

**Elena I. Golubeva^{1*}, Maria E. Ignatieva², Tatiana O. Korol¹,
Valentina A. Toporina¹**

¹ Lomonosov Moscow State University, Faculty of Geography, Moscow, Russia

* **Corresponding author**

² Division of Landscape Architecture, Department of Urban and Rural Development at Swedish University of Agricultural Sciences; PO Box 7012, SE-750 77 Uppsala, Sweden; Tel +46-18-672508; fax +46-18-673512; e-mail maria.ignatieva@slu.se; webpage www.slu.se

ECO-GEOGRAPHICAL APPROACH TO INVESTIGATION OF STABILITY OF CULTURAL LANDSCAPE

ABSTRACT. Today in Russia, much attention is given to research and practical identification of the cultural landscape (CL) stability parameters that define its dependency on the character of the territorial land use. As a rule, these are projects of territorial and landscape planning (LP) aimed at assessment of stability of the CL depending on the conditions of the social and natural environment, on the level of changes of its components, and on the direct relation with the nature and the type of natural resources management. This approach defines most fully conditions and the level of impact on the landscape.

The paper discusses the main types of natural resource management of the CL. Residential areas are the most complex and multifunctional types of natural resource management. They are of the greatest interest to the research as an object of "co-creation of man and nature" [Sochava, 1978]. This is determined by an important role of residential areas with their infrastructure as a landscape reshaping element that influences the functioning and structure of the CL. Cities, suburbs and towns, as human environment, require a special attention in order to achieve an environmentally friendly and sustainable landscape.

In the concept of LP, much attention is given to assessment of the natural components of the CL. As a rule, assessment of soil,

climate (atmosphere), water, and landscape sensitivity and significance is conducted [Drozdo, 2006]. The selection of assessment criteria varies depending on the natural resource management type. Obtained results are compared with parameters that are indicative for or specific to naturally occurring landscape. The crisis of environmental components makes LP the vitally necessary management instrument. The goals of landscape planning are broadly formulated – landscape planning should cover the entire territory of the country, should consider both natural and socio-economic factors, and should develop measures to prevent and control impacts on the landscape.

KEY WORDS: cultural landscape, stability of cultural landscape, landscape planning, landscape stability criteria, environmental management, sustainable development

INTRODUCTION

The concept of LP is connected with the concept of CL and specifically emphasizes sustainable development of these systems.

In summary, this concept (LP) means such a development (change), which allows the present generation to meet their needs without threatening the existence of such landscapes for future generations. This development is based on sustainable use of CLs to the extent that will not damage their

possible long-term use. This concept includes economic, social, environmental, and cultural aspects. The complex structure of “culture-nature” relationships in the CL is very diverse. It is expressed in material objects created by man through human activities (environmental management) specified by natural features. Culture is included in the natural landscape. It leaves there the objects of cultural heritage. Heritage preservation and restoration represents a special area of activities of modern society. Intensive economic activities are increasingly threatening objects of natural and cultural heritage and may lead to their loss and disappearance.

In order to determine the ability of the CL to its restoration and self-preservation and its resilience under human (external) impact, it is necessary to assess the stability of the CL components and adapt them to local conditions. It should be understood that, because of diversity of culture and nature, there are no accepted methods for integrated assessment of the CL. This is especially true for the “cultural” components which are dynamic objects.

In this context, the study of geographical aspects of the CL stability is very relevant and timely. The aim of our study is to identify a comprehensive and environmentally sound method of assessing the stability of Russian

cultural landscapes. The goal of the study involves the following objectives:

- To analyze approaches to the CL stability assessment;
- To review the stability criteria of natural components of the CL;
- To analyze the categories of the CL stability;
- To conduct assessment of the stability of natural components of the CL;
- To examine the concept of ecological foundation for sustainable development of the CL.

THE NATURE-CENTRIC AND CULTURE-CENTRIC APPROACHES TO THE STUDY OF THE STRUCTURE AND STABILITY OF THE CL

Let us consider the structure of the CL, i.e., the quantity and “quality” of its components that are essential to a comprehensive research approach. This structure is associated with a distinct vertical and horizontal orientation. The vertical orientation is expressed primarily in the “layering” of the landscape, where two main layers – cultural and natural – can be identified (Fig. 1).

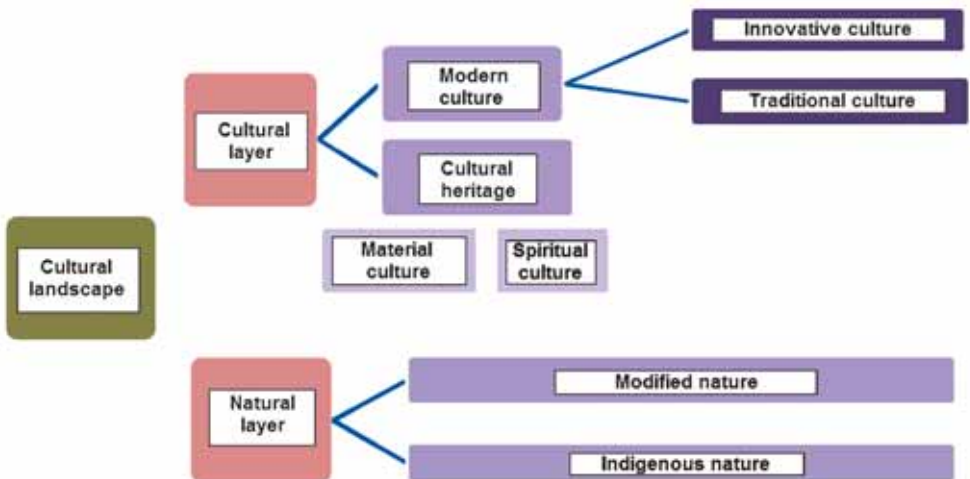


Fig. 1. The main components of the cultural landscape. The vertical structure [Vedenin, 1997]

The cultural layer is of particular interest to our research. This layer reflects the entire body of the processes and results of human activity aimed at creation of the system of values. The cultural layer, during the period of its accumulation, is becoming increasingly important in the landscape and eventually becomes a dominant factor of its further development. The saturation of the cultural layer with accumulated and new events and cultural objects defines its spatial character. The natural layer of the CL may be viewed as a complex of natural components from the stand point of its preservation and relation to technical and natural-technical systems [Vedenin, 1997].

The CL, as a research object, has a complex structure (Fig. 2). Thus, V.N. Kalutskov [2008] defines two different research approaches in respect to the CL, i.e., nature-centric and culture-centric. Each approach has its own features. For example, the nature-centric approach examines thoroughly natural components of the CL, while cultural components are scaled down and viewed as the cultural environment. In the nature-centric approach, the structure of the CL looks as follows: geological material, topography, climate, water, soil, vegetation, wildlife, and cultural environment [Solntsev, 2001].

In the culture-centric approach, when the priority is given to the cultural component

of the landscape, the structure of the CL is explained in detail. This structure consists of such components as the natural environment, human society, economy, residential areas, language, and spiritual culture [Kalutskov, 2008].

