Saprobic index of bivalve mollusks of families Unionidae and Sorbiculidae distributed in the aquatic ecosystems of Uzbekistan

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Abstract. A correlation between the level of distribution of bivalve mollusks of the families Unionidae and Sorbiculidae and their saprobic characteristics was studied in this article. Polysaprob groups of bivalve mollusks were not found in the lower parts of the rivers during studies, but α-mesasoprobe species that stood close to the polysabrob group comprised 60% of the bivalve mollusks of the families Unionidae and Sorbiculidae. α-mesasoprobe species have been found to include *Sinanodonta gibba*, *Sinanodonta puerorum*, *Colletopterum cyreum sogdianum*, *Colletopterum ponderosum volgense*, *Corbicula rigrigea*, *Corbiculina tibetensis*, *Corbiculina ferghanensis* which are distributed in the lower Zarafshon and Sirdarya region.

1 Introduction

Despite the fact that 70% of the globe is covered with water, fresh water accounts for only 3% of the total water reserve. Nevertheless, biota organisms cannot use 80% of fresh water. Today, in the process of using fresh water, humanity is faced with a big problem – all types of human activity are causing water pollution. With the increasing number of population and the increasing use of water in the industrialization of society the processes of natural purification of water sources and reserves is decreasing [1-3].

There is little data on the saprobic index of water pollution of mollusks in the world, specifically bivalve mollusks, in particular, no data on saprobic indexes of seed species of Sinanodonta, Colletopterum, Corbicula, Corbiculina.

The main polluting source of water ecosystems is considered to be agricultural and industrial wastewater. Even measures to completely clean wastewater do not always allow you to completely clean the organic and inorganic sources of contaminants in it. Accordingly, today the biological control of the quality control of natural and cleaned industrial waters is considered one of the urgent problems that bioindication methods used in this place are considered a reliable indicator that assesses environmental situations that arise in hydrosystems [4-6].

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The main purpose of the research is to determine the saprobic indices, saprobic spectrum of bivalve molluscs of the Unionidae and Sorbiculidae families distributed in Uzbekistan, and the level of distribution of mollusk species in the middle and lower parts of rivers.

Studying the saprobic index of bivalve mollusks of the families Unionidae and Sorbiculidae distributed in aquatic ecosystems of Uzbekistan is considered one of the urgent problems.

In hydrosystems, the main zoobentos include mollusks and oligochetes, a group of hydrobionts with a high survival rate. Their life expectancy is an average of 6 years, in addition, they contain a large part of the biomass of zoobentos in water bodies and streams [7-9].

Biota components with such a large number of living and high biomass are considered the best indicator of consistent pollution of ecosystems. In terms of the composition and structure of the same zoobentos, several methods of bioindification have been proposed in the following directions: determination of species indicators of saprobity, calculation of indication biotic indices for large toxins - oligochaetes, crustaceans, chironomids, mollusks; assessing the level of diversity [7,9].

In this place, the determination of the species indicators of saprobity of water bodies is considered as the indicators that serve to make a complex assessment of the aquatic environment. It represents the exact composition of the biocenosis and the processes of succession in it. The closest quantitative indicator to saprobity is the biochemical use of oxygen [10-12].

Saprobic indices of bivalve molluscs were determined by foreign scientists J.H. Thorp., A. Covich (1991) [13], P. Bouchet (2007) [14], H. Markus (2010) [15], A.F. Bogan (2010) [16], A. Cuttelod, M. Seddon., E. Neubert. (2011) [17], M. Haws (2002) [18].

In the CIS countries it is necessary to name the researchers: V.V. Bogatov, (2004, 2014) [10, 19], N.I. Andreev., S.I. Andreeva., A.N. Krasnogorova (2009) [11], G.P. Alyokhina I.A. Misetov.. M.V. Puzakova (2007) [12], M.O. Son (2009) [20], L.N. Yanovich (2013) [21], A.L. Rijinashvili (2009) [22], A.V. Sintyurina, A.B. Bigaliev (2009) [23], D.V. Kuzmenkin (2015) [24].

