

FOREST-STEPPE LANDSCAPE ORGANIZATION OF EASTERN EUROPE (FOR EXAMPLE PENZA REGION)

Serafima Artemova and Natalia Leonova

Received: 19.05.2014 / Accepted: 12.11.2014

Abstract: The forest-steppe landscape organization in Eastern Europe is triggered by natural, paleogeographic conditions and history of economic development. The leading factor landscape differentiation of the forest landscapes featuring of the Volga Upland is the morfolithogenic base. The landscape differentiation reflects the modern differentiation of vegetation.

Keywords: drawing the landscape, landscape, landscape organization, natural differentiation, vegetation, Volga Uplands.

Introduction:

The study of the formation of the landscape is still relevant. Unsolved questions on landscape science and landscape planning is the allocation of local boundary geosystems. According to classical ideas, the landscape science leading factor of landscape differentiation is the lithogenic base that form an invariant basis of a hydro-climatogenic development, soil formation, biogenic processes being significantly transformed owing to economic activities.

However, the practice of regional applied research for landscape planning shows that the allocation of natural boundaries of restored native landscape has been difficult, since the economic activity has significantly altered them. At various times, these boundaries were changed, and

also the "native" landscapes - it traces the use of the natural resources of the previous stage. The study of the modern morphological structure of landscapes, processes landscape genesis and the delimitation of indigenous geosystems at the regional level is necessary for monitoring, territorial environmental assessment and environmental management.

Recent advances in biocenology contained in the collective monograph "Eastern European forests - history in the Holocene and modernity" edited by O. Smirnova (2004) have changed the representation about the landscapes' formation processes. According to the concepts of biocenology population, biota strongly transforms the biotope. Analysis of historical, archaeological and paleontological literature has led to the conclusion that man's economic activity has been and still remains an important factor in the development of the living throughout Eastern Europe during the Holocene. That is why at the present stage for landscape ecologists it is important to grasp that modern landscapes are anthropogenic and it is essential to study the history of the antropogenical landscape.

Serafima Artemova and
Natalia Leonova:

Penza State University
40 Krasnaya Street, Penza
440026, Russia
e-mail:

Serafima Artemova: art-serafima@yandex.ru
Natalia Leonova: na_leonova@mail.ru

With the use of modern methods of decoding space images and GIS technology, the study of time slices has become available since the 18th century. It will forecast the ecologo-geographical situation and select methods of sustainable nature management.

The study of the transformation of landscapes forest-steppe was carried out in the European part of Russia within the Penza region, located on the western slopes of the Volga Upland and Oka-Don plain. The positional factor in the formation of Penza region landscapes is associated with the position of the study area at the border of the major geological structures of the East European platform, Volga-Urals anteclise and the Caspian syncline, on the border of the Oka-Don plain and the Volga Uplands, on the watershed of the Volga and the Don, on the border of northern and southern forest-steppe, on the border of the glacier and periglacial areas.

Materials and methods:

The methodological foundation work accounts for the constructive ideas and research results of the domestic geographers A.G. Isachenko, V.B. Sochava, N.A. Gvozdetskogo, F.N. Milkov, V.A. Nikolaev, S.V. Viktorova, T.V. Afanaseva, V.M. Friedland et al. (Nikolaev 1993). The starting materials for the study of the morphological structure of landscapes were space images, material funds, the findings of field studies in key areas. In studying the dynamics of landscapes there were used paleogeographic published materials on the results of spore-pollen analysis, literary and cartographic sources, archival materials.

The structural diversity of the phytocenoses has been evaluated by the ratio of ecologic-coenotic groups (ECG) species composition of vegetation. Under the ecologic-coenotic groups this paper comprises large groups of ecologically similar species in their genesis associated with different types of plant communities. The paper used ecologic-coenotic group

species of vascular plants in central Russia (Eastern European broadleaved forests 1994) based on the A.A. Nicenko ecological groups (Nicenko 1969), and taking into historical account by G.M. Zozulin (Zozulin 1955, 1973). These were allocated to the following groups of vascular plants:

- nemoral - Nm
- boreal - Br
- pine forest - Pn
- nitrophil - Nt
- group of different species of meadows and steppes - Md
- swamp-water - Wt.

