
Preservation of biological diversity: top-priority tasks of society and state

Sytnik K.M.

M.G. Kholodny Institute of Botany of the National Academy of Sciences of Ukraine, 2 Tereshchenkivska St., 01601 Kyiv, Ukraine,
e-mail: phytohormonology@ukr.net

Received 18.02.2010

Abstract

In this article a concept and meaning of the term “biological diversity” associated with the variety of living organisms is described. A scheme of structural-functional links among the basic levels of organization of the living things taken from the monograph by Prof. M.A. Holubets is represented and discussed. The biodiversity of Ukraine is characterized and the role and significance of the Red Book of Ukraine is critically evaluated. The author describes thoroughly a paradigm, object, subject and research methods of a new biological science, biodiversitology. A proper attention is paid to the studies for threats of impoverishment and extinction of different structures of the biodiversity, as well as the actions required for protecting populations of rare and relict species and landscapes and those valuable for the medicine, industry and science, which are commonly recognized and conserved because of their historical and cultural values. The tasks of Ukrainian botanists, zoologists and hydrobiologists are examined in relation with the International Year of Biodiversity announced by the United Nations in 2009.

Key words: biodiversity, diversitology, ecological systems, environmentalism, organization levels of the living things, Red Book species, plant gene pool

UDC: 574

Among various biological laws, postulates and rules, only some have been included into the vision and conception of the world by the most part of humanity. At least three such concepts may be singled out. The first is the Redi's principle formulated by the Italian scientist Francesco Redi in the XVII century: ‘*Omne vivum e vivo*’, i.e. ‘Life comes from life’, the idea which has been brilliantly approved by Louis Pasteur in the XIX century. The other revolutionary biological concept, which has found response in the views on both the natural and social problems, is the theory by Charles Robert Darwin that explains the origin of species. Another concept has already begun to spread outside the borders of biology. Still it has not got a definite author or, quite the contrary, has many authors among the botanists, zoologists, microbiologists, virologists, and palaeontologists. This is the concept of biological diversity.

The idea of preservation of biodiversity has become not only one of the key ideas among the concepts of nature protection. It has also entered into many spheres of science, politics and economical activity. In 1992 the Convention on Biological Diversity has been

adopted at the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro. This Convention has been ratified by the most of countries. In 2000 the World leaders have passed the Millenary Declaration, the Cartagena Protocol on Biosafety, in which some targets concerned with development of the international community in the XXI century have been formulated. One of the targets is reducing the rate of losing of many positive indicators of the biodiversity. At least in order to slow down a steady, inevitable and growing increase in the number of disappearing species of plants and animals, biocenoses and even whole landscapes, the United Nations has declared 2010 as the International Year of Biodiversity.

Biotic diversity represents a diversity of living organisms on the Earth at all the levels of organization of living things and in all spatially limited environments of their existence (on the land, in the freshwater, and in the seawater). Here one can distinguish the plant diversity (phyto-diversity), animal diversity (zoological diversity), and the fungus diversity (myco-diversity). To the opinion of the most part of biologists, the main object of the biodiversity is a population (a totality of individuals of the same species of animals or plants which, first of all, belong to the same terrain) of various species of living organisms that actually exist in the nature. They are the most homogeneous and capable of self-recovery. Since the population structure for the most of species is not yet studied in a sufficient detail, at the present point of time many specialists in flora and fauna consider the biotic diversity mainly on the level of species. Then the main unit of measure of the biodiversity is a total number of eukaryote (plants, animals, and funguses) and prokaryote (viruses, bacteria, and cyanobacteriae) species.

