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# Ecological and Faunistic Characteristics of the Leech Fauna in the Bukhtarma Reservoir, Eastern Kazakhstan

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**Abstract**—The taxonomic diversity of the Hirudinea fauna and its dependence on the ecological conditions in the Bukhtarma Reservoir (Eastern Kazakhstan) have been studied. The morphological analysis has shown that these leeches belong to two orders and three families: Rhynchobdellida (families Glossiphoniidae and Piscicolidae) and Arhynchobdellida (family Erpobdellidae). On the whole, eight leech species from five genera (*Alboglossiphonia*, *Helobdella*, *Theromyzon*, *Piscicola*, and *Erpobdella*) have been identified. Among them, there are three glossiphoniid species (*A. heteroclite*, *H. stagnalis,* and *T. tessulatum*), two species of piscicolid*s* (*Piscicola geometra* and *Piscicola* sp.), and three species of predatory leeches (*E. octoculata*, *E. vilnensis,* and *Erpobdella* sp.). Possible effects of hydrochemical parameters of the aquatic environment on the species diversity have been analyzed. Correlation has been revealed between the abundance of species and the physical and chemical characteristics of the environment.

*Keywords:* Hirudinea, species composition, Bukhtarma Reservoir, Eastern Kazakhstan
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Reservoirs are a special category of artificial water bodies with specific hydrochemical and hydrobiological regimes. The main purpose of their construction is to solve a complex of economic and social problems. The Irtysh cascade of reservoirs was built in the territory of Eastern Kazakhstan during the second half of the 20th century. It includes the Bukhtarma Reservoir, Ust-Kamenogorsk Reservoir, and Shulbinsk Reservoir [1]. The Bukhtarma Reservoir is the largest among them and functions as the main regulator of the hydrological level of the cascade. The lacustrine and lacustrine-fluvial parts of this reservoir are characterized by a low concentration of dissolved oxygen and an excess concentration of heavy metals due to the proximity of mining and nonferrous metallurgy enterprises [2]. Thus, the most favorable habitats for hydrobionts are in the northern part of the reservoir where the mountain landscape prevails, which makes it very difficult to take samples by standard hydrobiological methods.

The aquatic fauna of the Bukhtarma reservoir is distinguished by the maximum diversity among reservoirs of the Upper Irtysh basin, which is due to the diversity of its biotopes [2]. The specific composition of species in the Bukhtarma Reservoir is explained both by natural dispersal of species from water bodies included in it and by the presence of artificially introduced species [3, 4].

Freshwater leeches are an insufficiently studied and, at the same time, important ecological groups of hydrobionts. Representatives of the group of free-living nonparasitic (microphagous) leeches are of scientific interest as an important link in the trophic chain of aquatic ecosystems and also as indicators of pollution in water bodies [5–7]. The main ecological role of parasitic leeches is regulation of the abundance of host species. Ulcers, bleeding, and inflammation associated with the attachment of leeches weaken the host, because it ensures a supportive environment for bacterial infections. The interest in leech fauna has considerably increased in the recent years because of probable involvement of leeches in transmission of bacterial and viral infections [8–12], blood parasites (including trematodes, cestodes, and nematodes) [13], and parasitic flagellates [14–16], which are considered pathogenic for aquatic animals.

No object-orientated studies on the leech fauna of the Bukhtarma Reservoir have been performed to date. The taxonomic and ecological diversity of leeches in the reservoir has been investigated insufficiently. Data on the occurrence of some leech species were obtained randomly during the research on mac-

rozoobenthos [17] or fish parasitofauna [17]. Thus, only preliminary data without any description of the biology and ecology are available for such species. Furthermore, the significance of identification of some species is questionable and needs specification. The faunistic list of the Bukhtarma Reservoir [18] included two species of piscine leeches (*Piscicola geometra* (Linnaeus, 1758) and *Caspiobdella fadejewi* (Epstein, 1961)). However, it is known that the European freshwater leech *C. fadejewi* has a limited range, living exclusively in the basins of rivers flowing into the Sea of Azov and the Black Sea [19, 20], as well as in the Volga basin [21]. Possibly, *C. fadejewi* was accidentally introduced in Eastern Kazakhstan with fish, or this piscicolid species was incorrectly identified. In the later work [17], *C. fadejewi* is not on the checklist of macrozoobenthos, but there are three other leech species: *Piscicola geometra* (Linnaeus, 1758), *Hemiclepsis marginata* (Müller, 1774), and *Erpobdella octoculata* (Linnaeus, 1758).

The purpose of this study is to obtain more accurate data on the species diversity of leeches in the northern part of the Bukhtarma Reservoir and to analyze their ecological and faunistic characteristics.

