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## **ENVIRONMENTAL RESEARCH IN SLOVAKIA: FOUNDATIONS, CURRENT STATE, PERSPECTIVES**

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Development of landscape ecology has influenced in the last 30 years also Slovak geography, that adopted it as a useful scientific branch in the solution of environmental problems. The main motive was environmental protection, and that required a change in approach to landscape research subject. Landscape was perceived above all as a home of man. The main research subject - landscape potential, was derived of so formulated notion, as the required condition of the landscape for the fulfillment of functions for man with simultaneous preservation of long-term reproductive ability of the landscape. Landscape ecology has acquired through such approach features of environmental science, presently at the subject of environment - man.

Key words: landscape ecology, natural landscape, humanized landscape, landscape potential, landscape planning, environmental approach

### INTRODUCTION

Environmental research, i.e. study of the relation of man to natural environment expressed in the research of landscape and its anthropic changes does not have similar traditions to

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those in other branches of geography, for instance regional geography, with the personalities like Matej Bell in the 18th century and J. Hromádka in our century, but in spite of its short existence (practically only the last three decades) it aroused international response. The boom in the landscape research was definitely conditioned by the fact that research of so-called geographical environment did not find such support as in, for instance, Poland or former USSR. Environment in the sense of approach and formulation of research programme was in our country substituted by landscape. Position of landscape theme in research physico-geographical programmes along the response to the well-known specialization splitting, geography was influenced also by a big boom of landscape ecology from the end of the 50-ties in Germany and in the other Central European, Germanophone countries.

Landscape constitutes at the present moment almost exclusively the domain of landscape ecology, belonging to those branches of science with rather short tradition and a specifically limited study subject. It is a young, and therefore modern scientific discipline, remarkable for unusually dynamic development and expansion. It was founded by C. Troll as a branch lying on the boundary between geography and ecology. As geography deals with, as generally admitted (see Hagget 1972) space, and spatial aspect is the property of the research subjects of other disciplines of the Earth and biosciences, landscape ecology stepped out of the frame of the basic geographical research and penetrated into applied and spatial sciences (forest sciences, agricultural sciences, territorial planning). Its comprehensive views and approaches predetermined it to an active role in environmental planning and solution of ecological problems in general, leading to the foundation of the International Association of Landscape Ecology. Its expansion since the beginning of the 60-ties and transformation from geographically oriented discipline to interdisciplinary research area, and from the local to global one, reminds expansion and globalization of the ecological crisis, beginnings of which are generally placed in the beginning of the 60-ties.

Also the Institute of Geography of the Slovak Academy of Sciences and the geographical departments of universities contributed in the years 1978-1990 to the development of the landscape ecology in Slovakia, solving numerous research projects oriented to various aspects of landscape and worked out new approach to the investigation of man/environment relation on the basis of engaged, humanized science.

This contribution is oriented to analysis of the development of landscape research within the framework of geography, although its focus was in the Institute of Landscape Ecology of the SAS.

#### TRIAL AT THE CHANGE OF NAME

C. Troll was perhaps the first man who began to survey the landscape pattern, (spatial arrangement of landscape types) - by evaluation of air photographs (case study of African savanas). He published the results in 1939 and called this way of landscape surveying, landscape ecology. War events interrupted his work for ten years. In 1950 he presented a complete idea of landscape ecology in a conceptual and methodological form. He defined in his work the basic stone of the landscape - ecotope, defined the landscape of new, spatial-functional (geographical-ecological) aspect, basically different from, until now

physiognomically oriented, conceptions of landscape (like for instance Passarge 1919-1921).

C. Troll presented two basic approaches to landscape from the point of view of landscape ecology:

1. Approach oriented to regional differentiation of Earth spaces, investigating the mutual harmony of natural phenomena in space and representing in a certain sense a horizontal approach. In its nature it is geographical, landscape-scientific.

2. Approach oriented to functional relations on vertical profile in certain geographical point that investigates the mutual harmony of phenomena on the level of stand (ecotope) as ecological system. In its nature it is specifically bioecological.

