

“STEJARUL” RESEARCH STATION (PÂNGĂRAȚI, ROMANIA): LIMNOLOGICAL CONTRIBUTIONS, 1956-1982

Ioan Cărăuș

“Stejarul” Biological, Geological and Geographical Research Station in Pângărați (Neamț County, Romania) was founded 50 years ago, as a result of an initiative and the effort of “Alexandru Ioan Cuza” University of Iași.

The official “birth certificate” of this institution was the Decision no. 227/01.11.1956 of the Ministry of Education.

The reason for which this Station was created was, on one hand, to cover the needs for field practice of the students of the Faculty of Biology and Geography and, on other hand, the necessity to study the changes of the landscape due to the intended hydrotechnical developments in the middle and lower sector of Bistrița River valley (Eastern Carpathians, Romania).

This last objective determined the option for the placing of the new institution in several buildings (surrounded by an amazing natural mountain landscape), which initially lodged the Pângărați Monastery, founded in 1560 by Moldavian voivode Alexandru Lăpușneanu and stated later as a historical monument. After the foundation of the Station, a lot of reparations and arrangements were made in order to restore the buildings and to prepare all the rooms for the new, specific uses. As a result there were created spaces adequate for laboratory activities, for the scientific library, for a specialized museum, for students' accommodation, mechanical workroom a.o. Later a field base was created near the huge Bicaz dam reservoir, on the shore of Potoci bay.

A major opportunity for limnological investigation activities was the endowment of the Station with “Emil Racoviță” 35 tdw research ship, designed and built initially for studies on the Black Sea.

Created from the beginning as a multidisciplinary research unit, able to approach holistic investigation programs, the “Stejarul” Station developed in time and diversified its specialty range.

A special attention was paid to the development of **limnological studies**.

These were started on several specific directions, as the water chemical composition of Bistrița River, the composition of benthic diatom communities inhabiting the flowing waters within the flooded and adjacent areas of the future dam reservoir, benthic invertebrates, fish fauna, just before the building of the first huge dam reservoir in Romania (the dam was closed on July 1st, 1960).

Then, the investigations extended step by step to a lot of the aspects of the forming, structure and evolution of the lacustrine basin and ecosystem.

A special characteristic of the hydrotechnical developments on Bistrița valley resulted from the continuing of the works even after the construction of the high dam at Izvorul Muntelui – Bicaz. Between 1963 – 1966, downstream Stejaru power plant to the confluence with Siret River there were constructed eight dam reservoirs and a system of channels supplying 12 smaller hydroelectric plants.

From the beginning, a special attention was paid to the study of the forming and the characteristics of dam reservoir Izvoru Muntelui – Bicaz – the largest reservoir on the inland rivers of Romania (total capacity – $1.23 \cdot 10^9$ cubic meters)

In the field of **physical limnology**, there were investigated the geomorphological processes connected to the setting up of the huge reservoir at Izvoru Muntelui (Bicaz), as the littoral abrasion (increased due the major fluctuations of water level), the land-sliding phenomena, alluvial transport, sedimentation and silting processes. There were carried on long-term, systematic measurements on some climatic features in the area of Izvorul Muntelui – Bicaz reservoir and in the downstream sector of Bistrița valley, pointing out some aspects of the local impact of hydrotechnical developments upon several weather elements (air temperature, relative air moisture, cloudiness, local winds a.o.). There were also made comprehensive hydrological studies, searching the temperature regime of water masses related to seasonal variations and to the changes of the inflow of main tributaries, the evolution of freezing phenomena, surface water evaporation, the stratification of water layers and its seasonal changes, the characteristics of the waves and of the currents, transparency and the underwater light regime.

It was monitorized the situation of several major parameters of the chemical composition of water, characterizing its quality, both as environment for aquatic biota and as economical resource.

In the field of **limnobiology**, there were carried out investigations upon some communities of primary producers, consumers and decomposers.

