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Investigation of Soil Properties and The Red Book of Soils in the Landscape reserve "Teply Stan"

Duran Kala[(1)], Amir Nurullayevich Guseinov[(2)], Robert Anton Erikovoch [(3)]

[(1)]Biology Education Department, Ishik University,Erbil, Iraq

[(2)]Russian state geological prospecting University named after Sergo Ordzhonikidze, Moscow, Russia

[(3)]Gymnasium №1584, Moscow

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***Corresponding Author:**
Duran Kala
kaladuran@gmail.com

ABSTRACT

This article focuses on learning degree of anthropogenic transformation of the natural environment. Red Book of Moscow contains protected plant species and animal species that survive in habitat of Moscow.

Red book focuses on that you cannot save species without saving their soil habitat. Soil is a special habitat that focuses on relation between components of nature and soil. As it is the control center of the entire landscape reserve "Teply Stan". Only the protection and preservation of the soil can provide reliable guarantee of preservation of all life. However, none of protected natural territories of Moscow does not include direct purpose of protecting the soil.

This work is the first scientific attempt of preparing the Red Book of the soil in the city. The red book of soil will not only serve the protection of soil, but also helps emerging of city`s most tentative natural areas that need in protection.

Results of research findings include a series of maps and the Red Book of the soil, prepared by using IT technologies. Organization and carrying out such work allows to implement the requirements of the new regulations on natural habitats, reveals the practical significance of ecological and geographical knowledge and skills.

1. INTRODUCTION

1.1 Soil - control center of landscape

Natural areas of Moscow are specifically protected in 3 nature reserves, 11 nature and historical parks, 1 integrated reserve, 3 landscaped reserves, 1 national Park (SIDIGP, 1993). The red book of Moscow is a landmark event in the field of nature protection of Moscow was the establishment of the Moscow Government in 2001 (Samoilov B. L., Morozov G. V., 2011). It provides information on rare and endangered on the territory of the city the species of animals, plants and fungi, causes of deterioration and disappearance, contains a programme of action for the conservation and recovery of such species.

Consequently, Improvement of the environmental conditions in town improves the quality of life of Moscow residents. In this official document is put in direct dependence on the preservation of the local flora and fauna, and the endangered and vulnerable Animal and Plant species in Moscow.

Today, after 13 years of the first edition of the red book of Moscow, it can be noted that it has not fully met its expectations. Species such as the Heath spotted Orchid (*Dactylorhiza maculata*), cloves Fisher (*Dianthus fischeri*), Mallow (*Primula veris*), Manic butterfly (*Maianthemumbifolium*), Wintergreen (*Pyrola rotundifolia*), common meadow Rue (*Thalictrum minus*), were assigned in the first edition of the red book. In the second edition they were assigned as rare or scarce species also they were firstly classified in endangered category. Nowadays they are not living in the landscape reserve.

Compaction of the building and increasing the number of storeys in the city, unplanned urbanization near Moscow, reinforced insulation preserved in natural areas, increased population density and obvious mass motorization played negative role in the mentioned extinct species in the landscape reserve.

This is a natural interaction is the essence of the knowledge of nature... the best and highest beauty of natural science (Kovrigo V. P., Kaurichev I. S., Burlakova L. M., 2000). Vladimir Dokuchaev explained the principle of the need to study individual factors, phenomena of nature and natural connections in the book "the doctrine of zones of nature" in 1892.

Indeed, it is not possible to protect and preserve the plants, animals and fungi simultaneously without protecting and preserving their soil. Moreover, the soil is not just the habitat. It is focusing on all the communication between the components of nature, is the control center of all the landscape. Accordingly, only the protection and preservation of soil center can provide reliable guarantee of preservation of everything else - in particular, the "red book" of plants, fungi and animals.

Meanwhile, almost all the soil of specially protected natural territories (SPNT), located in an urban environment are in the field of different kinds of intense human impact: industrial, agricultural, and especially recreation. The threat of the permanent disappearance of some species of soil, now has become very real.Unfortunately, none of the protected areas does not put a direct objective to protect the soil. A standard mode protected areas protection does not protect the soil from degradation and destruction and does not include the specific basis the role of soils in the protection of ecosystem components (plants, birds, animals, etc.). It should be emphasized that the creation of the Red Book will serve not only the protection of the soils themselves, but at the same time filled with new content idea of protected areas (Aparin B. F. *et al.* 2007).

