

# Monitoring of the biological diversity of vegetation in the vicinity of Lake Kravtsovo

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**Abstract.** The purpose of this work was to conduct plant monitoring in the vicinity of Lake Kravtsovo within the framework of preserving animal and plant world biodiversity. Lake-swamp Kravtsovo - a unique object of the Stavropol upland, here you can study the diversity of almost half of the entire flora and fauna of Stavropol Territory. 139 species of vascular plants were registered in the studied territory, among which 11 are subject to protection – *Paeonia tenuifolia* L., *Cladium mariscus* (L.) Pohl, *Iris notha* M. Bieb., *I. halophila* Pall., *Adonis vernalis* L., *Calamagrostis canescens* (Weber) Roth, *Utricularia vulgaris* L., *Carex panicea* L., *C. ericetorum* Pollich, *Lythrum thesioides* Bieb, *Thelypteris palustris* Schott. In the structure of the coenosis, the most part is occupied by forbs – 67 %, then cereals – 27 %, legumes in a smaller amount – 6 %. The composition and structure of the community are changed in some way by grazing of farm animals, land plowing and afforestation (a characteristic increase in the proportion of shrubs and trees). The initial stage of pasture degression and the associated increase in the role of associated grazing species (poisonous, prickly, poorly eaten and weedy) are observed. The horizontal structure of the vegetation cover is also heterogeneous.

## 1 Introduction

The preservation of animal and plant world biodiversity is a mandatory condition for sustainable development of the biosphere. This is a global problem. In 1992, the UN Conference on Environment and Development (UNCED) in Rio de Janeiro adopted the Convention on Biological Diversity in response to the acute problem of a significant reduction in the diversity of genetic resources. The extinction of species is associated both with natural factors (general climatic changes) and with a constant increase in anthropogenic pressure [1]. The most accessible control method is monitoring, the purpose of which is to record and analyze the results. Despite the originality of the flora of the Stavropol upland, its phytocenotic study remains incomplete. Data on the composition and structure of plant communities are insufficient and are not always accompanied by the publication of geobotanical descriptions [2, 3].

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Vegetation surveys for individual steppe and forest formations are relevant for the purposes of regional typological work and the creation of a classification system for the vegetation cover of the Stavropol Territory. In-depth knowledge of the structure of vegetation cover and improvement of the typification of chorological units on the basis of geobotanical descriptions is one of the urgent tasks of botanical and geographical research. The results of our study are necessary both for mapping and zoning, and for assessing the actual phytocenotic diversity of taxa at different levels. In this connection, the purpose of this work is to monitor the biodiversity in the vicinity of the Lake Kravtsovo. This makes the work relevant for the inventory and monitoring of studies of steppe plant communities in the Stavropol Territory and allows to solve issues related to their protection.

## 2 Materials and Methods

Lake Kravtsovo is one of the oldest water bodies in the Stavropol Territory, formed during the ice age, it is a natural reserve of regional significance. The main object of interest of the lake is a one-of-a-kind floating island. In the northern part of its basin, there are underwater springs, there are pits at the bottom. Kravtsovo - lake-swamp is a unique object of the Stavropol upland and is of great value as an object of plant biodiversity studying, here the diversity of almost half of the entire flora and fauna of Stavropol can be studied. The total area is 169 hectares, including: land occupied by water - 73.91. It is located ten kilometers to the southwest of the city of Stavropol, on the upper terrace of the southern slope of the Grushevaya River, at an altitude of 560 meters above sea level. The basin has an elongated shape from east to west with a length of about 1.5 km, a width of 500-600 m, a depth of up to 2.5 m, in some places the coastline is steep up to 2.5 m high. The lake is fed by ground water, snow water, and precipitation. The flora of Lake Kravtsovo is characteristic of both open natural reservoirs and swamps, including peat bogs. In 2014, peat drifting "island", on which trees, shrubs, cattails, reeds, sedges, etc. grew, was washed up by strong wind gusts to one of the shores of the reservoir, where it broke up into four small fragments. Most of it joined the southwestern shore, while smaller parts were distributed along the western and southern shores. [4]

The main factual material was collected during the expedition research on the slopes and the shoreline of Lake Kravtsovo in 2013-2020. Cenotic surveys, collection and processing of field materials were carried out using generally accepted geobotanical methods [5, 6]. The accounted sites had a size of 10×10 m with a GPS-navigator marking. Algae, mosses, and lichens were not considered in the description. When studying the age conditions of populations, the following symbols were used: germs (pl), juvenile plants (j), immature (im), generative (g), and prussic (s). The vitality of the population was determined on a 5-point scale. The visual assessment of the abundance of the species in the cenosis is carried out in accordance with the Drude score scale [7].

