

## **History of hydrobiological research of the Institute**

During the time of the existence of the Dnieper Biological Station till the events of 1917, its staff collected numerous materials for different groups of hydrobionts (planktonic and benthic animals) and ornithological researches were carried out. During this period, two volumes of works "Proceedings of the Dnieper Biological Station" (1914, 1915) were published.

After the restoration of the station's work in 1919, the study of the typology and regional features of the Dnipro River and its floodplains, the patterns of nutrition and growth of fish, the issue of production and sanitary hydrobiology, and hydrochemistry are gradually becoming the leading topics in the station. The material on the hydrobiological and hydrochemical zoning of the Dnieper (Ya.V.Roll, Yu.M.Markovsky, V.M.Tovbin) is being accumulated, later it became the basis for the biological forecast of the Dnipro reservoirs. The results of this period are published in periodicals: "The Collection of Works of the Dnieper Biological Station" (1926-1931), "Proceedings of the Hydrobiological Station" (1934-1940).

Developing comprehensive limnological and ichthyological research, the Institute on the eve of the World War II expanded the study of the hydrobiological and hydrochemical regime of the middle flow of the Dnipro due to the future regulation of it.

During the World War II the Institute studied the reservoirs of Bashkortostan, carried out hydrobiological, sanitary-biological and ichthyological studies of the Bielaya River, provided substantial assistance to the health authorities, water and fish industry of Bashkortostan.

In 1944, upon returning to Kyiv, the staff of the institute joined the solution of complex hydrobiological and ichthyological problems, which were mainly related to the development of the fisheries sector. Comprehensive studies of the lower reaches of the Danube and Danube estuaries were initiated. The results of these works have played an important role in the preparation of international agreements on fisheries management in the Danube. The investigations of the bottom communities of hydrobionts in the lower reaches of the Danube, the Dnipro and the Dniester resulted in well-known capital publications of Yu.M.Markovsky [1].

Starting from the fifties, the main priority direction of the Institute's work was a comprehensive study of the Dnipro, related to the development of projects for the construction of the Dnipro cascade of hydroelectric power stations and reservoirs. A large cycle of research was carried out to study hydrobiological processes in the conditions of the regulation of the Dnipro River flow and the patterns of biological regime formation in reservoirs. The peculiarities of the influence of the construction of hydroelectric power stations on fish stocks and their reproduction under the new conditions are revealed, measures for fish development of reservoirs and enrichment of the fish feed base (V.I Vladimirov, V.A Movchan) have been developed and implemented [2].

The work was continued on the introduction of invertebrates of the Ponto-Caspian complex in the newly constructed Dnipro River reservoirs with the purpose of forming a high-yielding forage base of the fishery and enhancing the biodiversity of these reservoirs. The works were accompanied by comprehensive studies of ecosystems of newly created water objects [3].

It was first formulated the technical and biological conditions for the design, reconstruction and operation of reservoirs of hydroelectric power stations. At this time, the subject of the Institute was largely focused on clarification of the patterns of water quality and bioproductivity of newly created reservoirs on the background of the lack of world experience in the study of the dynamics of ecosystems of this type. Studies of the Institute on the Dnipro topics are summarized in a series of publications [4, 5, 6 etc.].

In the 1960's the theory of formation of the hydrochemical regime of reservoirs of plain rivers was developed, the bases of scientific forecasting of the hydrochemical regime of reservoirs were developed. The results of these studies were used in the practice of water management in the design and construction of canals and reservoirs, solving the tasks of technical and drinking water supply and irrigation. For a series of works on the hydrochemistry of waters of Ukraine, the staff of the Institute was awarded the State Prize of the Ukrainian SSR (Almazov O.M., Denisov AI, Maystroenko Yu.G., Kosenko AD, Nakhshina EP, Feldman M.V.) (1972). Subsequently, the hydrochemical studies were aimed at establishing the patterns of distribution of nutrients and organic substances and compounds of heavy metals among the abiotic components of reservoirs, estuarine sections of rivers and estuaries. As a result, a scientific and methodological basis was developed for the study of the component composition of dissolved organic substances and coexisting forms of metals in reservoirs of various types [7, 8].

