Prut River through Magnifying Glass – Educational Campaign for the Assessment of the Aquatic Ecosystem Health

„Râul Prut prin lupă" – Campanie educativă de evaluare a sănătăţii ecosistemelor acvatice

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Abstract

Aquatic ecosystems constitute fragile living environments that may respond in a sensitive way to alterations caused by human activities, in some cases the damage being irreversible.In this context public awareness of the importance of aquatic ecosystems, the knowledge of the morphological adaptations of the organisms that live in water, their habitat preferences and their role as indicator of environmental quality, could develop proper and responsible behaviour that is needed for a sustainable development of the society. The Galaţi Natural Sciences Museum Complex has developed in 2014 a successful educational project in the Zona inundabilă a Prutului Inferior Natural Park, which is an important wetland along the Prut Corridor. The project aimed to involve schools pupils from the Lower Prut area in the activities of knowledge of invertebrate aquatic fauna as indicators of the health of aquatic environments, and as a major source of food for fish and other aquatic animals. A number of 150 pupils from the communities belonging to the Lower Prut area were involved in identifying macro-invertebrate fauna based on experiment, interactivity, inter-disciplinary through sampling material, observations of species and their adaptations, indicator species determination, physicochemical water parameters measurement, interpretation of relationships among different factors and impact assessment of human activities.

The project was financed by the European Fisheries Fund - Operational Programme for Fisheries (FOP) 2007-2013 in the "Strategy for sustainable development of the fisheries area Prut-Danube, Galaţi County" Measure: 6, under the contract signed with the Ministry of Agriculture and Rural Development through the Fishing General Directorate as Managing Authority. The total value of the project was 10.000 Euro and the implementation period one year.

Keywords: aquatic ecosystem health, aquatic invertebrates, educational campaign for students, environmental learning

Introduction

The relationship of humans with their natural and artificial environment is now a firmly established topic in the curricula of European schools, including Romania. Aquatic ecosystems constitute fragile living environments that may respond in a sensitive way to alterations caused by human activities, in some cases the damage being irreversible. Therefore public awareness of the importance of aquatic ecosystems and the development of proper and responsible behaviour is needed for a sustainable development of the society. This involves gaining knowledge on the various adaptations of the organisms that live in water, their habitat preferences and their role as indicators of environmental quality. Educational research shows that people have greater

motivation to engage and learn if the subject matter is directly relevant to their lives and interests, if they have built up emotional links, and/or if the learning process is interactive-one in which the learner can directly affect the learning process, content, and/or outcomes of the experience (FALK, 2001). Students who directly participate during a field experience generate a more positive attitude about the subject. School field trips are widely regarded as teaching tools that enhance learning (FALK & DIERKING, 1992). Falk and Dierking (1997) found that field trips also promote long-term recall.

The Galaţi Natural Sciences Museum Complex has developed in 2014 a successful educational project entitled *"Prut River through magnifying glass" - Educational Campaign for the assessment of the aquatic ecosystem health,* developed in the Zona inundabilă a Prutului Inferior Natural Park, which is an important wetland along the Prut Corridor.

The project aimed to involve schools pupils from the Lower Prut area in the activities of knowledge of invertebrate aquatic fauna as indicators of the health of aquatic environments, and as a major source of food for fish and other aquatic animals.

Pupils were involved in identifying benthic (bottom-living) fauna based on observations of sampled specimens, experiment, interactivity, interdisciplinary work with sampled material, observations of species behaviour and their adaptations, indicator species determination, physicochemical water parameters measurement, interpretation of relationships among different factors, and impact assessment of human activities.

Material and Methods

The Prut River is the last tributary of the Danube River and marks the frontier between Romania and Moldova. The lower section of the Prut forms a ca 300 km long floodplain (with still >400 km^2 of functional floodplain) and consists an important north-south migratory route, and a gate to the Biosphere Reserve of the Danube Delta. The lowermost section of this floodplain is protected within the Zona inundabilă a Prutului Inferior Natural Park which has a surface about 8,200 ha, with a length of about 145 km, stretching downstream until at the confluence with Danube near Galaţi City. The park includes forested areas (2,627 ha), ponds and lakes (4,925 ha including Brateş Lake) as well as reed-marshes stretching until the flood dyke.