Algological studies aimed mainly the structure of planktonic communities, the changes in time of algal flora composition; there were pointed out some of algal population ways of Izvorul Muntelui – Bicaz dam reservoir ecosystem, as the carrying of living algae by waterfowl and the introduction of some algae originating in neighboring limnetic ecosystems, seasonal and multiannual dynamics of phytoplankton

numerical density, as well as its spatial distribution. Some special aspects of phytoplankton biology were considered, as the producing and the evolution of water-bloom phenomena (the most impressive being that determined by massive invasion/development of a population of *Oscillatoria rubescens* early in '70's), the natural process of phytoplankton sinking, the horizontal microdistribution of plankton algae populations. For several years the glass slide method for periphyton installation was used.

Due to the major oscillations of the water level in Izvorul Muntelui – Bicaz reservoir no significant communities of aquatic macrophytes was recorded. On the upper end of the lake were only observed some isolated, reduced as surface, groups of *Polygonum amphibium*.

Zooplankton investigations aimed to know the qualitative composition (species of Rotifera, Cladocera and Copepoda), its quantitative development, space distribution and seasonal dynamics.

The investigation of benthic invertebrates showed the small percentage of riverine populations which survived under the ecological conditions of the new man-made lake; later, in this ecosystem appeared and developed some populations specific to lake biocoenoses, mainly from Oligochaeta and Chironomids.

A special attention was paid to the study of Izvorul Muntelui – Bicaz reservoir ichthyofauna. As a result of breaking off the Bistrița river continuum and of the new biotope characteristics, major changes in the fish fauna were recorded. It was also investigated the adaptation of several fish species introduced here by the Man, as well as the significant change of the division into fish zones of the whole hydrographic Bistrița River basin. Natural food of selected fish populations was examined.

An other research program concerned the knowledge of the changes in the bird fauna of the middle Bistrița basin as connected to the forming of the huge Izvorul Muntelui - Bicaz dam reservoir and of the downstream reservoirs. A lot of waterfowl populations appeared, part of them coming here during their migration from Northern Europe toward southern regions. During winter, the relatively higher temperature of Pângărați reservoir (the first from downstream series, supplied mainly from the "warmer" hypolimnion of Bicaz reservoir) determined the installation here of a lot of wild ducks.

Within the complex limnological study of Bicaz water power reservoir it was approached – firstly for Romania – an important field of aquatic ecology – the lacustrine microbiology. At "Stejarul" Research Station was founded and developed the first laboratory of aquatic microbiology in Romania, with an ecological orientation. In time, it was passed from the study of the total number of germs in water and sediments, toward functional aspects of the bacterioplankton

and bacteriobenthos, by considering the physiological groups of bacteria (as nitrogen fixing bacteria, denitrifying bacteria, ammonifying, amyloclastic, pectinolytic and cellulolytic bacteria etc).

It may be said that Bicaz dam reservoir represents probably the most studied man-made lake ecosystem from Romania, both as concerning the period of investigation, the diversity of research fields and last, but not least, by the level of going deeply in several of study directions.

As mentioned above, downstream Stejaru power plant there were built new hydrotechnical objectives, represented by eight dam reservoirs much smaller as compared to Bicaz reservoir, a channel system which took over the most part of Bistrița river discharge; on the river's old bed remained a very reduced water flow, that resulted in major changes in the structure and function of reophytic biocoenoses. The ecological state of Bistrița River (both regularized and "natural") was complicated by the impact of some pollution processes determined by wastewater from chemical industry, from pulp and mill factories etc.

In order to see the downstream influences of great Bicaz reservoir, it was searched the situation of the phytoplankton after passing through the 4 km tunnel and the turbines of Stejaru power plant; it was stated that although the water outlet correspond to the hypolimnetic layers (at the depth of about 40 m), in the water passing through the turbines there are certain amounts of phytoplanktonic organisms, from which an important part remain alive, able to survive in downstream reservoirs.