Under the direction of O.V.Topachevsky, the study of the processes of biological contamination of reservoirs and the search for means of control of these processes was started. The causes and regularities of the mass development of blue-green algae in the reservoirs of the Dnipro Cascade and other reservoirs are determined, the scientific bases of measures for reducing the negative consequences of algal blooms, improving its quality and sanitary-biological state of reservoirs of hydroelectric power stations are developed. These achievements have been published in a series of monographic works [9, 10, 11].

For scientific achievements in researches of physiology of freshwater seaweed L.Ya. Sirenko was awarded the M.H. Kholodny Prize (1976).

The ecotoxicological research in the Institute started in the early 60's in connection with the search for chemical methods to control algal blooms. Under the guidance of L.P. Braginsky, natural and experimental studies were carried out, which allowed to generalize the danger of the use of algicides and other chemical agents and allowed to formulate the methodological and theoretical principles of ecotoxicological studies (L.P. Braginsky, F.Ya. Komarovsky, O.I. Merezko). The peculiarities of the action of the toxins and metabolites of blue-green algae on hydrobionts were determined, in particular - metabolic disorders in fish were detected (A.Ya. Malyarevskaya, T.I. Birger, O.M. Arsan, V.D. Solomatina). The results of research on ecological and toxicological situation of reservoirs of Ukraine are summarized in the collective monograph "Complex assessment of the ecological state of the Dnipro basin" (2000).

In the 1960's, the institute began the study of the patterns of the formation of the sanitary-biological regime of cooling ponds of thermal and nuclear power plants and channels of transfer of water runoff. The results of researches of cooling ponds of Ukraine were summarized in the monograph [12].

The large-scale hydraulic engineering construction on the Dnipro system accompanied by the creation of channels of territorial transfer of the Dnieper runoff in arid southern regions of Ukraine. Institute staff members led by prof. O.P.Oksiyuk created conceptual approaches to the elucidation of patterns of water quality in the channels. On the basis of them, engineering, hydrological and biological recommendations for maintenance of high water quality in the channels and prevention of troubles in the process of water transport were developed [13].

These recommendations were put into practice, in particular, during the construction and operation of the Dnipro-Donbas channel. These works laid the foundation for the development of a new direction in hydroecological science, namely the "Water Ecosystem Management", which is developing successfully today [14, 15, 16].

For work "Algae of canals of the world" and "Invertebrates of the USSR" O.P. Oksiyuk and O.G. Kaftannikov was awarded the M.H. Kholodny Prize (1976).

In the 80's the research of the institute in the waters of the Northwest Black Sea coast, including the Ukrainian part of the Danube, has considerably expanded. The most important task of the institute was the assessment of the ecological state and the forecast of changes in connection with the design of the construction of the Danube-Dnipro channel. For the first time in the world, conceptual approaches to environmental assessment of such global projects have been developed, a methodological base and its software have been created, which has made it possible to prove the ecological unreliability of such construction. These works were published in a number of monographs [17, 18 etc].

The cycle of works "Environmental impact assessment of hydrotechnical construction on water objects" was awarded by the State Prize of Ukraine in Science and Technology (1995) (V.D. Romanenko, O.P.Oksiyuk, V.M. Zhukinsky, V.I. Lavrik, F.V. Stolberg).

Hydro-botanical research has been widely developed at the institute. Beginning with studies Zerova K.K., Korelyakova I.L., Merezhko O.I. higher water plants has been regarded as one of the main components of hydrobiocenosis in continental waters, which determines their structural and functional peculiarities [19, 20].

In the 80-90 years under the leadership of the Dr. AI Merezhko were conducted comprehensive studies of small rivers of Ukraine, which was based on the principle of organic unity and river catchment area, the functional role and relationship of the components of biological processes in the evolution of river systems. Within the framework of the solution of the "problems of small rivers" scientific principles were developed concerning rational nature management in their basins, maintenance of water quality and processes of self-purification in river systems. From 1990 to 2005, an ecological certification of more than 2000 small rivers of Ukraine was conducted, which became the basis for their further rehabilitation [21, 22].