Humans society, having created and developed its CL, endues it with such qualities that make it both typical and unique and that allow its development, adaptation, and improvement. It also forms its spatial organization as well as architectural and sacral objects. Any CL has its own community that is inseparably, as a part of the whole, connected with it and views its landscape territory as its own. The residential aspect, through the system of settlement, promotes formation of the spatial infrastructure of CLs and may be viewed as the way of spatial structure/self-organization of a society. A world view of its own is formed through language. Local native geographical terminology, i.e., toponymic system, reflects natural and cultural features of the CL.

The nature and complexity of the links between the natural and cultural layers depend greatly on the level of development of the cultural component of the landscape. Peoples' culture, with its traditional ways and methods of production activities and traditional customs is best and seamlessly linked with the natural landscapes. The influence of the nature on the innovation

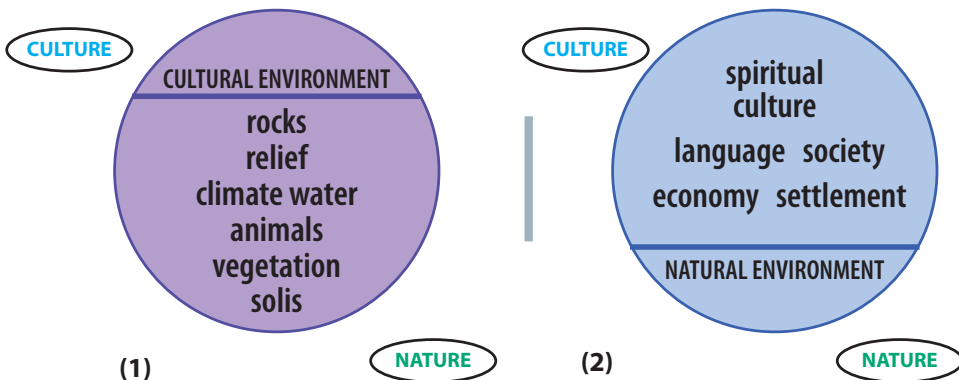


Fig. 2. The components of the cultural landscape in nature-centric (1) and culture-centric (2) approaches [Kalutskov, 2008]

culture and on the production of higher cultural values (science, professional art) is much weaker. The reason for it, first of all, is that, contrary to the traditional culture that leans towards weakly urbanized landscapes, the innovation culture associated with activities of professional specialized institutions often adopts international standards and modern technologies. Activities of artists who work in the area of innovative culture are often take place in urban landscapes where the nature has already been greatly modified, where a human is surrounded by structures from artificial materials, and where, instead of the natural environment, there are geometricized residential areas, artificial water bodies, orderly designed and specially created green areas, etc. Therefore, the development of the landscape cultural layer is also occurring with a relatively high degree of independence from the natural factors. At that, under the influence of different innovative and specific cultures and often on the same natural base, there form different elements of culture and, therefore, different CLs.

Under the influence of specific characteristics of the nature, the degree of its transformation and the level of development of society, regional and national features, a territorial cultural-natural system is formed. This system is defined by many mutually complementing cultural and natural communities, by pronounced vertical morphological structure, by existence of close links between different layers, and by territorial and genetic unity. The territorial cultural-natural systems differ depending on relations between heritage and contemporary culture and the level of development of traditional and innovative elements and cultural and natural layers of landscape.

The most noticeable differences are between urban and rural cultural-natural systems. They are associated, first of all, with the dominance of primarily innovative culture in cities. In the rural culture and in its associated territorial systems, the presence of traditional values is higher compared to cities. Significant differences in these two types of systems are

also manifested in the level of expression of their links with the natural components. It is weak in cities, but it is the leading factor in rural systems. Urban cultural-natural systems are characterized primarily by a high density of built-up areas, noticeable dominance of hard surfaces on the earth surface (asphalt, pavement), developed network of artificial elements in the landscape, almost complete absence of undisturbed natural systems, and by the high saturation of urban space with artistic and cultural-intellectual processes (that have, primarily, innovative character).

The rural system represents a collection of small built-up sites inside agricultural areas (fields, meadows, hay lands) and different natural elements (forests, river valleys, lakes, etc.). Here, the traditional culture dominates and innovative processes are manifested less compared with cities. At the same time, in the most part of the systems, the elements of urban and rural cultures are blending and, therefore, their specific properties are manifested not so clearly, which is reflected not only in the character of processes that take place here, but also in the morphology of the landscape.

The CL is composed of a set of territorial cultural-natural systems comprising an interconnected system that provide for development, regeneration, and preservation of objects and phenomena of both the innovative and traditional cultures. This predefines the original diversity of the CL, the basis of its hierarchical structure, and a specific interdependency of its internal elements.

Stability is the ability of a system to maintain its parameters under impact or to return to its original state after disturbance of its structure. The CL has its own limits of stability that have not yet been well studied. Now it is possible to state the following: stability is not a static state of a system, but fluctuations around some medial state. The wider the natural span of the landscape states, the lower the probability of an irreversible transformation after disturbance impacts [Golovanov, et al. 2006; Sochava, 1978; Isachenko, 1974, 1980].

STABILITY CRITERIA OF THE CL NATURAL COMPONENTS

Under the nature-centric approach to research on stability of the CL, it is necessary to discuss the natural basis of the landscape and regard as a system that consists of natural components.

The main stabilizing natural element is the biota, as the easily adapting and the most rapidly regenerating landscape element. Intense biological cycles and biological productivity are the main prerequisites of the landscape stability. The vegetation cover maintains gravitational balance of the landscape and prevents its denudation. The biota plays the leading role in the landscape self-regulation process.

The lithosphere is the most stable element of the landscape. However, if it is disturbed, it is not capable to regenerate. Its stability is an important prerequisite of the landscape stability. Three categories of stability can be identified in terms of impacts on geological-morphological basis of the landscape; these impacts are the results of abrupt disturbances of the surface at different types of construction, mining of mineral deposits, movement of track equipment in permafrost conditions, of violations of erosion- and filtration-preventive measures in agricultural and forestry sectors, and of other types of impacts [Vorontsov, et al., 1989]:

- relatively stable (in the absence of massive deformations of the morphological-lithogenic basis and with possibility of a complete regeneration of the landscape after disturbances);
- fragile (geological-geomorphological basis has substantial deformations as a result of active erosion, cryogenic-eolian, and other exogenic processes, with possibility of a partial natural or artificial regeneration of the landscape after disturbances);
- unstable (large and massive deformations of the morphological basis with intense

formation of landslides and gullies, thermokarst, thermoerosion, mudslides, etc., that lead to irreversible changes or to the degradation of the landscape).

For the first two types, there is a possibility of preservation or regeneration of the landscape through its recultivation and landscape planning activities. Landscapes with significantly modified morpho-lithogenic basis have little chance of resembling the original ones, however, there are ways of creation of artificial landscapes (for example, technoparks) with intensive recultivation.

