmito-Magnocaricetea*, PO – *Potametea*

Tab. 5. ***Ceratophylletum demersi***

*	Number of relevé	5	5	5	5	6	6	6	6	6	6	6	6	6	7	7	C	Ca
		6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1		
	Number of species	9	7	2	3	4	4	2	3	4	1	2	4	2	2	3	6		
	Dominant species																		
LE	*Ceratophyllum demersum*	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**4**	**5**	100	100
	Diagnostic species of the floristical and ecological variants																		
LE	*Utricularia vulgaris*	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6	4
CH	*Chara fragilis*	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6	-
LE	*Lemna minor*	.	3	3	B	4	B	1	+	+	.	.	.	.	.	.	.	50	52
LE	*Spirodela polyrhiza*	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	12	42
LE	*Lemna trisulca*	3	.	.	.	1	.	.	.	.	.	.	+	.	.	.	.	19	19
PO	*Potamogeton crispus*	1	.	.	.	.	+	.	1	.	.	.	B	.	.	.	.	25	19
PM	*Sparganium erectum*	.	.	.	.	.	.	.	.	+	.	.	r	+	.	.	.	19	-
PO	*Myriophyllum spicatum*	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	A	19	33
PO	*Potamogeton natans*	+	.	.	.	.	.	.	.	.	.	+	.	.	.	4	+	25	-
	Others species																		
PM	*Sagittaria sagittifolia*	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	12	-
PM	*Butomus umbellatus*	+	+	.	.	.	.	.	.	r	.	.	.	.	.	.	.	19	-
PO	*Potamogeton trichoides*	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	12	-
PO	*Potamogeton pectinatus*	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	+	12	28

C – constancy, Ca – constancy according to OŤAHEĽOVÁ (1995a)
* CH – *Charetea fragilis*, LE – *Lemnetea*, PM – *Phragmito-Magnocaricetea*, PO – *Potametea*

Tab. 6. *Ceratophylletum submersi*

*	Number of relevé	7	7	7	7	7	7	C	Ca
		2	3	4	5	6	7		
	Number of species	5	5	2	4	2	7		
	Dominant species								
LE	*Ceratophyllum submersum*	**5**	**5**	**5**	**5**	**5**	**5**	100	3
	Diagnostic species of the floristical and ecological variants								
LE	*Lemna minor*	3	B	B	+	.	+	83	3
PO	*Persicaria amphibia* f. *natans*	+	.	.	.	.	.	17	-
PM	*Sparganium erectum*	1	+	.	.	.	.	33	-
LE	*Lemna trisulca*	+	1	.	.	.	.	33	1
LE	*Utricularia vulgaris* agg.	.	1	.	.	.	.	17	-
LE	*Ceratophyllum demersum*	.	.	.	+	.	.	17	-
PO	*Myriophyllum spicatum*	.	.	.	+	+	.	33	-
PO	*Potamogeton pectinatus*	.	.	.	.	.	B	17	-
PO	*Batrachium trichophyllum*	.	.	.	.	.	+	17	-

C – constancy, Ca – constancy according to OŤAHEĽOVÁ (1995a)
* LE – *Lemnetea*, PM – *Phragmito-Magnocaricetea*, PO – *Potametea*

Tab. 7. Plant communities of the class *Charetea fragilis*

*	Number of relevé	7	7	8	C	Ca	8
		8	9	0			1
	Number of species	4	2	12			3
	Dominant species						
CHA	*Chara foetida*	**5**	**5**	**5**	3	100	.
CHA	*Nitella mucronata*	.	.	.	-	-	**5**
	Other species						
LE	*Lemna minor*	1	.	+	2	40	.
LE	*Ceratophyllum demersum*	.	.	1	1	-	+

C – constancy, Ca – constancy according to OŤAHEĽOVÁ (2001)
* LE – *Lemnetea*, CH – *Charetea fragilis*

Tab. 8: Physico-chemical characterics of the soil

No.	DM	clay	dust	sand	PH	C_{ox}	N_T	P_M	K_M	Ca_M	Mg_M
1.	94.62	15.2	32.9	51.9	5.50	11.9	0.89	28.3	60.1	2415	521
2.	97.63	3.6	22.9	73.5	7.03	4.08	0.40	42.1	53.2	2310	279

Legend:
No. 1: *Ricciocarpetum natantis* (tab. 3, rel. 45), No. 2: *Lemnetum minoris* (tab. 1, rel. 8)
Dry matter (DM) – expressed as a percentage of 2 g sample; clay, dust, sand, C_{ox}, N_T – % of DM and P_M, K_M, Ca_M and Mg_M – $mg.kg^{-1}$ of DM.