The participation of the species in the composition of the phytocenosis was assessed by its cover. To indicate the total projective cover (TPC) of the herbage when adding phytocenoses, a uniform assessment scale was used [8].

The species names of plants in our work are given in accordance with the summary "Synopsis of the Flora of the Caucasus" and the Synopsis of the Flora of the Stavropol Territory [9]. The Latin names of the plants in our work are given in accordance with the summary of the S.K. Cherepanov [10].

Sozological studies of rare species were carried out by analyzing the categories of protection and the status of the species condition. The category of protection means the importance degree of preserving the gene pool of a given species and is divided into five categories: regional endemics, subendemics, relict species that have point ranges in the region and are rare beyond its borders: glacial and xerothermal relicts, species that do not belong to the first four categories – rare for natural reasons [11].

The places of species growth were determined by spot mapping method. Monitoring of rare species in culture and nature was carried out according to the "Program and methodology of observations of plant species cenopopulations of the Red Book of the USSR" [12].

### 3 Results and Discussion

The Stavropol Territory, where the Lake Kravtsovo is located, is located in the center of the North Caucasus. It is characterized by a constant change of landscapes and different natural and climatic conditions. According to the conditions of moisture supply, the Stavropol Territory is located in the V moderately humid region, according to heat supply - an insufficiently hot subdistrict with HTC of 1.1-1.3. This is a zone of unstable moisture supply - from 650 to 700 mm of precipitation falls per year. During the growing season, the relative humidity ranges from 54-56 % [13]. During the years of research, acute uneven precipitation, mainly of a stormwater nature, and high temperatures in the summer were observed.

2019 and 2020 were warmer than the long-term norm, characterized by atmospheric and soil drought. The average daily air temperature for the year is 9.9°C, long-term - +7.5 °C. The maximum reached plus 35.0 °C, the minimum - minus 20.0 °C. Precipitation did not fall regularly, and had a stormy character. 518.0 mm of precipitation fell, which is less than the long-term norm (720.0 mm). Of course, this also affected the herbage. According to the literature data, 15% of the territory of the southern coast is covered with broad-leaved forest (*Fagus orientalis* Lipsky, *Salix caprea* L., *Quercus robur* L.), and 10% of the eastern slope is covered with shrubs (*Crataegus monogyna* Jacq, *Crataegus pentagyna* Waldst. & Kit. ex Willd., *Prunus spinosa* L., *Sambucus nigra* f. *laciniata* (L.) Zabel, *Rosa* sp.).

In the southern and northern parts of the water protection zone, the natural grassland of the meadow steppe has been preserved and grows, in which *Paeonia tenuifolia* L., *Cladium mariscus* (L.) Pohl listed in the Red Book of the Russian Federation [11], and *Iris notha* M. are found. Bieb., *Iris halophila* Pall., *Adonis vernalis* L., *Calamagrostis canescens* (Weber) Roth, *Utricularia vulgaris* L., *Carex panicea* L., *Carex ericetorum* Pollich, *Lythrum thesioides* Bieb, *Thelypteris palustris* Schott, listed in the Red Book of the Stavropol Territory, as well as *Poa pratensis* L., *Geranium sanguineum* L., *Fragaria viridis* (Duchesne) Weston, *Medicago falcata* L., *Euphorbia iberica* Boiss., *Polygala caucasica* Rupr., *Typha angustifolia* L., *Phragmites communis* (Cav.) Trin. ex Steud. with dense projective coverage from 81 to 98%.

The western slope of the lake is an elongated narrow area from south to west with a total area of 1.5 ha with xerophilic vegetation (the projective cover is not dense up to 40%) with a predominance of *Carex humilis* Leys., *C. supina* Willd. ex Wahlenb., *Phlum phleoides* (L.) H. Karst., *Festuca ovina* L., *Bromopsis inermis* (Leyss.) Holub, etc.