In the process of development, any landscape undergoes impacts and its stability is limited. The threshold of stability, expressed through resistance of the landscape and of its parameters and properties, as well as the critical parameters of impacts are defined in each particular case.

Thus, it is possible to formulate the general criteria of landscape stability [Isachenko, 1974, 1980]. First of all, it is a high level of organization and intense performance and balance of its functions, including biological productivity and ability to regeneration of the vegetation cover. These properties are defined by the optimal ratios of heat and moisture and are manifested by the level of development of the soil cover and, eventually, by soil fertility. The natural stability is one of the prerequisites for sustainable natural resource management [Sochava, 1978].

Resistance of landscape depends on the internal heterogeneity of its elements. For example, a diverse composition of meadow herbs makes the meadow more stable under different weather conditions compared with the artificial hay land with lesser species diversity (as well as in the case of lawns, for example). A well-defined micro-topography and variations in water-physical properties of soils also increase stability of both the soil and the vegetation covers: during dry periods of the year, the biomass productivity is higher in low parts; during wet periods it is better at micro-elevations.

Landscape stability grows with the increase in its ranking in the landscape classification system. In this sense, the least stable is the facies, i.e., the smallest unit. It is characterized by homogenous conditions of its location, environment, and biocoenosis. Facies have strongest response to both changes in external natural conditions and human activity. They are radically altered through natural resource use. Larger units of landscapes are less susceptible to change. In general, in defining static stability, there are the following determining relations between properties of natural elements and resistance to anthropogenic pressure [Kazakov, 2008]:

- gravitational, or denudational, potential of the area (relative elevations and differentiation) – the greater it is, the lesser is resistance to denudation, erosion, mechanical loads, and even to toxicants;
- surface slopes – the steeper they are, the lesser is the stability, however, at the slopes of lesser than 1°, stability may decrease due to possible water logging and low self-purification of landscapes from pollutants;
- mechanical composition of soils – is usually associated with natural territorial systems (landscapes) composed of light loams and fine sands, however, the maximum may shift somewhat depending on types of impacts (under the impact of acid precipitation, the graph of natural territorial system stability is sharply asymmetric; at the soil depth of 1.2 m, the natural territorial system stability falls with decreasing depth;
- hydrotopes (moisture content) – in meso moisture condition resistance is high; in dry and wet habitats it is decreased;
- climatic characteristics – high-resistant landscape enjoys the optimal ratio of heat and moisture (hydrothermal coefficient and humidity factor are close to one); the low-resistant corresponds to areas with distinct limiting thermal and moisture

factors and large amplitudes of their fluctuations; temperate winds of 2.5–4 m/sec also promote increase in landscape stability;

- soils – the greater the thickness of humus horizon, the humus content, and the base-saturation and capacity of the soil absorbing complex, the greater the natural territorial systems stability;
- biota – the greater the capacity and intensity of biogeochemical cycle and the density of the projective cover of the surface, the higher the natural territorial system stability.

The landscapes are resistant if they are:

- characterized by increased diversity and overlapping (doubling) of structures;
- located in the centers of their zonal and regional typology;
- trans-accumulative (more stable than trans-alluvial);
- larger in scale and matter;
- higher in hierarchal ranks.

THE CHARACTER OF NATURAL RESOURCE MANAGEMENT AS A CATEGORY OF THE CL STABILITY

After isolation of the main criteria of the natural landscape components, it is now necessary to identify categories of the CL stability. The connection between the natural and cultural elements is rather complex and the best correspondence is manifested through the character of the territorial natural resource management. The character reflects the natural structure of the CL and also the social-economic specifics of the territorial use.

The natural stability is one of the prerequisites of sustainable natural resource management. It is based on unaltered characteristics of

the natural components. With increasing economic activity, the natural stability of the natural landscape decreases and there appears a new acquired stability of, now, the CL. A new criterion is formed from given natural factors under the impact of the type of land use in the process of landscape evolution. The sense of the acquired stability is in the adaptive variability of the landscape structure and functions that undergo human impact.

Considering the main natural resource management function of the landscape, it is possible to suggest the typology of the CL in terms of their functional-economic classification [Basalikas, 1977; Fedotov and Dvurechenskiy, 1977; Runova, et al., 1993]. There are the following main functions of the isolated parts of the territory: agricultural, forestry, recreational, industrial-urbanistic, and reservational [Basalikas, 1977]. The further division occurs within the types that include distinct, in terms of functions, subtypes.

The following types of natural resource management can be isolated: forestry-industrial, forestry-agricultural, agricultural, agro-recreational-forestry-industrial, industrial, transportation, urban, traditional, reservational, and environmental disasters [Runova, et al., 1993].

From the works of classic landscape science, the correspondence of these classifications of the types of natural resource management to the classification of the CL in terms of its content, becomes apparent – agricultural, forest, water, industrial, residential; in terms of genesis – technogenic, shifting-agricultural, arable, pyrogenic, pastoral-digressive [Milkov, 1973].

It is known that any territory is used in many ways, and its landscapes can be multifunctional. During isolation of types and subtypes of territorial use, researchers identify the main (background) landscape use that makes the main impact on the nature. Thus, in the agricultural, such impact is represented by soil management; in the

forestry – by industrial logging. Significant changes of the natural landscape are associated with the industrial and urban types of natural resource management. These types contain all the most significantly altered landscapes and they, at the same time, reveal the main structure of the socio-economic subsystem – of the main carrier of stationary and mobile sources of the natural environment pollutants.

Thus, the industrial and urban types may be considered the most unstable natural-anthropogenic formations due to the intense economic activity and a relatively “young age” of these formations – all this promotes weakening of the internal links and prevents gradual restoration and regeneration of the natural stability of the industrial and urban territories. In order to optimize conditions of landscape rehabilitation, it is necessary to apply modern methods of reclamation and to use principles of sustainable territorial and landscape planning.

The agricultural and forestry-industrial types of territorial use differ qualitatively from the industrial and urban, whose identification principles are close to economic-geographic. They are characterized by the type of direct natural resource management – resource use, i.e., use of the nature as the means of the production of products of natural origin [Runova, 1985]. In this case, the nature stability is organically linked with its use and requires the support for sustainable economic activity.

These types of the territorial use encompass the largest ranges of native landscapes transformations. They create the main natural and anthropogenic-natural background for natural resource management.

The traditional natural resource management should be isolated into a special type that predetermines sustainable use of resources with the minimal impact on the natural environment. Such traditional types include reindeer husbandry, fishing, farming, stock-breeding, and economic activity of private

households that provide for the greatest stability of all CL components.

The other types of natural resource management are associated with the extensive character of the use of resource, thus, influencing the native landscapes to the smallest extent. Such types are the reservational and recreational types that maintain the function of landscape preservation. However, the number of such islands of natural environment is so small that they can not, without external support, provide stability and preservation of the entire CL saturated with industrial and residential areas.

