PROBLEM OF DISTINGUISHING AND CLASSIFICATION OF LANDSCAPE TECHNOTOPES (ON THE EXAMPLE OF LITHUANIAN TERRITORY)

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Abstract

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Landscape technogenization (change of landscape structure by using enginery, construction of new objects) is an important issue of contemporary landscape science as well as all other problems of sustainable development. Although technogenization is inseparably related with all other natural and social landscape processes, its significant influence on the structure of landscape demands some more explicit investigations as it is already being done in case of physiogenic or biogenic processes (in large number of works devoted to relief, climate, biotops, etc.). One of the ways to analyse the technogenic structure of today's landscape is to distinguish a kind of relatively independent parts of technogenic structure (technotopes), combinations of human created or modified and supported objects that are territorially concentrated and connected to each other by particular energy and substance structural links. They were designated on the map using the miscellaneous cartographic material of 1:50 000–1:200 000 scale and then digitized in order to do various overlay operations with number of GIS databases for their characterization. The ways of technotope classification are based on urbocomplex type, road net, landuse structure. Application of the research material in spatial planning is related with many targets of protection of landscape structural and emotional potentials, perfecting National Master Plan of Lithuania.

Key words: landscape technogenic structure, technotopes, technomorphological regions

Introduction

The proposed way of landscape technogenic structure investigation represents the morphological approach to landscape. Widely approved understanding of landscape as a complex of several components is of no doubt only one of many facets of the same phenomenon that was the cradle, playing ground, natural school for humanity and finally became a building lot for its uncountable undertakings. However, various structures of landscape are still not enough investigated. We can talk about geomorphological, hydrographical, biogeographical structures of landscape. Because of their relative stability and high visual expression they are the investigation objects of geographical sciences since centuries ago. The same physical qualities could be applied to the human-created landscape technogenic structure with the difference that its investigations are still in the state of initiation. The reason is the complexity, heterogeneity, juvenescence and rapid development of technogenic creations. But today the scale of anthropogenic landscape transformations reached the point where disregard of technogenic landscape frame as a separate phenomenon leads to uncompleteness of understanding of the structure and processes of contemporary cultural landscape and so limits our chances to balance the negative anthropogenic impact.

In Lithuania the landscape science develops through two main directions, namely processological-ecological and morphological, the latter is represented by this article. The concept of cultural landscape integrating natural (lithosphere, etc.) and anthropogenic (technosphere, anthroposphere, noosphere) components and processes offered by P. Kavaliauskas in 70ies later was also applied for morphological regionalizations in regional and national scales (Kavaliauskas, 1976, 1986). The other Lithuanian geographer, A. Basalykas, also developed the concept of cultural landscape, at first suggesting the "cultural robe" for natural territorial complexes, later presenting the complicated scheme of landscape organization levels (physiocomplex, biocomplex, sociocomplex) (Basalykas, 1971, 1986). The following work presents the concrete methodology and results of analysis of technosphere or sociocomplex in Lithuanian territory perfomed during last five years (Veteikis, 2003). The problem related to technomorphological transformation of landscape is not very popular in geoenvironmental sciences, it is delt in several ways – extracting settlement landscape elements (Steins, 1986), evaluating anthropogenic transformation of natural landscape patches (Richling, 1999), analysing the technogenic creations as new relief elements (Rozanov, 2001), etc. The way of distinguishing technomorphological territorial units as reflections of human impact on landscape structure was suggested in addition to all the other point of views.

Material and methods

Relatively independent combinations of human created/modified and supported objects that are territorially concentrated and connected to each other by particular energy and substance structural links were called technotopes.

Constituent technotope elements (technogenic objects) are classified into large types depending on their genesis (man-made or man-modified objects). Technogenic element classes are distinguished according to the peculiarities of their form. The classification of technogenic elements used for distinguishing technotopes is given bellow.

I. Man-*made* artificial elements: 1. building complexes – urbocomplexes, 2. solitary buildings, 3. infrastructure lines and nodes, 4. means of transport, 5. dumping grounds and open depots. II. Man-*modified* natural elements: 1. hydrotechnical complexes, 2. objects of artificial relief, but natural material, 3. arables, greenlands, 4. gardens, parks and other arboreal plantations of intensive handling, 5. forestry land-use and other arboreal plantations of episodic handling.

