SOME FEATURES OF DIVERSITY AND DISTRIBUTION OF THE *CHARALES* SPECIES IN UKRAINE

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Abstract: The species composition of Ukrainian charophytes is given on the basis of summarized published and original data. At present, there are 41 species from 6 genera known in the flora of Ukraine, namely: Chara L. (25), Nitella C. Agardh (9), Tolypella (A. Braun) A. Braun (4), Lamprothamnium papulosum (Wallr.) J. Groves, Lychnothamnus barbatus (Meyen) Leonh., and Nitellopsis obtusa (Desv. in Loisel.) J. Groves. The distribution pattern of the Charales species is discussed.
Key words: Charales, species diversity, distribution, Ukraine

Introduction

Ukraine is the third largest country in Europe. It borders with Russia in the east and northeast, Belarus in the north, Poland, Slovakia, Hungary, Romania and Moldova in the west and southwest. In the south it is washed by the Black and Azov seas. The present relief of Ukraine is determined by its geological structure, formed over a long geological time and represented by flat lowlands (70%), plateaus (25%), and mountains of low and medium heights (5%). There are more then 72,000 rivers, 27,000 ponds and reservoirs, 8,000 lakes. Dnipro, the biggest river of Ukraine, divides the territory in two parts which are traditionally called right bank and left bank areas. There are such physiographic zones as Mixed-Forest which represented only Ukrainian Polissia including 5 regions: Volyn, Zhytomyr, Kyiv, Chernigiv, Novgorod-Siversk Polissia as well as Forest-Steppe and Steppe [8].

The main types of water bodies of the Ukrainian Polissia are lakes (karsts and post-glacial in the northwestern part, flood-lands everywhere), ponds, reservoirs, bogs, rivers. Mineralization of hydrocarbonate-calcium water is from 100-200 mg/l in west to 233-389 mg/l in east. Forest-Steppe zone is characterized by an alternation of meadow-steppes with forests. Water bodies are transient between the Forest and Steppe ones. Average mineralization is 200-400 up to 3,000 mg/l. The main characters of Steppe zone are lack of humidity, high mineralization of ground water (up to 10-50 mg/l) and sulfate and chloride–sulfate type of water [8]. The main types of water bodies of the zone are rivers and reservoirs, large irrigation systems and estuaries of large rivers, as well as shallow bays and lagoons of Azov and Black seas which we consider as separate natural zone.

The aim of the work is to give an overview of the diversity and distribution of the *Charales* species in Ukraine.

Material and methods.

An analysis of the diversity and distribution of charophytes were conducted on the basis of herbarium materials: 150 samples fixed by 4% formaldehyde and exsiccate collected by Ukrainian botanists throughout Ukraine territory in 1938-1987 [7] and more then 800 ones in 1998-2010 (partly published [2–6,10,]). The material is stored in M.G. Khlodny Institute of Botany of National Academy of Sciences of Ukraine. Charophyte specimens were identified according to Manuals on charopytes of Ukraine [7] and Europe [14].

Results and discussions.

At present 41 species of *Charales* are recorded in the flora of Ukraine based on summarized published and original data. These are 25 species of the genus *Chara* L., 9 species of the genus *Nitella* C. Agardh, 4 species of the genus *Tolypella* (A.Braun) A. Braun, and one species of each of the genera *Lamprothamnium* J. Groves, *Lychnothamnus* (Rupr.) Leonh. emend. A. Braun, *Nitellopsis* Hy. All the species are listed below with the types of ecosystems in which they occurred and the number of occurrence (* – species cited from literature records [7, 9, 15]).