Considering the information presented above, it is possible to conclude that the CL stability is strictly linked with the character of natural resource management. This allows us to suggest three types of stability that depend on the territorial use type:

- stable, including extensive type – traditional, recreational, and nature reservational;
- moderately stable vast territories under forest-economic and agricultural use;
- fragile urban and industrial zones with significant differentiation and changes of the structure of the native landscapes.

ASSESSMENT OF STABILITY OF THE NATURAL ELEMENTS IN THE CL

The CL can be defined as a single system that consists of components whose number and characteristics are not always determined to the fullest extent. It is especially true for the “cultural” elements, for which it is not always possible to assess stability and to define significance in the common system. For some non-material elements, it is quite difficult as well. Therefore, in the identification of the landscape stability criteria, it is feasible to identify the main criteria of the assessment for the natural elements. They should satisfy the following requirements [Drozdzov, 2006]:

- be directed towards achieving the main goals of the territorial use in conditions of equal priorities of maintenance of the ecological balance and sustainable socio-economic development;
- reflect to the fullest extent the current conditions of the natural environment of both natural and altered by economic activity ecosystems;
- give an idea about possible changes in the state of isolated natural elements in achieving the main goals of the territorial use and under the allowable level of such use.

Landscape planning may serve as the main methodological instrument in identification of criteria of the landscape stability. It provides integrated assessment of the CL, its state, significance, and possible changes. The method is based on the assessment of natural elements, for which a set of criteria is developed; the criteria reflect the nature of the CL.

In order to provide a comprehensive approach to the landscape state, A.V. Drozdzov (2006) isolates the main element for the assessment, i.e., the biotope that reflects all natural landscape elements and defines its two criteria – sensitivity and significance.

The sensitivity criterion means the ability of a given natural element to change its properties and dynamic characteristics under the impact of human economic activity. In a general case, an object's sensitivity is:

- ability to react to change;
- strength of reaction; in this context, it is the thresholds of sensitivity – low, high, etc.;
- tolerance threshold; in this case, it is the range of a factor impact where an object is preserved (an organism survives, a state of something does not change, etc.).

Sensitivity of biotopes, depending on the true state of the environment of the biocoenosis,

should be defined considering possible consequences of impacts that may include fires, harvest, herd grazing, summer grazing and free-range animal husbandry, aerosols inputs, etc. The biotopes' assessment, in terms of sensitivity, is conducted based on the species composition of vegetation communities, their dynamic state, disintegration, and structural parameters. For forests, the latter includes structure, crown density, height, presence or absence of thick under-storey and undergrowth, character of grass cover, presence of rare species, forms of plants dissemination, presence of constraints, etc.

Highly sensitive systems may include biotopes where:

- part of species composition of the biocoenosis may be lost irreversibly due to large breaks between the area of distribution;
- specific life forms of the inhabitants may disappear for a long time due to the absence of conditions of secondary dissemination or to the elimination of the dissemination promoters;
- quality and of fodder grasses stocks attract herd animals and it increases the danger of overgrazing.

Moderately sensitive systems may include biotopes where:

- composition and structure of biocoenosis regenerate due to migrants or to the supply of seed material (germs) from the outside;
- soil is preserved or changes following the age-regeneration succession of biocoenosis.

Low sensitive systems include biotopes where conditions for emergence and expansion of fires are not favorable and consequences of other impacts (stock grazing, agricultural activities, etc.) are insignificant. Sensitivity of

soils is usually defined in terms of potential ability of water and wind erosion under the impact of different types of anthropogenic pressure [Isachenko, 1980]. The main soil sensitivity criterion is the degree of impact of the natural modern exogenic soil-destructive processes. The level of soil sensitivity is within, as a rule, three qualitative grades and is associated with the following cases or conditions:

- high sensitivity level – exogenic processes may completely disturb the natural soil structure or to completely destroy it;
- moderate soil sensitivity – partial changes of soil structure or of its elements are possible;
- low soil sensitivity – under anthropogenic impact, soils maintain their natural structure and functions, and soil fertility and other properties are preserved.

Soil sensitivity for territories affected by anthropogenic pollution should be assessed by using well-established methods [Glazovskaya, 1981].

Sensitivity of territories to changes in hydrological situation should be defined based on the assessment of runoff properties. Sensitivity of areas on the slopes of watersheds and sensitivity of alluvial-valley systems should be assessed individually.

Atmospheric sensitivity to pollution should be assessed using natural ability of air for self-purification from hazardous pollutants. The following criteria may be used in the assessment:

- annual amplitude of air temperature;
- mean annual wind speed;
- annual frequency of zero-wind;
- annual sum of atmospheric precipitation;
- number of days per year with the relative air humidity of 80% or greater;

- qualitative characteristics of conditions of formation of air temperature inversions in the surface atmospheric layer.

The assessment of landscape sensitivity under technical and recreational use is based on specifics of its reaction to changes in the morphological-lithogenic foundation (intensity and reversibility) in response to anthropogenic impacts. The following grades of landscape sensitivity can be suggested:

- stable, i.e., safe and favorable surfaces where activity of exogenic processes is insignificant; they are suitable for intense use;
- relatively stable, where the intensity of exogenic processes is not significant; they are suitable for extensive use under conditions of preservation of soil and ground cover;
- unstable, i.e., dangerous surfaces whose use may lead to landscape degradation and irreversible processes;
- extremely unstable, i.e., very dangerous surfaces whose use is not feasible; in this case, economic activity and even human lives are threatened by possibility of emergency disastrous situations.

Significance is the second criterion in the landscape assessment and for developing recommendations for further use. It defines the priority goals and objects for LP. In terms of significance, biotopes can be divided into three groups:

- highly significant – biotopes where original (potential) and existing conditions of the environment are almost identical (locations of rare endemic and relict species of flora and fauna; rare biotopes; biotopes that are relatively wide spread but only in specific conditions);
- moderately significant – biotopes where existing conditions (or those that can be restored) of the environment are close to the potential;

- insignificant – the current state is not the same as the original.

The criteria for the landscape significance assessment may be:

- diversity and uniqueness that are expressed through the quantity of different landscape types or their morphological parts that exist within a specific area;
- contrast that is defined by a combination of diverse landscapes and the level of topography differentiation;
- esthetic attractiveness that allows identifying landscapes with a unique appearance and the best distinctiveness;
- uniqueness that accounts for the distribution of rare and relict landscapes and of nature monuments of educational and scientific values;
- recreational and commercial potential (berries and mushroom picking, etc.); it also considers comfort that define types of recreation and its specialization.

As it can be seen, the methodology of LP has developed rather distinct recommendations for assessment of sensitivity and significance of the natural landscape elements, which cannot be said in respect to the CL that requires specific and individual approach in each case.

As we have already mentioned above, two approaches are possible in assessment of stability of the CL: the nature-centric and the culture-centric. First of all, let us review the nature-centric approach because the CL is developing within the limits of a specific natural territorial system.

