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ORIGINAL ARTICLE

The influence of changes of the hydrological regime on the formation of macrozoobenthos communities of the SouthernBuh within the village of Myhia

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The article presents the role of the elements of the hydrological regime in the formation of the benthos fauna of shallow water areas of the plain rivers. Studies have shown an increase in flow in the channel network can in a relatively short period of time lead to the reshaping of the species composition of macrozoobenthos at low depths. It was found that the intensification of the water exchange process contributes to the overall improvement of water quality in shallow watercourses and increase the location and quantitative indicators of rheophilic and oxyphilic species of macrozoobenthos. Also, it was found that the resumption of operation of Mygiivska HPP in 2017 primarily led to a redistribution of water consumption in the water system of the Southern Bug near the village. Migiya. Thus, according to the results of comparison of water flow distribution schemes in July 2017 and 2018 in the area above the dam, water consumption increased in the area of the left side, the central part of the reservoir and in the lower reaches of the HPP. The main biotic component of the aquatic ecosystem of the studied area of the Southern Bug, which underwent significant changes after the commissioning of the Mygiivska HPP, was macrozoobenthos. After the commissioning of Mygiivska HPP, rheophilic and oxyphilic species became more widespread, and the areas occupied by *V. viviparus* and *Th. fluviatilis.* Comparison of data on water quality for 2 years showed that in 2018 in almost all surveyed areas water quality has improved. This is especially noticeable in areas of the river below the dam. According to the saprobity index, the class and category of water quality by the degree of pollution decreased by one and two units in the direction of improvement.

Studies of macrozoobenthos confirm that the reform of water flow and velocities, changes in the distribution of bottom sediments in the Southern Bug within the village. Mygia caused by the restoration of Mygiivska HPP became a positive factor in the functioning of the aquatic ecosystem of the study area. A more even distribution of water consumption in the water system not only helped to reduce the capacity of silt deposits in the most stagnant areas of the water area, but also had a positive effect on the state of benthic invertebrates and led to an increase in rheophilic and oxyphilic species.

Keywords: Ecohydrology, hydrological regime, water balance, macrozoobentho, southern buh river.

Introduction

The operational mode of the hydroelectric power station is one of the main abiotic factors which regulate the state of the aquatic ecosystems of the river stretch, on which it is installed. Ecologically unreasonable mode of operation of the HPP (hydroelectric power plant) can have a significant ecological consequences and irreversible alterations in the processes of water quality formation, biodiversity and the construction of stable trophic links in the area of its direct influence.

The more electricity produced, the greater influence to the environment is being inflicted by the power plant. The level of the internal river regulatory capacity of the HPP is also important. The small hydroelectric power plants (with an installed capacity of 5 MW), which do not have the regulatory capacity, have the least significant influence to the water system. In this article, we give consideration to the ecohydrological aspects of influence of the small hydroelectric power plants without the internal river regulation to the aquatic ecosystems and biotopes that are located within the zone of their influence.

Materials and Methods

The materials of the field studies of the Southern Buh river stretch within the Myhia HPP before the resumption of work (July, 2017) and after a year of its operation (July, 2018) were used for the article. The choice of such time segments allowed assessing the influence of the hydroelectric power plant operation to the state of the aquatic environment within the zone of its impact and to identify the elements of redistribution of individual hydrological parameters after commissioning of the HPP.

During these periods, we investigated the distribution of water discharge, velocities and directions of flow, the composition of the bottom sediments in the area that begins at a distance of 350 meters above the dam and ends at the point of 130 meters below the HPP building (the exit point of the discharge channel to the natural riverbed). Samples collection took place according to the developed network of stations (Fig. 1).