The names of vascular plants are assigned by S.K. Cherepanov (Cherepanov 1995).

Results and discussion:

The results of studying the history and development of Penza region landscapes showed that the leading role in the distribution of steppe and forest landscapes of the Volga Upland plays a prominent part in the moisture balance, which depends mainly on the relief. This topic has been approached by researchers from the 50'-60' who studied the Volga sector of steppe forest: F.N. Milkov, I.I. Sprygin et al.

The neutral particular balance on the high peaks and in the northern areas of the region contributes to the spread of the forest, but in the south the negative balance contributes to the development of steppe vegetation.

The climate change in the Pleistocene was not so significant and broadleaved forests survived a period of glaciation in floodplains on the Volga Uplands, and migrated in the Atlantic period to watersheds.

Thus, presently in the forest-steppe there are favorable conditions for growth, both for the forest and steppe vegetation. The forests can grow on black soil and steppe grows on the spot of the forests. In addition, within the Volga Uplands well-defined vertical belts caused not so much height as high erosion

ruggedness, character of rainfall precipitation, foehn winds, barrier effect etc.

The high ruggedness of the relief causes mosaic patterns of landscape structure. Within the Penza region the asymmetric slopes are well-marked. It is connected not only with the geological processes, but also with the insolation. In the post-glacial period the characteristic thawing frozen soils differed on the northern slopes, north-eastern exposure and on the south slopes, south-east exposure. Therefore, the northern slopes feature gently sloping and there have been developed solifluction processes, while the southern slopes are steep and the erosion processes are more developed.

Throughout the Holocene, and especially at the present stage, the formation of the morphological structure of landscapes is greatly influenced by people, and thus the vegetation is changing. All comfortable steppe areas were ploughed, villages and towns were built, roads, pipelines, a lot of quarries were formed for the extraction of building materials. The mostly transformed one was the landscape of a low plateau of upland Volga, with a domination of steppe vegetation. Currently steppe is preserved only in reserved areas ("Ostrovtsovskaya forest-steppe", "Kuncherovskaya forest-steppe" and "Poperechenskaya steppe" State Nature Reserve "Volga steppe"), and it is dominated by agricultural landscapes.

Forest landscapes have largely remained in the east area of the high plateau on the Volga Uplands. It has also significantly reduced the area of forest, the forest biocenoses converted by the economic activity, but there still is the possibility to trace the dependence of the distribution of plant communities on the elements of the relief (Leonova et al. 2013a, 2013b). For Penza region this forested area has largely reformed the environmental resources and highlighted the recovery resources' value.

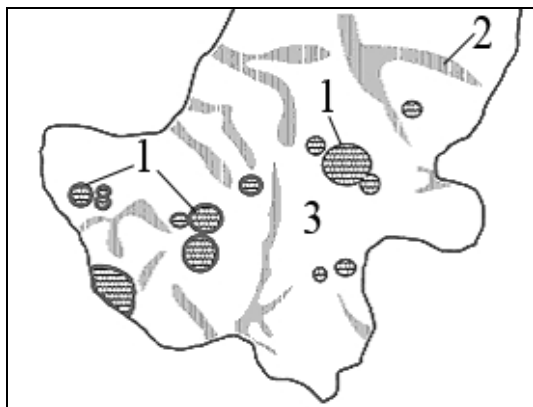
The modern morphological structure of the landscape of the Penza region is reflected in the general scientific synthetic landscape map of scale 1:200,000 (Yamashkin et al. 2011). For the core of mapping the objects

