Трансформация экосистем
Ecosystem Transformation

ISSN 2619-0931 Online
www.ecosysttrans.com

DOI: https://doi.org/10.23859/estr-240206
EDN: https://elibrary.ru/ocodaq
UDC 502.521(470.620)

Article

Features of vegetation and soil cover of the natural recreational zone of the "Krasnodarsky Forest Park" protected area

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Abstract. The article presents the description of vegetation and soil cover of the “Krasnodarsky Forest Park” protected natural area. It is the site of the natural and artificial forest established in the 1970s–1980s in the Kuban River valley within the city of Krasnodar. The natural vegetation is dominated by the communities *Salix alba* L. and *Populus alba* L. occupying 20% of the area and thriving on alluvial soddy, alluvial meadow and meadow-bog soils. In some places, the isolated patches of chernozem-meadow soils are found. Coastal willow-poplar communities develop on the primitive alluvial-soddy layered soils and represent the disturbed plant formations that retain native edificator species. Among the man-made plantings, the largest area falls on the communities Canadian poplar (*Populus* × *canadensis* Moench.), black locust (*Robinia pseudoacacia* L.) and black walnut (*Juglans nigra* L.) primarily confined to the sites with the anthropogenically transformed soils. Here, more than 30 invasive species have been recorded. The “Krasnodarsky Forest Park” protected area is generally characterized by the presence of various types of natural and anthropogenically transformed soils differing in morphological and physicochemical features due to specific soil formation in the floodplain.

Keywords: landscape, relief, climate, soils, Kuban River

Funding. ИThe study was conducted as the state assignment No. FENW-2023-0008 at the Southern Federal University with the financial support of the Ministry of Science and Higher Education of the Russian Federation.

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To cite this article: Litvinskaya, S.A. et al., 2025. Features of vegetation and soil cover of the natural recreational zone of the "Krasnodarsky Forest Park" protected area. *Ecosystem Transformation* **8** (4), 175–188. https://doi.org/10.23859/estr-240206

Received: 06.02.2024
Accepted: 09.10.2024
Published online: 12.12.2025

DOI: https://doi.org/10.23859/estr-240206
EDN: https://elibrary.ru/ocodaq
УДК 502.521(470.620)

Научная статья

Особенности растительного и почвенного покровов ООПТ «Природная рекреационная зона «Лесопарк Краснодарский»

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Аннотация. В статье приводится характеристика растительного и почвенного покровов особо охраняемой природной территории «Лесопарк Краснодарский», представляющей собой участок естественного и искусственного леса, сформированного в долине р. Кубань в черте г. Краснодара в период 1970–1980-х гг. Основу естественного растительного покрова лесопарка составляют сообщества с преобладанием *Salix alba* L. и *Populus alba* L., занимающие 20% территории. Данные сообщества функционируют на аллювиальных дерновых, аллювиальных луговых и лугово-болотных почвах, на отдельных участках точечно обнаружены черноземно-луговые почвы. Береговые ивово-тополевые сообщества формируются на аллювиально-дерновых слоистых примитивных почвах и представляют собой нарушенные растительные формации, сохраняющие при этом аборигенные виды-эдификаторы. Из рукотворных насаждений наибольшую площадь занимают сообщества из тополя канадского (*Populus* × *canadensis* Moench.), робинии ложноакациевой (*Robinia pseudoacacia* L.), ореха черного (*Juglans* nigra L.), приуроченные прежде всего к участкам антропогенно-преобразованных почв. Для этих же зон зафиксировано произрастание более 30 инвазивных видов. В целом территория «Лесопарк Краснодарский» характеризуется наличием различных типов естественных и антропогенно-преобразованных почв, отличающихся как по морфологическим, так и по физико-химическим характеристикам, что обусловлено спецификой почвообразования в пойменном режиме.

Ключевые слова: ландшафт, рельеф, климат, почвы, река Кубань

Финансирование. Исследование выполнено на базе Южного федерального университета при финансовой поддержке Министерства науки и высшего образования РФ в рамках государственного задания в сфере научной деятельности № FENW-2023-0008.

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Для цитирования: Литвинская, С.А. и др., 2025. Особенности растительного и почвенного покровов ООПТ «Природная рекреационная зона «Лесопарк Краснодарский». *Трансформация экосистем* **8** (4), 175–188. https://doi.org/10.23859/estr-240206

Поступила в редакцию: 06.02.2024
Принята к печати: 09.10.2024
Опубликована онлайн: 12.12.2025

Introduction

Floodplain forests of the Kuban River valley have preserved on small sites in the eastern regions of Krasnodar Krai partially confined to the protected areas. These are the "Krasny Kut Tract" and the "Krasnodarsky Forest Park" territories located directly within the boundaries the city of Krasnodar. In conditions of severe anthropogenic pressure and emerging signs of climate aridization, most natural floodplain forests have completely degraded and are hardly suitable for the recreational purposes in the near future. Furthermore, the studies of the late XX show that not a single hectare of the natural seed stands has remained. The existing coppice forests (dominated by adventitious species) alongside the declining native flora have lost the features characteristic of this forest formation. Because of digression, they are unable to realize the high forest potential of the area (Vorobyov, 1997).

