

СТОРІНКИ ІСТОРИЇ

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DNIPROPETROVSK HYDROBIOLOGICAL SCHOOL. THEORY AND PRACTICE OF ENRICHMENT OF RESERVOIRS WITH NEW FOOD ORGANISMS FOR FISH. LIFE AND WORK OF PROFESSOR P.A. ZHURAVEL (1901–1977) TO THE 120TH ANNIVERSARY OF HIS BIRTH

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The article is devoted to the description of the pages of the life of a prominent Ukrainian scientist who made highly significant contributions to the formation of the theoretical basis for the enrichment of natural and artificial reservoirs with food resources in the steppe zone of Ukraine. Petro Oleksiyovych Zhuravel, Doctor of Biological Sciences, not only made a great contribution to the development of the Dnepropetrovsk hydrobiological school studies, but was also a very sensitive and decent man. His students and followers remember him with great warmth and emphasize how easy it was to communicate with Petro Oleksiyovych; he was always attentive to other people's problems, and was reputed to have an unusual and interesting sense of humor. During the 1950s, under the leadership of Professor Zhuravel, these studies were developed into a broad multi-year program of work on the study of biology, ecology, and adaptation of Caspian fauna introduced into estuaries of Southern Ukraine and Crimea. The introduction of representatives of the estuarine-Caspian fauna was carried out in the Dnieper Reservoir, in the reservoirs of Kryvyi Rig (Karachunivske and Kresivske Reservoirs, Ingulets river, Saksagan river), in the Milk estuary of the Sea of Azov, in Vasylykiv Reservoir on the Vovchy River, and in the area of the future Kakhovka Reservoir. In connection with the acclimatization measures in the Dnieper Reservoir, new representatives of the fauna of the estuary-Caspian complex have appeared which have become feed components for many industrial fish species. A special merit of Professor Zhuravel was the introduction and acclimatization of forage invertebrates and fish in the reservoirs of southern Ukraine and the Crimea; acclimatization to the Chornorichensk (Sevastopol) Reservoir of the Crimea, employing biofilters, fish, and forage organisms from the estuarine fauna to improve w Petro Oleksiyovych ater quality. In the 1970s, in order to intensify the processes of biological self-purification of water in the Chornorichensk Reservoir in the Crimea, the acclimatization work started by

Professor Zhuravel was continued. These works had a real positive economic effect and are widely known. In the acclimatization center (Moscow) the work of Dnepropetrovsk hydrobiologists such as Professor Zhuravel has always been highly valued. Following the example of the Dnepropetrovsk Research Institute of Hydrobiology, work on the enrichment of fish feed was carried out in other regions: in the Baltic Sea, Lake Balkhash, lakes in Hungary, etc. The results of research by Professor P.A. Zhuravel are summarized in his work, "Acclimatization of forage estuarine-Caspian fauna in reservoirs and lakes of the USSR" and others.

Keywords: Professor Zhuravel, acclimatization, fish, aquatic bioresources, fodder base, reservoirs

Dnepropetrovsk Hydrobiological School of Technogenic-Transformed Freshwater Ecosystems is a scientific team that for more than 90 years has been studying the hydroecosystems of freshwater reservoirs (reservoirs, cooling reservoirs of energy facilities, canals, etc.) transformed by technogenic factors (water pollution, etc.). The establishment of the Dnepropetrovsk Hydrobiological School was due to the need to study the consequences of the construction of the Dnieper Hydroelectric Power Plant (Dniproges), which was planned to be created in the early 1930's, in order to generate electricity and radically solve the problem of navigation of the Dnieper rapids. In August 1927, a proposal was approved to establish the Dnepropetrovsk State Hydrobiological Station, which was tasked with conducting hydrobiological research related to the construction of DniproGES. The first director of the station was a prominent Ukrainian hydrobiologist-algologist Professor Dmytro Onysyforovych Svirenko [1]. Scientific and organizational activity of Professor D.O. Svirenko as the founder of complex hydrobiological studies of the impact of the construction of DniproGES on the natural aquatic environment became the basis for the formation of a team of Dnepropetrovsk scientists-hydrobiologists. The results of these studies, presented in seven volumes of the "Bulletin of the Dnepropetrovsk Hydrobiological Station", have made a significant contribution to the treasury of hydrobiological and ichthyological knowledge [1].

