THE BEHAVIOUR OF AQUATIC ORGANISMS AS A QUALITATIVE INDEX OF THE ECOLOGICAL STATE OF WATER BODIES

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The article touches upon the questions of the possibility of the usage of behavioral reactions of living organisms for identification of the toxicity of aquatic environment. We demonstrate that behavioral reactions serve as well-marked indices of the influence of small concentrations of pollutants and represent the first and the quickest responses to the change in the aquatic environment.

Keywords: aquatic organisms, ecological state, water bodies

Solving problems of environmental management we have to acknowledge the impossibility of complete prevention of the anthropogenic impact on aquatic environment in present or in the nearest future even if the industrial conditions become better. That's why the forehanded obtaining of the information about environmental pollution must be a constitutive stage of an ecological expertise, as these data enable to adequately evaluate the degree of technogenic pressure on aquatic objects and the probability of the risk of negative impact on its inhabitants.

In order to evaluate the degree of negative changes it is necessary to carry out an ecological monitoring, the system of observations and control of the changes in composition and functions of various ecological systems. Levels of the organization of the monitoring are different; it may be carried out in global, national, regional or local scope. Different chemical, physical and biological methods of analysis are being actively applied in ecological monitoring. The data of the monitoring are used for the comprehensive analysis of the environmental state and for the determination of the strategy of its management, for the regulation of its quality and for the qualification of the permissible ecological pressure on the environmental systems.

Despite the availability of effective efficient physical and chemical methods analytical procedure of detecting pollutants in aquatic environment has certain restrictions. Firstly, all stages of the procedure, from the stage of taking samples to the stage of identification and metrological evaluation of results of measuring take much time and are quite expensive, moreover, there is necessity in well equipped chemical laboratories and modern analytical facility. Secondly, a trustworthy identification of purposeful components in complex compounds of pollutants of different nature and toxicity is possible only in case of big sum-total of measurements and simultaneous application of three or four independent methods. A thorough and argumentative analysis in all cases of the situation threatening people's health or environmental hazard is completely essential.

The basic defect of physical and chemical methods is the disability to detect small concentrations of toxicants in aquatic environment in most of the cases.

Meanwhile, entering of even small concentrations of pollutants in a water body may cause change in the correlation of species, the change of the qualitative contents of the community may result in catastrophic decrease of the abundance of commercial species or decline of their quality. Organisms are able to live in a toxic environment for quite a long period of time, that's why one can get an impression of their full biological well-being.

A potential danger of small concentrations of pollutants consists in the fact that many substances are accumulated in organisms and are concentrated in considerable quantities in each of the following trophic link. As a result, the highest link may accumulate a substance many times more than it is present in the water of the same volume. Correspondingly, we can't deny the possibility of entering of pollutants into human body not only through waters but also through food.

In contradistinction to chemical and physical methods, the biological methods of analysis that use living organisms as analytic indicators make it possible to get an integral evaluation of an ecological situation. The principle of biological methods is based on the fact that all living organisms in active state interact with the environment and need the environment of a strictly defined composition for the optimal life-support. If you change the chemical composition by adding an additional component or deleting it, an indicating organism will give a reverse reaction. The reverse reaction of an indicating organism is transformed in an analytical signal that serves as a measure of qualitative evaluation or quantitative determination of the chemical composition of water.

Human beings have always treated living organisms as indicators of the quality of the environment. That's why recently scientists have started to pay more attention to behavioral reactions of living organisms with the help of which they can detect a pathology caused by chemical substances long before the integral responses of an organism are disordered.

The analysis of Russian and foreign literature devoted to the behavioral reactions of hidrobionts let us make the following conclusions:

1. As a basic criterion of the toxicity of chemical substance for hidrobionts we must consider the biological criterion that characterizes the danger represented by this or that toxicant for a reproduction of mass species, playing role in production and self-clarifying processes, or commercial species. When we study the toxic effect of different substances using hydrobionts, we need to define not only lethal but also critical concentrations of substances, i.e. such concentrations that evidence the least considerable disturbances in the processes of organisms' life activity.

2. The biological methods have become conventional and widely-spread for determining the toxicity of different chemical products as well as the quality of the aquatic environment as a whole. The reaction of living organisms to an integrated influence of any toxicants is approved and fully evidences the aggression of the studied environment.

3. The behavior of organisms is the most delicate and sensitive indicator of the toxicity. Organisms respond to any outer influence, including a toxic one, by their behavior long before the moment of irreversible pathological changes or death. Changes in behavior occur much earlier and in cases of smaller concentrations of toxic substances than vivid features of intoxication or animals' death.

4. The behavioral reactions of aquatic organisms on the influence of a toxicant are various and depend on a large number of factors: chemical and physical nature of a substance, concentration and the duration of influence, mechanism of influence, specious membership of systematic groups of animals, stage of ontogenesis, sex, size and other factors.

5. Behavioral manifestations of toxicosis may be observed at an individual level as well as at a group one. The degree of an audibility of the behavioral effect depends on the concentration and the duration of the pollutants' influence.

6. When studying the behavioral reactions of aquatic organisms to different toxic substances the following test objects are most commonly used: infusorians, crustaceans, leeches, mollusks, amphibians and fish. The choice of the biological objects is determined by the possibility of hydrobionts' cultivating in laboratory conditions or the maintenance of the normal life activity for the individuals cached in the natural habitat. The choice of functional indices of hydrobionts is determined by the regard of a possibility of receiving the quick reverse reaction in conditions of minimal changes of the water quality.

7. The complex of behavioral reactions is greatly varied. The following behavioral reactions are being recorded: change in the movement activity, change of phototaxis or chemotaxis, change of the preferred areas of the habitat, reactions of avoidance or attraction, change in the daily rhythms of the animals' behavior. The most reliable index of toxicity in this sense is the disorder in the complex of the fixed activities, directed at the achievement of the biologically relevant aims – nutrition, defense, reproduction.

8. In some cases the use of behavioral reactions makes it possible to state the fact of the toxicity of water as well as to assume the character of intoxication and the chemical nature of the toxicant. If one toxicant during an exposure causes different reactions in a definite sequence, while under the influence of another toxicant this sequence changes, there appears a possibility to identify the toxicants by the behavioral response. Studies in this direction are quite topical, as they may help to understand mechanisms of the peculiar influence of this or that toxicant on aquatic organisms.

Summing up, we would like to make the following conclusion.

The scientific ground of the permissible limits of the anthropogenic impact on aquatic ecosystems that guarantees their well-being as well as the economic efficiency of the nature-protecting activities brings to the forefront the purpose of an ecological regulation of the anthropogenic pressure.

The ecological regulation must be based not only on the data about the survival rate of the hydrobionts but also on the changes in the processes of their life activity. If we use lethal outcome as the only index of toxicity we don't pay attention to the numerous fore pathologic reactions of an organism in the period between the first contact of hydrobionts with polluting agents and the following manifestation of intoxication. In our case, behavioral reactions serve as well-marked indices of the influence of small concentrations of pollutants and can be treated as the first and the quickest reactions on the change of the aquatic environment.

There are no grounds to contradict one level to another one, or to treat one of them as the main one, and the others as subordinate ones. Studies of the toxicants' influence must be carried out at all levels of the organization of a living system. The information obtained at one level helps to understand processes taking place at another level.

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