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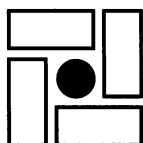
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Ecology on the Verge of the 21st Century (the VI International Congress of Ecology)

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International Congresses of Ecology are invariably events looked forward to by ecologists because the presentations made and the issues discussed provide insights into the major problems and trends of ecological science. At the V International Congress of Ecology held in 1990 in Yokohama (Japan) under the motto "Progress to Meet the Challenge of Environmental Change for the XXI Century," the focus was on such traditional trends in ecology as ecology of communities, population ecology, and physiological ecology. A considerable interest was aroused by the issues of mathematical ecology and mathematical simulation, in addition to the problems of global ecology and ecological safety with special reference to technological advancement. Very marked have become the tendencies to solving scientific and practical issues regarding the relationship between man and natural ecological systems, and biological diversity has become the first priority trend. Issues of biological diversity were also among those of major importance at the VI European Congress of Ecology (Marseilles, France, September, 1992).

Between the V and VI International Congresses of Ecology the scope of modern ecology has expanded into related areas through the advent of sophisticated research methods and as a result of a merger with other environmental sciences. An overview of these trends and analysis of the prospects for their development were published in "Ekologiya" (1993, no. 3). It should also be added that in recent years ecology has been enriched by a wide range of eco-humanitarian studies concerned with eco-social consequences of changes in the human environment. Directly after the VI Congress, these problems were considered at the International Conference "Ecology and Democracy: The Choice of the XXI Century" (September 5 - 9, 1994, Ceske Budejovice, Czech Republic). Another trend in modern ecology involving the theory of evolution was clearly marked. In Cambridge (Great Britain) the journal *Trends in Ecology and Evolution* is published; publication of the 100th issue was timed to coincide with the VI International Congress of Ecology.

The VI International Congress of Ecology was held from August 21 to 26, 1994, at the University of Manchester. The Congress was opened in the Free Trade Hall in the center of Manchester with an English folk music concert. The salutatory addresses by professors I. Newton (President of the British Ecological Society), M. Harris (Vice-President of Manchester University), and V. Haber (President of Intercol) alternated with emotional speeches by Prof. J. Lawton (Center of Population Biology, Silwood Park, Great Britain), a slide show about nature in Great Britain with a touching andante accompaniment of 18th century music, and an award ceremony for young British ecologists.

The opening addresses emphasized that the science of ecology is transcending national boundaries in its call for international and interdisciplinary efforts and large-scale studies. Hence, individualism and disagreement should be overcome to catch up with such advancing and well-financed sciences, such as molecular biology, and to concentrate efforts, neglecting minor issues. Priorities should be defined, and the banks of data on autecology and Earth biota should be coordinated.

The chief sponsors of the Congress were the Ecological Society of Great Britain and the Rufford Foundation. The Congress was also financially supported by the British Government, the Blackwell and Elsevier publishing companies, the J. Soros International Science Foundation, the Catherine and J. McArthur Foundation, and nine other societies and trusts. The participation of scientists from Russia and CIS countries (over 20 people) has become possible thanks to the sponsorship of the International Science Foundation and Organizing Committee and, in particular, to Dr. Hazel Norman.

The Congress was organized into 15 sessions, each having 3 - 6 symposia (a total of 78 symposia). Global environmental change and sustainable development issues were treated in a series of papers on plant ecophysiology, the carbon cycle, the role of climatic change in the dynamics of plant communities (Session 3: "Plant Ecophysiology and Environmental Change"), and environmental pollution (Session 7: "Pollution and Ecotoxicology").

A number of presentations were made on the management of biological diversity (Session 4: "Biodiversity and Evolution"), ecological management in agriculture and silviculture and resource management (Session 5: "Ecological Management"), and various aspects of ecological restoration of ecosystems, and applied landscape ecology (Session 6: "Ecology, Conservation, and Restoration of Landscape"). In addition, at community ecology sessions (tundras, deserts, boreal and tropical forests, etc.) the first priority was assigned to discussion of the response of ecosystems to anthropogenic modification of the environment. Two sessions (12: "Ecology and Society" and 13: "Environmental Ecology") were entirely concerned with applied ecology and its social and economic aspects.