The aim of this study is to examine the current state of the remainder of the floodplain forests in the Kuban River valley and to correlate the present plant formations with a complex of different soil types liable to periodic overwetting.

Materials and methods

Study object

The study was conducted in the floodplain forest of the Kuban River valley within the city of Krasnodar and administrative boundaries of the “Krasnodarsky Forest Park” protected area (SPNA) covering 78.7 hectares (Fig. 1). This SPNA was designed in accordance with the long-term landscaping plan for the city of Krasnodar and founded on the lands of the state forest fund in the urochishche “Kirghiz and Pavlovsk swamps”, including urban lands. The SPNA boundaries and its special protection regime were approved in 2017[1].

[1] Resolution of the Head of Administration (Governor) of Krasnodar Krai dated December 21, 2017 No. 1013 "On the establishment of specially protected natural areas of regional significance: the natural recreational zones 'Urochische Krasny Kut,' 'Krasnodarsky Forest Park' and 'Kuban Stadium Park.'"

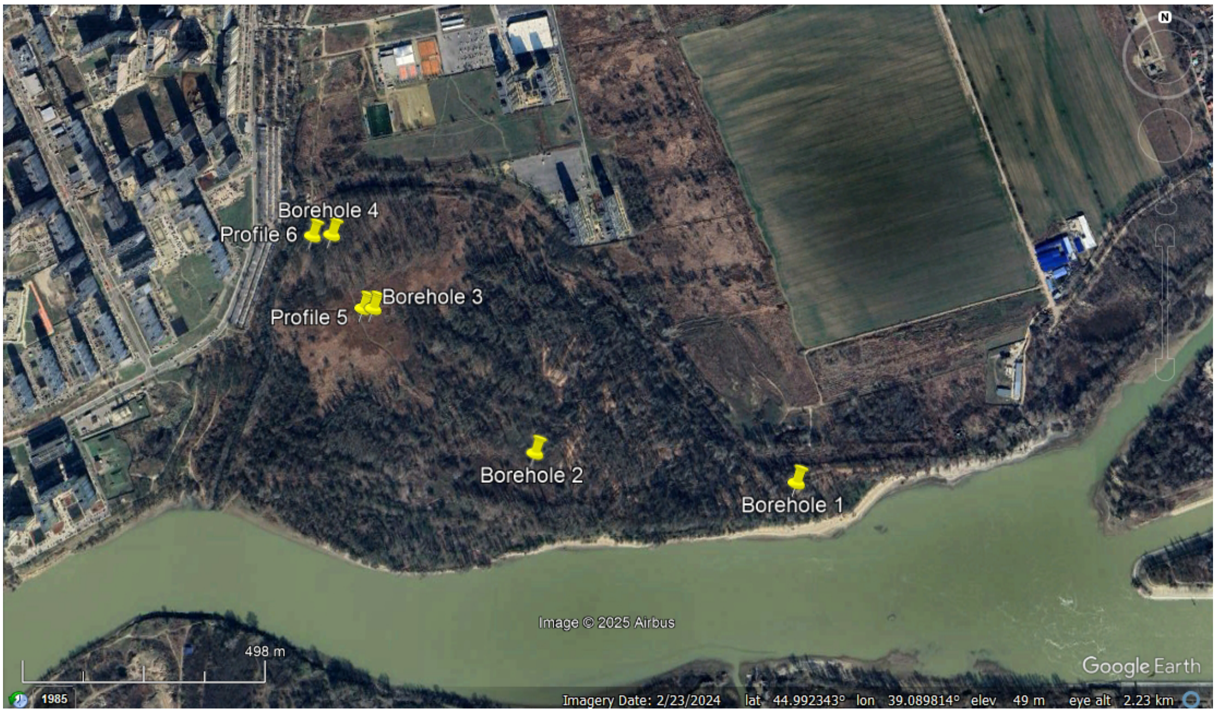

Fig. 1. The location of the "Krasnodarsky Forest Park" SPNA with boreholes/profiles indication.

The territory of the Kuban River valley is a part of the Crimean-Caucasian subzonal geographical variant of the lowland nemoral broadleaf forest and forest-steppe biome – the "Kuban oak forest-steppe" (Litvinskaya, 2023). Geobotanically, the biome belongs to the Eurasian forest-steppe region, the East European province, the Azov-Kuban subprovince (Shiffers, 1953).