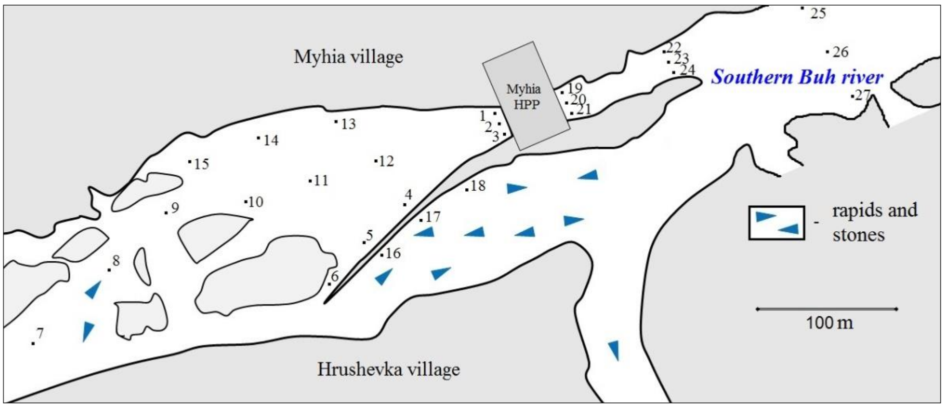

Fig. 1. Scheme of the network of field sampling stations in the zone of influence of Myhia HPP.

Processing of the obtained results was carried out according to the commonly accepted methods in hydrology and hydrobiology (Abakumov, 1983; Romanenko, 2006).
The samples of macrozoobenthos were taken with a Petersen grab (a small model with a capture area of 0,01 m^2). The soil lifted from the bottom (three liftings per sample) was washed through nylon gauze sieve №19. The samples were fixated with 4% formalin solution. The weighting of the organisms was accomplished on torsion weigh-scales VT-500 and general laboratory scales VLTK-500. The processing of the benthic samples was carried out according to commonly accepted methods (Romanenko, 2006). The microscopes MBS-9, MBR-3 and a number of identification guides (Cranston et al.; Bechesku et al., 1969; Andreeva et al., 2000; Yvanov et al., 2001; Stadnychenko, 1984, 1956; Anystratenko V.V. & Anystratenko O.Yu., 2001) were used to determine the species composition.

Results and Discussion

The Southern Buh within the village of Myhia, Mykolaiv district, flows through a narrow and shallow channel with rapids and rifts. Beginning in the mid-50s of the past century, an old mill that was found in 1888, then turned into the Myhia HPP station. The installed dam almost completely blocks the channel, it has two streamways: the free one which is near the right bank, and the adjusted one which flows through the units of hydro-engineering complex near the left bank.
In these latter days, Myhia HPP has not been operating for a long time (about 20 years), for this reason, the main water runoff was carried out though the right-bank streamway. Near the left bank above the dam, under conditions of almost absent runoff, a large stagnant zone was formed, where the processes of sedimentation, sludge production and overgrowing of the water reservoir with aquatic vegetation was actively proceeding. At this time, the right-bank area above the dam was much more flowing-through, with a well-washed bare stony bedding without the silted areas.
Beginning in 2017, after the privatization of Myhia HPP by the "EMZA" LLC, it restarted its work. Since then, in the aquatic ecosystem within the hydro-engineering complex, significant changes of the hydrological regime have taken place, which, most notably, were related to the restoration of the water runoff through the hydraulic units, increasing of the flowage of the left-bank part of the channel and reforming of the bottom sediments in the zone of the direct influence.
For the purpose of the complex analysis, we divided the entire zone of influence into a number of biotopes, which are vary from each other on hydrological and hydrobiological special aspects (Fig. 2) (Korzhov, 2019).
The restoration of operation of the Myhia HPP in 2017, first of all, led to the redistribution of the water consumption in the water system of the Southern Buh area near the Myhia village. Based on the materials of the field measurements of the flow velocities and the study of the specific features of the bottom orography, we have drawn schemes of the distribution of water consumption within the study area on 07.18.2017 and on 07.23.2018 (Fig. 3) (Korzhov, 2019).
In the area above the dam, the water consumption increased in the left-bank area and in the central part of the dub. Due to the sluice runoff, the volumes of water, which enter the lower pound lock of the HPP, have increased more than three times and now amount to 20% of the total river flow rate.