In water ecosystems of Uzbekistan studies were conducted by Z.I. Izzatullaev (1992,2002) [3-5,25,26], H. Boymurodov, Kh. Jabborov, T. Jabbarova, B. Aliyev, O. Mirzamurodov, A. Egamqulov (2017-2022) [6-9,27].

2 Materials and Methods

The study of mollusks and the collection of materials from the aquatic ecosystems of Uzbekistan took place in 2010-2022. A total of 242 samples were studied from the water ecosystems of the Zarafshan and Syrdarya rivers, including 762 molluscs.

The Zarafshan River is 781 km long, the basin area is 41680 km2, the mountainous part of the basin is 17710 km2. The Zarafshon River begins with the name "Mastchohdarya" in the place where the Turkestan, Zarafshon and Oloy ranges are connected in the (blue water) mountain point of Zarafshon ice, and after 200 km of flow the Mastchoh and Fondario join it and gets the name Zarafshon. The Zarafshan river splits into two major branches, the Akdarya and the Karadaryo, next to The Chupanata hills. Zarafshan is among the rivers that feed on ice and snow water, the amount of water in it does not change in large quantities throughout the year [14].

The Syrdarya is the longest (2,982 km) river in Uzbekistan, second only to the Amudarya in terms of water abundance. It is formed by the confluence of the Norin river with the Karadarya. Syrdarya feeds on ice and snow water. But its water begins to increase from April due to the melting of seasonal snow in the lower mountains and the heavy

rainfall, and this process continues until June. Due to the rapid melting of snow and ice in the mountains, the full-fledged period of Syrdarya starts beginning from June, and in the same month it bears the bulk of its annual flow. Among the Syrdarya tributaries, the most important ones are the Chirchiq and Ohangaron rivers.

The samples of this mollusk were studied with major systematic works, identifiers proposed by Rizhinashvili [22], Izzatullaev and Starobogatov [3], Izzatullaev and Boymurodov [4], Boymurodov [27], Izzatullaev [5].

3 Results and Discussion

Organic matters in water effect mollusks with the help of different factors-oxygen regime, rN. and others. The existence of organic matters characterizes the degree of contamination of water bodies. Accordingly, the distribution of mollusks according to these factors determines the importance of saprobic indication. As an indicator of contamination (saprobicity) of water bodies with organic matter, mollusks are used by folowwing facts: in extremely dirty or polysaprob zones, mollusks are not found; species found at higher levels of moderately polluted sites or α-mesasaprob may include Sphaerium corneum (which also exist in the β-mesasaprob zone); species found at lower levels of moderately polluted sites, or β-mesasaprob may include *Limnaea stagnalis*, *L. auricularia*, *L. ovata*, *Planorbis planorbis*, *Physa fontinalis*, *Valvata piscinalis* and many other species [11, 20]; species living in fresh waters or oligosaprobs include *Ancylus fluviatilis*, *Pisidium supinum*, *P. crassum*, *P. conventus*.

It should be noted that researches have not been carried out to determine the indicator characteristics of mollusks distributed in Uzbekistan, in particular, the contamination – saprobicity of water bodies by bivalve mollusks with organic matters. Accordingly, studies have identified saprobic possibilities of representatives of the genus of the bivalve mollusk *Sinanodonta*, *Colletopterum*, *Corbicula*, *Corbiculina* (Table 1 and Fig. 1). In studies, saprobic indices of bivalve mollusks mainly in the Zarafshan and Syrdaria rivers were studied according to the corresponding pollution groups of water.

Table 1. Saprobic indexes (Si) of bivalve mollusks distributed in Uzbekistan.

