

ENVIRONMENTAL ASSESSMENT OF NATURAL-TERRITORIAL COMPLEXES (NTC) OF A BIG CITY

Natalia Tupitsyna¹

¹Belarus State University, The Department of Geography, av. Fr. Skaryny, 4, 220050, Minsk, Belarus,
Phone: (+375 17) 209 54 91, e-mail: nataliatupitsyna@mail.ru

Abstract

The study's main purpose is to offer methodology for the evaluating human impacts on natural-territorial complexes (NTC) of the cities. It is largely neglected problem, insofar as urbanized NTCs routinely are not considered for environmental protection and monitoring, thereby this issue is under-theorised and lacking practical implications. The methodology comprises two sections, such as assessment of NTC's carrying capacity and direct consequences of human impact. The former has been assessed as arithmetical sum of the following indexes: geological environment, resistance of soil/plant cover and aquatic ecosystems to contamination, migrating conditions of geochemical landscapes. The last section is composed of geomorphological (degree of relief transformation within NTCs), geochemical (average coefficient of heavy metals' concentration), and geobotanical (character of the most common phytocenosis) indexes. The procedure was resulted in integrating above indexes into the assessment map, and making assumptions on the relevance of either natural or human factors to NTC's ecology in the city. Mogilev's (Belarus) case study has been done to approve this methodology. As the study's outcome, 99 NTCs have been classified into four classes, regarding their environmental conditions: 22% of the city was assessed as very good, 34% - good, 37% - bad, and 7% - very bad.

Introduction

Environmental urban evaluations form a significant instrument to study the cities and their environment. Modern investigations of urban areas in Belarus basically have branch character and as a rule they are submitted by the architectural, geological or medical works. A major challenge for studying the urban ecosystem will be to offer a methodical approach which provides a basis for (re)connecting and (re)integrating the different components and functions of an urban system (1). Environmental evaluation may be in general characterized as a process of the analysis, synthesis, management of the environment and prognosis regarding the development of environmental components of whatever spatial unit. Natural fragmentation of city area is the main factor of differentiation of the urban environment into various units with variety of ecological conditions. Therefore it can be proposed the approach based on natural-territorial complexes (NTC) as the principal compartments of the urban system.

Natural-territorial complex (natural landscape) is the natural combination of geographical components (an earth's crust, a relief, water, air weights, communities of alive organisms), which form complete material system (complex) (2), existential system of the geographical components mutually conditioned in the allocation and developing as a unit (3).

The aim of the study is to offer methodology for the evaluating human impacts on natural-territorial complexes of the cities. Mogilev (Belarus) – the big city with complicated landscape structure – has been selected as a study area.