Appendix 1: Species in one relevé only

Note: Only the taxa which were not classed as the diagnostic species of the floristical and ecological variants are mentioned.

Legend:

BI – *Bidentetea tripartiti* R. Tx. et al. in R. Tx. ex von Rochow 1951, CH – *Charetea fragilis*, LE – *Lemnetea*, MO – *Molinio-Arrhenatheretea* R. Tx. 1937 em. R. Tx. 1970, PM – *Phragmito-Magnocaricetea*, PO – *Potametea* R. Tx. et Preising 1942, O – Others.

Tab. 1: *Lemnetum minoris*

Glyceria maxima (PM) 3: r, *Hottonia palustris* (PO) 1: r, *Juncus effusus* (O) relevé 9: +, *Potamogeton nodosus* (PO) 8: 1, *P. trichoides* (PO) 9: A, *Riccia fluitans* (LE) 8: 4, *Rorippa amphibia* (PM) 21: +, *Rumex maritimus* (PM) 21: r.

Tab. 2: *Lemno minoris-Sprirodeletum polyrhizae*

Algae fil. (O) 32: A, *Bidens cernuus* (BI) 30: r, *B. frondosa* (BI) 30: r, *Butomus umbellatus* (PM) 27: +, *Phellandrium aquaticum* (PM) 28:+, *Utricularia vulgaris* agg. (LE) 28:+.

Tab. 3: Other plant communities of *Lemnion minoris* (*Lemnetum trisulcae* – 37–40, *Lemnetum gibbae* – 41–44, *Ricciocarpetum natantis* – 45, *Riccietum fluitantis* – 46–47)

Algae fil. (O) 42: 1, *Juncus effusus* (O) 38: r, *Lycopus europaeus* (PM) 47: +, *Lysimachia vulgaris* (PM) 47: 1, *Lythrum salicaria* (PM) 46: +, *Negundo aceroides* (O) 47: +, *Sparganium erectum* (PM) 37: +.

Tab. 4: Plant communities of *Utricularion vulgaris* (*Lemno-Utricularietum vulgaris* – 48–52, *Utricularietum neglectae* – 53–55)

Agrostis stolonifera (MA) 55: +, *Bidens frondosa* (BI) 55: +, *Carex riparia* (PM) 50: 1, *Phalaroides arundinacea* (PM) 53: +, *Rorippa amphibia* (PM) 52: +, *Solanum dulcamara* (O) 53: +, *Trapa natans* (PO) 55: A, *Typha angustifolia* (PM) 55: +.

Tab. 5: *Ceratophylletum demersi*

Algae fil. (O) 63: 3, *Alisma plantago-aquatica* (PM) 59: r, *Callitriche palustris* agg. (PO) 57: +, *Rorippa amphibia* (PM) 57: +, *Typha latifolia* (PM) 71: +.

Tab. 6: *Ceratophylletum submersi*

Glyceria fluitans (PM) 77: +, *Lythrum salicaria* (PM) 77: +, *Typha latifolia* (PM) 77: +.

Tab. 7: *Charetum vulgaris*

Alisma lanceolatum (PM) 80: +, *A. plantago-aquatica* (PM) 80: +, *Butomus umbellatus* (PM) 80: 1, *Eleocharis palustris* (PM) 80: +, *Glyceria maxima* (PM) 78: r, *Lythrum salicaria* (PM) 80: +, *Phragmites australis* (PM) 79: +, *Potamogeton crispus* (PO) 78: +, *P. pusillus* (PO) 80: +, *Sparganium erectum* (PM) 80: 1, *Typha latifolia* (PM) 81: r, *Veronica anagallis-aquatica* (PM) 80: +.

Appendix 2: Localities of relevés

Note: for the published data, only the country, orographical unit, locality and the cited paper where the relevé was published are presented. For other relevés, the header data are listed in the following order:

country (SK – Slovakia, HU – Hungary); orographical unit; town or village; locality and habitat; altitude (m); relevé area (m^2); total cover (%); depth of water level (cm); flow classes (S – stagnant, LF – low flow < 30 $cm.s^{-1}$, MF – medium flow 30–70 $cm.s^{-1}$, HF – high flow > 70 $cm.s^{-1}$); sediment classes (R – rock, A – artificial material, S – sand or gravel, F – fine inorganic material); date; author(s) of relevé (PB – Pavol Baláž, AC – Alžbeta Cvachová, RH – Richard Hrivnák, HO – Helena Oťaheľová, MV – Milan Valachovič,); field number.

