LAND COVER AND NATURAL LANDSCAPE TYPES IN THE FRONTIER PART OF THE ZÁHORIE LOWLAND

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1 Introduction

In relation to the planning of various human influences in the landscape (construction, agrotechnical, water-management, etc.) and respecting at the same time the ecological principles it is important to know its original natural, but also contemporary state, conditioned by various human activities. We obtain knowledge of the original natural character of the landscape and its regime through reconstruction of the landscape as they were before the human influences, especially on the basis of data on the substratum, terrain, soil and natural vegetation of the landscape. Recognition of the contemporary state is given by land cover, identified and analyzed for instance, from remote sensing data (FERANEC/OŤAHEĽ 1992, FERANEC et al. 1994). This information, as an initial base of the environmental solution, is obtained with various degrees of details and is analyzed in various scales, depending on aims of their application (FERANEC/OŤAHEĽ 1992).

The data base created in terms of the project of the European Communities CORINE Land Cover became one of the important sources of information on contemporary land cover of Slovakia. The purpose of this project is to create a consistent and compatible digital data base on land cover of Europe in the scale 1:100,000, by application of LANDSAT TM images. Such data base created for Slovakia will provide information on land cover in the period of 1990-1991 (the date of which the most recent satellite scenes LANDSAT TM from vegetation period were available). The created data base can also represent, among other things, one information time horizon important for the knowledge - analysis of the development of changes that occurred in the landscape.

Land cover with its bio-physical essence represents a materialized projection of natural assets and human activities (natural, semi-natural and artificial objects), and its knowledge is certain simplification of the knowledge of landscape. More

Bemerkung der Herausgeber:
Die Studie von J. Feranec und J. Oťaheľ widmet sich der Problematik der Bodendeckung und den Typen der Naturlandschaft im Grenzgebiet der Ebene von Záhorie. Die Autoren kamen zu Schlußfolgerungen, die auch heute an Aktualität nicht verloren haben. Es geht hauptsächlich um die Betonung der Notwendigkeit die natürlichen Landschaftstypen als eine grundsätzliche Voraussetzung der Ermittlung der Beziehungen und Determinanten der Nutzung der Landschaft mit Bezug auf die ökologischen und umweltbezogenen Prinzipien, zu erforschen. Diesbezügliche Forschungen können die Basis eines erfolgreichen Landschafsmanagements bilden.

consistent knowledge of the landscape is facilitated by analysis of its natural layer as potential resource for the application of socio-economic activities - the human layer. Human layer is represented in our work by land cover, knowledge of which is necessary mainly for the estimation of the relations to the natural layer.

The aim of the paper is to document on an example of the boundary part of the Záhorská nízina Lowland the natural landscape and the contemporary land cover, to try to analyze the changes in development, the correctness and suitability of the relations between them in the context of respect for environmental principles as an introductory basis for territorial planning procedures. This knowledge corresponds to the conception of the creation of the landscape use map (RICHLING and LEWANDOWSKI 1988). The map Ecology of Land Use in Central Europe in the scale 1:1,500,000 has just been published by the Austrian Institute of East and South-East European Studies in Vienna, edited by Dr. P. JORDAN and a team of authors led by Prof. A. RICHLING.

2 Methodology

For the creation of a land cover map of the studied area the methodology of the CORINE Land Cover project was used. It consists of five parts (KOLLÁFI 1992, FERANEC/OŤAHEĽ 1992, FERANEC et al. 1994):

a) **Preparatory work and selection of data** (selection of satellite scenes, topographical maps in the scale 1:100,000, other available topographical and thematic maps in more detailed scales, for instance 1:50,000 and aerial photographs; for the territory of the Slovak Republic maps in the scale 1:100,000 in Gauss-Krüger projection are used).

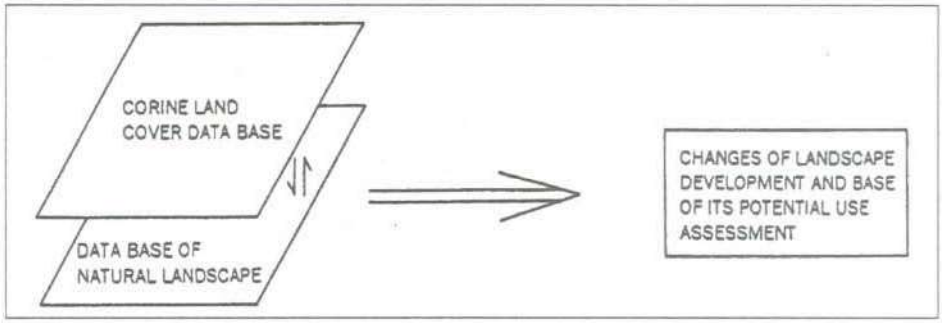
b) **Production of false-colour satellite images in the form of positive copies on paper**, geometrically corrected to Gauss-Krüger projection in the scale 1:100,000, represent the main source of thematic information for the creation of a digital data base on land cover.

