

A MODEL FOR HUMAN ECOLOGY

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Summary

General concepts of human ecology (HE) have been developed starting from geography to sociology and other disciplines as specific doctrines. HE came from the *monodisciplinary* stage through the *multidisciplinary* stage, and finally concerns the interaction between several environmental conditions and factors, and adaptational changes of humans which have been realizing by biological, social and cultural ways (the *transdisciplinary* stage). HE is no longer related to a single classical discipline—this is an interdisciplinary science where biomedical and social sciences are integrated in studies on human-environmental interaction. Contemporary studies in human ecology do not exist without complex research on humans together with complex research on their environment. Biological mechanisms of adaptation of individual organisms and populations of *Homo sapiens* to the environment, and social and cultural forms of this adaptation, are parallel studies, with investigations of the

environmental conditions in which human organisms and populations live. The entity of HE is the interaction, which means inter-relations between elements of the ecosystem. The elements are registered in the process of monitoring. The theoretical basis of HE is the general theory of systems, and modelling is the method of study. The research on human adaptational changes has been represented in anthropology since Darwinian times, first as the general idea of origin, evolution and variation of *Homo*, next as the interaction between genotype and environmental conditions in formation of the contemporary phenotypic variation. HE includes those aspects of problems which summarizes (on the basis of scientific research) effects of environment-human interactions, as a potential feedback risk for human organisms and population structures.

1. Human ecology as a science

Human ecology (HE) is the science about *Homo* as the biological genus and his culture as a dynamic component of ecosystems. The species *Homo sapiens* is characterized, among other things, by his unique and peculiar culture. Culture has differentiated us from other animals, has made us *humans* and finally *sapiens*. In the above definition, biological and cultural unity of humans has been marked. The subject of research in HE is the human organism and human population in its interaction with the environment in which it exists—in particular the biological, social and cultural inter-relations of humans with their living conditions. In this sense human ecology is understood as a transdisciplinary science based on system theory. Human population is the center of the system under study. Humans cope with the environment for survival in two ways:

- 1) By the biological adaptation of their own body, which allows for sufficient existence and procreation.
- 2) By cultural behavior, which is realized using the following ways:
 - a) Protection of the organism against detrimental environmental factors,
 - b) Changes of these harmful environmental conditions into beneficial ones, and
 - c) Migration into areas having better living conditions.

In some way humans coping with natural forces use their culture and create qualitatively new conditions for their existence. The influence of human activities listed above on the environment and other people, and the influence of the environment (and other people) on human being or a group of people (family, social stratum, population) is registered as effects of interactions. The process of monitoring of biological status of human populations is related to:

- Health status,
- Nutritional status, and
- Reproductive fitness (fertility and survival).

The process of monitoring of socio-cultural status of human societies is related to:

- Social institutions,
- Cultural traditions,
- Technological level,
- Economic system, and

- Political system

The main difference between bioecology and human ecology is that bioecology does not include research on adjustments on organism level and cultural adjustments to environment, which are the immanent subjects of HE. These two problems are basic to environmental protection and environmental problems of health care, nutrition, family planning, and well-being of human populations and societies.

2. Human ecology, and environmental protection and nature conservation

Research on endangered species and disappearing human civilizations, in some sense, is parallel. The former problem is a subject of ecology, while the latter is one of cultural anthropology. These are extremely important problems for the future of life on our planet. However, a very important problem of human ecology concerns the extinction of several plant and animal species, that means the destruction of ecosystem equilibrium, and how this phenomenon affects human living conditions and human life (human organisms and the structure of human populations). Another problem concerns the value of disappearing cultures, which had a way of life in a specific natural and social environment, for the future of humanity. Like particular species of plants and animals, which have a unique type of gene combinations (genotypes), practices and customs (results of human experiences) are unique for particular cultures. Various types of genotypes of many species were selected in different ecosystems, whereas various cultural behaviors and customs were the basis for effective survival of human societies. Whereas ecology (geoecology and bioecology) is the scientific background for nature conservation and environmental protection, human ecology is a scientific base for protection of the environment of human life. Humans are peculiar organisms among animals, not only because of their specific gene pools, but especially because their culture, social relations and symbolic communications are unique.

Human ecology (in addition to the population level, and biological mechanisms with which bioecology is concerned) takes into consideration adjustments on the individual level (*environmental physiology*) and cultural adaptational behavior (*cultural anthropology*). The part related to adaptational changes of individual subjects (their organism, psyche, and cultural behavior) is very important for evaluation of changes within the environment in which they live.