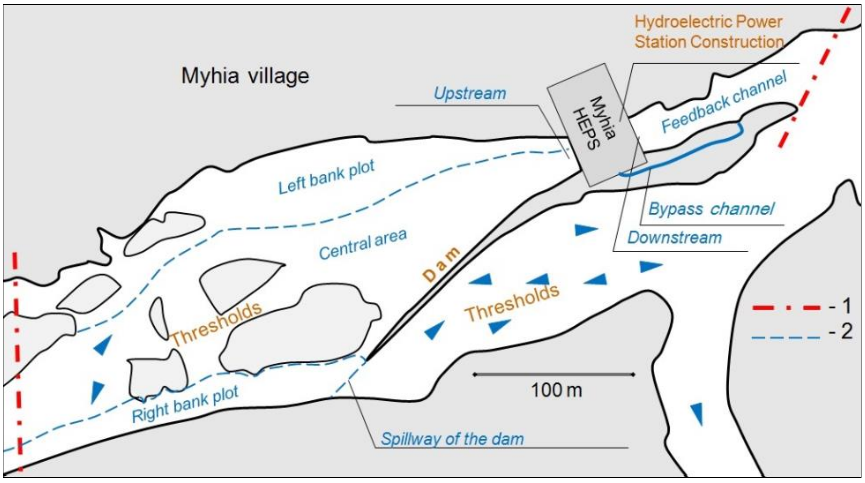

Fig. 2. The borderlines of the experimental area of the Southern Buh near the village of Myhia (1) and biotopes homogeneous in a number of features (2).

The increase of the water content of this area took place due to the decrease of the water consumption, which used to flow through the rapids before. If, according to the field work in 2017, 51% of water from the total runoff of the Southern Buh flowed through the rapids along the right bank, then, after the launch of the HPP, water consumption decreased by 15% here (Fig. 3).

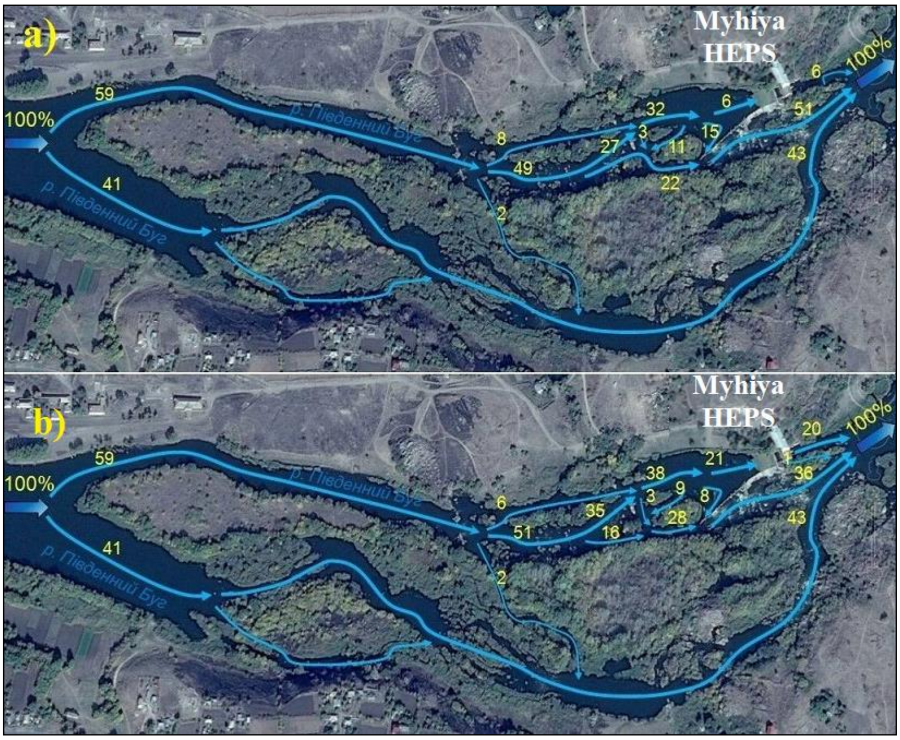

Fig. 3. The schemes of the runoff distribution in the water system in the area of Myhia village before (a) and after (b) restoration of Myhia HPP operation.

The stated redistribution of water consumption had a quite positive effect on the biotic and abiotic parameters of the studied area of the channel. The increase of the flowage of the left-bank and the central sectors above the dam supported greater dilution of water, which usually accumulated there in the stagnant zones. Due to the almost complete disappearance of the stagnant zones in these areas, the water masses became more transparent, the thickness of the silt deposits here decreased by 0.15-0.20 m, the color of water changed from yellow to yellow-green.