## MATERIAL AND METHODS

The biological material was sampled in August 2015 at three geographic points in the northern part of the Bukhtarma Reservoir (Fig. 1): near the village of Novaya Bukhtarma (station 1, 49°36′58″ N, 83°31′33″ E) and recreation centers Mokhnatka (station 2, 49°37′01″ N, 83°34′18″ E) and Goluboi Zaliv (station 3, 49°37′39″ N, 83°27′21″ E).

Leeches were collected by hand or with hydrobiological nets in the littoral area of the reservoir at the depths of 0.5–1.5 m. Leeches were quatitavely analyzed using a hydrobiological frame. All samples were fixed in 80% ethanol after preliminary anesthesia if leeches in a low-concentration alcohol solution.

Morphological analysis of the fixed samples was carried out in the laboratory under a MSP-2 binocular microscope (LOMO, Russia). Species affiliation was determined under existing systematic keys [20, 22] in accordance with the modern classification of the group. All biological samples were marked and deposited in the collection of the Limnological Institute, Siberian Branch, Russian Academy of Sciences (Irkutsk).

The main hydrochemical characteristics of water (pH, temperature, salt content, and electroconductivity) were measured in the field, at sampling points, with a PCSTestr 35 Series multiparametric tester (Oakton Eutech Instruments, United States).

To evaluate the relationship between the taxonomic composition of leech fauna and the physicochemical characteristics of the environment, we used multivariate statistics. The correlation matrix was constructed based on the Spearman correlation coefficient [23]. Advantages of the R programming language with additional function of the gplots package were used for statistical calculations and visualization of results [24].

## RESULTS AND DISCUSSION

The entire complex of environmental factors has an effect on the distribution and abundance of leeches, with water salinity being one of the main factors determining their composition and abundance [25–27]. Salinity within the range of 100 to 500 mg/L is most favorable for the living activity of leeches [27]. Ambient temperature is no less important factor influencing their distribution, abundance, and physiological state [28, 29]. In addition, the species composition and abundance of the leech fauna depend on organoleptic characteristics of the water, such as its odor, color, and turbidity [30].

To describe the habitats and reveal potential correlation between the species composition of leeches and certain hydrochemical characteristics, total water salinity and temperature were measured at each station; in parallel, of conductivity and pH were measured. The results showed that the parts of the Bukhtarma Reservoir where leeches were collected could be regarded as different biotopes with specific physicochemical characteristics (Fig. 1, table). Station 1 is a water-logged reservoir section with water temperature of 23.4°C, electric conductivity of 185 mS, and total salinity of 143 mg/L. This biotope was characterized by high water turbidity. Leeches were found in a free state and on various types of substrates, including the surface of aquatic plants and snail shells. Station 2 was located near the base of the Mokhnataya Mountain. Samples were taken along the shoreline in the zone of open water, which was relatively transparent. The bottom in this zone was stony, and leeches occurred only on solid substrates. At the moment of sampling, water temperature was 21°C; electric conductivity, 146 mS; and total salinity, 93.7 mg/L. This was the only station where water salinity was beyond the optimum range (table). Station 3 was in another bay of the reservoir, in close proximity to the dam of the Bukhtarma HPP. Abiotic environmental factors in this area were slightly different from the previous biotopes (see Table). Water temperature was the lowest (18.6°C), while the values of electric conductivity (172 mS) and total salinity (134 mg/L) were comparable to those in the first sample. The water was transparent, the bottom mostly sandy, with well-developed neritic vegetation. The substrates for leeches in this biotope solid human-made objects (mainly plastic) and macrophytes, with glossiphoniids occurring in their root system. Water pH at all stations varied insignificantly, within the slightly alkaline range (pH 7.6–7.7).

According to the literature, only four leech species, including *C. fadejewi*, were previously recorded in the