C. Troll was afraid, that his new approach to landscape and its new definition will meet with misunderstanding abroad where, mainly in Anglo-Saxon and Francophone sciences, landscape had an accustomed meaning in the sense of a image or scenery. That is why in his following work (1972) he suggested an international expression for landscape ecology in the form of geoecology.

It is possible that for the above mentioned reasons also Sočava (1963) proposed to use instead of landscape a term geosystem. Troll's fears were not justified. International scientific community, especially in the area of applied research did not accept international form of geoecology but the original expression. But it was accepted by a part of scientific community from the area of basic research who also consequently use the notion geosystem in the sense of landscape (for instance Sočava 1976, Turba-Jurczyk 1990). It is so, because a part of geographers does not consider landscape a subject of basic research, as it is not possible to define it, contrary to geosystem.

There is no difference between ecology and geoecology, they are synonyms denoting the same branch. Landscape ecology is not interpreted uniformly. There are tentatives to distinguish geoecology as a geographical discipline. It is given by the fact that it represents an interdisciplinary research area in which the scientists with different scientific background, intersectionally oriented experts (for instance geographers, territorial planners and urbanists) enter, as well as strictly oriented specialists of the basic and applied research. Each of them introduces in landscape ecology his professional input and defines it from his point of view. But the uniting idea is a mission of landscape ecology as a tool of environmental protection, as expressed in the aim of rational use of land resources on ecological basis of sustainable development. Work in landscape ecology is interdisciplinary, one cannot observe borders of a single discipline, the master idea is the solution of the problems.

## FOUNDATIONS

Landscape ecology has undergone a significant transformation during the last 30 years. After the sporadic studies originating in after-war period (for example Schmithüsen 1948), outlining the shapes of the landscape ecology, by the end of the 50-ties the German landscape-ecological school headed by E. Neef emerges producing in the 60-ties numerous important studies that established the landscape ecology as a branch with justified position within the scientific system (for instance, Neef 1961, 1964, 1970, Haase 1964, 1967,

Hubrich 1965, Klink 1966, Barsch 1968, and others). In this period the foundations of landscape ecology were laid down and attention was paid to implementation of C. Troll's thesis on two basic approaches of landscape ecology oriented to the investigation of relations - horizontal geographical, and vertical ecological. The aim of the research was the establishment of ecotope as a basic building stone of landscape, abiotic part of which was represented by the basic unit - physiotope (Neef 1968). Delimitation of ecotopes and their spatial structures constituted the basis for unfolding of further research - clustering of ecotopes into the units of higher hierarchic degree in choric dimension and by similar manner into the units in regionic dimension. The aim was to create a classification system of the units of type and regional character.

Splitting of the landscape research that caused the penetration of landscape ecology into the system of biological sciences manifested in Slovakia by the end of the 60-ties, when centre for the solution of problems of environmental protection (Institute of landscape biology of the SAS) was founded. Ružička (1965) presented a research conception of this Institute. The prevailing research theme at this Institute was landscape planning (Ružička, Drdoš 1973, Ružička and Miklós 1990, Miklós 1978) and the related problems (Žigrai 1973, Kozová 1983, Kozová et al. 1986, Kozová and Kalivodová 1992). The most important result, adopted by the international landscape ecology is the landscape-ecological plan (LANDEP). Landscape research had also distinct nature-scientific features, even if the use and transformation of landscape were explained by socio-economic factors and solved so-called conflicts of socio-economic character.

As viewed from the geographical point of view, landscape research dwelled on the position of basic physico-geographical research. In accordance with overall development of landscape ecology attention was concentrated at the beginning on the questions of so-called basic landscape units, their grouping into sets on a basis of genetic or ecological kinship, type delimitation (Drdoš 1967) and regional landscape units (Ot'ahel' 1978) of various hierarchic levels in order to learn about the ways of formation of the spatial landscape structure. Approximately at the same time also a trial at a physico-geographical approach to landscape study has originated, consisting in the characteristics of the individual components of natural environment, and resulting into brief comprehensive physico-geographical typification (Mazúr et al. 1971). However, this experiment was an isolated one because of lack of information integrity. Similarly to Germany, considerable attention was paid to the research of physiotoxes (Drdoš 1975). Methodological model of physiotope research presented in our geography was adopted as an international pattern (Miklós, Ot'ahel' 1978). Segmentation of landscape in various landscape - ecological dimensions was verified - i.e. on local (site) level, methodological form (Drdoš 1978, Lehotský 1981, 1991, Poláček and Ot'ahel' 1983), regionic dimensions (Mazúr et al. 1970) and global dimensions, requiring combination of typological and regional approaches (Mazúr et al. 1985).

