SPATIAL APPROACH TO THE ASSESSMENT OF ANTHROPOGENIC IMPACT ON BIODIVERSITY BASED ON THE NOMENCLATURE OF TERRITORIAL UNITS FOR STATISTICS (NUTS) APPLICABLE TO ROMANIA

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Abstract. *Based on the spatial scale, authors distinguish several levels of biodiversity: α diversity (for an ecosystem), β diversity (for ecosystems within a complex), γ diversity (for a regional complex of ecosystems), and δ diversity (for a macro-regional complex of ecosystems). Taking into account this "diversity of diversities", the paper recommends a hierarchy of methods that could be used to assess the impact of urban and spatial plans on biodiversity. Based upon the classification of the Nomenclature of Territorial Units for Statistics (NUTS), anthropogenic impact could be measured for urban plans (NUTS V) and county plans (NUTS III) by looking at changes in land use, e.g., using CORINE data. At regional (NUTS II) and national (NUTS I) levels, diversity can be assessed within the biogeographical regions, and the impact on it by the decrease of the areas covered by less represented or vulnerable classes, such as the Black Sea and alpine regions.*

Keywords: *biodiversity, NUTS, CORINE, biogeographical region.*

Rezumat. Abordarea spaţială a evaluării impactului asupra biodiversităţii pe baza nomenclatorului unităţilor teritoriale aplicabile României. *În funcţie de scala spaţială se disting mai multe niveluri ale diversităţii biologice: diversitatea de tip α (diversitatea unui ecosistem), diversitatea de tip β (diversitatea ecosistemelor din cadrul unui complex de ecosisteme), diversitatea de tip γ (diversitatea unui complex de ecosisteme regional) şi diversitatea de tip δ (diversitatea unui complex de ecosisteme macroregional). Având în vedere existenţa acestei „diversităţi a diversităţilor", prezentul articol recomandă o ierarhizare a metodelor folosite pentru evaluarea impactului planurilor de urbanism şi amenajarea teritoriului asupra biodiversităţii. Astfel, în funcţie de clasificarea nomenclatorului unităţilor teritoriale (NUTS), impactul antropic poate fi măsurat în cadrul planurilor de urbanism (NUTS V) şi amenajare a teritoriului judeţean (NUTS III) prin schimbarea destinaţiei terenurilor, un exemplu în acest sens fiind oferit de utilizarea datelor europene din cadrul programului CORINE. La nivel regional (NUTS II) şi naţional (NUTS I), diversitatea poate fi evaluată la nivelul regiunilor biogeografice, iar impactul asupra acesteia prin diminuarea suprafeţelor regiunilor biogeografice mai slab reprezentat sau vulnerabile, cum ar fi cele specifice zonei Mării Negre sau regiunii alpine.*

Cuvinte cheie: *biodiversitate, NUTS, CORINE, regiune biogeografică.*

INTRODUCTION

Based on the spatial scale, MAGURRAN (1998) and PUSCEDDU (2008) distinguish several levels of diversity; the first five levels include a spatial (scale) component:

- Alpha (α) diversity – diversity of an ecosystem, community, taxonomic or functional group or biocoenosis,
- Beta (β) diversity – diversity of ecosystems within a complex of ecosystems, diversity of habitats or diversity along gradients,
- Gamma (γ) diversity – diversity of a regional complex of ecosystems, a large area, *e.g*. biogeographical regions within continents, presented below,
- Delta (δ) diversity – diversity of higher rank (macro-regional) complexes of ecosystems, *e.g*. global biogeographical regions, presented below,
- Epsilon (ε) diversity – diversity of life environments (oceanic, terrestrial),
- Omega (ω) diversity – phylogenetic diversity / diversity of the global taxonomical hierarchy.

Urban and spatial planning is governed in Romania by several legislative instruments. Law no. 350 of 2001 on urban and spatial planning distinguishes based on the spatial scale between spatial planning, aiming to balance socioeconomic, ecological and cultural policies in order to ensure a balanced polycentric development, and increase territorial cohesion and socioeconomic efficiency, and urban planning, aiming to stimulate the complex evolution of urban settlements by phrasing short, average and long term strategies of development. The main difference between the two categories is that spatial plans consist of proposals establishing the general strategies, guidelines and principles, whilst urban plans concretely implement these proposals at the local level though operative regulations. Spatial plans are produced for the national territory, regions and counties, while urban plans cover urban and rural settlements, inner zones or the placement of a specific construction or assembly. Some of these areas are defined by the Constitution as base administrative territorial units, *i.e*., counties and urban or rural settlements.