Residual lowland forest-steppe woods grow along the floodplain terrace of the Kuban Valley and on the Kuban sloping plain. The "Krasnodarsky Forest Park" territory occupies the right-bank terrace-Kuban steppe and floodplain-forest landscapes (Tyurin et al., 2005). According to A.M. Kanonnikov (1973), the studied protected area includes the following landscapes: floodplain-swampy with reed vegetation formed on silty soils; lowland swampy floodplain with reed communities on alluvial meadow and alluvial meadow-marsh soils; floodplain with introduced plantings on alluvial soils.

The Krasnodar municipal territory is located within the Azov-Kuban Lowland, in the floodplain of the Kuban River. The water's edge fluctuations on the river occur throughout the year and depend on the Krasnodar Reservoir level.

Currently, the natural topography of the floodplain has been significantly transformed almost everywhere, owing to economic activity. The floodplain has been partially built up with residential areas and industrial enterprises.

According to the geomorphological zoning scheme of the North Caucasus, the protected area is situated at the junction of the alluvial Quaternary plain and the terrace of the Kuban low reaches (covered with loess) and the sloping terraced plain. The latter is the low-mountain and hilly relief formed on the latest folded structures (Safronov, 1969).

In terms of hydrogeology, the territory of Krasnodar belongs to the Azov-Kuban artesian basin, which is confined to the Paleogene, Neogene and Quaternary sedimentary formations filling the West Kuban Trough. Groundwater horizons are sporadic and associated with modern alluvial deposits of rivers and gullies, as well as alluvial-eolian-deluvial mantle sediments of watersheds.

The Kuban River is distinguished by a rapid current, a destructive power of floods and high waters due to considerable gradient of its riverbed (Fig. 2). The amplitude of the water level fluctuation near

Fig. 2. The Kuban River within the “Krasnodarsky Forest Park” SPNA.

Krasnodar reaches 5 meters. The Kuban annual solid runoff amounts about 8 million tons. The river's water is turbid the year-round because of high contents of suspended particles (Lurie et al., 2005). Besides spring and summer floods, the river experiences up to seven extra floods. Unlike spring floods, summer ones are more abundant that is explained by intense ice melting on the Main Caucasus Range.

The study area is dominated by continental air masses coming from temperate latitudes; incoming masses of the Atlantic, Arctic and tropical origin are usually substantially transformed. The climate is characterized by long hot summers (sultry in July and August) and mild moderately warm winters. According to the long-term observations, the average air temperature in Krasnodar makes up +12 °C (for the past 10 years the average annual temperature remains +13 °C). The coldest month in the city is January with the average temperature of +0.8 °C, while the warmest is July with the average daily temperature of +24.1 °C. The maximum daily air temperature amplitude in July reaches 23 °C. The average annual precipitation in Krasnodar is about 735 mm. Air humidity is approximately 72%: 64–66% in summer and 78–80% in winter. Precipitation falls more or less evenly throughout the year; its maximum and minimum indicators slightly differ. The absolute maximum occurs in June (86 mm) and the secondary peak – in December (77 mm). The minimum precipitation is recorded in August (44 mm)[2].

Research methods

To study vegetation, we used a detailed route method and generally accepted geobotanical techniques (geobotanical descriptions, herbarization, photography, and mapping) (Lavrenko and Korchagina, 1964).

When investigating soil cover, the microrelief of the study territory, the characteristics of plant communities, and the degree of anthropogenic transformation of the area were taken into consideration.

[2] Agroclimatic resources of Krasnodar Krai: Handbook, 1975. Gidrometeoizdat, Leningrad, USSR, 276 p.

Four soil boreholes were drilled (nos. 1–4) and two full profiles were laid (nos. 5–6). Field studies and soil descriptions were made in accordance with the generally accepted methods (Mazirov et al., 2012; Rozanov, 2004). Soil taxonomy was determined from the classification of V.V. Egorov et al. (1977). Samples collected from all genetic horizons were subsequently processed at the Biogeochemistry Research Laboratory of the Southern Federal University. Among key chemical parameters we defined: the humus content by means of the Tyurin wet ashing method with photometric termination[3]; the pH of soil suspension by the potentiometric method[4]; CO_2 of carbonate applying the Scheibler volumetric method (Vorobyeva, 1998); dry residue of the aqueous extract of soils using the gravimetric method[4].

Results and discussion

The “Krasnodarsky Forest Park” natural recreational area is the site of the anthropogenically transformed natural and artificial forest. Given the proximity of Krasnodar with its population of over one million, green zones of residential areas, and especially natural riverine forests, are of great habitat-forming and recreational value.