Within the project thematic lessons were given to introduce the topic, and nine field trips (also known as "excursions") were organized with groups of 15-20 children and chaperones teachers in June 2014. Field trips visited, four stations in the Zona inundabilă a Prutului Inferior Natural Park, both at the Prut River and also at floodplain lakes in order to assess both: lotic and lentic types of aquatic ecosystems. The target group consisted of 150 children from nine

schools located in the administrative territory of the protected area, as the schools from Cavadineşti, Suceveni, Oancea, Vlădeşti, Măstăcani, Folteşti, Frumuşiţa, Tuluceşti and School No. 24 from Galaţi.

The field trips were prepared and planned to ensure quality and success by establishing the field stations and visiting of them before, by acquisition and preparation of the equipment. Equipment constituted of fishing waders, rubber boots, long pond gloves and macroinvertebrate net for sampling benthic macroinvertebrates; aquatic ecology kits – magnified glasses, tweezers, scissors, white shallow trays, benthic sieves and buckets used to sort invertebrates; stereomicroscope and illustrated field guides used to identified the main groups of benthic macroinvertebrates; sampling jars, plastic Petri dishes, 70% ethyl alcohol used for preserving of the collected specimens; GPS for recording local coordinates; a handmade teaching tool used to measure water transparency; water chemistry field kits for measuring the main physical and chemical indicators of water quality – temperature, pH, dissolved oxygen, nitrates and phosphates; digital camera; folding table and chairs.

Based on scientific methods for water quality and monitoring assessments four worksheets were developed: for chemical and physical water parameters measurements, for benthic invertebrates assessment calculation, for impact assessment of human activities and the last one for the interpretation of relationships among different factors for the assessment of the aquatic ecosystem health. These worksheets were supplied as a working tool to the children, divided in small groups, for joint work with them based on experiential learning. A control of learning success has been added by applying 150 questionnaires in order to assess the knowledge of the pupils involved in the project before and after field trips activities. The questionnaires were focused on aquatic ecology and the importance of the wetlands, and also assessed their skills and knowledge gained from the project activities.

Results and Discussion

Our experience when conducting the project confirmed our initial assumptions and approaches. Responses in the questionnaires revealed that 95 % of all pupils (11-14 years-old) and involved adults most frequently remembered the field trips visiting natural sites and nature centres. The field trips represent high level learning experience and involve strong inter-relationships between cognition, affect, the physical context and social context (FALK & DIERKING, 1997).

Galaţi is a city surrounded by water, as the Danube and the lower parts of its two last tributary rivers, the Siret and the Prut Rivers and their floodplains form green corridors around the city. As these corridors are also linked to the

Danube Delta Biosphere Reserve, it constitutes an important educational task to improve the appreciation of the diverse aquatic ecosystems by people, and their understanding of their complex ecology. Such environmental learning may be achieved by different learning experiences and informal education activities in the nature, conducted by specialists trained to disseminate and communicate the results of the scientific studies to different kind of audience/ public.

Studies accompanying conservation measures or studies on the impact of pollution often focus on vertebrates colonizing wetlands: birds, fishes, amphibians, sometimes plants, but rarely aquatic invertebrate communities. Aquatic invertebrates are small animals that live in the water body and on the bottom of streams, rivers and lakes. Within this group, insects contribute the greatest diversity of organisms, which are represented by: mayflies, caddis flies, dragonflies, water bugs, stoneflies, bugs, flies. Other groups are aquatic worms, snails, clams, shrimps and crayfishes. These organisms represent most important members in the food web of aquatic ecosystems, as they are able to feed on living and dead (detritus) biomass of plants and micro-organisms, assimilate a significant part of this into their own biomass, and this make this basic food resources available for larger organisms, as fish and birds. As aquatic invertebrates living in the bottom of lakes and rivers have life times between some months and some years, they constitute a food resource for predatory fish that is available all year round. By processing their food, aquatic invertebrates recycle waste materials, and also accelerate the cycling of nutrients, and thus increase the bio production of aquatic ecosystems.