are landscapes and terrain (Milkov 1950). Interaction of biota, hydrological and geological-geomorphological factors resulted in the ruggedness of the borders of natural complexes of erosion-denudation and secondary moraine plain forest-steppe landscapes of the Volga uplands, water-glacial plains of forest landscapes of the Oka-Don plain and valley landscapes. Within a landscape there has been some variation of geological foundation: the uneven thickness of Quaternary deposits, different types of deposits on the elements of the mesorelief, different morphometric morphographic characteristics of the mesorelief, shape and arrangement of the mesorelief's elements. All these differences of morphological structure of the landscape are due to differences in the genesis of relief and relief-forming processes occurrence. This is reflected in the landscape drawing. Analysis of landscape drawing in areas with prevalent forest vegetation shows a good correlation of biotopes with relief within the erosion-denudation plains of the upper plateau of the Volga upland.

The upper plateau of the Volga Uplands occupies a special position: it has the highest altitude (280-320 m above sea level) piled rocks of the Paleogene not subjected to glaciation. This facilitated the penetration from the north zone of coniferous-broadleaved forests.

Features of the lithogenic base of the upper plateau of the Volga uplands (large amplitude heights, easily permeable breeds of the Paleogene, deep location of groundwater, widespread loess and solifluction Quaternary deposits) contribute to the fact that the main processes of landscape development are erosion, suffusion, and less frequently solifluction. Drawing outlier-watershed terrain type are diffuse and diffuse-banded, which reflects the leading processes of landscape – eluviale-suffusion with elements of erosion on gentle slopes (Fig. 1).

Figure no. 1 Figure landscape outlier-watershed terrain type of the upper plateau of the Volga Upland.



Note: 1-suffusion depressions, 2-hollows, 3-undulating watersheds terrain.

Background tracts are undulating watersheds and indigenous slopes of the upper plateau, thin folded ancient quaternary diluvial-loess deposits (fine-grained dusty-clayey sands) and indigenous sediments Paleogene (siliceous-clayey sandstones, crumbling gaize, diatomite and sands) on a light gray and gray forest soils under coniferous-broadleaved forests. The latter ones are mostly *Pineta borealiherbosa* (P-Br) – boreal pine forests. The tree-layer structure is formed of *Pinus sylvestris* with little involvement of the *Betula pendula*. The shrubs are weak (projective cover about 5-7 %) of *Euonymus verrucosa*. The grass-dwarfshrub layer dominates: *Orthilia secunda*, *Calamagrostis arundinacea*, *C. epigeios*, *Rubus saxatilis*, *Vaccinium myrtillus*, *Chimaphila umbellata*, *Molinia caerulea* and with high constancy are *Pyrola rotundifolia* and rare species for the Penza region – *Lycopodium annotinum*, *L. clavatum*, *Bupleurum aureum*, *Adenophora lilifolia*. In 70 % of the geobotanical descriptions there was noted the presence of moss layer of *Pleurozium schreberi*, *Polytrichum commune*, *Dicranum undulatum*. The aspen forest and the birch forest, formed by deforestation and after

fires, are also characterized by high participation of boreal species.

Subdominant complex tracts of hollows of gently sloping folded diluvial light loamy deposits with a combination of dark gray forest soils, gley hollows, gray forest soils with hollow slopes. Vegetation is represented by *Pineta pineticoliherbosa* (P-Pn) – pine forest. The tree layer consisting of *Pinus sylvestris* sometimes with little participation *Betula pendula*, *Quercus robur* and *Tilia cordata*. The shrubage forms *Euonymus verrucosa*. In the grass-dwarfshrub cover dominated species of pine forest as the number of species and their abundance: *Pteridium aquilinum*, *Hieracium umbellatum*, *Polygonatum odoratum*, *Potentilla argentea*, *Pulsatilla patens*.