We evaluated this approach using an example of such category of the CL as a country estate. Thus, the works of T.E. Isachenko (2004) give a detailed analysis of changes of the natural components, landscape structure, and fragmentation of the territory during

existence and abandonment of estates. Through analysis of country estates, the author arrives at a conclusion that maximal changes are associated with undulating plains in contrast to flattened tops of gently sloping hills and of steep slopes of kame hills (Fig. 3–5).

We used this approach for the analysis of the estates of Central Russia. We found similar trends in changes of the landscape structure during the establishment of the park estate complexes [Toporina, 2011]. Thus, in the estate of Almazovo (see Fig. 8), the dominant natural landmark is a flat surface of moraine-glacial plains with a characteristic nano-relief, i.e., alternation of elevations and depressions ($\pm 0.5\text{--}0.8\text{ m}$) of indistinct shape that are only noticeable through the presence or absence of hygrophilous vegetation. The main site is an undulating plain composed of loams. Its special feature is the absence of creek and river valleys. The natural vegetation cover

consists of mixed-herb-small-reed or mixed-herb-bracken pine and spruce forests.

The estate was owned by manufacturers Demidovs who created a uniquely designed park in Almazovo, i.e., a jewel – a “pearl” – of the Moscow countryside. Despite of being only partially intact, the estate, even now, is a picturesque place. The most impressive is the park established around an artificial water system.

During the estate construction (the 1860s), the transformation affected all components of the landscape:

- topography and hydrological network – in the 1860s–1870s, depressions (ponds and channels) were dug and elevations (hills and islands) were created (Fig. 6–8). The artificial hydrological network had decorative and functional meaning. The main 700 m-long channel was laid in a

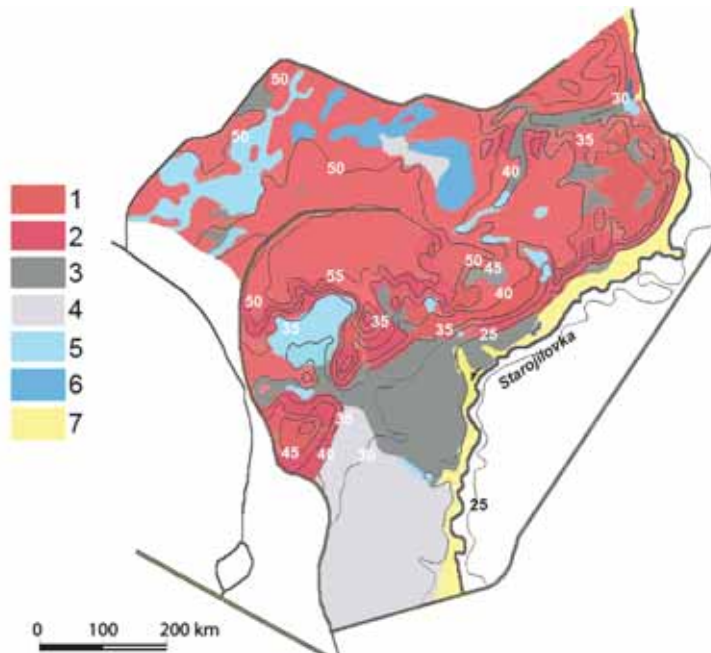


Fig. 3. Reconstruction of the landscape structure of the Shuvalov park prior to the establishment of the estate

Locations: 1. flattened tops and gently sloping kame hills; 2. steep slopes of kame hills; 3. undulating plains on sands and light sands covered with eutrophic peat of low thickness; 4. undulating plains on sands and light sands covered with mesotrophic peat of low thickness; 5. eutrophic peatlands and wetlands on slopes (with peat of different thickness); 6. mesotrophic peatlands; 7. floodplain with low-land peat of different thickness

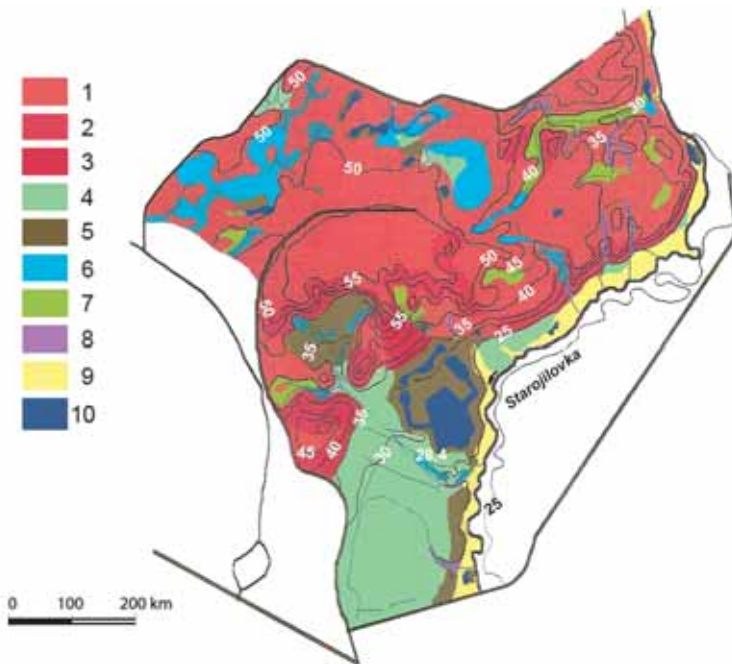


Fig. 4. Reconstruction of the landscape structure of the Shuvalov park, second half of the XIXth century

Locations: 1. flattened tops of gentle slopes of kame hills; 2. steep slopes of kame hills; 3. steep slopes of kame hills artificially terraced; 4. undulating terraced plains on sands and stoneless light sands; 5. artificially drained with mineralized peat of low thickness; 6. flattened surfaces with added soils; 7. drained mesotrophic and eutrophic peatlands; 8. artificially drained inter-kame depressions with mineralized peat of low thickness; 9. artificially deepened depressions with water flow regime (including creek valleys); artificial water bodies; 10. drained peat floodplain

straight line from west to east. It started from Small Pond near the three-tiered Mount Zion and ended in the Big Pond with an island in the middle. Approximately in its central part, the channel was divided into two arms. One arm surrounds a small round island with a wooden manor, galleries, and bridges that hang over the channels and connect the main house with wings on the “mainland.”

- natural vegetation cover was, by 1813, infused with park elements: a birch grove – between the island with the manor and the pond near the Mount Zion; a linden grove to the east of the Big Pond; an oak grove and a pine grove along the main alley (parallel to the channel) and to the east of the Bannyi Pond; spruce boskets and a labyrinth to the east of the round island.

In the birch grove, between the island with the manor, the estate theater was constructed. Later, a new magnificent house and a stone church were built at the estate.

Till this time, the general design of the estate has been preserved: two ponds and depressions of the formal channels, islands, and creeping hills. Vegetation of the park has also been partially preserved: linden (*Tilia cordata*) along the banks of the Big pond and oaks (*Quercus robur L.*). Formal (regular) spruce boskets, birch grove, and the labyrinth disappeared. The largest part of the territory is covered with birch-spruce and birch-pine mixed- herb-small-reed forests on low-podzolic clay soils.

