

RARE SPECIES OF ALGAE IN THE FLORA OF PONDS OF THE “OLEXANDRIA” DENDROLOGICAL PARK OF THE NAS OF UKRAINE

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Abstract. During 2023–2025, investigations of the algal species composition in the ponds of the “Olexandria” Dendrological Park of the National Academy of Sciences of Ukraine were carried out using traditional algological methods, including light microscopy and scanning electron microscopy. The study revealed that the algal flora of the park comprises 220 species. Among them, ten species rare for the Forest-Steppe zone of Ukraine were recorded: *Ellerbeckia arenaria* f. *teres* (Brun) R.M. Crawford, *Stephanodiscus parvus* Stoermer & Håkansson, *Diploneis oculata* (Brébisson) Cleve, *Surirella brebissonii* Krammer & Lange-Bertalot, *Fallacia subhamulata* (Grunow) D.G. Mann, *Stauroneis acuta* W. Smith, *Scenedesmus bacillaris* Gutw. In addition, one species, from Charophyta division — *Nitella* cf. *gracilis* (J.E. Sm.) C. Agardh, listed in the Red Book of Ukraine, was recorded in the studied ponds. These findings highlight the conservation value of the algal flora of the “Olexandria” Dendrological Park and emphasize the importance of continued monitoring of its aquatic ecosystems.

Keywords: Bila Tserkva, algae, dendrological park, rare species.

INTRODUCTION

The problem of studying and conservation biological diversity in Ukraine has gained global importance over the past decade due to climate change and the deterioration of various environmental factors, including environmental pollution caused by a full-scale war. According to the Ministry of Environmental Protection and Natural Resources of Ukraine, 20% of the country’s protected areas, including 600 species of animals and 750 species of plants and fungi, have been damaged. Russia occupied 8 national reserves and 12 national parks. Ukraine is one of the countries with great floristic diversity. On its territory grow more than 28 thousand species of plants along with algae and fungi. Algoflora of Ukraine is one of the richest in Europe and is quite fully and in detail studied. Algoflora of Ukraine unites 6553 species, represented by 7538 species and intraspecific taxa [4]. It represents over 42% of the species composition of the global continental algae flora, or about 10% of the Earth’s algal flora [3; 6; 7]. The basis of the species richness of the algal flora of Ukraine (about 72%) is formed by heterokontophyta (Heterokontophyta), green (Chlorophyta) and charophyte (Charophyta) algae [4]. The Red Book of Ukraine lists 60 species of algae. Among them, 1 species

is threatened with extinction (endangered), 29 are rare, and 30 are vulnerable [5]. Some objects of the nature reserve fund of Ukraine have a high species richness of algal flora. The algae flora of the Gomilshan Forests National Nature Park includes about 1,500 species of freshwater algae [11]. According to current data, 771 species, varieties and forms of algae from 13 departments have been identified in the territory of the Polesie Nature Reserve. The most numerous are green, diatom and desmids algae. 49 rare species have been identified in the reservoirs of the reserve, 7 of which are listed in the Red Book of Ukraine (2009) - *Pseudopediastrum kawraiskyi* (Schmidle) E.Hegewald, *Bulbochaete subquadrata* Mroziriska, *Roya anglica* G.S.West, *Bambusina brebissonii* Kützing, *Nitella gracilis* (J.E.Smith) C.Agardh, *Chara delicatula* C. Agardh, *Batrachospermum gelatinosum* De Candolle [8]. The diversity of algae in the Carpathian Biosphere Reserve has been studied fragmentarily. To date, the algal flora has 787 species, represented by 842 intraspecific taxa. The Red Book algae of the reserve are represented by two species - *Penuim borgeanum* Skuja and *Bambusina brebissonii* Kutz. ex Kutz. [9]. The algae flora of the Desniansko-Starohutsky National Nature Park is one of the richest in Ukrainian Polissya and includes 598 species [2,10]. The flora of Shatsk National Nature Park includes 265 species of diatoms [12]. Among the objects of the nature reserve fund of Ukraine, the algae flora is somewhat better studied in reserves and natural parks than in botanical gardens and dendroparks.

MATERIALS AND METHODS

During 2023-2025 years we studied the species diversity of algae of ponds of the “Oleksandria” Dendrological Park of the NAS of Ukraine. The “Oleksandria” Dendrological Park is located in the valley of the Ross River and has an area of more than 400 hectares.