In the Convention related to the biodiversity and mentioned above, the term 'biodiversity' implies literally a variability of living organisms. This notion includes a diversity within a species, as well as inter-species and inter-ecosystem ones. Some of the scientists, though not all of them, intend to embrace by the term of biodiversity also such items as ecosystems and plant and animal groups (i.e., biocenoses, zoocenoses and phytocenoses), along with the living forms of organisms (trees, bushes, grasses, etc.), which form a dominant aspect of groupings and considerably regulate the biodiversity. Finally, some other researchers venture as far as to define genetic, physiologic, biochemical and molecular-genetic biodiversities.

In the author's opinion, the mini-monograph by Prof. Holubets M.A. [1] has opened a very deep and correct approach to the semantic, conceptual and terminological aspects of the biodiversity. Basing on the critical analysis of the relevant works by many scientists and his own results of studies, he has generalized, first of all, the data on structurization of the living matter and has come to the following enumeration for the living systems and the organization levels of living things: macro-molecular, genic, organoid, subcellular, cellular, tissular, organular, organismal, generic, population-generic, population, coenotic, biocoenotic, bio-geo-coenotic, ecosystemic, biostromic, biospheric, consortic, as well as chromosomal, genomic, plastid, nucleonic, taxonomic, elementary-floristic, life-cyclic, etc. At the same time, to my viewpoint, all the known levels of organization and

levels of study of the living structures are subordinated to the three main degrees. Prof. Holubets have also suggested a detailed characteristic of the main functions of these levels. He has stressed that the systems of organismal, population and ecosystemic levels of living organization involve all the biochemical, bio-geo-coenotic, biophysical, bio-geo-chemical and other processes, which characterize a core of life, existence and evolution of biosphere.

In the monograph by Prof. Holubets mentioned above one can find an interesting and important diagram of the structural-functional links between the main levels of organization of living things, which seems to be useful for diversitologists (see Figure 1). Since the quantity of organization levels of the living things is unbounded, their studies need almost all the branches of biological sciences to get involved in, including a number of scientific areas which have appeared only in the last decades (ecosystemology, biosphereology, and diversitology).

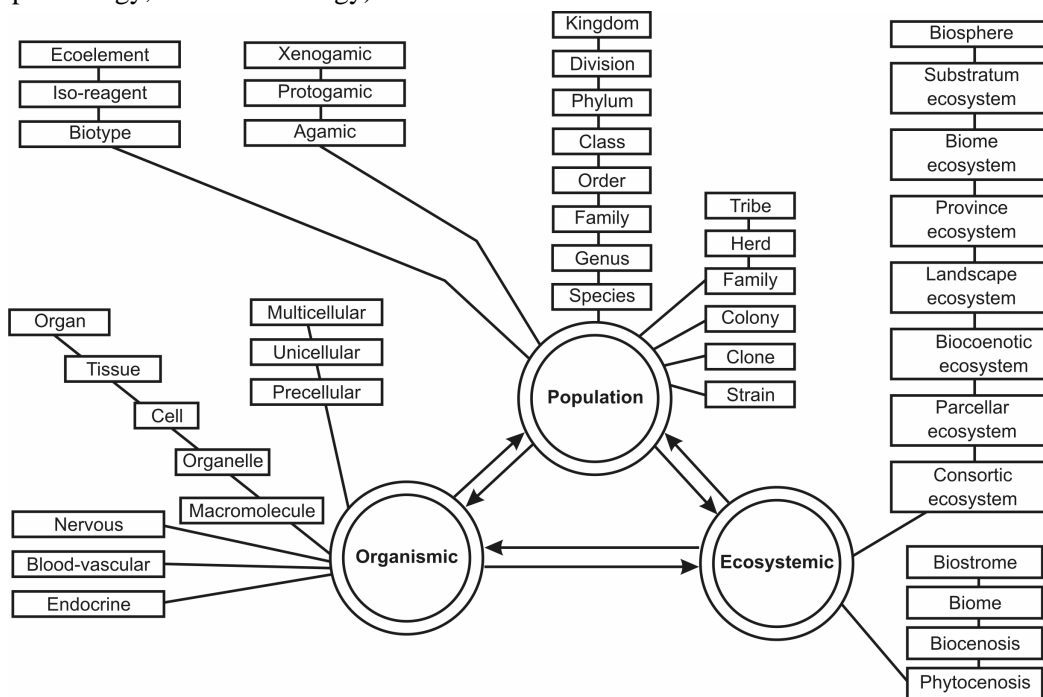


Fig. 1. Diagram of structural-functional links among the main levels of organization of the living things.