Classification of landscape units did not copy the German pattern of individual naming of units of various dimensions, but it went on using the successfully tested decimal classification. Basic landscape units are different in each mapping scale. Basis of landscape pattern in scale 1:5 000 is ecotope, in scale 1:10 000 it is micro-chore, and in scale 1:100 000 mezo-chore.

Neither is possible to assess precisely the binding criteria of classification of landscape

types. In our heavily humanized landscape it is very difficult to delimitate the types of natural landscape. Only their reconstruction by means of potential vegetation is possible. Basic landscape unit (of homogenous landscape-ecological character on topic level or with certain type of internal spatial structure on choric or higher levels) is characterized by uniform physico-fundamental (homogeneous or differentiated) and the corresponding unit of potential vegetation (corresponding to hierarchic level). Humanized landscape, i.e. spatial pattern of landuse, does not copy the natural landscape i.e. its spatial pattern. A suitable way of delimitation of real units, especially for the application aims (in landscape planning, in the USES programmes, commune restoration) is delimitation of the units of potential natural landscape with delimitation of their variants of real state (types of cultural landscape, eventually categories of landuse). In this conception connecting the natural landscape with humanized one, the landscape classification was situated on the local and micro-choric level in the western part of the Liptov Basin (Drdoš 1977). Another criterion applied, is the class and intensity of surface geomorphological processes, again mainly for application purposes (for instance, Drdoš 1979). Potential vegetation as a basic criterion of delimitation of the units of potential natural landscape is important for the purposes of ecological reconstruction of humanized, heavily anthropogenized, so-called "emptied" technicized landscape (for instance, Drdoš and Székely 1994), as it provides information what biological elements must be used for these purposes, criterion of class and intensity of surface modelling processes communicates, what consequences in the form of process acceleration and the following destruction of landscape can be expected after inadequate landuse. But more frequent way is a separated delimitation of the types of potential natural landscape and the types of humanized landscape (see O'ahel' and Poláček 1987, Drdoš 1988, Lehotský 1991). But this conception lacks the link of the pattern of humanized to natural landscape.

Special attention was at the same time dedicated also to the elaboration of the humanized landscape classification, summarized by Drdoš (1965) and Žigrai (1972). The basis of delimitation of units of humanized landscape is represented by the system of landuse categories. But in the typology of humanized landscape first of all the relations to the natural landscape, by use of which it originated, were looked for. Drdoš, Žudel (1984) classified the types of humanized landscape in dependence on spatial pattern of natural landscape. But this approach can be found also in the work of Žigrai (1973, 1973, 1982), who similarly classified the landuse categories. But in the delimitation of humanized landscape also other criteria were used, like for instance, degree of disturbance of natural landscape pattern by its use (Drdoš 1980), by more detailed characteristics of human activities, for instance agricultural production and size of production (Lehotský 1991).

## TRANSFORMATIONS

We can observe in the development of ecology and research of its subject from the beginning of the 70-ties a certain change, caused probably by the finalization of the research of the landscape pattern. A signal of new orientation was represented by the work of Neef (1966) on economic potential of territory, that resulted in a theme of natural-spatial potential in Germany and landscape potential in our country. Neef's work suggested that the analyses

of landscape pattern must be inevitably linked with the stage of its evaluation in the form of potential. The 70-ties were in the token of elaboration of this theme (Haase 1978, Mansfeld 1983, Barsch 1983 and others).

The notion of landscape potential began to play a decisive role also in our landscape research. It was considered a basis of elaboration of rational landscape use. Contrary to the German approaches though, it acquired integrative features, synthesizing various landscape properties.

