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## Geographical analysis of higher aquatic flora of Seversky Donets valley G.O.Kazarinova

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Geographical analysis of higher aquatic flora of Seversky Donets valley was carried out using the classification of types of species areas in the spatial three-dimensional coordinate system. Spectra of chorologic groups of species were made that reflect the phytogeographic structure of the investigated flora. It was established that the formation of its core was due to widely areal plurizonal circumpolar species indifferent to the degree of oceanity and continentality. It was found that the distinctive features of the investigated flora are significant participation of species with areas of northern attraction, almost equal representation of european and eurosibirian species, more of species of eucontinental group in comparison with aquatic floras of other regions of Ukraine.

**Key words:** *higher aquatic flora, geographical analysis, Seversky Donets.*

## Географічний аналіз вищої водної флори долини р. Северський Донець А.О.Казарінова

Проведен географічний аналіз вищої водної флори долини р. Северський Донець з допомогою методу класифікацій типів ареалів видів по просторовій тривимірній системі координат. Складено спектри хорологічних груп видів, які відображають фітогеографічну структуру досліджуваної флори. Встановлено, що формування її ядра походило за рахунок широкоареальних плюризональних циркумполярних видів, індиферентних по відношенню до ступеня океанічності та континентальності. Виявлено, що відмінними рисами досліджуваної флори є значна участь видів з ареалами північного тягіння, майже однакова представленість європейських і євросибірських видів, більше кількість видів євконтинентальної групи в порівнянні з водними флорами інших регіонів України.

**Ключевые слова:** *высшая водная флора, географический анализ, Северский Донець.*

## Географічний аналіз вищої водної флори долини р. Сіверський Донець Г.О.Казарінова

Проведено географічний аналіз вищої водної флори долини р. Сіверський Донець за допомогою методу класифікацій типів ареалів видів за просторовою тривимірною системою координат. Складено спектри хорологічних груп видів, які відображають фітогеографічну структуру досліджуваної флори. Встановлено, що формування її ядра відбувалося за рахунок широкоареальних плюризональних циркумполярних видів, індиферентних до ступеня океанічності та континентальності. З'ясовано, що відмінними рисами досліджуваної флори є значна участь видів з ареалами північного тягіння, майже однакова представленість європейських і євросибірських видів, більша кількість видів євконтинентальної групи в порівнянні з водними флорами інших регіонів України.

**Ключові слова:** *вища водна флора, географічний аналіз, Сіверський Донець.*

### Introduction

The valley of Seversky Donets administratively passes the territory of Belgorod, Kharkiv, Donetsk, Lugansk and Rostov regions of Ukraine and Russia. According to the physical-geographic zoning of Ukraine it crosses the forest-steppe zone on the edge of Kharkiv highland forest-steppe of the East-Ukrainian forest-steppe land and the steppe zone, where separates the Oril-Samara low-lying region of the Left-bank Dnieper-Priazov northern-steppe land, Western-Donetsk slope-highland region and Donetsk highland region of Donetsk northern-steppe land, and also Starobilsk slope-highland region of Zdonetsk-Donsk northern-steppe land. This region is characterized by a variety of environmental conditions, which leads to the existence of different types of natural and semi-natural ecosystems, including aquatic ones. Due to

continuous anthropogenic influence, the natural ecosystem of the region has undergone a significant transformation, so become relevant the questions of research and conservation of their floristic diversity.

Under higher aquatic flora we understand a complex of higher cryptogamic and flowering aquatic plants (aquatic and air-aquatic), for which the optimal habitat is aquatic environment (Raspopov, 1978; Papchenkov et al., 2006). The higher aquatic flora (hereinafter aquatic flora) of investigated territory is characterized by diversity. This is facilitated by the presence of different types of reservoirs of natural and artificial origin.

