The Abakan South-Western region flora

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Abstract. The basis for in-depth studies of the southwestern district of the city of Abakan vegetation, the Republic of Khakassia was the lack of information on the current status, structure and species composition of the whole city flora. Targeted floristic studies in the city of Abakan were not conducted. Since the mid-twentieth century, study of plant cover of the Republic of Khakassia was engaged in prominent botany of the Siberian scientific and educational institutions of Siberia, but most of them were passing through the city of Abakan. The study of the flora was held by the honored worker of the Russian Federation Krasnoborov I. M. while working at the Herbarium of Khakass state university (KhsSU) and Associate Professor of KhsSU T. M. Zorkina. Flora of the South-Western area was identified based on field research expedition model area (MA) within the administrative boundaries of the city of Abakan in 2017-2018, the study of literature data and herbarium materials of the Krasnoyarsk state pedagogical University (KSPU) and Khakass state university (KhsSU). Most of the territory of MA have been visited repeatedly and at different times of the growing season, and that suggests the method of urbanized landscape model areas. South-Western residential district of the city of Abakan, (known as the village of MR - Ministry of the Railways), consists entirely of multifamily housing, in 2011 there was a Komsomol Park, which determined the composition and structure of its flora. The taxonomic spectrum of the flora of the southwestern district of the city of Abakan includes 16 families of the world flora, of which only 3 families are with identical ranks: an Asteraceae, Fabaceae, Scrophulariaceae. The taxonomic spectrum of the flora of the southwestern district of the city of Abakan is of Brassicaceae-type, Fabaceae-subtype – extreme-Mediterranean, which corresponds to the position of the city of Abakan in the steppe zone of Eurasia and belonging to the Boreal floristic region.

1. Introduction
Abakan is located in the Central part of the Khakass-Minusinsk basin, at an altitude of 250 m above sea level at the mouth of the river Abakan. The area of the city is 112,38 sq. km. The territory, which houses the city of Abakan, is mostly low-lying. Only from the East and South-East the plain is bordered by a small elevation. The city is located in the area a significant part of which is occupied by swamps, which are about sixty percent of today's buildings. The city extends to the South and East by the river Abakan, spreads partly in the area of Sogrinsk industrial hub and country arrays on the river Yenisei; from the West it is delineated by river Tasheba and Abakan CHP buildings, and from the North by a causeway, built to protect the city from flooding and the territory of Abakan airport, part of which (without a runway) is included in the city limits [1, 2].
Targeted floristic studies in the city of Abakan were not conducted. Since the mid-twentieth century, study of plant cover of the Khakass Republic was engaged in prominent botany of the Siberian scientific and educational institutions of Siberia, but most of them were passing through the city of Abakan. The study of the flora was held by the honored worker of the Russian Federation Krasnoborov I. M. while working at the Herbarium of Khakass state university (HSU) and associate professor at KSPU Zorkina T. M., who conducted geobotanical descriptions of plant communities and the collection of herbarium on the Samokhval mountain and in the city from 2000 to 2019 [3].

Abakan is known as a cultural and scientific centre. Gardens, squares and boulevards occupy 1/3 of the city. Officially, the Abakan is not divided geographically, but at the same time for the legislative and Executive authorities to function effectively, public self-government began to operate. In the result the streets were combined into 6 administrative regions: Lower Sogra, Polar, Harbor, Red Abakan, North-West, South-West and South.

The South-West residential area, known as the village of the MR – an area which became an attractive place in Abakan. In 2011, there was a Komsomol Park. More than 16 thousand people are registered today in the South-West region, but actually there live more people than registered. The district has its own speciality, it consists entirely of multifamily housing.

In connection with gradual change in the composition and structure of vegetation cover of the city under the pressure of anthropogenic factors there is a need to identify the species composition of the major plant communities of the area. In the Central part of the city plant communities are represented in the parks and lawns. Natural vegetation (grasslands, forests, and meadows) have been preserved in fragments, close to the outskirts of the city [4]. A characteristic feature of urban flora that distinguishes it from the natural flora, is the high dynamism and volatility. Its composition and the total number of species can change over quite short periods of time. Thus, the younger the neighbourhood, the more unstable its flora is. This is facilitated by factors such as the extension of building, demolition of old buildings, the development of industry and transportation [2].

2. Materials and methods

The study of plant communities floristic composition of the South-West district of the city of Abakan was carried out in the spring and summer in 2017-2018. Material for the work was the collection of the higher plants of the Herbarium named after L. M. Cherepnin of KSPU collected by Chebotareva O. P. and Zorkina T. M. during flora cataloguing of the southwestern district of the city of Abakan [2].