1.2 Soil of landscape reserve "Teply Stan"

Landscape reserve "Teply Stan" is located in South-Western Administrative District of Moscow, between the Moscow Ring Road and Leninsky Prospects. It is surrounded by the streets of Ostrovityanova, Academician Varga, Teply Stan, Academician Bakuleva and Profsoyuznaya. Almost all sides Reserve surrounds a multi-storey Residential buildings in Figure 1. (Kala D, 2016).

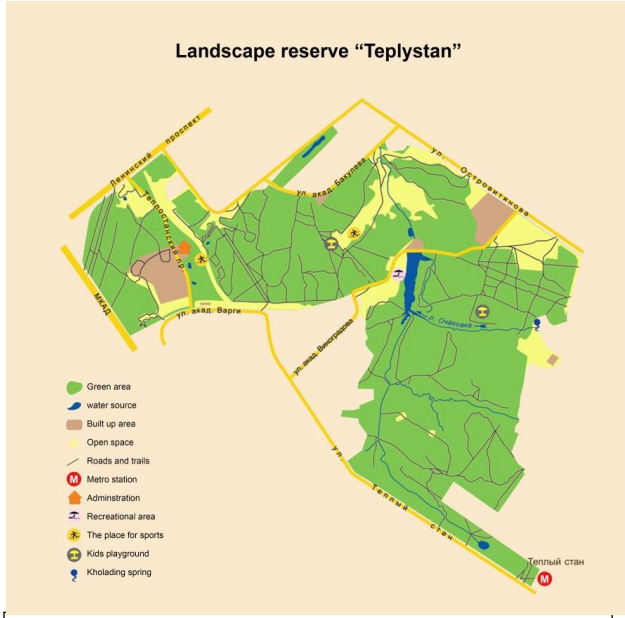

Figure.1. Landscape reserve "Teply Stan"

The reserve is located near the metro station "Teply Stan" and "Konkovo". It is almost surrounded by Roads.

Only the eastern boundary of the reserve contains residential areas in figure 1.The reserve is located on one of the highest points in Moscow that is called “Teply Stan” hill. Nature of landscape reserve was created by Ochakovka small river and its tributaries during centuries. Relief generally has a soft smooth outlines. A characteristic element of the relief are gullies that formed as a result of surface erosion waters of glacial water melt.

Forests of Landscape reserve is dominated by birch that over 50 years and a lot of old oak trees. Species of herbaceous plants are typical of deciduous forests hairy sedge, Ground Elder, Lungwort, protected lilies of the valley, two species of orchids, and bell flowers.

It is home to squirrels, hares and weasels, nesting woodpeckers, nuthatches and jays, the song thrushes and nightingales. The reserve preserves a number of archaeological monuments – burial group XI – XIII centuries (the ancient Slavic cemetery).

1.3. The problem of the red book of soils

Almost all soils of specially protected natural territories (SPNT), located in an urban environment, have different types of human impact from anthropogenic, agricultural and, especially recreation. The threat of extinction of some soil types became very real.

Unfortunately, none of the protected areas aim at conservation of soil (SIDIGP, 1993). The protection mode in the protected area does not protect the soil from degradation and destruction. The creation of the red book will not serve only soil conservation, but also fill new the content of the idea of protected areas. It was decided to create the Red Book of the landscape reserve "Teply Stan".

2. MATERIALS AND METHODS

2.1. Identification soil profiles of landscape reserve “Teply Stan”.

The study of soil and soil cover of the reserve were laid soil profiles, produced morphological description of soil horizons and selected soil samples (SFCU, 1984), (Revich B.A, *et al*. 1982) (Dokuchaev , 2008).

2.2. Determination of acidity, radioactivity and morphological characteristics of soil of landscape reserve “Teply Stan”.

Collected soil samples were sent to laboratory to determine the acidity, radioactivity and morphological characteristics of the soil made in the Russian Geology prospecting university laboratories .

