ECOLOGIA BALKANICA
2024, Vol. 16, Issue 1 June 2024 pp. 149-152

The Invasive Mollusc Monodacna colorata (Bivalvia, Cardiidae) In The Ecosystems Of Hydraulic Structures Of The Zaporizhzhia NPP (Enerhodar, Ukraine)

Oleh Marenkov[1], Serhii Yermolenko[1], Oleh Nesterenko[1], Viktoriia Kurchenko[1]*

[1]Scientific Research Institute of Biology, Oles Honchar Dnipro National University, 72, Haharin Ave., Dnipro, 49010, UKRAINE
*Corresponding author: serejamahno@gmail.com

Abstract. The mollusc *Monodacna colorata* (Eichwald, 1829) was detected for the first time in the cooling ponds of the Zaporizhzhia NPP. Hydrobiological studies of the NPP's hydraulic structures were carried out in the summer period of 2021. We used standard benthos sampling methods with the Ekman Dredge. Eight individuals of *M. colorata* were found in the samples. This is the Ponto-Caspian species, native to the Black Sea Basin. *M. colorata* usually inhabits transitional brackish water bodies. However, in recent decades it has shifted its range and settled in freshwater reservoirs. The reproduction of *M. colorata* in the cooling pond may lead to additional biological obstacles in the water supply system of Zaporizhzhia NPP. Therefore, regular monitoring is necessary to assess and control the abundance of *M. colorata*.

Key words: benthos, biological obstacles, cooling ponds, invasive molluscs, Zaporizhzhya nuclear power plant.

Introduction

The operation of energy enterprises is accompanied by an intensive impact on the environment (Pehlivanov & Kazakov, 2019; Valchovski et al., 2019; Gasso et al., 2020). The hydrological and hydrochemical conditions of power plants hydraulic structures create opportunities for the introduction and acclimatization of new species (Izhboldina et al., 2018; Dermendzhieva et al., 2019; Fedonenko et al., 2019). Currently, there are documented cases of colonization of cooling ponds at Ukrainian nuclear power plants (NPP) by new species of marine and tropical fauna. Moreover, penetration of new organisms may lead to disruptions in the operation of water cooling systems (Marenkov et al., 2018).

It should be noted that the introduction of new species of animals, the mechanism of their influence is complex and difficult to predict. For example, benthification can lead to deterioration of pumping station due to system contamination and complication of water circulation (Yesipova et al., 2022). Therefore, monitoring of biodiversity of hydraulic structures and reservoirs from which water is supplied to NPPs is an urgent task (An et al., 2019). A new mollusc *Monodacna colorata* (Eichwald, 1829) was registered in the conditions of hydraulic structures of Zaporizhzhya NPP, which can affect the state of plankton and benthos groups.

Materials and Methods

The studies were conducted in the summer period of 2021. The cooling pond and other hydraulic structures of Zaporizhzhya NPP (47.512° N, 34.551° E) were examined (Fig. 1). The cooling pond is reservoir of a lake-pond type with seasonal regulation of the level regime. The cooling

pond was separated from the Kakhovka Reservoir (Dnipro River) by a reclaimed sand dam. For the operation of the power units, water was taken from the Kakhovka reservoir. In summer, the temperature of chilled water was 28.7°C, respectively, in winter 17-18°C (Marenkov, 2018).

Fig. 1. Location of hydraulic structures of Zaporizhzhya NPP

Mollusks were collected at the hydraulic structures of Zaporizhzhya NPP using the Ekman Dredge. To determine the species composition, the obtained organisms were fixed in 4% formalin.

Results and Discussion

During the identification of mollusks from the hydraulic structures of Zaporizhzhya NPP, eight individuals of *M. colorata* were found (Fig. 2). It is possible that this species came from the nearby Kakhovka reservoir (Pligin et al., 2014). This species is a representative of bivalves of the Ponto-Caspian ecosystems. In recent years, there has been a rapid change in the distribution area of mollusks. This may be influenced by changes in hydroecological parameters and characteristics of bottom sediments (Ovcharuk et al., 2020; Gogaladze et al., 2021; Marenkov et al., 2021).

Fig. 2. *M. colorata* collected from the Zaporizhzhya NPP cooling pond, photo by O. Marenkov

In ecosystems typical for *M. colorata*, the population numbers of this species are decreasing due to anthropogenic and natural factors. However, this species continues to inhabit freshwater reservoirs (Gogaladze et al., 2021). *M. colorata* populations are known to occur in reservoirs in the middle and lower parts of the Dnipro River (Yurishinets et al., 2002; Son, 2007; Fedonenko et al., 2018). The ingress of this mollusk can significantly influence the growth of macrobenthos

biomass (Krupa et al., 2014). For example, during the study of Lake Balkhash (Kazakhstan), it was revealed that since 1996, the share of *M. colorata* in macrobenthos biomass has increased by more than 70% (Barinova et al., 2017). At the same time, the growth of *M. colorata* abundance affects the quantitative indicators of zooplankton. This is due to increased competition for phytoplankton consumption (Khassengaziyeva & Mamilov, 2020; Barinova et al., 2017).