The decrease of the consumption of water in the rapids also had positive aspects for the aquatic ecosystem of this area. Its reduction led to the decrease of the velocity of currents, which allows certain floral and faunal forms to more effectively hold on to the rocky rapids and develop, increasing the biodiversity of this area. The conducted similar studies on other sluggish rivers, in particular, on the mouth reach of the Dnipro and on Kalanchak River, confirm the significant role of the water masses dynamics upon the state of the aquatic ecosystems (Ovechko et al., 2016; Korzhov, 2013, 2014, 2016, 2018; Korzhov & Minaieva, 2014; Korzhov & Kucheriava, 2018; Korzhov & Honcharova, 2020; Timchenko et al., 2011, 2015). They showed that the dynamic of the water masses (and water exchange processes) is one of the most environmentally significant factors of the aquatic medium regardless of the water body area.

In the lower pound lock of the Myhia HPP and in the discharge channel, due to the inflow of significant volumes of water, a section with intensive movement of the water masses has formed. Due to significant water flowage and relatively small channel capacity, currents' velocities, in this section, reached the points of 1.5-1.8 m/s. Compared to the data of the field measurements, which we conducted in 2017 before the launch of the hydraulic complex, the ecological condition of the sector has improved in terms of hydrological criteria. The stagnant zone, which covered the area of entire discharge channel, completely disappeared after the launch of the hydro-engineering complex. Small-fractious silts and aquatic vegetation, which had accumulated here for many years, have completely disappeared under the effect of erosion capacity of the stream. The depths in the channel have currently increased from the points of 0.8-1.0 m (in July, 2017) to 1.6-1.8 m.

This redistribution in the field of velocities and water flow in the area of the HPP influence, mentioned above, supported to equalize the ecosystem parameters to the average level: the most flowing parts of the water body became less flowing, and in the stagnant zones, the flowage increased significantly.

A more proportional distribution of water consumption in the aquatic system, due to the restoration of the Myhia HPP operation, was reflected in the distribution of bottom sediments and deposits in the Southern Buh riverbed near the village of Myhia. Compared to the field measurements in July, 2017, the thickness of silt sediments above the HPP in the area of the left bank decreased by 0.15-0.20 m, which points to the positive changes in conditions of the aquatic ecosystem of this area. In the central part of the water area above the HPP, the thickness of the silts decreased to 0.05-0.10 m (Fig. 4a) (Korzhov, 2019).

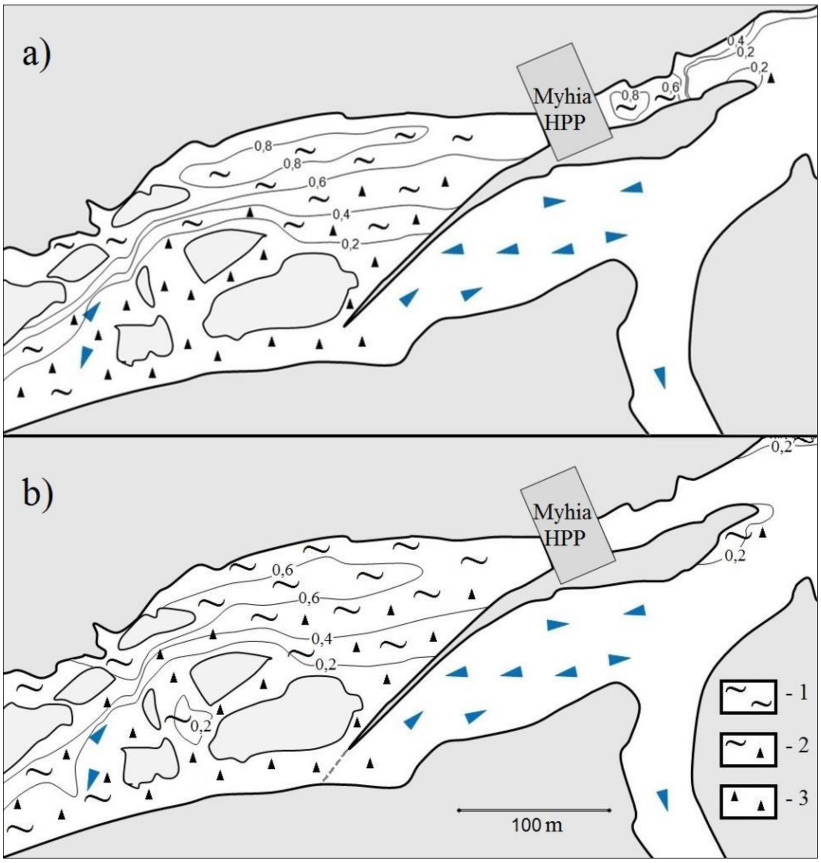

Fig. 4. The distribution of bottom sediments of the Southern Buh riverbed within the area of Myhia village in July, 2017 (a) and 2018 (b). Note: 1. silt sediments, 2. silt with stones, 3. washed stones.