2.3. Determination of Antropogeny (Human) pressure on the soil reserve by recreational load.

All territory visited and distribution of affinity and bonfires map has been drawn up by computer programs. As the most informative indicator of recreational load we examined the affinity coefficient - the ratio of the total length of trails per unit area. For this purpose the topographic map of scale 1:10 000 was used. To determine the affinity indicators on the map the area of the reserve was divided into equal plots (squares).With a mechanical curvimeter in each of the squares was determined by the total length of all trails. The ratio of the total length of the trails to the area of each plot (square) is the coefficient of affinity which became the basis for creating maps of recreational load in the scale 1:10 000. On this map the location of the fire pits were drawn which discovered during field soil and environmental research.

2.4. Preparation of the red book of soils of the landscape reserve "Teply Stan"

A series of maps and the Red Book of the soil prepared by using IT technologies.

3. RESULTS

On the basis of the field research the digitized soil map with the scale of 1:10 000 was drawn in figure 2.

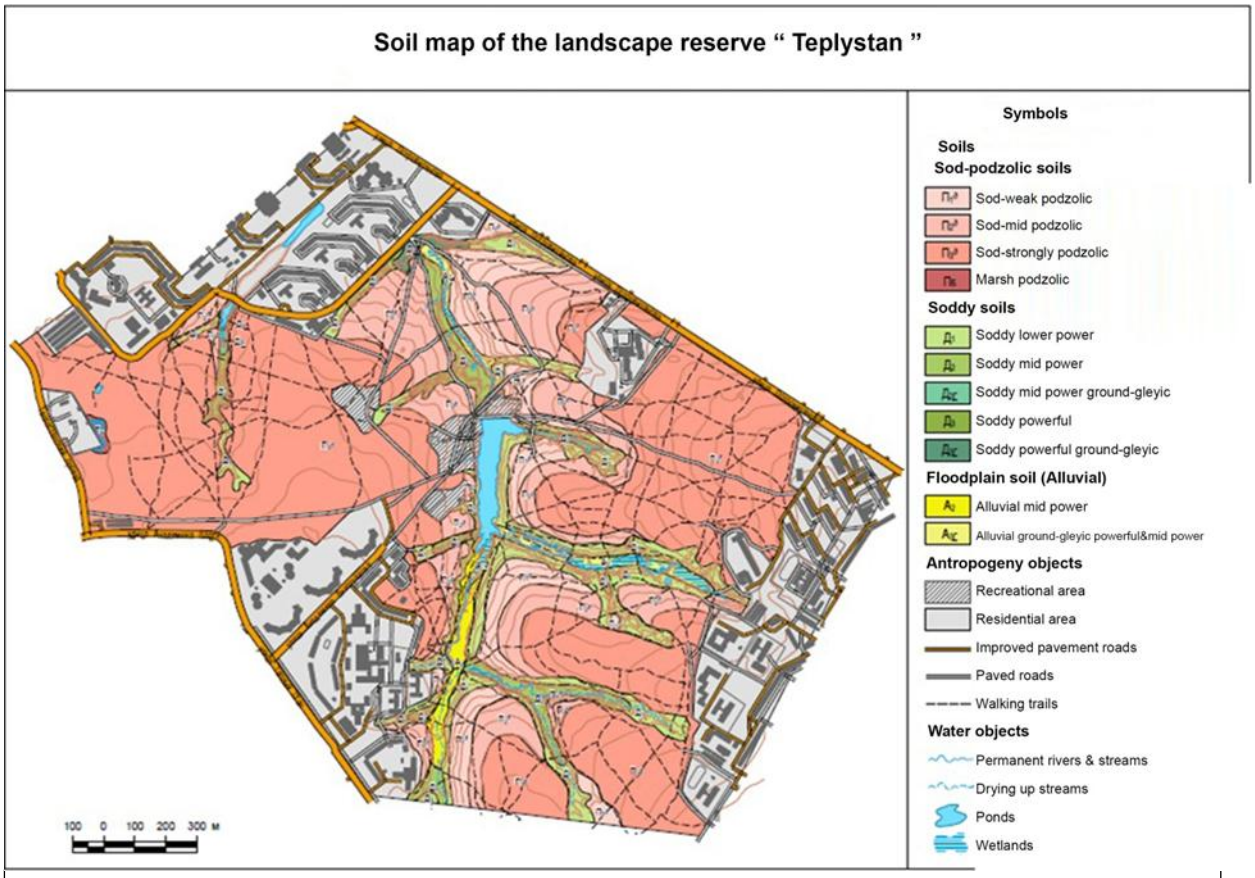

Figure 2. Soil map of the landscape reserve "Teply Stan"

