

Revised Checklist of Branchiopoda (Crustacea) in Uzbekistan Highlights Existing Blind Spots in the Knowledge of Regional Fauna

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After ca. 150 years of faunistic and taxonomic research, the branchiopods (Crustacea: Branchiopoda) of Central Asia still remain one of the poorly studied groups, despite their importance for freshwater ecosystems. Within the region, the most actively investigated country is Uzbekistan, containing a large diversity of water bodies. However, to date a large body of published literature devoted to the local branchiopod fauna lacks critical reviews. Here, we aim to summarize the existing knowledge of Uzbek Branchiopoda based on previous studies and original samples collected in twelve regions of Uzbekistan. Of 47 branchiopod taxa collected in this study, two species – *Camptocercus uncinatus* Smirnov, 1971 and *Ilyocryptus spinifer* Herrick, 1882 (Cladocera: Anomopoda) – are new records for the local fauna. Also, we confirm the presence of four more rare taxa in Uzbekistan and provide a list of branchiopod records for each province of the

country. With the new records, the list of Branchiopoda in Uzbekistan contains 107 species, which are unequally distributed within the country: Karakalpakstan has the richest fauna (82 species), followed by provinces of northeast Uzbekistan (40 or more taxa), while local faunas of Kashkadarya, Khorezm, Navoiy and Syrdarya Provinces include fewer than 25 taxa each. Such inequality might be due to several reasons, of which research effort seems to be the most significant. Faunistic compositions of the species-rich provinces appear to be uniform and are similar to those of West and South Tajikistan, comprising high proportions of cosmopolitan, boreal and thermophilic south temperate/tropical taxa. The best studied cladoceran local faunas of the Karakalpakstan and the Ferghana valley resemble that of Tajikistan and, to a lesser extent, those of the Mediterranean countries. Thus, these local faunas together form West Eurasian cluster, which fits the biogeographic pattern observed in the northern Palearctic. However, final conclusions about Uzbek Branchiopoda and similarity of the local faunas should not be made to date, as our study highlights a lack of research in several regions, taxonomic groups (Anostraca, Notostraca, Spinicaudata) and particular water body types (temporary pools, montane water bodies). Also, faunistic composition might be distorted by cryptic endemism or extinction of some branchiopod species due to environmental changes. We hope that the presented checklist will encourage further faunistic, taxonomic and phylogeographic research in Uzbekistan.

Keywords: Biogeography, Central Asia, Cladocera, Diversity, Zooplankton

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BACKGROUND

Branchiopoda Latreille, 1817 is a diverse group of crustaceans playing a pivotal role in continental waters. Due to their ability to form resting eggs that tolerate drought and spread easily, branchiopods often serve as pioneers colonizing newly formed and temporary water bodies (Hairston 1996; Louette and De Meester 2005; Moreno et al. 2019). Being able to survive in a wide range of salinities and temperatures, some representatives of Branchiopoda have become notorious invasive species (Telesh and Ojaveer 2002; Muñoz et al. 2014; Walsh et al. 2017; Kotov et al. 2022a). Nowadays, branchiopods are widely used in fish farming and aquaculture as an excellent food source for plankton-feeding fish, prawns, and other aquatic predators (Nakamoto et al. 2008; Bengtson et al. 2018; Rasdi et al. 2020). Moreover, such branchiopods as *Daphnia* O.F. Müller,

1785, *Moina* Baird, 1850 and *Artemia* Leach, 1819 are widely used in ecology, toxicology, physiology, and developmental biology as model objects (Dodson et al. 2010; Alyuruk et al. 2013; Ebert 2022).

However, despite the great importance of branchiopods, their diversity in many regions remains insufficiently studied. In particular, this is true for Central Asia, the region including Uzbekistan, Tajikistan, Kyrgyzstan, Turkmenistan, Southern Kazakhstan, and Xinjiang Province of China (Liu et al. 2019). Today, Central Asia, bordering the Caspian and the Aral Seas, is hypothesized to have played a crucial role in latitudinal transition of freshwater species through the Ponto-Caspian region during the Cenozoic (Bianco 1990; Artamonova et al. 2021). Nevertheless, the scarcity of recent phylogenetic and phylogeographic studies in this region is evident (Dadykin et al. 2024, but see Ketmaier et al. 2008).

Uzbekistan is one of the largest Central Asian countries harbouring a high diversity of landscapes and water bodies. Most of the territory of Uzbekistan is occupied by two major river basins: those of the Amu Darya and Syr Darya rivers (Rakhmatullaev et al. 2013; Abuduwaili et al. 2018). These rivers and their tributaries are actively used for irrigation (Rakhmatullaev et al. 2013; Petrov et al. 2017), providing water supply for rice fields, fishponds and running channels of East (Andijan, Fergana, Namangan, Tashkent, Syrdarya, Samarkand, Surkhandarya, Kashkadarya, Bukhara Provinces) and West (Khorezm Province, Karakalpakstan) Uzbekistan. The middle and lower reaches of the Amu Darya and Syr Darya rivers are highly affected by drainage discharge. Lowland lakes are large but not numerous and are located mostly in floodplains or river deltas (Abuduwaili et al. 2018). Among them, the Aydar-Arnasay lake system is the largest (Rakhmatullaev et al. 2013), with the exception of the Large Aral Sea which borders Uzbekistan in the west. The Aydar-Arnasay lake system is located in North Uzbekistan (Djizak and Navoiy Provinces) and is largely formed by drainage discharge from irrigated lands and, to a lesser degree, by water inflow from Chardara Reservoir (Ergasheva 2022). However, most lakes in Uzbekistan are concentrated in mountainous areas (Petrov et al. 2017; Abuduwaili et al. 2018). These lakes, fed by glaciers, are located mostly above 3000 m a.s.l. in Tashkent, Surkhandarya and Kashkadarya Provinces (Petrov et al. 2017). Montane water bodies are present to a lesser extent in Fergana and Samarkand Provinces. Also, there are more than 50 large reservoirs in Uzbekistan, located mostly in the eastern and southern parts of the country (Rakhmatullaev et al. 2013) and exceeding the total area of natural lakes (Abuduwaili et al. 2018). Additionally, depending on the season, various ephemeral pools can be found throughout Uzbekistan, including in towns and villages, river floodplains, and uninhabited lowland and mountainous areas.

Investigations of branchiopod fauna in Uzbekistan started at the end of the 19th century (Ulyanin 1875; Walter 1888; Richard 1892). In the most extensive of these early works, Ulyanin

(1875) provided notes on eight species of Anomopoda Sars, 1865 collected in Fergana, Djizak, Samarkand and Tashkent Provinces, although nowadays some of the attributed toponyms are unclear. The first half of the 20th century was a period of intense faunistic studies in Uzbekistan, conducted by Keiser (1925 1937 1950) and other hydrobiologists (Meisner 1906; Behning 1938; Sokolov 1931; Pazhitnova 1935; Nikolsky and Pankratova 1934; Akatova 1950), while taxonomic revisions were scarce (Daday 1910 1914; Smirnov 1949). The abovementioned publications cover several large lake systems (Lake Sudochoye, the Aral Sea and the lower reaches of the Amu Darya), fishponds of west and northeast Uzbekistan (Karakalpakstan, Samarkand, Bukhara, Tashkent, Andijan, and Fergana Provinces) and rice fields of the Syr Darya and the Amu Darya basins (Karakalpakstan, Khorezm, Syrdarya, and Tashkent Provinces).

In the second half of the 20th century, intense studies were conducted in South Uzbekistan, including reservoirs of Surkhandarya and Kashkadarya Provinces (Mukhamediev and Mukhitdinov 1967; Mukhitdinov 1967; Afanasyeva et al. 1972; Sibirtseva et al. 1972; Niyazov 1979). Along with these works, results of the faunistic investigations in Northeast Uzbekistan were summarized in two monographs devoted to the hydrobiology of the Fergana Valley (Mukhamediev 1967 1986). Also, Aripov (1972) reviewed the abiotic conditions, flora and fauna of rice fields in Khorezm Province and Karakalpakstan, reporting a total of 28 valid branchiopod species from there. Finally, the data on Uzbek branchiopod fauna were summarised in a number of wide-scale reviews (Manuilova 1964; Smirnov 1974 1976, etc.).

Between 1990 and 2010 the taxonomy of Uzbek branchiopods became a subject of intense studies, along with the faunal diversity. A significant contribution to the knowledge of the order Ctenopoda Sars, 1865 was made by N.M. Korovchinsky, resulting in a description of two new species and review of *Diaphanosoma* distribution in Uzbekistan (Korovchinsky 1987 2000; Korovchinsky and Mirabdullayev 1995 2001). Several taxonomic revisions were performed for different families of Anomopoda – particularly Moinidae Goulden, 1968 (Mirabdullayev 1993 1998), Daphniidae Straus, 1820 (Rakhmatullaeva and Mirabdullayev 1998; Berner and Rakhmatullaeva 2001), and Chydoridae Dybowski et Grochowski, 1894 (Sinev 2001). In addition, Rakhmatullaeva (1998) published a review of the morphological and ecological diversity of Daphniidae in Uzbekistan, focusing on distribution of the group in the region. These studies resulted in a preliminary checklist of Uzbek Cladocera Latreille, 1817 (Mirabdullayev et al. 1997).

During the last two decades, the fauna of Uzbekistan has been investigated actively, including both its general composition (e.g., Ginatullina et al. 2006b; Ginatullina 2010; Abdinazarov et al. 2019a; Khakimova et al. 2021) and ecological affinities (Ginatullina 2006a; Ginatullina et al. 2017 2023a). Nowadays, much attention is paid to the bioindication based on cladoceran diversity and abundance (Crootof et al. 2015; Ginatullina 2022; Mirzambetov and

Mirabdullayev 2022). The most recent data were summarized in three Ph.D. dissertations on the faunistic composition of mineralized lakes and reservoirs, and Fergana Valley water bodies (Ginatullina 2010; Abdinazarov 2018; Kuzmetov 2019). Recent studies mostly concern large natural and artificial water bodies, e.g., the Sudochoye lake system in Karakalpakstan, the Aydar-Arnasay lake system in Djizak Province, and Tuyabuguz Reservoir in Tashkent Province (Ginatullina et al. 2006a 2017 2023a c; Mirabdullayev et al. 2016; Abdullaeva et al. 2021; Erkabaev et al. 2024). Numerous investigations considering the Large Aral Sea should be mentioned particularly (Andreev 1989; Plotnikov 2013; Aladin et al. 2019 2021; Plotnikov et al. 2021).

Consequently, the branchiopod fauna of Uzbekistan seems to be relatively well-studied as compared to the faunas of the neighbouring countries. Previous investigations have covered both large and small water bodies, such as lakes, reservoirs, fishponds, and rice fields. However, great changes observed recently in water bodies of Central Asia (Aladin et al. 2019; Plotnikov et al. 2021; Erkabaev et al. 2024) have resulted in significant shifts in the diversity and structure of aquatic assemblages (Ginatullina et al. 2017), stimulating the need for continuous hydrobiological monitoring. Unfortunately, several recent publications used an outdated taxonomy (e.g., Mustafaeva and Mirzayev 2018a; Khodjayeva and Shamsiyev 2020; Khakimova et al. 2021; Abdinazarov and Madumarov 2022), which complicates the interpretation of their results. Also, there is an evident lack of actual large-scale reviews of the data on taxonomy and fauna of the Branchiopoda in Uzbekistan, despite a large body of published case studies. The recent attempt to summarize the scattered information of the Uzbek fauna was made by Rakhmatullaeva (2007), who presented an online checklist of Cladocera in Uzbekistan including 88 taxa. However, this summary does not consider a significant portion of the relevant literature and thus misses taxa recorded earlier. Also, notes on synonymy and distribution are unavailable for most of the listed records. Another recent summary of planktonic organisms observed in reservoirs of Uzbekistan includes only 35 species (Kuzmetov and Abdinazarov 2016), and thus also cannot be considered as exhaustive.