Forest plantations, composed of various (mostly adventitious) plant species, appeared in the 1970s–1980s. Currently, approximately 60% of 78.7 ha of the total protected area are covered by the artificially created tree plantations, while the natural floodplain willow-poplar forests fragmentally occupy about 20%. The central part of the park is represented by grass and shrub communities.

In the artificially created plantations, the largest area is occupied by the communities *Populus* × *canadensis* Marshall. The stands are single-tiered, with a crown density of 0.7. The height of the tree layer is 18–20 m, the average trunk diameter reaches 73 cm and even up to 85 cm in some specimens. Other tree species are represented by the young growth of *Morus nigra* L., *Juglans regia* L., *Acer saccharinum* L., and *Prunus spinosa* L. The undergrowth is clearly defined (density 0.8) and formed by *Rubus caesius* L. and *Swida australis* (C.A. Mey.) Pojark. ex Grossh. The 20% projective cover of the herbaceous-dwarf shrub layer consists of the cereals *Elytrigia repens* (L.) Nevski, *Phragmites australis* (Cav.) Trin. ex Steud., and *Sambucus ebulus* L. with an abundance of "Sp". Single species involve *Alliaria petiolata* (M. Bieb.) Cavara & Grande, *Erigeron annuus* (L.) Desf., *Galium aparine* L., *Parthenocissus quinquefolia* (L.) Planch., and *Torilis arvensis* (Huds.) Link. High proportion of liana forms should be noted as well. The most common among them are woody *Periploca graeca* L. and herbaceous vines *Humulus lupulus* L., *Aristolochia clematitis* L., and *Calystegia sepium* (L.) R.Br. Within an area of 625 m², floristic diversity ranges from 11 to 18 species.

The artificial forest plantations in the park include *Robinia pseudoacacia* L. Forest stands reach 12 m in height and 8–10 cm in diameter. Crown density is 0.5. Single undergrowth of *Quercus robur* L. is of 0.3–0.5 m accounting 1–3 specimens per 16 m². Coppice of *Acer saccharinum* L. of 2–3 m high with 5 cm diameter is also found. *Rubus caesius* forms the shrub layer with a 40% density. The herbaceous and dwarf shrub cover consists of *Calamagrostis pseudophragmites* (Haller f.) Koeler and *Elytrigia repens* with occasional specimens *of Armoracia rusticana* G. Gaertn. and B. Mey. & Scherb., *Cirsium incanum* (S.G. Gmel.) Fisch., *Equisetum arvense* L., *Geum urbanum* L., *Inula helenium* L., *Rumex conglomeratus* Murray, *Sambucus ebulus*, *Senecio grandidentatus* Ledeb., *Urtica dioica* L. Among herbaceous climbing vines, the species *Humulus lupulus and Calystegia sepium* are most frequently encountered. The floristic richness makes up 17 species per 625 m².

The natural plant communities of the forest park are primarily composed of *Salix alba* L. and *Populus alba* L., forming low-density mixed stands. They grow in the coastal zone of the Kuban River and are actively used for recreation purposes, as evidenced by trampling traces and the presence of picnic areas. Poplar-dogwood association (Fig. 3) and willow-dogwood association play an important role in maintaining the ecological balance of the Kuban coastal zone. The forest here is two-tiered. The first tier consists of 20–22 m old trees with trunk diameters from 60 to 96 cm. Crown density is 0.4. *Populus nigra* L., *Morus nigra*, *and Robinia pseudoacacia* are noted here. Height of the second tier is 11–12 m; trunk diameters are from 18 to 22 cm. In the undergrowth, only invasive species have been recorded. The herbaceous tier includes *Calamagrostis pseudophragmites*, *Elytrigia repens,* with

[3] GOST 26213-91. Soils. Methods for determining organic matter.

[4] GOST 26423-85. Soils. Methods for determining specific electrical conductivity, pH, and solid residue of aqueous extract.

Fig. 3. The poplar forest in the coastal zone of the Kuban River.

occasional participation of *Armoracia rusticana*, *Cirsium incanum*, *Equisetum arvense*, *Geum urbanum*, *Inula helenium*, and *Rumex conglomeratus*.

Open spaces between the woody stands are home to clearing-edge shrub communities dominated by invasive species. These are primarily *Amorpha fruticosa* L., *Rubus caesius*, and *Glycyrrhiza echinata* L. not having a clearly defined layering. Reed communities (*Phragmites australis* (Cav.) Trin. ex Steud.) inhabit waterlogged ecotopes.

Thus, more than 30 nvasive species inhabiting the forest park indicate significant disturbance. Nevertheless, the “Krasnodarsky Forest Park” still includes natural forest communities.