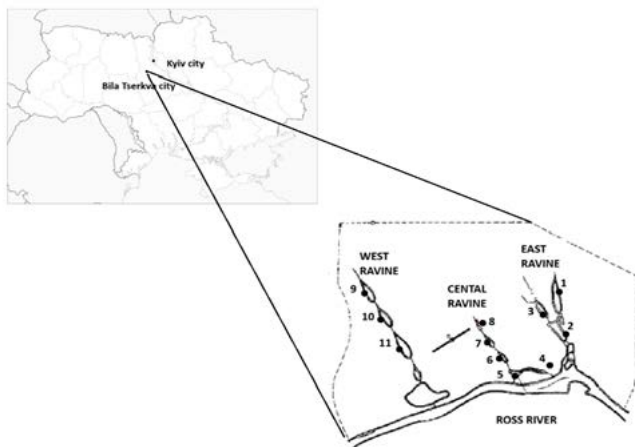


Figure 1. The map of location of the ponds of the “Olexandria” Dendrological Park: Water sampling sites: the Eastern ravine (1— “Dzerkalnyi”, 2 — “Laznevyi”, 3 — “Kholodnyi” ponds), the Central ravine (4 — “Lake Diana” pond, 5 — “Sribnyi Serpanok”, 6 — “Popovychiv Stav”, 7 — “Lebedynyi”, 8 — “Akvarium Zolotoi Rybky” pond), and the Western ravine (9 — “Poterchata”, 10 — “Rusalka”, 11 — “Vodianyky” ponds).

The hydrographic network of the Park is represented by the Ross River and the streams flowing into it. In the ravines on the park's territory situated decorative ponds that accumulate surface runoff and groundwater from aquifers (fig. 1)

The ponds are grouped into three cascades: eastern, central and western. The total area of the water surface of all ponds is 12 hectares. Currently, the ponds of the Park are under the influence of long-term technogenic pollution. Among the ponds of the three cascades, the waters of the western one are the most polluted. Main pollutants are ammonium ion (NH_4^+), nitrites (NO_2^-), nitrates (NO_3^-), hexavalent chromium (Cr^{6+}) and petroleum products.

The collection of algal material was carried out according to generally accepted methods, using the plankton net with a pore diameter of 10 μm . The material for the study of algae species diversity was algological samples taken during the summer period from 2023 -2025. Periphyton, benthic, and phytoplankton samples were collected. Phytoplankton samples were taken from the water surface using a boat at a distance of at least 2 m from the shoreline.

During the 2025 sampling campaign, water temperature, pH, salinity, and electrical conductivity were measured in situ. the (Table. 1). The samples were processed in a live and fixed state (4% formaldehyde solution).

Table 1.

Characteristics of the sampling sites and in situ environmental parameters

Water sampling sites	pH	T° C	TDS, ppm	Con, us	Salt, ppt
Eastern ravine					
1.Pond „Dzerkalnyi”	7,00	16,1	475	870	0,49
2.Pond „Laznevyi”	7,80	18,9	443	885	0,53
3.Pond „Kholodnyi”	7,27	16,8	432	864	0,52
Central ravine					
4. Pond “Lake Diana”					
5. Pond „Sribnyi Serpanok”	6,92	20,1	277	555	0,32
6. Pond „Popovychiv Stav”	7,19	20,7	306	613	0,35
7. Pond „Lebedynyi”	7,20	20,0	262	523	0,30
8. Pond „Akvarium Zolotoi Rybky”	7,28	19,0	316	633	0,37
Western ravine					
9.Pond „Poterchata”	7,27	21,7	150	299	1,61
10 Pond „Rusalka”	7,16	21,4	128	255	1,36
11.Pond „Vodianyky”	7,63	20,7	588	1176	0,71

Diatom samples were prepared using a standard technique with 35% H_2O_2 [13] and mounted in Naphrax® (RI = 1.74) [14]. Samples were examined using light microscopy (Olympus BX-53) and SEM (JEM-1230) at the M.G. Kholodny Institute of Botany, NAS of Ukraine.

RESULTS AND DISCUSSIONS

The results of the study showed that the algal flora of the ponds of the “Olexandria” Dendrological Park currently comprises 220 species (234 infraspecific taxa). The most species-rich divisions are Chlorophyta and Heterokontophyta, which together account for 86% of the total species diversity. The leading genera are *Desmodesmus* (Chodat) An, Friedl & E. Hegew. (10 species), *Navicula* Bory (9), *Monoraphidium* Komárk.-Legn. (5), *Scenedesmus* Meyen (4), and *Euglena* Ehrenb. (4). The quantitative development of the algal communities is mainly formed by cyanobacteria, green algae, and diatoms. During the summer period, all ponds were characterized by cyanobacterial blooms caused by *Aphanizomenon flos-aquae* and *Dolichospermum flos-aquae*.

The highest species diversity was recorded in the ponds of the Eastern Cascade, particularly in the “Laznevyi” Pond, where 77 species were identified. Measurements of the physicochemical parameters of the water in the ponds of the Eastern Cascade showed that their water quality characteristics are typical of natural, fresh, moderately mineralized water bodies.

Results of investigation showed that in the ponds of the eastern cascade of the Park were discovered more than 10 rare species for the Forest-Steppe of Ukraine: *Ellerbeckia arenaria* f. *teres* (Brun) R.M. Crawford, *Stephanodiscus parvus* Stoermer & Håkansson, *Diploneis oculata* (Brébisson) Cleve, *Fallacia subhamulata* (Grunow) D.G. Mann, *Stauroneis acuta* W. Smith, *Surirella brebissonii* Krammer & Lange-Bertalot, *Scenedesmus bacillaris* Gutw., *Caloneis bacillum* (Grunow) Cleve. and other.