The Statistical Office of the European Communities (EUROSTAT) had defined and developed a Nomenclature of Territorial Units for Statistics (NUTS), establishing five common levels applicable to all countries within the European Union. Three levels correspond to the Romanian territorial organization. The first one, NUTS I, corresponds to the national territory. The second one, NUTS II, corresponds to the eight Romanian regions of development. These regions do not have a Constitutional base (are not base administrative territorial units), but are useful for the elaboration of development strategies. The third level (NUTS III) corresponds to the 42 Romanian counties, while the fifth one

(NUTS V) corresponds to the smallest base administrative territorial units, *i.e.* urban and rural settlements (3174 municipalities, cities and communes in 2008, according to Eurostat).

The purpose of this paper is to propose a methodology for evaluating the impact on biodiversity based on the special scale, creating a correlation between the spatial levels of biodiversity and the NUTS territorial level, and provide examples on its application in Romania.

β DIVERSITY: URBAN AND COUNTY-LEVEL PLANS

The diversity of the types of ecosystems (β diversity) is also reflected by the diversity of habitats corresponding to biotopes and evaluated by land cover. The European Union uses the CORINE (Coordinated Information on the European Environment) classification, used initially for biotopes and applied today to land parcels to reflect their *cover* and *use*, presented in Table 1 (DE LIMA, 2005). Land use shows how man uses land; land cover indicates what lies on that surface, from a biophysical viewpoint (JENSEN, 2000) – *e.g.*, in a field, land could be covered by herbaceous vegetation, but used in agriculture (as a pasture or cropland), as a green space or park (if it lies within a city), or could be a natural pasture. CORINE classification has three levels, allowing for a very detailed classification. The first level distinguishes between five classes: artificial surfaces, agricultural areas, forest and semi natural areas, wetlands, and water bodies. Within the first class (artificial surfaces), for example, level 2 defines four categories (urban fabric, industrial, commercial and transport units, mine, dump and construction sites, and artificial, non-agricultural vegetated areas), while for each of these sub-classes are defined at the third level: continuous urban fabric, discontinuous urban fabric, industrial or commercial units, road and rail networks and associated land, port areas, airports, mineral extraction sites, dump sites, construction sites, green urban areas, and sport and leisure facilities. Generally, the categories of level 1 describe land cover, while the classes and sub-classes corresponding to the next levels define land use.

Taking into account that the development of a coherent approach at the European level, involving data acquisition and processing using a common methodology, requires extensive funds and takes a long time – 2000 dataset was made accessible in 2004 (DE LIMA, 2005) – updated information cannot be produced every year. The first two databases are based on 1990 and 2000 data. In the example provided below, a subset of data was used to analyze the changes in Vrancea county, as a part of the environmental report included in the spatial plan of the county (PETRIȘOR, 2008b). Fig. 1a presents changes according to level 3 of CORINE classification, in order to indicate the overall magnitude of all changes. Nevertheless, changes at an inferior level (2 or 3) present only a local relevance if the upper level is not changed – e.g, changing an urban function into another one would not affect the "urban ecosystem" status of the settlement. This is why Fig. 1b displays changes of the level 1 class; such changes, even though lesser in magnitude, are more relevant at the level of the entire county and are figured as points and not as areas.

γ DIVERSITY: REGIONAL AND NATIONAL PLANS

The evaluation of the European biodiversity is the output of successive studies, concluded with presentations delivered at DOBRIS (1995), AARHUS (1998), KIEV (2003) and BELGRADE (2007) and published by the European Environment Agency. The information used in these assessments is derived from satellite imagery or received from specialized agencies (DE LIMA, 2005). The spatial component of the assessment consists of mapping Europe's biodiversity based on 11 biogeographical regions, five of which can be found in Romania and are underlined: Arctic, Boreal, Continental, Atlantic, Macaronesian, Mediterranean, Alpine, Pannonian, Steppic, Black Sea, and Anatolian (PINBORG & LARSSON, 2002).

The diversity of biogeographical regions corresponding to the Romanian regions of development was performed as a part of the pilot study for the Strategic Concept of Territorial Development in Romania 2007-2030 (PETRIȘOR, 2008c) and is displayed in Fig. 2. The analysis of these maps leads to the conclusion that Romania possesses a high diversity of biogeographical regions (PETRIȘOR, 2008a). Even smaller regions of development include at least two biogeographical regions and the largest ones, four (South-East). Their complete characterization is summarized in Table 1. While assessing biodiversity changes, particular attention must be paid to vulnerable and smaller regions, such as the Black Sea region and the Alpine region. Even if it is lesser represented in Romania, the Pannonian region covers most of the Hungarian territory.