Single simple tracts suffusion depressions on slopes with peaty-gley soils of swamps occupied *Betuleta borealiherbosa* (B-Br) – boreal birch forest. The tree layer is formed by *Betula pubescens*, sometimes with the participation of *Pinus sylvestris*. In the undergrowth: *Daphne mezereum*, *Sorbus aucuparia*, *Frangula alnus*. The grass-dwarfshrub cover dominated boreal species ECG: *Vaccinium myrtillus*, *Calamagrostis arundinacea*, *Rubus saxatilis*, *Orthilia secunda*, there are *Molinia caerulea*, *Lycopodium clavatum*, sometimes rare for the Penza region – *Oxycoccus palustris*, *Drosera rotundifolia*. Characterized by the presence of moss in the ground cover (10 %): *Pleurozium schreberi*, *Polytrichum commune*, *Dicranum undulatum*, occasionally species of *Sphagnum*.

The correlation of morphological elements of relief and vegetation and paragenetic connection of the slopes tracts is depicted in Figure 2 (Annexes).

Conclusions:

The formation of forest-steppe landscape structure influences both natural and anthropogenic factors.

The leading factor landscape differentiation and organization of the high

plateau of the Volga Upland is the morfo-lithogenic basis and character of exogeodynamic processes. Leading processes are: erosion, suffusion and solifluction. Most pronounced lateral connections in sloping terrain types.

Vegetation cover of landscapes the upper plateau of the Volga Upland is a combination phytocenoses belonging to formations of pine, birch, oak, aspen and black alder forests. Ground cover some formations has a similar ecologo-coenotic structure.

Rezumat:

ORGANIZAREA MEDIULUI GEOGRAFIC DE PĂDURE-STEPĂ DIN ESTUL EUROPEI (EXEMPLU: REGIUNEA PENZA)

Organizarea mediului geografic de pădure-stepă din Europa de Est este determinată de condițiile naturale și paleogeografice, precum și de evoluția dezvoltării economice. Principalul factor în diferențierea caracteristicilor mediului geografic de pădure din zona de platou a râului Volga îl constituie baza morfo-litogenică. Diferențierea mediului geografic reflectă diferențierea modernă a vegetației.

References:

CHEREPANOV S.K. (1995), *The vascular plants of Russia and adjacent states (the former USSR)*, Russian edition. Publishing house Mir i semja, St. Petersburg, Russia.

Eastern European Broad-Leaved Forests (1994), Publishing House Nauka, Moscow, Russia.

LEONOVA N.A., ARTEMOVA S.N., KULAKOVA D.A. (2013a), Ecological cenotichesky structure phytocenoses upper plateau of the Volga Upland within the Penza region, "XXI century: Resumes of the Past and Challenges of the Present" plus, *Scientific Periodical Series: Ecology*, 9(13), 1: 12-18.

LEONOVA N.A., KULAKOVA D.A., ARTEMOVA S.N. (2013b), The vegetation cover of the upper plateau of the Volga upland terrain within the Penza region, *University proceedings Volga region, Natural Sciences*, 1(1): 72-81.

MILKOV F.N. (1950), *Russian forest-steppe plains. Experience landscape characteristics*, Publishing house Academy of Sciences of the USSR, Moscow, USSR.

NICENKO A.A. (1969), On the study of ecological structure of vegetation, *Botanical journal*, 54(7): 1002-1014.

NIKOLAEV V.A. (1993), *Regional problems of landscape studies*, Moscow University Press, Moscow, Russia.

SMIRNOVA O.V. (ed.) (2004), *Eastern European forests: history in the Holocene and modernity*, Book. 1, Publishing House Nauka, Moscow, Russia.

VICTOROV A.S. (1986), *Drawing landscape*, Moscow: Thought, Russia.