Clearly, the data on Uzbek branchiopod fauna need to be revised. In this study, we summarize and validate the knowledge on Branchiopoda in Uzbekistan using both literature data and original samples from various types of water bodies. The study covers most of Uzbekistan's territory, including water bodies frequently investigated by other authors. Also, we aim to compare Uzbekistan's local faunas with those from other Eurasian regions of comparable latitude.

MATERIALS AND METHODS

Field sampling

Qualitative samples were collected by M. Madumarov, S. Madumarova, I. Dadykin and P. Volkova in twelve regions of Uzbekistan (Andijan, Bukhara, Djizak, Fergana, Khorezm, Namangan, Navoiy, Syrdarya, Samarkand and Tashkent Provinces, and the Republic of Karakalpakstan) from March to August 2023–2024 (Table 1; Fig. 1A, B). A variety of water bodies were studied, including lakes, reservoirs, ponds, springs, channels, rice fields and temporary pools. I. Dadykin and P. Volkova collected the samples in the shallow littoral zones of the waterbodies which primarily contained littoral crustaceans (Fig. 1B, locs. 1–70). A simple plankton net (25 cm diameter, 50 μm mesh) was hauled horizontally through the shallow zone of the water body and scraped macrophytes if present. In some cases, an additional sample was taken from the same site by scratching the bottom and collecting the disturbed sediment. Each sample was filtered through the net and fixed in 96 % ethanol, with the ethanol replaced at 12 and 24 hours after collection. M. Madumarov and S. Madumarova mostly sampled pelagic zones (lacking macrophytes), collecting primarily plankton (Fig. 1B, locs. 71–108). For sampling, a simple plankton net (25 cm diameter, 50 μm mesh) was hauled vertically through the water column at depths of 2–15 m. In the case of shallow water bodies, water was scooped several times by a 2 L glass container and filtered through the net. Samples were fixed in 96 % ethanol replaced once, 48 or 72 h after collection.

Table 1. List of samples collected in Uzbekistan in March–August 2023–2024 by I. Dadykin, P. Volkova, M. Madumarov and S. Madumarova