Table 1. Characterization of the complexes of ecosystems within the regions of development.
Tabel 1. Caracterizarea complexelor de ecosisteme caracteristice regiunilor de dezvoltare.

Region of development	Biogeographical region
Bucharest	Steppic and Continental. High diversity despite of reduced surface.
Center	Alpine and Continental (in the center).
North-East	Alpine and Continental (predominant).
North-West	Alpine, Continental (predominant, central position) and Pannonian (West). High diversity.
South	Alpine (North), Continental (predominant, South) and Steppic (East). High diversity.
South-East	Alpine, Continental, Steppic and Black Sea, disposed in this order as parallel bands from NE to SW. Highest diversity.
South-West	Alpine (North, poorly represented), Continental (predominant, in the South). High diversity.
West	Alpine, Continental and Pannonian, disposed in this order as parallel bands, relatively equal, from NE to SW. High diversity.

CONCLUSIONS

The spatial approach to assessing environmental impact on biodiversity benefits upon the availability of data from the European Union, through the CORINE program. Such data finds a special relevance when analyzing ß diversity at the level of a county or even a smaller unit (urban or rural settlement). However, limitations are due to the impossibility to update information frequently, especially when aiming to investigate the immediate impact of urbanization. γ diversity can be analyzed spatially by investigating the biogeographical regions. However, such analyses do not exhibit a high potential for detecting changes.

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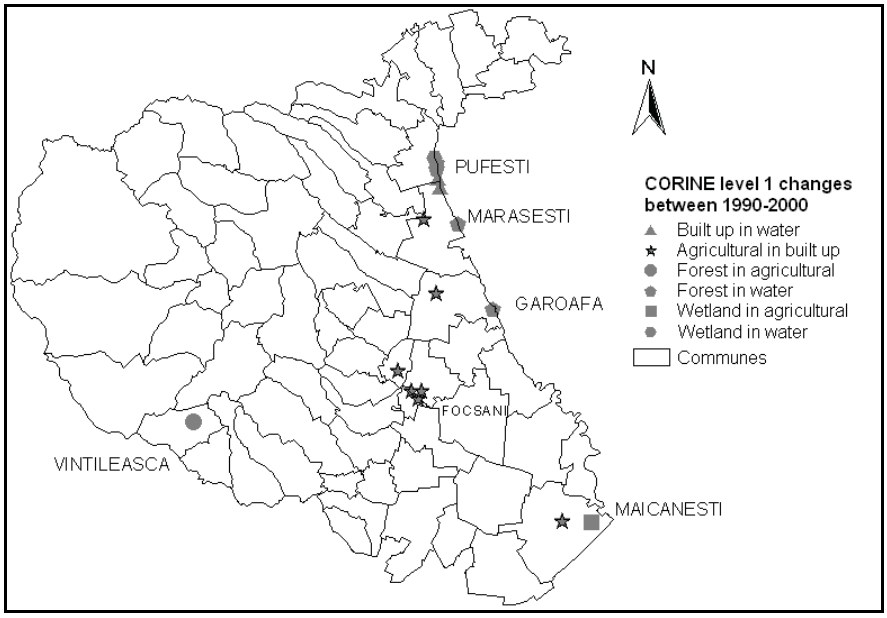

Figure 1a. Changes in land cover and use in Vrancea county between 1990 and 2000 (level 1 of CORINE classification).
Figura 1a. Modificări în acoperirea şi utilizarea terenurilor în jud. Vrancea în perioada 1990-2000 (nivelul 1 al clasificării CORINE).