Thus, after reviewing the estate complex history and the analysis of the current trends, we can conclude that, without a proper

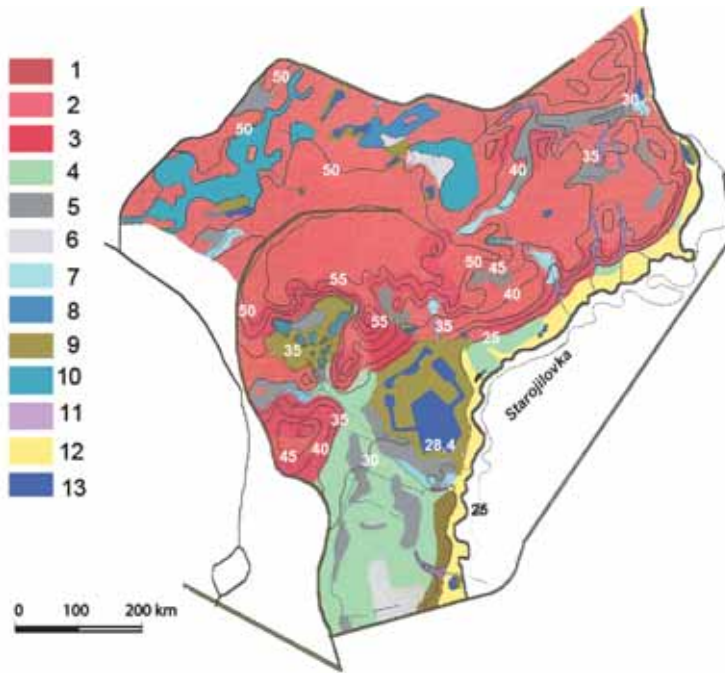


Fig. 5. Landscape structure of the Shuvalov park, 2002

Locations: 1. flattened tops and gentle slopes of kame hills; 2. steep slopes of kame hills, well drained; 3. steep slopes of kame hills artificially terraced; 4. undulating terraced plains on sands and stoneless light sands, artificially drained with mineralized peat of low thickness; 5. undulating plains on sands and light sands, covered with eutrophic peat of low thickness; 6. undulating plains on sands and light sands, covered with mesotrophic peat of low thickness; 7. eutrophic peatlands and wetlands on slopes (peat of different thickness); 8. mesotrophic peatlands; 9. flattened surfaces with added soils; 10. drained mesotrophic and eutrophic peatlands; 11. artificially deepened depressions with water flow regime (including creek valleys); artificial water bodies; 12. drained peat floodplain; 13. artificial water bodies

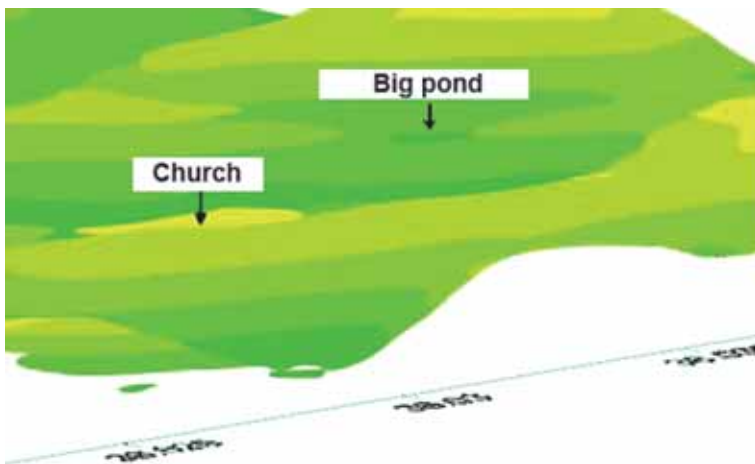


Fig. 6. A three-dimensional terrain model of the Almazovo estate (fragment)

human maintenance, the CL of estates is gradually returning to the initial landscape structure. This process is accompanied by the loss of the landscape architecture features and it follows the laws of natural succession.



Fig. 7. The vegetation cover of the Almazovo estate (circa 1813)

1a – spruce-broad leaved forest; 1b – birch-spruce (pine) forest; 1c – pine (spruce)-birch forest; 2a – spruce (pine)-birch forests blueberry-reed grass-mixed herb forest; 2b – spruce (pine)-birch forest; 3 – grass -mixed herb meadow; 4a – grass-reed birch grove; 5 – planted birch grove; 6 – planted linden grove; 7 – oak grove; 8 – pine grove; 9 – spruce bosket



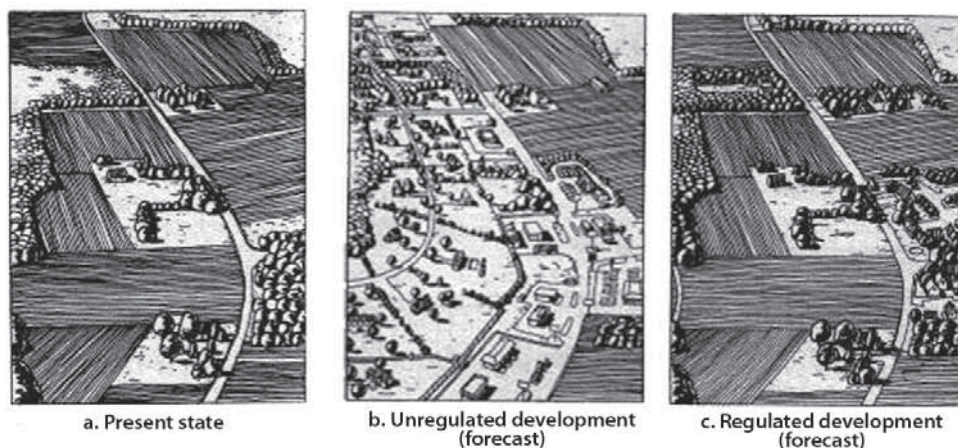
100 m

Fig. 8. Vegetation of the Almazovo estate (2009)

1a – spruce-broad leaved forest; b – birch-spruce (pine) forest; 1c – pine (spruce)-birch (with evidence of heavy logging) forest; 2a – spruce (pine)-birch blueberry-reed grass-mixed-herb forest; 2b – spruce (pine)-birch (with traces of heavy logging) forest; 3 – herb-grass meadow; 4a – birch mixed-herb-grass-reed forest; 4b – birch mixed-herb-grass-reed forest (with traces of heavy logging)

THE CONCEPT OF THE ENVIRONMENTAL FOUNDATION FOR SUSTAINABLE FUNCTIONING OF THE CL

Up till the last century, landscape changes were of extensive character and, likely, complemented it and did not destroy it. However, beginning in the middle of the XXth century, there began to appear industrial and urbanized territories characterized by a strong depletion and deterioration of the natural components. However, with development of science and technology, society learned to restore and maintain landscapes [Ignatieva, 2011].