It was pointed that in downstream reservoirs appeared in time abundant communities of aquatic macrophytes, occupying great surfaces on these basins; they were mainly populations of *Potamogeton crispus*, *Potamogeton pectinatus*, *Elodea canadensis*, *Myriophyllum spicatum* etc. In these ecosystems, characterized by a short water retention time, phytoplankton development is rather poor, so the main primary producer is represented by submerged macrophytes, including abundant periphytic communities installed on this vegetation.

It was also studied the situation of the zooplankton, animal benthos and fish fauna. Because of the fragmentation of river course by constructing channels, power plants and dams, and due to the functional peculiarities of the system related to the production of the electrical power, fish populations were strongly damaged. Besides the human impact determined by the presence and working of the hydrotechnical development, the fish fauna in the lower sector of Bistrița River was affected by pollution processes, very active along a period that exceeded 30 years. Water quality – both in the old river bed and in the artificial course was studied for many years by the research staff from "Stejarul" Station. Great amounts of nitrogen compounds, organic matter, phenols, even cyanides, were determined downstream Piatra Neamț. There were also studied microbial communities in relation to environmental characteristics of this river sector.



"Stejarul" Research Station in Pangarati
(Neamt County, Romania)



Research ship "Emil Racovita" on Bicz dam
reservoir

There were considered several aspects of physical limnology, as the temperature regime of the water, influenced to a great extent by water discharge from the hypolimnetic layers of upstream Bicz reservoir, the dynamics of freezing processes, the evolution of silting, as well as the influence of the presence and functioning of these hydrotechnical developments upon the level and characteristics of underground water layers within Bistrița valley.

Considering the need to improve the basic knowledge of the limnological peculiarities of the man-made lakes as a distinct type of aquatic ecosystems, and on the base of the experience already accumulated, the research staff of "Stejarul" Station started to study other dam reservoirs in Romania. There were organized research expeditions to Vidraru reservoir and to the smaller basins constructed downstream on Argeș River, to Vidra reservoir on Lotru River, to the dam reservoirs on Someș River (Gilău, Târnița, Mărișelu), to the Stânca-Costești reservoir, built on Prut River, to dam reservoirs on Olt River, to the great dam reservoir Iron Gates I on the Danube etc. As a result, it was obtained a lot of information on biocoenose formation in these man-made ecosystems, about their evolution in time.

A special field of activity of the research staff of "Stejarul" Station concerned the **experimental limnology**.

There were carried up laboratory studies for the determining the toxicity of some industrial waste waters or of some specific chemical

compounds, using algal tests, invertebrate populations (esp. *Daphnia magna*) and fish tests.

An other direction of activity aimed to the controlled cultivation of some aquatic organisms, as microalgae, cladocerans, macrophytes, fish. There were made laboratory cultures of several algae (*Chlorella*, *Scenedesmus*) on classic or original nutritive media, and large scale, open air cultures. It was intended to elaborate culture media able to determine a high quality biomass production; the use of some mineral waters was tested. In this institution there were obtained in 80's the first Romanian productions of *Spirulina platensis* biomass ranged tens of kilograms, by open air mass culture.

Research workers developed some original controlled rearing techniques, for high density growing of the rainbow trout (*Salmo irideus* Rich.). Fish populations were reared successfully in floating cages on Bicz reservoir. As a result of the study, an industrial production system was designed and operated.

Later a similar method was used for intensive/superintensive rearing of the carp (*Cyprinus carpio* L.) in fish ponds or on shallow dam reservoirs.

In both cases, a special attention was paid to the quality of fodder used (special original recipes were tested) and also, to the care for pathological incidence, related to high densities of fish populations.

During the research period, several **methodological aspects** of the study programs were approached, both principal or/and technical. There were analysed methodological problems specific to the complex study of dam reservoirs, proposing an multidisciplinary approach, close to the systemic conception and theory. Several major aspects of the eutrophication concept were analysed on the base of a holistic approach.

As concerning working techniques, there are to be mentioned the design and production of several original equipments, which were effectively used for years in the field research. Here are some of these devices and equipments: large capacity batometer for water sampling, a device for dissolved oxygen measuring in water layers near the mud-water interface, reversible plankton sampler, various devices for sediment and/or zoobenthos sampling, waterproof case for the depth immersion of a photosensitive cell, a device for passive collection and preservation of the sedimenting seston etc.