The session with the greatest number of participants, papers, and poster presentations was Session 1 on "Population Dynamics and Conservation." It was mostly concerned with autecological topics. For example, British ecologists reported on the role of females in the social organizations of island populations of voles, the dependence of the territories of domestic cats of Manchester on age and nutrition, the spatial dynamics of toad populations in crop fields, and the organization of amphibian monitoring in Great Britain. Indian zoologists reported on the migration of lions, the size of elephant groups, and the mode of life of Nepal endemic thrushes. A number of reporters attempted to combine field data with theoretical modeling, to apply an interesting method, or to consider the results in light of new concepts. In fact, the movements of natterjack toads on abandoned military testing grounds in Germany and the feeding habits of falcons in Spain was studied using radiotelemetry, whereas investigations of the habitats of the white-naped and hooded cranes, which migrate from Japan, involved satellite telemetry. The investigation of the wood grouse in the mountains of Central Europe showed that the two models used were complementary: one involved the stochastic pattern of births and mortality, and the other, the spatial structure and fitness of habitats. Analysis of data series (a 20 - 55 year period) by the captures of the burrowing form of the water vole in Switzerland revealed the action of the lagging and nonlinear mechanisms of population regulation and a trend whose nature was not understood. In light of the metapopulation theory, the findings of studies on intra- and inter-seasonal migrations of Alpine newts, the results of management (using feeding) of monkey populations in Japan, the population dynamics of grasshoppers in Germany, the effect on English butterflies of a sharp depleting the resources following a severe winter, and the effect of habitat patchiness on the populations of wetland birds in the Netherlands were considered.

At the same session, presentations were made on the effect of environmental patchiness on white ant communities in Brazil and the numbers of carabid species in German forests. A model demonstrated the effect of density-dependent migration of the black-headed gull

in Bavaria on the dynamics of its local populations. The combination of field research with modeling helped to investigate the forms of density-dependent mortality and survival chances in endangered species of grasshoppers and inter-gall migrations of aphids. The models are also useful for the conservation of vulnerable species in a heterogeneous environment. Canadian scientists used a system of man-made nests with domestic birds to test the ecological trap hypothesis (in marginal habitats), revealing that patchy ranges are examined by predators more thoroughly.

The number of synecological studies and those that compared two and more species was two times lower at this session. J. Batzli (USA), for example, showed how predators, food quality, and patchiness of the environment affected the relationships of two gray vole species. The population parameters of the yellow-throated mouse and bank vole in forest communities along the Elba and Saale Rivers were related to the forest structure (J. Haferkorn). Out of the nine mustelid species of Belarus' whose population dynamics were related to various environmental factors, three species proved to have adapted themselves to human impact (V. Sidorovich). The investigation of bats in French Guinea, which are normally considered to be *K*-strategists, has shown that the life strategies of Chiroptera are more diverse than was previously believed.

Ecologists from Japan, Great Britain, and Germany discussed the interrelations in the host-parasite systems. These relations were both simulated and studied experimentally using several pest species.

The methods of canonic analysis and multiple regression helped determine the effect of habitat patchiness and competition on the immigration and extinction of 49 ant species from Osaka. Due to the initiation of a long-term project for the conservation of 10 armadillo species in Argentina, a paper was read demonstrating that their biodiversity is a function of viability rather than habitat pattern and selection.

A number of papers were distinguished not only by the beauty of the slides and the logic and tactics of testing the hypotheses but also by elegant research methods. For example, with the help of a video-recorder and the matrix model of forward processes, British ecologists (J. Grover *et al.*) learned to identify a demographically important juvenile group of crustaceans and developed a technique for investigating the age structure of zooplankton.

The papers on the results of the investigations of animals of faraway countries were also interesting. In fact, British ecologists tested a hypothesis on the relationship between the competition and density-related processes in carabids in the islands of South Georgia (east of Argentina). A large series of species of Indonesian birds and butterflies revealed links between their density in primary habitats, the ability of species to use new habitats, body size, diet, taxonomic status, and other traits, which permit predicting the adaptability of

species. The multidimensional spatial and temporal model adopted from applied entomology helped American ecologists understand the history of the distribution of the musk rat in Holland.