Characeae:*Charaarcuatofolia* Vilh. – small lakes, pools (5); *C. aspera* Dethard. ex Willd.– lakes, brackish bays and lagoons of sea (20); *C. braunii* C.C. Gmelin* – shallow ponds (including fish-breeding ponds), rivers (7); *C. canescens* Desv. et Loisel. in Loisel. – shallow brackish lakes (12); *C. connivens* Salzm. ex A. Braun – ponds, rivers (9); *C. contraria* A. Braun in Kütz. – lakes, ponds, rivers (24); *C. dominii* Vilh.*– lake (1); *C. intermedia* A. Braun (=*C. aculeolata* Kütz. in Rchb.) – lakes, ponds, canales, brackish bays and lagoons of sea (34); *C. fischeri* Mig.* – pool, spring (2); *C. fragifera* Durieu* – lakes (2); *C.globularis* Thuill. (=*C. fragilis* Desv. in Loisel.) – lakes, ponds, rivers, ditches (106); *C. galioides* DC.* – salt marsh (1); *C.gymnophylla* A. Braun* – rivers (6); *C. hispida* L. – lakes, ponds, bays, lagoons (12); *C.horrida* Wahlst.* – bays of sea (1); *C. muscosa* J. Groves et Bull.-Webst.* – lakes (2); *C.neglecta* Hollerb. – lakes, bays of sea (3); *C.polyacantha* A. Braun in A. Braun, Rabenh. et Stitzenb.* – lakes (3); *C. rudis* (A. Braun) Leonh. – lake (1); *C. schaffneri* (A. Braun) Allen* – lakes, paddy-fields (4); *C. tenuispina* A. Braun – lake, peat-mire, soil-reclamation canal (4); *Ch. tomentosa* L. (2); *C. uzbekistanica* Hollerb. – lakes, fish-breeding pond (3); *C. vulgaris* L. (including *C. vulgaris* var. *longibracteata* (Kütz.) J. Groves et Bull.-Webst.) – ponds, pools, rivers, old river-beds., lagoon (125); *C. virgata* Kütz. (=*Ch. delicatula* C. Agardh) – lakes, ponds, open pits, ditches (38); *Lamprothamnium papulosum* (Wallr.) J. Groves – bays of sea (12); *Lychnathamnusbarbatus* (Meyen) Leonh. – lakes (2); *Nitellopsis obtusa* (Desv. in Loisel.) J. Groves – lakes, ponds, rivers (25).

Nitelleae: *N. capillaris* (Krock.) J. Groves et Bull.-Webst. – rivers, pond, pool (3); *N. confervacea* (Bréb.) A. Braun ex Leonh. – pools (2); *N.flexilis* (L.) C. Agardh – ponds, rivers (22); *N. gracilis* (Sm.) C. Agardh – ponds, bogs (8); *N.mucronata* (A. Braun) Miq. in C.H. Hall – ponds, rivers (24); *N. opaca* (C. Agardh ex Bruz.) C. Agardh – ponds, lake (4); *N. syncarpa* (Thuill.) Chev. – ponds, lakes, ditches (6); *N. tenuissima* (Desv.) Kütz.* – ponds, river (4); *N. translucens* (Persoon) C. Agardh* – pond (1); *Tolypella glomerata* (Desv.) Leonh. – river (1); *T.intricata* (Trentepolh ex Roth) Leonh. – ditch (1); *T. nidifica* (O. Müll.) A. Braun* – lake, bay of sea (2); *T. prolifera* (Ziz ex A. Braun) Leonh. – lakes (5). Overall, more then 500 locations were revealed.

Some new localities of 31 species have been found after 2005. Four of them (*C. rudis*, *Lychnathamnus barbatus*, *T. glomerata* and *T. intricata*) are indicated as new species for the flora of Ukraine. Presences of the rest 10 species are not confirmed by new findings so far. The sites of some species such as *C. braunii*, *C. fragifera*, *N. tenuissima*, *T. nidifica* revealed in the past in several places have been transformed or become inaccessible, but new ones are expectable. However the existence of *C. dominii*, *C. horrida*, *C. galioides*, *C. gymnophylla*, *C. polyacantha*, *C. schaffneri* and *N. traslucens* is still questionable. Nevertheless, in compare with a number of some European and Asian countries a species diversity of the Ukrainian charophytes is rather rich due to a high variety of geographic, climatic and hydrological conditions [12].

The results of a survey of the each species distribution show that the most widespread species are *Chara vulgaris* and *C. globularis*. But *C. contraria*, *N. flexilis* and *Nitellopsis obtusa* also rather widely distributed in Ukraine occur less frequently. Some species such as *C. aspera*, *C. hispida*, *C. intermedia*, *C. virgata*, *L. papulosum* and *N.mucronata* are common in some separate regions (West or Central Ukraine, Black Sea etc). The rest species are rare to very rare and included in the Red List of *Charales* of Ukraine [15], 9 of them – in the Red Data Book of Ukraine [11].

