KUCHURGAN STORAGE RESERVOIR - AS ONE OF THE KEY COMPONENT OF THE WETLANDS - OF THE LOWER PORTIONS OF DNIESTER RIVER

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Abstract: The article provides an evaluation of the nowadays' biological diversity of the ecosystem of the Kuchurgan storage reservoir. Records are provided about the levels of phytoplankton, the flora of the reservoir and its macrophytes overgrowth. A description is submitted about the main hydrobiont groups (zooplankton, benthos, ichthyofauna).

Keywords: avifauna, estuary, firth, hydrobionts, ichthyofauna, overgrowth, phytoplankton, storage reservoir, zoobenthos, zooplankton, wetlands

Introduction:

The Kuchurgan storage reservoir – which in the past was a river firth – is included in the estuary system of the Dniester river and, before its regulation and transformation in 1946 into the cooling pond of the Moldova central steam power station, it represented the preserved remains of the former larger Dniester firth (Yaroshenko 1957), a fact indirectly demonstrated by the presence in its benthic fauna of relict hydrobionts of the Ponto-Caspian fauna complex.

The flowing of the Dniester river into the Dniester estuary forms no delta, but one is formed by another river, Turunchuk, both being a part of the lower course up to the Tiraspol-Bendery district, covered with lakes and marshland reed beds and representing an ancient fluvial sedimentary (Morduhai-Boltovskoi 1960). The remains of this bay is the Kuchurgan storage reservoir, situated 50 km to the north of the Dniester estuary (Fig. 1).

Till the 1960s the physical and chemical properties of the Kuchurgan estuary had not differed much from other natural water reservoirs. After the building of the Moldova central steam power station in 1946, the banks of the estuary were laden with levees and the dam stopped the natural water exchange, and so the Kuchurgan estuary was transformed into a cooling pond of the Moldova central steam power station. According to the type of water supply, the estuary is an inlet water reservoir with a reverse water supply of the power station. Till the construction of the dam and the creation of the storage reservoir, the Kuchurgan firth was a spawning and nursery ground for a considerable amount of fish types of the lower Dnister river (Gorbatenski and Bizgu 1990).

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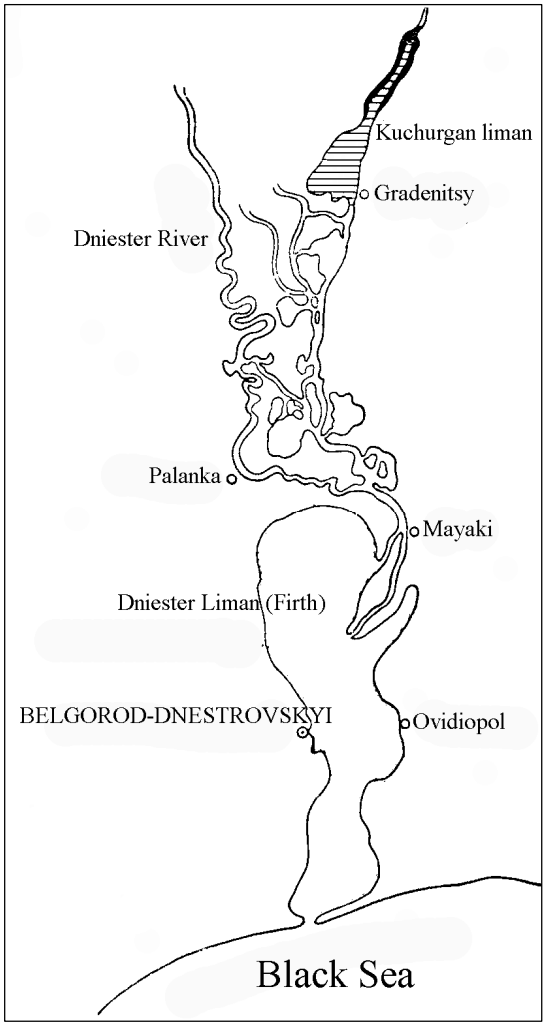
Nowadays, the water area of the reservoir is about 2730 hectares with an average depth of 3.5 meters and maximal - 5.0 meters, the water volume - 88 million cubic meters. The Kuchurgan reservoir can be classified as an elongated narrow, shallow water basin, whose vertical axis is mixed with an upper water outlet.