The practical need for hydrobiological study of the processes of transformation of aquatic ecosystems of the free-flowing Dnieper River into ecosystems of the lake-like Dnieper Reservoir prompted scientists of the Dnepropetrovsk Hydrobiological School under the guidance of Professor D.O. Svirenko (G.B. Melnikov, P.O. Zhuravel, etc.) to the formation of a new direction of hydrobiology of reservoirs [10]. The theoretical basis of hydrobiology of reservoirs was the provision that the fundamental changes in the hydrological, hydrochemical and hydrobiological regimes of the primary reservoir (rapids section of the Dnieper), due to hydraulic engineering (construction of the DniproGES), cause radical changes in quantitative and qualitative Dnieper Reservoir): plankton, benthos, periphyton, higher aquatic vegetation, ichthyofauna, etc.

Subsequently, students and followers of Professor D.O. Svirenko significantly expanded the scope of research. Innovative directions of hydrobiology were founded or considerably deepened: space hydrobiology (G.B. Melnikov) (1961); freshwater radioecology (I.P. Lubyarov) (1962); technical hydrobiology (I.P. Lubyarov); water toxicology (S.P. Fediy). In addition to D.O. Svirenko and others, Petro Oleksiyovych Zhuravel became the founder of the theory and practice of enrichment of reservoirs with new forage organisms for fish.



P.O. Zhuravel was born on January 5, 1901 in the village of Anivka, Petrovsky district, Kirovohrad region. From 1922 to 1926 he studied at the Dnepropetrovsk Institute of Public Education (now DNU named after O. Gonchar) at the agro-biological department of the faculty of vocational education. From 1926 to 1930 he worked as an assistant, then associate professor of zoology and biology at the Dnepropetrovsk Institute of Public Education, Faculty of Social Education. From 1930 to 1933 (without taking time off work) he studied and graduated from the Dnipropetrovsk State Hydrobiological Station under the guidance of Professor D.O. Svirenko. After graduating in 1933, he remained to work at the Dnepropetrovsk Hydrobiological Station as a researcher engaged in a comprehensive hydrobiological and fishery study of natural and artificial reservoirs of the steppe zone of Ukraine, enriching them with feed resources for fish. From 1932 to 1944 he worked as an associate professor of zoology at the Dnipropetrovsk Pharmaceutical Institute.

During this period, Associate Professor P.O. Zhuravel and Associate Professor O.I. Berestov studied the zoobenthos of the rapids section of the Dnieper River, productivity and its changes under the influence of the construction of the Dnieper dam. By the nature of biotopes, the rapids part of the Dnieper turned out to be quite diverse; turbulent rapids and cataracts alternated with calmer river reaches. The distribution of soils and organisms in the river was also associated with different flow velocities. The composition of the zoo population of the rapids area (coastal thickets, bottom, rapids and cataracts) was quite diverse. There were places with a fairly poor population, but there were also places with a rich population, for example, among the coastal thickets of macrophytes, on the stone thresholds, on silted areas, and, with increasing degree of silting, its zoo population increased. The population of sandy and

stony soils was relatively poor. The biological productivity of the benthic fauna of the entire area of the bottom of the rapids section before the changes was more than 590 tons. The biomass of the benthic fauna of the sandy soil of the rapids section of the Dnieper was 53 kg / ha, and of the stony soil was 88 kg / ha. With the creation of the Dnieper Reservoir, the rapids part of the Dnieper River changed dramatically. Large depths were formed, reaching 56 m in the lower section, and all rapids were submerged deep under water (10–35 m). The current became almost absent. After the creation of the Dnieper Reservoir and the accumulation of silt on its bottom, the bioproductivity of the bottom increased, reaching up to 300 kg / ha in the lower parts of the reservoir. In 1932, there were an average of 10,680 organisms per square meter, while before the rise of water on any of the soils such a number of organisms was not observed. After the creation of the Dnieper Reservoir and the accumulation of silt on its bottom, the bioproductivity of the bottom increased; in 1932 it reached 885 kg / ha in the lower parts of the reservoir.