In the area of the right bank and in the hollow sector of the water area above the HPP, contrarily, current's velocity decreased, which led to intensification of sedimentation processes of suspended in water substances. In this area, between the rapids, a small silted zone formed (Fig. 4b). The thickness of silt sediments here is 0.10-0.20 m.

In the zone of influence below the HPP, took place the complete reforming of the soil complex. Due to the torrential flow of water, the bottom is represented by well-washed sand and stones. Only at a distance of 100 m from the lower pound lock along the coast, mainly in the bed of reeds, there is a mild seasonal silting of the bottom. The main biotic component of aquatic ecosystem of the researched area of the Southern Buh riverbed, which underwent significant changes after the commissioning of the Myhia HPP, was macrozoobenthos.

The macrozoobenthos fauna of the studied area of the Southern Buh, both before and after the commissioning of the HPP, was diverse and is represented by the following benthic faunistic groups: *Turbellaria, Oligochaeta, Hirudinea, Gastropoda, Bivalvia, Amphipoda, Odonata, Ephemeroptera, Hemiptera, Coleoptera, Megaloptera, Trichoptera, Lepidoptera, Diptera.*

A total amount of 70 taxa of different ranks were noted in the composition of benthic invertebrates (57 in 2017 and 49 in 2018). The insects were represented the most diversely, 44% of the total number of species of benthic invertebrates belonged to the insects (first of all, due to *Diptera* (20 species) and *Trichoptera* (5 species) orders). The next largest group of species was mollusks (20 species).

The studied area of the Southern Buh was characterized by high index of the number and biomass of benthic invertebrates: in 2017, their average quantities were 8054 ± 2848 species/m^2 and 695,57 ± 457,34 g/m^2 for the number and biomass respectively; in 2018, the quantities were at the level of 9967 ± 7833 species/m^2 and 568,60 ± 463,70 g/m^2 respectively (Table 1).

Table 1. The average indexes of quantitative development of macrozoobenthos organisms in the Southern Buh area near the village of Myhia in 2018.

Studied Area	**Left Bank**	**Right Branch**	**Right Bank**	**Center**	**Lower Pound Lock 100 m Lower**	**Lower Pound Lock 200 m Lower**
Turbellaria	50 0,05	–	–	–	–	–
Oligochaeta	450 0,65	–	3600 1,00	12800 14,60	700 0,80	–
Hirudinea	50 1,50	–	100 1,60	–	–	–
Gastropoda	1050 121,50	1600 102,70	4000 700,70	1300 572,90	1200 7,70	2200 398,50
Bivalvia	150 211,50	–	300 65,30	100 1145,00	–	–
Amphipoda	100 1,25	200 1,00	2900 6,20	6700 18,00	10100 14,90	–
Odonata	100 0,80	–	–	–	–	–
Trichoptera	–	100 1,00	–	300 0,60	2000 10,50	–
Hemiptera	–	–	–	–	100 0,05	–
Diptera Ceratopogonidae	50 0,10	–	–	–	–	–
Chironomidae	200 0,35	–	200 0,20	600 2,20	800 0,30	–
Simulidae	–	–	–	–	5600 7,90	100 0,10
Total	2200 337,70	1900 104,70	11100 775,00	21800 1753,30	20500 42,15	2300 398,60
“Soft” benthos	1000 4,70	300 2,00	6800 9,00	20400 35,4	20380 34,45	100 0,10

Note: Here and further: density, species/m^2–above the line, biomass, g/m–under the line; the sign“–”means the absence of organisms.