The composition and structure of the community are changed in some way by grazing of farm animals, land plowing and afforestation (a characteristic increase in the proportion of shrubs and trees). The initial stage of pasture degeneration and the associated increase in the role of associated grazing species (poisonous, prickly, poorly eaten and weedy) are observed. The horizontal structure of the vegetation cover is heterogeneous.

The first tier, up to 2 m high, consists of *Typha angustifolia*, *Phragmites communis*, *Conium maculatum*, *Verbascum lychnitis* etc. The second tier, up to 60-70 cm high, consists of *Medicago falcata*, *Iris notha*, *Iris halophila*, *Glycyrrhiza glabra*, *Lomelosia micrantha*, *Centaurea orientalis*. The third tier – 30-40 cm high, consists of *Paeonia tenuifolia*, *Artemisia absinthium*, *Consolida paniculata*, *Salvia aethiopsis*, *Phlomis pungens*, *Eryngium campestre*; *Poterium polygamum*, *Achillea nobilis*, *Echium vulgare*, etc., the fourth tier is up to 20 cm high - *Artemisia austriaca*, *Festuca valesiaca*, the fifth tier – we did not take into account mosses, lichens and algae. In the cenosis structure, a large part is occupied by forbs, including woody and weedy vegetation - 67 %, then cereals – at least 27 %, legume components in a smaller amount – 6 %.

We determined the coordinates (N. 45°01'382", E. 41°49'176), approximate areas, and described the populations of sedges and peonies and other rare species. The results of the surveys are presented in table 1. During the period of 2013-2014, the number and age composition did not change much. Fires in 2014 led to a decrease in the number of individuals of *Carex lasiocarpa*, *C. diluta*, *C. acuta*, *Iris halophila*, *I. notha*, *Paeonia tenuifolia*.

**Table 1.** Species composition and characteristics of steppe phytocenosis

No.	Species, floristic group <i>Species, floristic group</i>	Abundance acc. to Drude <i>Abundance of Drude</i>		Life form (biomorph) <i>Life form</i> (biomorph)
		2014-2016	2020	
<b>Cereals and Carex/ Poa and Carex</b>				
1.	<i>Carex humilis</i> Leys	sp <sup>1</sup>	sp <sup>1</sup>	Pa
2.	<i>C. michelii</i> Host	sp <sup>1</sup>	sp <sup>1</sup>	Pa
3.	<i>C. tomentosa</i> L.	sp <sup>2</sup>	sp <sup>1</sup>	Pa, St