As a result of changes in the hydrological regime in the new reservoir, optimal conditions were formed for the emergence and mass reproduction of alien organisms, such as the bivalve mollusk *Dreissena polymorpha* (Pall.) [2]. It should be noted that the mass reproduction of *Dreissena*, which in a short time settled in the waters of the Dnieper reservoir, was first noted by P.O. Zhuravel in “On the state of some representatives of the fauna Mollusca and Crustacea in the Dnieper reservoir” [3]. The author noted that before the flooding of the porous part of the Dnieper, *Dreissena* was relatively rare, due to the hydrological regime of this part of the Dnieper and the conditions of existence of the mollusk. Beginning in 1932, noted P.O. Zhuravel, that is, from the time of filling the Dnieper reservoir, in the reservoir *Dreissena* begins to appear in a significant amount. The author notes the fact that *Dreissena* got into the water supply system of DniproGES. The DniproGES department was forced to fight clogging of the pipelines with *Dreissena* shells. From our point of view, it is important that DniproGES be advised about the need to conduct special studies of the reservoir to use more effective means of combating and counteracting the spread of *Dreissena* [4].

During the Great Patriotic War, with a pharmaceutical institute, P.O. Zhuravel was evacuated to Pyatigorsk in the Caucasus, and then to Semipalatinsk. After returning from evacuation in May 1944, P.O. Zhuravel worked at the Research Institute of Hydrobiology of the State University: from 1944 to 1947 – a researcher, head of department, and from 1947 to 1967 – director of the Research Institute of Hydrobiology. In 1951, P.O. Zhuravel defended his doctoral dissertation “On the formation of the biological regime of reservoirs in southeastern Ukraine and ways to enrich their natural feed (for fish) resources” [4]. The urgency of work on the enrichment of water bodies of southeastern Ukraine

with new forage organisms is explained by the poverty of their species composition. Depletion of species composition can be traced to the example of the hydrobiological complex of the Dnieper; in its mouth live 43 species of benthic and benthonectonic forms of invertebrates of marine origin, and in the area from the mouth to Dnepropetrovsk (just over 400 km) gradually falls to 33 species. In the Volga, representatives of this fauna are distributed almost to the upper reaches (more than 3,000 km from the mouth). The author explains this by the existence of rapids on the Dnieper. Biological fish productivity of reservoirs, which depends on providing them with food resources for fish (worms, mollusks, crustaceans, insects, etc.), can be increased by acclimatization of new organisms. Previous works of the Research Institute of Hydrobiology of Dnipropetrovsk University have shown that the hydrological and hydrochemical regimes of the reservoir of southeastern Ukraine resemble estuaries or riverbeds [9]. Along with the typically freshwater forms, they can be inhabited by representatives of the fauna of the estuarine complex (Caspian type): polychaetes-amphoretides, mollusks, crustacean amphipods, kumacei, and misidia, which are also more accessible to fish than the oligochaetes-tubinomids. This is evidenced by industrial fish in the Dnieper reservoir, such as pike, pike perch, perch, and other fish, eating a large number of young mussels.

The possibility of inhabiting the invertebrate fauna of the estuarine complex in new reservoirs is evidenced by the author's data on the content of mysids from various reservoirs of southeastern Ukraine in aquariums with water-fed plant detritus, and in winter hay infusion with bacteria, they both gave viable offspring. Experiments were also carried out on their transportation by various modes of transport: rail, road, etc. – to considerable distances. The oxygen concentration in the water was reduced to 2.45 mg / l (25.15% saturation), but no death was observed. In 1948, in two reservoirs of Kryvbas (quarries filled with water – Tarapakivsky in the area of Kryvyi Rih and Kamenolomnya in the area of Vecherny Kut) mysids were introduced by the author and began to take root, and in 1949 young mysids were found in these reservoirs. Tarapakivska quarry is similar to the reservoirs of southeastern Ukraine in terms of hydrological, chemical and biological regimes. It became a source of relocation of mysids to other reservoirs. Mysids in the Tarapakivsky quarry occurred among thickets of higher aquatic vegetation; Dorogostaisky's dredge received more than 100 specimens of mysids. In 1948 and 1949 Mysid specimens were obtained from the lower Ingulets and introduced to the Kresiv and Karachunivsky reservoirs of Kryvbas. In 1950, mysids began to take root in the reservoirs [10]. The author associates a fairly wide range of salinity and high ecological valence with their historical past: from the second half of the Tertiary period (Neogene) they lived in basins where there were significant changes in the aquatic environment (temperature, gas, especially salt: from significant salinity to almost complete desali-

nation). Conditions in the reservoirs of southeastern Ukraine are close to the estuaries of southern rivers, especially the Dnieper-Bug estuary, and are quite favorable for the fauna of the estuarine complex, so estuaries can be a source of enrichment of reservoirs in south-eastern Ukraine.