With our help and hands on experience, illustrated field guide sheets and worksheets, the pupils were able to:

- generate focused questions;
- identify the main groups of benthic invertebrates found in the Prut River and floodplain lakes and have a basic understanding of their ecologies;
- assess the physical-chemical characteristics of the water;
- become familiar with regularly used sampling gear to collect invertebrates, and to assess water quality across a broad range of aquatic ecosystem types;
- develop an understanding of important ecological relationships in Prut floodplain diverse aquatic ecosystems;
- develop an understanding of the potential consequences of human activities and natural disturbance events on the structure and function of aquatic ecosystems in Prut area.

For a better understanding of the presence or absence of species in the aquatic ecosystem it is necessary to know about the abiotic factors that influence life in an aquatic environment.

On the first field worksheet entitled *"Determining the health status of water in terms of physical-chemical factors*", students noted basic data related to respective river/lake studied. They marked and noted in the worksheet the GPS coordinates and described the location were samples were collected. There were made a series of investigations on abiotic factors that characterize the habitats. The students were asked to measure the water temperature by using a water thermometer, describe the colour of the water and note the results in the worksheet. The determination of some physical and chemical water parameters using field kits for dissolved oxygen, pH water, nitrates, phosphates, allows to learn about the physical and chemical characteristics of a river /lake, and also allows an insight into the overall functioning of a river or lake ecosystem, based on the analysis and discussion of the relationships between various factors within the working group.

The students helped by the museum experts in aquatic ecology have noted in the second field worksheet entitled "*Calculation sheet of benthic macroinvertebrates*" the results based on joint activities of collecting, sorting and identifying invertebrate species using the illustrated field guide sheets, magnifying glasses and microscopes. With these records they were able to calculate the Pollution Tolerance Index in order to assess water quality using the number of faunal groups founded, which have been assigned to different sensitivity classes for pollution.

On the third worksheet entitled *"The quality of water based on land use and pollution sources"* pupils have identified and analyzed problems and issues related with human intervention in the area. Thus, the children assessed the present and potential threats of the ecosystem analyzing the local pollution factors that can affect the health of the water and the aquatic organisms, the land use or the characteristics of the riverbanks.

On the final worksheet "*Interpretation of the results*" the pupils, organized in working groups, were motivated to discuss, identify and understand the relationships between different biotic and abiotic factors. Accordingly, they have found out responses to initial problems, issues and questions, have described the general functioning of the aquatic ecosystems, identifying solutions to support a healthy environment and future opportunities for nature, but also for the communities from the area, in a sustainable development context.

At the end, each group of children received an aquarium to be used at the respective school containing specimens of aquatic invertebrates in order to familiarize more pupils with these organisms. Additionally, they received equipment for future field trips, as T-shirts, caps, and rucksacks.

Students greatly appreciated practical exercises in the field in which they had the opportunity to familiarize themselves with some practices used in

aquatic ecology. The results of the success control study confirmed the idea that students appreciated more practical activities in the field and nature trips than theoretical activities like conferences or seminars developed in the classroom or in other cultural institutions. The pupils have equally appreciated both activities related with evaluation of water quality using physical and chemical parameters but also sampling and identifying invertebrates which highlights the role of practical application in the gaining knowledge process.

Finally, a 20 pages brochure was developed and published as a dissemination effort for the project "*Prut River through magnifying glass – Educational Campaign for the assessment of the aquatic ecosystem health developed by Galati Natural Sciences Museum Complex"*. This brochure was designed and developed with the aim to represent a tool for teachers to help them with exploration and discovery activities organized with students in nature. Through this non-formal education campaigns we have tried to increase the awareness and involvement in environmental issues among the local population. We assume that children not only gained some proper features to become responsible and active citizens, but will additionally tell about their experiences in their families and friends.

We are confident that more such activities could contribute to train new generations to behave in a more responsible and more sensitive way to their environment, and become more involved in environmental problems, both local and general ones.

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References

FALK, J.H., 2001, *Free-choice Science Education: How We Learn Science Outside of School*, New York: Teachers College Press.

FALK, J. H., DIERKING, L. D., 1992, *The Museum Experience*, Washington D.C., Whaleback Books.

FALK, J. H., DIERKING, L. D., 1997, *School Field Trips: Assessing their Long-term Impact*, Curator, 40 (3): 211–218.

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