4.	<i>C. pseudocyperus</i> L	[sol]	-	Ab
5.	<i>C. diluta</i> Bieb.	un	-	Ab
6.	<i>C. melanostachya</i> Bieb.	[sp <sup>2</sup> ]	[sp <sup>2</sup> ]	Aa
7.	<i>C. riparia</i> Curt	sp <sup>1</sup>	sp <sup>2</sup>	Ab
8.	<i>C. panicea</i> L.	[sol]	-	Aa
9.	<i>C. vulpina</i> L.	un	-	Ab
10.	<i>C. hirta</i> L.	[sp <sup>1</sup> ]	[sol]	Aa
11.	<i>C. praecox</i> Schreb.	sp <sup>1</sup>	sol	St
12.	<i>C. otrubae</i> Podp.	sol	sol	Ab
13.	<i>C. acuta</i> L.	[sol]	-	Ab
14.	<i>C. lasiocarpa</i> Ehrh.	[sol]	-	Ab
15.	<i>C. vesicaria</i> L.	[sol]	-	Ab
14.	<i>C. acutiformis</i> Ehrh.	sp <sup>2</sup>	sp <sup>1</sup>	Ab
15.	<i>Alopecurus arundinaceus</i> Poir.	sp <sup>1</sup>	sp <sup>1</sup>	Aa
16.	<i>Bothriochloa ischaemum</i> (L.) Keng	sp <sup>1</sup>	sp <sup>3</sup>	St
17.	<i>Brachypodium pinnatum</i> (L.) Beauv.	sp <sup>1</sup>	sol	S
18.	<i>Bromopsis inermis</i> (Leyss.) Holub.	sp <sup>1</sup>	sol	St
19.	<i>B. riparia</i> (Rehmann) Holub.	sp <sup>1</sup>	sp <sup>1</sup>	St
20.	<i>Calamagrostis canescens</i> (Weber) Roth	sp <sup>1</sup>	sp <sup>1</sup>	Aa
21.	<i>C. pseudophragmites</i> (Haller f.) Koeler	[sol]	[sol]	Aa
22.	<i>Catabrosa aquatica</i> (L.) P. Beauv.	sp <sup>1</sup>	sp <sup>2</sup>	Aa
23.	<i>Digitaria sanguinalis</i> (L.) Scop.	Sp <sup>1</sup>	sp <sup>1</sup>	Pa, Rb
24.	<i>Echinochloa crus-galli</i> (L.) P. Beauv.	sp <sup>1</sup>	sp <sup>2</sup>	Pa, Rb
25.	<i>Elytrigia repens</i> (L.) Nevski	sp <sup>1</sup>	sp <sup>3</sup>	Pa, St
26.	<i>Festuca valesiaca</i> Gaudin	sp <sup>1</sup>	sp <sup>3</sup>	St
27.	<i>Glyceria maxima</i> (Hartm.) Holmb.	sp <sup>1</sup>	sol	Aa
28.	<i>Koeleria macrantha</i> (Ledeb.) Schult.	sp <sup>1</sup>	sp <sup>2</sup>	St
29.	<i>Melica transsilvanica</i> Schur	sp <sup>1</sup>	sol	St
30.	<i>Phleum pratense</i> L.	sp <sup>1</sup>	sol	Pa
31.	<i>Poa palustris</i> L.	sp <sup>2</sup>	sp <sup>2</sup>	Aa
32.	<i>Setaria verticillata</i> (L.) P. Beauv.	sp <sup>1</sup>	sp <sup>1</sup>	Pa, Rb
33.	<i>S. viridis</i> (L.) P. Beauv.	sp <sup>1</sup>	sp <sup>1</sup>	Pa, Rb
34.	<i>Stipa lessingiana</i> Trin. & Rupr.	sp <sup>1</sup>	sp <sup>1</sup>	St
35.	<i>S. pulcherrima</i> K. Koch	sp <sup>1</sup>	sp <sup>1</sup>	St
36.	<i>S. ucrainica</i> P.A. Smirn.	sp <sup>1</sup>	sp <sup>1</sup>	St
37.	<i>Tragus racemosus</i> (L.) All.	sp <sup>1</sup>	sp <sup>1</sup>	Db, Ra