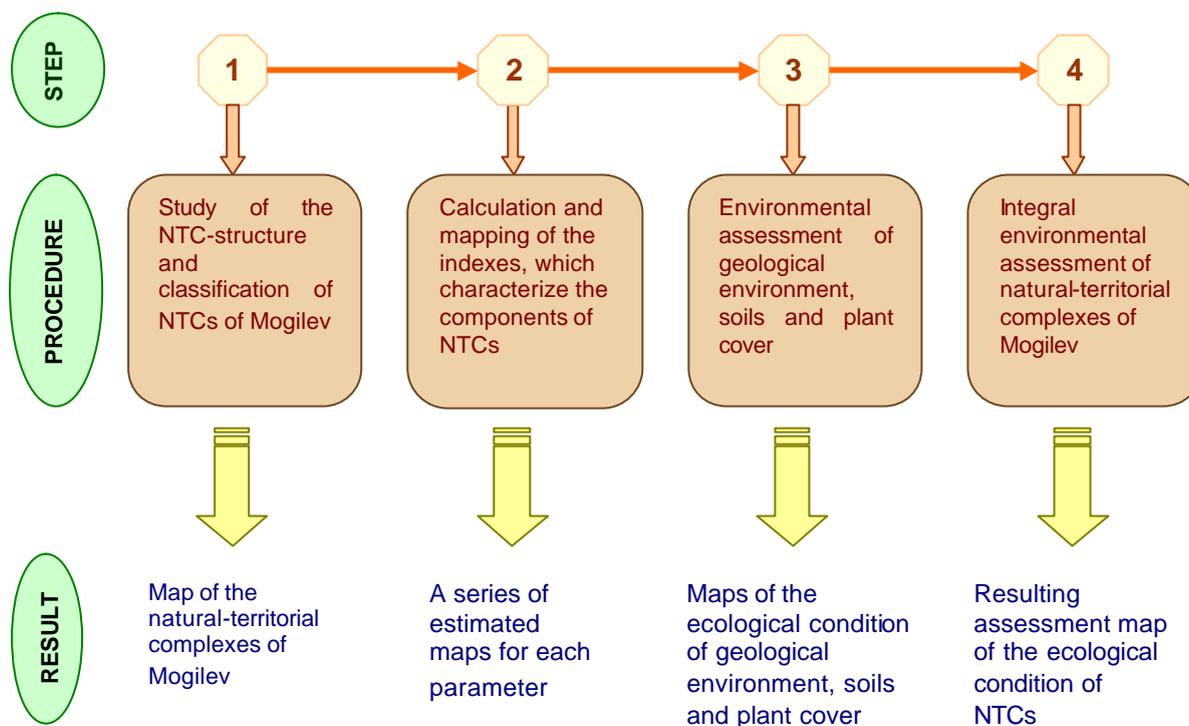
Methods

Environmental assessment was carried out to following steps (figure 1). In the course of the research materials of own field investigations, statistic data, archive materials of sanitary, town-planning and environmental control authorities of the city of Mogilev have been used and mathematical methods, methods of ecological computer cartography and GIS-technology have been applied.

The methodology comprises two blocs, such as assessment of NTC's carrying capacity and direct consequences of human impact. The factors determining stability of NTCs (favorability of geological conditions, resistance of soil/plant cover and aquatic ecosystems to contamination) have been appreciated according to a direct four-stage scale; for calculation of the factors reflecting man-made

transformation (geomorphological, geochemical, and geobotanical indexes) of NTCs have been used an inverse four-stage scale.

Figure1: Principal Scheme of Environmental Assessment of Natural-Territorial Complexes



For the evaluation of the index of favorability of geological conditions such criteria as the ground stability, level of ground water and danger of flooding have been discounted. Reception of the soils to contamination has been determined as a function of the type of soil, grading of soil, conditions of wetting, position on the geochemical landscape, ect. Index of the resistance plant cover to contamination considered type of phytocenosis and its natural stability. For the evaluation of the degree of relief transformation within NTCs the morphotype of the building-up areas and (or) open spaces and character of land use has been taken into account. Geochemical transformation has been estimated according to average coefficient of heavy metals' concentration. Geobotanical index has been calculated depending on character of the most common phytocenosis.

In the next step the ecological assessment of geological environment, soils and plant cover has been made. They have been assessed as arithmetical sums of all of the calculated parameters taken into account the coefficient of there significance.

The last stage included conjugate analysis of the assessment maps of NTC's components and integration above indexes into the map of the environmental assessment of NTCs.