Also, hydrochemical analysis of Zaporizhzhya NPP hydraulic structures revealed an increase of inorganic nitrogen in relation to normative concentrations, which can create favorable conditions for the increase of phytoplankton-feeding species. According to Pligin et al. (2014), the occurrence of *M. colorata* in the Dnipro may be a consequence of increased salinity levels. However, the salinity level in the hydraulic structures was within normal limits (Fedonenko et al., 2018). It is possible that this mollusk species has a wider range of tolerance to hydrochemical conditions of water bodies.

Conclusions

The life activity of *M. colorata* may cause possible biofeedback for the works of Zaporizhzhya NPP. Also, due to the accident at the Kakhovka hydroelectric power plant, there is a possibility of changing the environmental conditions for the existence of populations of this mollusc (Afanasyev, 2023; Sanina & Lyuta, 2023). Therefore, there is a need for further research, but this is complicated by the existing hostilities in the area.

Acknowledgements: We would like to express our gratitude to Dr. Vitaliy V. Anistratenko DSc, Professor, Head of the Department of Invertebrate Fauna and Systematics of the I. I. Schmalhausen Institute of Zoology for help in identification of mollusk species.

References

Afanasyev, S.O. (2023). Impact of war on hydroecosystems of Ukraine: Conclusion of the first year of the full-scale invasion of Russia (a Review). *Hydrobiological Journal*, 59(4), 3-16. doi: 10.1615/HydrobJ.v59.i4.10.

An, L., Wang, L., Ou, D., Jia, C., Li, W., Ding, Y., You, C., Liao, J., & Huang, H. (2021). The ecological mechanisms of *Acetes* blooms as a threat to the security of cooling systems in coastal nuclear power plants. *Journal of Coastal Conservation*, 25, 1-10. doi: 10.1007/s11852-021-00845-0.

Barinova, S.S., Krupa, E.G., Protasov, A.A., & Novoselova, T.N. (2017). Benthification in the inland water ecosystems of Eurasia, some ecological aspects. *MOJ Ecology & Environmental Sciences*, 2(7), 00048.

Dermendzhieva, D.M., Zhelyazkov, G.I., Beev, G.G., Kostadinova, G.S., Dinev, T.G., & Petkov, G.S. (2019). Agro-ecological assessment of Ovcharitsa Dam (Bulgaria) water used for thermal power plant cooling. *Ecologia Balkanica*, 11(2), 168-180.

Gasso, V.Y., Hahut, A.N., Yermolenko, S.V., Hasso, I.A., Agca, C.A., Nedzvetsky, V.S., & Sukharenko, E.V. (2020). Local industrial pollution induces astrocyte cytoskeleton rearrangement in the dice snake brain: GFAP as a biomarker. *Biosystems Diversity*, 28(3), 250-256. doi: 10.15421/012033.

Gogaladze, A., Son, M.O., Lattuada, M., Anistratenko, V.V., Syomin, V.L., Pavel, A.B., Popa, O.P., Popa, L.O., ter Poorten, J.-J., Biesmeijer, J.C., Niels, R., Wilke, T., Sands, A. F., Trichkova, T., Hubenov, Z.K., Vinarski, M.V., Anistratenko, O.Y., Alexenko, T.L., & Wesselingh, F.P. (2021). Decline of unique Ponto-caspian biodiversity in the Black Sea Basin: A review. *Ecology and evolution*, 11(19), 12923-12947. doi: 10.1002/ece3.8022.

Izhboldina, O.O., Pishchan, I.S., Khramkova, O.M., Mylostyvyi, R.V., Sapunov, V.V., & Korzhenevska, P.O. (2019). Early sex detection and physiological stimulation of spawning in the Mozambique tilapia *Oreochromis mossambicus* (Peters, 1852). *Ukrainian Journal of Ecology*, 9(4), 657-660. doi: 10.15421/2019_805.

Fedonenko, O., Ananieva, T., Sharamok, T., & Marenkov, O. (2018). Environmental characteristics by eco-sanitary and toxic criteria of the cooling pond of Zaporizhzhya nuclear power plant (Ukraine). *International Letters of Natural Sciences*, 70, 1-10. doi: 10.18052/www.scipress.com/ILNS.70.1.

Fedonenko, O., Marenkov, O., & Petrovsky, O. (2019). The Problem of biological obstacles in the operation of nuclear power plants (Illustrated by the Operation of Zaporizhzhya

NPP Techno-Ecosystem). *Nuclear and Radiation Safety*, 2(82), 54-60. doi: 10.32918/nrs.2019.2(82).10 (In Ukrainian).