<b>Legumes / Pulsus</b>				
38.	<i>Astragalus bungeanus</i> Boiss.	[sol]	[sol]	St
39.	<i>A. pseudotataricus</i> Boriss.	sol	[sol]	St, Db
40.	<i>Chamaecytisus ruthenicus</i> (Fisch. ex. Woloszcz.) Klaskova	[sp <sup>1</sup> ]	[sp <sup>2</sup> ]	St
41.	<i>Glycyrrhiza glabra</i> L.	sp <sup>1</sup>	sp <sup>1</sup>	St
42.	<i>Hedysarum biebersteinii</i> Zertova	sol	-	Da
43.	<i>Medicago falcata</i> L.	sp <sup>1</sup>	sp <sup>2</sup>	St
44.	<i>Melilotus officinalis</i> (L.) Pall.	[sp <sup>1</sup> ]	sp <sup>2</sup>	Rb
45.	<i>Trifolium repens</i> L.	sp <sup>1</sup>	sp <sup>2</sup>	Pa, Rb
46.	<i>Vicia sepium</i> L.	sp <sup>1</sup>	sp <sup>2</sup>	Pa, Rb
<b>Forbs / Raznotravie</b>				
47.	<i>Juglans regia</i> L.	-	un	Pa
48.	<i>Malus domestica</i> Borkh.	-	[sol]	S
49.	<i>Populus alba</i> L.	[sol]	[sp <sup>1</sup> ]	Aa
50.	<i>Armeniaca vulgaris</i> Lam.	-	[sol]	Pa
51.	<i>Crataegus monogyna</i> Jacq	sol	sp <sup>1</sup>	Pa, St
52.	<i>C. pentagyna</i> Waldst. & Kit. ex Willd.	sol	sp <sup>1</sup>	Pa, St
53.	<i>Elaeagnus orientalis</i> L.	sol	sp <sup>1</sup>	Db
54.	<i>Prunus spinosa</i> L.	sp <sup>1</sup>	Sp <sup>3</sup>	Pa, St
55.	<i>Pyrus caucasica</i> Fed.	-	[Sol]	S
56.	<i>Rosa</i> sp.	sol	sp <sup>1</sup>	S
57.	<i>Rosa spinosissima</i> L.	sol	sp <sup>1</sup>	S
58.	<i>Rubus caesius</i> L.	-	[sp <sup>1</sup> ]	S
59.	<i>Salix caprea</i> L.	[sp <sup>1</sup> ]	[Sp <sup>2</sup> ]	S
60.	<i>Sambucus nigra</i> f. <i>laciniata</i> (L.) Zabel	-	[sol]	S, Rb
61.	<i>Thelypteris palustris</i> Schott	[sp <sup>1</sup> ]	[Sp <sup>3</sup> ]	Ab
62.	<i>Aster amellus</i> L.	sol	Sp <sup>1</sup>	Pa, St
63.	<i>Adonis vernalis</i> L.	[sp <sup>1</sup> ]	[sp <sup>1</sup> ]	Pa, St
64.	<i>Agrimonia eupatoria</i> L.	sp <sup>1</sup>	Sp <sup>2</sup>	Pa, St
65.	<i>Ajuga genevensis</i> L.	sol	sp <sup>1</sup>	Pa
66.	<i>Alcea rugosa</i> Alef.	sol	sol	Pa, St
67.	<i>Alisma lanceolatum</i> With.	[sol]	[sol]	Aa
68.	<i>A. plantago-aquatica</i> L.	[sp <sup>1</sup> ]	[sp <sup>1</sup> ]	Aa
69.	<i>Ambrosia artemisiifolia</i> L.	-	sp <sup>1</sup>	Rb, Pa
70.	<i>Artemisia absinthium</i> L.	sol	sp <sup>1</sup>	Rb
71.	<i>A. vulgaris</i> L.	sol	sp <sup>1</sup>	Rb
72.	<i>Atriplex littoralis</i> L.	sol	sp <sup>1</sup>	Dc
73.	<i>Bolboschoenus maritimus</i> (L.) Palla	Cop <sup>1</sup>	sp <sup>1</sup>	Aa, Ab
74.	<i>Butomus umbellatus</i> L.	[sol]	-	Ab
75.	<i>Campanula praealta</i> Galushko	sol	sol	Pa
76.	<i>Carduus crispus</i> L.	sp <sup>1</sup>	sp <sup>1</sup>	Rb
77.	<i>C. nutans</i> L.	sol	sp <sup>1</sup>	Rb
78.	<i>C. thoermeri</i> Weinm.	[sol]	sp <sup>1</sup>	Rb
79.	<i>Centaurea orientalis</i> L.	sp <sup>1</sup>	sp <sup>1</sup>	St
80.	<i>Conium maculatum</i> L.	[sol]	[sol]	Rb
81.	<i>Chelidonium majus</i> L.	-	[sol]	Rb, S
82.	<i>Cichorium intybus</i> L.	sp <sup>1</sup>	sp <sup>1</sup>	Rb, Pa
83.	<i>Cladium mariscus</i> (L.) Pohl	[Sol]	[sol]	Ab
84.	<i>Crocus reticulatus</i> Stev. ex Adams	sol	sol	Pa, St
85.	<i>Dictamnus caucasicus</i> (Fisch. & C.A. Mey.) Grossh.	Sp <sup>2</sup>	[sp <sup>1</sup> ]	S, Pb
86.	<i>Daucus carota</i> L.	sp <sup>1</sup>	Sp <sup>2</sup>	Rb, Pa