Hagget's book *Geography a Modern Synthesis* according to which mission of geography was to present a comprehensive picture of the surrounding world, solving the relation of man and his activities in the space, was an important impulse for the development of landscape research in Slovak Geography. Reaction to the book manifested in the use of methodological approach of landscape ecology to the solution of the quoted relations, that cannot be studied without knowing the subject of environment and man. The point was an effort to maintain identity of geography that disintegrated through the process of specialization into a series of independent disciplines connected only by the name. The aim was to bridge over the physical and human geography not in a mechanical manner, but in a synthetic connection of both branches with the purpose to learn about the relation man/environment. This intention did not meet with success for insufficient integration ability of human geography. The trial confirmed that physical and human geography are two independent scientific branches connected only by common name. Its results was finally a formulation of integrated landscape research programme that became an organic part of landscape ecology.

The cited effort was not limited only to Slovakia, its aim was to arouse an international discussion on integrative geographical stream and paradigm of engaged humanized geography.

At the stimulus of the Slovak geography in 1979 an international symposium on Current State and Perspectives of Landscape Research was organized. It resulted in constitution of Working Group within IGU for the landscape research with applicaatin of Hagget's concept. Its research programme was called "Landscape Synthesis - Geocological Foundation of the Landscape Management". The title expressed the effort to formulate the approach to the system of landscape-ecological information (synthesis of information) relevant to rational landscape use and management. In the series of symposia organized in Slovakia, France, Finland, Eastern Germany and Spain, the representatives of the centres of 60 countries of all continents discussed the theoretical, as well as methodological problems of landscape research. In 1988 the Working Group according to the statutes of IGU finished its activity. In 1991 a symposium on landscape synthesis was held in Bratislava. It concentrated upon further activities and possible direction of research work. In 1993 the 1st symposium with the new Working Group of International Association of Landscape Ecology in Warsaw was held, and it produced 5 research themes to be worked on until the end of the century.

New research programme at the Institute of Geography of the SAS brought several tasks. The first of them was to change the accustomed approach to the landscape. The landscape could not be perceived anymore as a "neutral" subject. It had to be perceived as a subject to which man has a existential relation. Landscape ecological research, therefore, had to obtain the features of engagement. The relation between man and landscape is a complex

one. Man is a part of landscape linked with it by his existential bonds (man is a product of landscape and permanently remains its part by his physiological dependencies through the air, water, food and space) on one side and landscape is his shelter and his home on the other. This relation is given by the biological essence of man, who similarly to all species, withdraws of the landscape the substances and energy for his existence. But man is a creature endowed by reason, a source of his working creativity. Landscape in this relation is object of man's work and it represents for the man a resource (generally defined as economic category). The most important aspect of all the presented is the first one, because landscape is irreplaceable for man, it is his only home he has got (Gould 1991). Already by the end of the 70-ties was this relation elevated to a dominating one, decisive at the solution of man/landscape relation, at the solution of the use of its resources (see Drdoš 1982, Huba 1982).

The reason was that the preceding criterion of approach to the landscape as a "store room" with unlimited stocks led to global ecological crisis and a possible collapse of the Earth, with consequent dying out of life. It was the first signal of the onset of sustainable development, although exclusive in the sphere of science (sustainable development includes all spheres of life beginning with learning, through application, decision-making sphere and ending by politics on local, regional and global levels).

But what represents man's home - landscape? Landscape is an extraordinarily complex phenomenon (Urbánek 1992), landscape is a time-spatial form - region. It has a particular spatial composition and a time rhythm. It is contained in global and local time-spatial dimension. On global level proceed processes of global scope and long-run character of "ecological" trends. Time and space are continuous here. Compositional principle here is the existential bond or dependence. Existentially strongest are inorganic processes. Organic processes are existentially weaker. Existentially strongest are human processes. Within this deterministic composition, the mankind appears as an epiphenomenon, it is existentially dependent on natural processes.

Local dimension is characterized by point and ephemeral processes. Time and space are discontinuous, they are constituted by the threshold of point, momentary events. Compositional principle is the relation of epigenesis i.e. loosing up the existential dependence. This is obvious especially in contemporary mankind. Thanks to modern technique a locality can be radically changed, it can be more result of human work than work of natural processes. Dependence of such locality on natural processes is small and flexible. Man finds himself as a hegemon.