Aquatic flora in the region still remains insufficiently investigated. In the beginning of XX century at research of flora of Kharkiv and its neighboring provinces it, along with other types of vegetation, was studied by such famous researchers as V.M.Sukachev, M.Savenkov, M.M.Fadeev, E.M.Lavrenko (Kazarinova, 2011). However, in their works the little attention is paid to phytogeographical characterization of aquatic species of plants. A more detailed study of this question is found in the work of G.A.Chorna (Chorna, 1982). But in the basis of geographical analysis, conducted by above-mentioned authors, was laid zonal-regional principle, which makes impossible describing of areas of aquatic species in sufficient detail, since their formation occurred with relative independence from the climate and relief (Dubyna, Shelyag-Sosonko, 1984).

The purpose of this study is to identify the features of the geographical structure of higher aquatic flora of Seversky Donets valley and its comparison with the aquatic floras of other regions of Ukraine.

### Materials and methods

The article deals with the results of field researches, conducted in the 2011–2014, that covered the different types of reservoirs of Seversky Donets valley. The gathering of material was performed using the reconnaissance and detailed-route methods. To establish the species composition of aquatic flora there were used own and literature data, and also herbarium collections from herbaria of Kyiv and Kharkiv (KW, CWU).

To analyze the geographical structure of higher aquatic flora of Seversky Donets valley there was taken as a basis the scheme of botanical-geographical regionalization of the world, developed by Meusel with collaborators (Meusel et al., 1965). It allows to estimate equally all types of areas, to identify the different in size and detailing groups, to determine their zonal and regional affinity and degree of oceanity and continentality (Dubyna, Shelyag-Sosonko, 1984). On the base of this scheme there were composed spectra of chorologic groups of species that reflect the geographic structure of higher aquatic flora of Seversky Donets valley.

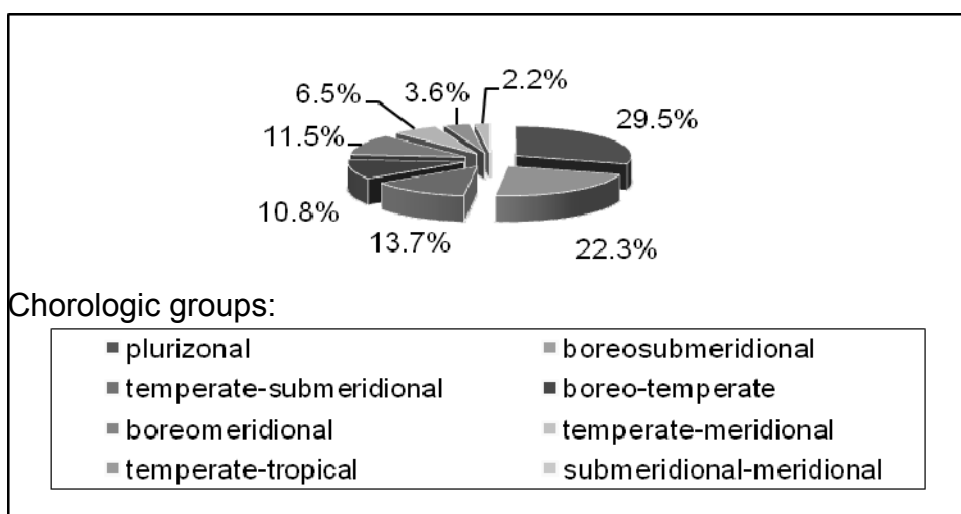
### Results and discussion

In zonal relation to the type of area the higher aquatic flora of investigated region is represented by 8 chorologic groups: I – plurizonal group, which includes species with areas in arctic, boreal, temperate, meridional and tropical zones; II – boreosubmeridional group, which represented by species with areas in boreal, temperate and submeridional zones; III – boreo-temperate group, consisting of species with areas in boreal and temperate zones; IV – boreomeridional group, in which included the species with areas in boreal, temperate, submeridional and meridional zones; V – temperate-tropical group represented by species with areas in temperate, submeridional and tropical zones; VI – temperate-meridional group with species, which have the areas in temperate, submeridional and meridional zones; VII – temperate-submeridional group, which include the species with areas in temperate and submeridional zones; VIII – submeridional-meridional group with the species, which are characterized by areas in submeridional and meridional zones.