Several interesting symposia were held at the session "Communities and Ecosystems." In addition to "descriptive" studies on diverse insects attacking tree trunks and cereals in Germany and Poland, the investigation of soil microarthropods affecting the decomposition of forest litter in Ireland and Nigeria, and a decrease in competition among Japanese shrimps under the effect of predators, a number of papers were distinguished by interesting goals and methods. The results of introducing 137 avian species in New Zealand revealed that only 20% of them survived. A multivariate analysis demonstrated the characteristics of the birds associated with their invasion capacity. Zh. Reznikova (Novosibirsk) described a new form of links in multivariate ant communities. By controlling the density of subordinated species, the dominants use them as scouts in complicated hunting situations. A coinertial analysis between the matrices of the distributed species, the surrounding conditions and species features, has shown how changes in habitats and interspecific relations affect the structure of amphibian communities in France.

Interesting papers were read by ecologists of the United States, Canada, Spain, and Denmark at the symposium "Thermodynamic Prospects of the Development of Ecosystems."

At the symposium "Ecophysiology of Animals and the Investigation of Life Strategies" the speakers discussed the frost-resistance of three species of crane flies and the experiment on the investigation of the nature of phase polyphenism in caterpillars of the African moth, which were classified with respect to their cold-resistance. American ecologists reported the results of experiments on grasshopper nutrition, which are important for the investigation of phytophage-plant interactions, and also related an interesting attempt to predict the species abundance of grasshoppers on the basis of mechanistic correlations, i.e., mandibulae and the relationship between body weight and wing area.

At the Symposium "Ecology of Nutrition and Food-Chain Dynamics," British ecologists made interesting presentations on their study of the feeding of Spitzbergen polar foxes using radioactive marking of food. American ecologists presented a synthesis of fresh empirical data and theoretic concepts to demonstrate that cannibalism is an important density-dependent mechanism in the population dynamics of a number of species.

Session 4 "Biodiversity and Evolution" aroused considerable interest in the participants, which is not accidental. An all-round investigation of biodiversity from molecules to ecosystems is a prioritized trend in the international cooperation of world biologists today and is coordinated by their International Union of Biological Sciences. This problem was discussed in Sep-

tember, 1994, at a special meeting of the IUBS General Assembly in Paris. Several regional and thematic international conferences were also held. The VI International Ecological Congress was also concerned with the biodiversity issue despite the fact that some specialized meetings to this effect were held in 1994. Scientific ecological periodicals contain ample information on ecological mechanisms of the maintenance of biodiversity at the population, ecosystem, and global levels. The ecological mechanisms of the conservation and restoration of biodiversity in the human-modified environment also receive much attention. A number of ecologists consider the analysis of changes in living nature through the prism of biodiversity. This is exemplified by such studies as "Ecological Diversity in Theory and Practice" (J.F. Grassle *et al.*) and "Ecological Theory and Species Diversity" (R. Corwell). Methodological directories and manuals published under the International Program of Statistical Ecology by the International Association of Ecology and the International Society of Environmetry for the VI International Ecological Congress. In 1994, several detailed monographs appeared with which participants of the Congress could familiarize themselves on biodiversity in populations, communities, and food chains, the hierarchy of ecological relations, and taxonomic diversity in different groups of living organisms.

At the symposium meetings of the session "Genetics and the Ecology in Evolution" organized by Prof. R. Berry, Yu. Vigorov (Russia), in his report on the ecological aspects of the behavior of 80 species of rodents in the "open field," attempted to relate the irregularity of species differentiation of behavior and other systems of traits, which is well manifested in rats, voles, and gerbils, to ecological plasticity of rodents. In her paper accompanied by beautiful slides, F. Osborn of Venezuela discussed the evolutionary trends of the interactions of brown argus butterflies and ants. In New Guinea a hypothesis on the interrelationship between the morphology and chemical composition of fruit was advanced, and it was found that this relationship is a function of the pressure of selection created by the animals distributing the fruit. British scientists reported their success in discovering a chromosome marker of sex in birds and polymorphous enzymes in the Psocoptera pest of food resources. The diversity of the topics at this symposium (the evolution of ecosystems of arable lands, the biochemistry of Psocoptera, the resistance of soil bacteria to mercury, the behavior of rodents under stress, heterozygosis of salmonids and mosquitoes) was also characteristic of other symposia. The organizers of the Congress seemed to overcome the attachment of participants to their "own" subjects.