Diversity of Ukrainian *Charales* algae in terms of numbers is different in some parts of Ukraine. The most number of species is revealed in Steppe (28) and Ukrainian Polissia (25), less in Forest-Steppe (22), the least in Ukrainian Carpathians (8) and the Azov and Black seas (9). It should be noted that the number of species in Ukrainian Polissia decreases from west to east. For example, the number of species is 20 in Volyn Polissia and 11 in Zhytomyr, 8-9 in Kyiv and Chernigiv Polissia. The same pattern of the distribution is observed in Forest-Steppe. There are 16 species of *Charales* in right bank area and 13 species in left bank area. However, the number of species in right bank area of Steppe is less then in left one and reaches 12 and 22, respectively.

The species composition of *Charales* in forest and steppe zones also is rather

different. In Forest-Steppe it shows a transitional character and mainly consists of some species from both forest and steppe zones. The basis of the *Charales* flora of Ukraine is the members of the genera *Chara* and *Nitella* which ratio varies depending on territories under study. Such difference is typical for different regions of Earth [13]. Thus, the ratio of species of the genera *Chara* and *Nitella* in Western Europe is 2:1, in Mediterranean countries – 3:1, in Asia within Holarctic region – 6:1. In the forest and forest-steppe zones of Ukraine this ratio is 2:1 as the most of European countries, in steppe zone – 3:1 as the Mediterranean ones. The members of other genera occur in some regions, e.g. *Tolypella* in Forest-Steppeand Steppe, *Lychnothamnus* – in Ukrainian Polissia and Forest-Steppe, *Lamprothamnium* – in Steppe (in shallow bays and lagoons of the Azov and Black seas). Also, a complex of species which occur most frequently is specific for the physiographic zones of Ukraine. In Ukrainian Polissia it is represented by *C. globularis*, *C. contraria*, *C. vulgaris*, *N. flexelis* and*N. mucronata*; in Forest-Steppe – *C. vulgaris* (including *C. vulgaris* var. *longibracteata*), *C. globularis* and *N. mucronata*; in Steppe – *C. vulgaris* (including *C. vulgaris* var. *longibracteata*), *C. hispida* and *Nitellopsis obtusa*; in the Azov and Black seas – *C. intermedia*, *L. papulosum* and so on. The same pattern of distribution can be noticed in other natural areas, e.g. in five regions of forest zone. In Volyn Polessia this complex includessuch species as *C. virgata*, *C. globularis*, *C. intermedia*, *C. contraria*, *C. aspera* and *C. vulgaris*; in Zytomyr – *C. virgata*, *N. flexilis* and *N. mucronata*; in Kyiv – *C. globularis* and *Nitellopsis obtusa*; in Chernigiv and Novgorod-Siversk Polessia – only *C. globularis*. The centers of *Charales* species diversities have been found. They are the lakes in Volyn Region and on the Black sea coast, the flood-lands of great rivers of Ukraine such as Danube, Dniester, Dnepro, Pivdennyi Bug, Siverskiy Donets, shallow bays and lagoons of the Azov and Black seas etc.

Conclusion

An analysis of summarized published and original data is revealed 41 species of *Charales* recorded in the flora of Ukraine which belongs to *Chara* L. (25), *Nitella* C. Agardh (9), *Tolypella* (A. Braun) A. Braun (4), *Lamprothamnium papulosum* (Wallr.) J. Groves, *Lychnothamnus barbatu*s (Meyen) Leonh. and *Nitellopsis obtusa* (Desv. in Loisel.) J. Groves. The most widespread species are *Chara vulgaris* and *C. globularis*. Also widely distributed in Ukraine *C. contraria* and *N. mucronata* occur less frequently. Some species such as *C. aspera*, *C. hispida*, *C. intermedia*, *C. virgata*, *L. papulosum*, *N. flexilis* and *Nitellopsis obtusa* are common in some separate regions.

The species composition of charophytes in Ukrainian Polissia, forest-steppe and steppe zones and other natural region is different that confirms of the zonal differentiation in distribution of the *Charales* genera and species within Ukrainian territory and a presence of some centers of the species diversity.

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