The Kuchurgan reservoir, although subjected to a strong anthropogenic influence and, above all, to a thermic impact, it plays a crucial role in the maintaining the wetlands biodiversity of the lower basin of the Dniester river.

Figure no. 1 The estuary system of Dnister River (by Y.M. Markov)



Materials and methods:

The materials for the articles were taken from the results of the studies of the Kuchurgan reservoir, conducted in the research laboratory "Biomonitoring" of the Transdniestrian State University.

Results and discussion:

Among all the water basins of the lower Dniester within the Moldova territory, the Kuchurgan reservoir is remarked by a rich diversity of species, thus playing the role of a central (key) component of the wetlands in the southern part of Transdniestria.

The phytoplankton of the Kuchurgan reservoir is characterized by a rich species diversity and nowadays includes 366 species of algae: Cyanophyta - 69 species, Chrysophyta - 2, Bacillariophyta - 127, Pyrrophyta - 13, Euglenophyta - 38, Volvocophyceae - 24, Chlorococcophyceae - 73, Desmidiales - 20 species (Ungureanu 1999).

Despite all the changes that took place at different times in the taxonomic structure of the reservoir's phytoplankton, the ratio between the main groups of algae remained unchanged. In all the periods of the operation of the reservoir its flora was dominated by Bacillariophyta, Chlorococcophyceae and Cyanophyta.

In the period 2011-2013 as part of the aquatic and semi-aquatic flora of the Kuchurgan reservoir, there were recorded about 66 species of land plants belonging to 25 families (Philipenko et al. 2013). Apart from the macrophytes of the Kuchurgan reservoir, its waters are overgrown mainly with *Potamogeton crispus*, and its banks with *Phragmites australis*.

The intensive overgrowing of the reservoir with *Potamogeton crispus* occurs in the first or second decade of May, when the water surface is covered by long stems and the inflorescences raise above the surface of the water. The *Potamogeton crispus* overgrowth is more prone to open the water

area of the lower and upper portions of the reservoir - about 80 % of the water surface (Fig. 2, Annexes). The intensity of the overgrowth is so high that not only does it prevent the normal reservoir water exchange, but also the passage of motor boats.

If the open water areas of the reservoir were overgrown with *Potamogeton crispus*, then the "windows" among the bank reed thicknesses mainly were overgrown with *Myriophyllum spicatum* and *Ceratophyllum demersum*.

In May and June the dominating species which condition the overgrowing of the reservoir are *Potamogeton crispus*, *Ceratophyllum demersum*, *Myriophyllum spicatum*, *Potamogeton pectinatus* and *Vallisneria spiralis*. In the first decade of July the most massive forms of macrophytes are *Ceratophyllum demersum* and *Myriophyllum spicatum* with a smaller participation of *Potamogeton perfoliatus*. In August along the bank areas of the reservoir among the dense thickets of reeds there are formed totally overgrown "windows" with *Hydrocharis morsus-ranae*, as well as the Transdniestrian Red Book species - *Salvinia natans* (Fig. 3, Annexes), with a mixture of *Lemna minor* and *Lemna trisulca*. On the margins of the thickets *Phragmites australis* and *Typha angustifolia*, *Salvinia natans* also form small congestions.

Nowadays as before, among the rigid overwater plants of the Kuchurgan reservoir it is the *Phragmites australis* that prevails. The upper portions of the reservoir is characterized by a denser overgrowth in comparison with the middle and lower portions. All the shoreline of the reservoir is covered by thickets of *Phragmites australis* with a width of 30 meters, in some places up to 50 meters. In the upper parts of the reservoir one may notice numerous isles of reed thickets with a surface of about 100 sq. m., many of which are situated about 300 meters from the bankline. The upper portion of the reservoir, which is the narrowest part of the water basin, is totally overgrown with *Phragmites australis*. The width of the thickets is over 1000-1500 meters.