It is established that the core consists of species of plurizonal (29.5%) and boreosubmeridional groups (22.3%) (fig. 1). Further there are temperate-submeridional (13.7%), boreomeridional (11.5%), boreo-temperate (10.8%) groups. Significantly fewer there are the representatives of temperate-meridional (6.5%), temperate-tropical (3.6%) and submeridional-meridional (2.2%) groups.

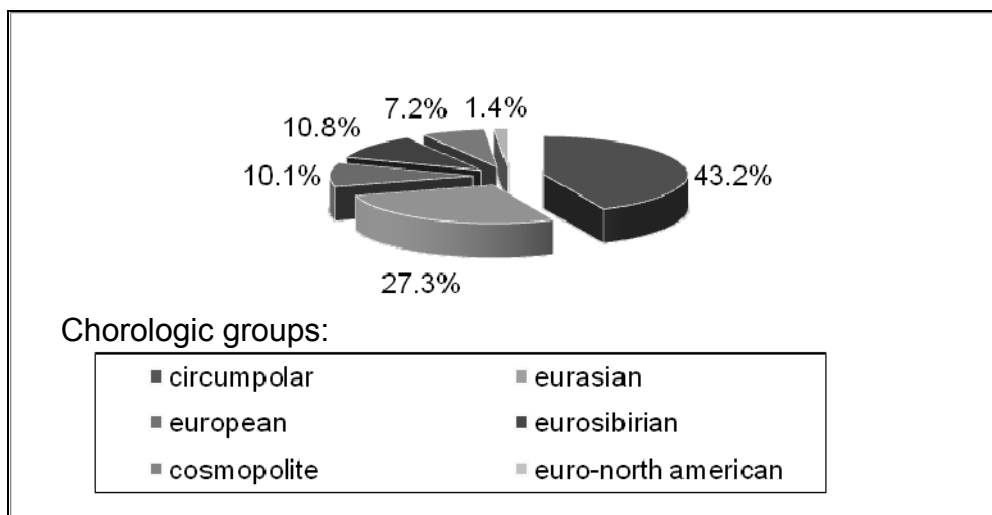
A similar ratio of groups is typical for chorologic spectra of aquatic flora of Western Podolia, south-western regions of the Left Bank Forest-Steppe (basin of river Sula), Volyn-Podolsk upland, Precarpathian and Carpathians and Ukraine as a whole (Dubyna, Shelyag-Sosonko, 1984; Kozak, 2009; Borsukevych, 2009; Starovoitova, 2013). It should be noted that in the higher aquatic flora of investigated region compared to aquatic flora of Ukraine proportion of species with boreosubmeridional, boreo-temperate and boreomeridional types of area is higher, with temperate-submeridional, temperate-meridional and submeridional-meridional types of area – lower. This is due to the penetration of boreal elements south along the Seversky Donets valley. Representation of species with submeridional-meridional and temperate-tropical

types of area, that are confined to the more southern regions, is caused by location of investigated region in the forest-steppe and steppe zones, as well as the participation of adventive species.



**Fig. 1. The distribution of species in zonal chorologic spectrum**

In accordance with the regional distribution the cosmopolite, circumpolar, eurasian, euro-north american, eurosibirian and european types of areas are distinguished. In regional chorologic spectrum of higher aquatic flora of Seversky Donets valley the circumpolar (43.1%) and eurasian (27.3%) species are prevailed (fig. 2). There are much less the species with european (10.1%), eurosibirian (10.8%) and cosmopolite (7.2%) types of areas. The species with the euro-north american type of area (1.4%) are also presented.