Many years of floristic and faunistic research in the Dnieper basin on the territory of the Republic of Belarus, the Russian Federation and Ukraine allowed the development of a strategy for the conservation of biological and landscape diversity in its basin [23].

As a result of complex ichthyological studies, the state of the fish farm of the Dnipro basin has been studied and a general list of fish of the Dnipro basin in the territory of Ukraine, the Republic of Belarus and the Russian Federation has been compiled, accounting for 90 species. Among them there are a number of introduced species, intervenes that actively and significantly expanded their area, invasive species in the natural waters inadvertently during fish-breeding or unauthorized resettlement and not belonging to fish-breeding facilities [24].

On the basis of complex researches of the ecosystems of the Dnipro reservoirs, especially their littoral zone, the theory of formation and development of ecosystems of plain reservoirs as a succession process was developed, which was generalized in monographic works [25, 26]. The principles developed in the theory gave the tools for improving the ecological situation in the Dnipro reservoirs, inhibition of the "aging" of these ecosystems due to changes in the hydrological regime, hydro-amelioration measures in shallow waters, land improvement and shore consolidation, which was realized in practice by water management organizations of Ukraine.

Theoretical generalizations concerning buffer capacity, mechanisms of formation of water ecosystems and aquatic ecosystems relative to external anthropogenic factors, their biodiversity and functional activity are carried out. It has been established that aquatic ecotones are especially sensitive to environmental pollution. Using the accumulation properties of ecotones in the process of accumulation of various types of pollutants and toxicants, and monitoring these contact areas, it is possible to develop environmental measures that extend not only to the ecotone zone, but also to much larger territories adjacent to its landscape complexes [27].

The materials on freshwater periphyton are generalized, its structural and functional features are considered in reservoirs of different types - watercourses, lakes, reservoirs, technical reservoirs, including cooling ponds of thermal and nuclear power plants. The principles of classification of periphyton groups and the system of cenecomorph are developed [28].

Parasitological studies of Ukrainian reservoirs which were started back on the Dnipro Biological Station in the 20's of the last century by academician O.P. Markevich's subsequently covered the main groups of hydrobionts (fish, molluscs, crustaceans). The main direction of the research was a systematic study of the parasitological situation in different water objects of Ukraine and the development of theoretical and applied bases of hydroparasitology. O.P. Markevich was awarded the State Prize of the Ukrainian SSR in Science and Technology (1988) for his significant contribution to the creation of the Ukrainian scientific zoological nomenclature. Modern hydroparasitological studies are aimed at developing principles and methodology for assessing the status of freshwater ecosystems and the quality of the aquatic environment based on parasitological parameters. For the cycle of scientific works "Integrated approach to the estimation of the state of anthropogenically modified reservoirs with the use of physiological-biochemical, cytogenetic and parasitological indicators", a team of young scientists of the institute (Yuryshynets VI, Mardarevich M.G., Stoyka Yu.O.) was awarded the prize President of Ukraine for Young Scientists (2004).

The role of exometabolites of freshwater algae in the processes of water quality formation has been established [29]. It is shown that higher aquatic plants produce biologically active substances that can significantly affect the functional activity of algae and cyanobacteria. Among them, polyphenols, terpenes, alkaloids are the most active. Cyanobacteria are characterized by the highest sensitivity to the action of polyphenols, which leads to a significant reduction in their number in algal communities.

The main focus of ecological physiology of aquatic animals is to study the mechanisms of adaptation of water animals (invertebrates) to saline, ionic and temperature factors of the aquatic environment. The role of individual ions and their complexes in the metabolic reactions associated with bioenergetic and biosynthetic processes in freshwater fish as representatives of poikilothermic organisms is determined. The neurohormonal mechanisms of adaptation of fish to temperature factors of the aquatic environment have been studied, the possibility of controlling metabolic processes in their organism by directing changes in water temperature, photoperiod and other physical and chemical factors has been substantiated.