In a landscape reserve "Teply Stan" stands out 3 types of soils: podzolic, soddy and alluvial. The largest areas are podzolic soils, small areas on the slopes and bottoms of shallow gullies contain sod soils. Third place on the area occupied by alluvial soils distributed mainly within the floodplain of Ochakovka river.

3.1.1 Sod-podzolic soils are soils that consist of humus and podzolic horizon in their profile. In the reserve sod-podzolic soils are formed under the birch, birch and aspen forests, pine plantations, spruce forests covered by well-developed herbaceous plants and aligned sufficiently drained surfaces between the rivers. Parent rocks are covering by loam, lying on the Moscow moraine. On the steep, heavily eroded slopes, soils are formed directly on the reddish moraine clay loams.

A small part of sod-podzolic soils of the reserve is characterized by a ground surface gleying caused by periodic congestion in the soil profile of atmospheric moisture. Characteristic feature is the appearance of ferruginous incrustations and bluish spots in the alluvial horizon. In shallow depressions in the upper watersheds of gullies, where stagnant atmospheric moisture added dripstones water, groundwater regime gleying is quite long.

On the territory of the landscape reserve "Teply Stan", depending on podzolic horizon power, we can distinguish:

• Soddy-weakly podzolic soils, podzolic horizon up to 10 cm;

• Sod- mid-podzolic soils with a podzolic horizon of 10 to 15 cm;

• Sod-rich podzolic soils, podzolic horizon more than 20 cm.

3.1.2 Soddy soil in which the leading process of soil formation is the accumulation of humus. In sod podzolic soil horizon is absent.

Soddy soils of reserve are developed on the steep slopes of the river valley of Ochakovka river. Many estuaries coming to the valley of Ochakovka river (occupy about 14-15% of soil areas). In the soil profile one or more of humus horizons develops and transitions to rock horizon.

Power of humus layer painting ranges from 5 to 80 cm (due to flushing or alluvium); its color is usually gray-brown, lumpy structure. On the territory of the landscape reserve "Teply Stan", depending on the thickness of the humus horizon, stand out:

• Sod thin, with humus horizon of up to 5 cm;
• Sod, medium, with humus horizon of 5 - 15 cm;
• Sod powerful humus horizon more than 15 cm

3.1.3. Alluvial soils occupy a small area (about 5%), usually have a sandy or sandy loam mechanical composition, contain enriched humus layer. On the territory of the landscape reserve "Teply Stan", depending on the capacity of the humus horizon,

• Alluvial medium power, with humus horizon of 5-15 cm
• Alluvial powerful, with humus horizon of more than 15 cm.

3.2 Determination of acidity, radioactivity and morphological characteristics of soil of landcape reserve "Teply Stan"

Table 1 shows that the Landscape reserve soil is predominantly loamy soils. The acidity of the soil solution varies within a small range (from slightly acid to slightly alkaline) soil radioactivity is normal.

Table 1: Morphological and physical-chemical parameters of Landscape reserve soil

Soil Property	Sod-podzolic	Soddy	Floodplain	Marshy
Mechanical composition	loamy	loamy	loamy	heavy loam
Density	The compacted-tight	thick	friable	friable
Humidity	humidified	fresh	wet	raw
Acidity (pH)	Slightly acidic (5.5-6.5)	Neutral (6.5-7.5)	Neutral (6.5-7.5)	Slightly alkaline (7.0-7.5)
Radioactivity (mR / hr)	safely (19-20)	safely (17-18)	safely (16-17)	safely (17-18)
The proportion of area (%)	70	14	5	1

3.3 Determination of Antropogeny (Human) pressure on the soil reserve by recreational load

By measuring the lengths of the paths of different categories and using curvimeter mapping bonfire sites in the reserve has made a map of recreational load in scale 1:10 000.

