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# Plant communities of the class *Charetea* Fukarek ex Krausch 1964 in Ukraine: an overview

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**Abstract:** The paper presents the results of the first syntaxonomical survey of the submerged plant communities belonging to the class of *Charetea* Fukarek ex Krausch 1964 in Ukraine based on the interpretation of about 80 published and unpublished phytosociological relevés. Fourteen associations of two alliances and one order are characterized briefly. The diversity of charophyte communities in Ukraine is also described in brief. A preliminary prodromus of charophyte communities in Ukraine is given. Associations of *Charetum intermediae* (Corillion 1957) Fijałkowski 1960, *Charetum rudis* Dąmbska 1966, *Nitelletum gracilis* Corillion 1957 are indicated for Ukraine for the first time.

**Key words:** syntaxonomy, charophytes, *Charetea*, Ukraine

## 1. Introduction

Charophytes (*Charales*) are benthic submerged macrophytes growing in freshwater and brackish water bodies of different types where they could form dense meadows and play a significant role as primary producers. These macroscopic algae are usually considered sensitive indicators of good ecological quality of aquatic ecosystems (Coops 2002).

At present, 41 species of *Charales* are recorded in the flora of Ukraine based on herbarium collections, published and original data (Hollerbach & Palamar-Mordvintseva 1991; Palamar-Mordvintseva 1998; Palamar-Mordvintseva & Tsarenko 2004a, 2004b; Borysova 2005; Palamar-Mordvintseva *et al*. 2005; Palamar-Mordvintseva & Borysova 2006; Borysova & Honcharenko 2007, 2011; Borysova *et al*. 2008; Borysova & Tkachenko 2008; Borysova & Orlov 2009; Borysova & Chorna 2011). These include 25 species of the *Chara* L. genus, 10 species of the *Nitella* C. Agardh genus, 3 species of the *Tolypella* (A. Braun) A. Braun genus and one species of each of the *Lamprothamnium* J. Groves, *Lychnothamnus* (Rupr.) Leonh. emend. A. Braun, and *Nitellopsis* Hy genera. Over the last two decades, 31 species were found again (3 of them are indicated as new for Ukraine), but 10 species known only from literature sources. The most widespread species are: *Chara vulgaris* L. and *C. globularis* Thuill. The second most abundant species including *C. contraria* A. Braun ex Kütz., *Nitella flexilis* (L.) C. Agardh and *Nitellopsis obtusa* (Desv. in Loisel.) J. Groves occur less frequently. A number of species such as *C. aspera* Dethard. ex Willd., *C. delicatula* C. Agardh, *C. intermedia* A. Braun in A. Braun, Rabenh. & Stitzenb., *C. hispida* L., *Nitella mucronata* (A. Braun) Miq. in C.H. Hall and *Lamprothamnium papulosum* (Wallr.) J. Groves are rather common only in certain regions (the Western or Central Ukraine, Black Sea etc.). The remaining ones are rare to very rare and are included in the Red list of *Charales* of Ukraine (Palamar-Mordvintseva & Tsarenko 2004b), 9 of them – in the Red Data Book of Ukraine (Didukh 2009).

However, the syntaxonomy of charophyte plant communities has not been developed yet and, therefore, the plants are not cited in the national vegetation surveys (Solomakha 1996; Dubyna 2006). Also our knowledge on the distribution, environmental preferences and structure of charophyte communities in Ukraine is still incomplete (Palamar-Mordvintseva *et al*. 2005). The first publications with phytosociological relevés of 9 associations belonging to the class *Charetea* Fukarek ex Krausch 1964 have appeared just recently (Iakushenko

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*et al*. 2007; Borysova & Iakushenko 2008; Solomakha 2008; Orlov *et al*. 2009; Borysova & Chorna 2011; Iakushenko 2011).

The aim of the article is to describe the diversity of charophyte communities in Ukraine, to characterize them briefly in the acceptable form for Prodromus of the Vegetation of Ukraine and to present a comprehensive syntaxonomy scheme of charophyte communities for the area under current stage of our studies.

## 2. Materials and methods

The phytosociological surveys were performed in the years 2004-2010 in different types of water bodies situated in the northern, western and central parts of Ukraine. About 80 relevés were made according to the Braun-Blanquet method (Westhoff & van der Maarel 1973). The phytosociological relevés were stored in the TURBOVEG database (Hennekens & Schaminée 2001) and classified by TWINSPAN protocol (Hill 1979) using JUICE 6.5 software package (Tichý 2002).

Charophytes were identified with the use of identification guides by Hollerbach & Palamar-Mordvintseva (1991) and Krause (1997). The names of vascular plants species followed Tutin *et al*. (1968-1993). The authors of the plant names given by Brummitt & Powell (1992). The nomenclature of the syntaxa followed the 3rd edition of the International Code of Phytocoenological Nomenclature (ICPN) (Weber *et al*. 2000). The syntaxonomy scheme of the Ukrainian charophyte communities was compiled according to that presented in the book chapter by Šumberová *et al*. (2011) as the most relevant for the ICPN rules; other surveys were taken into consideration, too (Corillion 1957; Krausch 1964; Dąmbska 1966; Krause & Lang 1977; Doll 1989; Dąmbska 1996; Brzeg & Wojterska 2001; Husák 2001; Oťaheľová 2001; Hrivnák *et al*. 2005; Gąbka & Pełechaty 2006; Gąbka 2010).