**Fig. 9. Possible scenarios for the development
(Program “Dealing with Change in the Connecticut River Valley”)**

One of the first cases of recultivation of disturbed landscape took place in 1860s in France, where at the site an old quarry, a park with an artificial pond and man-made topography was created (Le Parc des Buttes Chaumont) [Sokolskaya, et al., 2007]. In Russia, one of the largest landscape parks was established at the site of former manganese quarries near Vladikavkaz only in the 1960s [Ozhegov, 1993].

Soon, there emerged a method of preservation and maintenance of the natural landscape, i.e. designing planned activities that provide for the minimal changes in the landscape environment during new activities.

Targeted preservation of the natural landscape is an extremely complex and multifaceted task. In the last century, landscape projects were initiated in the USA, Germany, The Netherlands, Russia, and a number of other countries. In the USA in the state of Massachusetts, the Center for Rural Massachusetts created a program entitled “Dealing with Change in the Connecticut River Valley” (1988) [Robert et al., 1988]. In order to promote its program, the Center demonstrates, with the help of simple figures, how specific intact landscapes look (Fig. 9a), how they might look in a number of years after traditional spontaneous development (Fig. 9b), and how they might look as a result of targeted management pursuing the

same goals as in spontaneous management (Fig. 9c). This clearly shows the work of landscape planners.

One of the main areas of a planner’s activity is the maintenance and preservation of CL properties and functions. For sustainable functioning of the CL as an ecosystem, a concept of the ecological framework (EF) has been introduced. The EF is a minimal, in terms of area, formation that is able to provide suitable conditions for humans and to preserve the nature in isolated reserves [Kolbovsky, 2008].

The EF is a complex of natural (wild) and cultural ecosystems located around the centers and axes of economic activities and created on the basis of large reserves connected by ecological corridors. The EF secures ecological stability (relative homeostasis) of the space that they encompass at appropriate scales (region, farm, territory of rural administrative area, municipality). The EF addresses the following goals [Kolbovsky, 2008]:

- regeneration of main components of the natural environment that provide a necessary balance in interregional flows of matter and energy;
- maintenance of the balance between the strength of anthropogenic impact and the

level of biochemical activity and physical stability of the natural environment including the existence of conditions for sufficiently high rates of pollution, their biological processing, and stabilization of impact of transportation, engineering, and recreational loads on the landscape;

- maintenance of the biological mass balance in intact or lightly disturbed areas that are affected by economic activity in main landscapes of the region;
- provision of maximal possible, in given conditions, diversity and complexity of environmental systems in the region.

In reality, the EF is formed among given structural lines and ranges, i.e. a city with its suburbs and industrial areas, large transportation centers and arterials, agricultural areas and forests, river network, sources and range of pollution, interregional transit flows of pollution, etc. The main blocks (components) of such foundation are forests of different size, river network, wetlands (that represent hydrographic centers), reserves and national parks, and different natural monuments.

As it was mentioned above, the main unstable territories are the industrial-urbanized areas. In order to improve conditions of settlement areas, the principles of creation of the urban EF have been developed. The urban EF is an environment territorial system designed for enhancement of the environmental situation of urbanized areas through [Yang, et al. 2004]:

- isolation of the most hazardous centers of technogenic impact;
- protection of historical elements of the CL;
- restoration of valuable components of natural ecosystems;
- enhancement of comfort level in residential environment.

The urban EF should consist of different elements of the CL (parks, gardens,

boulevards, street trees) and elements of the remaining nature (suburb forests, parks, valley forest-meadow areas). The EF includes blocks of different size (large inter-arterial wedges and spots of vegetation of residential gardens and of different functional purposes – green, recreational, sanitary-protective, and engineering-protective). Finally, and the most importantly, the EF is characterized by integrity – all components and blocks should be spatially connected in a single live network of centers (areal blocks of the EF) and corridors (linear blocks of the EF). From the positions of zoning law, the EF achieves urban nature-protective and recreational goals, forming special legal zones: recreational, specially protected natural territories, protected historical and cultural monuments, and their landscape space. Development of the EF assumes regeneration of its natural elements and the formation of new green spaces that restore continuity of the urban natural landscape structure; preservation, identification, and visual realization and accentuation of historically characteristic landscape views, garden-park complexes, and urban scenic views [Gobster, et al., 2007].

Restoration of spatial continuity of the natural and semi-natural elements of the urban EF is achieved through the creation of a well-developed system of green connectors that unite isolated territories and the natural complexes. It assumes:

- formation of a system of specially protected suburb territories by identification of the most valuable, typical, and unique ecosystems and landscapes (or their elements) of both the natural and the cultural origin;
- preservation of existing and restoration of lost landscapes of valleys of large and small rivers as environmental corridors;
- identification and preservation, in each sector, of the urban rosette of free arterial wedges and territories-connectors that include existing and reserve areas of the

EF and that provide interconnection of its main areas and between them and suburb landscapes;

- restoration and design of new large urban parks (as spatial intercity areas of the EF) instead of old and lost, especially in the new housing development areas;
- formation, in the contact zones of the EF and in the urbanized territories of buffer zones, of low-density and heavily green areas that are able to decrease pressure on the natural complex;
- development of a system of inter-block greening and of greening of pedestrian zones, streets, industrial zones, and engineering network;
- preservation and creation of new green areas of common use (boulevards, gardens) and areas of special purposes (protective belts along railways, engineering-technical zones, and networks);
- recultivation and rehabilitation of wastelands, industrial areas, storehouse and public utilities zones, protected zones of different purposes, developed depositing sites, watersheds, slurry reservoirs, ash disposal areas, and tailing dumps;
- establishment of environmental corridors along major roadways and railways.

The urban EF is, at the same time, a recreational foundation. In urban conditions, these two concepts practically blend together because it is difficult to rely here on the creation of protected elements of the EF that are closed for the public and for the recreational use (it may only be possible within botanical gardens, protected private areas, or areas with regulated schedule of operation). Therefore, the formation of the EF assumes a simultaneous creation of recreational areas. Park is seen as the main urban recreational type. In the urban environment, large parks (exceeding 5 ha) are especially important since they maintain

complex layered structure of the biota (ground layer, several shrub layers, low-trees layer, groundfloor, and layer of developed species different in height). Specifically such parks exhibit the maximal biodiversity and are able to regulate and form microclimate. Parks may be artificially created or created on the basis of natural vegetation.

Parks and urban cultivated green areas are, of course, the main remnants of the nature at any urbanized territory with a set of environmental niches [Alvey, 2006]. Their species diversity depends on the age and the storey-structure of plantings, frequency of mowing, soil and fertilizing regime, intensity of trampling, and existence of water bodies. These factors, in turn, determine the number of nesting sites and shelters for birds that nest in hollows of trunks or in branches of trees. Parks are the refuges for disappearing local species and for archaeophytes and neophytes; besides, they are the islands for lichens in urban conditions. In parks, there are also edge communities and communities of grazing areas; locally, there are thickets of shrubs similar to natural [Goroshyna and Ignatyeva, 2000]

Urban parks are a vivid example of the island environment under significant anthropogenic impact (disturbance by people, dogs, automobile pollutants, chlorides, dust, pesticides, mechanical disturbances, altered microclimatic parameters). As any island, a park, depending on its size and configuration, consists of an internal center and an edge. The edge zone carries an especially strong anthropogenic load. The smaller the park, the greater a relative area of the edge zone where the influence of the surrounding environment of the urban territory is spread through the entire island and the central zone disappears; after that, its functional zoning is obsolete.

