Floristic findings of new and rare plants in the city of Abakan, 2 (Republic of Khakassiya, Russian Federation)

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Abstract. The city of Abakan is an urban district, the capital of a constituent entity of the Russian Federation of the Republic of Khakassiya, with a population of 171.2 thousand people. According to the botanical and geographical zoning of L. M. Cherepnin, the city of Abakan is located in the Pryabakan valley steppe (S1) 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. Despite the fact that the territory of the Republic of Khakassia has been sufficiently studied botanically, information on the current state, structure and species composition of the flora of the city of Abakan remains far from complete, which served as the basis for in-depth studies of its vegetation cover. The aim of the work was to identify the flora of the city of Abakan and new and rare species of plants in it. Floristic fees in the city were held from 2016 to 2019 by the method of model areas (MA) of the urbanized landscape. For the Republic of Khakassia, as a result of field studies of 11 MA within the administrative borders of the city of Abakan, new and rare plant species were found and first identified: 1 new species for Siberia (Potentilla pimpinelloides L.), 2 new species for the Republic of Khakassia (Dianthus deltoides L., Potamogeton obtusifolius Mert. et WDI Koch.) And additional locations for 6 rare species in the city of Abakan (Lilium pumilum Delile, Oxytropis ammophila Turcz., Rosa spinosissima L., Stuckenia filiformis (Pers.) Boern., Taraxacum bessarabicum (Horn) Hand.-Mazz., Myricaria bracteata Royle.).

1. Introduction
The area of the city of Abakan is part of the Altai-Sayan floristic province [1]. According to geobotanical zoning, it belongs to the Altai-Sayan geobotanical region, Minusinsk province, Pryabakan (Central Khakas) steppe district [2] and is included in the Abakan steppe area [3], or the composition Pryabakan valley steppe [4]. According to soil-geographic zoning of N. D. Gradoboev [5], Abakan refers to similar Pryabakan valley-steppe area. There is the warmest climate of the valley of the Abakan – the sum of temperatures of 1950°C for the warm season, precipitation is 270 mm with a total annual precipitation of 300 mm. The average annual temperature is +0.2°C. The vegetation cover of the city is composed of steppes, forests, meadows and other vegetation – wetland, shrub, saline, weed etc. Steppe is the zonal type of vegetation [2].

The most typical for the steppe vegetation of the Pryabakan district are the small-soddy true steppes in the four-cereal steppe variant. Coarse-grained steppes are represented by feather grass (Stipa capillata) and feather grass-sheep steppes. In the composition of meadow vegetation, there are dry and primary natural meadows of the Abakan valley - fescue, campfire, and grassland floodplain meadows [6]. On saline soils, barley, foxtail, besklinitsovye and beckmannia salt marshes develop. The city line
extends from the south and east along the Abakan river, partially passes in the region of the Sogrinsk industrial hub and summer cottages along the Yenisei River, from the west it is delimited by the Tasheba River and the buildings of the Abakan CHP, and from the north a dam is built to protect the city from flooding and the territory of the Abakan airport, part of which (without a runway) is a part of the city [7].

The aim of the work was to identify the flora of the city of Abakan and new and rare species of plants in it. In this regard, it is necessary to carry out the following tasks: collecting herbarium material when compiling geobotanical descriptions of the plant communities (phytocenoses) of the city, determining the collected herbarium samples according to the latest identifiers, searching for information on the distribution of the revealed rare and new species of the flora of the city of Abakan.

2. Materials and methods

Material for the work was the flora of the city of Abakan, based on the collection of higher plants of the Herbarium of L. M. cherepnin (KRAS) collected by us during the inventory of flora of the city and rare species in 2016-2019. Field work was carried out by the method of model areas urbanized landscape (MA). Most of the territory of MA have been visited repeatedly and at different times of the growing season [8] and involves the use of this method. In addition, taken into account the literature data on the flora and vegetation of the region and the data of the Herbarium of the Krasnoyarsk state pedagogical university (KRAS) and Khakass state university (HGU). In the composition of the MA there are patches of natural habitats located within the city limits (mount SAMOKHVAL, Culture and Leasure Park near the river Tasheba, etc.), and anthropogenic habitats with disturbed vegetation: man-made – the territory of industrial enterprises, railway station, garden and villa zone, areas of the East and South Dam, the habitat of a residential area (residential urban development and the private sector) and habitats artificial plantations (Victory Park and Komsomol Park). Cited specimens are kept in Herbaria named after L. M. Cherepnin of Krasnoyarsk state pedagogical University. The types are arranged in order of the Latin alphabet. Species names and their authors are quoted from S. K. Cherepanov [9] and the electronic database according to the list of plants an IPNI (http://www.ipni.org/ipni/plantnamesearchpage.do).