## 3. Results

The Prodromus of the *Charetea* F. Fukarek ex Krausch 1964 communities in Ukraine:

*Charetea* Fukarek ex Krausch 1964

Synonyms: *Charetea* F. Fukarek 1961, *Charo-Potametea* Kępczyński et Ceynowa-Giełdon 1972 p.p., *Charetea globularis* sensu auct.
Diagnostic species (only taxa occurring in the analyzed relevés are given): *Chara aspera*, *C. contraria*, *C. delicatula*, *C. globularis*, *C. intermedia*, *C. rudis* (A. Braun) Leonh., *C. tenuispina* A. Braun, *C. vulgaris*, *Lychnothamnus barbatus* (Meyen) Leonh., *Nitella flexilis*, *N. gracilis* (Smith) C. Agardh., *N. mucronata*, *N. syncarpa* (Thuill.) Chev., *Nitellopsis obtusa*.
Communities of submerged charophytes in mesotrophic and eutrophic inland fresh to brackish waters and sea littoral zone.

*Charetalia hispidae* Sauer ex Krausch 1964

Synonyms: *Charetalia fragilis* Sauer 1937, *Charetalia hispidae* Sauer 1937, *Nitelletalia flexilis* Krause 1969.
Diagnostic species: as diagnostic species for the class.
Communities of submerged charophytes in mesotrophic and eutrophic water bodies.

*Charion globularis* Krausch 1964

Synonyms: *Charicion* Rübel 1933 (orig. form), *Charion* Sauer 1937, *Charion canescentis* Corillion 1957, *Charion canescentis* Krausch 1964, *Charion fragilis* Krausch 1964 em. van Raam et Schaminée in Schaminée *et al*. 1995, *Limno-Charion* Krausch 1964, *Limno-Charion* Krausch 1968, *Charion asperae* Krause 1969, *Thero-Charion asperae* Krause 1969, *Tolypellion* Krause 1969, *Charion vulgaris* (Krause ex Krause et Lang 1977) Krause 1981, *Charion vulgaris* Dąmbska 1966 ex Krause 1981, *Charion contrario-asperae* Pietsch 1987, *Charion rudis-hispidae* Pietsch 1987.
Diagnostic species: *Chara aspera, C. contraria, C. delicatula, C. globularis*, *C. hispida, C. intermedia, C. rudis, C. vulgaris, Lychnothamnus barbatus, Nitellopsis obtusa*.
Submerged charophytes communities dominated mainly by *Chara* species in mesotrophic and eutrophic, slightly acid, neutral to alkaline water bodies.

1. *Charetum asperae* Corillion 1957

Diagnostic species: *Chara aspera.*
Habitats: Littoral zone of relatively large calcareous mesotrophic lakes with sandy, silty-sand or carbonate deposits, mainly in shallow parts (0.1-0.3 m depth), sometimes to 10.0 m depth.
Distribution in Ukraine: Rare in the Western Polissia (Lake Svitiaz, Lake Pisochne). Protected in the Shatsk National Nature Park.
Phytosociological materials: Borysova & Iakushenko 2008 (P. 229, Table 1., rel. 2-19), Borysova & Chorna 2011 (P. 109, Table 2, rel. 2). See also Table 1, column 4 *hoc loco*.

2. *Charetum contrariae* Corillion 1957

Diagnostic species: *Chara contraria.*
Habitats: Mesotrophic calcareous water bodies with clay and silt deposits at the depth from 0.5 to 3.0-5.0 m.
Distribution in Ukraine: Sporadically. Protected in the Shatsk National Nature Park (Lake Svitiaz, Volyn Region).