In the past, adaptation had mainly acted on the population level, and natural selection had eliminated inadequate (*maladjusted*) subjects. In contemporary civilization, where medicine, education and welfare are highly developed, this directional selection does not exist. Stabilizing selection works against extremes of variation. In this sense, most scientists share the opinion that the biological evolution of *Homo sapiens* does not exist any more. The human species is evolving only as a cultural creature.

Human ecology *per se* is not about nature changes, even though anthro-pressure is making some species of fauna and flora extinct. Neither is HE about nature protection and environmental management. If human populations change environment, this is a subject of research in *ecology, geology, economics, and even political sciences*, with humans as the species existing in this ecosystem. The main interest of HE is how

environmental changes, not only caused by anthropo-pressure, affect (in the last case as a feedback mechanism) humans on the individual and population level.

3. Monitoring of the biological status of a population

The only objective way to register the influence of environment (living conditions) on humans is evaluation of their biological status. Health is not only the lack of diseases, but should be understood as full psychophysical well-being. We can measure the health status using negative (ill health) and positive (good health) indices. Existence of diseases (registered as frequency of illnesses, or causes of deaths) is included into the negative indices of health. The positive indices of health are more objective. They include measurements of physical status and fitness of the organism, and this mechanism is based on evaluation of morphological measurements (anthropometrics), physiological and biochemical examinations, psychomotor fitness (physical fitness tasks, measurements of working capacity, etc.). The nutritional status is evaluated by measurements of body composition, and concerns proteins, fat and mineral components of the organism, and its supply with energy and vitamins. Reproductive fitness is evaluated by fertility of each family and survival to the mean age of reproductive period. The synthetic index of reproductive fitness at the populational level uses data concerning mortality and fertility in each age group, and measures the probability of an average population member taking part in the production of a new generation. In human ecology not only the proportion of mortality to fertility is important, but also information about which couples have more children and what biological properties are characteristic for subjects who died, in relation to general population and in the presence of existing conditions. The evaluation of well-being on the basis of psychological self-feelings, and/or cultural practices is not accurate because it depends on emotions, and this opinion can be frequently changed. The evaluation of social and cultural means of adaptation to environment is also not a measure of well-being, since it is only a method used by society to cope with existing conditions.

4. Interaction and ecosystem modelling

Sociological studies on the role of social institutions in a particular area monitor the collective actions of the people who settled there. Ecological studies on species living in the ecosystem are monitoring a *biocenosis*, but not yet an *ecosystem*. Ethnological studies on cultural behavior of a particular ethnic group monitor the activities of this group, in other words, how the people cope with the environment using cultural means. Medical and anthropological studies on human populations from the point of view of health status, physical development, nutritional status, and fertility monitor the biological status of a human population. Such studies have traditionally been realized for at least half a century, initially within classical disciplines like sociology, ecology (zoology or botany), ethnology, epidemiology or human biology. This is not “human ecology” and it does not make sense to use the term. Each of the traditional scientific disciplines monitors and describes, from its own point of view, *humans and/or (rarely) their environment*. The process of monitoring only, is not a science per se, because it answers only the question “*what*”.

Contemporary science answers the questions “*how*” and “*why*”. Within each scientific

discipline these questions are asked, and phenomena interesting from the point of view of these two questions are mostly studied. The method of analysis, which also serves also for further discussion and conclusions, related to mechanisms of interaction, is modelled. This activity requires cooperation between different specialists and mathematicians specialized in programs of modelling. The main methodology of HE is a description of a system in which elements are interrelated, which means construction of the interaction model.

This model is related to the ecological system in which a human population is located as the center. This step is called modelling and is a basis for research in both, bioecology (studies on communities of various species with their environment as a background and in the aspect of energy flow and matter turnover, e.g. a nutritional net), and in HE, where adaptational changes of human populations to environment are studied.

In the HE aspect, the biological status of a population is a mirror of environmental conditions, including matter turnover and energy flow thorough the human settlements and ecosystems in which the population lives. This population has an impact on its settlement and ecosystem (*anthropo-pressure*), and is then an object of a feedback influence from the changed environment. The genetic and cultural (symbolic) information transmitted through this system is also an important subject of research. Models show a network of inter-relations between causes and effects and this explains mechanisms of changes in natural environment, social institutions and cultural practices. Models describe the way of management of environment and its (including a feedback mechanism) influence on the biological status of human populations. In ecological language, it is the examination in terms of matter turnover, and energy and information flow through the ecosystem. During this process the elements of ecosystems are changed. The main component of this model is a human population, which is related to the environment in a biological and cultural way.