Fedonenko, O., Yakovenko, V., Ananieva, T., Sharamok, T., Yesipova, N., & Marenkov, O. (2018). Fishery and environmental situation assessment of water bodies in the Dnipropetrovsk region of Ukraine. *World Scientific News*, 92(1), 1-138.

Khassengaziyeva, G.K., & Mamilov, N.Sh. (2020). Diversity of hydrobionts in delta of the Ile river in changing human impact. *Eurasian journal of Ecology*, 1(62) 78-86. doi: 10.26577/EJE.2020.v62.i1.08.

Krupa, E., Slyvinskiy, G., & Barinova, S. (2014). The effect of climatic factors on the long-term dynamics of aquatic ecosystem of the Balkhash Lake (Kazakhstan, Central Asia). *Advanced Studies in Biology*, 6(3), 115-136. doi: 10.12988/asb.2014.4523.

Marenkov, O.M. (2018). Ichthyofauna of the Zaporizhia nuclear power plant cooling pond (Enerhodar, Ukraine) and its biomeliorative significance. *Ukrainian Journal of Ecology*, 8(2), 140-148. doi: 10.15421/2018_321.

Marenkov, O., Batalov, K., & Kriachek, O. (2018). Biological and biomechanical principles of controlling mollusks *Melanoides tuberculata* (MHler 1774) and *Tarebia granifera* (Lamarck, 1822) in reservoirs of strategic importance. *World Scientific News*, 99, 71-83.

Marenkov, O.M., Izhboldina, O.O., Nazarenko, M.M., Mylostyvyi, R.V., Khramkova, O.M., Kapshuk, N.O., & Nesterenko, O.S. (2021). Influence of heavy metals on physiological and biochemical parameters of *Pseudorasbora parva* (Cypriniformes, Cyprinidae). *Regulatory Mechanisms in Biosystems,* 12(4), 745-752. doi: 10.15421/0221103.

Ovcharuk, V.A., Daus, M.E., Kichuk, N.S., & Myroshnychenko, M.I. (2020). The analysis of time series of river water mineralization in the Dnipro basin with the use of theoretical laws of random variables distribution. *Journal of Geology, Geography and Geoecology*, 29(1), 166-175. doi: 10.15421/112015.

Pehlivanov, L.Z., & Kazakov, S.A. (2019). Ichthyofauna of the Iskar River section affected by the hydropower cascade „Middle Iskar". *Ecologia Balkanica,* Special Edition 2, 107-115.

Pligin, Y.V., Matchinskaya, S.F., Zheleznyak, N.I., & Linchuk, M.I. (2014). Long-term distribution of alien species of macroinvertebrates in the ecosystems of the Dnieper reservoirs. *Hydrobiological Journal,* 50(2), 3-17. doi: 10.1615/HydrobJ.v50.i2.10.

Popa, O.P., Iorgu, E.I., Krapal, A.M., Kelemen, B.S., Murariu, D., & Popa, L.O. (2011). Isolation and characterization of the first microsatellite markers for the endangered relict mussel *Hypanis colorata* (Mollusca: Bivalvia: Cardiidae). *International journal of molecular sciences*, 12(1), 456-461.

Sanina, I.V., & Lyuta, N.G. (2023). Environmental consequences of the Kakhovka hydroelectric power plant dam explosion and ways to improve water supply to the population. *Mineral Resources of Ukraine*, 2, 50-55. doi: 10.31996/mru.2023.2.50-55. (In Ukranian).

Son, M.O. (2007*). Invasive molluscs in fresh and brackish waters of the northern Black Sea region*. Odessa (UA): Druk. (In Russian).

Valchovski, H., Tsolova, V., Kolchakov, V., & Tomov, P. (2019). Earthworms (Annelida: Lumbricidae) biodiversity affected by pyrogenic carbon emissions at the "Maritsa-Iztok" basin (Bulgaria). *ZooNotes,* 149, 1-3.

Yesipova, N., Marenkov, O., Sharamok, T., Nesterenko, O., & Kurchenko, V. (2022). Development of the regulation of hydrobiological monitoring in circulation cooling system of the Zaporizhzhia nuclear power plant. *Eastern-European Journal of Enterprise Technologies*, 2((10)116), 6-17 doi: 10.15587/1729-4061.2022.255537.

Yurishinets, V.I., Korniushin, A.V., & Mynasypova, I.S. (2002). On recent Lymnocardiidae (Bivalvia: Cardioidea) in the fauna of Ukraine: unresolved problems. *The Herald of Zhytomyr State Ivan Franko University*, 10, 110-112. (In Russian).

Received: 30.01.2024
Accepted: 09.06.2024