The peculiarities of occurrence of physiological and biochemical processes in carp fish with their growing in heated waters of energetic objects are established, on the basis of which are developed ways of optimization of their bioproductivity through ionic activation of the reaction of carboxylation, which is achieved by the introduction of micro-and macro elements in the feed (M.Yu. Evtushenko).

The possibility of controlling the reproductive processes of fish has been scientifically substantiated, which made it possible to develop a method of polycyclic reproduction of fish regardless of the season and weather conditions [30].

The works related to the disclosure of the mechanisms of adaptation of aquatic animals to changes in environmental conditions of the environment have been awarded with the prize of the NAS of Ukraine named after V.Ya. Yuriev (Romanenko V.D., 1984).

The problem of adaptation of aquatic animals is one of the most important in understanding the patterns of their distribution in water objects of different types. Knowledge of the mechanisms of adaptation of hydrobionts to the physical and chemical factors of the aquatic environment is the fundamental basis for the legislative restriction of the discharge of pollutants into water bodies.

This explains why after the proclamation of Ukraine's independence this trend became one of the priorities of the Institute.

The main achievements in this direction are summarized in monographic works: [31, 32, 33]. These works formed the basis for the development of biotechnologies for the cultivation of hydrobionts in regulated water treatment systems. The cycle of works "Ecological bases of biotechnologies for the reproduction of fish and invertebrates in aquaculture" was awarded in 2002 in the M.M. Schmallhausen Prize of the National Academy of Sciences of Ukraine (V.D.Romanenko, Y.G.Krot, V.D.Solomatina).

Hydrobionts of different taxonomic levels are becoming increasingly important as an effective source of biologically active substances (including medicinal ones), food and feed products, growth stimulants, pest control drugs etc. They are used in determining the quality of natural and waste waters, cleaning and restoring their biological value, adjusting the technological cycles of enterprises.

Taking into account this, it is possible to assume that the further introduction of hydrobiotechnologies developed at the institute will significantly expand the scope of application of hydrobionts in various fields of human activity.

The development of both fundamental and applied researches in this area is facilitated by the modern experimental base of the Institute, which allows the cultivation of aquatic organisms of different trophic levels throughout the year and the practical implementation of developments at the Bila Tserkva Hydrobiological Station. At this station for the first time in Ukraine were introduced herbivorous fish of the Far Eastern faunal complex [34]. Vovk P.S. was awarded the Yuryev Prize for a series of works on biology and fishery development of Far Eastern herbivorous fish in Ukraine.

Radioecological studies of the Institute related to the study of migration, transformation and biological action of radionuclides in continental reservoir ecosystems. Under the leadership of M.I. Kuzmenko in the post-Chernobyl period, many years of radioecological research of the processes of distribution, migration and transformation of radionuclides  $^3\text{H}$ ,  $^{90}\text{Sr}$ ,  $^{134}\text{Cs}$ ,  $^{238}\text{Pu}$ ,  $^{239+240}\text{Pu}$ ,  $^{241}\text{Am}$  and others in the ecosystems of the reservoirs of the ChNPP, Dnipro, and its tributaries and cooling ponds of the NPP were carried out. Doses of irradiation were established and the peculiarities of the disturbances in the activity of hydrobionts were determined in the conditions of their stay in ecosystems with different levels of radioactive and chemical contamination [35, 36, 37].

The Institute of Hydrobiology actively cooperates with higher educational institutions: Taras Shevchenko National University of Kyiv, Zhytomyr State University, National University of Biological Resources and Nature Management of Ukraine, National University of Kyiv-Mohyla Academy, National Aviation University and others. In the framework of agreements on creative cooperation, students of higher educational establishments pass different types of educational practices at the institute in the corresponding specialties. The staff of the institute conduct teaching activities in educational institutions, prepare new training courses, publish textbooks and study guides.

In 2004, the textbook "Fundamentals of Hydroecology", 2001 - author: Romanenko V.D. - was awarded the State Prize of Ukraine in Science and Technology. In 2004, the Russian-language edition of this textbook came out.

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