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# BIOINDICATION AND ITS SIGNIFICANCE IN ENVIRONMENTAL MONITORING

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**Abstract.** This article presents the method of bioindication as a way of solving the problems of environmental monitoring in cases where it is impossible to directly measure the aggregate of anthropogenic pressure factors acting on biocenoses, as well as the advantage of using natural bioindicators that serve as indicators of natural processes, conditions, or anthropogenic changes in the habitat.

**Bioindication** is the detection and determination of ecologically significant natural and anthropogenic loads on the basis of the responses of living organisms to them.

It is considered that the use of the bioindication method makes it possible to solve the problems of environmental monitoring in those cases when the aggregate of factors of anthropogenic pressure on biocenoses is difficult or inconvenient to measure directly. The role of bioindication can be reduced to the following actions: a) identification of one or several environmental factors under study; b) collection of field and experimental data; c) drawing a conclusion about the indicator significance of a particular species.

Considerable attention is paid to bioindication in the narrow sense, which refers to anthropogenic or anthropogenically modified environmental factors. In this case, the matter concerns predominantly not the assessment of the presence, concentration, or intensity of some environmental parameter, but the response of biological systems, i.e., the biological effect of the environmental factor is considered. [2]

**Bioindicators** are organisms whose presence, quantity, and developmental characteristics serve as indicators of natural processes, conditions, or anthropogenic changes in the habitat. It is logical to assume that any factor, if it goes beyond the limits of the “comfort zone” for a given organism, becomes a stress factor. In this case, the organism reacts with a response of varying intensity and duration, the manifestation of which is nothing other than an indicator of its indicator value.

Let us consider the list of advantages possessed by living indicators:

– elimination of the need to register the chemical and physical parameters that show the state of the environment;

– reflection of the state of the environment as a whole, summing up the influence of biologically important impacts;

– recording of the rate of the changes taking place;

– indication of the pathways and places of accumulation of various kinds of pollutants in ecological systems, together with the possible entry of these poisons into human food.

An ideal biological indicator must meet a number of requirements:

– have a high abundance in the object under study;

– have a short period of ontogenesis in order to make it possible to track the influence of the factor on subsequent generations;

– be found under conditions convenient for sampling;

– inhabit the given place over a number of years, so that the dynamics of pollution can be traced;

– make it possible to carry out direct analyses without preliminary concentration of the samples.

Bioindicators are found both among plants and among animals, a small part of which we will give as vivid examples. [2]

**Plants.**

In the subzone of the northern deserts of Central Asia and Kazakhstan, the indicators of gypsum-bearing clays include the communities of Anabasis salsa (biyurgun), white orache or kokpek, semi-shrub sea-lavender (Limonium), and Marseille camphorosma (Camphorosma monspeliaca); of interbedded loams, sandy loams, and sands – grey-white wormwood, saltpetre wormwood, and leafless Anabasis (biyurgun); of ferruginized sands and sandstones – pea-podded saxaul and saxaul; of sands and sandy loams – feather grass (Stipa capillata); of sands – sand wormwood, raceme lyme grass, and brittle wheatgrass; of strongly saline silt deposits – knobby sarsazan (Halocnemum); of limestones – shrubby bindweed, candelabra Anabasis (biyurgun), and truncated Anabasis (biyurgun). [1]

Very informative bioindicators of the state of the air environment and its changes are the lower plants: mosses and lichens, which accumulate in their thallus many pollutants (sulfur, fluorine, radioactive substances, heavy metals). Lichens are very undemanding with respect to environmental factors; they settle on bare rocks, poor soil, tree trunks, and dead wood; however, for their normal functioning they require clean air. They are especially sensitive to sulfur dioxide. The slightest pollution of the atmosphere, which does not affect most plants, causes the mass death of sensitive lichen species. They disappear as soon as the concentration of sulfur dioxide reaches 35 ppb, whereas its average content in the atmosphere of large cities exceeds 100 ppb. The scientific direction of biomonitoring (i.e., tracking) of the state of the air environment with the help of lichens is called lichenoindication. [1]

**Animals.**

In polluted areas, the following change in animals: the size and proportions of the body – in a number of aphids and some gastropod mollusks; coloration – in the peppered moth (Biston betularia) and the two-spotted ladybird; deformities – in fish (curvature of the spine, disturbance of pigmentation, reduction of the fins and of the pupil); the change in eggshell thickness in birds; a fall in fertility – in aphids, the gypsy moth, and springtails (Collembola); a change in lifespan – in grasshoppers, caterpillars, and fly larvae; a change in behavior – in crabs (disturbance of sexual behavior, that is, the males do not respond to the females).

Indicators of high soil salinity are the small larvae of beetles of the family Heteroceridae, the short-elytra beetles of the genus Bledius, and the larvae of some tiger beetles that dig burrows in the salt marshes. [1]

Bioindication is of considerable importance in human life. Its application in epidemiology and sanitation lies in the ability to assess the threat of infectious diseases. In ecology, its importance lies in the assessment of the quality of the habitat and its individual characteristics. It is also applicable to geological studies for the assessment of soils, making it possible to identify possible sites for the search for mineral resources. At the same time, it is necessary to note the shortage of educational literature on these important issues and, undoubtedly, the great need for it.

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