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BIODIVERSITY STUDIES

New data on aquatic flora of eastern Uzbekistan highlight the need of its detailed study in the whole country

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ABSTRACT

The floristic research in Uzbekistan was intensified in the 21st century, being raised on new methodological level. As plants of aquatic habitats are often missed in routine floristic studies, we aimed to test the completeness of aquatic flora representation in the checklists, published recently for particular administrative regions. We studied all types of waterbodies in Dzhizak, Navoi, Samarkand and Tashkent regions. We revealed three taxa new for Uzbekistan (*Bolbochoenus laticarpus*, *Potamogeton* × *angustifolius*, *Limosella aquatica*). All the 12 species that we found for the first time in some regions of the country are not rare in Uzbekistan and in Central Asia in general. Thus, in spite of significant progress of floristic studies in Uzbekistan, more attention still should be paid to aquatic plants. Lowland artificial freshwater reservoirs and montane lakes are the most promising for future aquatic plant surveys.

Keywords: barcoding, Central Asia, field survey, lake, reservoir

РЕЗЮМЕ

Волкова П.А., Иванова М.О., Дадыкин И.А., Бобров А.А. Новые данные о водной флоре восточного Узбекистана свидетельствуют о необходимости ее подробного изучения на территории всей страны. Исследования флоры Узбекистана в XXI веке интенсифицированы на новом методическом уровне. Поскольку водные растения часто пропускают при рутинных флористических работах, мы решили проверить полноту информации о гидрофильном компоненте флоры, представленной в недавно опубликованных кадастрах флоры отдельных административных областей страны. Мы обследовали все типы водных объектов в Джизакской, Навоийской, Самаркандской и Ташкентской областях. Обнаружили три новых для Узбекистана таксона (*Bolbochoenus laticarpus*, *Limosella aquatica*, *Potamogeton* × *angustifolius*). Все 12 видов, которые мы обнаружили впервые для отдельных областей страны, нередки в Узбекистане и Средней Азии в целом. Таким образом, несмотря на значительный прогресс флористических исследований в Узбекистане, следует уделить дополнительное внимание водному компоненту флоры. Наибольшего разнообразия водных растений следует ожидать в равнинных водохранилищах и горных озерах.

Ключевые слова: водохранилище, генетическое штрихкодирование, озеро, полевые исследования, Средняя Азия

Uzbekistan, one of the largest Central Asian countries, is characterized by diverse landscapes and rich flora that has been studied almost for two centuries (reviewed e.g. by Tozhibaev et al. 2021). The floristic research in this country was intensified in the 21st century, being raised on new methodological level (Sennikov 2016). The main attention was paid to the eastern part of the country, characterized with the most complex relief (from lowland deserts to alpine glaciers). This resulted in a series of flora checklists for particular administrative regions of Uzbekistan (Tozhibaev et al. 2018, 2019, 2021, Gaziev 2025).

During these studies, quite rich aquatic flora was reported for different regions of Uzbekistan. For example, in Dzhizak Region, hydrophytes belonged to a number of genera (Tozhibaev et al. (2021): *Aldrovanda* L., *Ceratophyllum* L., *Lemna* L., *Marsilea* L., *Myriophyllum* L., *Najas* L., *Persicaria* Hill, *Ranunculus* L. section *Batrachium* DC., *Potamogeton* L., *Ruppia* L., *Salvinia* Ség., *Sparganium* L., *Stuckenia* Börner, *Utricularia* L., *Vallisneria* L., *Zannichellia* L.). However, plants of aquatic habitats are often missed in routine floristic studies that we have demonstrated on example of Kyrgyzstan (Volkova et al. 2024b) and Tajikistan (Volkova et al. 2024a). In this respect, we aimed to test the completeness of aquatic flora representation in the available checklists to evaluate the possibility of their integration in distribution patterns analysis of Central Asian macrophytes.