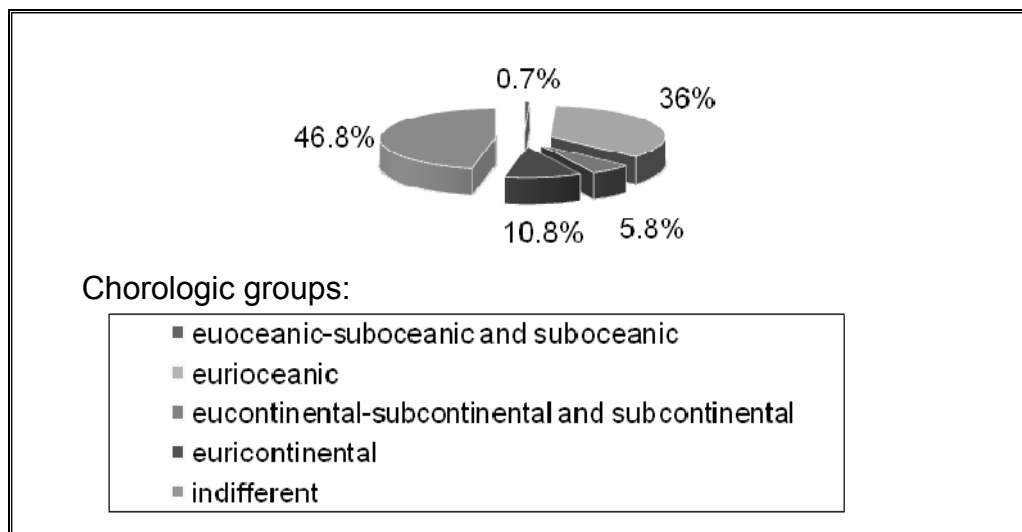


**Fig. 2. The distribution of species in regional chorologic spectrum**

The prevalence of circumpolar and eurasian species is characteristic for higher aquatic flora of Ukraine as a whole (Dubyna, Shelyag-Sosonko, 1984). The investigated territory differs by almost equal participation of eurosibirian and european species in aquatic flora (10,8% and 10,1% respectively). In flora of reservoirs of forest-steppe of Ukraine (Chorna, 2006) european species predominate over eurosibirian (11,6% and 16,8% resp.). The same trend is typical for aquatic flora of Ukraine as a whole (7,19% and 14,3% resp.). This is due primarily to zonal-climatic conditions. European species are often associated with

nemoral and submeridional zones, which include the forest-steppe and steppe regions of Ukraine. Therefore, the part of european species in the above regions is higher. Eurosibirian species are characteristic for more northern regions, mainly located in the boreal zone. On the one hand, the high percentage of european species is typical for investigated territory, which crosses the forest-steppe and steppe zones. On the other hand, a significant part of boreal elements in higher aquatic flora of Seversky Donets valley explains the increase in the proportion of species with eurosibirian type of area.

Depending on the nature of the location of areas of species in the oceanic or inland (continental and transitional) regions were identified five types of areas (fig. 3). The most numerous is group of indifferent species (46.8%). A significant part is of euriocenic group (36%). Euricontinental species are less represented (10.8%). Eucontinental species make up 5.8%, euoceanic – 0.7% of the total number of aquatic species.



**Fig. 3. The distribution of species according to the degree of oceanicity/continentality**

It is determined that in comparison with aquatic flora of Forest-steppe and Ukraine as a whole, for the investigated territory the ratio between the number of species of euoceanic and eucontinental groups differs and is 1:8. This is explained by a more continental climate of investigated territory and confirmed by the data obtained for other regions of Ukraine, where, in connection with more pronounced oceanic conditions, the ratio of these two groups varies from 1:1 (Kozak, 2006; Starovoitova, 2013) to 1:2 (Chorna, 2006; Borsukevych, 2009).

In structure of higher aquatic flora of Seversky Donets valley there is also one endemic species of Southeastern Europe (*Ceratophyllum tanaiticum* Sapjog.). Aquatic flora of the region, as well as a whole of Ukraine, is characterized by a low index of endemism due to the leveling conditions of the aquatic environment and climatic indifference of species.

### Conclusion

The analysis of the geographical structure of higher aquatic flora of Seversky Donets valley proved that its formation was due to widely areal plurizonal circumpolar species, indifferent to the degree of oceanicity and continentality, that coincides with chorologic spectrum of higher aquatic flora of Ukraine as a whole. A characteristic feature of the flora of investigated territory is significant participation of species with areas of northern attraction, almost equal representation of european and eurosibirian species, more of species of eucontinental group compared to aquatic floras of other regions of Ukraine.

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