№	Species	Si	Spectrum Saproblic	Water quality group
1.	*Sinanodonta orbicularis*	β	1,6-2,2	III
2.	*Sinanodonta gibba*	β-α	1,6-3,1	III-IV
3.	*Sinanodonta puerorum*	β-α	1,6-2,6	III-IV
4.	*Colletopterum bactrianum*	β	1,6-2,0	III
5.	*Colletopterum cyreum sogdianum*	β-α	1,6-2,7	III-IV
6.	*Colletopterum ponderosum volgense*	β-α	1,6-2,7	III-IV
7.	*Colletopterum kokandicum*	β	1,6-2,0	III
8.	*Corbicula cor*	β	1,6-2,2	III
9.	*Corbicula purpurea*	β-α	1,6-2,6	III-IV
10.	*Corbicula fluminalis*	β	1,6-2,1	III
11.	*Corbiculina tibetensis*	β-α	1,6-3,5	III-IV
12.	*Corbiculina ferghanensis*	β-α	1,6-3,3	III-IV

We found out that in Uzbekistan, groups VI and VII of the water quality group, that is, extremely polluted and extremely polluted water bodies, are located in the lowest parts of the Zarafshan river - in the part after Navoi. At the site sampled in the studies – the part of the Zarafshan river until it reaches Navoi – water pollution belongs to group V, with a

water pollution index (WPI) of 6. In the Fergana Valley region of Sirdarya, the "WPI" indicator is moderately polluted (1.2) at the site of the sample, and belongs to group II according to water quality. The indicator "WPI" was a slightly higher 2.7 on the territory of the Syrdarya region, it belongs to the 5th contaminated group according to the water pollution degree.
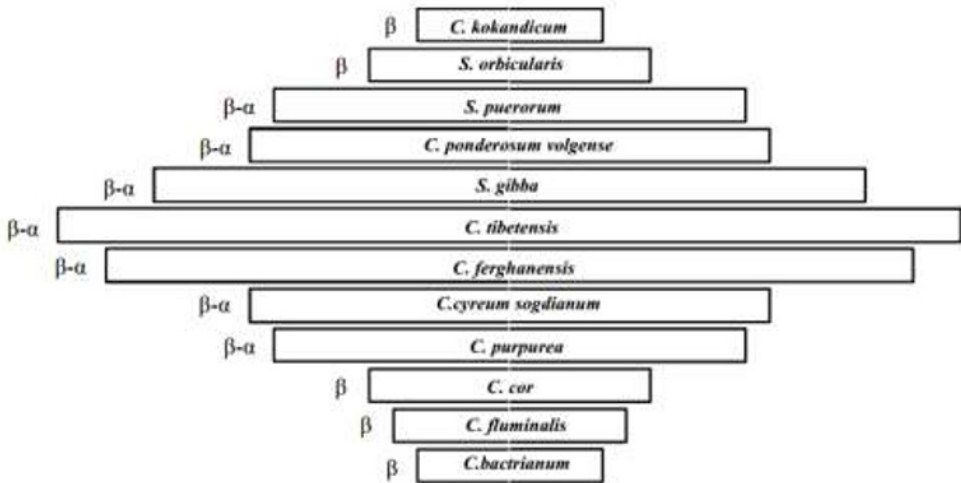

Fig. 1. Saprobic spectrum of bivalve mollusks.

As noted by sources above, no "polysaprob" groups of bivalve mollusks were found in the lower parts of the rivers during studies, but α-mesasoprobe species that stood close to the polysabrob group comprised nearly 60% of bivalve mollusks. Such species mainly belong to the species (*Sinanodonta gibba, Sinanodonta puerorum, Colletopterum cyreum sogdianum, Colletopterum ponderosum volgense, Corbicula rigrigea, Corbiculina tibetensis, Corbiculina ferghanensis*) which exist in the lower part of Zarafshon and the Syrdarya region of the Syrdarya river. Within these species, *Sinanodonta gibba, Corbiculina ferghanensis*, and *Corbiculina tibetensis* have a broad spectrum of saprobicity, according to saprobicy index (3.3 on average) it comes close to the polysaprobic index of saprobicity (3,5). In particular, *Corbiculina tibetensis* and *Corbiculina ferghanensis* have a saprobic index of 3.3-3.5, it worth noting that these species exist even in the salty Ashikol lake, located in the lower Amudarya area, where no other bivalve molluscan species can exist, which also corresponds to their saprobic index (Table 1 and Figure 1).

