Piotr Goss

In the face of global climate changes natural resources, especially water, became one of critical factors of sustainable development

Water, Ecosystems, Society

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The International Center for Ecology focuses on advancing the science of ecohydrology and on the practical application of its principles, so as to regenerate our drinking water resources and improve their quality

At the outset of the 21st century, more than 70% of the Earth's surface has been altered by mankind through deforestation, agriculture, urbanization, etc. As a consequence, there has been a catastrophic reduction not only in biological diversity, but also in the ecological processes underpinning the water cycle. Global climactic changes have thus led natural resources, especially water, to be recognized among the decisive factors in sustainable development.

Hydrological processes are determined by the climate, while water quality is to various extent degrees dependent on biological processes. However, the classical approach to water resource management has so far not taken solutions based on the integration of ecology and hydrology into account.

The field of ecohydrology is a sub-discipline of hydrology that studies the basic ecological aspects of two phases of the hydrological process: the land phase, i.e. the inter-

dependencies between water, plants, and soil, and the aquatic phase, i.e. the links between nutrients, pollutants, flora, fauna, and the water quality.

The theory of ecohydrology chiefly rests upon the notion that the environmentally-safe utilization of water resources hinges not only upon our ability to curb pollution emissions but also in large part on our capacity to renew and regulate the circulation of water and nutrients, in order to boost the ecosystem's resistance to the impact of human activity. One novel means proposed by the science of ecohydrology for regulating ecological processes, from the molecular level up to the landscape level, is called "dual regulation": regulating the function of the plant and animal world via hydrology, and vice versa. From the standpoint of managing and protecting the ecosystem, this model supplies a conceptual and methodological foundation for answering the question of how to best harness the properties of the ecosystem so as to maximally harmonize mankind's needs with the environment's potential.

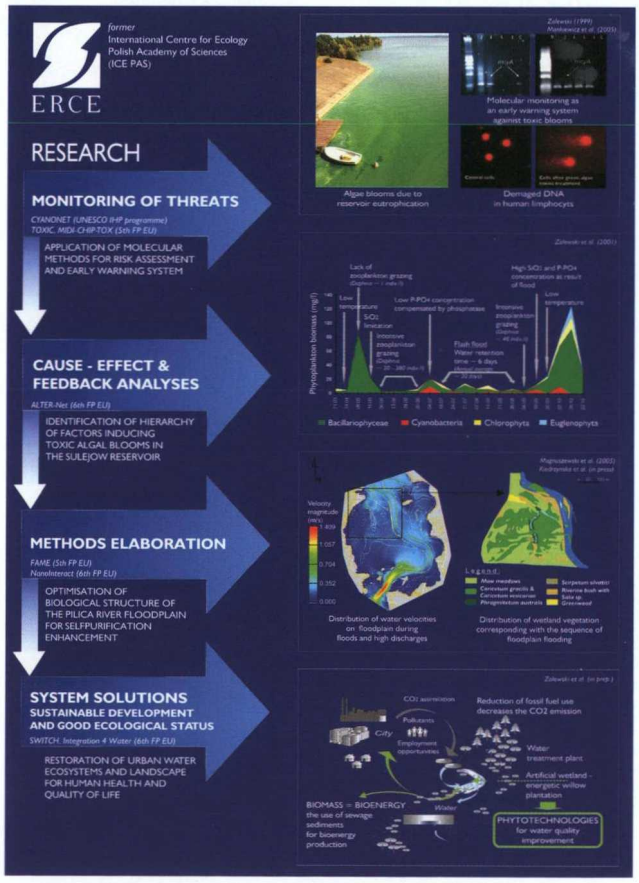
The Center's role

The formal basis for the European Regional Center for Ecohydrology, operating under the auspices of UNESCO, was laid by the International Center for Ecology, Polish Academy of Sciences, whose research profile had previously been based on ecological bioenergetics. The idea of reducing ecological processes to the laws of physics, the key tenet of ecological bioenergetics, paved the way for dialog between ecologists and hydrologists in the 1990s. The theoretical and empirical foundations for formulating the principles of ecohydrology had been laid in the 1980s and 1990s at the Department of Applied Ecology at Łódź University. Under an agreement between the President of the Polish Academy of Sciences and Łódź University, the two institutions work together in the field of ecohydrology.

The Center's research profile is concentrated on advancing the science of ecohydrology and on the practical application of its principles, so as to improve water resources at 10 demonstrations sites in Europe, Africa, South America and Asia under UNESCO's International Hydrological Program. One of its priorities is to achieve better implementation of the European Water Directive, requiring EU member states to achieve a good ecological status of their water ecosystems by 2015.

International projects

One of the 10 most advanced international ecohydrological projects aimed at protecting water resources is underway in Poland: under the Pilica River project, Polish scientists are working to tackle the problem of eutrophication and the ensuing blooms of cyanobacteria (toxic plant organisms that flourish in over-nutritious water reservoirs and lakes). Such algae pose one of the most important threats to water quality and biodiversity. To curb the processes of eutrophication in this area, the three principles of ecohydrology have been applied. The first, of a hydrological nature, involves assessing the threats to the Pilica River Basin (GIS) and developing an optimal strategy for improving water quality, biodiversity, and proper resource use. The second principle, of an ecological nature, involves the need to develop the natural environment's capacity to absorb pollution in view of mankind's ever-greater expansion. In the case of the Pilica River, this means optimizing the biological structure of floodplain areas so as to boost the area's capacity for water self-purification, based on a numerical map of the area, a hydrological model of flooding, and the types of species occurring in the area. The third principle is one of ecological engineering, facilitating the harmonization of "dual regulation" techniques within the river basin with the hydrological infrastructure and society's needs by development of decision support systems and mathematical modeling. The Center's scientists play a leading role in all the research and their publications appear in the world's most high-caliber journals like the *International Journal of Ecohydrology and Hydrobiology* and *Ecological Engineering*. ■



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An example of implementation of ecohydrology for reduction of eutrophication and creation of positive socio-economic feedback