Locality	Water body type	Region and District	Latitude, °N	Longitude, °E	Collectors	Date
1	large brackish lake with Myriophyllum and Stuckenia (benthos sample)	Dzizak Province, Forish District	40.81968	67.90863	I. Dadykin, P. Volkova	24 June 2024
1a	large brackish lake with Myriophyllum and Stuckenia (plankton sample)	Dzizak Province, Forish District	40.81968	67.90863	I. Dadykin, P. Volkova	24 June 2024
2	small drying brackish lake	Dzizak Province, Forish District	40.82679	67.90714	I. Dadykin, P. Volkova	24 June 2024
3	channel with fast current, <i>Phragmites</i>	Dzizak Province, Forish District	40.82811	67.88626	I. Dadykin, P. Volkova	24 June 2024
4	large lake with muddy sediment, <i>Phragmites</i> and Myriophyllum (plankton sample)	Dzizak Province, Forish District	40.82606	67.88126	I. Dadykin, P. Volkova	24 June 2024
4a	large lake with muddy sediment, <i>Phragmites</i> and Myriophyllum (benthos sample)	Dzizak Province, Forish District	40.82606	67.88126	I. Dadykin, P. Volkova	24 June 2024
5	channel with concrete banks, <i>Potamogeton</i>	Dzizak Province, Forish District	40.82606	67.88126	I. Dadykin, P. Volkova	24 June 2024
6	large lake with muddy sediment, <i>Phragmites</i> and <i>Potamogeton</i>	Dzizak Province, Forish District	40.85007	67.86377	I. Dadykin, P. Volkova	24 June 2024
7	large lake with muddy sediment, Myriophyllum	Dzizak Province, Forish District	40.84490	67.88982	I. Dadykin, P. Volkova	24 June 2024
7a	large lake with sandy sediment, <i>Potamogeton</i> and Myriophyllum	Dzizak Province, Forish District	40.84490	67.88982	I. Dadykin, P. Volkova	24 June 2024
8	small roadside brackish lake with <i>Stuckenia</i>	Dzizak Province, Forish District	40.82227	67.88913	I. Dadykin, P. Volkova	24 June 2024
9	small lake with <i>Stuckenia</i>	Dzizak Province, Forish District	40.83833	67.87122	I. Dadykin, P. Volkova	25 June 2024
10	Lake Amassay, sandy littoral with <i>Phragmites</i> and <i>Potamogeton</i> (plankton sample)	Dzizak Province, Forish District	40.94334	67.97201	I. Dadykin, P. Volkova	25 June 2024
10a	Lake Amassay, sandy littoral with <i>Phragmites</i> and <i>Potamogeton</i> (benthos sample)	Dzizak Province, Forish District	40.94334	67.97201	I. Dadykin, P. Volkova	25 June 2024
11	hypersaline lake with muddy sediment	Dzizak Province, Forish District	40.95166	67.98301	I. Dadykin, P. Volkova	25 June 2024
12	Lake Amassay, muddy littoral with <i>Phragmites</i> (benthos sample)	Dzizak Province, Forish District	40.96393	67.98075	I. Dadykin, P. Volkova	25 June 2024
12a	Lake Amassay, muddy littoral with <i>Phragmites</i> (plankton sample)	Dzizak Province, Forish District	40.96393	67.98075	I. Dadykin, P. Volkova	25 June 2024
13	Lake Amassay, sandy littoral with <i>Potamogeton</i>	Dzizak Province, Forish District	40.96362	67.94786	I. Dadykin, P. Volkova	25 June 2024
14	drying lake with <i>Phragmites</i>	Dzizak Province, Forish District	40.88358	67.93370	I. Dadykin, P. Volkova	25 June 2024
15	small lake with <i>Phragmites</i> and <i>Zannichellia</i>	Dzizak Province, Forish District	40.45797	67.65411	I. Dadykin, P. Volkova	26 June 2024
16	fish pond with muddy sediment, <i>Phragmites</i>	Dzizak Province, Forish District	40.45824	67.65301	I. Dadykin, P. Volkova	26 June 2024
17	small channel with slow current, <i>Phragmites</i> , <i>Potamogeton</i>	Dzizak Province, Forish District	40.45864	67.65137	I. Dadykin, P. Volkova	26 June 2024
18	large brackish lake with muddy sediment	Dzizak Province, Forish District	40.45844	67.64989	I. Dadykin, P. Volkova	26 June 2024
19	deep channel with muddy sediment, <i>Phragmites</i> , and <i>Typha</i>	Dzizak Province, Forish District	40.45352	67.68476	I. Dadykin, P. Volkova	27 June 2024
19a	deep channel with muddy sediment, <i>Phragmites</i> and <i>Typha</i> (benthos sample)	Dzizak Province, Forish District	40.45352	67.68476	I. Dadykin, P. Volkova	27 June 2024
20	deep channel with muddy sediment, <i>Phragmites</i> and <i>Typha</i> (benthos sample)	Dzizak Province, Forish District	40.45767	67.67861	I. Dadykin, P. Volkova	27 June 2024
21	irrigation ditch in the field	Dzizak Province, Forish District	40.43914	67.66669	I. Dadykin, P. Volkova	27 June 2024
22	irrigation ditch in the field	Dzizak Province, Forish District	40.43451	67.66322	I. Dadykin, P. Volkova	27 June 2024
23	roadside puddle near irrigation ditch	Dzizak Province, Forish District	40.42509	67.67762	I. Dadykin, P. Volkova	27 June 2024
24	small puddle near irrigation ditch	Dzizak Province, Forish District	40.40599	67.72261	I. Dadykin, P. Volkova	27 June 2024
25	Kily River onflow, <i>Phragmites</i> , <i>Najas</i> , <i>Ruppia</i>	Dzizak Province, Forish District	40.33251	67.70544	I. Dadykin, P. Volkova	27 June 2024
26	drying lake with muddy sediment, algae	Dzizak Province, Forish District	40.33180	67.70249	I. Dadykin, P. Volkova	27 June 2024
27	Karatape Lake, muddy sediment and <i>Phragmites</i>	Dzizak Province, Sharof Rashidov District	40.28253	67.72492	I. Dadykin, P. Volkova	28 June 2024
28	roadside puddle in Timiryazev	Dzizak Province, Forish District	40.28961	67.74672	I. Dadykin, P. Volkova	28 June 2024
29	fish pond with muddy sediment, <i>Phragmites</i>	Dzizak Province, Sharof Rashidov District	40.28423	67.75184	I. Dadykin, P. Volkova	28 June 2024
30	small pond with rocky sediment, <i>Phragmites</i>	Dzizak Province, Forish District	40.35774	67.37540	I. Dadykin, P. Volkova	28 June 2024
31	spring with sandy sediment, filamentous algae	Dzizak Province, Forish District	40.36007	67.37982	I. Dadykin, P. Volkova	28 June 2024
32	small stream with slow current, muddy sediment, <i>Chara</i>	Dzizak Province, Forish District	40.36859	67.38802	I. Dadykin, P. Volkova	29 June 2024
33	small stream with slow current, sandy sediment, <i>Chara</i> and <i>Batrachium</i>	Dzizak Province, Forish District	40.36859	67.38802	I. Dadykin, P. Volkova	29 June 2024
34	running pond with muddy sediment, filamentous algae	Dzizak Province, Forish District	40.37217	67.38575	I. Dadykin, P. Volkova	29 June 2024
35	running pond with muddy sediment, filamentous algae, <i>Potamogeton</i> , <i>Batrachium</i>	Dzizak Province, Forish District	40.37047	67.38522	I. Dadykin, P. Volkova	29 June 2024
36	running puddle with muddy sediment, algae, <i>Stuckenia</i>	Dzizak Province, Forish District	40.34127	67.40240	I. Dadykin, P. Volkova	29 June 2024
37	large puddle with rocky sediment and muddy water	Dzizak Province, Forish District	40.33622	67.40951	I. Dadykin, P. Volkova	29 June 2024
38	spring with muddy sediment in the spring valley	Dzizak Province, Forish District	40.31083	67.33291	I. Dadykin, P. Volkova	29 June 2024
39	puddle with muddy sediment fed by spring	Dzizak Province, Forish District	40.30874	67.28913	I. Dadykin, P. Volkova	30 June 2024
40	road puddle with muddy sediment	Dzizak Province, Forish District	40.35911	67.29208	I. Dadykin, P. Volkova	30 June 2024
41	puddle in the bed of drying river, algae	Dzizak Province, Forish District	40.37930	67.28047	I. Dadykin, P. Volkova	30 June 2024
42	Senatob Reservoir, muddy sediment, <i>Potamogeton</i> and Myriophyllum	Navoiy Province, Nurata District	40.64245	66.68204	I. Dadykin, P. Volkova	30 June 2024
43	small stream with muddy sediment, filamentous algae	Navoiy Province, Nurata District	40.56441	66.61379	I. Dadykin, P. Volkova	1 July 2024
44	small stream with sandy sediment	Navoiy Province, Nurata District	40.56441	66.61379	I. Dadykin, P. Volkova	1 July 2024
44a	small stream with sandy sediment, filamentous algae	Navoiy Province, Nurata District	40.56441	66.61379	I. Dadykin, P. Volkova	1 July 2024
45	small stream with fast current, <i>Chara</i> and terrestrial plants	Navoiy Province, Nurata District	40.56298	66.61950	I. Dadykin, P. Volkova	1 July 2024
46	puddle with sandy sediment fed by spring	Navoiy Province, Nurata District	40.55194	66.60079	I. Dadykin, P. Volkova	1 July 2024
47	Lake Fozilmon, muddy sediment, <i>Potamogeton</i> , <i>Stuckenia</i> (plankton sample)	Navoiy Province, Nurata District	40.55045	66.59095	I. Dadykin, P. Volkova	1 July 2024
47a	Lake Fozilmon, muddy sediment, <i>Potamogeton</i> , <i>Stuckenia</i> (benthos sample)	Navoiy Province, Nurata District	40.55045	66.59095	I. Dadykin, P. Volkova	1 July 2024
48	deep lake with muddy sediment fed by spring, <i>Batrachium</i>	Samarqand Province, Ko'hisrabad District	40.56648	66.57979	I. Dadykin, P. Volkova	1 July 2024
49	small lake with muddy sediment	Samarqand Province, Ko'hisrabad District	40.56725	66.58156	I. Dadykin, P. Volkova	1 July 2024
50	puddle with muddy sediment fed by spring	Navoiy Province, Nurata District	40.61133	66.60261	I. Dadykin, P. Volkova	2 July 2024
51	immersed quarry with rocky sediment and fast current (benthos sample)	Navoiy Province, Nurata District	40.60357	66.63001	I. Dadykin, P. Volkova	2 July 2024
52	shallow stream with slow current, algal mats	Navoiy Province, Nurata District	40.60508	66.64560	I. Dadykin, P. Volkova	2 July 2024
53	shallow stream with slow current, <i>Zostera</i> , tadpoles	Navoiy Province, Nurata District	40.60508	66.64560	I. Dadykin, P. Volkova	2 July 2024
54	running pond with rocky sediment, <i>Zannichellia</i> and filamentous algae, tadpoles	Navoiy Province, Nurata District	40.61276	66.64411	I. Dadykin, P. Volkova	2 July 2024
55	small puddle with immersed terrestrial plants	Samarqand Province, Jambay District	39.69312	67.10952	I. Dadykin, P. Volkova	3 July 2024
56	stream with slow current, immersed terrestrial plants	Samarqand Province, Jambay District	39.61184	67.10388	I. Dadykin, P. Volkova	3 July 2024
57	drying onflow with muddy sediment	Samarqand Province, Jambay District	39.61866	67.18569	I. Dadykin, P. Volkova	3 July 2024
58	small lake with muddy sediment, immersed terrestrial plants	Samarqand Province, Jambay District	39.61923	67.18592	I. Dadykin, P. Volkova	3 July 2024
59	stream with slow current, muddy sediment	Samarqand Province, Jambay District	39.62366	67.18306	I. Dadykin, P. Volkova	3 July 2024
60	channel with rocky sediment, <i>Chara</i> and <i>Potamogeton</i>	Samarqand Province, Jambay District	39.63186	67.17907	I. Dadykin, P. Volkova	3 July 2024
61	puddle with decomposing organic matter, <i>Stuckenia</i> , <i>Caulinia</i>	Samarqand Province, Jambay District	39.62323	67.18022	I. Dadykin, P. Volkova	3 July 2024
62	dump lake in the quarry, rocky sediment	Samarqand Province, Jambay District	39.61108	67.23461	I. Dadykin, P. Volkova	4 July 2024
63	Karsultepa Reservoir, muddy littoral	Dzizak Province, Gallaorol District	39.86082	67.51754	I. Dadykin, P. Volkova	4 July 2024
64	roadside puddle, muddy sediment and plant matter	Dzizak Province, Sharof Rashidov District	40.07512	67.94738	I. Dadykin, P. Volkova	5 July 2024
65	river Akhangaran lower to Tuyabuz Reservoir dam, muddy sediment	Tashkent Province, Orta Chirchiq District	40.98997	69.28961	I. Dadykin, P. Volkova	5 July 2024
66	small pond with muddy sediment fed by springs, <i>Chara</i> and terrestrial plants	Tashkent Province, Orta Chirchiq District	40.99481	69.27816	I. Dadykin, P. Volkova	5 July 2024
66a	small pond with muddy sediment fed by springs, shallow part with terrestrial plants	Tashkent Province, Orta Chirchiq District	40.99481	69.27816	I. Dadykin, P. Volkova	5 July 2024
67	large fish pond with muddy sediment, <i>Potamogeton</i>	Tashkent Province, Orta Chirchiq District	40.99506	69.27882	I. Dadykin, P. Volkova	5 July 2024
68	Tuyabuz Reservoir, muddy littoral with <i>Najas</i> and <i>Potamogeton</i>	Tashkent Province, Orta Chirchiq District	40.99106	69.31135	I. Dadykin, P. Volkova	6 July 2024
69	Tuyabuz Reservoir, muddy littoral with <i>Caulinia</i>	Tashkent Province, Orta Chirchiq District	40.99203	69.31203	I. Dadykin, P. Volkova	6 July 2024
70	Tuyabuz Reservoir, <i>Potamogeton</i> bush	Tashkent Province, Orta Chirchiq District	40.98314	69.31465	I. Dadykin, P. Volkova	6 July 2024
71	Lake Sarikamish	Karakalpakstan, Kamgrad District	42.30778	57.47611	M. Madumarov	10 July 2024
72	Lake Sadochiye	Karakalpakstan, Mynyak District	43.57278	58.54417	M. Madumarov	9 July 2024
73	Lake Sadochiye	Karakalpakstan, Mynyak District	43.58686	58.54653	M. Madumarov	11 July 2024
74	Lake Karatere	Karakalpakstan, Takhtakupir District	43.29527	60.38422	M. Madumarov	12 July 2024
75	Lake Goraluk	Khorezm Province, Klaiya District	41.40556	60.38500	M. Madumarov	13 July 2024
76	Lake Goraluk	Khorezm Province, Klaiya District	41.40647	60.38628	M. Madumarov	13 July 2024
77	Lake Ulyshurkul	Khorezm Province, Yangiariq District	41.26307	60.48550	M. Madumarov	13 July 2024
78	Lake Karakir	Bukhara Province, Peshkum District	40.40028	63.27472	M. Madumarov	14 Aug 2024
79	Lake Dengukul	Bukhara Province, Olot District	39.16679	64.03006	M. Madumarov	14 Aug 2024
80	Lake Khadicha	Bukhara Province, Karaulbazar District	39.26424	64.52188	M. Madumarov	11 June 2024
81	Lake Ayaskajima	Bukhara Province, Gijduvon District	40.60440	64.54212	M. Madumarov	7 June 2024
82	Lake Devkhona	Bukhara Province, Karaulbazar District	39.19148	64.62842	M. Madumarov	9 June 2024
83	Lake Kuyumazar	Navoiy Province, Kiziltepa District	39.85610	64.72556	M. Madumarov	15 July 2024
84	Lake Aydarul	Navoiy Province, Nurata District	40.91444	66.09167	S. Madumarova	8 May 2023
85	Lake Aydarul	Navoiy Province, Nurata District	41.05778	66.42944	M. Madumarov	14 June 2023
86	Lake Tuzkan, open pelagic in the southern part	Dzizak Province, Forish District	40.55592	67.46889	M. Madumarov	25 May 2024
87	Lake Tuzkan, open pelagic near the east shore	Dzizak Province, Forish District	40.61806	67.61528	M. Madumarov	26 June 2024
87a	Lake Tuzkan, open pelagic near the east shore	Dzizak Province, Forish District	40.61806	67.61528	M. Madumarov	29 June 2024
88	rice field near Bakhtal	Syrdarya Province, Saykumbad District	40.77448	68.75041	M. Madumarov	30 June 2024
88a	rice field near Bakhtal	Syrdarya Province, Saykumbad District	40.77448	68.75041	M. Madumarov	30 June 2024
89	rice field near Yangkhiot	Syrdarya Province, Mirzabod District	40.35207	68.78440	M. Madumarov	30 June 2024
90	fishpond near Esimzabod	Syrdarya Province, Khavast District	40.25236	68.95152	M. Madumarov	30 June 2024
91	small pool in Uzbekistan National University	Tashkent City	41.34809	69.20254	S. Madumarova	28 Apr 2024
92	Tuyabuz Reservoir, western part, open pelagic	Tashkent Province, Orta Chirchiq District	40.97030	69.30000	M. Madumarov	17 Aug 2024
93	Tuyabuz Reservoir, eastern part, open pelagic	Tashkent Province, Orta Chirchiq District	40.93763	69.34520	M. Madumarov	26 May 2024
94	Lake Sarikamish	Fergana Province, Beshariq District	40.40444	70.38333	M. Madumarov	31 Mars 2024
95	onflow of Syr Darya River	Fergana Province, Beshariq District	40.57034	70.59685	M. Madumarov	15 Apr 2024
96	fishpond near Usmanobod	Fergana Province, Beshariq District	40.57105	70.59954	M. Madumarov	7 July 2024
97	fishpond in Sarvokasy River valley	Namangan Province, Pop District	40.89105	70.69702	M. Madumarov	20 June 2023
98	Lake Madimank	Namangan Province, Pop District	41.37062	70.74892	M. Madumarov	13 Aug 2024
99	fishpond near Navrokhoh	Namangan Province, Mingbulak District	40.76648	71.10726	M. Madumarov	22 Apr 2024
100	Reaksay Reservoir, open pelagic	Namangan Province, Chirchik District	40.93367	71.29776	S. Madumarova	15 May 2023
101	Ertikan Reservoir, open pelagic	Namangan Province, Kasansay District	41.15882	71.55718	S. Madumarova	30 June 2023
102	Eskiyar Reservoir, open pelagic	Namangan Province, Yangiulugay District	41.16363	71.71596	M. Madumarov	20 June 2023
103	Chartak Reservoir, open pelagic	Namangan Province, Chartak District	41.17922	71.81655	S. Madumarova	23 June 2024
104	Central Fergana Reservoir, open pelagic	Fergana Province, Yazyyvan District	40.64778	71.50152	S. Madumarova	25 Apr 2023
105	fishpond near Akalya	Andijan Province, Ulginar District	40.73663	71.70763	S. Madumarova	5 Apr 2024
106	fishpond near Avlanat	Andijan Province, Ulginar District	40.72671	71.76746	S. Madumarova	26 June 2023
107	Lake in Nodirbegim Park, Andijan	Andijan Province, Andijan District	40.79356	72.37471	S. Madumarova	15 June 2024



Fig. 1. Locations of the studied water bodies. (A), global position of Uzbekistan in Eurasia. (B), location of the studied water bodies. The locality numbers correspond to that in the Table 1. Green filling indicates protected areas, Uzbekistan provinces are labelled.

Laboratory processing and images

Specimens of the branchiopods (orders Anomopoda, Ctenopoda, Onychopoda, Haplopoda, Anostraca and Spinicaudata) were provisionally identified using an Olympus SZ-51 stereomicroscope (Olympus Corporation, Japan) directly from the unsorted samples. For further identification, crustaceans were individually picked by a pipette or by forceps, placed in a drop of glycerol, dissected by electrolytically sharpened tungsten needles (Kotov and Štifter 2006) and studied using an Olympus CZ-41 (Olympus Corporation, Japan) high-power optical microscope. Identifications were based on Korovchinsky et al. (2022) and Rogers et al. (2017 2019). For photography, a LOMO BLM-L compound optical microscope equipped with an MS-12 digital camera (LOMO-MA, Russia) was used. Each specimen was photographed using focus stacking; the resulting series of image files was subsequently merged with Helicon Focus 8 software (Helicon Soft Ltd., Ukraine). The localities and regions were visualized on a map in QGIS 3.34.6 software (QGIS Development Team, USA), with the CartoDB Positron (retina) and the Natural Earth Vector data (<https://www.naturalearthdata.com/>) as base layers.