The biodiversity on the Earth is still not studied well enough. 1.7 million species have already been described, while the prognostic estimates assume that 5 to 100 million species can exist. From the viewpoint of biodiversity, tropical forests are the most rich among the ecosystems, in which 90 per cent of all the Earth species are concentrated.

In Ukraine, the biodiversity of vascular plants, mosses, lichens, and vertebrates has been studied almost completely, owing to extensive labour of scientists who have studied both fauna and flora at the botanic gardens and zoological branches of academic and applied-research Institutes, together with the corresponding departments of Universities. As

a result, such fundamental monographs as “The flora of Ukrainian SSR” and “The fauna of Ukrainian SSR” have been published many years ago. Algae, fungi, slime fungi, insects, worms, and protozoa are somewhat less studied, whereas many microorganisms and viruses are studied rather poorly. Here one should note that Ukraine comprises 35 per cent of the Europe’s biodiversity. The biota of our country includes 70 thousand species, including more than 27 thousand flora species and 45 thousand fauna ones.

In the end of 2009, the third edition of the Red Book of Ukraine has been published, which reflects the modern state of Ukrainian biodiversity and includes the official information on 826 species of plants and fungi and 542 species of animals, which stay under danger of disappearing and need to be protected. This Book also cites both the Ukrainian and Latin titles of each species, the taxonomy groupment, environmental status, scientific importance, geographic range of the species and its distribution within Ukraine, the population size and structure, and some other data.

The authors of the Red Book believe that just the fact of inclusion of a given species into the Red Books of Ukraine or the other countries is already an action of preserving the diversity of flora and fauna. I am reluctant to readily agree with this point of view. The reasons are as follows. The first single-volume edition of the Red Book of Ukraine has been published in 1980 and included 151 species of vascular plants and 85 species of animals. The second edition of the Red Book has included the two volumes: the first one, “World of the animals”, has been published in 1994 and itemized 382 species, while the second one, “World of the plants”, has appeared in 1996 and included 541 species. Finally, the third edition has been published 13 years later after issuing of the second volume of the second edition. It has already included 542 species of animals and 826 species of plants and fungi.

Thus, the third edition of the Red Book of Ukraine includes more than twice as larger number of disappearing species. This testifies with a particular strength all the disgrace of both the Ukrainian state power and the Ukrainian society which, due to their own damaging activity or inactivity, have assisted in disappearing of many Red Book species, which represent a precious rarity and a gene pool and which should have required developing and timely applying an exclusive protection regime.

The government should have been informed annually by the academic scientific institutions and the biological departments of Universities about the state of biodiversity. Relevant proposals should have been applied by these institutions and departments to the government and the local authority, concerning elimination of the reasons for swift depletion of the biodiversity of Ukraine and the appropriate funding needed for its preservation, first of all that of the phyto-genetic stock. Besides of inventory and accounting of the Red Book species, studies for the distribution, enriching, living state and possible practical utilization of particular populations need a deeper attention of botanists and zoologists. Studies of the biology, intraspecific structure, the methods of reproduction and preservation of the Red Book species at the national parks, botanic gardens, parks, scientific institutions, etc. are also the important points.