Tab. 1

1. SK; Lučenská kotlina basin (LK); Boľkovce village, SW, river oxbow; HRIVNÁK (1998b: tab. 1, rel. 2).
2. SK; LK; Veľká nad Ipľom village, NE, canal near gravel pit; 164; 30; 100; 5–60; S; S; 11. 8. 1997; RH; 174.
3. SK; Ipeľská kotlina basin (IK); Slovenské Kľačany village (part Jazero), ditch with water; 242; 24; 100; 45–60; S; F; 19. 7. 1999; RH; 660.
4. SK; LK; Boľkovce, NE, river oxbow; 181; 25; 100; 5–25; S; F; 7. 9. 1999; RH; 799.
5. SK; Ipeľská pahorkatinna Mts. (IP); Vyškovce nad Ipľom village, NNE, canal; 119; 50; 100; 80–100; S; F; 3. 9. 1999; RH; 783.

6. SK; LK; Veľké Dálovce village, canal in Nature Reserve (NR) Dálovský močiar; HRIVNÁK (1999: 79).
7. SK; IK; Bušince village, NNE, ditch with stagnating water; HRIVNÁK & al. (2001b: tab. 1, rel. 1).
8. SK; LK; Nitra nad Ipľom village, N, river oxbow; 181; 24; 100; 10–30; S; F; 7. 9. 1999; RH; 797.
9. SK; LK; Veľká nad Ipľom village, S, inundation area of Ipeľ river, canal;165; 12; 100; 30–65; S; F; 10. 9. 1999; RH; 805.
10. IK; IK; Tešmak village, SE, ditch near village and Veľké jazierko marsh; 125; 10.5; 100; 10; S; S with layer of F; 15. 10. 1996; AC, RH; -.
11. SK; LK; Boľkovce – Osada village, terrain depression near the road from Lučenec town to Boľkovce village; HRIVNÁK (1998b: tab. 1, rel. 3).
12. HU; -; Litke village, opposite the railway station, inundation area of Ipeľ river, canal; 160; 6; 100; 5–20; S; F; 14. 6. 2000; RH; 902.
13. SK; Revúcka vrchovina Mts. (RV); Divín, SE, canal near the Ružiná water reservoir; 255; 15; 100; 20–35; S; -; 11. 9. 1998; RH;508.
14. SK; IK; Ipeľské Predmostie, E, ditch; 127; 16; 100; 40–100; S; F; 23. 6. 1997; RH; 88.
15. SK; LK; Nitra nad Ipľom, N, river oxbow; HRIVNÁK (1999: tab. 1, rel. 1).
16. SK; Krupinská planina Mts. (KP); Cerovo village, NNW, Veľký Šiaš fishpond; 420; 25;100; 35–50; S; -; 12. 8. 1999; RH; 747.
17. SK; IP; Vyškovce nad Ipľom village, Ipeľské Piesky, sand pit; 118; 25; 100; 80–120; S; S; 3. 9. 1999; RH; 787.
18. SK; LK; Kalinovo village, pool at the park; 201; 25; 100; 10–25; S; F; 8. 6. 1998; RH; 300.
19. HU; -; Piliny village, NE, stream without name; 190; 17.5;100; 15; SF; F; 5. 9. 1996; RH; -.
20. SK; IP; Šahy, seepage canal; 125; 200; 100; 20–45; S; F; 15. 10. 1996; AC, RH; -.
21. SK; LK; Rapovce, N, terrain depression near railway; 171; 25; 90; 30–45; S; F; 11. 8. 1999; RH; 726.
22. SK; LK; Malé Dálovce village, NW, N from Frenčok settlement, terrain depression in the inundation area of Dálovský potok stream; 190; 12.5; 85; 5–30; S; F; 4. 5. 2000; RH; 824.
23. SK; LK; Kalinovo vilage, part Hrabovo, river oxbow; 199; 18; 100; 15–60; S; F; 17. 9. 1999; RH; 811.
24. SK; LK; Nitra nad Ipľom village, E, gravel pit; 180; 24; 100; 5–10; S; S with layer of F; 7. 9. 1999; RH; 796.