A special success – notably for Romanian limnology – was the design and construction of a submerged laboratory, which was used for some underwater observations in Izvorul Muntelui – Bicz reservoir.

An important part of the results of the scientific activity of the limnological team of "Stejarul" Station was published in various serials, as the Scientific Annals of the University of Iași, and within the own publication of the Station (Travaux de la Station de Recherches "Stejarul"). Its first issue appeared in 1968; later, the publication was divided in three series, one of them referring to limnology. The last volume (X) was published in 1981. This publication was sent

to libraries inland and abroad. As a result of publication exchange a lot of scientific literature was obtained, that resulting in a significant increase of the documentary base of the Library of “Stejarul” Station, which was used also by scientists who visited this institution.

In time, over 15 Ph.D. theses were elaborated by the researchers, based on the studies carried up on Bistrița valley. It was also published a limnological monographic book (1983) including a major part of the information on Izvorul Muntelui – Bicaz reservoir.

During the years, the researchers attended hundreds of scientific meetings; there were also organized several own scientific sessions, at the Station, to which participated a lot of scientists from other research institutions, from different universities or invited from abroad.

One of the most important achievements was the accumulation of a vaste knowledge on the forming and the evolution of the man-made lakes and, also, the accumulation of a valuable research experience in the field.

And, may-be, last but not least, “Stejarul” Station represented the formation of a complex, functional, team (researchers, laboratory assistants, technicians, workers, sailors, administrative staff) which, frequently, appeared and worked as a true family.

Unfortunately, in 1982, a Decision of the communist Government led to the “re-organizing” of the “Stejarul” Research Station from Pângărați, by the fragmentation of the research staff, of the logistic base and of the library and the founding of three new research units. The new “Stejarul” Research Station (moved in Piatra Neamț) included the collective of Vegetable Biology-Genetics and the geological-geographical teams; a small part of the limnological section formed Trout Culture Station at Potoci-Bicaz, and the rest of limnologists constituted the Laboratory for Aquaculture and Aquatic Ecology, in Piatra Neamț.

The main loss determined by this change was the breaking down of the integrality of a powerful, consolidated, multidisciplinary collective, able to approach complex research programmes, unique in Romania at that time. An other damage resulted from the obligation to abandon the old location of

the Station, having functional spaces, prepared along a period of 25 years to be used for research activities.

To make a final estimation on what meant “Stejarul” Research Station in Pângărați for the Romanian limnology, we have to emphasize the following aspects:

- the foundation, from the beginning, of this institution as a multidisciplinary team offered the possibility to a comprehensive study both of the physical environment, and of the main bioceenoses from man-made lakes;
- the location of the Station on Bistrița valley near the hydrotechnical developments offered the major opportunity for an immediate and continuous (along the whole year) access to study areas;
- the multiannual studies on Bicaz reservoir, of other man-made lakes in Romania led to an augmentation of the basic knowledge on the forming and evolution of these ecosystems, on their environmental impact;
- it was completed the knowledge of the impact of human activities (hydrotechnical development, pollution processes) on the aquatic resources and on other components of the natural capital;
- there were elaborated some methodological contributions, both at the conceptual level and at technical level;
- in experimental limnology there were developed research programs on eco-physiological and technological bases for controlled rearing of selected aquatic organisms, both for biomass production (algae, fish), for biotesting (algae, invertebrates) and for supplementary cleaning of waste water (aquatic macrophytes);
- there were grown specialists who accumulated a vaste knowledge in their field of activity and major skills, so, even after the “re-organization” of “Stejarul” Research Station in Pângărați, they could continue and develop their work in limnology, either in research institutions or in different universities.

AUTHOR'S ADDRESS

IOAN CĂRĂUȘ - University of Bacău, Faculty of Sciences, 157, Calea Mărășești, 600115 Bacău, România, e-mail : caraus@ambra.ro