c) **Visual (analogue) interpretation** of colour space image maps (based on analysis of textures forming the land cover patterns). The interpretation results in schemes formed by areas of the identified land cover forms and marked by the corresponding identifying number of the class. The legend contains 5 basic classes: artificial surfaces - urbanized and technicized landscape, agricultural areas, forest and semi-natural areas, wetland and water. The basic classes are divided into 15 classes of the second level and 44 classes of the third level. Each country participating in the project can delimit for its needs additional levels. The size of the smallest area mapped is 25 ha, and that corresponds to a 5 mm square or a 2.8 mm radius circle in the scale 1:100,000. Verification of interpretation of the results forms part of this methodology as well.

d) **Digitizing of the interpretation results** (raster or vector)

e) **Creation of a data base of land cover information system.** Knowledge of the natural landscape is aimed at analysis of the key characters, decisive in the mechanism of self-regulative processes and the natural landscape regime. Their identification is most suitable in the conditions of the original landscape or little changed natural landscape. With regard to the contemporary character of the cultural landscape its knowledge represents, as a matter of fact, reconstruction of landscape as it was before man's intervention. Analysis of the potential natural vegetation (e.g. J. MICHALEKO et al. 1986) is methodologically similar to the reconstruction of landscape. Spatial taxonomy, i.e. presentation of the key characters of the natural landscape according to the spatial units and relatively homogeneous signs is used as a suitable tool for the expression of the spatial knowledge of these characters. For their identification synergic and spatial relations of the single components (especially substratum, relief, soils, potential vegetation) and their key characters are analyzed, and in their spatial expression technique of superposition is applied. Identification of the types of natural landscape is methodologically based in the works of the geo-ecological school, in our country presented mainly in the works of E. MAZÚR et al. (1980) or on regional level those of J. OŤAHEĽ/ POLÁČIK (1987), J. OŤAHEĽ et al. 1993, etc.

Changes of landscape development were identified by comparison of the land cover map and natural landscape types map (Fig. 1).



(Fig. 1) *Comparison of land cover data with natural landscape data*

3 Natural Landscape Types

The study area represents the river plain of the river Morava (the Dolnomoravská niva) and contiguous undulated plain (Záhorské pláňavy) as a boundary part of the Záhorská nížina Lowland, or the hierarchically higher Vienna basin. The surface with a height of of 138-172 m above sea level belongs to a morphostructure with a negative movement trend as is manifested in its formation. After the sedimentation of the Pliocene clays and gravels the surface of the area was differentiated by tectonic germanotype movements (Wallachian phase) and conditioned the origin

of the block building of the lowland. Its manifestation in the study area is the Zohorská depression, hydrologically important as the Zohorsko-Marcheggská nádrž (reservoir) of the Quaternary ground waters, the thickness of the gravels and sands is 85-88 m (KULLMAN 1980). Block building is also confirmed by the different thickness of the Quaternary sediments reaching only 5.2 m north of the Vysoká pri Morave.