MATERIAL AND METHODS

Field studies were conducted on 24 June – 6 July 2024 by P. Volkova and I. Dadykin. We studied all types of waterbodies in the following botanical-geographic regions (according to Sennikov et al. 2016, see Fig. 1): Nuratau (Mountain Central Asian province; Nuratinskii Ridge in Navoi and Dzhizak administrative regions); Middle Zeravshan (Turan province; valley of Zeravshan River in Samarkand administrative region); Mirzachul (Turanian province; eastern shore of Aidarkul Lake in Dzhizak administrative region); Chinaz (Turanian province; northern shore of Tuyabuguz Reservoir in Tashkent administrative region). We focused on aquatic plants, additionally sampling semiaquatic plants whenever possible.

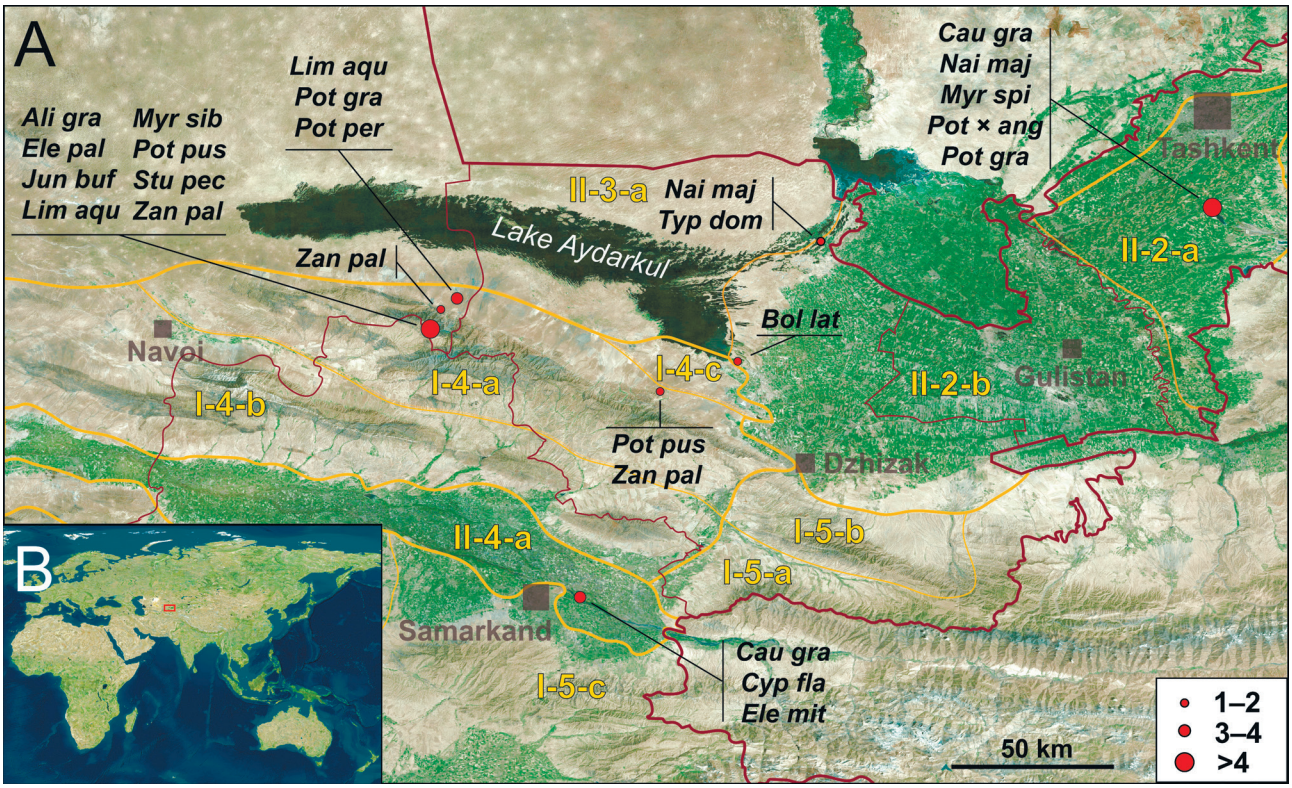

Figure 1 Floristic findings in eastern Uzbekistan (A) and its location on the global map (B), basing on satellite image. All taxa names are abbreviated, localities are indicated by red circles (with size proportional to the number of new taxa). Administrative borders are marked with dark red lines (thin line is the country border); region centers are indicated. Borders and abbreviations of botanical-geographical regions are given in yellow according to Sennikov et al. (2016). We studied the following regions: Nuratau (I-4-a); Middle Zeravshan (II-4-a); Mirzachul (II-2-b); Chinaz (II-2-a)

