

Biological methods of ecological diagnostics for making representative predictions related to assessment of stability in ecosystem processes and environmental quality for a human being.

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Any complex system including human civilization develops, as a rule, ambiguously and irregularly. In the course of evolution, there can be periods of relatively stable processes (homeostatic states) as well as periods of transitional, fluctuated and other unstable processes. Sustainable development of mankind being declared nowadays has been always connected mostly with sustainable technical progress and sustainable growth of welfare of every member of human society. It should be noticed that for some objective reasons nowadays the notion “sustainable development” is also understood as “harmonization” of relationships between human society and other Nature. Even without taking into account philosophic, ethic and fundamental natural science aspects, it is evident that for realization of “sustainable development” we need representative forecast of possible changes as a result of any human disturbances of Nature that must be in harmony with mankind. Reliability of such forecasts are connected with assessment of environmental quality and ecological diagnostics that means to reveal the degree of deviation, if there is any, from norm in the state of both the whole ecosystem and its structural units. Representative assessment of environmental quality and proper diagnosis enable to develop ecological norms that is necessary for ecosystem process to develop in the right directions.

First it is necessary to find limits and a range within which variations of parameters of environment do not cause irreversible changes of its initial properties. Regardless the importance

of this task, assessment of environment quality and norm establishment are being carried out on the basis of different and sometimes contradictory positions. The most part of ecological norms is connected with concentrations of chemical substances polluting environment as a result of human activity. At present there are already over twelve million different substances being produced by people. But norms have been established only for 0.1-0.05% out of this number. It is unlikely that in the nearest future general norms will be established for all the substances and, moreover, norms for the same substances differ significantly in different countries. Norms must be different for different habitats (water, air, soil), they are different indoor and outdoor, in different seasons, in mountainous and flat landscapes, etc. Besides norms for chemical substances, there must be also norms for physical influences such as radiation, warmth, radio-waves, etc. Ecological norms together with the standards of chemical and physical environmental parameters are used to control the parameters characterizing the state of separate biosystem units, biosystems themselves and the whole ecosystems. Norms are always developed on the basis of a certain position. The parameters are the most often chosen from the position of health care (most part of maximum allowable concentrations for different substances are general sanitary norms and rules - SNR), less often from the position of ecosystem protection against external disturbances (ecological allowable levels EAL) and much less from the position of protection of both health and ecosystems. Most sanitary-hygiene norms (MAC, MAL,and others) are obtained in the experiments with animals and do not consider effects of combinations of different substances and their possible transformation and distribution in natural environment. Long experience showed that sanitary-hygiene norms are not a real border between danger and safety but they are more likely to evaluate a particular level of risk differing not only between different units of ecosystems but even between different groups of human population. Ecological allowable level similarly evaluate the degree of risk but for the whole ecosystem, not for its separate components. It is evident that any human activity might harm health and/or environment and consequently human population well-being. For this reason, economic criteria are mostly

used for environmental quality assessment. But until the general world economic standards of the cost of different influences on environment have been developed (e.g. Kiotian protocol has not been realized by now), economic criteria will work (not always) only in local scales, and the situation as a whole will be deteriorating.

Thus there is some kind of a “closed circle”. On the one hand, characteristics of environment, biological systems and the whole biosphere are found taking into consideration that disturbances would influence safety and human vital activity at present and in future. And such an approach is evident and natural from the point of view of sustainable development and civilization conservation. On the other hand, the criteria being used for assessment of environment quality for ecological norms do not allow us to reach the necessary results and moreover, they make the situation more difficult. We think that such a situation has been created as a result of insufficient attention to biological methods in ecological diagnostics. In Fig.1 we give the block-scheme of ecological diagnostics management. It should be noticed that the first three items in the block “data of environmental quality” offer integral data on environmental quality for organisms, not only on physical-chemical parameters. In general this scheme proposes a proper choice of key environmental parameters, key objects (biosystems) and monitoring data on these parameters and possible disturbances of homeostatic states of key objects. If mechanisms of homeostatic processes are disturbed, biosystem can get “ill” that may lead to homeostasis instability at the higher levels of biosystem organization.

We applied this eco-diagnostics approach to the land and marine ecosystems. The former was forest-steppe communities of the Southern Urals in the area of western-Urals radioactive pollution, the latter was coast tropical reef communities of Southern Vietnam (the bay Njachang). Our methodical approaches allow us to choose such complex of methods which enables to evaluate if the environment is favorable (or not favorable) for living organisms, to

find key time periods showing if the biological system is safe or not, and to predict development of the system under disturbances effects, if there are any, in different situations.

Fig.1. Bloch-scheme of ecological diagnostics management.

1. Investigation of environment and ecosystems states. Data of:
 - integral environment quality for photosynthetic organisms.
 - integral environment quality for species-identificators (key species) and people
 - mutagenic, immunogenic, and teratogenic environment activity
 - physical-chemical environment parameters
 - community organisms structure
 - populations states
 - physiological state of particular species, etc.
2. Comparison of obtained data and parameters with the standards
 Climate norms, sanitary norms and rules (maximum allowable concentration.....),
 biodiversity, population age and sex structure, physiological and medical norms, etc.
3. Preliminary diagnosis
4. Monitoring management
 - The choice of environment and ecosystems parameters under control
 - The choice of methods, intervals of data registration, ways of their treatment and their presentation
 - Preliminary predictions of processes development (modeling)
 - Clarification of the preliminary diagnosis
 - Preliminary measures of prophylactic and healing (elaboration of management algorithms)
5. Final diagnosis
 Processes management (healing and prophylactic of complications and side effects)

Such approaches for environmental quality assessment exclude subjectivism. If, for a example, photosynthesis mechanisms are disturbed, or environment is characterized by higher levels of mutagenic, immunogenic, and teratogenic environment activity, or toxic for heterotroph organisms, it is evident that environmental quality cannot be accepted as normal even if maximum allowable concentrations and ecological permissible levels are within their normal range.

Preliminary diagnosis of environmental quality and biosystems states in a number of cases can be made quickly enough using quite limited standard set of parameters.

Preliminary diagnosis can and must be made by using standard fluometric, bioluminometric and genetic methods. The short description of these and other methods being used in ecological diagnostics can be found in the encyclopedia – guide “Ecological diagnostics” (2000) and in the book “Foundations of ecological diagnostics: biological and information aspects” (Smurov, 2003).

References:

1. Smurov A.V. Ecological diagnostics: biological and information aspects, 2003, M. Oikos 188pp.
2. Ecological diagnostics. Series Russian Safety, 2000, MGF Znanie, Mashinostroenie, 564 pp.