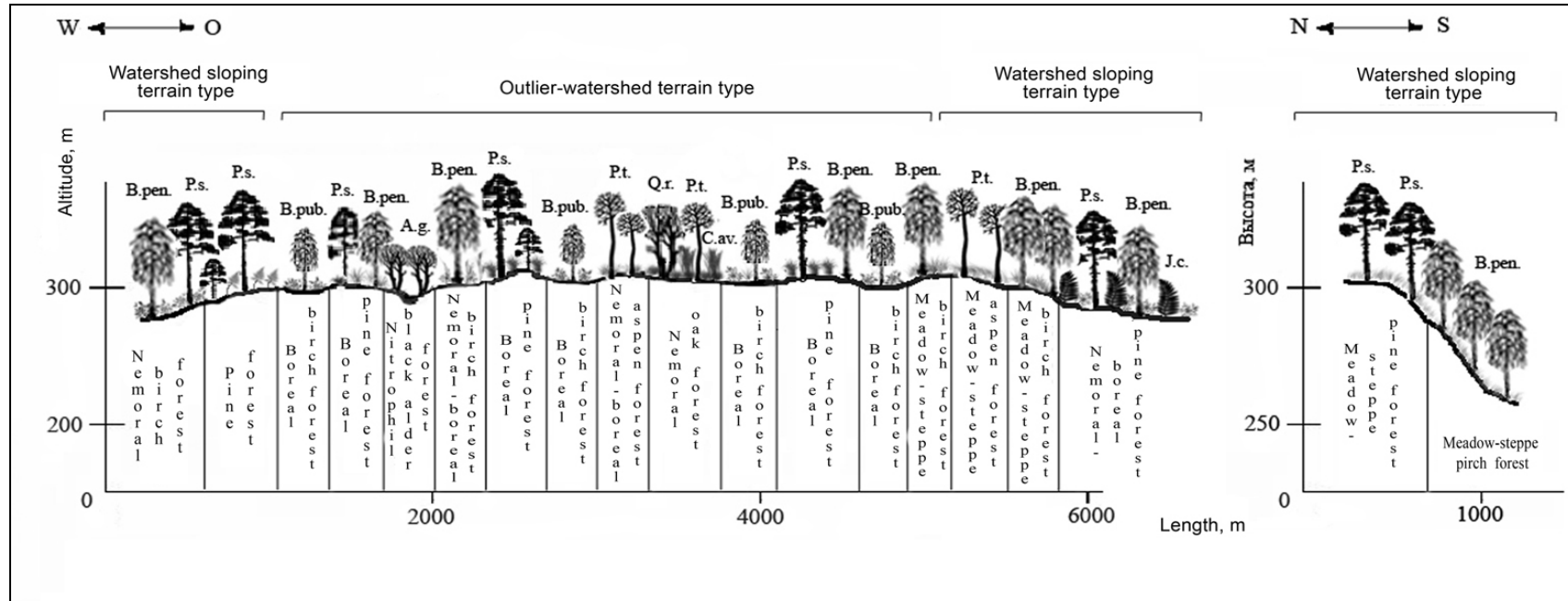
YAMASHKIN A.A., ARTEMOVA S.N., NOVIKOVA L.A., LEONOVA N.A., ALEKSEEVA N.S. (2011), Landscape map and spatial patterns of the natural differentiation of the Penza region, *Problems of regional ecology*, 1: 49-57.

ZOZULIN G.M. (1955), Relations forest and grass vegetation in the Central Black earth state reserve, *Proceedings of the Central Black earth state reserve*, 3: 102-234.

ZOZULIN G.M. (1973), Historic suite vegetation European part of the USSR, *Botanical journal*, 58(8): 1081-1092.

Annexes:

Figure no. 2 Scheme of distribution of plant communities along the profile.



Note: Species of trees and shrubs: Q.r. - *Quercus robur*, P.s. - *Pinus silvestris*, P.t. - *Populus tremula*, B.pen. - *Betula pendula*, B.pub. - *Betula pubescens*, A.g. - *Alnus glutinosa*, J.c. - *Juniperus communis*.