However, not all of the above mentioned technogenic elements, depending on the scale, are adequately mapped, especially in national level. The generalization and reduction of elements is inevitable. Technotopes were designated on the map using the cartographic material of 1:50 000–1:200 000 scale and then converted

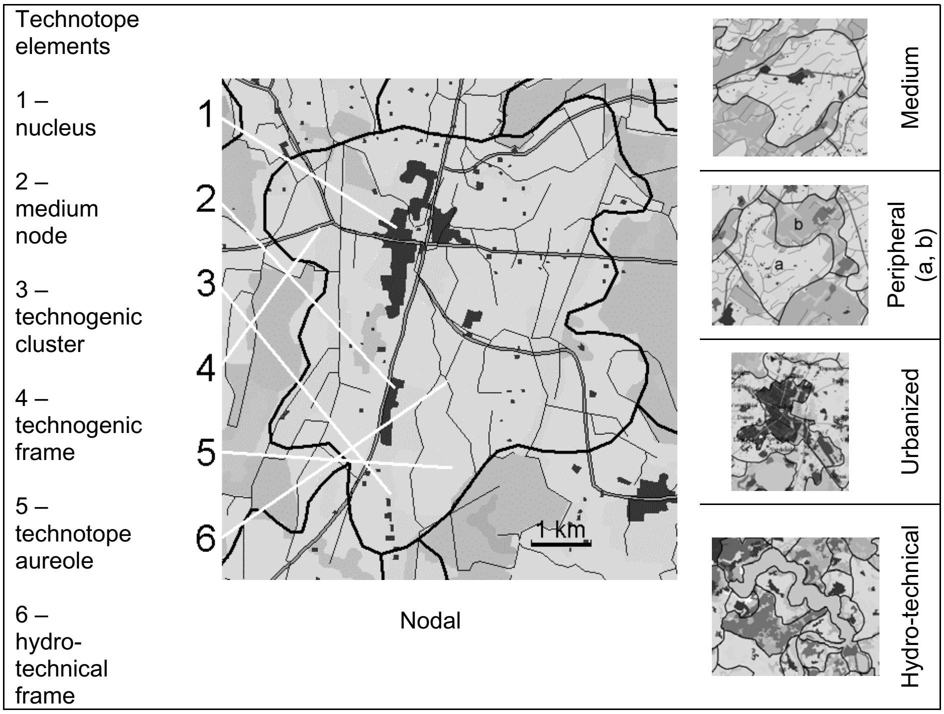

Fig. 1. Technotope types and their elements in cartographic expression (scale 1:50 000 to 1:200 000).

into a GIS information layer in order to do overlay operations with various other GIS databases (land cover, infrastructure, hydrotechnical net) for their characterization. Different technogenic elements (only generalized ones are taken) carry a different function in the structure of technotope. Urbocomplexes (complexes of buildings), depending on their size, can be nuclei (technotope nucleus is a relatively large urbocomplex, in most cases town, sometimes industrial or power plant, surrounded by radial or more complex road net), medium nodes (small urbocomplexes that are situated on a single road or simple crossing) or make technogenic clusters (groups of dispersed steadings, farmyards); infrastructure lines make the frame of technotope; various types of land-use create the technotope aureole that can be fragmented by the hydrotechnical net of various density and configuration (Fig. 1). Typical combinations of technogenic elements underlay the distinguishing of 1969 technotopes in Lithuania territory.

The very method of distinguishing technotopes is based on detecting of so called territorial technogenic mass centre and the most significant boundaries separating the reach zones of neighbouring mass centres. The mass centre depends on the size of urbocomplexes and road net while the land-use structure supposes the landmarks for technotope boundaries. In most cases cultivated land surrounds the technogenic mass centre in a form of aureole ending in the periphery with solid or discontinuous forest line. Forest line or dispersed forest plots are selected as technotope boundaries because they are the least anthropogenized landscape areas. Discussion rises in places where the landscape cover is predominantly agrarian or afforested. The boundaries of technotopes in the agrarian landscape are steered keeping to the average distance between mass centres and also to those rare forest plots. Woody landscape, especially where forest wedges or bars reach the technogenic mass centres, is rather complicated to distinguish technotopes. The technotopes here become complicated in form, often branchy, with asymmetrical mass centre position. Landscapes of large cities, towns or enterprises require