Without any doubt, the Ukrainian state should be thankful to the researchers from the scientific and educational institutions in Ukraine, the Ministry for Environmental Protection of Ukraine, activists of the All-Ukrainian Ecological League and some other environmental-protection public associations, which have created the Red Book of Ukraine and assisted its publication. On the other hand, it is necessary to notice that another chapter in this Book would be desirable, that devoted to the fundamentals of preservation and enrichment of the biodiversity. Simultaneously, it would be necessary to develop the measures accounting for specific features of protecting different plants and animals and their specific protection statuses (e.g., extinct, extinct in the nature, staying under the condition of critical danger, vulnerable, close to the unsafe state, staying under the great danger, etc.).

The flora of Ukraine is represented by almost 27 thousand plants, among which there are approximately 5 thousand vascular plants (4523 of them growing wild), whereas the myco-diversity includes 15 thousand funguses and myco-organisms. The algae-flora includes 4720 species of water plants, the moss-flora – approximately 800 species of mosses, while the lichen-flora – 1322 species of lichens. The Ukrainian fauna embraces more than 45 thousand animal species, including 400 species of birds, 200 fish species, and more than 35 thousand insect species. The economical and other activities affect significantly the biotic diversity. The mankind destroys or substantially changes the environmental niches of many species, or unnecessarily employs valuable plant and animal species without considering their reproduction capabilities. Vandal deforestation, ploughing of the soils, draining of marshes, creating of storage reservoirs based upon pseudoscientific grounds, pollution of the environment, fragmentation of ecosystems by arterial roads and development of land – all these phenomena make destructive effect on the flora and fauna and so hinder preservation of sanguineous biotic diversity.

On November 9, 2009 the Secretary-General of the United Nations, Ban Ki-moon, has finished his appeal to the world community by the dictum “Biodiversity is life. Biodiversity is our life.” This emphasizes a deep idea: the studies and preservation of the biodiversity cannot be reasoned only by a care for the animal and plant world. It is an important condition for the very existence of humanity on our planet, the human society, as well as its development and advance. This is nothing more than our present and our future.

One can find in the United Nations Proceeding some interesting information on the rate of species disappearing: in the XXI century it is 50–100 times higher than the natural rate. Almost 34000 species of plants, 52000 of animals and almost 30 per cent of the main breeds of farm animals are remaining under threat. Not only particular species but entire ecosystems are disappearing or are being threatened. The permanent changes in the landscapes and water areas comprise an actual danger for the biodiversity. So, the forests of the world have been reduced by almost 50 per cent during the last century.

The negative changes occurring to the biodiversity are an important part of the environmental crisis. This phenomenon needs a thorough study, since any actions for preservation of the environment should have necessary scientific grounds.

At the present stage of development of the science, there also appears a problem of some generalizations in the area of biodiversity. Here one has to pay attention to one of the important ecological principles, the principle of emergency. On the scientific and cognitive levels it may be interpreted as follows: any simple sum of information on the biodiversity in a region of this or that scale, and even in the biosphere as a whole, cannot provide a clear picture of the meaning of biodiversity in the local ecological and biospheric processes. The appropriate generalizations might be achieved on the basis of new principles and in frame of a novel scientific discipline. The biodiversity as a separate phenomenon is dealt with by neither of the traditional biological branches, though some particular elements of the biodiversity are studied by the zoology, botany, and the ecology. The author of the present article, together with Prof. Protasov O.O., have suggested [2] to name the science about the biotic diversity as a biodiversitology.

Each of the scientific branches should include its own paradigm, an object and subject of studies, as well as its specific techniques. At the present time, the **paradigm** of the diversitology may be formulated as follows: the biodiversity as one of the most important parts of diversity of the biosphere represents a precondition and a basis of stable existence and development of the latter. The **object** of the diversitology is a composition and quantitative relations among the biologic elements of the ecosystems, biomes and the living cover of the Earth (the living matter, according to Acad. V.I. Vernadsky). The **subject** of the scientific branch is to be considered as the processes of forming of the biodiversity, the links of the biodiversity with the diversity of medium where the biotic systems exist, and the mechanisms for maintaining a stable existence of the systems of different levels, beginning with the local groupment and finishing by the whole biosphere. The working **techniques** of the diversitology cannot be sharply separated from the techniques used by the other biological and ecological researches. These methods and methodological tools should provide both obtaining the information and facilities for its analysis in the following directions: (i) the content of the biotic components (species, populations, ecomorphic groups, etc.) for the ecosystems of different levels, (ii) the quantitative relations and the relative enriching of these elements, and (iii) the characteristics of the medium in which different biological systems exist.