All the herbarium specimens cited below are stored in IBIW (Papanin Institute for Biology of Inland Waters RAS, Borok, Russia, https://en.herb.ibiw.ru). For each specimen, the accession number is indicated (the digital photos of voucher specimens are available on request). All specimens were identified according to Kovalevskaya (1968), Pakhomova (1976), Adylov (1987), if not stated otherwise, by M. Ivanova with consultations of A. Bobrov. The identifications in critical groups were approved by genetic analysis as described in detail for each genus elsewhere (*Myriophyllum*: Volkova et al. 2024c; *Najas*: Rüegg et al. 2017; *Typha*: Volkova & Bobrov 2022). The isolate number is provided for each specimen that was analyzed genetically.

RESULTS

Three additions to the flora of Uzbekistan

Bolboschoenus laticarpus Marhold, Hroudová, Ducháček et Zákr. – Dzhizak Region, eastern shore of Tuzkan Lake (outskirts of Lolazor village), pond bank, 40.458437°N 67.649885°E, 250 m, 26.06.2024, IBIW 78477. It has wide range in Eurasia, but is known in Central Asia only from northern Kazakhstan (Tatanov 2007). *Bolboschoenus laticarpus* could be distinguished from the rest of Eurasian *Bolboschoenus* taxa by the endocarp cells, non-visible on the entire fruit surface (Tatanov 2007). This species, basing on morphological variation, is supposed to be a stabilized hybrid of *B. yagara* (Ohwi) Y.C. Yang et M. Zhan with either *B. planiculmis* T.V. Egorova or *B. maritimus* (L.) Palla (Tatanov 2007). The latter two species were reported from Dzhizak Region (Tozhibaev et al. 2021), where we found *B. laticarpus*, and we collected *B. maritimus* (IBIW 78477) directly in the locality of *B. laticarpus*.

Limosella aquatica L. – **1**. Navoi Region, Nuratinskii Ridge, 2 km north of Sentyab village, reservoir, 40.643079°N 66.681024°E, 550 m, 30.06.2024, IBIW 78492. **2**. Navoi Region, Nuratinskii Ridge, northern shore of Fazilman Lake, 40.552165°N 66.588563°E, 1650 m, 01.07.2024, IBIW 78493. The species was known from all Central Asian countries, with except for Uzbekistan (Adylov 1987). Low number of existing records, especially the most recent ones, indicates not the species rarity, but rather insufficient attention to aquatic flora in Central Asia (Volkova et al. 2024b). Registration of annual *L. aquatica* is also hampered by unsustainability of its populations that is typical for species of drying mud (Salisbury 1967).

Potamogeton* × *angustifolius J. Presl (*P. gramineus* L. × *P. lucens* L.) – Tashkent Region, northern shore of Tuyabuguz Reservoir, 40.99106°N 69.31135°E, 400 m, 06.07.2024, IBIW 78511–78512. The hybrid was previously reported in Asia for one river in north-western Mongolia (Shiga et al. 2020) and one lake in southern Kyrgyzstan (Kovalevskaya 1968), being not rare in the southern part of Siberia (Chepinoga et al. 2024). In Tuyabuguz Reservoir we found it in mixed thickets with one of the parental species (*P. gramineus*, Fig. A1). Our specimens resemble *P. gramineus*, differing from it by shortly petiolate submersed leaves (they are sessile in *P. gramineus* and petiolate in *P. lucens*).