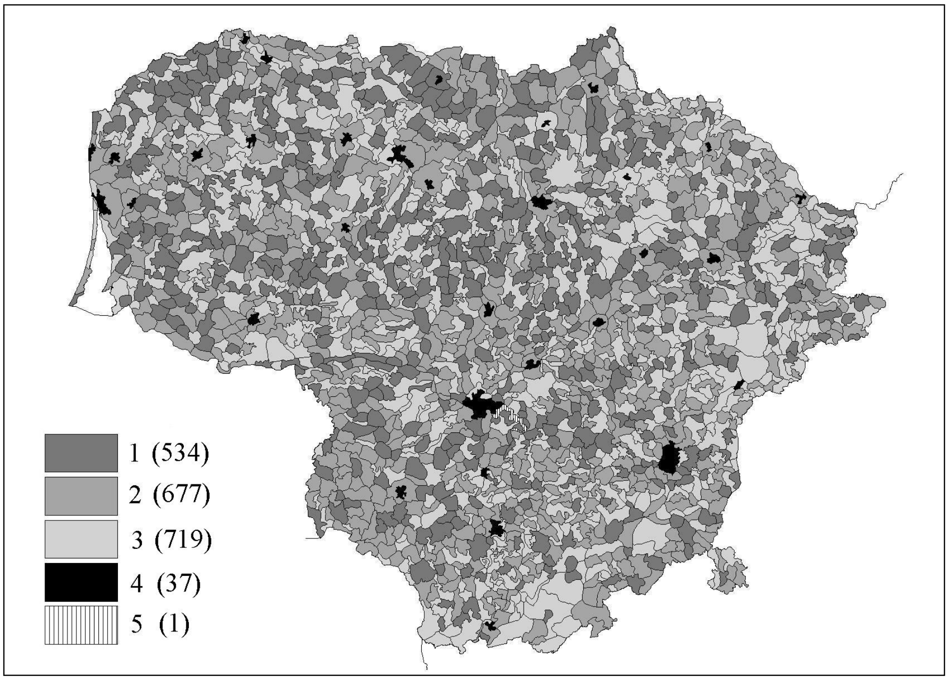

Fig. 2. Territorial distribution of technotopes in Lithuania. Numbers indicate the following types: 1 – nodal, 2 – medium, 3 – peripheral, 4 – urbanized, 5 – hydrotechnical (in brackets the number of the technotopes of the respective type is given).

the special attitude as they represent the most anthropogenized areas. They are distinguished as separate technotopes. The larger ones (e.g. Vilnius or Kaunas cities) with several mass centres were divided into several technotopes separated by natural boundaries like rivers or city's greeneries systems.

Results

1969 technotopes were distinguished in Lithuanian territory (averagely 33 km^2 each). According to the internal structure, technotopes are divided into nodal, peripheral, medium, urbanized, hydrotechnical (Fig. 1). A *nodal* technotope has a nucleus, medium nodes, technogenic cluster, frame and aureole. A *medium* technotope lacks nucleus, a *peripheral* one has no nucleus and medium node, only technogenic cluster, weakly developed frame and relatively homogeneous aureole. *Urbanized* technotopes are characterized by relatively solid technogenic cover, they usually comprise the territories of large cities and industrial or power complexes. The type of *hydrotechnical* technotopes was offered for the cases of the large artificial water bodies with all the water-mass controlling equipment. Territorial distribution of technotopes in Lithuania is shown in Fig. 2.

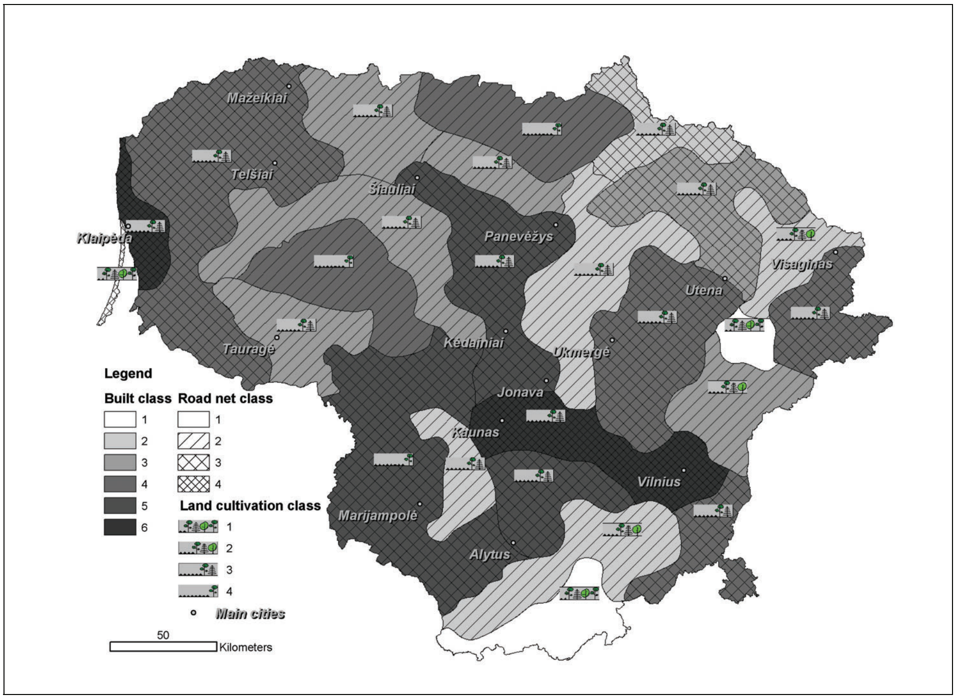

Fig. 3. Technomorphological regionalization of Lithuania. Built, road net, and land cultivation classes are described in Table 1.