High fluctuations in quantitative development are, above all, associated with different living conditions and life cycles of certain groups of organisms. The most prevailing species of macrozoobenthos with more than 66% of appearance were *Theodoxus fluviatilis* (Linnaeus, 1758) and *Viviparus viviparus* (Linnaeus, 1758) among the mollusks and *Chaetogammarus ischnus* (Stebbing, 1899) and *Dikerogammarus haemobaphes* (Eichwald, 1841) among the crustaceans.

In this section of the river, in 2017, we identified the following biotopes:

1) silt deposits with inclusions of higher aquatic vegetation;
2) silted sand deposits with inclusions of solid substrate (small stones, shell detritus and mollusk shells);
3) sand with stones;
4) large stones and boulders.

These biotopes were preserved in 2018 too, but some changes took place in the areas they occupied. The comparison of quantitative and qualitative indexes of macrozoobenthos in mentioned above biotopes for 2 years are given in Table 2.

The biotopes of the silt deposits have been preserved on the left bank. There, a noticeable increase in quantitative (biomass) and qualitative (species composition) indexes were marked, first of all, due to the mollusks. In the "soft" benthos, as it was before, oligochaetes were dominating in quantitative index.

Table 2. Comparative characteristics of macrozoobenthos of the Southern Buh area near the village of Migiya in different years of research.

Indicator	Years	Substrate type			
		Silt with vegetation	Silt sand with stones	Sand with stones	Large stones
Total benthos	2017	2950 18,10	16983 1330,15	1250 125,55	10550 1943,85
	2018	2200 337,70	11600 877,67	20500 42,15	2300 398,60
"Soft" benthos	2017	2600 8,10	10500 18,55	800 0,55	7800 11,10
	2018	1000 4,70	9166 15,47	20380 34,45	100 0,10
Number of faunal groups	2017	7	5	3	4
	2018	9	5	6	3
Number of taxa in the sample	2017	9	17	9	12
	2018	18	11	15	9

In both periods of research, the rich and diverse fauna of benthic invertebrates was concentrated in biotopes of the silted sand with stones. Thus, on the right bank, in 2018, at different depths (0.2-1.5 m) the number of taxa of the rank of species ad higher amounted to 5-17.

A high number of invertebrates were indicated in the area below the dam, where due to increasing flow velocity, washout of silt deposits (this biotope was represented here in 2017) and replacing it with sand and stones (in 2018), rheophilic fauna reached a mass development: members of *Diptera* (Simulidae family), *Amphipoda* and *Trichoptera* together accounted 86% of the total number of macrozoobenthos organisms. A percent of mollusks in the total biomass of benthos in this biotope was the lowest–18%, which is almost 6 times less than was rated in 2017. In our opinion, this is due to the fact that the renewal of mollusk population takes more time than in the case of heterotropic insects and crustaceans.

A similar situation, in regard to malacofauna, can be observed on the stone-boulder biotopes, located below the dam. However, for the biotopes, located here, the high concentrations of the "soft" benthos were not characteristical, which was reflected in the general decrease of quantitative indexes of benthic invertebrates.

The saprobiological assessment of water quality by the Pantle-Buck method (Pantle & Buck, 1955), using data of individual saprobity of benthic organisms, showed that, in the area of influence of Myhia HPP in 2018, the quality of water according to macroinvertebrates in the bottom layer varied from II to III class, quality category varied from 3 to 4, saprobity index remained in the range of 1.58-2.28. The highest value of saprobity index in the bottom layer of water on the left bank corresponded with the quality class according to the degree of pollution–polluted; quality category–slightly polluted; zone of saprobity-β''-mesosaprobic. In other areas, in the bottom layer, the water quality corresponded with II class of water quality–clean; quality category–quite clean; zone of saprobity-β'-mesosaprobic.

Comparing the data of the water quality for 2 years, it is apparent that, in 2018, in all studied areas, except the right bank, the quality of water had improved. This is especially notable in the areas of the river, which located below the dam. According to the saprobity index, class and category of the water quality by the degree of pollution has decreased by one and two points in the direction of improvement: quality class–from polluted to clean; quality category–from slightly polluted to quite clean; saprobity changed from α'-mesosaprobic to β'-mesosaprobic. On the right bank, the water quality according to macroinvertebrates remained unchanged in general.