The human niche, in additions to biological connections, which is common for all living organisms as a result of their needs, includes also social connections and cultural relations, which are specific only for humans. Human culture, characterized by prediction of future and tools' behavior, is a very important part of the ecological niche. As a matter of fact, cultural relations make the modelling of human societies much more complicated than other ecosystems, in which the analysis is limited to examination of energy flow and matter turnover, without the symbolic information flow. As a consequence, the modelling of "natural ecosystems" is rather well developed, but modelling of human societies is in an early stage of development.

Contemporary studies in human ecology (as the transdisciplinary stage) do not exist without complex research on humans together with complex research on their environment. Biological mechanisms of adaptation of individual organisms and populations of *Homo sapiens* to the environment, and social and cultural forms of this adaptation are parallel studies together with investigations of environmental conditions in which organisms and human populations live. This means that HE is interested in the time and place where the population lives. This range must include not only the place where individuals actually live, but also places where their growth and development took place (the process of onto- and phylogeny), as the part of the ecosystem. In other words, that part of an integrated ecosystem, in which a certain sociocultural system has

been developed, has to be carefully studied. Mathematical tools, which were introduced to human ecology, allow for continuation of synthesis of systemic studies. Factor analysis makes it possible to identify the principal components (latent factors) of both—the environment and human organisms and populations. These latent factors are not correlated with each other. Several forms of multifactorial analysis of regression and analysis of variance give results, which allow understanding and calculating inter-relations between natural elements of environment and society, and the biological and sociocultural entity of humanity.

5. Origin and development of human ecology

Human ecology as an institutional structure has its history. The concept of research has been represented in anthropology since Darwinian times, first as the general idea of origin, evolution and variation of *Homo* in particular conditions, next as interaction between genotype and environmental conditions in formation of phenotypic variation. Finally, research and teaching has become the most important activity in this science.

5.1. Monodisciplinary human ecology

In 1916, the term *human ecology* was used the first time by Huntington, a famous American geographer and traveller. There was a crisis in geography, because the description of its objects (lands, oceans, islands, continents, mountains, etc.) had been almost finished, and he tried to open new perspectives for this discipline. Huntington described a new concept explaining the entity of inter-relation between geological contents, the landscape of our planet and objects on its surface, and analyzed human populations and their cultural products on the background of environmental conditions. Huntington believed that climatic factors and their variations (fluctuations) determine human capacity and possibilities.

In some way the similar goal was sought by the Chicago sociological school of Park in the early 1920s. They took from biology the environmental background as the sociological doctrine that states that jointly settled territory unites the people into a society, and influences the character and structure of social inter-relations and institutions. Such inter-relations have both biological and cultural characters.

About 20 years later, human ecology was understood as a discipline in medicine, called epidemiology, which was created when environmental causes of diseases (etiology) were considered. This doctrine had a very positive influence on epidemiology, changing its understanding from ecology of diseases into ecology of health. This introduces problems concerning environmental health values and health promotion.

Similar *monodisciplinary* concepts had also existed in some other disciplines: psychology, ethnology (cultural anthropology), archeology, etc. There was no need to emphasize anthropology, because this discipline was, from the beginning, the main issue of human ecology, as mentioned above, starting from the Darwinian theory of natural selection explaining the origin and evolution of *Homo* by natural phenomena. The roots of human ecology are in several classical disciplines, but human ecology does not belong to any of them.

5.2. Multidisciplinary human ecology

In 1964 the “International Biological Programme” (IBP) was initiated, and within its structures the “Section of Human Adaptability” (HA) was created. This section had been initiating, organizing and coordinating studies of adaptational changes of human populations to changing environmental conditions in various biomes, and in various stages of civilizational development. Two main streams of studies were propagated. The first one included the influence of environment on:

1. Ontogenetic development
2. Adaptational changes in adult organisms
3. Structure of morbidity
4. Gene frequency (including gene pools of population's of ancient cultures)

The second stream included studies on traditional populations in the aspect of their adaptation to and management of extreme environmental conditions—cold, high altitudes, tropics, and arid zones (deserts).

IBP, including the HA section, did not use the research methods used by many different specialists; regions (ecosystem, landscape, settlement) were not studied according to their climate, fauna, flora and human populations. Investigations were made by the same comparable, unified methods, but observations and measurements (e.g. morphological, physiological, hematological, and psychomotor) were not conducted on the same subjects. Various cohorts, populations, regions or even continents were studied. Thus, it was impossible to study causal and coincidental relations of various properties observed in a certain environment. It was a patchwork of knowledge, and impossible to synthesize. Because of this the results have never been interdisciplinarily elaborated, as real syntheses.