Technotopes can be described by several technogenization characteristics: built area, road net density, percentage of agricultural plots in land-use structure. Every characteristic is rather complicated by itself, e.g., built area can be compact or disperse, consist of multi-storeys or village cottages; roads are also of different importance, traffic load, and cover; agriculture plots can be cultivated differently. This suggests many ways of technotope classification. Different attributes of the technotopes create several types of land mosaic and large regions can be demarcated when this is expressed cartographically. This process of partial regionalization according to each of the characteristics was performed as the medium link towards complex technomorphological regionalization. The attempt was made to distinguish large regions and districts with different domination of the mentioned features (built area, road net density, percent of agriculture lands). The result presents the general technogenic structure of the landscape in regional or national scale. Suggested territorial units (Fig. 3) finally can be attributed to the following descriptive classes (Table 1).

Built characteristic (urbanization) is divided into six classes (coupled into three groups) according to the percentage of the urbanized area in the region. The four road net classes represent the total density of all the roads (arterial, regional, local) in a region. The four

T a b l e 1. Classification features of technomorphological territorial regions

1. Built classes (percentage of built area):
Low urbanization: 1 Class < 2% 2 Class 2–3% Medium urbanization: 3 Class 3–4% 4 Class 4–5% High urbanization: 5 Class 5–8% 6 Class > 8% (up to 12.15%)
2. Road net classes (road density):
1 Class (very rare net) < 0.75 km/km^2 2 Class (rare net) 0.75–1 km/km^2 3 Class (dense net) 1–1.25 km/km^2 4 Class (very dense net) > 1.25 km/km^2
3. Land cultivation classes (percentage of agriculture cultivation land):
1 Class (very low cultivation) 0–25% 2 Class (low cultivation) 25–50% 3 Class (high cultivation) 50–75% 4 Class (very high cultivation) 75–100%

land cultivation classes are distinguished according to the percentage of agriculturally cultivated land in the region.

Discussion

The regions distinguished reflect the characteristic areas and directions of landscape anthropogenization in Lithuania territory. This picture is the result of long-term interaction between nature and culture in landscape. However, the problem which part of this interaction played more important role in the development of particular landscapes still persists. The exploration of the historical conditions and reasons of growth of technogenic elements in a specified place and in the whole Lithuanian landscape is one of the fundamental tasks of landscape science.

The results of technomorphological (qualitative) analysis of landscape structure can suggest a quantitative attitude for landscape research namely the calculation of technogenic masses. Technomass is understood as a quantitative characteristic of man-made, transformed or injured objects. Its meaning depends on the direction and intensity of both technogenic activity and nature impact. Full evaluation of technomass could comprise the three indeces: a) effective work done by enginery (ergotechnical index), b) artificial-ness of the man-made or affected matter, c) technogenic resistance of the object (technogenic life; opposite to the object's submission to renaturalization).

Both qualitative (by distinguishing and describing technotopes) and quantitative (by calculation of technomasses) analyses can be important in physical planning, namely in creating the paradigms of landscape design. The main tasks of landscape design are related to protection of landscape structural and emotional potentials respectively dealt with by geographical and architectural design paradigms (Kavaliauskas, 1992). In the regional and national levels, where the postulates of Master Plan are being constructed, understanding of the landscape technogenic structure enables realisation of several planning tasks. Landscape studies from the point of technogenic morphology have resulted in the complex nationwide technomorphological regionalization (Fig. 3). This kind of research material can be of great support while shaping national urban frame as the technomorphological regionalization contains information like built area, road net, etc. On the other hand, this information can be useful in delimitation of the opposite landscape structure – national natural frame, in determination of areas of overlapping/friction between urban and natural frames. Most monuments of cultural heritage also are technogenic objects in general sense, therefore landscape technogenic morphology has to play some important role in the cultural landscape protection policy, as well.

Conclusion

Developed methodology of analysis of landscape technogenic structure as well as the very result of this analysis expanded the research field of landscape morphology science. Possibilities to analyse the territorial organization of both internal and external technotope structure suggest the comparison with other landscape component organizations, like biotope, geomorphotope, etc., that finally can lead to the integrated understanding of complex landscape structure.

The results of research conducted prove that landscape technogenic morphology makes a solid contribution to landscape design paradigms both geographical and architectural. Dealing with various aspects of landscape technogenic structure it provides necessary information and knowledge for proper understanding of landscape design targets and objectives (preserving, controlling, protecting qualities of landscape potential). In perspective landscape technogenic morphology could contribute to developing conceptions of different landscape planning models, perfecting National Master Plan.

Translated by the author

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