Owing to the complex interaction of climate, relief, parent material and biota, soil cover performs the important utilitarian functions thereby providing the balanced existence of the ecosystem as a whole. In light of the modern paradigm of creating aquatic and green urban frameworks, soil surveys are a must since they ensure the formation of sustainable anthropogenic landscapes and their resource potential. A general assessment of functioning soil types is made from the humus and carbonate contents, pH of soil suspension coupled with morphological studies. It can serve as the basis for practical recommendations on zoning the territory and implementation of necessary soil transfer works.

Soil cover of the study area represents a diverse combination of types and varieties, differing in physicochemical properties. This is due to the main feature of soil formation in the region, i.e. the development of floodplain and alluvial processes (Kirichenko, 1953; Valkov et al., 2008).

According to the soil map of V.M. Friedland et al. (1972), soil cover of the floodplain sites of Krasnodar includes leached chernozems complexes in combination with various meadow and alluvial soils (Fig. 4)

Formed under specific climatic conditions of the Caucasus foothills, leached chernozems are the most typical representatives of zonal soils of the region with predominantly downward moistening. Soils are thick (80–120 cm), free from both gypsum and readily soluble salts in the profile. Gradually decreasing down the profile humus content accounts up 4–8% in the upper 10-cm humus-accumulative

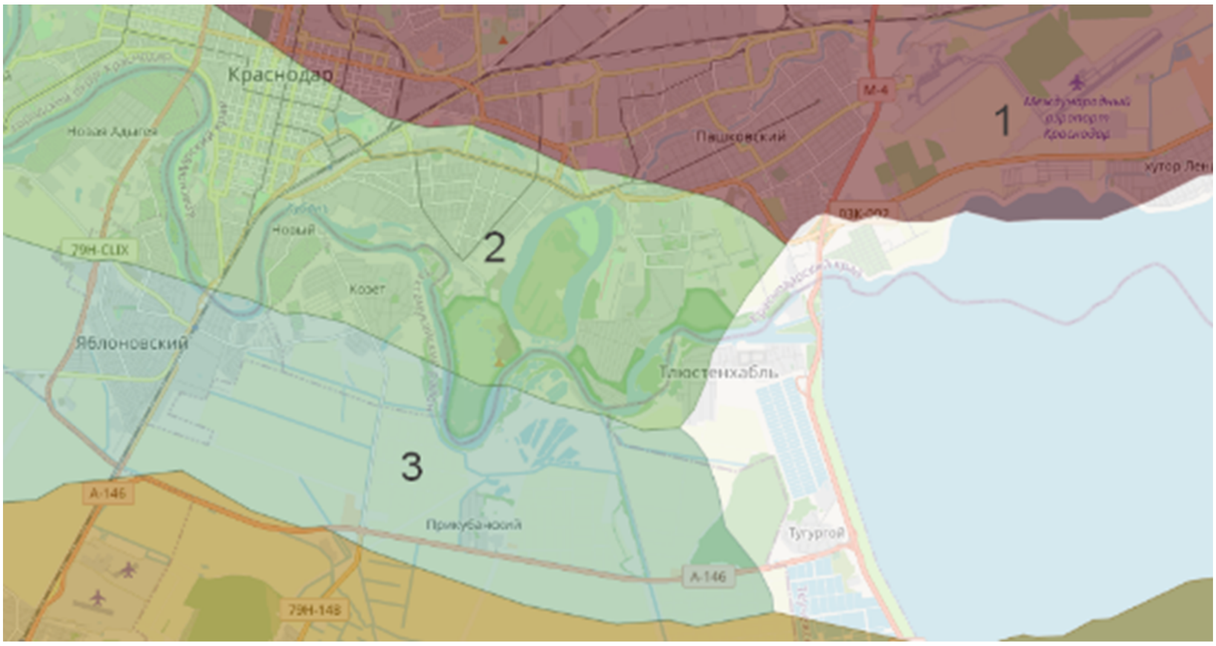

Fig. 4. A fragment of the soil map of Russia (Krasnodar and its suburbs) (Friedland et al., 1972): 1 – leached chernozems; 2 – alluvial soils; 3 – meadow soils.

horizon. In the upper part of the humus layer, the medium reaction is close to neutral or neutral; soil effervescence is observed at a depth of 100–150 cm. In mid profile, silt fraction accumulation takes place due to leaching from the upper layer and clay formation (Egorov et al., 1977; Kovda and Rozanov, 1988). However, zonal soils are absent in SPNA because of the park location in the floodplain section between the Kuban and its small tributary the Erik River. As a result of anthropogenic transformations caused by the construction of the protective earthen dam along the Kuban River, the area has acquired a distinct gently undulating shape with a vast depression in the central part of the park that brings to accumulation and stagnation of atmospheric and ground waters, including partial waterlogging of certain sites of the protected area. By and large the "Krasnodarsky Forest Park" territory can be divided into four zones (Fig. 5).