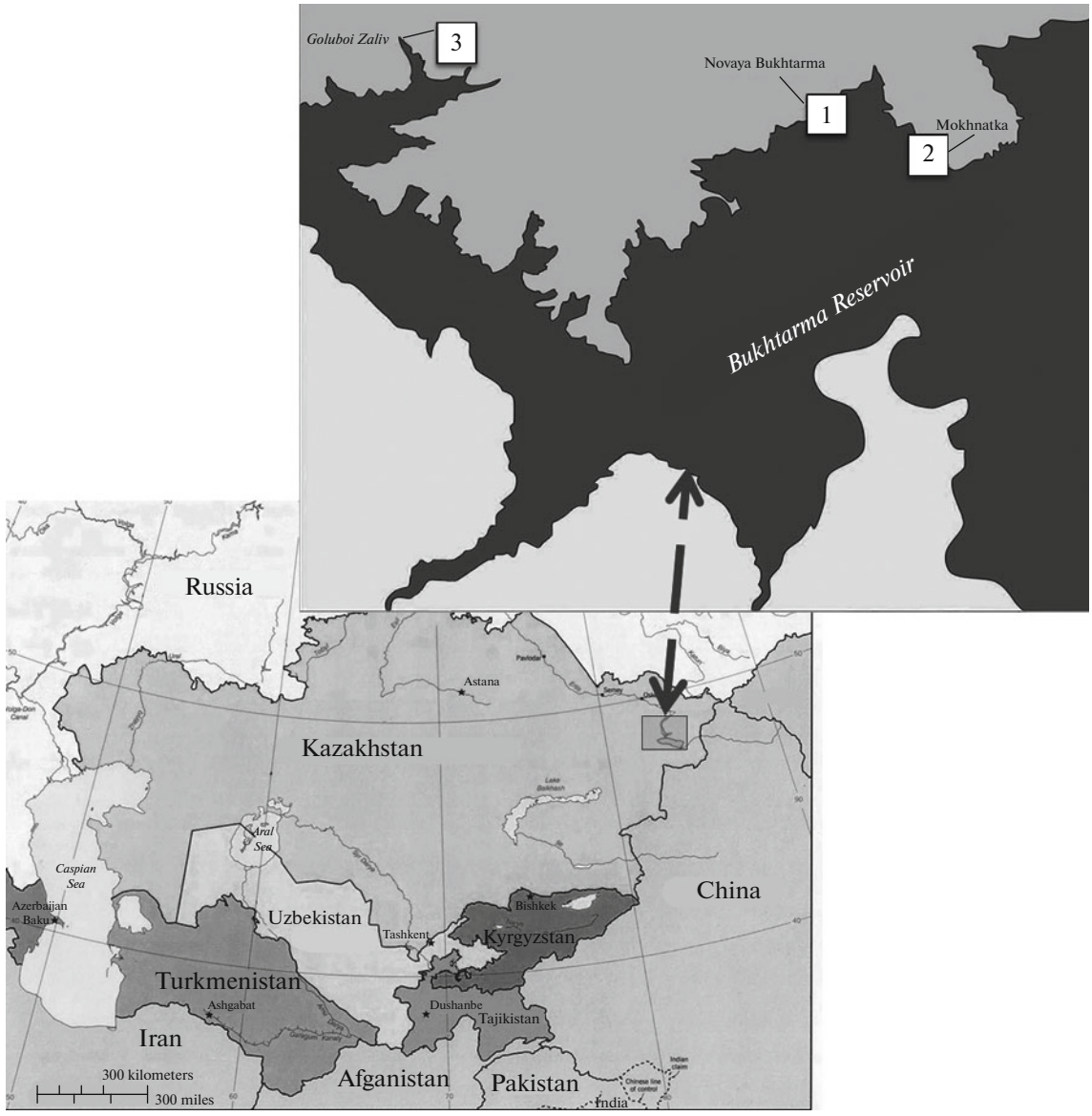


**Fig. 1.** Geographic locations of sampling stations: (*1*) near the village of Novaya Bakhtarma (49°36′58″ N, 83°31′33″ E), (*2*) – near the Mokhnatka Recreation Center (49°37′01″ N, 83°34′18″ E), (*3*) near the Goluboi Zaliv Recreation Center (49°37′39″ N, 83°27′21″ E).

Bukhtarma Reservoir [17, 18], but the presence of the latter species is questionable. Our data show that the species composition of leech fauna in the Bukhtarma Reservoir has become three times as rich as before and comprises nine species of parasitic and nonparasitic leeches from two orders, Rhynchobdellida and Arhynchobdellida. The checklist includes five fairly common species (*H. marginata, H. stagnalis*, *A. heteroclite*, *P. geometra*, *E. octoculata*) and two rare species (*T. tessulatum* and *E. vilnensis*). *Hemiclepsis marginata* was added to the revised species list based on the data by Devyatkov [17], despite the fact that we have not found it in the northern part of the reservoir. Furthermore, there are representatives of two potentially new species (*Piscicola* sp. and *Erpobdella* sp.) that have not been attributed to any known taxa because of their specific morphological features.

The Palearctic species *E. vilnensis*, contrary to the traditional point of view that it is a typical representative of upland and mountain regions of Central, Eastern, and South-Eastern Europe [20, 29], was for the first time found in Asia. As the geographic range of research on leeches expands, new data on the distribution of *E. vilnensis* appear. For example, it has been recently recorded in rivers of Odessa and Nikolaev