Additions to some regions of Uzbekistan

Alisma gramineum Lej. – Navoi Region, northern shore of Fazilman Lake, 40.552165°N 66.588563°E, 1650 m, 01.07.2024, IBIW 78474–78475. The species was previously known in Uzbekistan only from Tashkent (Gaziev 2025) and Samarkand (Zaamin: Kudryashev 1941) regions and has been recently observed on the Fazilman Lake by N.Yu. Beshko (https://www.inaturalist.org/

observations/227932158). We firstly publish the finding of *A. gramineum* for Navoi Region.

Caulinia graminea (Delile) Tzvel. (*Najas graminea* Delile) – **1**. Samarkand Region, valley of Zeravshan River, 2 km SW of Sulakli village, lake, 39.62365°N 67.18306°E, 750 m, 03.07.2024, IBIW 78501. **2**. Tashkent Region, western shore of Tuyabuguz Reservoir, pond, 40.99481°N 69.27816°E, 350 m, 05.07.2024, IBIW 78502. The species was known in Uzbekistan from several localities in central and western parts of the country (Triest 1988). We firstly report it for Samarkand (Fig. A2) and Tashkent regions.

Cyperus flavescens L. (*Pycreus flavescens* (L.) P. Beauv. ex Reichenb.) – Samarkand Region, valley of Zeravshan River, 2 km SW of Sulakli village, lake, 39.62365°N 67.18306°E, 750 m, 03.07.2024, IBIW 78483. The species was previously known in Uzbekistan from Tashkent Region (Gaziev 2025), we firstly report it for Samarkand Region (Fig. A2).

Eleocharis mitracarpa Steud. – Samarkand Region, valley of Zeravshan River, 2 km SW of Sulakli village, lake, 39.62365°N 67.18306°E, 750 m, 03.07.2024, IBIW 78485. The species was previously known in Uzbekistan from Dzhizak (Tozhibaev et al. 2021) and Tashkent (Gaziev 2025) regions, we firstly report it for Samarkand Region (Fig. A2).

Najas major All. – **1**. Dzhizak Region, Arnasai lake system, eastern part of Aidarkul Lake, 40.88358°N 67.93370°E, 250 m, 25.06.2024, IBIW 78503, isolate 24-232. **2**. Tashkent Region, western shore of Tuyabuguz Reservoir, fish pond, 40.99506°N 69.27888°E, 350 m, 05.07.2024, IBIW 78504, isolate 24-233. **3**. Tashkent Region, northern shore of Tuyabuguz Reservoir, 40.99106°N 69.31135°E, 400 m, 06.07.2024, IBIW 78505 (Fig. A1). This species is usually not separated from *N. marina* L., in spite of their morphological and genetical differences (Rüegg et al. 2017). *Najas major* was indicated for Central Asia in general (Tzvelev 1976), being only recently documented for northern Kyrgyzstan by joint genetic and morphological analysis (Volkova et al. 2024b). We firstly report it for Dzhizak and Tashkent regions of Uzbekistan.

Potamogeton gramineus L. (*P. heterophyllus* Schreber.) – **1**. Navoi Region, Nuratinskii Ridge, 2 km north of Sentyab village, reservoir, 40.643079°N 66.681024°E, 550 m, 30.06.2024, IBIW 78516–78518. **2**. Tashkent Region, northern shore of Tuyabuguz Reservoir, 40.99106°N 69.31135°E, 400 m, 06.07.2024, IBIW 78519. The species was reported in Uzbekistan only from one locality in the vicinities of Fergana city (Kudryashev 1941). We firstly report it for Navoi (Fig. A3) and Tashkent (Fig. A1) regions.

Typha domingensis Pers. – Dzhizak Region, Arnasai lake system, wet lowland, 40.902896°N 67.949213°E, 250 m, 25.06.2024, IBIW 78569, isolate 24-234. The species is known for different regions of Uzbekistan (GBIF Secretariat 2023) and perhaps has been reported for Uzbekistan under the name *T. angustata* Bory et Chaub. (Kudryashev 1941, Kovalevskaya 1968, Tozhibaev et al. 2021), although the taxonomy in sect. *Bracteolatae* Graebn. is confusing (Volkova & Bobrov 2022). It is the first verified record in Dzhizak Region (Fig. 2).