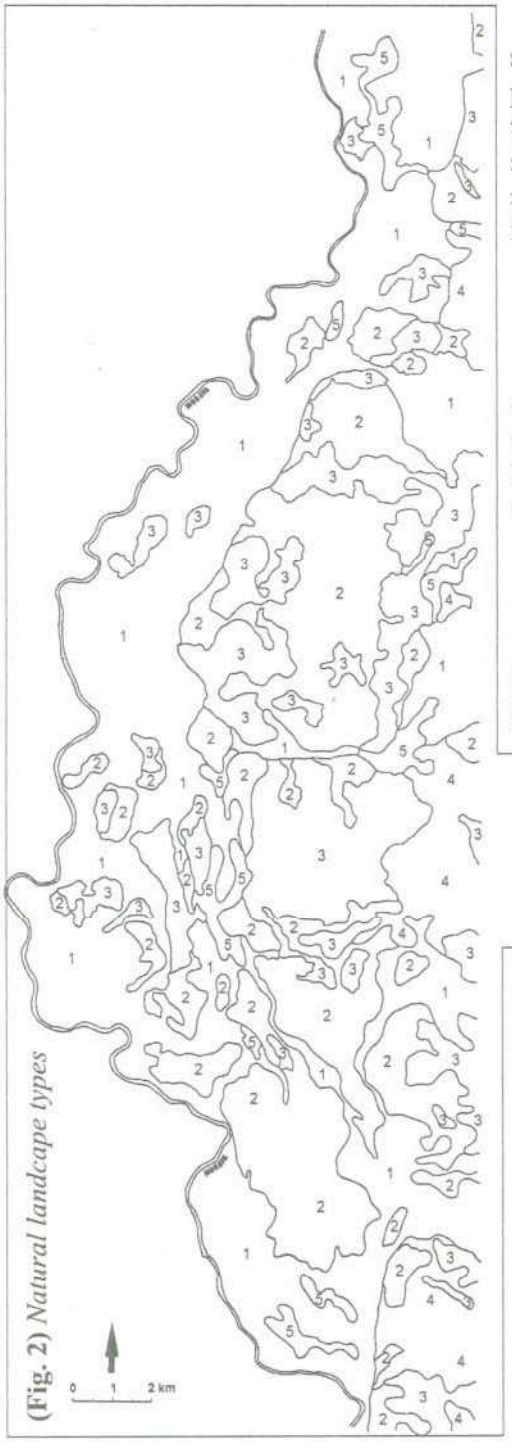
Besides the tectonic movements a pronounced morphological agent of the lowland is represented by the river Morava, as it modelled the surface through sedimentation of the gravels and sand-clay material. The Pleistocene climatic oscillation conditioned the formation of the system of fluvial terraces and simultaneously of the complexes of eolian sands. The blown sands can be found in the form of smaller scattered isles or as the whole system of Bor. The surface of the fluvial plain, especially in the inundation area is enlivened by the remains of old arms in various stages of silting and with various thicknesses of organic sediments.

Besides the tributaries of the Morava (Myjava, Rudava, Sološnický potok) there is an entire system of drainage channels (Zohorský and so-called Hlavný prívodný kanál). The lower part of the Morava has the character of a plain river with small gradient and slow flow (the mean annual discharge is 109 $m^3.s^{-1}$ at Moravský Sv. Ján). An other type of mountain regime is that of the river Danube, (in Bratislava with mean annual discharge 1993 $m^3.s^{-1}$) influencing during high discharges of the alpine regime also the inundation area of the Morava. Numerous small lakes, that originated after the extraction of gravel and sand, and are used for recreational purposes (Malé Leváre, Jakubov, Moravský Sv. Ján, Sekule), are typical of the area. The river lakes that originated by natural isolation of the original arms (Stará Morava, Malina, Šrek) are object of special research.

The area of interest has a warm, mildly dry lowland climate with a mild winter. The highest mean temperatures in July reach over 20 °C (Malacky 20.3 °C), the lowest drop in January to -2 °C (Borský Sv. Mikuláš -2.3 °C). Strong and drying summers and autumn SE winds are typical for the lowland. The lowest average annual total is that of the alluvial plain of the Morava (550 mm), Zohor has 602 mm.

On the sand-clay sediments of the alluvial plains fertile fluvisols to phaeozems, or less fertile gleysols have originated.

Depending on the level of the ground water, or of the surface inundations in the inundation area, they were covered by originally continuous willow-poplar floodplain woods (soft alluvial forests) or elm floodplain woods (hard alluvial forests). Marshland or birch woods with Molinia are bound to the depressions or dead arms with a high ground water level. On higher Pleistocene terraces the fluvisols change into cambisols and out of the original oak woods to oak-hornbeam woods are reconstructed. Arenic regosols with vegetations of acidophilous pine woods with oak developed on sand dunes.