Tab. 2

25. HU; -; Ludányhalázsi village, N, river oxbow near the railway bridge; HRIVNÁK & al. (2001b: tab. 1, rel. 3).
26. SK; IK; Ipeľské Predmostie village, NR Ipeľské hony marsh; 130; 18; 95; 25–40; S; F; 15. 10. 1996; AC, RH; -.
27. SK; IK; Ipeľské Predmostie village, NR Ipeľské hony marsh, SE margin; 130; 17.5; 100; 25–40; S; F; 23. 6. 1997; RH; 78.
28. SK; IK; Kováčovce village, marsh on SW margin of village, terrain depression; HRIVNÁK & al. (2001b: tab. 1, rel. 2).
29. HU; -; Szécsény town, W, terrain depression; HRIVNÁK & al. (2001b: tab. 1, rel. 4).
30. SK; LK; Kalinovo village, part Hrabovo, canal; 197; 25; 100; 30–60; S; F; 14. 9. 1998; RH; 513.
31. SK; LK; Holiša village; river oxbow near the water gate in Ipeľ river; 177; 25; 100; 20–40; S; F; 10. 8. 1998; 450.
32. SK; LK; Pinciná village, WNW, river oxbow; 188; 25; 100; 10–30; S; S with F layer; 10. 8. 2000; RH; 940.
33. SK; IK; Kováčovce village, marsh on SW margin of village, canal; HRIVNÁK & al. (2001b: tab. 1, rel. 5).
34. HU; -; Hugyag village, W, river oxbow; HRIVNÁK & al. (2001b: tab. 1, rel. 6).
35. HU; -; Ludányhalázsi village, part Halázsi, W, river oxbow; HRIVNÁK & al. (2001b: tab. 1, rel. 7).
36. SK; LK; Rapovce village, N, canal; 169; 12; 100; 30–45; S; F; 11. 8. 1998; RH; 728.

Tab. 3

37. HU; -; between Litke and Ipolytarnóc villages, ditch in the inundation area of Ipeľ river; 162; 9; 100; 30–70; S; -; 14. 6. 2000; RH; 904.
38. SK; LK; Veľká nad Ipľom village, S, canal; 165; 25; 100; 30–80; S; F; 10. 9. 1999; RH; 808.

39. SK; LK; Veľká nad Ipľom village, S, canal in the inundation area of Ipeľ river; 164; 7.5; 100; 30–110; S; -; 10. 9. 1999; RH; 806.
40. SK; IK; Ipeľské Predmostie village, NR Ipeľské hony marsh; 130; 16; 65; 20–30; S; -; 13. 5. 1993; AC, RH; -.
41. SK; IK; Tešmak village, Veľké jazierko pool; OŤAHEĽOVÁ & al. (1998: Fig. 3d).
42. SK; LK; Panické Dravce village, SE, canal; 169; 18; 100; 25–40; S; F; 11. 8. 1999; RH; 730.
43. SK; IK; Glabušovce village, water reservoir, outlet; 160; 7.5; 100; 8–15; S; A with a layer of F; 8. 9. 2000; RH; 956.
44. SK; LK; Mikušovce village, part Béter, terrain depression near railway; 183; 15; 100; 15–60; S; -; 5. 8. 1998; RH; 445.
45. SK; LK; Rapovce, terrain depression near railway; HRIVNÁK (1998a: 112).
46. SK; LK; Zelené village, fishpond; 222; 5; 100; 5–30; S; F; 21. 8. 1996; RH; -.
47. SK; LK; Pinciná village, WNW, river oxbow; 222; 9; 100; 0–1; S; F; 8. 10. 2000; RH; 939.

Tab. 4

Note:
Utricularia vulgaris s. str. (rels 49, 50, 51, 52), *Utricularia vulgaris* agg. (rel. 48).
48. SK; LK; Zelené village, N, sand pit; 224; 14; 100; 25–50; S; S; 29. 7. 1999; RH; 693.
49. SK; IK; Malý Kiarov village, NR Kiarovský močiar, canal in the southern part of NR; HRIVNÁK & al. (2001b: tab. 1, rel. 13).
50. SK; LK; Veľké Dálovce village, NR Dálovský močiar, canal; HRIVNÁK (1999a: 79).
51. SK; IK; Ipeľské Predmostie village, Cúdenica, river oxbow; 129; 16; 95; 15–25; S; F; 15. 10. 1996; AC, RH; -.
52. SK; IK; Ipeľské Predmostie village, Cúdenica, river oxbow; 129; 9; 100; 15–25; S; F; 24. 6. 1997; AC, RH; 97.
53. SK; IP; Vyškovce nad Ipľom village, river oxbow near road; 20; 100; 35–80; S; F; 3. 9. 1999; RH; 784.
54. SK; LK; Zelené village, fishpond; 222; 9; 100; 40–70; S; -; 21. 8. 1996; RH; -.
55. SK; LK; Zelené village, fishpond; 222; 7; 100; 7–40; S; -; 11. 11. 7. 1997; RH; 152.