**Table 1.** Synoptic table of some charophyte communities from Ukraine

| Column number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Number of relevés | 6 | 6 | 5 | 18 | 11 | 10 | 10 | 6 |
| Total number of species | 14 | 15 | 11 | 6 | 14 | 10 | 17 | 9 |
| **D.s. Cl. *Charetea*** | | | | | | | | |
| *Chara vulgaris* | **V$^{4-5}$** | **V$^{4-5}$** | . | . | . | . | . | . |
| *Nitella flexilis* | . | . | **V$^{5}$** | . | . | . | . | . |
| *Chara aspera* | . | . | . | **V$^{5}$** | . | I$^{+}$ | I$^{1}$ | . |
| *Chara globularis* | . | . | . | . | **V$^{4-5}$** | . | I$^{1}$ | . |
| *Nitellopsis obtusa* | . | . | . | . | . | **V$^{4-5}$** | I$^{+-4}$ | . |
| *Chara delicatula* | . | . | . | . | 1$^{+}$ | . | **V$^{3-5}$** | **V$^{2-5}$** |
| *Chara intermedia* | . | . | . | . | . | . | II$^{5}$ | . |
| **D.s. Al. *Nymphaeion*** | | | | | | | | |
| *Nymphaea candida* | . | . | . | . | III$^{1-5}$ | I$^{4-5}$ | II$^{2-5}$ | . |
| *Potamogeton natans* | II$^{2}$ | . | . | . | I$^{1}$ | I$^{2}$ | I$^{2}$ | . |
| *Nuphar lutea* | . | . | I$^{1}$ | . | I$^{3}$ | I$^{2}$ | I$^{2}$ | . |
| *Nymphaea alba* | . | . | I$^{5}$ | . | . | . | . | . |
| *Trapa natans* | . | I$^{+}$ | . | . | . | . | . | . |
| **D.s. Cl. *Potametea*** | | | | | | | | |
| *Elodea canadensis* | I$^{4}$ | II$^{+-1}$ | I$^{1}$ | . | . | I$^{4}$ | I$^{1}$ | II$^{1}$ |
| *Potamogeton pectinatus* | II$^{2-4}$ | . | . | I$^{2}$ | I$^{4-5}$ | . | . | . |
| *Myriophyllum verticillatum* | . | I$^{+}$ | IV$^{1-2}$ | . | I$^{1}$ | . | . | . |
| *Ceratophyllum demersum* | . | IV$^{+}$ | I$^{1}$ | . | II$^{1-3}$ | . | I$^{3}$ | . |
| *Potamogeton friesii* | . | . | . | . | III$^{3-5}$ | . | I$^{1-2}$ | . |
| *Potamogetom compressus* | . | . | . | . | II$^{4}$ | . | . | . |
| *Potamogeton lucens* | . | . | . | I$^{3}$ | . | IV$^{3-5}$ | II$^{1-5}$ | . |
| *Myriophyllum spicatum* | . | . | . | . | . | I$^{1-2}$ | III$^{+-4}$ | V$^{1}$ |
| *Potamogeton praelongus* | . | . | . | . | . | . | . | III$^{1}$ |
| *Ranunculus trichophyllus* | . | . | . | . | . | . | . | II$^{1}$ |
| *Potamogeton perfoliatus* | . | . | . | I$^{1-2}$ | . | . | . | I$^{2}$ |
| *Potamogeton berchtoldii* | . | II$^{+}$ | . | . | . | . | . | . |
| **D.s. Cl. *Lemnetea*** | | | | | | | | |
| *Hydrocharis morsus-ranae* | . | II$^{+}$ | . | . | . | . | I$^{1}$ | . |
| *Lemna trisulca* | . | V$^{+-1}$ | . | . | II$^{+-2}$ | . | . | . |
| *Spirodela polyrrhiza* | . | II$^{+-1}$ | . | . | . | . | . | . |
| *Lemna minor* | . | II$^{+}$ | . | . | . | . | . | . |
| *Wolffia arrhiza* | . | II$^{+}$ | . | . | . | . | . | . |
| *Utricularia vulgaris* | . | I$^{+}$ | III$^{1}$ | . | I$^{+}$ | . | . | . |
| *Stratiotes aloides* | . | . | . | . | III$^{1-2}$ | . | I$^{1-3}$ | I$^{+}$ |
| *Aldrovanda vesiculosa* | . | . | . | . | . | I$^{2}$ | I$^{1}$ | . |
| **D.s. Cl. *Littorelletea*** | | | | | | | | |
| *Eleocharis acicularis* | . | . | III$^{2}$ | . | . | . | . | . |
| *Utricularia minor* | . | . | I$^{+}$ | . | . | . | II$^{1-2}$ | . |
| *Potamogeton gramineus* | . | . | . | . | . | . | . | I$^{1}$ |
| **D.s. Cl. *Phragmitetea*** | | | | | | | | |
| *Alisma plantago-aquatica* | IV$^{+-1}$ | I$^{+}$ | . | . | . | . | . | . |
| *Eleocharis palustris* | I$^{1}$ | . | . | . | . | . | . | . |
| *Equisetum fluviatile* | I$^{1}$ | . | . | . | . | . | . | . |
| *Glyceria fluitans* | I$^{1}$ | . | . | . | . | . | . | . |
| *Lycopus europaeus* | I$^{+}$ | . | . | . | . | . | . | . |
| *Sparganium erectum* | I$^{1}$ | . | . | . | . | . | . | . |
| *Oenanthe aquatica* | . | III$^{+}$ | . | . | . | . | . | . |
| *Glyceria maxima* | . | I$^{+}$ | . | . | . | . | . | . |
| *Sagittaria sagittifolia* | . | . | I$^{5}$ | . | . | . | . | . |
| *Phragmites australis* | . | . | . | I$^{3}$ | I$^{2}$ | . | . | . |
| *Typha angustifolia* | . | . | . | . | . | I$^{1}$ | . | . |
| **Other species** | | | | | | | | |
| *Juncus articulatus* | II$^{1}$ | . | . | . | . | . | . | . |
| *Callitriche cophocarpa* | I$^{2}$ | . | III$^{2}$ | . | . | . | . | . |
| *Veronica beccabunga* | I$^{1}$ | . | . | . | . | . | . | . |
| *Veronica anagalis-aquatica* | I$^{+}$ | . | . | . | . | . | . | . |
| *Zanichellia palustris* | . | . | . | I$^{1}$ | . | . | . | . |
| *Aegagropila linnaei* | . | . | . | . | . | . | . | II$^{5}$ |