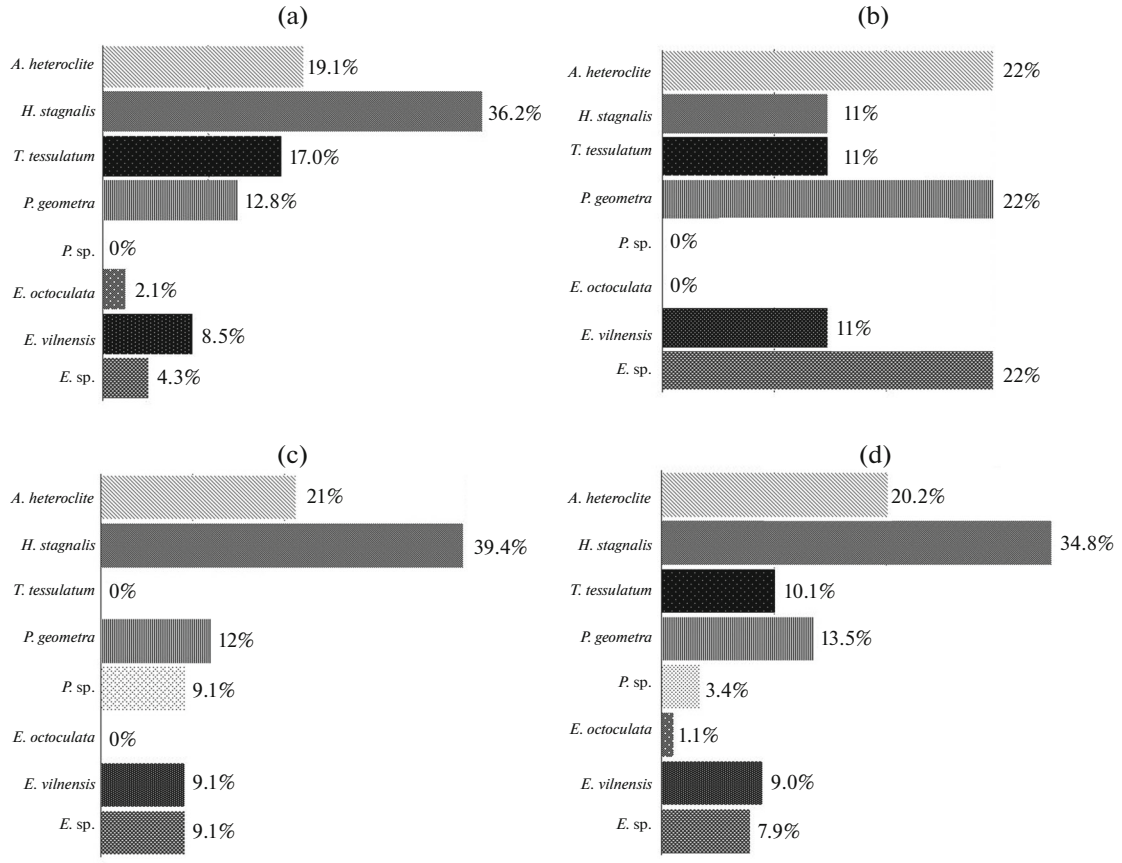


**Fig. 2.** The ratio of species abundance in different leech communities inhabiting the Bukhtarma Reservoir: (a) station 1, (b) station 2, (c) station 3, and (d) average for the reservoir.

regions of Ukraine [31]. This species is widespread in the northern part of the Bukhtarma Reservoir (table).

The leech fauna of the Bukhtarma Reservoir includes both typical representatives of flowing water bodies (*E. vilnensis*) and specific species for waters with decreased run-off (*H. marginata, T. tessulatum, A. heteroclite,* and *H. stagnalis*). Comparative analysis of the taxonomic diversity of leech communities inhabiting different areas of the reservoir revealed dominance of *H. stagnalis* and *A. heteroclite*. Their average occurrence frequencies were 34.8% and 20.2%, respectively (Fig. 2). Despite the dominant role of common Palearctic species from the family Glossiphoniidae, the level of their species diversity was generally low, regardless of the high abundance of bivalve mollusks and snails, their potential hosts (table). Nevertheless, the proportion of parasitic forms in the community of leeches inhabiting the Bukhtarma Reservoir was very high (82.0%) (see Fig. 2d), which may be evidence for the diversity of host organisms in this water body. In fact, its ichthyofauna is more diverse than in other reservoirs of the Upper Irtysh cascade [2], which is attributed not only to the variety of biotopes but also to artificial introduction of organisms [3, 4].

The parasitic group of the Bukhtarma Reservoir includes piscine leeches (*P. geometra* and *Piscicola* sp.), leeches parasitizing waterfowl (*T. tessulatum*), and all glossiphoniids parasitizing mainly mollusks. The proportion of macrophagous leeches (*E. octoculata*, *E. vilnensis, Erpobdella* sp.) in the communities is relatively low, only 18.0% of the total number of samples (table, Fig. 2d). The atypical ratio of parasites and benthophages (normally, it must be opposite) is probably explained by the instable regime of the shore zone. The northern part of the Bukhtarma Reservoir is in close proximity to the HPP dam and, hence, is subject to fluctuations in the water level, which apparently influences the abundance and distribution of free-living leeches, whose habitat is confined to the shore zone of the reservoir. It is known that large species of predaceous or macrophagous leeches are prey for fish and birds [22]. Therefore, if the abundance of the latter increases, leeches become less numerous.