In 1946, under the leadership of P.O. Zhuravel, work began on enriching the forage base of fish by acclimatizing the representatives of the estuarine-Caspian fauna (mysids, hamarids, kumacei, etc.).

The introduction of invertebrate fauna of the estuarine complex into the reservoirs of southeastern Ukraine has enriched their foraging and contributed to the increase of fish stocks. Along with the practical significance, these works had an important theoretical significance: the ability of organisms of the estuarine complex (Caspian type) to take root in reservoirs can shed light on the origin and evolution of these forms of fauna in freshwater bodies.



**Meeting of the Scientific Council of the Research Institute of Hydrobiology, January 8, 1973.
From left to right – S.P. Fediy, P.O. Zhuravel, O.M. Chaplina, I.P. Lubyarov**

During the 1950s, under the leadership of Professor P.O. Zhuravel, these studies were developed into a broad multi-year program of work on the study of biology, ecology and distribution of representatives of the estuary and Caspian fauna. The introduction of representatives of the estuarine-Caspian fauna was carried out in the Dnieper reservoir, in the reservoirs of Kryvyi

Rih (Karachunivske and Kresivske reservoirs, Ingulets river, Saksagan river), in the Milk estuary of the Sea of Azov, in Vasytkiv reservoir on the Vovcha-river and in the area of the future Kakhovka reservoir [7]. In connection with the acclimatization measures in the Dnieper Reservoir, new representatives of the fauna of the estuary-Caspian complex have appeared which have become feed components for many industrial fish species. A special merit of Professor P.O. Zhuravel lies in the introduction and acclimatization of forage invertebrates and fish in the reservoirs of southern Ukraine and the Crimea; acclimatization to the Chornorichenske (Sevastopol) reservoir of the Crimea of biofilters, fish and forage organisms from the estuarine fauna to improve water quality.

In the 1970's, in order to intensify the processes of biological self-purification of water in the Chornorichensky Reservoir in the Crimea, the acclimatization works started by Professor P.O. Zhuravel were continued. These works had a real economic effect and were protected by copyright. The works of Professor P.O. Zhuravel are widely known. In the acclimatization center (Moscow) the work of Dnipropetrovsk hydrobiologists has always been highly valued. Following the example of the Dnipropetrovsk Research Institute of Hydrobiology, work to enrich the feed base of fish was carried out in other regions: in the Baltic Sea, Lake Balkhash, lakes in Hungary, etc. The results of Professor P.O. Zhuravel's research are summarized in his works "How to enrich fish food in freshwater" [6], "Acclimatization of forage estuarine-Caspian fauna in reservoirs and lakes of the USSR" [8] and others.

**ДНІПРОПЕТРОВСЬКА ГІДРОБІОЛОГІЧНА ШКОЛА.
ТЕОРІЯ ТА ПРАКТИКА ЗБАГАЧЕННЯ ВОДОЙМ
НОВИМИ, КОРМОВИМИ ДЛЯ РИБ, ОРГАНІЗМАМИ.
ЖИТТЯ ТА ДІЯЛЬНІСТЬ ПРОФ. П.О. ЖУРАВЛЯ
(1901–1977) ДО 120-РІЧЧЯ ВІД ДНЯ НАРОДЖЕННЯ**

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Стаття присвячена опису сторінок життя видатного українського вченого, який зробив великий внесок в формування теоретичної бази зі збагачення природних та штучних водойм кормовими ресурсами в умовах Степової зони України.