The study of macrozoobenthos confirm that the reforming of water flowage and velocities, changes in distribution of bottom sediment in the area of the Southern Buh within the village of Myhia, caused by the restoration of the Myhia HPP, became a positive factor in the functioning of the aquatic ecosystem of the studied area. A more equal distribution of the water flowage in the aquatic system not only helped to reduce the thickness of silt deposits in the most stagnant sectors of the water area (the left bank, the central sector above the dam and the discharge channel of the HPP), but also had a positive effect on bottom invertebrates and caused the increase of rheophilic and oxyphilic species.

Conclusion

The restoration of Myhia HPP operation had a very positive effect on the Southern Buh area within the village of Myhia. After many year of the idle time, the renewal of the flowage in the central and left-bank areas above the dam and in the discharge channel of the HPP caused a significant decrease of thickness of bottom deposits. The right-bank area and the rapids above the dam became less flowing, however, as a result, the stony biotopes began to overgrow more intense, which in the future may also be a favorable factor for the spreading of species of flora and fauna there that previously could not withstand the significant velocities of the flow. After the commissioning of the Myhia HPP, the quantitative composition of macroinvertebrates has undergone partial changes: rheophilic and oxyphilic species became more widespread; the areas, occupied by *V. viviparus* and *Th. fluviatilis* groups, increased. The comparison of data on water quality according to macroinvertebrates during the period of study points to the fact that, after the restoration of the HPPs operation, water quality has improved in all studied areas, except the right bank. This is especially apparent in areas of the river, which are located below the dam. According to the saprobity index, the class and the category of water have decreased by one and two points in the direction of improvement: quality class–from polluted to clean, quality category–from slightly polluted to quite clean; water saprobity changed from α'-mesosaprobic to β'-mesosaprobic.

References

Abakumov, V.A. (1983) Guide to methods of hydrobiological analysis of surface waters and bottom sediments. L.: Hidrometizdat, p:240.

Ovechko, S.V., Aleksenko, T.L., Korzhov, Ye.I.ta., Ovechka, S.V. (2016). Hidroekosystemy Pivdnia Ukrainy. Richka Kalanchak Kherson: Khersonska hidrobiolohichna stantsiia NAN Ukrainy, p:100.

Cranston, P. (2008). Chiro Key Elektronniy resurs. http://chirokey.skullisland.info/

Korzhov, Ye.I. (2013). External water exchange of channel and lake systems of the lower reaches of the Dnieper in the modern period. Hidrolohiia, hidrokhimiia i hidroekolohiia. Tom, 2:37-45.

Korzhov, E.Y. (2013). Influence of climatic changes on the territory of Ukraine on the thermal and ice regimes for the maintenance of the Dnieper section. Vodnye resursy, ekolohyia ta hydrolohycheskaia bezopasnost: Sbornyk trudov VII mezhdunarodnoi nauchnoi konferentsyy molodykh uchenykh y talantlyvykh studentov FHBUN YVPRAN, 11-13 dekabrya, pp:51-54.

Korzhov, Ye.I. (2014). Features of the shape of the bath of bottom outcrops in the waters of the lowering of the Dnipra River due to the intense intensity of water exchange. Naukovi chytannia prysviacheni 95-richchu NAN, 6:27-32.

Korzhov, Ye.I., Minaieva, H.M. (2014). Influence of rezhymu techii on kilkisni pokaznyky fitoplanktonu milkovodnykh vodoim ponyzzia Dnipra. Hidrolohiia, hidrokhimiia i hidroekolohiia. Tom 2:61-65.

Korzhov, Ye.I., Kucheriava, A.M. (2018). Osoblyvosti vlivu zovnishnoho vodoobminu na hidrokhimichnyi rezhym zaplavnykh vodoim ponyzzia Dnipra. Hydrobyolohycheskyi Zhurnal. Vyp, 54:112-120.

Korzhov, Ye.I. (2018). Scientifically practical recommendations for the reduction of the aquatic ecosystems of the Dnipro horlovoy dilyanka by a path to the reversal of their water exchange.

Korzhov, Ye.I. (2016). Peculiarities of the hydrolonic regime of the Kalanchak River. Naukovi chytannia, prysviacheni Dniu nauky. Ekolohichni doslidzhennia Dniprovsko-Buzkoho rehionu. Vyp. Zbirnyk Naukovykh Prats. Kherson, p:12-19.