Analysis of relations between the species diversity of phytocenoses of industrial landscape and the duration and intensity of land use in France demonstrates that they are determined by the heterogeneity of landscapes. Beginning in the 1960s with urbanization and development of recreation on the coast of Turkey, a

sharp impoverishment of biological diversity occurred that was manifested at different levels. Virtually all the species of Leguminosae, Compositae, and Gramineae disappeared, and other communities were destroyed and became rare. It has been proved that biodiversity in the chestnut forest ecosystems of southern France is high at the initial stages of anthropogenic transformation. L. Ryszkowski and his associates (Poland) demonstrated the possibility of maintaining a high level of biodiversity of plants and animals due to optimization and structuring of the agrolandscape. A large body of concrete data on the change in species composition of the plants of tropical forests of Latin America and optimal methods of their exploitation were presented by ecologists of the USA, Great Britain, and Brazil.

The problems of the formation, dynamics, and conservation of biodiversity were the topic of several plenary papers. In fact, an overview of the problems of population biology was made by Prof. Robert May of Oxford (Great Britain), one of the most prominent specialists in this field.

At the session "Landscape Ecology," British ecologists explained the integral system of raising earthworms and their use in restoring the soil, and German scientists discussed the assessment of restored landscapes using grasshoppers. British and German researchers traditionally have prevailed at the symposia of this session. Along with theoretical papers on the development and conservation of biological diversity under conditions of anthropogenic landscape in Europe, a number of papers dealt with the results of ecological restoration, e.g., restoration of the ecosystems of over-moist lands and moors in England and Wales. Canadian ecologists showed the possibility of restoring broad-leaved forests of Ontario, where over 80% of the area has been destroyed. The methods of restoring ecosystems in the USA differ from European methods because the transformation of natural ecosystems in the former is more transient, and initial and intermediate stages of successions in the temperate climate of North America are blocked by introduced species. This was noted by A. Tishkov (Russia) in his survey of ecological restoration of steppes in Russian and Ukraine. The steppe biome of the Russian plain almost entirely disappeared during the last century. The realistic method of restoration is recovering herbaceous ecosystems using the seed stock from steppe resources. The results of the experiments of 1981 - 1991 on ecological restoration instill optimism. A series of interesting and purely applied papers were read by ecologists of China, Bangladesh, and India.

At the session "Pollution and Ecotoxicology," descriptive papers prevailed that did not delve into the causes of particular responses of the species; hence, these papers were not instrumental in predicting these responses. An example is found in the inter- and introspective differences in the response of two species of freshwater crustaceans to heavy metals, the population

dynamics of mollusks on the seashore of Israel faced with pollution by xenobiotics. A. Rozhdestvenskaya (Belarus) described the abundance of 12 species of insectivores and rodents in the region of Chernobyl. British ecologists studied the effect of pesticides on the brown frog in the agricultural landscape and the effect of sulfuric and nitrate pollutions of the air on the life cycle of the bean aphid. No matter how important such studies were for particular cities, countries, and regions, it should be noted that they are not as significant for fundamental ecology, since they are based on methods used for dozens of years and traditional concepts and approaches.

A novel contribution was the transition from discussing concrete levels of ecotoxicants in living subjects and human environment to assessing ecological and social consequences of pollution and elaborating the theory and practice of the methods of evaluating ecological hazards. In this respect, applied ecology started a new life creating a unique approach for assessing the consequences of pollution on the basis of comparable ecological and mathematical indices, which, before this time, was not possible. For the first time, several manuals for assessing ecological hazards appeared at the book market held during the Congress (Suter *et al.*, 1993; Burgman *et al.*, 1993; Calabrese, Baldwin, 1993). It is noteworthy that the Ecological Congress was followed by the international Symposium on the "Assessment of Chemical Hazards" held from September 13th through September 17th, 1994, at Moscow International University. Thus, this new trend in applied ecology has also been widely publicized in Russia.

The limited number of papers on pollution accepted by the Organizing Committee of the Congress can be explained by the desire of the organizers to focus on the fundamental aspects of ecology and also by the organizational structure of modern science. The International and European Unions of Ecotoxicologists were recently established and in 1994 held their meetings in Belgium and in Switzerland. Today ecotoxicology covers all aspects of the science of environmental pollution: chemical, biological, medical, geographical, economic, social, legal, and those related to mathematical simulation. At the international level there is active exchange of information, standardization of measurement methods, and development of world pollution databases. The decisive factors in pollution and liquidation of its consequences are human economic activities rather than natural ecological processes, which was evidently taken into account by the organizers of the Congress in Manchester. In addition, the International Society of Chemical Ecology, which holds independent meetings and publishes *Journal of Chemical Ecology*, is active in this field.