In figure 3 analysis of the map indicates to homogeneous spatial distribution of the coefficients of affinity and the locations of campsites. The highest values of affinity characteristic were the zone of rest "Troparevo" and surrounding areas. The lowest rates are found in woodlands and swamps.

The average characteristic for the territories near the pond "Central". The reason for this distribution of affinity, apparently, is the degree of availability of places for walking and territorial features of the tertiary units. Most of the campsites are concentrated in the Western part of the reserve. As you move towards East the number drops significantly.

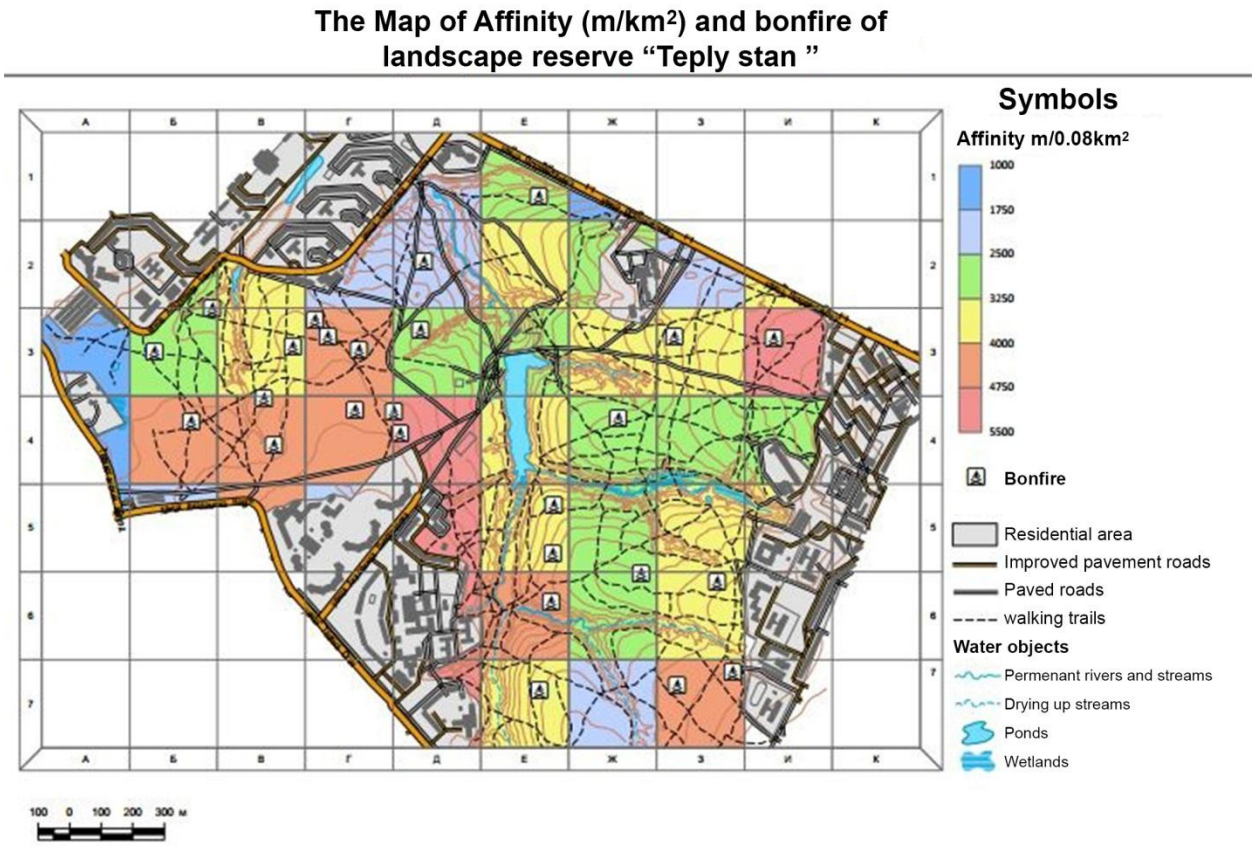

Figure 3. Distribution of indicators of affinity and bonfire on the territory of the landscape reserve "Teply Stan"