Tab. 5

56. HU; -; Hugyag village, NE, river oxbow; Hrivnák & al. (2001b: tab. 1, rel. 10).
57. SK; IK; Ipeľské Predmostie village, NR Ipeľské hony, canal near the road Veľký Krtíš – Šahy; 128; 15; 100; 25–40; S; F; 23. 6. 1997; RH; 87.
58. SK; LK; Boľkovce village, river oxbow; 180; 16; 100; 40; S; F; 15. 8. 1996; RH; -.
59. SK; LK; Boľkovce village, river oxbow; HRIVNÁK (1998b: tab. 1, rel. 4).
60. HU; -; Szécsény town, NW, canal; HRIVNÁK & al. (2001b: tab. 1, rel. 9).
61. HU; -; Hugyag village, NE, river oxbow; Hrivnák & al. (2001b: tab. 1, rel. 8).
62. SK; LK; Halič village, pool at the park near castle, ENE part; 240; 25; 85; 20–70; S; F; 6. 9. 1997; RH; 205.
63. SK; LK; Kalonda village, SW, gravel pit; 164; 21; 95; 20–100;
S; -; 30. 7. 1998; RH, HO, MV.
64. SK; LK; Holiša village, seepage canal near gravel pit; 177; 12; 100; 30–40; SF; F; 10. 8. 1998; RH; 447.
65. SK; LK; Zelené village, N, gravel pit; 225; 60; 100; 20–40; S; -; 21. 8. 1996; RH; -.
66. SK; LK; Zelené village, N, gravel pit; 225; 25; 100; 60–80; S; -; 29. 7. 1999; RH; 692.
67. SK; LK; Rapovce village, NW, gravel pit; 169; 24.5; 100; 40–70; S; -; 11. 8. 1999; RH; 734.
68. SK; LK; Rapovce village, ditch near the road Rapovce–Lučenec; 171; 9; 100; 10–50; S; S with a layer of F; 24. 8. 1997; RH; 195.
69. SK; LK; Zelené village, N, gravel pit; 225; 5; 100; 15–25; S; -; 21. 8. 1996; RH; -.
70. SK; LK; Zelené village, N, gravel pit; 225; 2; 100; 5–25; S; -; 21. 8. 1996; RH; -.
71. SK; LK; Veľká nad Ipľom village, E, gravel pit; 165; 25; 100; 10–60; S; S; 11. 8. 1997; RH; 170.

Tab. 6

72. HU; -; Hugyag village, NE, Sovány rét, terrain depression; HRIVNÁK & al. (2001b: tab. 1, rel. 11).
73. SK; IK; Malý Kiarov village, NR Kiarovský močiar, canal in the southern part of NR; HRIVNÁK & al. (2001b: tab. 1, rel. 12).
74. SK; LK; Trebeľovce village, part of Lazy settlement, former gravel pit on the left bank of Ipeľ river; 175; 25; 100; 30–80; S; S; 17. 7. 1997; RH; 165.

75. SK; LK; Trebeľovce village, part of Lazy settlement, former gravel pit on the left bank of Ipeľ river; 175; 20; S; S; 15. 8. 1996; RH; -.
76. SK; LK; Trebeľovce village, part of Lazy settlement, ditch; 175; 25; 100; S; -; 50–100; 17. 7. 1997; RH; 166.
77. SK; LK; Boľkovce village, marsh on the NNW margin of village; HRIVNÁK (1998b: tab. 1, rel. 5).

Tab. 7

78. SK; LK; Ožďany village, E, canal of Maštínsky potok stream about 50 m below a water reservoir; 196; 6; 100; 5–20; LF; F; 26. 8. 1996; RH; -.
79. SK; LK; Podrečany village, S, sludge bed; 212; 36; 100; 50–100; S; -; 9. 6. 1997; RH; 40.
80. SK; LK; Veľké Dravce village, NE, canal of Šťavica stream about 100 m below water reservoir; 192; 21; 100; 1–10; LF; -; 14. 8. 1997; RH; 180.
81. SK; LK; Zelené village, the ditch with a water on the NW margin of fishpond; HRIVNÁK & al. (2001a: p. 14).

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