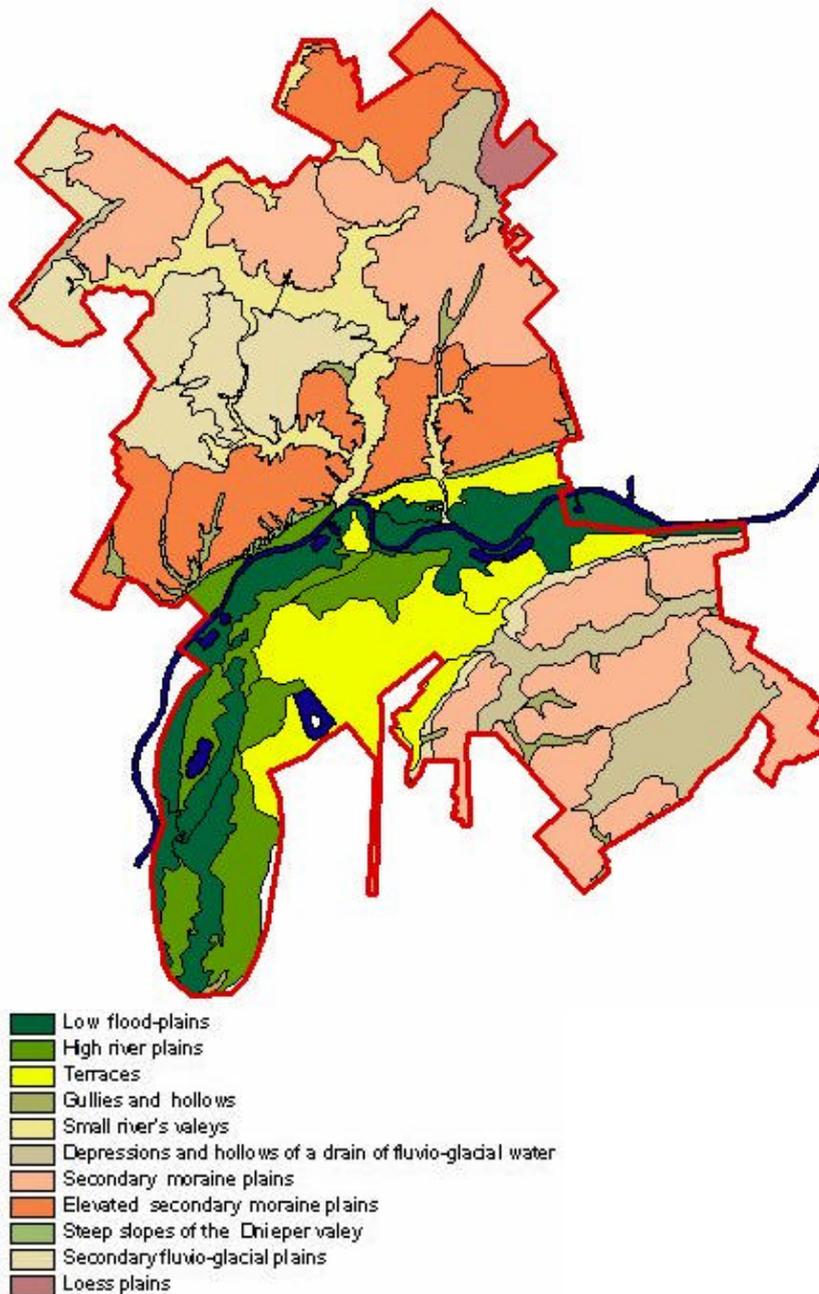
Results

Within tasting area 99 NTCs, which have been divided and aggregated into 11 types. NTC's structure of the territory of study is reflected by illustration 1.

Within the territory of Mogilev complexes secondary - moraine and elevated secondary - moraine plains with sod-podzol soils on loess-like loams, moraine loamy sands and the loams spread moraine loams, possessing high ground stability prevail. More than 15 % of territory is occupied by complexes of a valley of Dnieper (low and high flood-lands on alluvial sand and loamy sands, terraces on alluvial and ancient alluvial sand and loamy sands). The most part of territory of city is characterized by a low level of ground waters. Wide spread of the moraine and loess-like loams integumentary laydowns and a low level of the

ground waters allow to estimate the environmental geological conditions of study's area as favorable on the most part. Widely submitted loamy and loamy - sandy sod-podzol soils possess a low susceptibility to geochemical pollution. Prevailing in the city artificial phytocenosis are characterized by the low level of stability to human impact.

Illustration 1: Types of Natural-Territorial Complexes of the Territory of Mogilev