Checklist processing

For the construction of the checklist, we used both original data and published literature, including Ulyanin (1875); Meisner (1906); Daday (1910 1914); Keiser (1925 1937); Pazhitnova (1929 1935); Nikolsky and Pankratova (1934); Behning (1938); Smirnov (1949); Akatova (1950); Stepanova and Ledyeva (1957); Aripov (1966 1972); Mukhamediev (1967 1986); Mukhamediev and Mukhitdinov (1967); Mukhitdinov (1967); Afanasyeva et al. (1972); Lyakhnovich et al. (1972); Sibirtseva et al. (1972); Lebedeva and Rakhmanova (1982); Korovchinsky (1987 2000); Mordukhai-Boltovskoi and Rivier (1987); Kazakhbaev (1988); Andreev (1989); Mirabdullayev (1993 1998); Korovchinsky and Mirabdullayev (1995 2001); Kuzmetov (1998 2019); Rakhmatullaeva and Mirabdullayev (1998); Berner and Rakhmatullaeva (2001); Rakhmatullaeva and Khurshut (2001); Sinev (2001 2015); Rogers (2003 2020); Dobrynina (2004); Ginatullina et al. (2006a b 2017 2023a b c); Mustafaeva et al. (2006 2021a b 2022); Ketmaier et al. (2008); Van Damme and Dumont (2008); Arashkevich et al. (2009); Ginatullina (2010 2013 2022 2023); Marden et al. (2012); Plotnikov (2013); Crootof et al. (2015); Atashbar et al. (2016); Kuzmetov and Abdinazarov (2016); Turemuratova and Kuzmetov (2016); Abdinazarov (2018); Ginatullina and Temirova (2018); Mustafaeva and Mirzayev (2018a b); Turemuratova et al. (2018 2021 2022 2024); Abdinazarov et al. (2019a b); Aladin et al. (2019 2021); Saparov et al. (2019); Khodjayeva and Shamsiyev (2020); Abdullaeva et al. (2021); Atamuratova (2021); Karimov (2021); Korovchinsky et al. (2021); Khakimova et al. (2021); Shao et al. (2021); Turemuratova and Nagmetov (2021); Abdinazarov and Madumarov (2022); Mirzambetov and Mirabdullayev (2022); Utemuratova et al. (2022); Mukhamediev and Bekchonova (2023); Temirbekov et al. (2023); Erkabaev (2024); Madumarov et al. (2024); Turemuratova and Kosymbetova (2024); Sinev et al. (2024). The synonymy of taxa is given following Rogers (2013 2020), Rogers et al. (2019), and Korovchinsky et al. (2021). The checklist is organised according to modern taxonomy of the branchiopods (WoRMS 2025).

The administrative division and city names follow the Government Portal of the Republic of Uzbekistan (2024). Distribution data is mainly given in accordance with Rogers et al. (2017), Rogers (2020), and Korovchinsky et al. (2021). For classifying the distribution types of Branchiopoda, a strongly modified system of Kotov (2016) initially proposed for East Asia is applied. The following faunistic complexes are recognised: CAE, Central Asian endemics; EA, taxa primarily distributed in East Asia; PAL, taxa widely distributed in the Palearctic or Holarctic; PCA, taxa of the Ponto-Caspian origin; ST, species widely distributed in the south temperate zone (the South Palearctic); TR, tropical taxa; WE, West Eurasian taxa; WU, cosmopolitan unrevised taxa. In

the case of some Anomopoda and Ctenopoda, the data on species distribution were supplemented with information from Korovchinsky et al. (2021).

Region comparisons

For comparison of faunistic richness between the provinces and regions and visualising the results, R 4.3.2 package (R Core Team 2023) was applied. The most studied regions of Uzbekistan, the Ferghana Valley (including Andijan, Namangan and Ferghana provinces) and Karakalpakstan, were compared with relatively well-explored regions of Eurasia located at the same latitudes, to the extent that their faunistic lists could be obtained from few recently published reviews. Only the representatives of Cladocera (Anomopoda, Ctenopoda, Haplopoda, Onychopoda) were included in the analysis, as the diversity of the remaining groups is only provisionally studied in Uzbekistan. The local faunas of Spain, Italy, Greece, Russian North Caucasus, Russian Ciscaucasia, Turkey, Tajikistan, Mongolia, Chinese Tibet, Chinese Xinjiang Uyghur Autonomous Region, Chinese Inner Mongolia, and South Korea were compared. Data for these regions was obtained from Behning (1941); Margaritora (1985); Alonso (1996 2010); Flößner et al. (2005); Kaya and Altındağ (2007); Güher (2014); Jeong et al. (2015); Ji et al. (2015); Ustaoglu (2015); Xiang et al. (2015); Błedzki and Rybak (2016); Chertoprud et al. (2017); Kotov et al. (2017 2022b); Bozkurt and Bozça (2019); Aksenova et al. (2021); Gu et al. (2021); Korovchinsky et al. (2021); Stamou et al. (2022); Sheveleva et al. (2023); Dadykin et al. (2024). The resulting dataset is shown in Table S2. It should be noted that the local fauna of Tajikistan comprises two different components, the lowland one and the high-altitude one, which is specific to the Tajik Pamir (Dadykin et al. 2024). Nevertheless, these components each comprise a relatively small number of species; thus, they were unified in our analysis. The local faunas were compared by Sørensen–Dice similarity coefficient (K_S) widely used for comparison of faunistic lists (Dice 1945; Murguía and Villaseñor 2003; Albuquerque et al. 2022). Anticipating incomplete data, we used just the Sørensen-Dice index based on the species presence in a particular region and ignoring absences (Murguía and Villaseñor 2003). Hierarchical clustering was performed using the R 4.3.2 package, using the Sorensen-Dice dissimilarity ($1 - K_S$) as a distance measure and “ward.D2” as an agglomeration method.

RESULTS

New and rare records of Branchiopoda

In the original set of samples, 47 branchiopod taxa were identified (Table 2, bold font; see Table S1 for a database of records). The species list was significantly expanded for Navoiy, Djizak, Tashkent, and Samarkand Provinces (12, 11, 7 and 7 new records, respectively, Table 2). The majority of the new records belong to common (or relatively common) benthic taxa previously observed in Uzbekistan. However, two water fleas of the order Anomopoda, *Camptocercus uncinatus* Smirnov, 1971 and *Ilyocryptus spinifer* Herrick, 1882, have not previously been reported from the country (Figs. 2C–F and 3A–D). Also, we confirm the presence of several rare anomopod species in Uzbekistan and provide short remarks on their morphology and distribution.

Table 2. List of Branchiopoda taxa recorded in Uzbekistan

Taxon	Distribution type	KAR	KH	NAV	BU	KAS	SAM	SU	DJ	SYR	TAS	NAM	FE	AN
Class Branchiopoda Latreille, 1817														
Subclass Sarsostraca Tasch, 1969														
Order Anostraca Sars, 1867														
Family Artemiidae Leach, 1819														
<i>Artemia</i> sp. !	WU		1							1*				
Family Branchinectidae Daday, 1910														
<i>Branchinecta orientalis</i> Sars, 1901 ?	ST				1									
Family Thamnocephalidae Packard, 1883														
<i>Phallocryptus spinosus</i> (Milne-Edwards, 1840) sensu Rogers, 2003	ST		1											
Subclass Phyllopoda Preuss, 1951														
Order Notostraca Sars, 1867														
Family Triopsidae Keilhack, 1909														
<i>Triops cancriformis</i> (Bosc, 1801) s. lat. ?	WU							1						
Superorder Diplostraca Latreille, 1829														
Order Anomopoda Sars, 1865														
Family Daphniidae Straus, 1820														
<i>Ceriodaphnia cornuta</i> Sars, 1885 s. lat.	WU	1	1					1		1	1	1	1	1
<i>Ceriodaphnia dubia</i> Richard, 1894 s. lat.	WU	1									1			
<i>Ceriodaphnia laticaudata</i> P.E. Müller, 1867	WU	1								1*			1	
<i>Ceriodaphnia pulchella</i> Sars, 1862 s. lat.	WU	1	1							1	1		1	
<i>Ceriodaphnia quadrangula</i> (O.F. Müller, 1785) s. lat.	WU	1	1	1*				1*	1		1	1	1	1
<i>Ceriodaphnia reticulata</i> (Jurine, 1820)	WU	1	1		1		1	1	1*	1		1	1	1*
<i>Ceriodaphnia turkestanica</i> Berner et Rakhmatullaeva 2001	CAE	1	1		1	1		1	1		1	1	1	1
<i>Daphnia</i> (<i>Ctenodaphnia</i>) <i>lumholtzi</i> Sars, 1885	TR	1						1						
<i>Daphnia</i> (<i>Ctenodaphnia</i>) <i>magna</i> Straus, 1820	WU	1	1	1*	1	1	1	1	1	1	1	1	1	1
<i>Daphnia</i> (<i>Ctenodaphnia</i>) <i>similis</i> Claus, 1876	ST	1				1	1*	1			1			
<i>Daphnia</i> (<i>Daphnia</i>) <i>cucullata</i> Sars, 1862	WE	1		1				1	1	1			1*	
<i>Daphnia</i> (<i>Daphnia</i>) <i>curvirostris</i> Eylmann, 1887	WE	1	1		1	1		1	1	1	1		1	1
<i>Daphnia</i> (<i>Daphnia</i>) <i>galeata</i> Sars, 1863 s. lat.	WU	1	1	1*	1	1	1	1	1	1	1	1	1	1
<i>Daphnia</i> (<i>Daphnia</i>) <i>hyalina</i> Leydig, 1860	PAL	1						1			1			
<i>Daphnia</i> (<i>Daphnia</i>) <i>longispina</i> O.F. Müller, 1776 s. lat. +	WU	1	1	1*	1	1	1	1	1	1	1*	1	1	1
<i>Daphnia</i> (<i>Daphnia</i>) <i>pulex</i> (Linnaeus, 1758) s. lat.	WU	1	1		1	1	1	1	1	1	1		1	1
<i>Daphnia</i> (<i>Daphnia</i>) <i>pulicaria</i> Forbes, 1893 s. lat.	WU					1		1	1		1	1	1	1
<i>Megafenestra aurita</i> (Fischer, 1849)	WE							1		1	1		1	1
<i>Scapholeberis kingii</i> Sars, 1888 s. lat. ! +	TR	1	1	1*				1*	1	1*	1	1	1	1
<i>Scapholeberis mucronata</i> (O.F. Müller, 1776) s. lat.	PAL	1	1					1		1	1	1	1	1
<i>Simocephalus</i> (<i>Aquipiculus</i>) <i>heilongjiangensis</i> Shi et Shi, 1994	EA		1								1			
<i>Simocephalus</i> (<i>Crownocephalus</i>) <i>serrulatus</i> (Koch, 1841)	WU	1	1								1*	1	1	
<i>Simocephalus</i> (<i>Echinocaudus</i>) <i>exspinosus</i> (De Geer, 1778) s. lat.	WU	1	1	1*				1	1		1	1	1	1
<i>Simocephalus</i> (<i>Simocephalus</i>) <i>mixtus</i> Sars, 1903	WU	1	1			1		1		1	1	1	1	1
<i>Simocephalus</i> (<i>Simocephalus</i>) <i>vetulus</i> (O.F. Müller, 1776)	WU	1	1		1			1	1	1	1*	1	1	1
Family Moinidae Goulden, 1968														
<i>Moina brachiata</i> (Jurine, 1820) s. lat. +	WU	1	1	1*	1			1	1	1	1	1	1	1
<i>Moina lipini</i> Smirnov, 1976 s. lat.	PAL							1				1	1	
<i>Moina macrocopa</i> (Straus, 1820) s. lat.	WU	1	1					1*	1	1		1	1	1
<i>Moina micrura</i> Kurz, 1874 s. lat.	WU	1	1		1			1	1	1	1	1	1	1
<i>Moina salina</i> Daday, 1888 s. lat.	ST	1	1		1*				1	1*		1*	1*	1*
<i>Moina weismanni</i> Ishikawa, 1896	EA	1						1				1	1	1
Family Acantholeberidae Smirnov, 1976														
<i>Acantholeberis curvirostris</i> (O.F. Müller, 1776)	WE												1	1
Family Macrothricidae Norman et Brady, 1867 emend. Smirnov, 1976														
<i>Lathomura rectirostris</i> (O.F. Müller, 1776) ?	PAL	1												
<i>Macrothrix hirsuticornis</i> Norman et Brady, 1867	WU	1						1				1	1	1
<i>Macrothrix laticornis</i> (Jurine, 1820)	WU	1								1	1	1		
<i>Macrothrix odiosa</i> Gurney, 1916	TR	1	1					1	1		1*	1	1	1
<i>Macrothrix rosea</i> (Liévin, 1848)	WE			1*								1*	1	1
<i>Macrothrix spinosa</i> King, 1853	WU	1	1		1			1	1	1*	1*	1	1	1
<i>Macrothrix triserialis</i> Brady, 1886	TR	1	1										1	1
Family Ilyocryptidae Smirnov, 1992														
<i>Ilyocryptus agilis</i> Kurz, 1878	WE	1								1*		1*	1	1
<i>Ilyocryptus sordidus</i> (Liévin, 1848)	PAL							1	1	1	1		1	1
<i>Ilyocryptus spinifer</i> Herrick, 1882 *	TR									1*				
Family Bosminidae Baird, 1845 emend. Sars, 1865														
<i>Bosmina</i> (<i>Bosmina</i>) <i>longirostris</i> (O.F. Müller, 1776) s. lat.	WU	1	1		1			1	1	1	1	1	1	1
<i>Bosmina</i> (<i>Eubosmina</i>) <i>coregoni</i> (Baird, 1857) ?	WE											1		
Family Chydoridae Dybowski et Grochowski, 1894														
Subfamily Aloninae Dybowski et Grochowski, 1894														
<i>Acroporus harpae</i> (Baird, 1834)	PAL	1											1	1
<i>Acroporus angustatus</i> Sars, 1862 ?	WE	1												
<i>Alona quadrangularis</i> (O.F. Müller, 1785)	WE	1						1			1	1	1	1