Association names and sources of the relevés:
1 – ***Charetum vulgaris***: Ivano-Frankivsk region, Kosiv distict, „Hutsulshchyna" NNP, Iakushenko *et al*. 2011 (P. 282, Table 9.18, rel. 10-13, P. 285, Table 9.19, rel. 6, 18); 2 – ***Charetum vulgaris***: Kharkiv and Cherkasy regions, Borysova & Chorna 2011 (P. 108, Table 1, rel. 6-11); 3 – ***Nitelletum flexilis***: Zhytomyr region, Ovruch district, 1.5 km N from Mozhary village, D. Iakushenko, 2006, unpubl.; 4 – ***Charetum asperae***: Volyn region, Shatsk district, Shatsk NNP, Lake Svitiaz, Borysova & Iakushenko 2008 (P. 229, Table 1, rel. 2-19); 5 – ***Charetum globularis***: Volyn region, Shatsk district, Shatsk NNP, D. Iakushenko, 2005, unpubl.; 6 – ***Nitellopsidetum obtusae***: Volyn region, Shatsk district, Shatsk NNP, Lake Svitiaz, D. Iakushenko, 2005, unpubl.; 7 – ***Charetum delicatulae***: Volyn region, Shatsk district, Shatsk NNP, Lake Svitiaz, D. Iakushenko, 2005, unpubl.; 8 – ***Charetum delicatulae***: Rivne region, Volodymyrets district, Rivne Natural Reserve, Lake Bile, Orlov, Iakushenko, Borysova, 2009 (P. 261, Table 1, rel. 1-6)

Phytosociological materials: Borysova & Iakushenko 2008 (P. 230, Table 2, rel. 5-7).

### 3. *Charetum delicatulae* Doll 1989 ex Gąbka et Owsianny 2010

Synonim: *Charetum delicatulae* Doll 1989 nom. nudum, *Charetum delicatulae* Blaženčić et Blaženčić 1994 prov.
Diagnostic species: *Chara delicatula*.
Habitats: Mesotrophic to meso-eutrophic slightly acidic standing waters (lakes, forest pools, open pits) with silt, silty-peat or sandy-silty bottom deposits at the depth from 0.5 to 10 m.
Distribution in Ukraine: Sporadically in the Right-Bank Polissia: Volyn (Lake Svitiaz), Rivne (Lake Bile), and Zhytomyr regions, also known from Male Polissia and Ukrainian Carpathians (very rare). *Chara delicatula* is listed in the Red Data Book of Ukraine (2009). Protected in the Rivne Natural Reserve and the Shatsk National Nature Park.
Phytosociological materials: Borysova & Iakushenko 2008 (P. 230, Table 2, rel. 3-4); Orlov, Iakushenko, Borysova 2009 (P. 261, Table 1, rel. 1-6). See also Table 1, columns 7-8 *hoc loco*.

### 4. *Charetum globularis* Zutshi ex Šumberová, Hrivnák, Rydlo et Oťaheľová in Chytrý 2011

Synonyms: *Charetum fragilis* Corillion 1957, *Charetum fragilis* Fijałkowski 1960 prov., *Charetum globularis* Zutshi 1975, *Charetum globularis* Schaminée *et al*. 1988.
Diagnostic species: *Chara globularis*.
Habitats: Eutrophic and mesotrophic water bodies (lakes, pools, pits, channels etc.) with standing or slow-flowing water and different types of bottom deposits, at the depth from 1.0 to 7.0 m.
Distribution in Ukraine: Common in the northern (Polissia), western and central (Forest-Steppe) regions.
Phytosociological materials: Borysova & Iakushenko 2008 (P. 230, Table 2, rel. 1-2), Borysova & Chorna 2011 (P. 108, Table 1, rel. 3-5). See also Table 1, column 5 *hoc loco*.

### 5. *Charetum intermediae* (Corillion 1957) Fijałkowski 1960

Synonym: *Charetum aculeolatae* Corillion 1957, *Magnocharetum aculeolatae* Corillion 1957, *Charetum aculeolatae* Dąmbska 1966 prov.
Diagnostic species: *Chara intermedia*.
Habitats: Shallow mesotrophic neutral low-calcium lakes and pools with silty-peat deposits, drainage channels on the fens and bogs, from 0.5 to 1.7 m depth.
Distribution in Ukraine: Sporadically in the Forest-Steppe area and in the Western Polissia (Volyn Region). Protected in the Shatsk National Nature Park.
Phytosociological materials: Borysova & Chorna 2011 (P. 109, Table 2, rel. 3-5), also – rel. 139, 19.07.2005, Volyn Region, Shatsk district, Shatsk National Nature Park, Lake Svitiaz, Buzhnia bay. Relevé area – 10 m$^2$, depth – 1.5 m, surface cover – 15%, total cover – 100%. *Potamogeton natans* L. – 10%, *Hydrocharis morsus-ranae* L. – 1%, *Nymphaea candida* C. Presl – 5%; *Chara intermedia* – 80%, *Ch. delicatula* – 20%, *Nitellopsis obtusa* – +, *Utricularia minor* L. – 10%. D. Iakushenko (unpubl.).