Novelties for Nuratau botanical-geographic region (Nuratinskii Ridge)

Eleocharis argyrolepis Kier. – Navoi Region, northern shore of Fazilman Lake, 40.552165°N 66.588563°E, 1650 m, 01.07.2024, IBIW 78484.

Potamogeton perfoliatus L. – Navoi Region, 2 km north of Sentyab village, reservoir, 40.643079°N 66.681024°E, 550 m, 30.06.2024, IBIW 78528.

Potamogeton pusillus L. – **1**. Dzhizak Region, 1.5 km west of Karatash village, pond, 40.37047°N 67.38522°E, 600 m, 29.06.2024, IBIW 78535–78536. **2**. Navoi Region, northern shore of Fazilman Lake, 40.552165°N 66.588563°E, 1650 m, 01.07.2024, IBIW 78537.

Stuckenia pectinata (L.) Börner – Navoi Region, northern shore of Fazilman Lake, 40.552165°N 66.588563°E, 1650 m, 01.07.2024, IBIW 78565–78566.

The four above listed species were known from several lowland and foothill botanical-geographic regions of Dzhizak Region (Tozhibaev et al. 2021) and from Zeravshan River valley of adjacent administrative regions: Lower Zeravshan in Navoi Region (Tozhibaev et al. 2019) and Middle Zeravshan in Samarkand Region (Tozhibaev et al. 2018).

Zannichellia palustris L. aggr. – **1**. Dzhizak Region, 1.5 km west of Karatash village, slow stream, 40.36859°N 67.38802°E, 600 m, 29.06.2024, IBIW 78576–78577. **2**. Navoi Region, northern shore of Fazilman Lake, 40.552165°N 66.588563°E, 1650 m, 01.07.2024, IBIW 78578–78579. **3**. Navoi Region, 3 km south of Sop village, stream, 40.61276°N 66.64411°E, 700 m, 02.07.2024, IBIW 78580 (Fig. A4). In this study, two forms were observed: those with short fruit rostrum and peduncles (referred to as *Z. repens* Boenn.) and those with long rostrum and peduncles (*Z. pedunculata* Reichenb.). However, continuous morphological variation and no genetic differentiation were observed between them (Kirina et al., unpubl.). Representatives of *Zannichellia* are firstly reported for Navoi Region. They were also listed in the checklist of Dzhizak Region for several lowland botanical-geographic regions (Tozhibaev et al. 2021) and have been recently observed on the Nuratinskii Ridge in Dzhizak Region by N.Yu. Beshko: Nuratinskii Nature Reserve, Khayatsai tract, valley of mountain river, small ancient pond, 40.521500°N 66.747900°E, 1100 m, 03.04.2022 (https://www.plantarium.ru/page/image/id/826006.html).

DISCUSSION

Given fast current and annual level fluctuations of rivers and streams in Uzbekistan (Abuduwaili et al. 2019), they host low aquatic plant diversity, comparing with stagnant water bodies. However, nowadays lowland lakes in Uzbekistan often suffer from salinization and their biodiversity is decreasing (Ginatullina et al. 2017), as we observed on example of poor aquatic flora of the eastern (less salinized) part of the Aidar-Arnasai lake system. Namely, we found there (not taking into account the irrigation system) only five species (*Myriophyllum spicatum* L., *Najas marina*, *Potamogeton lucens*, *Ranunculus rionii* Lagger, *Stuckenia pectinata*). Two more species (*Ceratophyllum demersum* L. and *Potamogeton perfoliatus* L.) were found only in freshwater channel system in that area. Alpine lakes are more numerous in Uzbekistan than lowland ones (Abuduwaili et al. 2019). However, the former are usually unsuitable for vascular aquatic plants, because of abrupt stony shores. Thus, montane lakes are the most promising for aquatic plants surveys.