The middle-portion of the reservoir is less subjected to the overgrowing with *Phragmites australis* than the upper and the lower portions. The width of the thickets near the bank is in the limit of 5-10 meters, at places more than 15 meters. Closer to the upper portion of the reservoir the width of the thickets is up to 25-30 meters (Philipenko and Tischenkova 2010).

The lower portion of the reservoir, more exactly its coastline, is overgrown with *Phragmites australis* in a smaller degree than in the upper and more than in the middle portion. The width here is about 35-40 meters. One may find here groups of thickets of *Phragmites australis* interspersed with small groups of *Typha angustifolia* with a surface of 40 sq. m.

On the whole coastline, with the exclusion of the territory of the right bank, *Phragmites australis* grows in the form of a thick wall, excluding the access to the bank from the water area. The density of the overgrowth of the coastline by *Phragmites australis* in the reservoir is in average about 50-70 plants/sq. m.

Visual observations from the boat were confirmed by the satellite photos of the "Google Maps", on the basis of which we draw a map of the Kuchurgan reservoir with the areas of the overgrowing rigid leaf vegetation (Fig. 4, Annexes).

With the help of the application program MATLAB we had processed the map of the Kuchurgan reservoir and designed the area of the overgrowth (highlighted in gray). Computer simulations have shown that the area overgrown with reeds at the Kuchurgan reservoir is of 498 hectares, accounting for 19 % of the total cooling reservoir surface. (Philipenko et al. 2013).

The fauna of the reservoir is also rich in species composition.

The basis of zooplankton in Kuchurgan reservoir is formed of around 40 species of invertebrates, of which Rotatoria represents 54 %, Copepoda 16 % and Cladocera 30 %.

The dominant forms, which form the basis of zooplankton in Kuchurgan reservoir in recent years are Rotatoria (*Keratella*

quadrata, Brachionus angularis, Brachionus budapestinensis, Brachionus calyciflorus, Brachionus diversicornis, Asplanchna priodonta, Polyarthra dolichoptera) and Cladocera (*Bosmina longirostris*).

The subdominant forms are Rotatoria (*Keratella cochlearis, Synchaeta pectinata, Synchaeta tremula*), Cladocera (*Chydorus sphaericus*), Copepoda (members of the genus *Cyclops*) (Chur 2012).

The average reservoir zooplankton abundance in 2008-2012 was of 51855 ex./m^3, including Rotatoria 38178 ex./m^3, Cladocera - 7025 ex./m^3, Copepoda 6652 ex./m^3; zooplankton biomass – 701.4 mg/m^3, including: Rotatoria 462.6 mg/m^3, Cladocera 169.22 mg/m^3, Copepoda 69.58 mg/m^3.

The dynamics of the changes in abundance and biomass of zooplankton in Kuchurgan reservoir are shown in Fig. 5 (Annexes).

The benthic fauna of the Kuchurgan reservoir before the commissioning of the Moldova power station was quite rich and varied, and was represented by 167 species. During the period of weak thermal load in the cooling pond there were observed 190 taxa of benthic aquatic organisms, of which 16% were from Ponto-Caspian species. In the 1980s the species diversity of benthic communities of the reservoir has decreased by almost 70 types (Vladimirov and Toderash 1998). At the same time, at this stage of hydrobiological regime were registered 25 previously unmentioned species, mainly chironomids and mollusks. As a result, by nowadays the benthos fauna has consisted of about 168 taxa types.

The zoobenthos reservoir over the past years has maintained a quality characteristic of this body of water which has been formed as a result of the conversion of the estuary into the cooling pond of the Moldova power station. The "soft" benthos, as before, is formed by oligochetes, polychetes, higher crustaceans, chironomid larvae and other insects. Malacofauna in number and biomass is determined by the zebra mussel (*Dreissena polymorpha*).

The dynamics of changes in abundance and biomass of the "soft" (aft) zoobenthic composition of the Kuchurgan reservoir are shown in Fig. 6 (Annexes).