On the cited background of general approach to the landscape and formulation of principles of research programme of landscape (Drdoš et al. 1980, Mazúr et al. 1980, Urbánek et al. 1980, Drdoš 1983, Mazúr and Urbánek 1984), a concept of landscape potential was elaborated. New conception of landscape and expanding economic crisis requested a new approach to landscape potential. An assumption of natural space to fulfill the function for man was defined in German literature. Contrary to the natural resource the point here is not the evaluation of substance or energy, but evaluation of natural space that in consequence of its substance characters, latent energy and the processes occurring between them, has a certain amount of abilities, through which the needs of society can be satiated (see Hasse 1979). In our research we did not depart only of the characters of natural space when determining the potential, but of a landscape as an entity. As the sense of

potential assessment is rational landuse, based in the use of resources of economic, in time changing socio-economic category, we defined potential from the natural and socio-economic aspects. It is because potential exists only in relation of man to landscape, it is realized by man, while the way of realization depends on the man's characters (professional interests, educational level, technological equipment, environmental awareness, etc).

The first works began to verify the idea of potential in various areas, above all in choric landscape-ecological dimension by the end of the 70-ties and beginning of the 80-ties (Drdoš 1978a, Huba 1980, Hanušin and Huba 1982, Mazúr et al. 1984).

Realization of the idea of landscape potential required a delimitation of a set of criteria and evaluation of further characters of the landscape that are given by the relation man/environment like stability (Drdoš et al. 1980, Huba 1984) and carrying capacity of the landscape (Drdoš et al. 1980, Drdoš 1990b, 1992), Huba (1982) called the man-related, because they can be distinguished in the landscape by the man's purpose. Both were perceived as utilizable only in relation of potential, determining the trait of its rate. Potential was defined by Mazúr and Drdoš (1984) as an condition of landscape necessary for its use by man, without disturbance of its long-term reproductive capacity, while criterion for the assessment of threshold value of the use was its carrying capacity, i.e. concept formulated also by Ortolano (1984).

Synthesis of branch potentials (for the individual classes of landuse) is represented by so-called preference of potentials, denoted by Mazúr (1980) as functional delimitation of landscape. In choric dimension it was worked out by Lehotský (1991) and by means of component analysis by Otáhel' and Poláček (1987).

The theme of potential and the accompanying characters is useful for the solution of rational landuse, i.e. for the landscape planning. We mentioned that landscape planning was not the main subject of the Institute of Geography of the SAS, as the Institute was oriented to basic research. Usefulness of this research in the solution of the problems of environment was pointed at by Drdoš (1978b). Methodology of landscape planning was elaborated in modern, variant form by Huba (1981, 1982, 1986), in application in individual regions by Drdoš (1971), Mazúr et al. (1983), Michaeli and Kandráčková (1985), Otáhel' (1986), Lehotský et al. (1991). Landscape planning required also evaluation of landscape scenery (Otáhel' 1980). The focus of landscape planning was in the Institute of Landscape Ecology of the SAS, that elaborated the LANDEP method. Formulation of new approach to the landscape as a man's home and the derived landscape potential and accompanying man related characters for the aims of landscape planning, landscape ecology changed from academic discipline to humanized and engaged research area of interdisciplinary character, fully concentrated on the solution of man's relation to environment. The focus of interest lied though in the research and evaluation of natural environment, as landscape ecology did not abandon the framework of natural science, even though it shifted its research subject closer to humanities. Its environmental features were forged by the penetration into applied research, solving the questions of relatively conflict free landscape use.

## PERSPECTIVES

New political situation and precise definition of environmental problems after 1989 conditioned formulation of environmental projects in science, economy and legislation.