The remaining species (40%) belong only to the β-mesasaprob group (*Sinanodonta orbicularis, Colletopterum bastrianum, Colletopterum kokandicum, Corbicula cor, Corbicula fluminalis*), most of which are unique and sparsely distributed species. According to β-mesasaprobial spectrum, *Sinanodonta orbicularis* dominates the remaining 4 species (Table 1 and Figure 1).
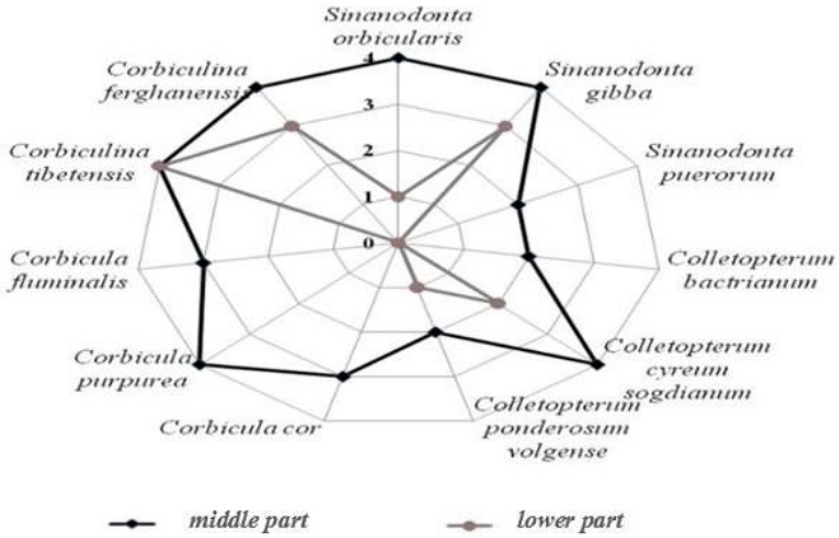
Fig. 2. Rates of distribution of bivalve molluscan species in Uzbekistan in the middle and lower parts of rivers (number of rivers 1-4) [compiled by Authors]

It should be noted that the data obtained proves that bivalve mollusks are important in determining the quality of water. In particular, the fact that β-mesasaprob species belong to the category of rare and unique species means that they cannot live in dirty waters, and this factor is important in their distribution. Such species can be classified in group III (moderately polluted) according to the degree of contamination of waters. The survival potential of the other β-α-mesasoprobe species in the saprobic zone is high, and the existence of them in watersheds, especially "Sinanodonta gibba, Corbiculina ferghanensis" and "Corbiculina tibetensis", means that the watersheds belong to (polluted) group III and IV.

If we compare the degree of distribution of bivalve mollusks studied in Rivers (see Fig. 2) with their saprobic spectrum in Rivers (Fig. 1), it can be seen that there is a correlation between the distribution of bivalve mollusks and their saprobic spectra. According to the degree of their distribution in rivers, the first 5 groups can be shown as follows: 1 – *Corbiculina tibetensis*, 2 – *Corbiculina ferghanensis*, 3 – *Sinanodonta gibba*, 4 – *Colletopterum cyreum sogdianum*, 5 – *Colletopterum ponderosum volgense*. These 5 groups are also positioned in the same position in the saprobic spectrum.

4 Conclusion

It can be said that the saprobic nature of water plays an important role in the distribution of bivalve mollusks in water bodies. The inclusion of "Colletopterum cyreum sogdianum" in the β-α-mesasoprobe group within the species included in the "Red Book" and its positivity of population indicators in all bodies of water also means that there is a correlation between the extent of distribution of bivalve mollusks and their saprobic features. No polysaprobic groups of bivalve mollusks were found in the lower parts of the rivers during studies, but the α-mesasoprobe species that stood close to the polysabrob group comprised nearly 60% of the bivalve mollusks in the families Unionidae and Sorbiculidae. It is determined that α-mesasoprobe species of *Sinanodonta gibba*, *Sinanodonta puerorum*, *Colletopterum cyreum sogdianum*, *Colletopterum ponderosum volgense*, *Corbicula rigrigea*, *Corbiculina*

tibetensis, *Corbiculina ferghanensis* are the species which are mainly found in the lower Zarafshonn and Syrdarya regions..

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