### 6. *Charetum rudis* Dąmbska 1966

Diagnostic species: *Chara rudis*.
Habitats: Mainly in small ponds, from 0.3 to 1.5 m depth, with springs on the bottom and clear, highly transparent water with low nutrient contents, on highly hydrated organic substratum.
Distribution in Ukraine: Very rare, only one locality known in vicinities of Kniazhdvir village (Ivano-Frankivsk Region). This association is reported for Ukraine for the first time.
Phytosociological materials: 03.06.2008, Ivano-Frankivsk Region, Kolomyia district, Kniazhdvir village, shallow part of the small pond with bottom spring. Relevé area – 25 m$^2$, depth – 0.4 m, total cover – 80%. *Chara rudis* – 70%, *Potamogeton trichoides* Cham. & Schltdl. – 10%, *Myriophyllum spicatum* L. – +. D. Iakushenko (unpubl.).

### 7. *Charetum tenuispinae* Dąmbska 1966 ex Tomaszewicz 1979

Synonims: *Charetum tenuispinae* Dąmbska 1966 prov.
Diagnostic species: *Chara tenuispina*.
Habitats: Drainage channels and small ponds with slow-flowing water and peaty bottom deposits in carbonate fens, at 0.5-1.0 m depth.
Distribution in Ukraine: Rare, mainly in vicinities of Brody (Lviv Region).
Phytosociological materials: Borysova & Chorna 2011 (P. 109, Table 2, rel. 1).

### 8. *Charetum vulgaris* Corillion 1957

Synonims: *Charo-Tolypelletum glomeratae* Corillion 1957 p.p., *Thero-Charetum vulgaris* Krause 1969, *Charetum vulgaris* Zutshi 1975
Diagnostic species: *Chara vulgaris*.
Habitats: Standing neutral or slightly alkaline eutrophic and mesoeutrophic shallow water bodies with silty, sandy or silty-peat deposits, from 0.2 to 1.5 m in depth.
Distribution in Ukraine: Common in the central and western regions, sporadically in the northern areas (Polissia).

Phytosociological materials: Borysova & Chorna 2011 (P. 108, Table 1, rel. 6-11); Iakushenko *et al*. 2011 (P. 282, Table 9.18, rel. 10-13, P. 285, Table 9.19, rel. 6, 18). See also Table 1, columns 1-2 *hoc loco*.

9. *Lychnothamnetum barbati* (Gołdyn 1984) Brzeg et M. Wojterska 2001

Diagnostic species: *Lychnothamnus barbatus*.
Habitats: Mesotrophic lakes with muddy bottom deposits at the depth from 1.5 to 7.0-10.0 m.
Distribution in Ukraine: Very rare in Volyn Region (Svitiaz Lake). Protected in the Shatsk National Nature Park.
Phytosociological materials: Borysova & Iakushenko 2008 (P. 230, Table 2, rel. 8-9).

10. *Nitellopsidetum obtusae* (Sauer 1937) Dąmbska 1961

Synonim: *Chareto-Nitellopsidetum obtusae* J. Blaženčić 1983 p.p.
Diagnostic species: *Nitellopsis obtusa*.
Habitats: Eu-mesotrophic and eutrophic standing water bodies (lakes, river oxbows) with deep muddy deposits.
Distribution in Ukraine: Sporadically in Polissia. This species is listed in the Red Data Book of Ukraine (2009). This association is reported for Ukraine for the first time.
Phytosociological materials: Table 1, column 6 *hoc loco*.

*Nitellion flexilis* Krause 1969

Synonyms: *Nitellion flexilis* Corillion 1957, *Nitellion* Segal 1965, *Nitellion* Dąmbska 1966 prov., *Nitellion syncarpae-tenuissimae* Krause 1969.
Diagnostic species: *Nitella flexilis*, *N. gracilis, Nitella mucronata, N. syncarpa*.
Submerged charophytes communities dominated by *Nitella* species in acidic to neutral, low nutrient, carbonates poor, shallow water bodies.

11. *Nitelletum flexilis* Corillion 1957

Synonym: *Nitelletum flexilis* (Corillion 1957) Dąmbska 1966
Diagnostic species: *Nitella flexilis*.
Habitats: Shallow, slightly acidic forest pools, open pits, ephemeral water bodies with sandy-silty bottom deposits.
Distribution in Ukraine: Sporadically in the Right-Bank Polissia (Volyn, Rivne and Zhytomyr Regions). Protected in the Rivne and Cheremskyi Natural reserves.
Phytosociological materials: Table 1, column 3 *hoc loco*.

12. *Nitelletum gracilis* Corillion 1957

Synonym: *Nitelletum gracilis* Tomaszewicz 1979
Diagnostic species: *Nitella gracilis*.
Habitats: Shallow standing acidic water bodies (forest ponds) with silty or sandy bottom deposits.
Distribution in Ukraine: only one locality on the Western Polissia (the Rivne Natural Reserve) is known so far. *Nitella gracilis* is listed in the Red Data Book of Ukraine (2009) and in the Red List of *Charales* in Ukraine (Palamar-Mordvintseva & Tsarenko 2004b). This association is reported for Ukraine for the first time.
Phytosociological materials: 14.07.2009, Rivne Region, Rivne Natural Reserve, Karasyn forestry, q. 22; ephemeral brown-colored humic waterbody on ground road with hard sandy bottom. Relevé area – 1 $m^2$, depth – 0.1 m, cover – 70%. Aggregation (monodominant stand) of *Nitella gracilis* – 70%. D. Iakushenko (unpubl.).