doubtful records of valid taxa or unrevised taxa included; †, probably extinct in Uzbekistan. Regions: KAR, Karakalpakstan; KHO, Khorezm Province; NAV, Navoiy Province; BU, Bukhara Province; KAS, Kashkadarya Province; SAM, Samarkand Province; SU, Surkhandarya Province; DJ, Djizak Province; SYR, Syrdarya Province; TAS, Tashkent Province and Tashkent City; NAM, Namangan Province; FE, Ferghana Province; AN, Andijan Province. Distribution types: CAE, Central Asian endemics; EA, East Asian; PAL, Palearctic or Holarctic; PCA, taxa of Ponto-Caspian origin; ST, South temperate; TR, tropical; WU, widely distributed unrevised; WE, West Eurasian.

Class Branchiopoda Latreille, 1817
Superorder Diplostraca Latreille, 1829
Order Anomopoda Sars, 1865
Family Daphniidae Straus, 1820
***Ceriodaphnia laticaudata* P.E. Müller, 1867**
(Fig. 2A, B)

In Uzbekistan, the species is rare and has been reported from a few lakes in Karakalpakstan (Rakhmatullaeva 1998) and from the Kokon vicinity, Fergana Province (Ulyanin 1875). In this study, few specimens of *C. laticaudata* were observed in a lake with a muddy sediment (loc. 26) in Djizak Province. *Ceriodaphnia laticaudata* is widely distributed in North Eurasia and Africa (Korovchinsky et al. 2021). The diagnostic characters of *C. laticaudata* are as follows: postabdominal claw basal pectens are similar in length and thickness (Fig. 2B, black arrow), postabdomen has its greatest height in basal portion (Fig. 2B, black arrow).

Family Ilyocryptidae Smirnov, 1992
***Ilyocryptus spinifer* Herrick, 1882**
(Fig. 2C–F)

This is a new record for Uzbekistan. A few specimens of *Ilyocryptus spinifer* were collected in the littoral zone of the Arnasay lake system, Djizak Province (loc. 13). *Ilyocryptus spinifer* is very common in the tropical and subtropical zones of all continents; in Eurasia, this species penetrates far north from its typical range (Korovchinsky et al. 2021). In Central Asia, the species was recorded in Southwest Tajikistan (Dadykin et al. 2024). Some previous records of *I. agilis* from Uzbekistan might in fact belong to *I. spinifer*, as the two species differ mainly in moulting pattern. *Ilyocryptus spinifer* differs from its relatives in incomplete moulting and presence of retained exuviae on the valves and headshield (Figs. 2C, F, black arrows), presence of spinose setae at posterior margin of valve (Fig. 2F, black arrows), and in armature of postabdomen, which bears a proximalmost lateral seta of postanal margin far removed from the anal opening (Fig. 2D, black arrow; Fig. 2E) and a very short seta located ventral to the claw base (Fig. 2E) (Kotov and Štifter 2006; Korovchinsky et al. 2021). See Kotov and Štifter (2006) for a complete morphological description.

Family Chydoridae Dybowski et Grochowski, 1894

***Biapertura affinis* (Leydig, 1860)**

(Fig. 2G–I)

In this study, two parthenogenetic females of *Biapertura affinis* were found in the drainage of Tuyabuguz Reservoir, Tashkent Province (loc. 65). The species is very rare in Uzbekistan, having been observed only in the littoral zone of Lake Khodjakul, Karakalpakstan (Ginatullina 2010). *Biapertura affinis* is a Palearctic taxon widely occurring in Central Asia (Korovchinsky et al. 2021), though it is uncommon in this region. The species is distinct from other alonines by an elongate body shape (Fig. 2G), the presence of two head pores, a large subrectangular postabdomen with dorsal margin evenly concave, bearing thick teeth (Fig. 2H). The absence of denticles at the valve posteroventral angle (Fig. 2I) distinguishes *B. affinis* from its relative, *B. sibirica* Sinev, Karabanov et Kotov, 2020 (Sinev et al. 2020).

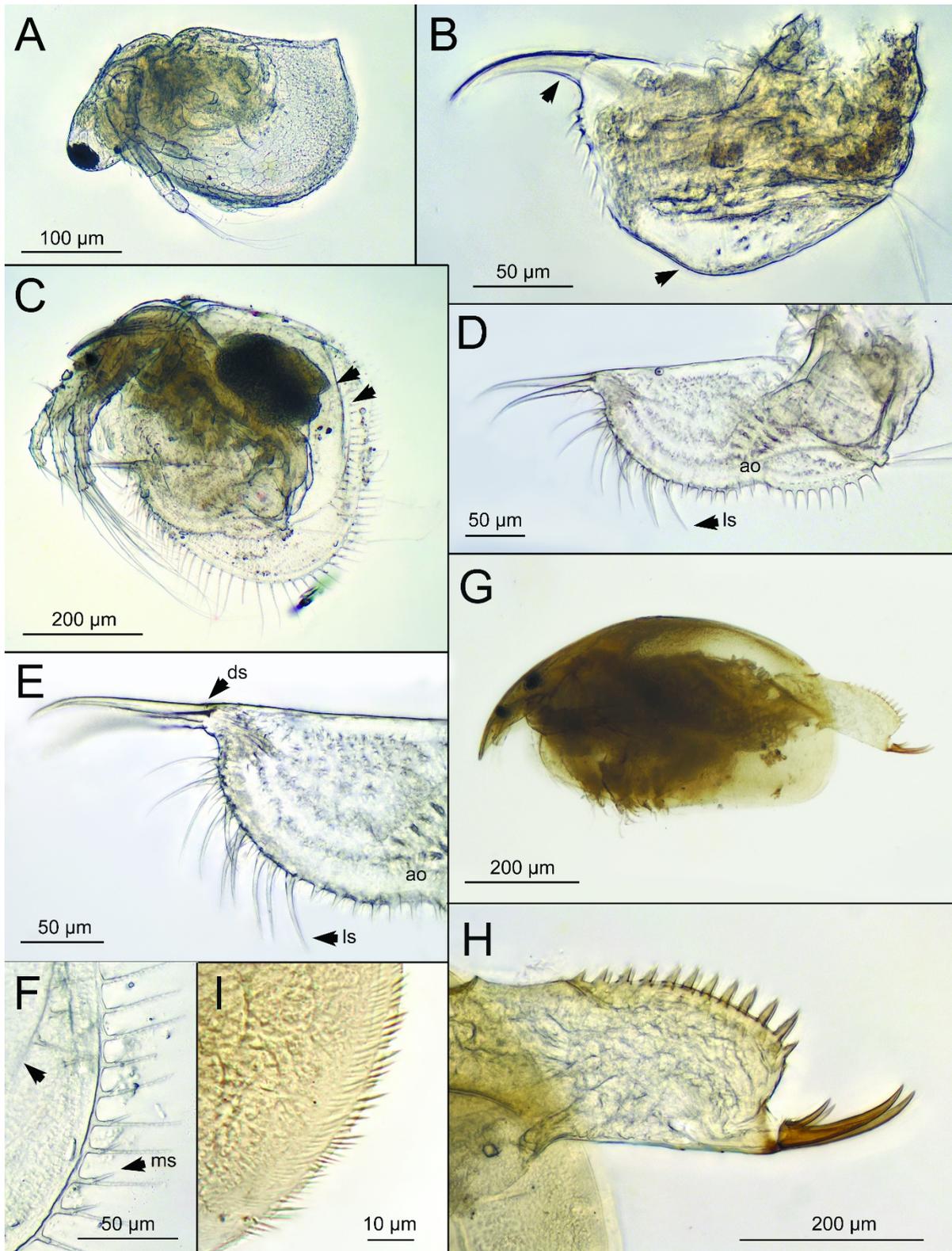


Fig. 2. New and rare Anomopoda species from Uzbekistan. (A–B), *Ceriodaphnia laticaudata* P.E. Müller, 1867, parthenogenetic female from an unnamed lake in Djizak Province (loc. 26): (A), general view; (B), postabdomen. (C–F), *Ilyocryptus spinifer* Herrick, 1882, parthenogenetic female from Lake Arnasay in Djizak Province (loc. 13): (C), general view; (D, E), postabdomen; (F), posterior valve margin. (G–I), *Biapertura affinis* (Leydig, 1860), parthenogenetic female from a drainage of Tuyabuguz Reservoir, Tashkent Province (loc. 65): (G), general view; (H), postabdomen; (I), posteroventral valve angle. Abbreviations of morphological characters are as follows: ao, anal opening; ls, lateral setae of postabdomen; ms, marginal setae of valve; vs, seta ventrally to the base of postabdominal claw.

***Camptocercus uncinatus* Smirnov, 1971**

(Fig. 3A–D)

This is a new record for Uzbekistan. A single parthenogenetic female was collected in the vegetated littoral zone of Tuyabuguz Reservoir, Tashkent Province (loc. 68). The species occurs in south temperate, subtropical and tropical regions of Eurasia, and in North Africa (Smirnov 1974; Korovchinsky et al. 2021), but has not been recorded previously in Central Asia. Nevertheless, it could have been previously identified as *Camptocercus rectirostris* Schödler, 1862. *Camptocercus uncinatus* differs from its relatives by absence of any teeth at the valve posteroventral angle (Fig. 3A); acute rostrum (Fig. 3B, black arrow); relatively short basal spine of postabdominal claw, progressively narrowing distally (Fig. 3C, black arrow); wide serrate postanal teeth (Fig. 3D, black arrows) (Korovchinsky et al. 2021). See Sinev (2014) for a complete description.