Statistical analysis has shown that the leech species diversity was the highest in sample 1 taken near the village Novaya Bukhtarma (table, Fig. 2), where conditions for feeding and reproduction of leeches were favorable (wide shoals, macrophyte beds, and high density of various invertebrates and fish fry). The

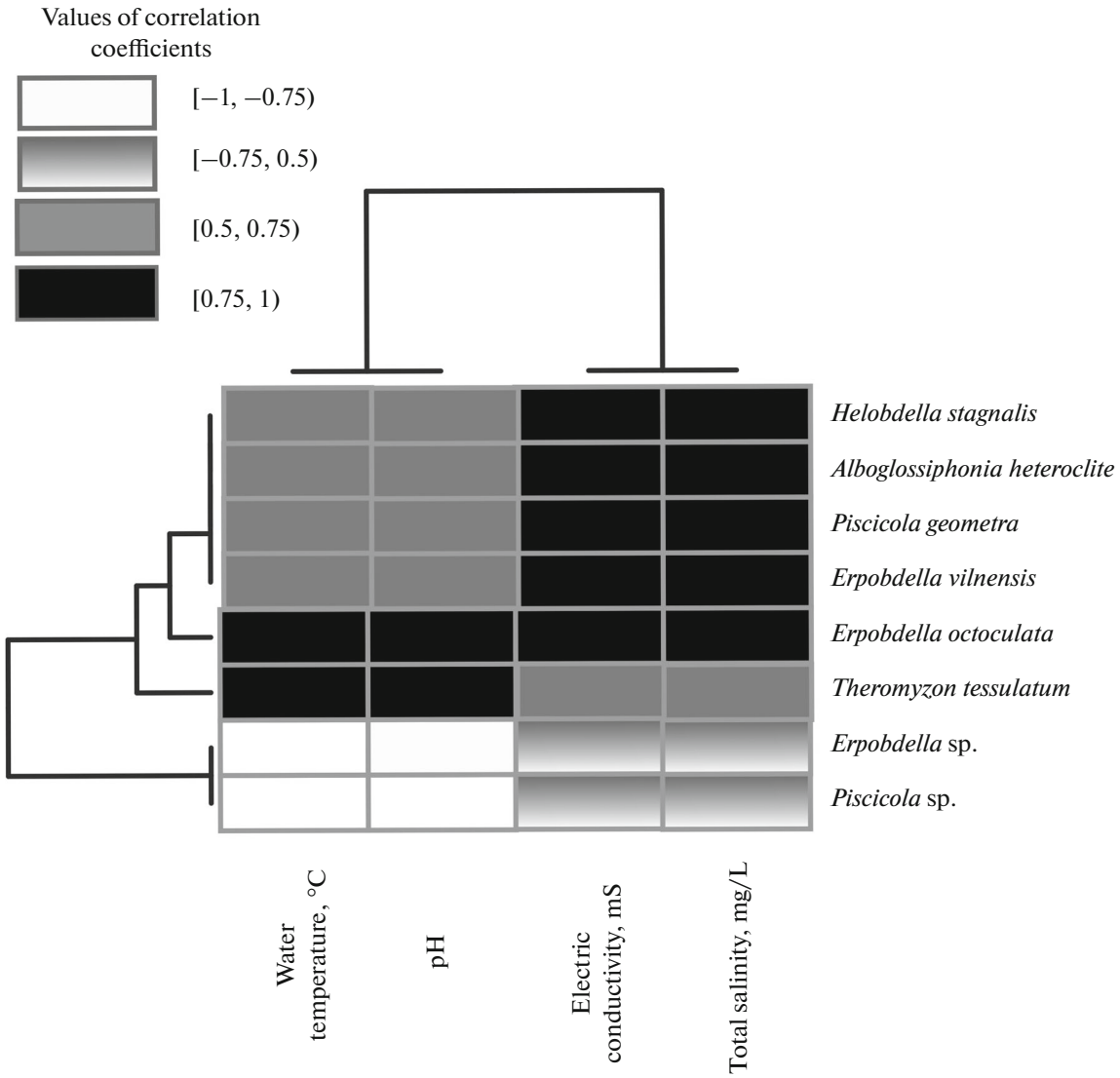


**Fig. 3.** Heat map of correlation matrix for the relationship between physicochemical characteristics of the environment and the abundance of leech species.

qualitative and quantitative parameters of leech development were relatively low in the areas with high anthropogenic load (near the Goluboi Zaliv and Mokhnatka recreation centers).