The host, both in number and biomass component of the diet of zoobenthos reservoir is the oligochaeto-chironomid complex. The oligochetes of the reservoir (about 40 species) are mainly represented by tubificids. The most spread types are the representatives of the species *Tubificidae: Limnodrilus hoffmeisteri, L. claparedeanus, Psammoryctes barbatus, Tubifex tubifex* and other ubiquitous species. The number of oligochetes during 1997-2012 remained consistently high with an average of 6571 ex./m^2 with a biomass of 11.3 g/m^2.

Among the 56 chironomid species in Kuchurgan reservoir the majority is represented by: *Chironomus plumosus, Leptochironomus tener, Limnochironomus nervosus, Cryptochironomus defectus, Procladius ferrugineus, Polypedilum bicrenatum* and others. The changes in the level of the thermic status of the reservoir brought about a change concerning the common species of chironomids, while *Chironomus plumosus* strengthened its dominance, obtaining a share of total chironomids accounting for about 40 % and about 70 % of the biomass. The average indices in the density of the chirinomids in 1997-2012 were 1249 ex/m^2 with a biomass of 15.8 g/m^2.

The malacostraca of the reservoirs is mainly represented by gammaridae and korofiidae, rarely by cumaceans crustaceans and mysids. Among the gammaridae, which are quite common in the reservoir, are the following: *Dikerogammarus haemobaphes, D. villosus, Pontogammarus robustoides, P. crassus*, and among the corophiidae – *Corophium maeoticum*. During the years 2004-2012 the number of higher crustaceans remained small, in average about 65 spec./m^2 with a biomass of 0.3 g/m^2. In the recent years the numbers of the samples of crustaceans, were significantly reduced compared to the years 1981-2000. Among the macrophytes of the reservoir the

introduction in 1984 of the freshwater prawn *Macrobrachium nipponense* has become common.

The fauna of the insect larvae (without chironomids) is formed by Ceratopogonidae, Ephemeroptera, Odonata, Trichoptera and Diptera. All these groups of the zoobenthos are not significant. Among the oligo- and mezosaprobes we may mention the following species: *Palingenia longicauda*, *Potamanthus luteus*, *Cloen dipterum*, *Heptagenia sulfurea*. Among the larvae of dragonflies the following are common: *Coenagrion puella, Coenagrion pulchellum, Aeschna sp., Gomphus vulgatissimus*; among the caddisflies (*Trichoptera*) - *Orthotrichia tetensii* and *Agraylea multipunctata*.

Currently, at the bottom of the Kuchurgan reservoir the malacofauna counts with about 35 species of molluscs including *Theodoxus fluviatilis, Valvata piscinalis, Lithoglyphus naticoides, Viviparus contectus* and others. Among the bivalve, particularly abundant is *Dreissena polymorpha*. Besides this one, from the Ponto-Caspian relics types there was found *Hypanis pontica*.

The ichthyofauna of the Kuchurgan estuary, before its transformation into the cooling pond, consisted of 46 species of fish from 13 families. Currently, it is inhabited by 40 species of fish belonging to 12 families: Cyprinidae - 19 species, Gobiidae - 8 species, Percidae - 3 species, Clupeidae - 2 species and families Esocidae, Cobitidae, Siluridae, Ictaluridae, Atherinidae, Gasterosteidae, Singnathidae, Centrarchidae - one species of each. In the period of 1991-1995 a new invasive non-target species appeared - the Black Sea Silverside (*Atherina boyieri*), which due to an euribionthic and high reproductive potential had taken a leading position in the fish fauna (25.5 %) (Krepis et al. 2013). In recent years the growth of another invasion type has been observed: that of - *Lepomis gibbosus.*

The ecological succession during the intensive thermic impact of the reservoir (1981-1985) led to a significant reduction in the number of walleye and pike and a slight decrease for bream and roach. On the other hand, the new environmental conditions allowed the forming of a highly productive fish reservoir complex on the basis of the introduction of phytophagous fishes.

The avifauna of the Kuchurgan reservoir is typical of the wetland ornithine-complexes of large bodies of water such as the lakes and marshes in the south of Moldova. Among the wetlands of the Kuchurgan reservoir and the surrounding area there are 99 bird species belonging to 12 order. About 43 species are nesting, 30 species are on flight (only during migrations), 44 species are wintering, 4 species can be attributed to stray types.