Today, urban and other planners have a sufficient number of ways to maintain environmental situation in residential areas by forming the EF that includes blocks different in size, i.e., inter wedges, green belts and urban nature-protective and recreational zones.

CONCLUSION

1. The CL is less stable compared with its original natural landscape. Stability of the natural landscape is defined by its intrinsic diversity. As a rule, the following potentially more stable geocosystems can be isolated: with increased diversity and overlapping (doubling) components of structure; in the centers of their zonal and regional typicality; trans-accumulative are more stable than trans-alluvial; larger in area and matter; and of higher hierarchal ranks. The main methodological instrument of assessment of landscape stability is LP that defines stability criteria of the natural landscape components. The main element of assessment is the biotope. It reflects all natural components of the landscape. Its two criteria, i.e., sensitivity and significance, are identified. The sensitivity criterion assumes an ability of a given natural complex to change its properties and dynamic characteristic under the impact of human economic activity. The second criterion is significance that helps to identify priority goals and objects for LP.

2. Identification of the stability categories of the CL is associated with a number of difficulties. The methodology of LP has developed rather clear recommendations for assessment of sensitivity and significance of the natural landscape, which cannot be stated in respect to the CL that requires a specific and individual approach in each particular case. In contemporary scientific research, only basic and general assessment criteria of natural components are used for the identification of the CL stability criteria.

3. The link between the natural and cultural components is rather complex and the maximal correspondence is manifested through the character of territorial natural resource management. It reflects the natural structure of the CL and it also considers the socio-economic features of the territorial use. The natural stability is one of the prerequisites for sustainable resource use. With the increase in human economic activity, the natural stability of the natural landscape decreases and there

emerges new acquired stability, but in this case, already of the CL. The essence of the acquired stability is in the adaptive variability of structures and functions of the landscape under anthropogenic impact.

4. Stability of the CL is closely associated with the character of natural resource management. This allows identifying three groups of stability that depend on the types of territorial use: stable (they include extensive types – traditional, recreational, nature protective), moderately stable (vast territories of forest management and agricultural purposes), and unstable (urbanized and industrial zones with strong differentiation and changes in the structure of the native landscapes).

5. For the sustainable functioning of the CL as an ecosystem, a concept of the EF has been introduced; the EF is the minimal, in area, formation that is able to provide for suitable environmental conditions for humans, to preserve the nature at least in the form of isolated reserves, to identify the most hazardous centers of technogenic impact, to preserve historical elements of the CL, to restore valuable fragments of natural ecosystems, and to enhance comfort of the residential area. The urban EF consists of different elements of the CL (parks, gardens, boulevards, and street plantings) and of fragments of the remaining nature (suburb forest, parks, and valley forest-meadow spaces).

6. The EF achieves the nature protective and recreational goals of urban territories, forming special legal zones: recreational, specially protected natural areas, and protected historical and cultural monuments together with space around them.

7. Development of EFs assumes restoration of the natural urban elements, formation of new green spaces (a system of inter-block green areas and greening of pedestrian zones, streets, industrial areas, storehouse and public utilities zones, protected zones of different purposes, developed

depositing sites, watersheds, slurry reservoirs, ash disposal areas, and tailing dumps) that restore continuity of the urban natural-landscape structure; preservation, identification, visual realization, and accentuation of characteristic historical landscape views, park-garden complexes, and urban scenic views.

Thus, we can reach a conclusion on the incomplete and insufficient level of development of criteria for assessment of stability of the CL in modern science. This results from great diversity of both the CLs themselves and their natural conditions of

formation, as well as of the types of natural resource management. All discussed research approaches on CL stability were developed with the obvious domination of the nature-centric approach that is based on assessment of the natural component of the landscape. This is explained by the difficulty of identification of the structure of the CL, its components, and assessment of their stability. Today, the methodology of the EF for urbanized areas may be considered the best developed methodology of the CL stability assessment. Modern methods of assessment and formation of the EFs in cities promote preservation of properties and functions of the CL. ■

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Elena I. Golubeva is Professor of Environmental Science Department and Head of Education Program "Landscape Planning & Design" at the Faculty of Geography, Lomonosov Moscow State University. 1974–M.Sc. in Biogeography, 1982–Ph.D. in Biogeography and Bioproduction, 1999 – D. Sc. in Biology. Member of the Russian Academy of Nature Science. Laureate of Russian Governmental Award in Science and Technology (1997). Her primary research interests are in diagnostics of ecosystem health under nature and anthropogenic pressure. Main publications: Methods of diagnostics of transformed ecosystems (1999); Change of structure and function of vegetation under pollution impact in the North (2007, with co-authors); Urban Cultural Landscape: Traditions and Modern Trends (2012, with co-authors).



Maria E. Ignatieva is Professor in Landscape Architecture, Division of Landscape Architecture, Department of Urban and Rural Development at Swedish University of Agricultural Sciences. MSc.: Leningrad Forest Technical Academy (1982). PhD: Moscow State University in 1987. Honorary doctor at St. Petersburg State Forest Technical Academy (2012). Main research is urban biodiversity and design and history of landscape architecture. Main publications: Gardens of Old and New World. Journey of a Landscape Architect (2011); Design and future of urban biodiversity (2010). Maria has realised several landscape architecture projects in the USA and New Zealand.



Tatiana O. Korol graduated with a MSc from the Department of Social and Economic Geography of Russia, Lomonosov Moscow State University, in 1999, and with a PhD in Geography in 2003. Since 2010 she is a Senior Researcher at the Environmental Science Department and Supervisor of Distance Education Program "Landscape Planning & Design" at the MSU Faculty of Geography. Her primary research interests are in land-use planning, urban and landscape design, sustainability of cultural landscapes. Main publications: Art and design landscape. Textbook (2010, editor with E.I. Golubeva); Experience in the use of tools of landscape planning in the project landscaping of private land ownership (2010); Landscape research with application to land-use planning of building zones: a case of study for Skolkovo, Moscow region (2012, with E.I. Golubeva).



Valentina A. Toporina graduated from the Lomonosov Moscow State University in 2003. She is a Scientific Researcher at the Environmental Management Department, MSU Faculty of Geography. She received her PhD degree in Geography from the Lomonosov Moscow State University in 2012. Her primary research interests are in cultural geography, cultural landscapes, and mapping of cultural landscapes, attributes and categories of landscape sustainability. Main publications: Contribution of manorial estates to cultural landscapes in Russia (2010); Landscape conditionality types of manorial estates: case study for European Russia (2011); Challenges of cultural heritage conservation: case study for estates' parks in European Russia (2012).