It is known that the specifics of leech distribution is largely dependent on abiotic factors of their habitat [32]. This is confirmed by the distribution patterns of leeches in the Bukhtarma Reservoir. Correlation analysis was performed to evaluate the nature of the relationship betwen the species abundance and each particular factor of the aquatic environment. The results of this analysis are displayed as a heat map (Fig. 3). The abundance of species sampled in different parts of the reservoir correlates with the physical and chemical characteristics of the environment. Four ecological groups of leeches can be distinguished in the Bukhtarma Reservoir, depending on correlation coefficient.

The largest group comprises *H. stagnalis, A. heteroclite, P. geometra*, and *E. vilnensis*. All these species show high correlation with characteristics of the aquatic environment such as electric conductivity ($r \approx 1$) and total salinity ($r \approx 1$). The coefficient of correlation with temperature and pH is $r \approx 0.5$. (see Fig. 3). This implies that leeches of this group respond to changing factors of the aquatic environment in a particular wat: the abundance of the above species becomes higher with an increase in concentration of dissolved salts (total salinity), while changes in temperature and pH only slightly affect their numbers.

The second group consists of *E. octoculata*. The only specimen of this leech species was found in the

Physicochemical properties of water and species composition of leeches in the northern part of the Bukhtarma Reservoir, Eastern Kazakhstan

| Hydrochemical parameter | Station | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| Water temperature, °C | 23.4 | 21.0 | 18.6 |
| pH | 7.70 | 7.67 | 7.66 |
| Electric conductivity, mS | 185 | 146 | 172 |
| Total salinity, mg/L | 143 | 93.7 | 134 |
| Taxon | Abundance, ind./m$^2$ | | |
| *Theromyzon tessulatum* | 8 | 1 | |
| *Alboglosiphonia heteroclita* | 9 | 2 | 7 |
| *Helobdella stagnalis* | 17 | 1 | 13 |
| *Piscicola geometra* | 6 | 2 | 4 |
| *Piscicola* sp. | | | 3 |
| *Erpobdella octoculata* | 1 | | |
| *Erpobdella vilnensis* | 4 | 1 | 3 |
| *Erpobdella* sp. | 2 | 2 | 3 |
| Number of leeches per station, ind./m$^2$ | 47 | 9 | 33 |
| Total number of species | 7 | 6 | 6 |

sample from station no. 1, with the highest values of water temperature, pH, electric conductivity, and total salinity (table). Correlation analysis has shown that *E. octoculata* is characterized by high positive coefficients of correlation between its abundance and all these physicochemical parameters ($r \approx 1$) (Fig. 3). The extremely low abundance and occurrence of *E. octoculata* in the northern part of the Bukhtarma Reservoir (table) suggest that this species, the most common in the Palearctic, prefers environments with high electric conductivity, total salinity, temperature, and pH of water. The relatively high values of hydrochemical parameters at station 1 appear to be at the minimum level allowing the survival of this leech.

The occurrence and abundance of *T. tessulatum* have relatively low coefficients of correlation with conductivity and total salinity ($r \approx 0.5$) and, on the other hand, high positive coefficients of correlation with water temperature and pH ($r \approx 1$) (see Fig. 3). Thus, *T. tessulatum* responds to a rise of water temperature by increasing in abundance and is less dependent on water salinity. In fact, this species was absent in the sample taken at the station with colder water (table).

Another group of leeches includes *Piscicola* sp. and *Erpobdella* sp. As is seen from the pattern (Fig. 3), a low correlation can be observed between the species abundance within the group and the electroconductivity and total salinity of water ($r \approx 0$). At the same time, there is a high negative correlation ($r \approx -1$) with temperature and pH (Fig. 3). Therefore, *Piscicola* sp. and *Erpobdella* sp. become more abundant, when temperature and pH values decrease and are not sensitive to changes in conductivity and water salinity. *Piscicola* sp. is apparently more sensitive to the temperature factor and does not occur in environments with water temperatures above 20°C, while *Erpobdella* sp. decreases gradually in abundance as the ambient temperature rises (table). Furthermore, it has been noted that the ecological preferences of *Erpobdella* sp. are radically different from those in other representatives of the genus (*E. octoculata* and *E. vilnensis*) inhabiting the Bukhtarma Reservoir, which indicates indirectly its independent taxonomic status.

Therefore, the studied leech species differ in their responses to environmental factors that either contribute to their intensive reproduction and, consequently, high abundance or inhibit their living activity.

## CONCLUSIONS

Our investigations have allowed us to update information on the species composition of leech fauna in the Bukhtarma Reservoir. As a result, the species list is expanded to nine species, including *H. marginata* which we have not found in the northern part of the reservoir. The leech fauna of the reservoir includes both species characteristic of water bodies with decreased run-off and typical rheophilic species. *Helobdella stagnalis* and *A. heteroclite*, the most common in the Palearctic, are the dominant species. The prevalence of parasitic forms in the leech community of the Bukhtarma Reservoir may indicate the significant diversity of host organisms that, in turn, affect the

abundance of benthic species (their prey). The poor species composition and the low proportion of benthophages in the structure of leech fauna are, presumably, a result of the instable hydrological regime in the shore zone of the reservoir.