(Fig. 2) *Natural landcape types*

The cited natural conditions in the sense of methodology are spatially expressed in the map Natural landscape types (Fig. 2) which differentiates the study area into 5 classes with dominant representation of flood-plains, fluvio-eolian terraces and dunes

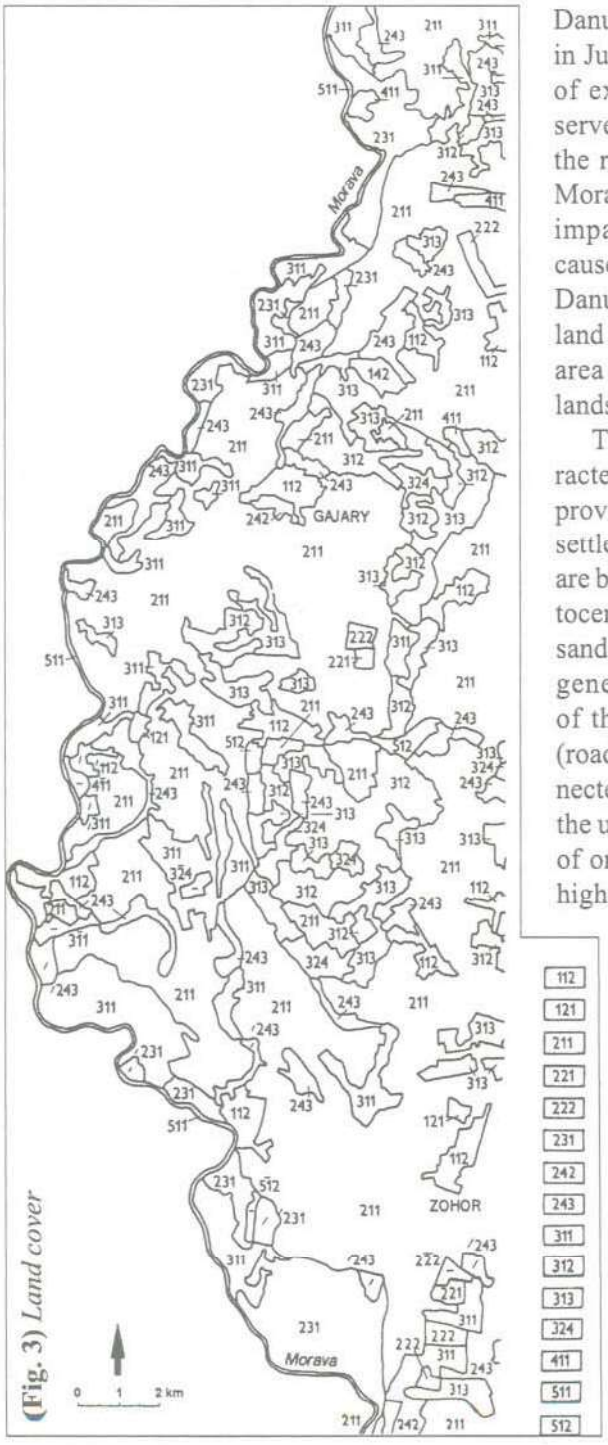
4 Contemporary Land Cover

The land cover is represented by 15 classes identified in the sense of the CORINE Land Cover legend (see Fig. 3) in which the classes of agricultural and forest landscape dominate.

5 Comparison and Proposals

The contemporary pattern of land use on single nature landscape types implies their internal synergic and outer choric relations of the natural and socio-economic components of the landscape. Their significance gradually grows after knowing their stability during the temporal changes and it positively evokes the subsequent need to respect and preserve them. The ecological significance of marshlands and forest areas within the flood plains (aggradation plains and backswamps) of the lowlands and basins is connected with the oscillation of the ground and surface waters in these natural landscape types.

Especially interesting is the relationship of the surface floods in the inundation area of the Morava, associated with high water levels of the