MA of are given in abbreviated form in the study: Hs – MR housing sector, Ms – mountain SAMOKHVAL, Sd – South dam, Ed – East dam, Ov – Orbitovsk villas, Pc - Culture and Leasure Park.

3. Results and discussion

Currently, for the Republic of Khakassia, the urgent task is to preserve all growing plant species. With the development of economic activity in the city of Abakan over many decades, the environment was exposed to strong anthropogenic impact. The most vulnerable elements of regional flora are rare and endangered plant species. According to recent data, more than 1670 species of higher plants grow in the territory of Khakassia, of which 85 species are endemic to the Altay-Sayan mountain country and 28 are endemic to the Khakass steppes [10]. However, in order to take timely measures to conserve species, it is necessary to know about their presence in the region, characteristic habitats, the state of populations, and limiting factors [11]. Therefore, field surveys are so necessary to identify flora elements, as a result of which new and rare plant species in the city of Abakan were found and identified.

3.1. New species for Siberia

*Potentilla pimpinelloides* L. East European-Caucasian relict species with a disjunctive range. The main part of the range covers the highlands and foothills of the northern slope of the Caucasus Range, Transcaucasus and Turkey; the other, isolated part is the Central Russian forest-steppe (Lipetsk, Oryol, Voronezh regions). Literary data on finding and studying in Khakassia are absent. It is probably alien.

Single charges were noted on the Eastern Dam (Ed), 53°72′73″ n. l., 91°48′82″ e. l. and in Culture and Leasure Park (Pc), 53°72′53″ n. l. 91°47′85″e. l.
3.2. New species for the Republic of Khakassia

*Dianthus deltoides* L. It is a Eurasian species found from the Atlantic coast of Western Europe (Spain, France) to Siberia (Irkutsk region, isolated in Buryatia) and the Far East [12]. This species was not noted in the Flora Catalog of the Republic of Khakassia [13]. It can be found on the South Dam (Sd), 53°70′82″ n.l., 91°47′43″ e.l., in a forest glade. There is the only herbarium specimen from the city of Abakan, collected on Mounts Samokhval (Gs) in 1998, Gagarin (HGU; exact coordinates and the slope section are not indicated).

*Potamogeton obtusifolius* Mert. et W. D. I. Koch. Asian boreal-moderate species, absent in the Flora Catalog of the Republic of Khakassia [13]. It is rare in a significant part of the range. The species was collected in a pond in the Culture and Leisure Park (Pc), 53°72′53″ n.l. 91°47′85″ e.l. In the Herbarium of KhSU there is data on the collection in the city of Abakan: it was once noted by Tumanskaya in 1997 on the Tasheba River (KhSU), the exact location is not indicated, presumably on the Eastern Dam (Ed), 53°72′73″ n.l., 91°48′82″ e.l. Our find, first noted in the city of Abakan, 20 years after its only collection, supplements the few known locations in Central Siberia [14, 15].

3.3. New species for the city of Abakan

*Lilium pumilum* Delile. It occurs in the Krasnoyarsk Territory, Kemerovo, Irkutsk and Chita Regions, Buryatia and the Far East (south), Mongolia, China and the Korean Peninsula. The range is East Asian [10]. The species is listed in the Red Book of the Republic of Khakassia as declining in number.

Distribution: Shirinsk district – locality of Topanovo St., villages Shira and Zhemchuzhny, lakes Belyo and Itkul; Ust'-Abakan district - locality of village Ust'-Abakan, village Kamzyyaki: Bogradsky district - Oblakhty Mountains, locality of village Davydovo. In the city was met once on the South Dam (Sd), 53°70′82″ n.l., W, 91°47′43″ e.l.

