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ALIEN SPECIES OF ZOOPLANKTON IN SARATOV RESERVOIR (RUSSIA, VOLGA RIVER)

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The data on alien species of zooplankton of Saratov Reservoir of the Volga River are presented. Materials were collected during the period of 2002–2009. Species composition, seasonal dynamics and contribution of alien species into biomass of reservoir zooplankton are investigated. There are 11 alien species coming from the northern basins of Europe and 5 ones coming from southern water bodies. Alien species are important part of zooplankton of Saratov Reservoir during all seasons of the year; they can form 10 to 70% of zooplankton biomass. Saratov Reservoir is a recipient zone and part of important invasive corridor – the reservoir system of the Volga River.

Key words: Saratov Reservoir, Volga River, biological invasion, zooplankton, alien species.

Introduction

Intensive antropogenic transformation of ecosystems, creation of artificial communities, and transport system development broaden opportunities for ecologically plastic species for spreading into new areas. Foundation of the reservoir system on the Volga River has radically changed this waterbody, turning it in fact in the chain of polytypic lake-like basins. Thereby it is unique partially artificial ecosystem located on the one of the largest rivers on the Earth and investigations of its development are of great interest and urgent need.

Region of research

Saratov Reservoir is located in the lower part of the Volga River. It has three morphologically and hydrologically different parts: the upper (Zhigulevsk – Vinnovka) – river part, the middle (Vinnovka – Kashpir) – river-lake part and the lower part (Kashpir – Balakovo) which has a lake condition [Gorin, 1972].

Materials and methods

Research of alien species of zooplankton in Saratov Reservoir was carried out in 2002–2009. Samples were collected with quantitative Juday net (diameter of the upper ring – 19 cm, gauze № 70), fixated with formalin (4%) or ethanol (70%) during the cold season. Sampling was performed on the year-round basis – weekly in spring and summer and every ten-day period in winter and autumn. There were explored pelagic zone, littoral parts, floodplain and channels of all three parts of Saratov Reservoir.

Terms and abbreviations

We will use terms “alien”, “non-native”, “adventive species” interchangeably in this paper. Frequency (pF) is calculated as pF=100m/n, где n – overall number of samples, m – number of samples in which species is detected. For quantitative characteristics of zooplancton we will use number of individuals per cubic metre – ind./m^3 and if the numbers are significant – thousands of individuals per cubic metre – ths ind./m^3.

Results and discussion

Alien species in Saratov Reservoir

Though rivers, especially such large and connected with many different water bodies (tributaries, lakes, seas, channels,

other rivers) as the Volga River, always promote natural range extensions of various life forms, human activities significantly increases invasion rate, provides new invasion vectors, creates comfort conditions for generalist species, aggravates an impact of invasion on native ecosystem. Reservoir system of the Volga River has two streams of biological invasion of zooplankton: boreal-arctic species are spreading from the North (Beloe, Siverskoe, Onega lakes and other basins) and southern species ascend from the Caspian Sea and other south water bodies [Biological Invasions, 2004].

Formerly it was supposed that there are more then 30 adventive species in Saratov Reservoir [Biological Invasions, 2004, Popov, 2006]. However, there are some problems in definition of alien species. They are related with poor data on condition of zooplankton of the Volga River before reservoirs foundation, constant changes in taxonomy of some zooplankton organisms, contradictory information on natural habitats of some species and methodical shortcomings. Currently there are 16 zooplankton species acknowledged as non-native.

During all of research period alien species were detected in Saratov Reservoir year-round. They can produce 20–90% of zooplankton biomass in winter months, 30–70% in spring, 40–70% in summer and 10–30% in autumn. Ponto-Caspian and other southern species are registered in active plankton from May to October, Boreal-Arctic – throughout the year.

Boreal-Arctic complex of alien species

Northern non-native complex is presented by 11 species: Rotifera – 2, Cladocera – 4, Cyclopidae – 1, Calanidae – 4 species. All of them were naturalized in Kuybyshev Reservoir before Saratov Reservoir filling [Volga and its life, 1978].

Rotifera. At present time it is supposed that there are 2 alien species of rotifers in Saratov Reservoir. *Keratella hiemalis* is detected from December to April, it is most common in winter months, average quantity – 1.2 ths ind./m^3. *Kellicottia longispina* is detected year-round, most common from December to March, averge quantity – 0.7 ths ind./m^3. Both species consume fine-dispersed detritus, bacteria and phytoplankton.