87.	<i>Delphinium consolida</i> L.	sol	sol	St
88.	<i>Echium russicum</i> J.F. Gmel.	sol	sol	Pa
89.	<i>Eleocharis palustris</i> (L.) Roem. & Schult.	[sol]	[sol]	Aa
90.	<i>Epilobium hirsutum</i> L.	sp <sup>1</sup>	sp <sup>1</sup>	Aa
91.	<i>Euphorbia iberica</i> Boiss.	sol	sol	Rb, St
92.	<i>E. stepposa</i> Zoz ex Prokh.	sol	sol	St
93.	<i>Falcaria vulgaris</i> Bernh.	sp <sup>1</sup>	Sp <sup>2</sup>	Pa, St
94.	<i>Filipendula vulgaris</i> Moench	sp <sup>1</sup>	sp <sup>1</sup>	Pa, St
95.	<i>Fragaria viridis</i> (Duchesne) Weston	sp <sup>1</sup>	sol	Pa
96.	<i>Galium aparine</i> L.	sol	sp <sup>1</sup>	Ra, Rb
97.	<i>Geranium sanguineum</i> L.	sol	sp <sup>1</sup>	Pa
98.	<i>Hypericum elegans</i> Steph. ex Willd.	Sp <sup>2</sup>	Sp <sup>2</sup>	St
99.	<i>Inula helenium</i> L.	[sol]	[sp <sup>1</sup> ]	Pa, Aa
100.	<i>Iris notha</i> Bieb.	sol	sol	Pa
101.	<i>I. halophila</i> Pall.	sol	sol	D, St
102.	<i>Juncus effusus</i> L.	[sol]	sp <sup>1</sup>	Aa
103.	<i>J. inflexus</i> L.	[sol]	[sp <sup>1</sup> ]	Aa
104.	<i>J. gerardii</i> Loisel.	[sol]	[sol]	Aa
105.	<i>Leonurus quinquelobatus</i> Gilib.	sol	sol	Rb
106.	<i>Lythrum salicaria</i> L.	sol	sp <sup>1</sup>	Aa
107.	<i>Leontodon hispidus</i> L.	sol	sol	Rb, Pa
108.	<i>Lomelosia micrantha</i> (Desf.) Greuter & Burdet	sol	sp <sup>1</sup>	St
109.	<i>Muscari muscarimi</i> Medikus	[sp <sup>1</sup> ]	[sol]	Pa, St
110.	<i>Oberna behen</i> (L.) Ikonn.	sp <sup>1</sup>	sp <sup>1</sup>	Rb, S
111.	<i>Origanum vulgare</i> L.	[sol]	[sol]	Pa, St
112.	<i>Ornithogalum ponticum</i> Zahar.	sp <sup>1</sup>	sol	Pa
113.	<i>Paeonia tenuifolia</i> L.	[sol]	[sp <sup>1</sup> ]	Pa, St
114.	<i>Petasites hybridus</i> (L.) Gaertn. B. Mey. & Scherb.	[sol]	[sol]	S, Aa
115.	<i>Phlomis pungens</i> Willd.	sol	sol	St
116.	<i>Phragmites communis</i> (Cav.) Trin. ex Steud.	cop <sup>1</sup>	cop <sup>3</sup>	Aa, Ab
117.	<i>Plantago maxima</i> Juss. ex Jacq.	sol	sp <sup>1</sup>	Ra, Rb
118.	<i>Plantago media</i> L.	sol	sol	Ra
119.	<i>Polygala caucasica</i> Rupr.	sp <sup>1</sup>	sp <sup>1</sup>	Pa
120.	<i>Primula macrocalyx</i> Bunge	sp <sup>1</sup>	sp <sup>1</sup>	S, Pa
121.	<i>Psephellus dealbatus</i> (Willd.) K. Koch	[sol]	[sol]	Pa
122.	<i>Rumex acetosa</i> L.	sol	sol	Pb
123.	<i>Salvia verticillata</i> L.	sp <sup>1</sup>	sol	Rb, Pa
124.	<i>Schoenoplectus lacustris</i> (L.) Palla	sp <sup>1</sup>	sp <sup>3</sup>	Aa, Ab
125.	<i>Sparganium erectum</i> L.	sp <sup>1</sup>	sp <sup>1</sup>	Ab
126.	<i>Sonchus arvensis</i> L.	sp <sup>1</sup>	sp <sup>2</sup>	Rb, Ra
127.	<i>Stellaria neglecta</i> Weihe	sol	sol	Pb
128.	<i>Tanacetum vulgare</i> L.	sol	sol	Rb, Pa
129.	<i>Taraxacum officinale</i> F.H. Wigg.	sol	sol	Rb, Pa
130.	<i>Thalictrum minus</i> L.	sp <sup>1</sup>	sp <sup>2</sup>	Pa, St
131.	<i>Thymus marschallianus</i> Willd.	[sp <sup>1</sup> ]	[sp <sup>1</sup> ]	Pa, St
132.	<i>Typha angustifolia</i> L.	sp <sup>1</sup>	sp <sup>2</sup>	Ab
133.	<i>T. latifolia</i> L.	sp <sup>1</sup>	sp <sup>2</sup>	Ab
134.	<i>Urtica dioica</i> L.	-	sp <sup>1</sup>	Rb
135.	<i>Verbascum thapsus</i> L.	sol	sol	Rb