13. *Nitelletum mucronatae* Corillion et Guerlesquin 1972

Synonim: *Nitelletum mucronatae* Tomaszewicz 1979 ex Hrivnák *et al*. 2001
Diagnostic species: *Nitella mucronata*.
Habitats: Standing shallow humic pools, eutrophic bogs, ephemeral water bodies, open pits with silty-peat deposits and detritus, from 0.5 to 1.5 m depth.
Distribution in Ukraine: Sporadically in Polissia and Forest-Steppe regions.
Phytosociological materials: Borysova & Chorna 2011 (P. 108, Table 1, rel. 1-2).

14. *Nitelletum syncarpae* (Corillion 1957) Dąmbska 1966

Synonym: *Nitelletum syncarpo-tenuissimae* Krause 1969
Diagnostic species: *Nitella syncarpa*.
Habitats: Shallow (up to 0.3 m depth) littoral plots with sandy deposits in mesotrophic lakes.
Distribution in Ukraine: Very rare, known in Volyn Region (Lake Svitiaz). Protected in the Shatsk National Nature Park.
Phytosociological materials: Borysova & Iakushenko 2008 (P. 229, Table 1, rel. 1).

## 4. Discussion

The first challenge, connected with the charophyte syntaxonomy, was to choose the accepted name for the class according to the ICPN rules. Despite the fact that the name *Charetea fragilis* Fukarek 1961 is commonly used in scientific literature (Schaminée *et al*. 1995; Oťaheľova 2001; Hrivnák *et al*. 2005; Gąbka 2010; etc.), we support the well-argued opinion of Czech colleagues

that the accepted name for this class is *Charetea* Fukarek ex Krausch 1964 (according to art. 2b ICPN) (Šumberová *et al*. 2011). Also we agree with the opinion that there are not sufficient floristic and nomenclatural criteria for the recognition of neither the distinct order *Nitelletalia flexilis* Krause 1969, nor the alliances *Nitellion syncarpae-tenuissimae* Krause 1969 and *Charion vulgaris* (Krause ex Krause et Lang 1977) Krause 1981.

The other problem is that less than one hundred phytosociological relevés are currently available from the studied area and only a minor part of them are published, so the present syntaxonomical scheme is not adequate to the charophytes species richness of Ukraine. The prodromus of the Ukrainian plant communities of the class *Charetea* is preliminary and includes 14 associations so far. The list of diagnostic species consists of about 34 % from the general number of the *Charales* species known in Ukraine (45% from the ones found during recent two decades).

Nevertheless, it covers the communities typical for Ukrainian territory occurring more frequently in all its parts or in some separated regions. Associations such as *Charetum globularis*, *Charetum contrariae*, and *Charetum vulgaris* are found elsewhere in Ukraine. However, *Charetum globularis* occurs more frequently in the northern, western and central regions; *Charetum vulgaris* – in the central and southern areas; *Charetum contrariae* – elsewhere, but rather seldom. The distribution of the other associations is restricted to only some regions of Ukraine. For example, *Charetum delicatulae* and *Nitelletum flexilis* occur mainly in the north-western and northern regions, respectively.

The syntaxonomical scheme also includes such associations as: *Charetum rudis*, *Charetum tenuispinae, Lychnothamnetum barbati*, *Nitelletum gracilis*, *Nitelletum syncarpae* whose diagnostic species are rare not only for Ukraine but also for Europe in general. In Ukraine, they were found only in 1-2 localities.

Thus, even this preliminary prodromus displays a rather rich diversity of syntaxa due to a high variety of geographic, climatic and hydrological conditions. In the near future, it could be amended by some new syntaxa, after conducting the phytosociological investigations of the charophyte species whose capacity to form stands and chorology are well known from previous studies. Recurrent studies are also necessary due to a disappearance of most species caused by anthropogenic transformation of their habitats. Among them, the most interesting species are: *Chara hispida* L. and *Lamprothamnium papulosum* which were widely distributed in the early twentieth century through South Ukraine (Podlessky 1936; Pogrebnyak *et al*. 1973; Maslov & Borysova 2008), *Chara connivens* Salzm. ex A. Braun, *C. neglecta* Hollerb., *Nitella capillaris* (Krock.) J. Groves et Bull.-Webst., rather rare species for Ukrainian territory (Palamar-Mordvintseva & Borysova 2005; Borysova & Orlov 2008); *Tolypella prolifera* (Ziz ex A. Braun) Leonh., occurs scarcely in the south-east regions (Borysova 2005), as well as *Chara uzbekistanica* Hollerb., inhabits mainly in the lake Yalpuh (Odesa region) (Tkachenko 2005). New research focused on the description of community structure and environmental conditions in various water bodies and different geographical regions is urgently needed.

## 5. Conclusion

The preliminary prodromus of the charophyte communities from the territory of Ukraine is presented. For the first time, 3 associations (*Charetum intermediae* (Corillion 1957) Fijałkowski 1960, *Charetum rudis* Dąmbska 1966, *Nitelletum gracilis* Corillion 1957) are indicated for the investigated area. The syntaxonomical scheme consists of 14 associations, 2 alliances and 1 order within the class *Charetea* Fukarek ex Krausch 1964.

## References

Borysova O. V. 2005. Species composition and distribution of Charales in the Ukraine. Inter. J. on Algae 7: 88-102.