Comments. Previously such species as *Notholca squamula, N. acuminata, N. cinetura, N. labis, N. cornuta, N striata, Synchaeta lakovitziana, S. verrucosa, Conochilus unicornis, Conochiloides natans,* were considered as adventive in Saratov Reservoir. But rotifers of genus *Notholca* appeared to have very wide distribution (to world-wide) [Chuykov, 2000], *Synchaeta* were identified to genus only, *Conochilus* and *Conochiloides* usually dissolve during fixation, so the latter ones were not registered.

Cyclopoida. The only representative of alien *Cyclopoida* in Saratov Reservoir is *Cyclops kolensis* which naturalised in Kuybyshev Reservoir before the filling of Saratov Reservoir. This cyclops is detected year-round, but its quantitative maximum (0.6–1.3 ths ind./m^3) falls on April – June. Adult individuals and later copepodite stages can be found mostly in pelagic zone, although in spring it is almost evenly distributed in reservoir. *Cyclops kolensis* is predator/omnivorous species.

Calanidae. The Boreal-Arctic Calanidae noted in Saratov Reservoir are: *Heterocope appendiculata*, *Eurytemora lacustris, Eudiaptomus gracilis*, and *E. graciloides.* All this copepods form relatively low biomass, some of them are detected irregularly. *Heterocope appendiculata* is registered from April to September (occasionally in October), average quantity – only 20 ind./m^3. *Eudiaptomus gracilis* and *E. graciloides* can be found throughout the year. The first one has a peak of quantity in July – September, sometimes also in October and January (up to 30–50 ind./m^3), during the rest part of the year its average quantity is 5–9 ind./m^3, but it is detected constantly. As for *Eudiaptomus graciloides*, it is registered singularly. *Eurytemora lacustris* can be discovered from April to October, it is most numerous in July – August (0.1–0.2 ths ind./m^3), but this crustacean

can disappear from zooplankton in some years. This species are predators/filtrators.

Cladocera. There are 4 cladoceran crustaceans from Boreal-Arctic invasion complex in Saratov Reservoir: *Bythotrephes brevimanus*, *B. cederstroemi*, *Limnosida frontosa* and *Daphnia cristata*. Selective predators from genus *Bythotrephes* appear in reservoir in May and disappear in September (18–75 ind./m^3), a peak of quantity falls on July – August (up to 200 ind./m^3 and more). *Limnosida frontosa* is registered regularly in summer months, its average quantity is only 4–10 ind./m^3. *Daphnia cristata* is noted year-round (3–20 ind./m^3). The latter two species are filtrators.

Comments. Formerly we acknowledged as alien species *Bosmina crassicornis*, *B. coregoni*, and *B. longispina.* However, outdated identification keys [Manujlova, 1964] were used and considering the revision of the genus *Bosmina* [Kotov et al., 2009] our data are unreliable. Taxonomy of the genus *Bythotrephes* is given according to its revision [Litvinchuk, 2005].

Ponto-Caspian complex of alien species

Rotifera. *Keratella tropica* and *Brachyonus forficula* are not Ponto-Caspian proper species – they are widely distributed in southern basins of Europe and Asia [Chuykov, 2000]. Both of these rotifers were registered since 2005 year in summer months: July – August and July respectively. These species are detected irregularly, in relatively low numbers (about 0.1–0.2 ths ind./m^3). Both species consume fine-dispersed detritus, bacteria and phytoplankton.

Calanidae. *Heterocope caspia* is one of the most important components of summer zooplankton of Saratov Reservoir. It is noted from May to September, average quantity is 0.8 ths ind./m^3 (up to 4 ths ind./m^3), it is most numerous in July – August. This species is predator/filtrator which naturalized in Kuybyshev Reservoir before the establishing of Saratov reservoir [Timohina, 2000].

Comments. *Calanipeda aquae-dulcis* was detected in 1982 and 1990 years but never appeared after [Romanova et al., 2005].

Cladocera. Ponto-Caspian cladocerans are represented by two species of predatory crustaceans – *Cornigerius maeoticus* and *Cercopagis pengoi.* These species are the most recent invaders in this region – 1990–1995 and 2003–2005 [Popov, 2006, Bychek, 2008], respectively. At present, both species are registered regularly from June to September; they are distributed in Saratov Reservoir and to the upper reaches of Kuybyshev Reservoir. Their number varies year to year – 70–100 ind./m^3 (up to 1.7–2 ths ind./m^3) and 9–34 (up to 200 ind./m^3), respectively.