136.	<i>V. lychnitis</i> L.	sol	sol	Pa
137.	<i>Veronica anagallis-aquatica</i> L.	sol	sol	Aa, Ab
138.	<i>V. spicata</i> L.	sol	sp <sup>1</sup>	ST
139.	<i>Vinca herbacea</i> Waldst. & Kit.	-	[sp <sup>1</sup> ]	Pa

**Symbols:** S — forest, Rb – ruderal, Ra –segetal, Pa – plain, St – steppe, Ab – hydrophilic, Aa – hygrophilic, Db – psammophilic, Da – calcepetrophilic; [] – local location, Cop<sup>3</sup> – very abundant; Cop<sup>2</sup> – abundant; Cop<sup>1</sup> – quite abundant; Sp<sup>3</sup> – abundantly scattered, Sp<sup>2</sup> – scattered, Sp<sup>1</sup> – little scattered; Sol – single (very little); Un – in a single unit on the site.

According to the literature and herbarium data, 20 species of sedge (*Carex hallerana* Asso, *C. vesicaria* L., *C. ericetorum* Poll., *C. disticha* Huds, etc.) grew in the coastal zone of the lake [14, 15]. During the entire period of our expeditionary activity, we did not find *C. ericetorum* Poll., *C. disticha* Huds. During the survey of the surrounding area and the coastal zone of the lake in 2014-2016, 16 species of the genus *Carex* were identified, and in 2020 – only 8. Until 2019, the sedge populations are stable, vital - 5 points, the distribution of the group is uneven. They grow together with *Astragalus bungeanus* (Sol), *Hedysarum biebersteinii* (Sol), *Iris halophila* (Sp), *Astragalus pseudotataricus* (Sol), *Stipa pulcherrima* (Sp) and other species in the associations *Carex humilis- vario-herbosum*, *Carex praecox - vario-herbosum*, *Carex caryophyllea - vario-herbosum*, *Carex tomentosa – vario-herbosum*, , where forbs predominate. In 2020, we observed a decrease in the number of generative individuals by 50% compared to previous years (fires, lack of moisture in the dry 2019-2020 years).

Rare species *Paeonia tenuifolia*, *Adonis vernalis*, and *Iris halophila*, *I. notha* grow on the western slope in the forb-fescue-feather grass steppe on fertile, thick medium-humus, leached and saline clay chernozems. In 2014, due to the fire, the number of germs and vegetative individuals decreased by 20%, but by 2020, the population recovered, thanks to good seed productivity. Environmental factors that affect the vegetation cover are economic activity (land development), decrease in precipitation and wind erosion, which leads to decrease in the height of the fertile soil layer [3]. These factors cause an accelerated change in plant associations in terms of diversity of composition and structure, and the appearance of a large number of weeds and woody vegetation, which happened in 2020. The number of weeds and woody vegetation increased due to anthropogenic factors (fires and increase in temperature with decrease in precipitation): *Elytrigia repens*, *Atriplex littoralis*, *Urtica dioica*, *Ambrosia artemisiifolia*, etc., trees – *Pyrus caucasica*, *Malus domestica*, shrubs – *Crataegus monogyna*, *C. Pentagyna*, *Prunus spinosa*, species *Rosa*, etc.

## 4 Conclusions

1. 139 species of vascular plants were registered in the studied territory, among which 9 are subject to regional protection (subendemics, xerothermal relics, vulnerable and heavily exploited species).
2. The results obtained allow to assess the real phytocenotic diversity of the surroundings of the Lake Kravtsovo, as well as to update further work on the inventory and monographic generalization of vegetation materials of the Stavropol Territory. As well as monitoring conducted in relation to rare species, it will allow to conduct environmental activities in relation to them.
3. The phyto-diversity of vegetation in the vicinity of the Lake Kravtsovo confirms the high environmental significance of plant communities for the region.

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