Since the end of the 1950s, Paul Baker in the USA had been giving lectures under the title human ecology, and at the same time Napoleon Wolański had organized several interdisciplinary field research studies on the same topic and created in Poland a scientific institution in the area of human ecology. This was the first world-scale such institution. *The Laboratory of Child Ecology* was created in the years 1958-60 and was officially established in 1961 as the National Research Institute of Mother and Child. In 1969 it was transferred into the Polish Academy of Sciences as the *Department of Human Ecology*. Since the beginning these institutions have been realizing complex investigations based on more than 2000 families, two-three generational, which settled different climatic and economic regions of Poland. More than 600 morphological, physiological and psychomotor characteristics on each individual were measured. These studies were granted by the National Institutes of Health (US PHS), then by the International Biological Programme and several Polish governmental grants.

The definition of human ecology, used at that time, as “*the science about Man and his environment*” was rejected in the late 1970s. It was calculated that this defined area contains about 70% of human knowledge, which means that this is a discipline about almost everything. It was recognized instead as a topic for philosophical speculations. Since 1964 and for a period of about twenty years, human ecology developed in the so-called *multidisciplinary stage*.

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Bibliography

Collins K.J. and Weiner J.S. (Editors) (1977). *Human Adaptability. A History and Compendium of Research*. Taylor and Francis, London. [This is a report and summary of studies in the frame of the Human Adaptability Section of the International Biological Programme].

Campbell B. (1995). *Human Ecology. The story of our place in nature from prehistory to the present*. 2nd Edition, Aldine de Gruyer, New York. [This presents an evolutionary perspective of mainly social and cultural adaptations to different biomes].

Harrison G.A., Tanner J.M., Pilbeam D.R. and Baker P.T. (1988). *Human biology. An introduction to human evolution, variation, growth, and adaptability*. 3rd edition, Oxford University Press, Oxford, New York, Tokyo. [This is a textbook in which part 4 "Human adaptability" describes the biological mechanisms of adaptational changes in human populations].

McElroy A., Townsend P.K. (1989). *Medical anthropology in ecological perspective*. 2nd edition. Westview Press, Boulder, San Francisco and London. [This book presents ecology of health and disease, interdisciplinary research in health problems, meaning of adaptation, changing pattern of birth, disease and death, ecology of economics of nutrition, nutrition through the life cycle, stress and disease, health repercussions of culture contacts, and health costs of modernization].

Moran E.F. (1982). *Human Adaptability. An Introduction to Ecological Anthropology*. Westview Press, Boulder. [This monograph describes most extensive presentations of biocultural adaptation of human populations].

Sargent F. (1983). *Human Ecology. A guide to information sources*. Gale Research Company, Detroit. [This is the history and annotated bibliography of early publications in human ecology]

Siniarska A., Dickinson F. (1996). *Annotated bibliography in human ecology*. KamlaRaj Enterprises. Delhi. [This is the most extensive annotated bibliography of publications in all branches of human ecology in the 30 years preceding publication].

Siniarska A., Wolanski N. (Editors) 2000. *Ecology of Aging*. KamlaRaj Enterprises, Delhi. [This is a set of 12 chapters related to aging and involution with special emphasis on the role of environmental factors].

Wolański N. 1993. Selected problems of human ecology related to town planning. *Acta Oecologiae Hominis*, 2, Lund. [This publication presents principles of human ecology, environment factors and the impact of urban environment on town dwellers].

Wolański N. and Bogin B. (Eds.) 1996. *The Family as an Environment for Human Development*. KamlaRaj Enterprises, Delhi. [This book has 12 chapters related to different problems of the family place in nature, family transformation, and family environmental conditions in human growth, development and education].

Young G.L. (Editor) (1983). *Origins of Human Ecology*. Benchmark Papers in Ecology, 12, Hutchinson Ross Publ. Comp., Stroudsbouurg. [This book presents selected historical papers related to seminal statements, mid-line assessments, discovery of additional disciplines, recent perspectives and human ecology as an interdisciplinary domain - with editors' comments].

Young G.L. (1989). A conceptual framework for an interdisciplinary human ecology. *Acta Oecologiae Hominis*, 1, Lund. [This presents the theoretical concept and basic problems of transdisciplinary human ecology].