It has been shown that the species composition and abundance of leech faunal communities depend on ecological characteristics of different areas of the Bukhtarma Reservoir and that the leech community can be divided into four groups depending on sensitivity to physical and chemical factors of the aquatic environment.

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## REFERENCES

1. Vinokurov, Yu.I., Chibilev, A.A., Krasnoyarova, B.A., et al., Regional ecological problems in transboundary basins of the Ural and Irtysh rivers, *Izv. Akad. Nauk, Ser. Geogr.,* 2010, no. 3, pp. 95–104.
2. Kulikov, E.V., Kirichenko, O.I., Kulikova, E.V., et al., *Rekomendatsii po uluchsheniyu sostoyaniya rybnykh resursov vodoemov Irtysh-Zaisanskogo basseina* (Recommendations for Improving the State of Fish Resources in Water Bodies of the Irtysh–Zaisan basin), Astana, 2011.
3. Zadoenko, I.N., Leis, O.A., and Grigor'ev, V.F., Results and prospects of acclimation of Baikal gammarids in water bodies of the Soviet Union, *Sb. Nauch. Trudov GosNIORKh,* 1985, vol. 232, pp. 30–34.
4. Evseeva, A.A., Specific features of food resource utilization by whitefish *Coregonus albula ladogensis* in the Bukhtarma Reservoir, *Vestn. Kazakh. Nats. Univ., Ser. Biol.,* 2011, no. 5 (51), pp. 56–61.
5. Bezmaternykh, D.M., Zoobenthos as an indicator of ecological state of aquatic ecosystems in Western Siberia: An analytical review, in *Ekologiya. Seriya analiticheskikh obzorov v mirovoi literature* (Ecology: A Series of Analytical Reviews of International Literature), 2007, no. 85, pp. 1–86.
6. Romanova, E.M. and Klimina, O.M., The role of leeches in the biological mechanism of toxicant accumulation, *Vestn. Ulyanovsk. Gos. S–kh. Akad.,* 2009, no. 1 (9), pp. 85–88.
7. Romanova, E.M. and Klimina, O.M., Biological resources of the class Hirudinea in the middle Volga region: Ecological significance and prospects for use, *Istoriya Samarsk. Nauch. Tsentra Ross. Akad. Nauk,* 2010, no. 1 (12), pp. 208–211.
8. Ahne, W., *Argulus foliaceus* L. and *Piscicola geometra* L. as mechanical vectors of spring viraemia of carp virus (Svcv), *J. Fish Dis.,* 1985, vol. 8, pp. 241–242.
9. Mulcahy, D., Klaybor, D., and Batts, W.N., Isolation of infectious hematopoietic necrosis virus from a leech (*Piscicola salmositica*) and a copepod (*Salminocola* sp.), ectoparasites of sockeye salmon *Oncorhynchus nerka, Dis. Aquat. Organ.,* 1990, vol. 8, pp. 29–34.
10. Cruz-Lacierda, E.R., Toledo, J.D., Tan-Fermin, J.D., and Burreson, E.M., Marine leech (*Zeylanicobdella arugamensis*) infestation in cultured orange-spotted grouper *Epinephelus coioides, Aquaculture,* 2000, vol. 185, pp. 191–196. doi 10.1016/S0044-8486(99)00356-7
11. Faisal, M. and Schulz, C.A., Detection of viral hemorrhagic septicemia virus (VHSV) from the leech *Myzobdella lugubris* Leidy, 1851, *Parasite Vectors,* 2009, vol. 282, no. 1, p. 45. doi 10.1186/1756-3305-2-45
12. Faisal, M., Schulz, C., Eissa, A., and Whelan, G., High prevalence of buccal ulcerations in largemouth bass, *Micropterus salmoides* (Centrarchidae) from Michigan inland lakes associated *with Myzobdella lugubris* Leidy, 1851 (Annelida: Hirudinea), *Parasite,* 2011, vol. 8, no. 1, pp. 79–84. doi 10.1051/parasite/2011181079
13. Demshin, N.I., *Oligokhety i piyavki kak promezhutochnye khozyaeva gel'mintov* (Oligochaetes and Leeches as Intermediate Hosts of Helminths), Novosibirsk: Nauka, 1975.
14. Khan, R.A., The life cycle of *Trypan somamurmanensis* Nikitin, *Can. J. Zool.,* 1976, vol. 54, pp. 1840–1949.
15. Khamnueva, T.R. and Pronin, N.M., New species of kinetoplastids (Kinetoplastida: Kinetoplastidea), in *Spravochniki i opredeliteli po faune ozera Baikal* (Handbooks and Identification Keys on the Lake Baikal Fauna), Timoshkin, O.A., Ed., Novosibirsk: Nauka, 2004, vol. 1 (2), pp. 1255–1260.
16. Burreson, E.M., Hemoflagellates of Oregon marine fishes with the description of new species of *Trypanosoma* and *Trypanoplasma, J. Parasitol.,* 2007, vol. 93, no. 6, pp. 1442–1451. doi 10.1645/GE-1220.1
17. Devyatkov, V.I., On the diversity of macrozoobenthos in the Bukhtarma Reservoir in 2005 to 2009, *Vestn. Kazakh. Nats. Univ. im. Al-Farabi, Ser. Ekol.,* 2012, no. 1 (33), pp, 162–165.
18. Izyumova, N.A., *Parazitofauna ryb vodokhranilishch SSSR i puti ee formirovaniya* (Fish Parasite Fauna and Pathways of Its Development in Reservoirs of the Soviet Union), Leningrad: Nauka, 1977.
19. Epshtein, V.M., Ringed worms, the type Annelida, in *Opredelitel' parazitov presnovodnykh ryb fauny SSSR* (Identification Key to Parasites of Freshwater Fishes in the Fauna of the Soviet Union), Bauer, O.N., Ed., Leningrad: Nauka, 1987, vol. 3 (2), pp, 340–372.
20. Nesemann, H. and Neubert, E., Clitellata, Branchiobdellada, Acanthobdellada, Hirudinea, in *Susswasserfauna von Mitteleuropa,* Schwoebel, J. and Zwig, P., Eds., Heidelberg: Spectrum Akad. Verlag, 1999, vol. 6, no. 2, pp. 1–178.
21. Lapkina, L.N., Zharikova, T.I., and Svirskii, A.M., Fish infestation by leeches (family Piscicolidae) in Volga reservoirs, *Parazitologiya,* 2002, no. 36 (2), pp. 132–139.
22. Lukin, E.I., *Piyavki presnykh i solonovatykh vodoemov (fauna piyavok SSSR)* (The Leech Fauna of the Soviet Union: Leeches in Fresh and Brackish Water Bodies), Leningrad: Nauka, 1976.
23. Hollander, M. and Wolfe, D.A., *Nonparametric Statistical Methods,* New York: Wiley, 1973, pp. 185–194.
24. The R Project for Statistical Computing. R Version 3.2.2 Release of 2015-08-14. http://www.R-project.org.
25. Bezmaternykh, D.M., Water salinity level as a factor of zoobenthos formation in lakes of the Baraba–Kulunda limnobiological region, *Mir Nauki Kul'tury Obraz.,* 2007, no. 4 (7), pp. 7–11.