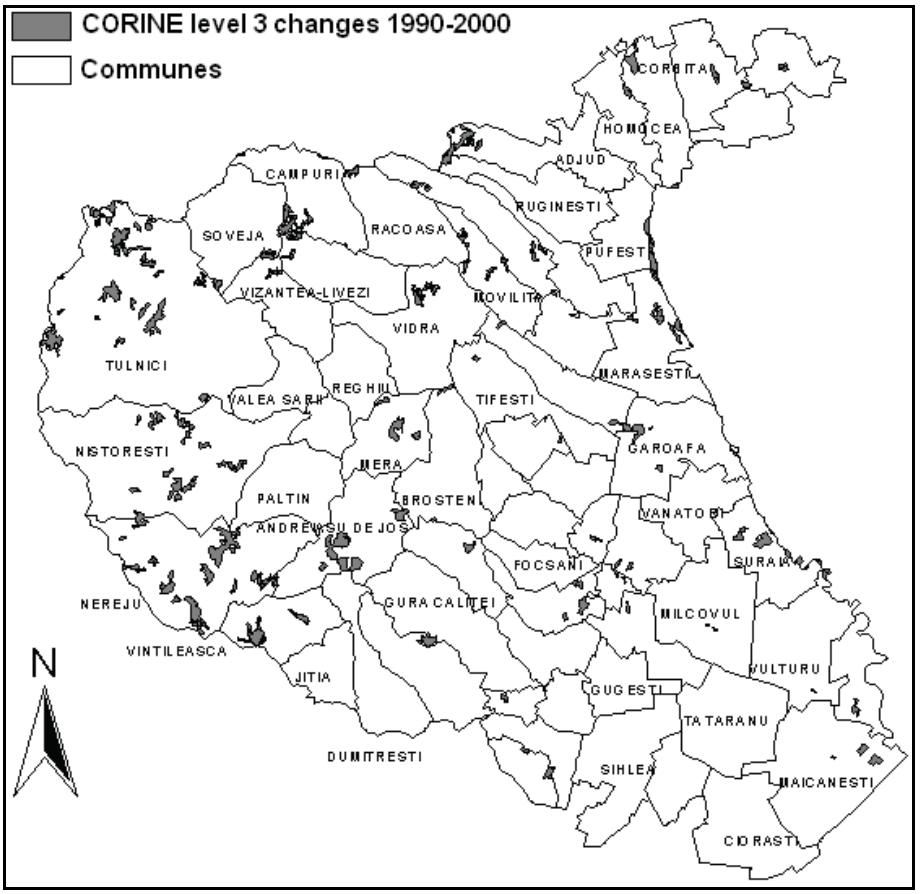

Figure 1b. Changes in land cover and use in Vrancea county between 1990 and 2000 (level 3 of CORINE classification).
Figura 1b. Modificări în acoperirea şi utilizarea terenurilor în jud. Vrancea în perioada 1990-2000 (nivelul 3 al clasificării CORINE).

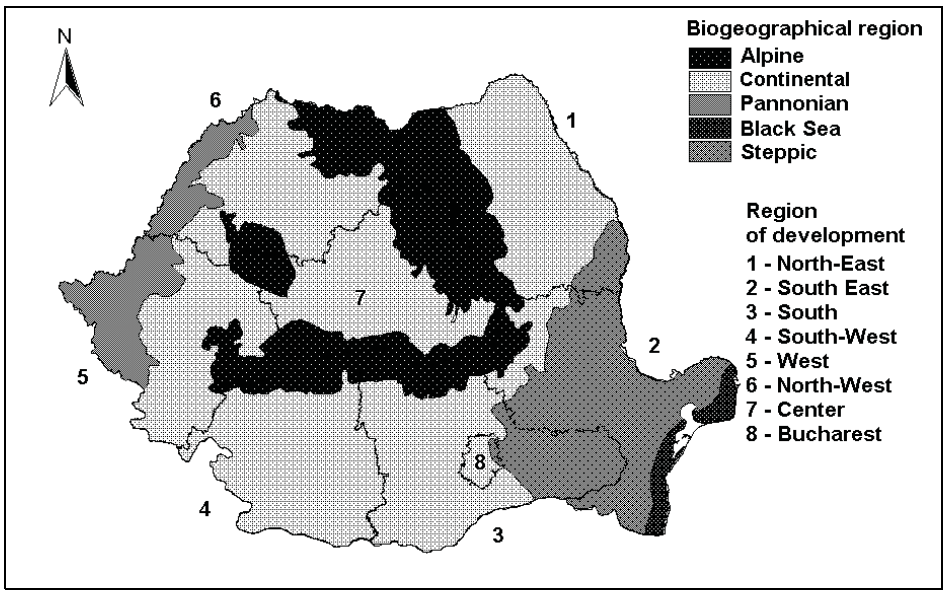

Figure 2. Biogeographical regions corresponding to the regions of development.
Figura 2. Regiuni biogeografice corespunzătoare regiunilor de dezvoltare.

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