The significant difference in the anthropogenically-induced elevation (up to 13 m) of the park alongside the intensive hydromorphic processes, greatly increase soil cover complexity (compared to the Friedland soil map (Fig. 4)), making it more fragmented. Field studies allowed to reveal the most common soil types, i.e. alluvial sod, alluvial meadow and meadow-marsh with isolated chernozem-meadow soils in some sites.

In the riverbed area, a thin strip of soil cover is formed of primitive alluvial sod layered soils. Previous studies (Egorov, 1977; Kovda and Rozanov, 1988) suggest that a characteristic feature of these soils is the profile layering formed by alluvium introduction and discontinuous humus accumulation that is typical for initial stages of sod soil formation. Thickness of the sod horizon Ad is 3–10 cm. These soils have a light texture (light loam, sandy loam), a slight compaction, a poorly defined structure, a profile washed from carbonates, and a strong penetration of plant roots.

Zone 1 is characterized by slight east-to-west sloping of the floodplain. In the eastern part, alluvial meadow soils are present. Table 1 gives their main physicochemical characteristics. These soils generally develop in the central part of the floodplain under the permanent or temporary influence of the alluvial river regime. Participation of ground waters, which occur at a depth of up to 2 m, is essential in soil genesis (Egorov, 1977; Kovda and Rozanov, 1988) that is manifested as hydromorphism of the low humus horizon and parent rock. Forb-grass meadow vegetation is common for this soil type, which potentially facilitates humus formation. However, because of a light texture, the studied soils provide relatively poor accumulation of organic matter. The upper humus-accumulative horizon is characterized by a low humus content thus classifying soil as low-humus. The content of soil organic matter drops sharply with depth (Table 1). The pH of suspension is estimated to be alkaline. In the 35–65 cm layer,

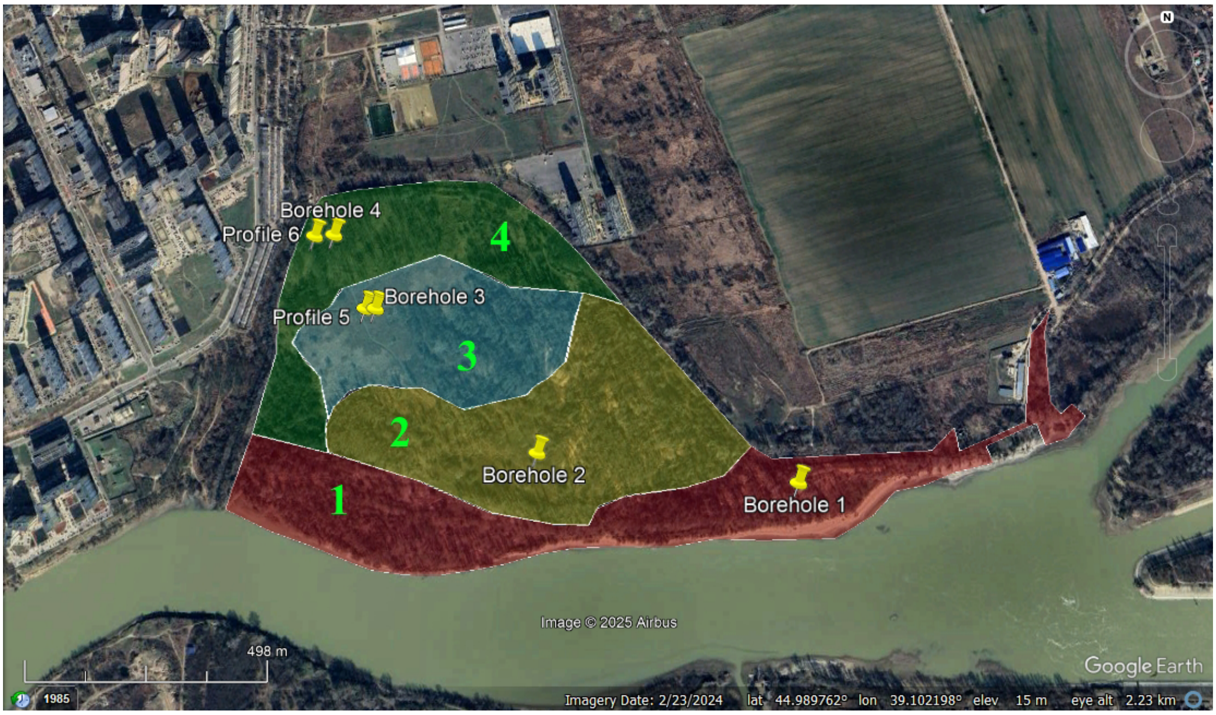

Fig. 5. Zonation of the study area and sampling sites. 1 – riverbed part of the Kuban River floodplain, 2 – gentle southern slope, 3 – central swampy part, 4 – riverbed part of the Erik River floodplain.

this indicator is 8.6 and soil salinity is zero despite negligible dry residual. The carbonate content is low and uniformly distributed throughout the profile.