We illustrate this on the example of Fazilman Lake (Navoi Region, Fig. A5), situated at 1650 m a.s.l., where 11 macrophyte species were recorded during this study. In spite of long history of botanical research (the last one being conducted in several days after our survey: https://www.inaturalist.org/observations/227932158), this lake was especially rich for floristic novelties (Fig. 1). In additions to the above listed six species that were firstly recorded at least for Nuratau botanical-geographical region, we found there

Figure 2 *Typha domingensis* Pers. is distinguished in the field from *T. angustifolia* L. by whitish spikes (A), and brown glands on the inner side of leaf sheath (B). *Typha domingensis* in the eastern part of Aidar–Arnasai lake system (C)

two species that were not mentioned in the checklist of Navoi Region flora (Tozhibaev et al. 2021). The first species, *Juncus bufonius* L. (IBIW 78489), was reported from Lower Zeravshan botanical-geographical region of Navoi Region (Tozhibaev et al. 2019), Nuratinskii Nature Reserve (Dzhizak Region: Beshko 2025) and for a number of botanical-geographical regions of Samarkand Region, including Nuratau (Tozhibaev et al. 2021) – at least from the vicinities of Fazilman Lake (TASH herbarium: Fazilmantau Plateau, 15 June 1969, Mambetzhumaev). The second species, *Myriophyllum sibiricum* Kom. (IBIW 78494), was marked for that region on the map by Grintal (1993), but without exact localities. Earlier, we documented this cold-tolerant species for montane (mainly alpine) lakes of Kyrgyzstan (Volkova et al. 2024b) and Tajikistan (Volkova et al. 2024a), while its main range in continental Asia lies north of 50° N (Volkova et al. 2024c). Although the plants had no reduced leaves with thickened segments originated from turion that are typical for *M. sibiricum* (Volkova et al. 2024c), probably due to adaptation to warmer climate, we verified the identification genetically (isolate: 24-144). Indeed, in agreement with the published data (Tozhibaev et al. 2018, 2021, Gaziev 2025) in the lowland water bodies of Dzhizak, Samarkand and Tashkent regions we found only thermophilous *M. spicatum*.

Artificial stagnant water bodies, that are numerous in lowland Uzbekistan (large reservoirs and to lesser extent – ponds: Abuduwaili et al. 2019) that are more resistant to salinization than natural ones due to greater volume and inflow of fresh water, usually also host relatively rich aquatic flora. Interestingly, a number of species, including rare ones for Uzbekistan that are listed above, grow not only in rather old (built in 1962) Tuyabuguz Reservoir (Tashkent Region, Fig. A6), but also in the constructed much later (after 1990) reservoir near Sentyab village (Navoi Region, Fig. A3). This could be explained by active dispersal of aquatic plants by water birds (Green et al. 2023) and highlights an important role of artificial water bodies in arid Central Asia in preserving not only fresh water, but also biodiversity (Dadykin et al. 2025).

CONCLUSIONS

Our floristic survey of eastern Uzbekistan continues the inventory of aquatic vascular plants in Central Asia that has been launched in Kyrgyzstan (Volkova et al. 2024b) and Tajikistan (Volkova et al. 2024a). We revealed three taxa new for Uzbekistan. Two of them (*Bolboschoenus laticarpus* and *Potamogeton* × *angustifolius*) are of hybrid origin and thus are hardly differentiated from the parental species, while annual *Limosella aquatica* has a highly fluctuating abundance and could be easily overlooked in unfavorable years. All the 12 species that we found for the first time in some regions of the country are not rare in Uzbekistan and in Central Asia in general. The floristic novelties, provided in this study, are located mainly in places, being a subject of ongoing botanical studies. Thus, in spite of significant progress of

floristic studies in Uzbekistan (summarized e.g. by Sennikov 2016, Tozhibaev et al. 2018, 2019, 2021), more attention still should be paid to aquatic plants. Until the diversity of macrophytes in the country is sufficiently revealed, we consider the analysis of their distribution patterns to be premature.

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