One of conceptual principles of the diversitology is to ascertain that the biodiversity does not add up only to the number of elements of the system, i.e. the number of species in the group or in the overall biosphere. The diversity is a two-component system: it consists of both the resources of components of the system and a so-called 'equalization', which is defined not only by the sum of those elements but also the frequency of the latter, i.e. by the relative enriching.

One of the principal aims of the diversitology is to answer the question: what exactly is the diversity? The world is diverse and this is one of its inalienable and important properties. However, the biological systems have diversities of their own. It is impossible to distinguish between two different molecules of water, though each of the individuals inside a group manifests its unique individual features, as pointed out by

Acad. V.I. Vernadsky in his conceptual statements concerned with the living matter of the biosphere. Despite of the fact that the term “biological diversity” is recorded in the International documents (e.g., in the Convention on Biological Diversity, 1992: “biological diversity” means variability of living organisms from all sources ...”), a simple statement like ‘biodiversity is diverse’ cannot satisfy the researches in the meaning of their needs in the systematic knowledge of biodiversity as a phenomenon of the nature. Thus, the important branch of the diversitology is given by clarification of the problem of levels of the biodiversity.

Assuming that here a “law of general diversity” is also valid and that at least two approaches, deductive and inductive ones, can be applied, I would prefer as more acceptable the concept of the levels of diversity, which is based on the teaching of Acad. V.I. Vernadsky regarding the diversity of the biospheric matter. The living matter as a totality of all living beings exists only on the basis of almost infinite diversity of individuals. They are united into different associations which, in their turn, are united with different components of the environment (including different inanimate matter) and create different ecosystems. The totality of uniform ecosystems creates the biomes, which represent the components of the biosphere. Hence, the circle has locked-in and the system of levels of the diversity in the biosphere has acquired a cyclic character.

The interconnection of the biotic diversity with the diversity of environmental components and factors is an important problem of the ecological diversitology. The studies of this coupling open up prospects for operating the biodiversity on the basis of purposeful changes in the abiotic units of any ecosystem.

Although a large set of data has been accumulated concerning a positive relation between the reproduction of system and the biodiversity, this problem is rather difficult and needs both natural and experimental studies, in addition to the relevant theoretical generalizations. A practical experience and the results of studies available up to now show that the biomass of different groupments increases with increasing predominance of a particular species, i.e. with decreasing equalization.

Until the theoretical principles and the practical recommendations concerning particular actions have been developed, there is always a fear that the idea of preservation of the biodiversity might remain forever merely a good-looking humanistic slogan. The ‘simplest’ way in this direction would be rather attractive. This is complete removal of all the negative anthropogenic influences and creating, at least locally, stable (‘auspicious’) conditions that would have led to preservation and, what is better, enriching of the biodiversity. However, both the theoretical elaborations (e.g., a so-called hypothesis of average disturbances) and the empiric data indicate that the maximum diversity should be expected under moderate stresses and moderate (intermediate) trophic actions. It is just this “moderateness” that needs careful argumentation on the basis of deep scientific studies.

I have tried to find more or less acceptable information about the threat of depletion or destruction of the population, ecosystemic and some other structures of the biodiversity. However, it seems to be absent yet. I am ready to agree with the statement by

Prof. Holubets M. A. in the monograph mentioned above: we have three principal aims. The first is to study extensively the ecological system and the population diversity with the aid of genetics, ecologists and ecological taxonomists. The second is to determine clearly the populations and ecosystems in Ukraine which need to be protected first of all. At last, the third aim is to begin immediately with and create, during the next 3 – 5 years, the cadastre of the diversity of populations and ecosystems, which need to be preserved, basing on the existing information or the recent studies.