The western part of zone 1 is represented by alluvial soddy soils, alluvial bog soils in depressions, and a strip of cohesive sands along the Kuban River. Alluvial soddy soils typically have a well-defined soddy horizon against a background of the generally thin soil profiles (around 30 cm or less). In the studied area, alluvial soddy soils were formed under conditions of short-term overwetting by floodwater. Meanwhile, groundwater does not play any role in soil genesis; there are no signs of soil waterlogging.

The emerging edaphic characteristics are favorable for the development of the grass meadow communities with *Calamagrostis pseudophragmites*, *Elytrigia repens*, *Phragmites australis*, *Alopecurus myosuroides* Huds., *Juncus tenuis* Willd., the forest communities with participation of the alien species (*Populus alba* + *Juglans nigra*; *Salix alba* + *Populus alba* + *Amorpha fruticosa*; *Populus canadensis* + *Rubus caesius* + *Urtica dioica*; *Acer negundo* + *Salix alba* + *Robinia pseudoacacia*) and natural floodplain communities (*Salix alba* + *Populus alba* + *Rubus caesius*; *Salix alba* + *Populus alba* + *Swida australis*; *Populus alba* + *Rubus caesius* + *Phragmites australis*; *Populus alba* + *Salix alba* + *Rubus caesius* + *Swida australis*; *Populus alba* + *Salix alba* + *Phragmites australis*).

Zone 2 is represented by a gentle south-facing slope. Alluvial meadow soils also predominate here; chernozem-meadow soils are present locally on the elevated terrain.

Compared to zone 1, the humus content is higher in the top 30 cm (3.65%). The amount of soil organic matter drops sharply with depth. A distinctive feature is carbonate abundance in upper horizons. Increasing with depth, pH of soil suspension is characterized as alkaline (Table 2). The communities *Populus alba* + *Juglans nigra*; *Populus canadensis* + *Rubus caesius* + *Urtica dioica*; *Acer negundo* + *Salix alba* + *Robinia pseudoacacia* are typical for this zone.

Zone 3 is a depression in the central part of the forest park, which may have originally been natural, but the construction of artificial embankments along the rivers intensified waterlogging. Alluvial meadow and meadow-marsh soils are common in this area. Alluvial meadow-marsh soils are formed beneath meadow-marsh herbaceous vegetation (*Phragmites australis*; *Phragmites australis* + *herbosa* + *Amorpha fruticosa*; *Phragmites australis* + *herbosa* + *Periploca graeca*; *Phragmites australis* + *Rubus caesius*; *Phragmites australis* + *herbosa* + *Glycyrrhiza echinata*; *Amorpha fruticosa*; *Phragmites australis* +

Table 1. Physicochemical properties of alluvial meadow soils (borehole 1).

Fluvisols	Sampling depth, cm	Hygroscopic moisture, %	pH (aqueous suspension)	CO_2 carb., %	Dry residue, %	Humus content, %
Fluvisols	Ad 0–35	3.35	7.99	0.53	0.18	2.90
	I 35–65	0.87	8.64	0.60	0.16	0.18

Table 2. Physicochemical properties of alluvial meadow soils (borehole 2).

Soil type	Sampling depth, cm	Hygroscopic moisture, %	pH (aqueous suspension)	CO_2 carb., %	Dry residue, %	Humus content, %
Fluvisols	Ad 0–30	5.81	8.05	1.25	0.26	3.65
	B 30–50	5.57	8.42	1.42	0.12	2.38
	C 50–90	2.00	8.68	0.88	0.11	0.35

Sorghum halepense; *Trachomitum sarmatiense + herbosa*; *Rubus caesius + Sambucus ebulus*) due to increased hydromorphism within the profile.

In zone 3, soil moistening is constant; groundwater occurrence is of 1–1.5 m. Morphologically, this is reflected in the heterogeneous coloration of soil horizons. For instance, against the dark gray background of soil structural units, ocherous films of iron oxide appear in the upper horizons, whereas gleyed patches in the profile bottom. The construction of the Krasnodar Reservoir dam is responsible for making the water regime unstable. If previously, it depended on flooding, today on precipitation amounts.