***Disparalona rostrata* (Koch, 1841)**

(Fig. 3E, F)

In this study, a single female of *Disparalona rostrata* was collected in the drainage of Tyabuguz Reservoir (loc. 65). In Uzbekistan, *D. rostrata* seems to be a very rare taxon; the only records are from the littoral of Lake Kalgansyr in Syrdarya Province, Uchqizil Reservoir in Surkhandarya Province, and Lake Kargaly in Tashkent Province (Keiser 1925; Mukhitdinov 1967, as *Rhynchotalona rostrata*). The species is widespread in North Eurasia and Central Asia (Korovchinsky et al. 2021). *Disparalona rostrata* can be distinguished from its relatives by a long spine at the exopodite basal segment, exceeding the length of the next segment (Fig. 3E, black arrow); the postabdomen progressively narrowing distally (Figs. 3E, F); the short basal spine of the postabdominal claw (Fig. 3F, black arrow) (Smirnov 1974; Korovchinsky et al. 2021).

Order Onychopoda Sars, 1865

Family Podonidae Mordukhai-Boltovskoi, 1966

***Podonevadne camptonyx* (Sars, 1897)**

(Fig. 3G–I)

In this study, *Podonevadne camptonyx* was found in Lake Sarikamish, Karakalpakstan (loc. 94). In Uzbekistan, *P. camptonyx* has been observed in the Large Aral Sea but now appears to have gone extinct there (Aladin et al. 2021). The species is a Ponto-Caspian endemic and occurs in the

Caspian Sea and the Small Aral Sea (Korovchinsky et al. 2021). The diagnostic characters for *P. camptonyx* are as follows: the head lacking projections (Fig. 3G); the short conical or rounded shell (Fig. 3G); the postabdominal claws present, divergent (Fig. 3H); the endopodite of the thoracic appendages II–IV bearing two setae (Fig. 3I) (Korovchinsky et al. 2021).

Faunal diversity of Branchiopoda in Uzbekistan

Taking into account the original and literature data, we compiled a checklist of Uzbek Branchiopoda that includes 107 species (80 taxa of Anomopoda, 10 of Ctenopoda, 6 of Onychopoda, 1 of Haplopoda, 6 of Spinicaudata, 1 of Notostraca Sars, 1867, 3 of Anostraca) (Table 2; Appendix). However, 14 of these records require further confirmation (Table 2, marked by ?), as they were observed in Uzbekistan only once and more than 30 years ago. Also, these records could easily have been confused with sibling taxa (see Appendix for notes on these records). The taxonomic status of at least six taxa should also be revised in accordance with recent identification guides (Table 2, marked by !). These taxa belong to the species groups containing taxa that are difficult to identify, and information provided by the authors of the records is insufficient to verify their real status. Additionally, earlier records of some potentially valid but unrevised taxa were combined with those of their sibling relatives (Table 2, marked by +): for instance, records of *Moina mukhamedievi* Mirabdullayev, 1998 were included with *M. brachiata* (Jurine, 1820) *s. lat.* (see notes on these records in Appendix). Four onychopod taxa, *Cercopagis pengoi* (Ostroumov, 1892), *Evadne anonyx* Sars, 1897, *Podonevadne angusta* (Sars, 1902) and *P. trigona* (Sars, 1897), are likely extinct in Uzbekistan (Table 2, marked by †) due to the disaster in the Aral Sea – the only water body where they have been recorded for the country. Finally, two taxa were erroneously listed for Uzbekistan. First, the record of *Daphnia atkinsoni* Baird, 1859 was published by Rakhmatullaeva (1998) and refers to the monograph of Mukhamediev (1986), but the latter reports *D. atkinsoni* only for the territory of North Tajikistan (Mukhamediev 1986). Second, the only record of *Bythotrephes longimanus* Leydig, 1860, listed by Rakhmatullaeva (1998), appears to be a misidentification of its relative, *Cercopagis pengoi*, and lacks any reference to literature source.

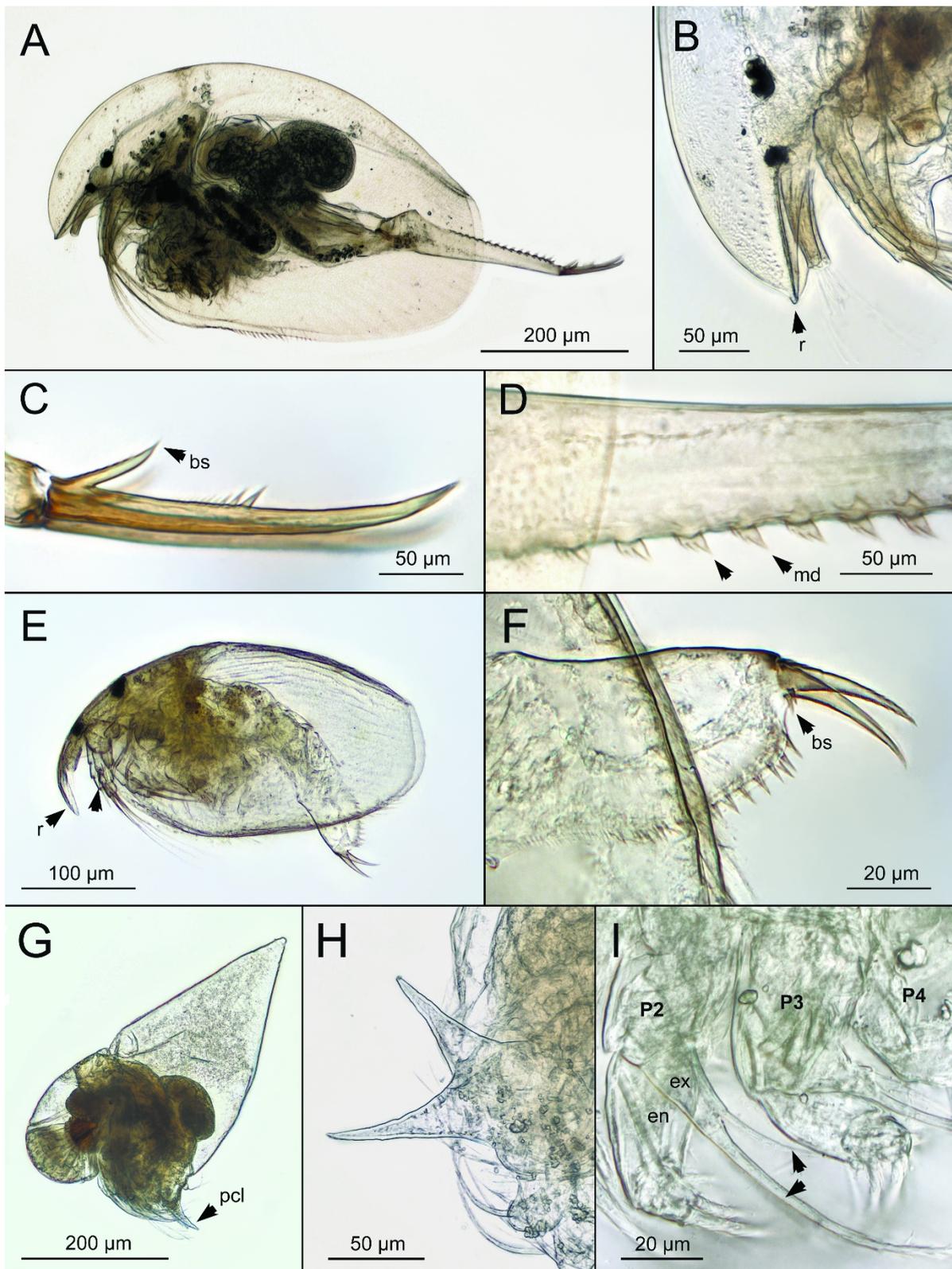


Fig. 3. New and rare Branchiopoda species from Uzbekistan. (A–D), *Camptocercus uncinatus* Smirnov, 1971, parthenogenetic female from Tuyabuguz Reservoir, Tashkent Province (loc. 68): (A), general view; (B), head in lateral view; (C), postabdominal claw; (D), postanal spines of postabdomen. (E–F), *Disparalona rostrata* (Koch, 1841), juvenile parthenogenetic female from the drainage of Tuyabuguz Reservoir (loc. 65): (E), general view; (F), postabdomen. (G–I), *Podonevadne camptonyx* (Sars, 1897) from Lake Sarikamish, Karakalpakstan (loc. 94): (G), general view; (H), postabdominal claws in anterior view; (I), thoracopod armature. Abbreviations of morphological characters are as follows: bs, basal spine of postabdomen; r, rostrum; P2–4, thoracic appendages II–IV; pcl, postabdominal claw.

Combining literature data with our original records, we reveal a clear inequality in faunal richness among the provinces of Uzbekistan (Table 2; Fig. 4). The local fauna of Karakalpakstan is the most diverse and includes a total of 82 branchiopod taxa, followed by relatively rich faunas of Northeast and East Uzbekistan with 40 taxa or more each (Table 2; Fig. 4). At the same time, local faunas of Khorezm, Navoiy, Kashkadarya and Syrdarya Provinces are relatively poor and include 25 or fewer taxa each (Fig. 4). General faunal composition of the species-rich regions is quite similar and comprises a significant number of cosmopolitan taxa (WU), along with high proportions of boreal (PAL, WE, and EA) and south temperate/tropical (TR, ST, and ST, TR) taxa. Central Asian endemics (CAE) constitute a minor faunal component but are present in most regions. Finally, the fauna of Karakalpakstan includes five Ponto-Caspian onychopod taxa (PCA) specific to this province (Table 2; Fig. 4). The species-poor regional faunas include a high proportion of cosmopolitan taxa, but proportions of the other groups strongly vary between the regions (Fig. 4). The performed comparison of the two most studied regions of Uzbekistan, the Ferghana Valley, and Karakalpakstan, with relatively well-explored Eurasian regions located at similar latitudes, shows a relatively high Sørensen similarity of both Uzbek regions to each other ($K_S = 0.75$) and to Tajikistan ($K_S = 0.66$ and 0.60 for the Ferghana Valley and Karakalpakstan, respectively) (Fig. 5, Table S3). The local fauna of Karakalpakstan exhibits high similarity to those of Russian Ciscaucasia and Turkey (Table S3, $K_S = 0.70$ and 0.68 , respectively). Notably, local fauna of the Ferghana Valley seems to be closer to some Mediterranean faunas (Turkey, Greece, Italy, and Russian Ciscaucasia, $K_S = 0.59$, 0.60 , 0.58 and 0.63 , respectively, Table S3), than to those of Mongolia and North China ($K_S = 0.42$ – 0.55 , Table S3). As for Karakalpakstan, its fauna seems to be equally similar to the Central Asian faunas (Tajikistan, Mongolia, and Chinese Xinjiang Uyghur Autonomous Region, $K_S = 0.60$, Table S3), and to those of the West Mediterranean (Greece, Italy and Spain, $K_S = 0.61$, 0.63 , and 0.56 , respectively). Local faunas of both Uzbekistan and Tajikistan are grouped with those of Mediterranean countries (Fig. 5A, B), together forming a major South European—West Asian cluster distinct from the East Asian cluster. Unfortunately, comparison of Uzbek branchiopod fauna with that of most neighbouring countries is very limited due to the lack of reliable data or published checklists.