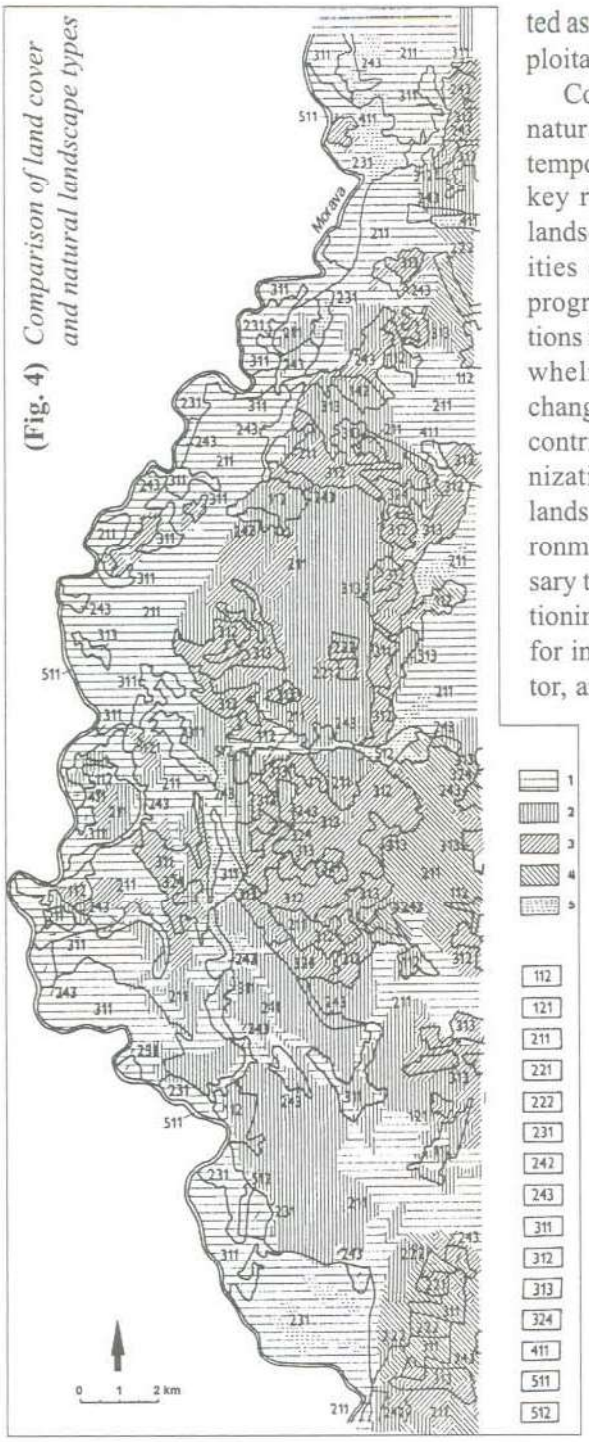


(Fig. 3) *Land cover*

Danube (the maximum discharge in June and July) and occurrence of extensive areas of well preserved grasslands in this part of the river plain up to Vysoká pri Morave. Further north where the impact of the summer floods caused by the alpine regime of the Danube is not so distinct, arable land also occurs in the inundation area besides the forests, marshlands and grasslands.

The original "marshland" character of the fluvial plain is also proved by the distribution of the settlements. Their historical cores are bound to higher situated Pleistocene terraces, covers of blown sands or undulated plains of polygenetic Neogene. The origins of the communication network (roads and railroads) is also connected with the higher position of the undulating plain. The relation of orchards and vineyards to the higher positions of the terrain is linked to the warm character of the substratum, as well as to the ground water level.

A very close dependence can be found between the prevailing pine and mixed (less oak) forests and dunes. Their changes brought about numerous negative phenomena like increased wind erosion that warn against any interventions into this relation. This is proved by intensive forest management and its manifestation: often plan-



(Fig. 4) *Comparison of land cover and natural landscape types*

ted as transitory formations after exploitation or after recent fires.

Comparison of the reconstructed natural landscape types with contemporary land use points to various key relations between the natural landscape regime and human activities (Fig. 4). Even though social progress facilitates great interventions into the landscape and its overwhelmingly unusual technicized change, knowledge of natural laws contributes to rational spatial organization of social activities in the landscape, to the reduction of environmental risks, and the cost necessary to ensure its conflict-free functioning. Neglect of this knowledge, for instance in the agricultural sector, and organization of large-scale production in an effort to obtain new areas of arable land (by drying out the backswamp depressions, ploughing the grasslands on steep slopes, etc.), brought many errors and ecological conflicts (changes of the microclimatic and water regime of the given parts of landscape, loss of balance of biodiversity and of the natural regulations of biota, increased soil erosion, etc.). Disturbed ecological landscape stability affected not only the proper sector, but also further activities and their spatial organization.

6 Conclusion

At present changes of landscape are more intensive, they are realized in comparatively short periods and affect extensive areas of the Earth's surface. Knowledge of natural landscape types, natural regimes and laws make it possible to estimate the relations and dependencies on the contemporary land use/land cover, especially emphasizing respect for ecological and environmental principles. Comparison of these abstracted layers of landscape, also known in the concept of landscape use, then becomes an initial and basic estimation, but at the same time presentation of the first results of knowledge of these relations. In this sense it also offers basic solutions at the landscape planning and management, especially at the level of prevention and therapy.

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