Table 3 presents the physicochemical analysis of the soils' data for zone 3, where a soil borehole was drilled and a full-profile pit was laid. The surface 0–20 cm horizon of borehole 3 is defined as low in humus, with an alkaline pH of 8.2. Profile 5 is characterized by more pronounced hydromorphic processes. The humus content in the upper soil layer is 2.95% that also characterizes soils as low-humus. Downward, the humus content in the profile stabilizes at 1.44% on average. The pH of soil suspension is alkaline; its values do not change with depth in contrast to increasing carbonates.

In the near-river zone of the Erik River, significant anthropogenic transformations of the forest park are noted. This is reflected both on the microrelief of the territory and anthropogenically transformed soil types present here. Their distinctive feature is the profile duality, i.e. the presence of the surface urbic layer and the buried profile of scalped native soils.

Soils in sections no. 6 and no. 4 have similar morphological features. The humus content in the upper (reducing sharply with depth) soil layer is comparable. The pH of soil suspension is assessed as alkaline. In the urbostratified illuvial meadow soil (no. 4), the pH of the surface layer is a bit lower (7.88). The carbonate content in the profile (no. 6) is comparable, but in the urbostratified soil (no. 4) it increases with depth (Table 4).

The anthropogenic soil transformation has influenced on the forest communities growing along the banks of the Erik River. They are formed by stands dominated by the introduced and invasive tree

Table 3. Physicochemical properties of alluvial meadow soils (borehole 3, profile 5).

Soil type	Sampling depth, cm	Hygroscopic moisture, %	pH (aqueous suspension)	CO_2 carb., %	Dry residue, %	Humus content, %
Fluvisols (borehole № 3)	Ad 0–20	6.68	8.21	0.86	–	2.61
Fluvisols (profile № 5)	Ag 0–20	7.09	8.34	0.72	0.09	2.95
	ACg 20–35	5.45	8.38	0.94	0.08	1.39
	Cg 35–100	6.19	8.27	2.14	0.11	1.49

Table 4. Physicochemical properties of alluvial meadow soils (borehole 4, profile 6).

Soil type	Sampling depth, cm	Hygroscopic moisture, %	pH (aqueous suspension)	CO_2 carb., %	Dry residue, %	Humus content, %
Urbic Technosols (profile № 6)	Aur 0–15	4.16	8.27	1.23	0.13	3.01
	I 15–40	3.28	8.42	1.06	0	0.75
	II 40–60	4.18	8.41	1.24	0.12	0.84
	III 60–100	4.00	8.23	1.32	0.27	1.56
Urbic Technosols (borehole № 4)	Aur 0–20	4.19	7.88	0.47	–	3.90
	I 20–40	3.39	8.41	0.77	–	1.67
	II 40–60	2.90	8.51	0.86	–	0.84
	III 60–80	4.49	8.41	1.43	–	0.95

species: *Acer negundo, Populus nigra, Robinia pseudoacacia, Morus nigra* and *Acer saccharinum.* Their crown density makes up 0.5, a stand height 14 m, and trunk diameters 12–14 cm.

Conclusion

The studied area is characterized by the differentiated vegetation and the highly complex soil cover, including natural and anthropogenically transformed soils. There are no natural zonal soils (leached chernozems) in the forest park; the proportion of chernozem-meadow soils is insignificant. The greatest part of the protected area is occupied by alluvial-meadow and meadow-bog soils with poor agrochemical characteristics. A distinctive feature of these soils is excessive waterlogging affecting both their pH and salinity, as well as the functioning of the dominant plant communities mainly represented by *Phragmites australis*. Consequently, a vast territory is a habitat for extensive monodominant reed beds, with small waterlogged areas where meadow-bog soils predominate. Open areas overgrown with weed species (including reed, licorice and marsh sow thistle) do exist as well.

Natural floodplain forests have been virtually destroyed in the SPNA. The introduced and native forest communities of the “Krasnodarsky Forest Park” protected area differ in terms of coenoses and the flora: the floodplain regime leads to the spread of hygrophilous vegetation. Riparian willow-poplar communities have been disturbed, but retain the growing native edificators: white poplar (*Populus alba*) and white willow (*Salix alba*). Among the man-made plantings, the largest area is occupied by the communities of cottonwood (*Populus × canadensis*), black locust (*Robinia pseudoacacia*) and black walnut (*Juglans nigra*) primarily confined to the sites of anthropogenically transformed soils.

It should be noted that a long-term anthropogenic impact is responsible for complete extinction (from the park) of the native pedunculate oak forest communities previously common for the Kuban River valley floodplains. Restoration of the communities without human intervention is no longer possible. An attempt to restore the original ecosystem was made in 2024 when old decaying poplar trees were removed and 300 pedunculate oak seedlings were planted. Currently, the management company continuously implements the monitoring of plantings and performs the appropriate maintenance.

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