At Session 9 "Forest Ecology," the most interesting papers were concerned with solving ecological problems in foreign countries and applying methods that

permit mass collections for assessing species diversity: a Swedish ecologist discussed the distribution of insect guilds in gradients of rain forests of Amazonia (Brazil), and German scientists reported on fish communities, the effect of white ants on soil fauna, and biodiversity of arthropods and carabids in Amazonia and in the rain forests of Malasia and Sulawesi. In mass collections of insects the method of tree pollination with *Piretrum* was used. An ecologist from France (C. Amedegnato) in his study of Amazonian orthopterans revealed a link between the ecology and type of group biodiversity with their phyletic and biogeographical history. The papers by British ecologists also discussed exotic subjects. At this session they discussed the composition of the arthropod fauna in the rain forest canopy in Indonesia and Venezuela and the edge effect in the diversity of vertebrates in the coniferous forests of Canada. An ecologist from Colorado (B. Farrell, USA) in his study in Amazonia showed that insect-plant interaction, by modifying the resources and determining the local abundance and biodiversity of species, appears to exert a long-term effect on their evolutionary success.

Some interesting presentations were made at the marine ecology symposium, the human ecology symposium, and, in particular, at the symposium on those problems of ecology that "cannot be answered." At the latter, an attempt was made to outline the range of problems that required particular accuracy of study and to discuss the categories important for correct judgment (the accuracy of concepts, determination of processes and reliability of data, and substantiation of the models). Nine out of 12 presentations at this symposium, which was very important methodologically, were made by ecologists from different cities in Germany and three from the Netherlands, Great Britain, and China.

At sessions and symposia of the Congress, numerous papers were read on human ecology and urban ecology, new technologies and statistical methods in ecological studies, ecological education, ethics, and even interrelations between ecology and religion. It was not difficult to recognize studies made "to order" by the object of research (e.g., agricultural landscapes, etc.) and by the precision of the problems, which were occasionally schematic, set to be solved, similar to a training problem, in a short period of time as stipulated by the grant. There was no depressing predominance of "practitioners" at the Congress, nor were there claims to immediate usefulness of the project as determined by

financial or other reasons detached from the subject of ecology, i.e., the activities of living supra-organismal systems for the sake of purely technological, nature-conservation, or geological-geographical problems. At the same time, in the years that have passed since the V International Congress of Ecology, there has been a noticeable increase in the number of studies – aimed at solving applied problems – associated with global environmental change (climate, land use, etc.), ecological feasibility of sustainable development, and issues of biodiversity conservation. Is this merely a trend or a manifestation of the actual replacement of the paradigm? Apparently, the former is the case, since extended interpretation of ecology attracts to congresses specialists in related fields of knowledge rather than stimulating the profundity of fundamental research proper. This research arouses discussions at conferences and symposia between the congresses.

The atmosphere of the Congress was benevolent, and the meeting had the equipment needed for the exchange of scientific information. Its organizers ensured opportunities for informal communication and organized an exhibition sale of books published by the main scientific publishers of Great Britain and the USA. Forty-one excursions to the most interesting regions of the country were organized for the participants in the Congress. The price of each excursion was similar to that of a good book (20 pounds sterling).

Among the 968 papers included in the program, the papers from Russia accounted for less than 5%, and the number of presentations that were actually read was still smaller. The program of the poster session consisted of 807 poster presentations, among which the presentations from Russia accounted for less than 14% and, judging the actual number of those who came, only a fraction of the percentage. Very few presentations (3%) were on the program of the fourth poster session, where the issues of the management of ecological processes, ecology of the environment, and ecology and society were discussed. Judging from the program of the Congress, there is no cooperation among Russian and foreign scientists in solving ecological issues in Russia and abroad.

The Congress proceedings are published in the book: *Progress to Meet the Challenge of Environmental Change: Proc. of the VI Internat. Cong. of Ecology*, 24 to 26 August, 1994, Tallis, John H., Norman, Hasel J., Berton, Richard A., Eds., Manchester, UK.