The most numerous nesting species are *Acrocephalus arundinaceus*, *Fulica atra, Gallinula chloropus*, the common species are *Podiceps cristatus*, *Ixobrychus minutus*, *Panurus biarmicus*, *Aythya ferina*, *Remiz pendulinus* and others.

The Kuchurgan reservoir is also a habitat for a number of rare birds introduced in the Red Book: *Cygnus olor*, *Botaurus stellaris*, *Aythya nyroca*, *Egretta alba*, *Phallacrocorax pygmeus*, *Haliaeetus albicilla*, *Pandion haliaetus*, *Mergus serrator* and others. (Tischenkov 1998).

Conclusions:

The Kuchurgan reservoir is subjected to an active human intervention, particularly to the thermal pollution. It plays an important role in maintaining the biological diversity of the wetland basin of the Lower Dniester. The current state of the water ecosystem can be estimated as tense. Unstable ecological condition of the reservoir leads to successive overgrowing of the pond, accompanied by fixing in the ecosystem of atypical invasive species. The monitoring of the ecological status of water bodies will lead to the development of a system of measures aimed at maintaining its biological balance.

Rezumat:

BAZINUL DE ACUMULARE KUCHURGAN – O COMPONENTĂ CHEIE A ZONELOR UMEDE DIN PORȚIUNEA INFERIOARĂ A RÂULUI NISTRU

Articolul oferă o evaluare a biodiversității actuale din ecosistemul existent în bazinul de acumulare de la Kuchurgan. S-au realizat înregistrări ce evidențiază nivelurile fitoplanctonului, flora bazinului de acumulare și creșterea excesivă a macrofitelor. Este prezentată o descriere a pricipalelor grupe de hidrobionți (zooplancton, bentos, ihtiofaună).

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Annexes:

Figure no. 2 Overgrown water area of the Kuchurgan reservoir *Potamogeton crispus* in May 2013.

Figure no. 3 Thickets of *Salvinia natans* on Kuchurgan reservoir.

Figure no. 4 The surface of Kuchurgan reservoir overgrown area of the rigid vegetation.

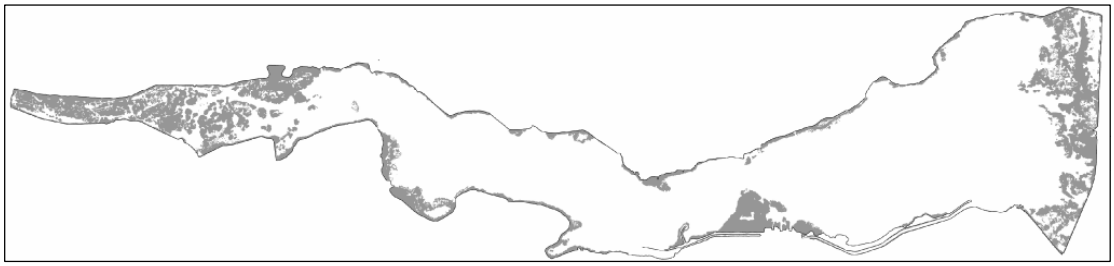
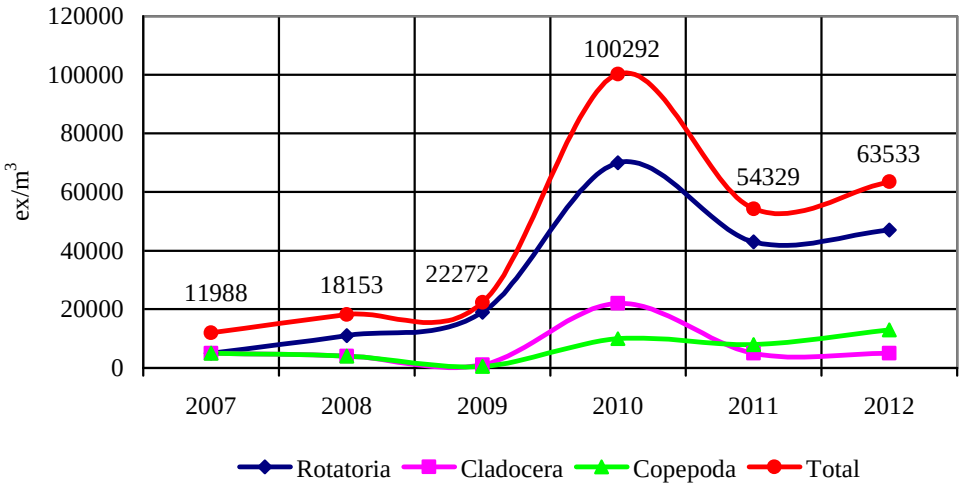