Comments. *Cercopagis pengoi* sometimes forms large clumps consisting of hundreds of individuals, so its quantity can reach several thousands in one sample. Thus, the numbers above indicate the numbers of free individuals, which do not couple together in their caudal processes.

Some information on alien species is given in the table below.

Table. Alien species of zooplankton in Saratov Reservoir in 2002–2009

Species	Native range	First appearance in Saratov Reservoir	Frequency (pF) in 2002–2009
Rotifera			
Keratella hiemalis	North basins of Europe	registered before flow regulation	12.3
Kellicottia longipina	North basins of Europe	registered before flow regulation	9.3
Keratella tropica	South basins of Europe and Asia	1960s – 1970s	1.9
Brachyonus forficula	South basins of Europe and Asia	2002	1.5

Cyclopidae			
Cyclops kolensis	North basins of Europe	1960s	32.7
Calanidae			
Heterocope appendiculata	North basins of Europe	1960s	26.8
Eurytemora lacustris	North basins of Europe	1960s	17.1
Eudiaptomus gracilis	North basins of Europe	registered before flow regulation	13
E. graciloides	North basins of Europe	registered before flow regulation	9.9
Heterocope caspia	Caspian Sea	registered before flow regulation	35.2
Calanipeda aquae-dulcis	Caspian Sea	1982, 1990	0
Cladocera			
Cornigerius maeoticus	Caspian Sea	1990s	25.3
Cercopagis pengoi	Caspian Sea	2003–2004	17
Bythotrephes brevimanus	North basins of Europe	registered before flow regulation	18.5
Bythotrephes cederstroemmi	North basins of Europe	–	15
Limnosida frontosa	North basins of Europe	registered before flow regulation	16.1
Daphnia cristata	North basins of Europe	registered before flow regulation	16.9

Comments. Species detected before the establishing of reservoir were usually not numerous, they often existed only in backwaters connected with the Volga River, and their naturalization became possible after fundamental ecosystem change associated with flow regulation.

Conclusion

Reservoir system of the Volga River is a recipient zone and a channel of spreading for adventive species from both northern and southern water bodies. Biological invasions accompany a complex process of the reservoir ecosystem formation.

References

Биологические инвазии в водных и наземных экосистемах. М.: Товарищество научных изданий КМК, 2004. 436 с.

Бычек Е.А. Новые для волжских водохранилищ виды Polyphemoidea // Российский журнал биологических инвазий, 2008. Т. 1. С. 2–4.

Волга и её жизнь. Л.: Наука, 1978. 350 с.

Горин Ю.И. Некоторые черты гидрологического режима Саратовского водохранилища // Труды ИБВВ РАН. 1972. Вып. 23(26). С. 193–199.

Литвинчук Л.Ф. К истории изучения систематики и распространения представителей рода *Bythotrephes* (Polyphemoidea, Cladocera) на территории России и сопредельных стран. // В кн.: Биологические ресурсы пресных вод. Беспозвоночные. Рыбинск: Изд-во ОАО «Рыбинский дом печати», 2005. С. 224–240. (416 с.)

Мануйлова Е.Ф. Ветвистоусые рачки фауны СССР. М.; Л.: Наука, 1964. 327 с.

Попов А.И. Современная структура зоопланктона Саратовского водохранилища и экологии (экология) биоинвазийных видов. Дисс. … канд. биол. наук. Тольятти, 2006. 101 с.

Романова Е.П., Кулаков Р.Г., Кузнецова С.П. Саратовское водохранилище как инвазионный коридор для зоопланктона // Чужеродные виды в Голарктике (Борок-2). Рыбинск; Борок, 2005. С. 102–103.

Тимохина А.Ф. Зоопланктон как компонент экосистемы Куйбышевского водохранилища. Тольятти: ИЭВБ РАН, 2000. 193 с.

Чуйков Ю.С. Материалы к кадастру планктонных беспозвоночных бассейна Волги и Северного Каспия. Коловратки (Rotifera). Тольятти: ИЭВБ РАН, 2000. 196 с.

Kotov A.A., Ishida I., Taylor D.J. Revision of the genus Bosmina Baird, 1845 (Cladocera: Bosminidae), based on evidence from male morphological characters and molecular phylogenies // Zoological Journal of the Linnean Society. 2009. V. 156. P. 1–51.