Korzhov, Ye.I. (2016). Hidrolohichni rules polipshennia state vodnoi Kalanchak ecosystems. Meteorolohiia, hidrolohiia, monitorynh dovkillia v konteksti ekolohichnykh vyklykiv sohodennia: Mat. Vseukrainskoi konferentsii molodykh uchenykh. Kyiv, 16-17 Lystopada 2016 r. K.: TOV Nika-Tsentr, pp:33-35.

Korzhov, Ye.I., Honcharova, O.V. (2020). Formation of the salinity regime of the waters of the Dniprovsko-Buzka khorlovaya area with an inflow of climatic zmins in the current period. Actual problems of natural sciences: modern scientific discussions: Collective monograph. Riga: Izdevniecība Baltija Publishing, pp:315-330.

Korzhov, Ye.I. (2019). Ecohydrological investigation of plain river section in the area of small hydroelectric power station influence. Collective monograph: Current state, challenges and prospects for research in natural sciences. Lviv-Toruń: Liha-Pres, p:135-154.

Korzhov, Ye.I., Kucheriava, A.M. (2018). Peculiarities of external water exchange impact on hydrochemical regime of the floodland water bodies of the lower dnieper section. Hydrobiological Journal. Begell House (United States). 54:104-113.

Za red, V.D., Romanenka, K. (2006). Metody hidroekolohichnykh doslidzhen poverkhnevykh vod. LOHOS, p:408.

Naukova dumka, T. (1969). Opredelytel fauny Chernoho y Azovskoho morey. K.:Svobodnozhyvushchye bespozvonochnye. Rakoobraznye. sostavytely M. Bechesku y dr, p:535.

Dvukrylye nasekomye, T., Andreeva, R.V., Brodskaia, N.K., Makarchenko, E.A. (2000). Opredelytel presnovodnykh bespozvonochnykh Rossyy y sopredelnykh terrytoryi. pod obshch. red. S.Ia. Tsalolykhyna. Sankt-Peterburh: Nauka, p:997.

Vysshye nasekomye, T., Yvanov, V.D., Lvovskyi, A.L., Kyreichuk y dr, A.H., Pod-obshch, R.S.Ya. (2001). Opredelytel presnovodnыkh bespozvonochnыkh Rossyy y sopredelnыkh terrytoryi. Tsalolykhyna. Sankt-Peterburh: Nauka, p:825 (in Russian).

Pantle, R., Buck, H. (1955). Die biologische uberwachung der gewasser und die darstellung der ergebnisse. Gas und Wasserfach, Bd, 96:604-618.

Rukovodstvo po raschetu elementov hydrolohycheskoho rezhyma v prybrezhnoi zone morey v ustiakh rek pry ynzhenernykh yzyskanyiakh. (1973). M.: Hydrometeoyzdat, p:535.

Timchenko, V.M., Korzhov, Ye.I., Guliayeva, O.A., Batog, S.V. (2015). Dynamics of environmentally significant elements of hydrological regime of the lower dnieper section. Hydrobiological Journal. Begell House (United States), 51:75-83.

Tymchenko, V.M., Korzhov, E.Y., Huliaeva, O.A., Darahan, S.V. (2015). Dynamics of the ecologic significant elements of the course of the lonic regime of the lower reaches of the Dnieper. Hydrobyolohycheskyi Zhurnal. 51:81–90.

Timchenko, V.M., Hilman, V.L., Korzhov, Ye.I. (2011). Basic factors pohirshannia ekolohichnoho stan ponyzzia Dnipra. Hidrolohiia, Hidrokhimiia, Hidroekolohiia. Tom, 3:138-144.

Veles, K., Perlivnytsevi, T., Kulkovi, A., Stadnychenko, P. (1984). Fauna Ukrayny:(v 40 t.) Vyp, 9:384.

Veles, K., Molliusky, T., Stadnychenko, A.P. (1990). Fauna Ukrayny:(v 40 t.): Vyp. 4: Prudovykovoobraznye (puzyrchykovye, vytushkovye, katushkovye), p:292.
Anystratenko, V.V., Anystratenko, O.Yu. (2001). Fauna Ukrayny: (v 40 t.). K.: Veles, 1956. T.29: Klass Pantsyrnye yly Khytony, klass Briukhonohye. Syclobranchia y Pectinibranchia. Vyp, 9:240.

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