Conjugate analysis of soil maps and maps of recreational load shows that the maximum anthropogenic impact have the distribution of the sod-rich podzolic soils with the highest affinity range from 3000 to 4200 m /of 0.08 km^2. Based on these findings, as well as data about the location of camp-fires and residential areas, sod-rich podzolic soils were classified (according to the criteria of the International Union for conservation of nature) to category 4 (SR) soil standards (Datadeficient): soils requiring special attention due to the importance of these soils to maintain the state landscape reserve.

3.4. Drawing up of the red book of soils of the landscape reserve "Teply Stan"

The process of creating red book begins with a description of the characteristics recommended for the protection of the soil of the individual, because the individual soil is the subject of the red book. However,it should be noted that in fact the protection is subject to soil the area represented by the totality of soil individuals. Therefore, in the content of the essay on soil protection combines descriptions of how the soil of the individual, and soil of the area is protected soil.

The object of the red book of soils is the soil of the individual, which is close corresponds to the object of protection in biology – plant, animal, bird, etc. Dualism in soil conservation is that really protected soil habitat presents a collection of soil data of individuals (protected territory). In the areas of sod-podzolic soils tropism varies from 3000 to 4200 m/0,08 km. Based on these data, as well as data about the location of Bonfires and residential areas of sod-podzolic soils was assigned to this category (for the criteria of the International Union for conservation of nature): ***2 (EN) – endangered soils***

2 (EN) - endangered soils (Endangered): The areas occupied by these soils are steadily declining in connection with direct and indirect human activities. This soil endangered extinction by the destruction of soil areas, such as mountain development, construction, as well as a fundamental change in soil-forming

factors. This decision was taken due to the fact that, despite the fact that sod podzolic soils are indicators of the ecosystem of mixed forests landscape reserve "Teply Stan", they do not fully meet the requirements of 4 (SR) , because these soils are under threat (Revich B.A, *et al*. 1982). Soil profile location is shown in figure 4.

4 (SR) soil standards (Datadeficient): soils requiring special attention, although the immediate threat to their conservation due to the importance of these soils to maintain the state of the landscapes in which they are indicators.

Description sod- rich podzolic soil:

Sod-podzolic light on mantle loams underlain moraine Moscow.
Category 2 (EN).
It occurs under the cover in the mixed forest loam.
Soil profiles No in figure 4: ER-23

3.4.1.3. Morphology: Morphology of sod-rich podzolic soil is shown in figure 5.

A0 - litter of brown or brown tones, consisting of plant residues of varying degrees of decomposition, with a power of more than 7 cm is divided into two or three sub horizon
A1 - humus horizon of 3 to 20 cm or more, gray or whitish-dark gray, lumpy-powdery or powdery structure, friable;

A2 - podzolic horizon, whitish light gray, sometimes with a touch of pale yellow tinge; platy structure with appreciable thin flake or foliated, in sandy soils often structureless;

A2B - transitional horizon, 10-20 cm, brownish-whitish, finely fragile lumpy-nutty structure, contains abundant whitish powder, they are found also A2 horizon;

B - illuvial horizon, the densest in the profile, brown, brown-brown or reddish-brown, nutty, nutty-prismatic structure can be divided into subhorizons (Bl, B2, B3), each of which becomes less intense staining, rougher and a large structure, less density;

BC - transitional, light brown, light brown, lumpy, or cloddy-prismatic structure is gradually transformed into soil formation is not changed rock.