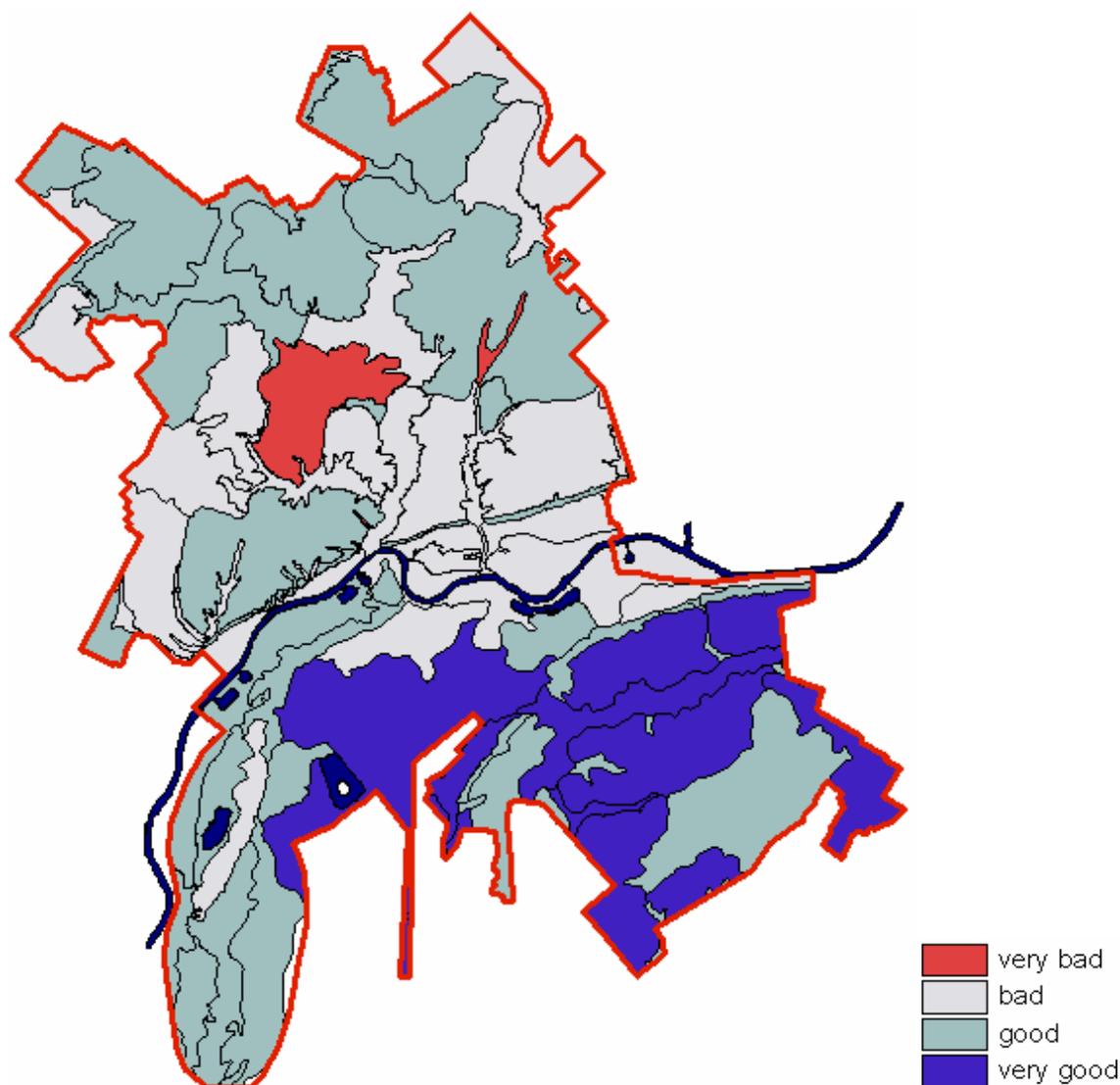
During the estimation of degree of geological environment transformation morphotypes of building up and open spaces and the character of land use were taken into account. Within the territory of Mogilev vast areas are presented by the open spaces (flood-plains, city parks and forests, etc.) and wooden housing. Industrial and transport areas render the greatest influence on the geological environment, but they

occupy a sufficiently small areas. That's why level of relief transformation for the most part of territory of city has been assessed as low and moderate. Level of the heavy metals' concentration of tested area can be characterized as low and moderate.

Discussion

On the basis of the characteristics of geological environment, soils and plant cover for each natural landscape unit the final environmental assessment of NTCs has been accomplished. The procedure was resulted in integrating above indexes into the assessment map (illustration 2).

Illustration 2: Environmental Conditions of Natural-Territorial Complexes



As the map displayed, 22% of the city can be assessed as very good, 34% - good, 37% - bad, and 7% - very bad. This favourable situation first of all is explained by the high carrying capacity of natural-territorial complexes for the most part of testing territory.

Therefore we can said, that in spite of high degree of human impact NTCs in Mogilev predominantly characterizes by good and very good ecological conditions and can be defined as the primary factor of stabilization of the urban ecosystem on the whole.

Conclusion

The methodology has been approved by local city-planners. Obtained results have been taken into account for working out new Strategic Development Plan of Mogilev.

The methodology empowers to consider urbanized NTCs for environmental protection and monitoring. It can be purposed for decision making in city-planning, environmental management and public health.

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