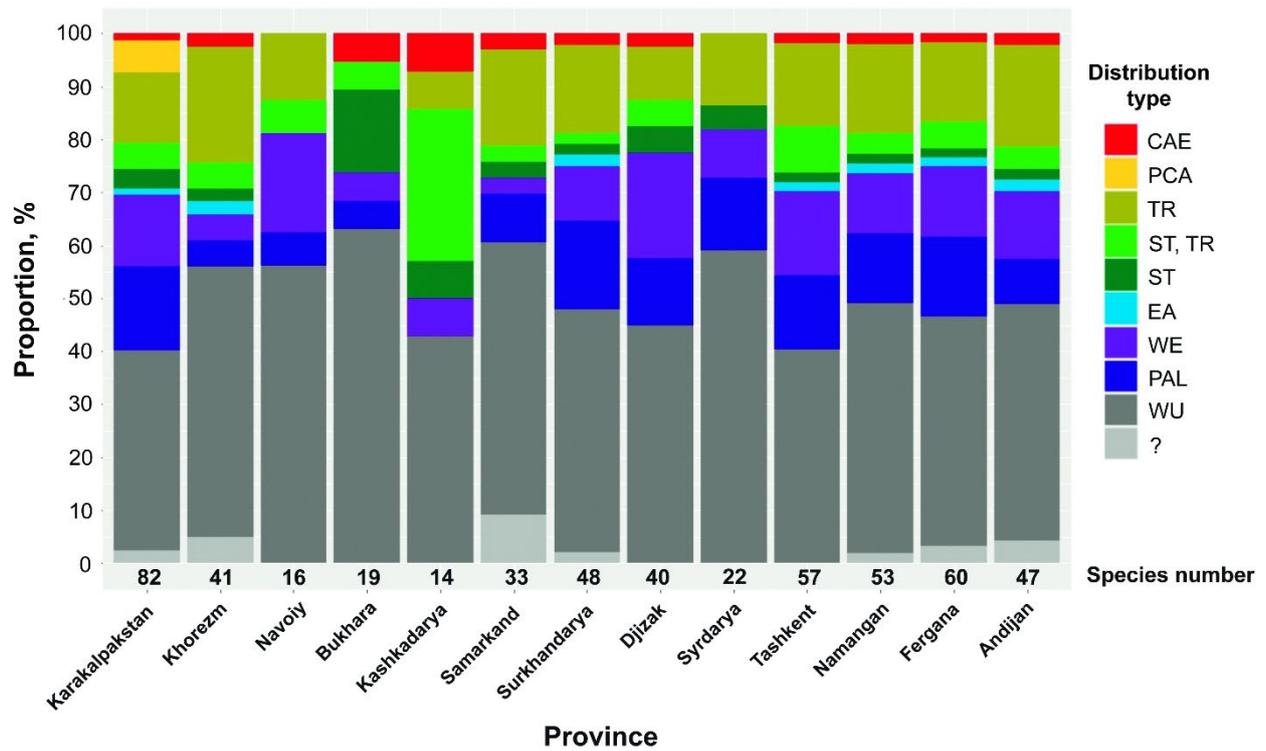


Fig. 4. Proportion of species belonging to different distribution types in local faunas of Uzbekistan provinces. Provinces are roughly ordered from west to east. Abbreviations: CAE, Central Asian endemics; EA, taxa primarily distributed in East Asia; PAL, taxa widely distributed in the Palearctic or Holarctic; PCA, taxa of the Ponto-Caspian origin; ST, taxa widely distributed in the south temperate zone; TR, tropical taxa; WE, West Eurasian taxa; WU, cosmopolitan unrevised taxa; ?, taxa with unclear distribution.

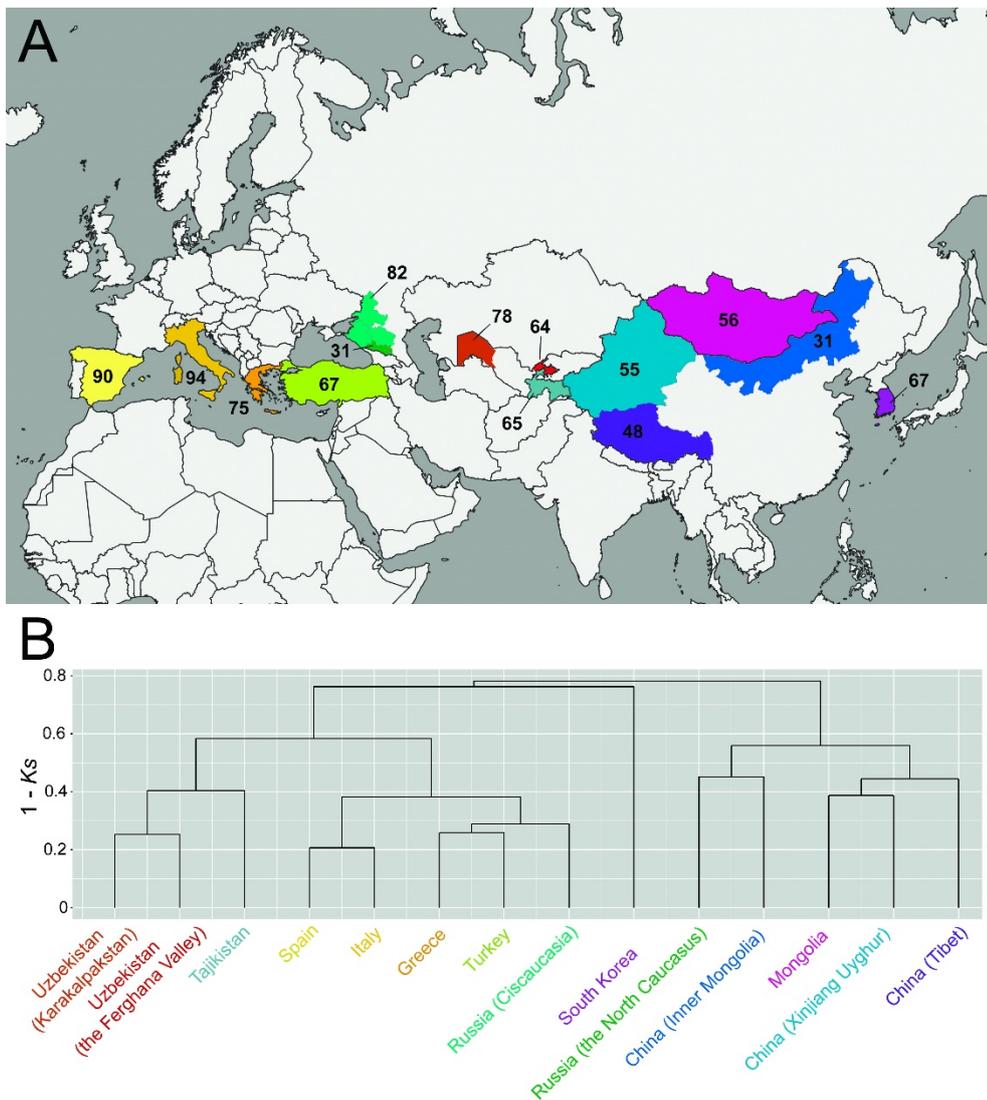


Fig. 5. Comparison of Cladocera local faunas between several regions of Eurasia. (A), location of the regions included to the analysis (numbers indicate total species richness of local faunas); B, hierarchical clustering of the regions by Sorensen-Dice dissimilarity (ward.D2 agglomeration method). Label colour in Fig. 5B corresponds to the region filling in figure 5A. See Table S2 for faunistic lists of the regions and Table S3 for Sorensen-Dice similarity coefficients.

DISCUSSION

General patterns of Branchiopoda diversity in Uzbekistan

This study provides a summary of Branchiopoda records in Uzbekistan. A review of published literature shows that documented faunal richness of the Uzbek provinces is very unequal (Fig. 4), which might be explained by several factors. First, geographical location and diversity of water bodies could contribute to the faunal richness of particular provinces. For instance, the highest number of recorded branchiopod taxa in Karakalpakstan could be explained by the high

diversity of natural water bodies present there, including large lakes. In contrast, in neighbouring Khorezm Province the majority of water bodies are artificial, being built less than 150 years ago (Rosen et al. 2018), which might be a reason for its comparatively low local faunal diversity. However, the age and origin of the water body do not always determine its zooplankton diversity (Dodson et al. 2007; Alfonso et al. 2010), especially in intensively farmed areas (Dodson et al. 2007). Instead, the zooplankton richness depends to a higher degree on a number of biotic and abiotic factors, including size and productivity of the water body, density of water bodies in the area, predation pressure, etc. (Hobæk et al. 2002).

Second, research effort seems to be a factor strongly determining the documented diversity of the territory. This explains well the highest faunal richness of Karakalpakstan in comparison with other regions of Uzbekistan, which is likely to be due to a large body of published literature on this region, especially on the Aral Sea, the Sudochoye lake system and other water bodies of the lower reaches of the Amu Darya. In contrast, low numbers of species recorded in Khorezm, Navoiy, Kashkadarya, and Syrdarya Provinces are probably caused by insufficient research in these regions. For instance, only Lake Aydarkul and Tudakul Reservoir have been investigated in Navoiy Province to date (Ginatullina 2010; Khakimova et al. 2021), resulting in a total of four branchiopod records for Navoiy Province. However, our short sampling session has already yielded 12 more taxa in small water bodies of the Nurata Mountains (Table 2) which have never been studied before. Similarly, only a small part of water bodies was explored in Khorezm and Syrdarya Provinces during the previous studies (Aripov 1972; Mirabdullayev 1998; Rakhmatullaeva 1998), because those studies were mainly focused on rice fields and fishponds (but see Crootof et al. 2015).

Sampling methods are the third important factor in revealing branchiopod diversity. The bulk of previous studies sampled only pelagic zone of water bodies (Mustafaeva et al. 2019 2022; Khakimova et al. 2021; Abdullaeva et al. 2021), which explains a high number of new records for several provinces in this study. For instance, previous hydrobiological studies of Tuyabuguz Reservoir, Tashkent Province processed quantitative planktonic samples collected in different seasons in 2019, 2020, and 2022 by Jedi net (Atamuratova 2021; Abdullaeva et al. 2021; Ginatullina et al. 2023c), but recorded only seven branchiopod taxa, including two littoral (benthic or phytophilous) species. Unfortunately, the total number of collected planktonic samples was not reported by the authors. In the same water body, our study yielded 18 branchiopod species from just five samples (locs. 68–70, 92, 93), with 11 littoral records (Table S1; Appendix). A high diversity of littoral branchiopod taxa has been repeatedly demonstrated for different parts of the world (Walseng et al. 2006; MaiaBarbosa et al. 2008; Jeong et al. 2015) including Uzbekistan (Akatova 1950) and should be taken into account when conducting monitoring studies. Our results confirm that a simple

planktonic net is quite sufficient for revealing littoral branchiopods when sampling the vegetated zone or the bottom of the water body.

The faunal composition of most species-rich Uzbek provinces is similar, representing a mixture of boreal and thermophilic south temperate/tropical taxa with a minor component of Central Asian endemics. The Karakalpakstan local fauna comprises several Ponto-Caspian species (Fig. 4) absent in other provinces, but these taxa are not numerous and have a very restricted distribution. Combination of boreal and thermophilic faunal components has already been observed in plain West and South Tajikistan (Dadykin et al. 2024), and thus might be expected for several poorly studied regions of Uzbekistan (Kashkadarya, Khorezm, Navoiy, and Syrdarya Provinces) and probably for lowland north Afghanistan. Earlier, such a mixing of the boreal and tropical branchiopod faunas has been shown for plain East Asia, where it forms a distinct transitional zone (Garibian et al. 2020; Krolenko et al. 2023). In this area, faunal diversity decreases from north to south, along with changes in dominance structure (Garibian et al. 2021). However, in the case of Central Asia, more monitoring studies are needed to compare diversity patterns between particular territories within the region.

Uzbek local faunas and general Cladocera distribution in Eurasia

To date, comparison of Uzbek fauna with that of neighbouring regions is strongly limited due to lack of reliable data. However, a number of regions of the same latitudinal zone (*i.e.*, so-called ‘South Palearctic,’ see our comments below) seem to be relatively well-studied (see the Region comparisons section in Materials and Methods for a list of references). A preliminary biogeographic analysis conducted in this study (Fig. 5, Table S3) supports a high similarity of the best studied Uzbek local faunas (Karakalpakstani and Ferghanian) to each other and to that of Tajikistan (Fig. 5B), which as expected given their geographical proximity. Notably, based on the hierarchical clustering results, the local faunas of Karakalpakstan, the Ferghana Valley, and Tajikistan seem to be closer to those of the Mediterranean, than to Mongolian and Chinese local faunas (Fig. 5B). The Mediterranean and Central Asia are supposed to have undergone multiple faunal exchanges via the Paratethys (Artamonova et al. 2021). Therefore, the observed faunal similarity could be a result of common palaeohistory of these regions. Unfortunately, the existing schemes of biogeographic regionalization for Cladocera (Korovchinsky 2004) do not have enough resolution to validate our results.