26. Zhukova, O.N. and Bezmaternykh, D.M., Water salinity level as a factor of zoobenthos formation in lakes of the southern Ob–Irtysh interfluve, *Tr. Zool. Inst. Ross. Akad. Nauk,* St. Petersburg, 2013, vol. 317, no. 3, pp. 120–127.
27. Zinchenko, T.D. and Golovatyuk, L.V., Salinity tolerance of benthic organisms in river waters: A review, *Arid. Ekosist.,* 2013, vol. 19, no. 3 (56), pp. 5–11.
28. Chernaya, L.V., Geographic and seasonal variation in the amino acid composition of tissues in the freshwater leech *Haemopis sanguisiga* L., 1758, *Sovrem. Probl. Nauki Obraz.,* 2014, no. 6, p. 1353.
29. Cichocka, J., Jablonska-Barna, I., Belecki, A., et al., Leeches (Clitellata: Hirudinea) of an upland stream: Taxonomic composition in relation to habitat condition, *Oceanol. Hydrobiol. Stud.,* 2015, vol. 44 (2), pp. 245–253. doi 10.1515/ohs-2015-0023
30. Magomedov, M.A. and Aliev, Sh.K., Effect of organoleptic parameters of ecosystems on the species and numerical composition of leech fauna in lowland and piedmont regions of Dagestan, *Izv. Dagestan. Gos. Ped. Univ., Ser. Estestv. Tochnye Nauki,* 2011, no. 4, pp. 44–47.
31. Utevsky, S.Y., Son, M.O., Dyadichko, V.G., and Kaygorodova, I.A., New information on the geographical distribution of *Erpobdella vilnensis* (Liskiewicz, 1925) (Hirudinea, Erpobdellidae) in Ukraine, *Lauterbornia,* 2012, no. 75, pp. 75–78.
32. Mann, K.H., *Leeches (Hirudinea): Their Structure, Physiology, Ecology and Embryology,* New York: Pergamon Press, 1962, vol. 11.

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