Field work was carried out using the model areas (MA) of urbanized landscape, complemented by routing research [5-7]. As a result, the territory of the South-West area of the city was divided into relatively equal geographic areas 250 x 250 m with a strong visual and environmental isolation. The permanent plot was laid out within the administrative borders of the district of the city of Abakan and were allocated on the basis of phytocoenotic diversity and peculiarities of the anthropogenic load [2]. Literature data and Herbarium specimens of the KSPU and KhSU were also studied.

3. Results and discussion

On the whole, the flora of the model area is rather small, but has a significant variety of species belonging to 23 families, which indicates the heterogeneity of the study area.

The first stage of any floristic analysis is taxonomic spectra, that is, lists of leading taxa distributed by number of species in descending order [7-12]. The taxonomic spectrum of the flora in the South-West region of Abakan includes 16 families of world flora (table 1), of which only 3 have the same ranks - these are Asteraceae, Fabaceae, Scrophulariaceae [13]. The remaining families have much higher ranks in the studied flora, reflecting its regional characteristics.
Table 1. Taxonomic spectrum of flora of the South-Western region of the city of Abakan

| Rank family | Families       | The number of species /% of the total number of species | Leading world flora families | Leading Holarctic families |
|-------------|----------------|--------------------------------------------------------|-----------------------------|---------------------------|
| 1           | Asteraceae     | 17/17.7                                                | 1                           | 1                         |
| 2           | Poaceae        | 14/14.5                                                | 3                           | 3                         |
| 3           | Brassicaceae   | 12/12.5                                                | 15                          | 5-6                       |
| 4           | Fabaceae       | 10/0.5                                                 | 4                           | 2                         |
| 5           | Rosaceae       | 8/8.3                                                  | 13                          | 7                         |
| 6           | Lamiaceae      | 7/7.2                                                  | 12                          | 4                         |
| 7           | Chenopodiaceae | 4/4.2                                                  | 37                          | 14                        |
| 8-15        | Ranunculaceae  | 2/2.0                                                  | 32                          | 12                        |
|             | Convolvulaceae | 2/2.0                                                  | 36                          | -                         |
|             | Crassulaceae   | 2/2.0                                                  | 40                          | -                         |
|             | Polygonaceae   | 2/2.0                                                  | 51                          | 15                        |
|             | Apiaceae       | 2/2.0                                                  | 19                          | 5-6                       |
|             | Scrophulariaceae | 2/2.0                                              | 8                           | 10                        |
|             | Oleaceae       | 2/2.0                                                  | -                           | -                         |
|             | Salicaceae     | 2/2.0                                                  | -                           | -                         |
| 16-23       | Aceraceae      | 1/1.0                                                  | -                           | -                         |
|             | Berberidaceae  | 1/1.0                                                  | -                           | -                         |
|             | Caryophyllaceae| 1/1.0                                                  | 33                          | 9                         |
|             | Papaveraceae   | 1/1.0                                                  | -                           | -                         |
|             | Plantaginaceae | 1/1.0                                                  | -                           | -                         |
|             | Ulmaceae       | 1/1.0                                                  | -                           | -                         |
|             | Urticaceae     | 1/1.0                                                  | 67                          | -                         |
|             | Violaceae      | 1/1.0                                                  | 61                          | -                         |
| Total       |                | 96 / 100%                                              | -                           | -                         |

Holarctic families in the flora are fewer in number (11), but their ranks are closer to the ranks in the studied flora. Especially stand out in the top 10 families the following ones: Brassicaceae (3 - 5 - 6), Chenopodiaceae (7 - 14), Poaceae (2 - 3), Rosaceae (5 - 7). The southern families Fabaceae (4 - 2), Lamiaceae (6-4), Apiaceae (9-5-6) play a slightly smaller role. Such an arrangement is determined by the fact that Abakan belongs to the Boreal floristic region [14] and the steppe zone of Eurasia.

According to the structure of the first triad (As-Po-Br), the flora of the South-West region of the city of Abakan belongs to the extreme “Arctic-desert” Brassicaceae type according to the classification of A. P. Khokhryakov [13]. This type characterizes the flora located in extreme conditions, which in this case is apparently connected with the urban environment, where the strong influence of the anthropogenic factor is traced. This is indicated by the high role in the spectrum and composition, along with cruciferous and cereals, of the Chenopodiaceae family, the presence of xerophilic species from the Lamiaceae family [15].