Our provisional data suggest that the Uzbek cladoceran local faunas fall within the West Eurasian cluster, which fits well to the existing knowledge of Cladocera biogeography in Eurasia. Indeed, recent phylogeographic studies have differentiated "European—Western Siberian" and

"Eastern Siberian—Beringian" cladoceran faunas in Northern Eurasia, with a wide transitional zone in Central Siberia (Bekker et al. 2016; Kotov et al. 2025), located northeast to Uzbekistan.

Moreover, it was shown that the traditional recognition of the Palearctic and Nearctic Provinces within the Holarctic is incorrect with reference to the Cladocera: biogeography of the latter implies three major provinces, the Western Holarctic, the Beringian and the Eastern Holarctic (Korovchinsky et al. 2021). We have demonstrated that Uzbek cladoceran fauna clearly belongs to that of the Western Holarctic Province, although such conclusions should be directly confirmed by future phylogeographic studies.

We believe that such a general pattern is adequately revealed, but fine-scale comparisons between regions seem to be somewhat premature. Our biogeographic comparisons are sensitive to the revealed species number, thus poor regional faunas tend to cluster with each other. This can significantly distort the analysis results (Dadykin et al. 2025). In our dataset, a similar trend can be observed for the poorly studied faunas of the North Caucasus and Inner Mongolia comprising only 31 species each (Fig. 5A, B). Also, the biogeographic comparison should take into account the area of the compared regions (Novichkova and Azovsky 2017). Moreover, incompleteness of faunal lists and a high number of unrevised taxa hamper the revelation of local biogeographic patterns. Populations of cosmopolitan taxa, such as *Daphnia longispina* O.F. Müller, 1776, *Chydorus sphaericus* (O.F. Müller, 1776), *Triops cancriformis* Bosc, 1801, and others, need further taxonomic revisions, as these taxa often prove to be groups of sibling species or genetically divergent lineages (Perez et al. 1994; Korn et al. 2006; Belyaeva and Taylor 2009; Bekker et al. 2016; Zuykova et al. 2019; Boyer et al. 2021; Asem et al. 2023 2024).

The status of several taxa listed for Uzbekistan remains unclear despite recent revisions in their respective groups. For instance, numerous records of *Scapholeberis kingii* Sars, 1888 *s. lat.* might refer to either a single or a few morphologically indistinct but valid species of this group, including *S. smirnovi* Garibian, Neretina, Taylor et Kotov, 2020 common in the Palearctic. Reliable identification of the group representatives can be made using gamogenetic stage morphology or standard molecular markers (Garibian et al. 2020), but no such research has been conducted to date. Similarly, application of molecular methods might be suitable for identification of parthenogenetic *Artemia* populations, although standard gene fragments might be unsuitable for differentiating closely related species and parthenogenetic lineages (Asem et al. 2023 2024). In the case of rare taxa such as *Karualona* sp. and *Leberis* sp., however, the major problem is collecting and thorough description of the material, rather than difficulties with its identification. Some of the existing records still require confirmation: these include mostly rare littoral taxa such as *Lathonura rectirostris* (O.F. Müller, 1776), *Monospilus dispar* Sars, 1862, *Anchistropus emarginatus* (Sars, 1862), and others, which usually have low density and are difficult to collect due to their

association with a particular substrate. Also, unconfirmed records include pelagic anomopod *Bosmina (Eubosmina) coregoni* (Baird, 1857), which may be a misidentification of common *B. (Bosmina) longirostris* O.F. Müller, 1776.

To summarize, more studies are needed to compare Uzbek local faunas, for which incomplete knowledge on branchiopods in Uzbekistan is one of the important restrictions. In the next section, we highlight existing white spots in knowledge on branchiopod fauna of Uzbekistan, in order to outline future perspectives of Branchiopoda studies in the country.

Future perspectives of branchiopod faunistic studies in Uzbekistan

Although studies having been conducted for about 150 years, there are still gaps in our knowledge on branchiopods of Uzbekistan. Most of the published literature in this field is devoted to crustacean fauna of lowland fishponds, reservoirs and lakes. As lowland water bodies in Central Asia are usually artificial or highly transformed by intense agriculture and farming (Karthe et al. 2015), a vast majority of recent studies concern a relatively small portion of branchiopod diversity. Moreover, the lowland water bodies of Uzbekistan and other Central Asian countries are highly affected by drought, mineralization, and pollution (Huang et al. 2021; Liu et al. 2019 2021; Zadereev et al. 2020), that causes a significant decrease in crustacean diversity (Ginatullina et al. 2017). These negative trends have been observed in a number of large lakes across Uzbekistan, including the Aydar-Arnasay lake system (Ginatullina 2010; Ginatullina et al. 2017; Erkabaev et al. 2024), which was also investigated in the present study. In the 1970s, a diverse oligohaline branchiopod complex including dominant *Daphnia* spp. and *Bosmina longirostris* was typical of the Aydar-Arnasay lake system (Fedorova 1970; Ginatullina et al. 2023a). Currently, however, this complex is restricted to areas with low mineralization, being replaced by a less diverse mesohaline assemblage with dominants *Diaphanosoma mongolianum* Ueno, 1938 and *Moina salina* Daday, 1888 (Ginatullina 2023; Ginatullina et al. 2023a), which were also recorded in this study. The Large Aral Sea is the best-studied case of salinization: since the 1970s, a diversity of Onychopoda (*Cercopagis pengoi*, *Evadne anonyx*, *Podonevadne angusta*, *P. camptonyx*, *P. trigona*), as well as several representatives of Anomopoda and Ctenopoda, has become extinct in the Large Aral Sea due to salinity level increase (Aladin et al. 2019 2021; Table 2). In this study, however, we unexpectedly recorded *Podonevadne camptonyx* in large Lake Sarikamish in Karakalpakstan, although the water body is also undergoing salinization (Matmuratov 2017). Nevertheless, the imminent extinction of *Podonevadne* in Lake Sarikamish is also likely. In contrast, the knowledge on the fauna of montane waters of Uzbekistan remains limited. Montane water bodies of Central Asia are less affected by anthropogenic pressure and drought and thus might

become potential refugia for a variety of branchiopods. In Uzbekistan, montane lakes and small water bodies are numerous and widespread (Petrov et al. 2017). However, knowledge about their fauna is extremely scarce: Stepanova and Ledyeva (1957) recorded four anomopod species in Lake Kokkul, Fergana Province. In this study, we provide the first data on a relatively rich boreal branchiopod assemblage (nine species) observed in Lake Fozilmon, Navoiy Province (Table S1; Appendix). In small water bodies of Lake Fozilmon vicinity (locs. 48, 49), branchiopod diversity was much lower, with two and three species were observed, respectively (Table S1). However, further studies of these and other montane waters might bring new branchiopod records, including some high-altitude species recorded in the Pamir mountains (Dadykin et al. 2024).

Temporary pools represent another type of habitat essential for the branchiopods (Brendonck et al. 2008) but poorly studied in Uzbekistan. Records of Anomopoda, Anostraca, Spinicaudata, and Notostraca from ephemeral water bodies of Uzbekistan are still mostly occasional (Daday 1910 1914; Mukhamediev 1986; Van Damme and Dumont 2008), which hampers the comprehensive study of these groups. As the systematics and taxonomy of ‘large branchiopods’ remain complicated due to their high cryptic diversity and morphological plasticity (Brendonck et al. 2008 2022), more integrative studies are needed to reveal diversity of Central Asian representatives. In particular, the taxonomy of Spinicaudata apparently requires further clarification, as many species of this group are known as endemics with narrow distribution ranges (Rogers 2020). To date, the status and presence of the most spinicaudatan taxa recorded for Uzbekistan remain questionable (Rogers et al. 2017, 2020). In this study, a number of ephemeral water bodies were investigated in Djizak, Navoiy and Samarkand Provinces (locs. 23, 24, 28, 37, 40, 50, 61, 64). In these water bodies, 15 anomopod taxa were recorded, of which the two, a spinicaudatan *Eocyclus davidi* (Simon, 1866) *s. lat.* and anomopod *Macrothrix odiosa* Gurney, 1916, were not found in other habitat types during this study (Table S1). This highlights a high potential of ephemeral pools for branchiopod colonization and the importance of these water bodies for monitoring branchiopods.

Currently, non-indigenous species have become an essential issue for the freshwater communities (Anufrieva and Shadrin 2018; Kotov et al. 2022a). Multiple cases of anthropogenic transportations have been recently observed among the branchiopods, particularly in Onychopoda and Anomopoda (Kotov et al. 2022a). From this point of view, West Uzbekistan is of particular interest, as the Ponto-Caspian region is considered to be a donor region of several important invasive onychopod species (Panov et al. 2007; Korovchinsky et al. 2021; Macêdo et al. 2024), including *Cercopagis pengoi* and *Bythotrephes longimanus*. Neither was recorded in this study, and in Uzbekistan both taxa seem to be rare or absent (Appendix). On the other hand, artificial water bodies actively used for fishery and agriculture are especially vulnerable to invasions (Johnson et al. 2008; Parkes and Duggan 2012), as well as systems experiencing salinity and hydrological

fluctuations (Anufrieva and Shadrin 2018). As most lowland water bodies in Uzbekistan are either artificial or transformed (Karthe et al. 2015), alien aquatic species might soon become a crucial factor affecting Uzbek aquatic communities. However, no such cases have yet been reported for Central Asia.

Overall, our knowledge on the branchiopod fauna of Uzbekistan and Central Asia is still full of blind spots in many aspects. Therefore, the region retains potential for future faunistic, taxonomic and phylogeographic research on aquatic crustaceans. Given its geographical position and potential role in aquatic invertebrate migrations (Artamonova et al. 2021), Central Asia might provide a key to understanding global distribution patterns of Branchiopoda in Eurasia.

CONCLUSIONS

Our Branchiopoda checklist comprising 107 taxa is still preliminary, as Kashkadarya, Khorezm, Navoiy, and Syrdarya Provinces remain scarcely studied, while montane and temporary water bodies are still poorly sampled across the whole territory of Uzbekistan. Our results enable more precise evaluation of branchiopod faunal diversity in Central Asian lowlands, with the exception of unrevised groups (Anostraca, Notostraca, and Spinicaudata). Placement of well-explored Uzbekistan Cladocera local faunas in the West Eurasian cluster corresponds well to the known biogeographical patterns for this group and might reflect a genesis of the faunal assemblages, although broader-scale studies in the South Palearctic are needed for precise conclusions regarding Cladocera biogeography. We hope that this study will serve as a base for further faunistic, taxonomic, and phylogeographic research. The presented checklist might also be suitable for tracking changes in branchiopod communities in Uzbekistan and Central Asia in the whole.

List of abbreviations

CAE, Central Asian endemics.

EA, taxa primarily distributed in East Asia.

PAL, taxa widely distributed in the Palearctic or Holarctic.

PCA, taxa of the Ponto-Caspian origin.

ST, species widely distributed in the south temperate zone (the South Palearctic).

TR, tropical taxa.

WE, West Eurasian taxa.

WU, cosmopolitan unrevised taxa.

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Supplementary materials

Table S1. Database of Branchiopoda records in the samples collected in 2023–2024 by the authors.
(download)

Table S2. Local Cladocera faunas of Uzbekistan and some regions of Eurasia. (download)

Table S3. Sorensen-Dice similarity coefficients for local faunas of several Eurasian regions.
(download)

Appendix. Annotated checklist of Branchiopoda in Uzbekistan. (download)