Петро Олексійович Журавель – доктор біологічних наук, професор, зробив не тільки великий внесок в розвиток дніпропетровської гідробіологічної школи, а був дуже чуйною та добропорядною людиною. Його учні та послідовники з великим теплом згадують про нього і підкреслюють як легко було спілкуватися з Петром Олексійовичем, він завжди був небайдужим до чужих проблем, володів дуже цікавим та яскравим почуттям гумору. Протягом 50-х років під керівництвом професора П.О. Журавля ці дослідження були розгорнуті у широку багаторічну програму робіт з вивчення біології, екології та поширення представників лимано-каспійської фауни. Особлива заслуга професора П.О. Журавля полягає в інтродукції й акліматизації кормових безхребетних і риб у водосховища півдня України та Криму; акліматизації в Чорноріченське (Севастопольське) водосховище Криму біофільтраторів, риб та кормових для них організмів з лиманої фауни для підвищення кормової бази риб та поліпшення якості води. Практична потреба в гідробіологічному вивченні процесів трансформаційного перетворення водних екосистем вільно протікаючої річки Дніпро в екосистеми озероподібного Дніпровського водосховища підштовхнула вчених дніпропетровської гідробіологічної школи під керівництвом проф. Д.О. Свіренка (Г.Б. Мельникова, П.О. Журавля та ін.) до формування нового напрямку гідробіології – гідробіології водосховищ [1]. Теоретичною основою гідробіології водосховищ стало положення про те, що фундаментальні зміни гідрологічного, гідрохімічного та гідробіологічного режимів первинного водоймища (порожистої ділянки Дніпра), обумовлені гідротехнічним будівництвом (спорудженням Дніпрогесу), викликають докорінні зміни у кількісному та якісному стані всіх біотичних складових водної екосистеми новоствореного водоймища (Дніпровського водосховища): планктону, бентосу, перифітону, вищої водної рослинності, іхтіофауни і т. д. В подальшому, учні та послідовники проф. Д.О. Свіренка значно розширили проблематику досліджень; були засновані або значно поглиблені новаторські напрями гідробіології: космічна гідробіологія (Г.Б. Мельников) (1961); прісноводна радіоекологія (І.П. Луб'янов) (1962); технічна гідробіологія (І.П. Луб'янов); водна токсикологія (С.П. Федій) тощо. Засновником теорії та практики збагачення водойм новими кормовими, для риб, організмами став П.О. Журавель.

Ключові слова: професор Журавель, акліматизація, риба, водні біоресурси, кормова база, водосховища

ЛІТЕРАТУРА

1. Байдак Л.А., Дворецький А.І. Техногенно трансформовані прісноводні екосистеми Придніпров'я. Ретроспективний аналіз досліджень (30-ті–90-ті рр. ХХ ст.): монографія. Вид. 2-ге, допов. та виправл. Дніпро, 2019. 228 с.
2. Журавель П.О. Про надто масову появу *Dreissena polymorpha* Pall. у порожистій частині р. Дніпра в 1932 р. Збірник праць зоологічного музею Академії Наук УРСР. 1934. № 13. С. 131–148.
3. Журавель П.О. Про стан деяких представників фауни *Mollusca* та *Crustacea* у водосховищі Дніпрогесу. Вісник Дніпропетровської Гідробіологічної Станції. Т. II. Дніпропетровськ. 1937. С. 149–160.

4. Журавель П.А. О формировании биологического режима водохранилищ юго-востока Украины и пути обогащения их естественных кормовых (для рыб) ресурсов : автореф. дис. на здобуття наук. ступеня докт. біол. наук: 03.00.17. Днепропетровск, 1950. 24 с.
5. Журавель П.А. О фауне лиманного комплекса Днепровского водохранилища после его восстановления. Вестник научно-исследовательского института гидробиологии. Т. XI. По вопросам гидробиологии и рыбного хозяйства Днепровского водохранилища после его восстановления. 1955. С. 121–145.
6. Журавель П.О. Як збагатити корм для риб у прісних водоймах. Дніпропетровськ: Дніпропетровське обласне видавництво, 1957. 42 с.
7. Журавель П. А. Некоторые итоги и перспективы акклиматизации кормовой для рыб лиманной фауны в водохранилищах Украины. Биологическая наука в университетах и педагогических институтах Украины за 50 лет: материалы межвуз. республ. конф. Харьков, 1968. С. 202–204.
8. Журавель П.О. Акклиматизация кормовой лиманно-каспийской фауны в водохранилищах и озерах СССР. Днепропетровск, 1974. 124 с.
9. Загубиженко Н.И. Акклиматизация кормовых беспозвоночных в водоемах Криворожья. Итоги и перспективы акклиматизации рыб и беспозвоночных в водоемах СССР. М. 1980. С. 49–50.
10. Poleva, J.L. Characteristics of bottom fauna of small reservoirs of the Steppe zone of Ukraine. Ecology and noospherology. Dnipro, Ukraine. 105–107.