Figure 4. Location of the reference soil profile (ER-23)

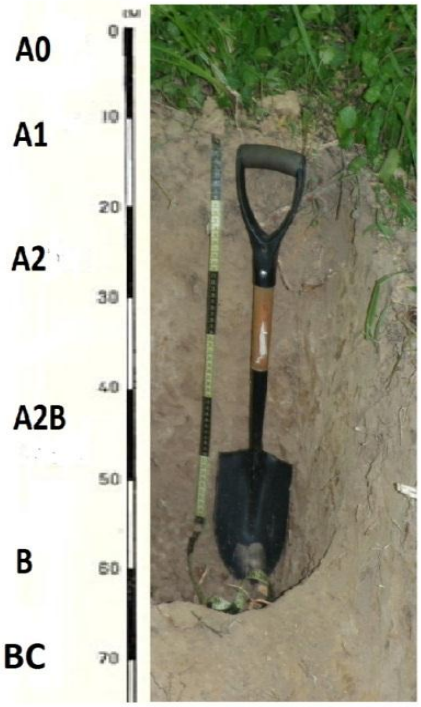

Figure 5. Morphological parameters of reference soil

3.4.3. Description of the protected soil area

The area Soddy- strong podzolic light loamy soil is located 700m to the North-East of spring "Khalodniy".
Relief. Apical surface aligned moraine hill.
Soil-forming rock. Covering loams.
Vegetation. Mixed pine-birch forest with well-developed grass cover in figure 6.

3.4.4. Soil characteristics (section ER-23)

The soil has a well differentiated profile with pronounced podzolic and illuvial horizons. Mechanical composition of the soil is loamy, characterized by weak acid and unsaturated bases throughout the profile. The content of exchangeable bases is insignificant. The amount of humus in the horizon A1 does not exceed 4%.

Figure 6.Mixed pine-birch forest with well-developed grass cover

3.4.4. Protection and Preservation

Sod-podzolic soils of the landscape reserve "Teply Stan" should be protected. It is standard soil of typical moraine hills landscape reserve.

3.4.4.1. Protection regime

Management and reduction of recreational load, improving the health of the forest.

3.4.4.2. Proposed protection regime provides:

1. Soil protection against various types of mechanical impact, leading to disruption of the natural structure of the soil profile, compaction, loss of soil structure, water erosion and loss of humus
2. Preserving or restoring soil-forming factors as the condition of conservation of this type of soil (mixed forest restoration).
3. The protection against chemical and biological pollution.
4. Optimization of recreational loads in the reserve.
5. Limitation of constructions in the reserve.
6. Preparation of special information stands to improve the ecological culture of vacationers.

4. CONCLUSIONS AND DISCUSSION

In modern conditions of rapid degradation of the natural environment, the problem of preserving the biosphere is the main task of all mankind. In practice, one of the significant aspects of the preservation of the biosphere is the organization of nature reserves, protected mainly plants and animals, the creation of the Red books of plants and animals. Thus in spite of the invaluable role of soils and soil cover in the life of nature and society, significant achievements in the field of research of ecological functions of soils, and although soils are the Central link in the global biospheric system, the main ecological niche of the organisms of the land and the center of biological diversity, in environmental policy, the soil still receives too little attention. As a result, the soil and the soil cover is still not protected by a network of soil reserves, reserves and monuments of nature soil, although work on the creation of the Red Book of soil, since the 90s, is underway.
At present, the Red book of soils of more than three dozen subjects of the Russian Federation: republics, territories and regions. In this list there are no Red data books of soils of the cities of the Russian Federation. We offer to your attention article devoted to the creation of the red book of soils of urban protected areas . The relevance of red book of soils of urban protected areas is dictated by the following considerations: first, protection of rare, threatened disappearance of soils is the desired direction of environmental protection. Secondly, soil, protected areas, located in the city, both the nature and intensity of anthropogenic pressure are the specific

conditions: pollution is mostly of a complex nature, and the degradation is total, often rapid and catastrophic.

A common and important problem for all categories of the Red book of soils are many methodological, methodical and legal aspects of their preparation, and their use for the protection and rational use of soils. This is despite the fact that you have already created the Red book of soils of a number of subjects of the Russian Federation . However, this situation does not restrict, on the contrary, stimulates the soil scientists and ecologists in the organization of an active search for ways to solve the problem.

However, Nowadays, Red book of soils of the Russian Federation is still not adopted and, accordingly, the allocation of soils to rare and being under threat of extinction, as well as the procedure for establishing the modes of use of land, soils are classified as rare and under threat of disappearance, has not been determined. But, the work in this direction continues. We hope that publishing of this article will encourage further research.

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