Borysova O. V. & Chorna G. A. 2011. Contributions to the flora and syntaxonomy of Ukrainian charophytes. Ukr. Bot. Zhurn. 68: 105-112.

Borysova O. V. & Honcharenko V. I. 2007. The members of Charales of some lakes in Shatsk National Nature Park (Volyn Polissia). Visn. Lviv. Univ. Biol. ser. 44: 46-51.

Borysova O. V. & Honcharenko V. I. 2011. The distribution of the Charales species in some lakes of Volyn Polissia (Ukraine). Visn. Lviv. Univ. Biol. ser. 57: 94-101.

Borysova O. V. & Iakushenko D. M. 2008. Communities of charophytes in the south-west part of Lake Svityaz (Volyn Polissia). Ukr. Bot. Zhurn. 65: 226-233.

Borysova O. V. & Orlov A. A. 2009. Research of Charales of Zytomir Polissia (Ukraine). Algologia 19: 197-205.

Borysova O. V. & Tkachenko F. P. 2008. A contribution to the flora of the Southwest Ukraine. Algologia 18: 287-298.

Borysova O. V., Tsarenko P. M. & Iakushenko D. N. 2008. Current diversity of *Charales* of Lake Svitiaz (Shatsk National Natural Park, Volyn Polissia, Ukraine). Algologia 18: 449-456.

Brzeg A. & Wojterska M. 2001. Zespoły roślinne Wielkopolski, ich stan poznania i zagrożenie. In: M. Wojterska (ed.). Szata roślinna Wielkopolski i Pojezierza Południowopomorskiego. Przewodnik sesji terenowych 52. Zjazdu PTB (24-28 września 2001), pp. 39-110. Bogucki Wyd. Nauk., Poznań.

Brummitt R. K. & Powell C. E. (eds.). 1992. Authors of the plant names. 732 pp. Kew Roy. Bot. Gardens.

Coops H. 2002. Ecology of charophytes: an introduction. Aquat. Bot. 72: 205-208.

Corillion R. 1957. Les Charophycées de France et d'Europe Occidentale. Bull. Soc. Sci. Bretagne 32: 1-499.

Dąmbska I. 1966. Zbiorowiska ramienic Polski. PTPN, Prace Komisji Biologicznej 31: 1-76.

Didukh Ya. P. (ed.). 2009. Red Data Book of Ukraine. Plant Kingdom. 900 pp. Globalkonsaltyng, Kyiv.

Doll R. 1989. Die Pflanzengesellschaften der stehenden Gewässer im Norden der DDR. Teil I. Die Gesellschaften des offenen Wassers (Characeen-Gesellschaften). Feddes Repertorium 100: 281-324.

Dubyna D. V. 2006. Higher aquatic vegetation. *Lemnetea, Potametea, Ruppietea, Zosteretea, Isoeto-Nanojuncetea* (*Eleocharition acicularis, Isoetion lacustris, Potamion graminei, Sphagno-Utricularion*), *Phragmito-Magnocaricetea* (*Glycerio-Sparganion, Oenanthion aquaticae, Phragmition communis, Scirpion maritimi*). In: Yu. R. Shelyag-Sosonko (ed.). Vegetation of Ukraine. 412 pp. Phytosociocentre, Kyiv.

Gąbka M. 2010. *Charetea*. In: H. Ratyńska et al. (eds.). Multimedialna encyklopedia zbiorowisk roślinnych Polski. NFOSiGW, UKW, IETI.

Gąbka M. & Pełechaty M. 2006. Zagadnienia klasyfikacji taksonomicznej i synekologicznej ramienic (Characeae, Charophyta) i ich zbiorowisk. Ekologia i Technika 14 (3): 87-92.

Hennekens S. M. & Schaminée J. H. J. 2001. TURBOVEG, a comprehensive data base management system for vegetation data. J. Veg. Sci. 12: 589-591.

Hill M. O. 1979. TWINSPAN: A FORTRAN program for arranging multivariate data in an ordered two-way table by classification of the individuals and attributes. Section of Ecology and Systematics. Cornell University, Ithaca, NY.

Hollerbach M. M. & Palamar-Mordvintseva G. M. 1991. Charophytes (*Charophyta*). In: Identification guide of freshwater algae of Ukraine. Vol. IX. 196 pp. Naukova dumka, Kyiv.

Hrivnák R., Oťaheľová H., Kochjarová J., Blanár D. & Husák Š. 2005. Plant communities of the class *Charetea fragilis* Fukarek ex Krausch 1964 in Slovakia: new information on their distribution and ecology. Thaiszia – Journal of Botany 15: 117-128.

Husák Š. 2001. Vegetace parožnatek. In: M. Chytrý, T. Kucera & M. Kocí (eds.). Katalog biotopů České republiky, pp. 23-24. Agentura ochrany prírody a krajiny ČR, Praha.

Iakushenko D. M. 2011. Charophyte communities. In: Ya. P. Didukh (ed.). Biotopes of Forest and Forest-Steppe zones of Ukraine, pp. 37-39. MACROS, Kyiv.