*Oxytropis ammophila* Turcz. It is Yenisei endemic and is listed in the Red Book of the Republic of Khakassia as a rare species [10]. It occurs in different regions of Khakassia (Altai, Askiz, Ordzhonikidze, Tashtyp, Shirinsky) [13]. It can be found in the Krasnoyarsk Territory (Minusinsk District), Tuva [16]. In the city it was assembled for the first time in the Culture and Leisure Park (Pc), 53°72′53″ n.l. 91°47′85″ e.l. Herbaric materials proving the presence of this species in the city of Abakan were not found (HGU, KRAS).

*Rosa spinosissima* L. The Red Book species is declining in number in the territory of the Republic of Khakassia [10]. It naturally grows in the south of the European part of Russia, in the Crimea and the Caucasus, in Western Europe, Western and Eastern Siberia, Central Asia. In the Catalog [13], only the locations in the Tashtyp and Ust'-Abakan regions of Khakassia are noted. Herbarium materials were previously collected in the city of Abakan were not found (HGU, KRAS). In the city of Abakan, it grows on dry rocky slopes, and often forms clean thickets. It is met in the Park of Culture and Rest (Pc), 53°72′53″ n.l. 91°47′85″ e.l. In the Ministry of Railways, 53°70′57″ n.l., 91°41′22″ e.l.

*Stuckenia filiformis* (Pers.) Boern. Circumpolar, plurizonal species. It is rare in the Altai Territory, Novosibirsk Region, Krasnoyarsk Territory, Kemerovo Region, Khakassia, Irkutsk Region, Tyva, Buryatia. In the Flora Catalog [13], this species is noted only in the Ordzhonikidze and Shirinsky districts of Khakassia. In the city there is the only herbarium specimen collected by Andreenkova in 1987 near Mostotryad in the locality of the city of Abakan, in a reservoir (HGU). No other materials confirming the presence of this species in the city were found (HGU). The district of the Bridge Detachment of the city of Abakan is located on the border with the Altai region of the Republic of Khakassia, the exact coordinates of the reservoir in which the view was collected are not indicated. The species was collected on the South dam (Yud), 53°70′82″ n.l., 91°47′43″ e.l.

*Taraxacum bessarabicum* (Hornem.) Hand.-Mazz. Grassy polycarpic. Eurasian arid-nemoral species. It grows in solonetzic and solonchak meadows, less often along the banks of water bodies. The Catalog [13] contains locations in Altai, Askiz, Bograds and Ordzhonikidze districts of Khakassia. According to herbarium materials, it is known 35 km from the city of Abakan on the way to the village of Tashtyp, in a meadow (Cherepin, Luzganov, Kashina, 1962, KSPU); Ust'-Abakan district, 3 km from the village Podsinego, in a pickle meadow (Kalinina, Luzganov, Cherepin, 1962, KSPU). No materials
were found in the herbarium of KhSU proving the presence of this species in the city of Abakan (HGU). Assembled in a clearing of Victory Park (VP) 53º72’04 “ n. l., 91º43’28”e.l. This Myricaria bracteata Royle. Grows in the valleys of mountain rivers, on pebble and rocky-sandy shores. In the mountains rises to 1900 m above sea level. The range covers Altai, Western Sayan, Eastern Europe, Central Asia, Pamir, Himalayas, Mongolia. Within a rather limited Siberian range, a decrease in the number under the influence of the anthropogenic factor is observed. Requires protection [17]. It is found only in the Tashyp district [13]. It is listed in the Red Book of the Republic of Khakassia as a declining species. It grows exclusively on pebbles and sand deposits along rivers and streams. On the islands, most often singly or in small groups, it rarely forms extensive thickets [10]. In the city of Abakan assembled in the Park of Culture and Rest (Pe), 53º72’53 “ s. w., 91º47’85”c. d.

4. Conclusion
The studies revealed 1 new species for Siberia, 2 new species for the Republic of Khakassia and additional locations for 6 rare species in the city of Abakan.

The conscious activity of a man aimed at optimizing the urban environment - the human environment has played and continues to play a major role in the formation of urban vegetation. [18].

The most vulnerable elements of regional flora are usually rare and endangered plant species. However, in order to take timely measures to preserve such species, it is necessary to know their exact recorded locations in a particular region, the state of populations, and threats to the existence of species.

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