Figure no. 5 The dynamics of the changes in abundance (a) and biomass (b) of zooplankton in Kuchurgan reservoir (2007-2012).

a)



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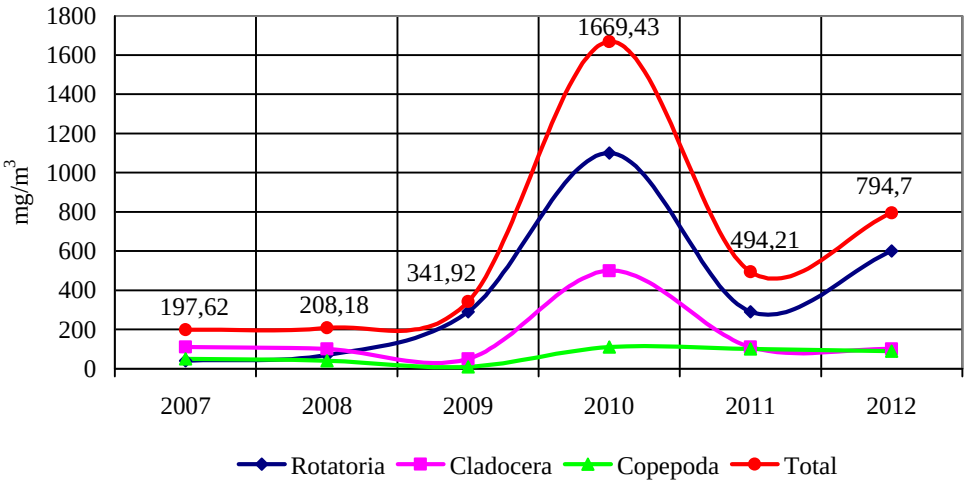
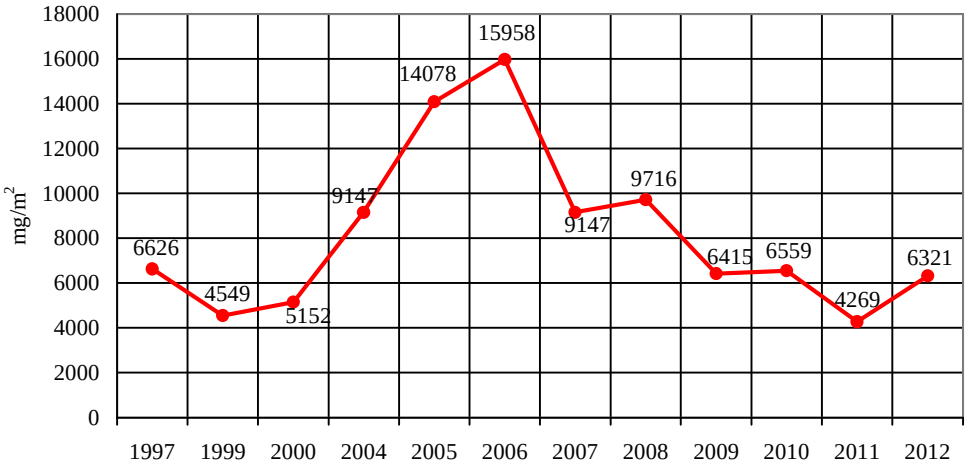


Figure no. 6 The dynamics of changes in abundance (a) and biomass (b) of the "soft" (aft) zoobenthic composition of the Kuchurgan reservoir in 1997-2012.

a)



b)