Landscape ecology that fully participated in the solution of environmental research and legislation projects has transformed in environmental science. It was provoked especially by the preparation of law on environmental impact assessment and its methodology. The subject of the solution is man as a subject of environment and its natural, social and economic environment. Landscape ecology created a suitable methodological and concept apparatus of the investigation of natural environment and processes determining the biophysical carrying capacity (Midriak 1993) and its anthropogenic transformation for the assessment of its man-related properties, mainly potential and methodology of landscape planning, even on the principles of environmental impact assessment (Huba 1981, 1982). So far it dealt with the problems of hazards and risks (Huba 1993, Ira and Kollár 1992) acting as environmental limits (Tremboš 1992a, 1992b). Here emerge some promising perspectives of assessment for practical participation of the insuring companies. IALE created for this problem a thematic group within a newly established Working Group for Landscape Analysis and Synthesis. Leadership of this Group was conceded to our geography. The most important problem for the future is investigation of man, a particular individual, subject of environment and his professional interests. New serious criterion of man's interests, his environmental awareness, behaviour and attitudes (Ira 1992) will have to be introduced into the landscape planning. Up-to-now realized projects of environmental impact assessment confirmed that our specialists have managed to find a way to the solution of the problem in a short time (Kozová and Drdoš, 1992, Kozová 1993, Kozová and Pavličková 1994). Emphasis on this aspect of research moves landscape ecology into a position of interdisciplinary science with distinct social features. Its interdisciplinary character is even stressed by the entry of sociologists, human geographers, environmental lawyers and economists and other specialists of socio-economic sciences. "Natural-scientific - and socio-economic" branches are in balance. But they are not comparable with classical disciplines, because their focus and unifying criterion is environmental approach, i.e. investigation of natural elements from the point of view of man's interests, and investigation of man through his dependence on natural environment. These points of view are united on the basis of sustainable development. P. Gould (1991) writes that the contemporary science needs a synthesis like never before. A. Gore says, that paradigm of the science of the 3rd millennium must be a holistic one, because the solution of ecological crisis is possible only on the principle of wholeness. It is an advantage that we have developed in the last 20 years landscape ecology on the basis of modern conception of holism, and also on basis of approach to landscape as a home of man, relying on sustainable development.

Translated by H. C o n t r e r a s o v á

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Ján D r d o š

## ENVIRONMENTÁLNY VÝSKUM NA SLOVENSKU: ZÁKLADY, STAV, PERSPEKTÍVY

Rozvoj krajinej ekológie za posledných 30 rokov významne ovplyvnil aj slovenskú geografiu, ktorá v rokoch 1978-1990 venovala výskumu krajiny mimoriadnu pozornosť. Hlavným zdrojom metodických prístupov k riešeniu problémov bola nemecká škola krajinej ekológie. Pozornosť sa venovala výskumu štruktúry prírodnej a kultúrnej krajiny, krajinnému potenciálu a ďalším účelovým vlastnostiam krajiny. Na rozdiel od nemeckej školy slovenská geografia chápala krajinnú ekológiu ako humanistickú, angažovanú vedu, cieľom ktorej je riešiť vzťah človeka k prostrediu na báze zachovania podmienok života na Zemi. Tento cieľ si vyžiadala sformulovanie nového prístupu ku krajine, a to nie ako k neutrálnemu predmetu, ale k predmetu, s ktorým je človek bytostne spätý svojim existenčným záujmom. V skratke bol tento vzťah formulovaný vo výraze "domov človeka". Toto poňatie bolo bázou pre definovanie pojmu *potenciál krajiny*.

Ďalšími významnými pojmami vo výskume krajiny boli *únosnosť krajiny* a *stabilita krajiny*. Obidva sa ponímali ako zložky pojmu *krajinného potenciálu*, určujú mieru využiteľnosti krajiny, aby sa nenarušila jej dlhodobá reprodukčná schopnosť. V tomto ponímaní sa prejavovali prvky terajšieho programu trvale udržateľného rozvoja. Slovenská geografia novým prístupom ku krajine a ku krajinnému potenciálu transformovala krajinnú ekológiu na environmentálne odvetvie, poslaním ktorého je riešiť vzťah človeka k prostrediu. Jej ťažisko je v spoločenskej praxi, pretože je zameraná na riešenie praktických úloh racionálneho využívania krajiny na báze zachovania jej funkcie ako domova človeka.

V súčasnosti sa ťažisko výskumov presúva na subjekt prostredia - človeka, ktorý si vnímaním prostredia cez svoje záujmy vytvára environmentálne vedomie, správanie a postoje k prostrediu. Významnú úlohu ziskáva problematika environmentálnych hazardov a rizík. Krajinná ekológia ako interdisciplinárna environmentálna výskumná oblasť sa posúva na rozhranie medzi prírodné a sociálno-ekonomické vedy.