With high conscience and understanding of responsibility for preservation of the fito- and zoo-diversities, all the botanists and zoologists of Ukraine should provide development and realization of the first-priority actions for unconditional protection of the following objects: (1) the populations of rare and relict species which remain under the threat of disappearing; (2) the medical, food, fodder, ornamental or other valuable species, or those which are persistent to the prevalent harmful factors; (3) the ecosystems which are exclusively valuable, unique or promising for the studies of theoretical problems of the botanic sciences; (4) the diversity of landscapes, which have got traditional recognition and are being preserved due to their historical and cultural values.

It is necessary to notice once again that the idea of preservation of the biodiversity is extremely important. It is a response to human aspiration for living in harmonic, safe and rich world. Nonetheless, it could remain only a nice idea if not supported by the scientific elaborations of higher quality. The National Academy of Sciences of Ukraine has all the facilities for successfully carrying out these studies. Moreover, the International Year of Biodiversity should become a year of deep care of botanists and zoologists of the Academy about the preservation and enriching of the biodiversity of Ukraine.

The famous Ukrainian botanist, Prof. Shelyag-Sosonko Yu.R., has supposed [4] that the biodiversity acquires a unique meaning for the society and each individual, since it forms their principal aspects of life, the material and spiritual ones, including the views of the world. To his point of view, the state of the biodiversity, which has become a global-scale problem, is related to globalization and degradation of humanity. He states, though everyone would not agree with him, that the level of civilization is determined not only by the scientific achievements and increase in the world population but the state of the biodiversity.

Undoubtedly, destruction of the biosphere and all the biotic diversity, would lead to a self-destruction of the humanity. In my opinion [3], the only alternative to this outcome for the Homo sapiens species could be mastering, by all the mankind, of a novel ideology and mentality, the environmentalism, which underlies the science about the environment, the environmentology.

References

1. Holubets M A, Biotic diversitology and scientific approaches for its preservation. Lviv: Liga-Press (2003).
2. Sytnik K and Protasov O, 2010. International Year of Biodiversity and the prospects of development of diversitology. Bulletin of NAS of Ukraine. **3**: 13–16.

3. Sytnik K M, 1994. Environmental crisis: estimations, development, and possible outcomes. Ukr. Bot. J. **51**: 3–17.
 4. Shelyag-Sosonko Yu R, 2008. Biodiversity: the concept, culture, and the role of science. Ukr. Bot. J. **65**: 3–26.
-

Sytnik K.M., 2010. Preservation of biological diversity: top-priority tasks of society and state. Ukr.J.Phys.Opt. **11**, Suppl. 1 Sc. Horiz.: S2-S10.

***Анотація.** У статті висвітлено поняття і зміст терміну біологічне різноманіття, який означає варіабельність живих організмів. Наведено запозичену з монографії М.А. Голубця схему структурно-функціональних зв'язків між основними рівнями організації живого. Характеризується біорізноманіття України, критично оцінюється роль і значення Червоної книги України. Автор ретельно описує парадигму, об'єкт, предмет і методи дослідження нової біологічної науки – біодиверситології. Багато уваги надано вивченню загрози збіднення і зникнення окремих структур біорізноманіття та заходам щодо охорони популяцій рідкісних, реліктових і цінних для медицини, промисловості та науки видів і ландшафтів, які користуються традиційним визнанням і зберігаються завдяки їхній історичній і культурній цінності. Розглянуто завдання українських ботаніків, зоологів і гідробіологів у зв'язку з відзначенням Міжнародного року біорізноманіття, проголошеного Організацією Об'єднаних Націй 9 листопада 2009 року.*