REFERENCES

1. Bajdak L.A., Dvorec'kij A.I. (2019). *Tehnogeno transformovani prisnovodni ekosystemy Pridniprovy'a. Retrospectyvnyi analiz doslidzhen` (30-ti – 90-ti rr. XX st.* [Technogenically transformed freshwater ecosystems of the Dnieper. Retrospective analysis of research. (30-s–90-s of XX century)]. Monografiya. 2-e vid., dop. ta vipr. Dnipro. [in Ukrainian].
2. Zhuravel' P.O. (1934). *Pro nadto masovu poyavu Dreissena polymorpha Pall. u porozhy`stij chasty`ni r. Dnipro v 1932 r.* [About too mass appearance of *Dreissena polymorpha* Pall. in the porous part of the Dnieper in 1932]. *Zbirny`k prac` zoologichnogo muzeyu Akademiyi Nauk URSR*, no.13, 131–148. [in Ukrainian].
3. Zhuravel' P.O. (1937). *Pro stan deyaky`x predstavny`kiv fauny` Mollusca ta Crustacea u vodosxovy`shhi Dniprogesu* [On the state of some representatives of the fauna of *Mollusca* and *Crustacea* in the Dnieper reservoir]. *Visny`k Dnipropetrovs`koyi Hidrobiologichnoyi Stanciyi. Dnipropetrovsk*, Vol. II, 149–160. [in Ukrainian].
4. Zhuravel' P.A. (1950). *O formirovanii biologicheskogo rezhima vodohranilishh jugo-vostoka Ukrainy i puti obogashheniya ih estestvennyh*

- kormovyh (dlja ryb) resursov* [About formation of a biological mode of reservoirs of the south-east of Ukraine and a way of enrichment of their natural forage (for fishes) resources] : avtoref. dis. na zdobuttja nauk. stupenja dokt. biol. nauk: 03.00.17. Dnepropetrovsk. [in Russian].
5. Zhuravel' P.A. (1955). *O faune limannogo kompleksa Dneprovskogo vodohranilishha posle ego vosstanovlenija* [On the fauna of the estuarine complex of the Dnieper reservoir after its restoration]. *Vestnik nauchno-issledovatel'skogo instituta gidrobiologii*, Vol. XI. Po voprosam gidrobiologii i rybnogo hozhajstva Dneprovskogo vodohranilishha posle ego vosstanovlenija. Kyiv. 121–145. [in Russian].
 6. Zhuravel' P.O. (1957). *Yak zbagaty ty` korm dlya ry`b u prisny`x vodojmax* [How to enrich fish food in fresh water]. Dnipropetrovsk. [in Ukrainian].
 7. Zhuravel' P.A. (1968). *Nekotorye itogi i perspektivy akklimatizacii kormovoj dlja ryb limannoj fauny v vodohranilishhah Ukrainy* [Some results and prospects of acclimatization of food for fish of estuarine fauna in reservoirs of Ukraine]. *Biologicheskaja nauka v universitetah i pedagogicheskikh institutah Ukrainy za 50 let: materialy mezhvuz. respubl. konf. Har'kov*. 202–204. [in Russian].
 8. Zhuravel' P.O. (1974). *Akklimatizacija kormovoj limanno-kaspijskoj fauny v vodohranilishhah i ozerah SSSR* [Acclimatization of forage estuarine-Caspian fauna in reservoirs and lakes of the USSR]. Dnepropetrovsk. [in Russian].
 9. Zagubizhenko N.I. (1980). *Akklimatizacija kormovyh bespozvonochnyh v vodoemah Krivorozh'ja* [Acclimatization of forage invertebrates in water bodies of Krivoy Rog region]. *Itogi i perspektivy akklimatizacii ryb i bespozvonochnyh v vodoemah SSSR*. Moscow. 49-50. [in Russian].
 10. Poleva, J.L. (2020). Characteristics of bottom fauna of small reservoirs of the Steppe zone of Ukraine. *Ecology and noospherology*. Dnipro, Ukraine. 105–107.