Geoecological state of natural complexes in Europe

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Abstract

The small-scale environmental research of terrestrial macroregions of the Earth is now based on the concept of geoecological quality of natural complexes (geosystems). Geoecological quality of a geosystem is such a state of initial (modal) landscape which results from the integration of economic objects into its structure, emergence and development of landscape response in the form of natural-anthropogenic processes, formation of new material, energy and information flows, the demand and realization of its ecosystem services by the society and economy.
The geoecological assessment aims at the improvement of landscape management and is performed in three stages: 1) identification, systematization and classification of modal (natural) landscapes; 2) inventory of economic objects and their impact on natural landscapes, and 3) analysis of the actual geoecological situation in the region. Each stage demands the elaboration and application of particular GIS, and produces, as a result, the specialized cartographic materials. Use of GIS-technologies is possible only if extensive and detailed informational database is available which supports necessary calculations. A model of operational units of the analysis, i.e. landscape-geoecological systems (LGES), is developed on the basis of the ecosystem services evaluation. LGES consist of four subsystems – natural, production, social and management. The key issue is the analysis of social (population) and management subsystems which provide for the sustainable development of a natural complex and made the geoecological assessment possible.

The territory of Europe as an object of this regional research was studied basing on the landscape map at the scale of 1:5 million. The procedure of assessment is illustrated for the territory of Italy. Modal landscapes are absent in Italy, and its natural-anthropogenic complexes fall into two natural zones belonging to the temperate and subtropical geographical belts.

The production subsystem is analyzed on the basis of remote sensing data (the LANDSAT and SPOT imagery processed under the CORINE Land Cover 2010 program). The results of the analysis show that the total area of the country (30 134 thousand ha) is by 24% arable lands, 8% plantations, 14% pastures and meadows, 34% forests, and 20% other lands. If particular natural zones are considered the structure is somehow different. In the zone of temperate semi-humid broad-leaved forests the ameliorated arable lands and plantations account for 54% and the cities for 28% of its area. In the zone of subtropical summer-dry forests arable lands and plantations occupy 66%, forests – 21%, and settlements – 7% of the total area.

To investigate the social subsystem of LGES it is necessary to analyze population, living

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in each landscape, and the ecosystem services provided by the landscape. The most important of all services, i.e. food security, was chosen for the analysis. The ecological footprint of consumption (EF) was calculated for each landscape. In 2013 the national EF in Italy amounted to 4.6 gha per capita, while the biocapacity was only 1.1 gha. In the majority of landscapes of Italy the ecological balance is deficient (-3.5 gha per capita on the average), varying from -9.65 gha to +17 gha. The ecological footprint of production demonstrates that the national productive lands cover just 30% of produced goods. In 2013 the deficit of productive lands for 61 million of Italians amounted to 229 million hectares being 8 times the area of the country. Therefore the majority of Italian landscapes are debtors, and this is the principal indicator of their geoecological quality posing serious problems to landscape management and conservation of biodiversity.

Similar analysis was performed to assess the geoecological situation in several countries and regions of Europe (Czechia, France, British Isles, Iberian Peninsula etc.). The results of calculations for all 613 landscape units made it possible to elaborate the map of the "Geoecological Quality of Landscapes of Europe" at the scale of 1:5 million.

Keywords: natural anthropogenic landscapes, geoecological assessment, landscape geoecological systems, Europe, Italy.