The conducted studies showed that the algal flora of the ponds of the State Dendrological Park “Olexandria” of the National Academy of Sciences of Ukraine has algosozological value [15] and is characterized by the presence of rare. In particular, two representatives of the stonewort genus *Nitella* (Characeae, Charophyta), *N. confervacea* (Bréb.) A. Braun ex Leonh. and *N. gracilis* (J.E. Sm.) C. Agardh, were recorded by different scientists.

*Nitella confervacea** (Bréb.) A. Braun ex Leonh. (= **Nitella gracilis** var. **confervacea** Bréb.) is included in the IUCN Red List with the status ****Vulnerable (VU)**** and is legally protected in Ireland, the United Kingdom, and Norway. In Ukraine, only two recent localities have been reported, in Zhytomyr Region (2009) and Kyiv Region (2012) [1]. The species is considered extremely rare and faces a high risk of extinction [16]. A specimen was previously collected by H.H. Liliiska in the summer of 2012 from one of the water bodies within the “Olexandria” Dendrological Park, although the exact sampling locality was not specified.

*Nitella gracilis** (J.E. Sm.) C. Agardh (fig.2) is a rare relict species with a gradually declining distribution range. Owing to its vulnerable conservation status, it was included in the third edition of the Red Data Book of Ukraine [5]. At present, only eight localities of this species have been documented in Ukraine, three of which, located in the vicinity of Lviv and Kharkiv, have already disappeared. The newly discovered population in the “Diana” Pond of the “Olexandria” Dendrological

Park represents the sixth currently confirmed locality in Ukraine and the first record for Kyiv Region.

The specimen was collected on 15 July 2024 from a depth of 2 m. At the time of sampling, the water had a pH of 7.48, a temperature of 25.3°C, an electrical conductivity of 377 $\mu\text{S cm}^{-1}$, and a total dissolved solids (TDS) concentration of 201 mg L^{-1} . *Nitella confervacea* (Bréb.) A.Braun ex Leonh. is rare species, under extreme threat of extinction. In Ukraine two modern locations are known - within the Zhytomyr region (2009) and in the Kyiv region (2012) [1]. The species was discovered and collected by G.G. Liliitskaya in the summer of 2012 in one of the ponds in the territory of the the “Olexandria” Dendrological Park, without specifying the location.

An important finding of this study was the detection of oospores of another charophyte, *Nitella mucronata* (A.Braun) Miquel, in the collected algological samples (fig.2)

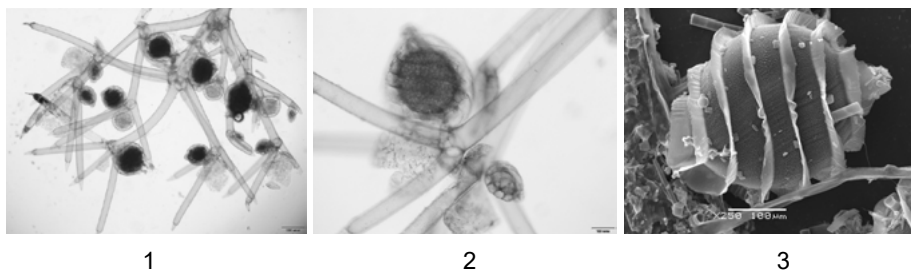


Figure 2. 1–2 – Thallus fragment of *Nitella gracilis* with antheridia and oogonia (scale bar 100 μ); recorded in water samples from the “Lake Diana” pond; 3 – oospores of *Nitella mucronata* (A.Braun) Miquel

The possibility of misidentification between these species at certain stages of development has been noted by several authors and corroborated by recent studies (Charophytes of Europe, 2024). Therefore, further molecular phylogenetic analyses are required to clarify the taxonomic status of the collected specimens and to confirm the occurrence of *Nitella gracilis* in the flora of Ukraine.

CONCLUSIONS

1.The results of the research showed that the species diversity of algae in ponds of the “Olexandria” Dendrological Park currently includes 220 species (234 intraspecific taxa).

2. The conducted studies showed that the algal flora of the ponds of the Dendrological Park “Olexandria” has algosozological value and is characterized by the presence of rare species that require protection and conservation. In particular, 2 representatives of charophyte algae (Characeae, Charophyta), genus *Nitella*, were noted, namely - *N. confervacea* and *N. gracilis*.

3. It is shown that 10 rare species for the Forest-Steppe of Ukraine - *Ellerbeckia arenaria* f. *teres*, *Stephanodiscus parvus*, *Thalassiosira faurii*, *Diploneis oculata*, *Surirella brebissonii*, *Fallacia subhamulata*, *Stauroneis acuta*, *Surirella minuta*

Brébisson, *Scenedesmus bacillaris*, *Caloneis bacillum* were found in the algal flora and one species *Nitella gracilis*, listed in the Red Book of Ukraine.

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