According to the second triad, the studied flora belongs to the southern "Mediterranean-Central Asian" Fabaceae-subtype - "extreme Mediterranean", which corresponds to the geographical position in the steppe zone (belt), since the city is located in the intermountain basin.
4. Conclusion
The flora of the South-West region of the city of Abakan is of the Arctic-desert type which in the case of urban flora shows the extreme nature of the environment in which it exists, and is confirmed in the systematic spectrum by urban families (Brassicaceae, Chenopodiaceae, Polygonaceae, etc.), which are leading in the flora.

The taxonomic structure of the region’s flora defines its subtype as “extreme Mediterranean,” which thus characterizes the process of xerophytization of the city’s flora and is confirmed by its leading “southern” families (Fabaceae, Apiaceae, Lamiaceae, Scrophulariaceae).

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References
[1] Torosov V M 1994 Abakan (Moscow: Tsitsero)
[2] Antipova E M and Chebotareva O P 2019 Floral finds in the city of Abakan (Republic of Khakassia, Russian Federation) IOP Conf. Ser.: Earth and Environmental Science 315 022021
[3] Antipova E M and Chebotareva O P 2019 History of floristic studies in Abakan IOP Conf. Ser.: Earth and Environmental Science 421 (2020) 082021
[4] Antipova E M, Chebotareva O P and Zorkina T M 2018 Overview of floristic studies in the city of Khakassia, Abakan (second half of the 20th century) Proc. of Sci. and Prac. Conf. on Modern Biocological Studies in Central Siberia (Krasnoyarsk: KSPU) pp 5-10
[5] Antipova E M and Kulechina Yu In 2016 Flora of small towns on the example of Sosnovoborsk (Krasnoyarsk Territory, south of middle Siberia) Proc. of the 6th All-Russian Conf. on Flora and Vegetation of Siberia and the Far East (Krasnoyarsk: KSPU) pp 58-85
[6] Antipova EM and Chebotareva OP 2018 Floristic studies of the city of Abakan of the Republic of Khakassia Proc. of the 7th Int. Sci. and Prac. Conf. on Biocological Study of Local Lore: World, Russian and Regional Problems (Samara: Samara State Social and Pedagogical University) pp 20-23
[7] Il’minskikh N G 1993 Florogenesis in an Urbanized Environment (through the Example of the Cities of the Vyatka-Kama Territory) (St. Petersburg) p 36
[8] Antipova E M 2006 Systematic structure of the flora of the northern forest-steppes of Central Siberia Proc. of the 4th All-Russian Conf. on Flora and Vegetation of Siberia and the Far East (Krasnoyarsk: KSPU) pp 32-57
[9] Antipova E M and Enuleiko O V 2016 Flora of the Sydinskaya foothill and Pribaitak meadow steppes (Krasnoyarsk Territory) Proc. of the 6th All-Russian Conf. with Int. Participation on Flora and Vegetation of Siberia and the Far East ed E M Antipova (Krasnoyarsk: KSPU) pp 32-58
[10] Antipova E M and Kuleshova Yu. In 2013 Taxonomic analysis of the archegoniates of flora of the city of Sosnovoborsk (Krasnoyarsk Territory) Bulletin of the Krasnoyarsk State Pedagogical University named after V P Astafyev 2 (24) 218-22
[11] Yuzefovich F S and Tupitsyna N N 2019 Taxonomic structure of the flora of the Angara-Chun interfluve Proc. of a School-Seminar of Schoolchildren, Students, Graduate Students and Teaching Scientists on Modern Biocological and Chemical Studies in Central Siberia ed E M Antipova (Krasnoyarsk: KSPU) pp 55-58
[12] Antipova E M и Enuleenko O B 2019 Taxonomic structure of local floras in Sidinskiy and Pribaitaksky steppes (Krasnoyarsk region) // BIO Web of Conferences “Results and Prospects of Geobotanical Research in Siberia”, dedicated to the 75th anniversary of the laboratory of
ecology and geobotany of CSBG SB RAS. N N Lashinsky and N I Makunina (Eds.) (Novosibirsk: CSBG SB RAS) p 00002
[13] Khokhryakov A P 2000 Taxonomic spectra and their role in comparative floristics Botanicheskii Zhurnal 85 (5) 1–11
[14] Takhtadzhyan A L 1978 Floristic Regions of the Earth (L: Science) p 248
[15] Antipova E M и Antipova S V 2020 Synanthropization of small towns' flora (Krasnoyarsk region) IOP Conf. Ser.: Earth and Environmental Science 421(8) 82018