Iakushenko D. M., Borysova O. V. & Tsarenko P. M. 2007. Cenotic characteristic of two charophytes species in Shatsk National Nature Park (Ukraine). In: Lake ecosystems: biological processes, anthropogenic transformation, water quality. Proceedings of the III International scientific conference, 17-22 September 2007, Minsk-Naroch, pp. 193-194. Editorial center of BSU, Minsk.

Iakushenko D. M., Iusyp S. V., Solomakha V. A., Chornei I. I., Tokaryuk A. I., Budzhak V. V., Danylyk I. M., Tomych M. V., Solomakha I. V., Derzhypilsky L. M. & Senchyna B. V. 2011. The vegetation of the NNP "Hutsulshchyna". In: Nature reserve territories of Ukraine. Plant Kingdom. Issue 9, pp. 194-298. Phytosociocentre, Kyiv.

Krausch H.-D. 1964. Die Pflanzengesellschaften des Stechlinseegebietes In: Die Gesellschaften des offenen Wassers. Limnologica 2: 145-203.

Krause W. 1997. Charales (Charophyceae). In: H. Ettl et al. (eds.). Süsswasserflora von Mitteleuropa. Bd. 18, 202 pp. G. Fischer Verlag, Jena.

Krause W. & Lang G. 1977. Klasse: Charetea fragilis (Fukarek 1961 n.n.) Krausch 1964. Gesellschaften aus Armleuchteralgaen. In: E. Oberdorfer (ed.). Süddeutsche Pflanzengesellschaften. Teil I, pp. 78-88. G. Fischer Verlag, Stuttgart, New York.

Maslov I. I. & Borysova O. V. 2008. Charophytes of Syvash. Bull. Nikit. Bot. Sada 96: 8-12.

Orlov O. O., Iakushenko D. M. & Borysova O. V. 2009. Syntaxonomy of vegetation of Lake Bile (Rivne natural reserve). In: M. Budz et al. (eds.). Biodiversity protection and reproduction on nature protected areas. Proceedings of the International scientific conference, Sarny, 11-13 June 2009, pp. 258-266. Rivnenska drukarnia, Rivne.

Oťaheľová H. 2001. *Charetea fragilis*. In: M. Valachovič (ed.). Rastlinné spolocenstvá Slovenska 3. Vegetácia mokradí, pp. 393-406. Veda, Bratislava.

Palamar-Mordvintseva G. M. 1998. Charophyta of Crimean peninsula (Ukraine). Algologia 8: 14-22.

Palamar-Mordvintseva G. M. & Borysova O. V. 2006. New occurrences of *Charales* in the Ukraine. Inter. J. on Algae 8: 338-344.

Palamar-Mordvintseva G. M., Borysova O. V. & Tsarenko P. M. 2005. Results and current tasks of study on the Ukrainian Charales. Ukr. Bot. Zhurn. 62: 538-547.

Palamar-Mordvintseva G. M. & Tsarenko P. M. 2004a. *Charales* of Volyn Polissya (Ukraine). Algologia 14: 178-184.

Palamar-Mordvintseva G. M. & Tsarenko P. M. 2004b. Red list of *Charales* of Ukraine. Algologia 14: 399-412.

Podlessky V. I. 1936. *Charophyta* of the southwestern part of the Ukrainian SSR. Zhurn. Inst. Bot. UAN 7: 65-69.

Pogrebnyak I. I., Ostrovchuk P. P. & Eremenko T. I. 1973. Charaphytes in gulfs of the southwestern part of Black

sea. In: Charophytes and their use in research of biological processes in cell, pp. 67-74. Vilnius.

Schaminée J. H. J., Maier E. X. & van Raam J. C. 1995. Charetea fragilis. In: J. H. J. Schaminée et al. (ed.). De vegetatie van Nederland. 2. Plantengemeenschappen van wateren, moerassen en natte heiden, pp. 45-64. Opulus Press, Uppsala-Leiden.

Solomakha V. A. 1996. Syntaxonomy of the vegetation of Ukraine. Ukrainian Phytosociological Collection 4: 1-119.

Solomakha V. A. 2008. Syntaxonomy of the vegetation of Ukraine. Third approximation. 296 pp. Phytosociocentre, Kyiv.

Šumberová K., Hrivnák R., Rydlo J. & Oťaheľová H. 2011. Charetea Fukarek ex Krausch 1964. In: M. Chytrý (ed.). Vegetace České republiky. 3. Vodní a mokřadní vegetace, 3. Aquatic and wetland vegetation, pp. 248-250. Academia, Praha.

Tichý L. 2002. JUICE, software for vegetation classification. J. Veg. Sci. 13: 451-453.

Tkachenko F. P. 2005. The new location of rare species of Ukraine flora *Chara uzbekistanica* Hollerb. Algologia. 15: 230-235.

Tutin T. G. et al. 1964-80. Flora Europaea, vol. 1 (1964), vol. 2 (1968), vol. 3 (1972), vol. 4 (1976), vol. 5 (1980). Cambridge University Press, Cambridge.

Weber H. E., Moravec J. & Théurillat J.-P. 2000. International Code of Phytosociological Nomenclature. 3rd edition. J. Veg. Sci. 11: 739-768.

Westhoff V. & van der Maarel E. 1973. The Braun-Blanquet approach. 2-nd ed. In: R. Whittaker (ed.). Classification of Plant Communities, pp. 287-399. Junk, The Hague.