

The Southern Territories of Chatkal Range – Key Botanical Territories of Fergana Valley

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Abstract Environmental problems in their social significance have come to one of the first places in the modern world. Development of economic activity has led to an intense, often destructive influence on the environment. Human's influence on the nature takes place both through the transformation of natural systems that have developed over thousands of years, and as a result of pollution of soil, water, and air. In Fergana Valley, walnut forests have almost halved, and juniper forests reduced by one third. In some places, this led to a decrease in the soil-protective and water-regulating role of forest ecosystems, an increase in the occurrence of natural disasters and erosion development. In this paper, we describe the section, identified as KBA in Fergana Valley. The main purpose of the work is to isolate the southern part of the Chatkal mountain range of the Fergana Valley as a Key Botanical Area and to identify rare, endemic and endangered species in the flora that need protection.

Keywords Vegetation cover, Flora, Endemics, Red data book species, Rare and endangered species, Geographic range, Population, Relict

1. Introduction

In the conditions of Fergana Valley, population growth and advancement of urbanization processes recoils in the loss of natural ecosystems. One of the major anthropogenic factors – overgrazing has led to an increase in weed species in pastures near settlements, strong degradation of mountain and high mountain pastures [24, 14].

The relevance of floristic research and the need to identify key botanical areas (KBA) have been described in detail in previous publications [13, 16, 17]. In this paper, we describe the following section, identified as KBA in Fergana Valley.

The southern branches of the Chatkal Range are located in the northeast of Fergana Valley and administratively belong to Namangan region of the Republic of Uzbekistan (Kasansay, Chartak and Yangikurgan districts). The main part of the area is developed for settlements and farmland. Nevertheless, there are islands of natural vegetation with a unique set of rare and precinctive species, limited of the distribution within Fergana Valley and the Chatkal Range. Within the limits of Uzbekistan part of valley, the selected territory belongs to Southern Chatkal region of Fergana district of Mountain-Middle Asian provinces [24] and

occupies only a small area covering southern foothills of Chatkal range to the east of the Kasansay river and the Western foothills of Fergana range. Here is a landscape of chatoyant and knobby alluvial-proluvial plains and willow-hilly elevations - Adyr, younger than the powerful mountain ranges at the foot of which they are located. The hydrothermal regime of the growing season from hot and dry to very warm and moderately wet, winters are very mild and mild with moderate frosts.

2. Materials and Methods

In 2012-2016 as part of fundamental and practical research, floristic, geobotanical investigations were conducted in the mountain and foothill areas of the South Chatkal of the Fergana Valley.

According to the notion of KBA, we agree with the previously formulated positions [1, 23, 25, 31, 35]. When segregation of KBA, we operated with species included in all editions of the national Red Data Book of Uzbekistan, endemics of Uzbekistan, Fergana Valley, and species that are considered rare for Fergana Valley flora.

For European countries' conditions, the criteria and categories in the KBA segregation, they are elaborated point by point [1]. In some Asian arid zones, the common provisions for the segregation KBA remained unchanged [33, 35]. In Central Asian countries and Uzbekistan there are some difficulties in methodological terms. An example is the formulation of the category of A criterion. In earlier published works [26], we proposed the following grade for A

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category:

Ai - rare species included in the IUCN list.

Aii - species of the Red Data book of Uzbekistan with status 0, 1 and 2.

Aiii - Fergana Valley endemics (within three countries), national endemics and rare endangered species.

Aiv - endemics of the Mountain Central Asian province.

The investigations were carried out within the framework of the governmental fundamental project F-5-19 “Isolation of the key botanical territories – is a new direction in the study and preservation of biodiversity in Uzbekistan (in terms of Fergana Valley)” and the applied project A-7-21 “Assessment of anthropogenic transformation of vegetable blanket in the Northern part of Fergana Valley”. Field works covered all available sites with a description of vegetation, formation of a list of vascular plants, and collection of herbarium material, localization of rare species, included in the composition of category. The routes were recorded with a navigation device GPS and mapped onto the study area map.

At the preparatory stage of research, a working list was compiled that included the Red Data Book species of Uzbekistan [11], valley endemics and endemics of Uzbekistan, growing in Fergana Valley flora. The main literature sources were works of M.M. Arifkhanova [2], R.S. Vernik and T. Rakhimova [5]. The flora of Uzbekistan [28], the Identifier of Plants of Central Asia [19] and the “Cadaster of Kyrgyz Flora: Vascular Plants” [12] served as important sources of flora. During the vegetation period of 2013–2015, a series of expedition trips were organized to different parts of Fergana Valley. Herbarium specimens were used that stored at the universities of Fergana Valley and Central Herbarium of the Institute of the Gene Pool of Flora and Fauna of the Academy of Sciences of the Republic of Uzbekistan (TASH). Herbarium specimens, at addition into the database, were not redefined, unless there are specialists in these groups in Uzbekistan. Herbarium collections from 1909, collected from the KBA territory were involved in the database. Of the total number of more than 500 sheets of herbarium were collected by the authors during field works. The collected herbarium material is stored in the herbarium of Andizhan State University and the Central Herbarium of the Institute of the Gene Pool of Flora and Fauna of the Academy of Sciences of the Republic of Uzbekistan (TASH).

In the following stages of research for each collection, the locations were determined in the system of botanical and geographical zoning of Uzbekistan and geographical coordinates on Google Earth.

3. Results and Discussion

The vegetable cover of Uzbek part of the South Chatkal region was described in the classical works of M.M. Arifkhanova [2], R.S. Vernik and T. Rakhimova [5]. Here there is a significant difference from the vegetation, for example, the neighboring Chorkesar district of the West

Tien-Shan region, where wormwood absolutely dominates in the foothill and low mountain belts (*Artemisia sogdiana* Bunge, *A. namanganica*, *A. tenuisecta* Nevski) and saltwort. In the South Chatkal region, in addition to the abovementioned wormwood species, ephemerooids play a significant role in the vegetable cover (*Carex pachystilis* J. Gay., *Poa bulbosa* L.). Wormwood-bearded communities (*Artemisia tenuisecta*, *Botriochloa ischaemum* (L.) Henr.) are also characteristic, small pistachio areas have been preserved in places in the border area. So-called Fergana type of zoning is characterized for this territory. The lower belt of the foothills is occupied by ephemerooid and wormwood-ephemerooid communities, on the rocky areas there is spiny almond (*Amygdalus spinosissima*). Outcrops of variegated rocks are widespread with specific gypsophilous plant communities, which are characterized by a number of endemic species [15]. Above 700–800 m above sea level xerophytic shrub woodlands (*Pistacia vera*, *Cerasus erythrocarya*, *C. tianschanica*, *Crataegus pontica*, *C. turkestanica*), wormwood (*Artemisia tenuisecta*, *Botriochloa ischaemum* (L.) Henr, indicating a more humid nature of vegetation compared with the western frontier sections of Chatkal and Kurama ranges.

From floristically point of view, the area is poorly studied, there is no published list for the Uzbek part. The total number of species of flora of the area is estimated at 450–500 species. Although the main number of endemics of Fergana district grows outside Uzbekistan, there are still some rare and endemic species characteristic of Fergana district (for example, an endemic of the northern foothills of the Fergana valley - *Acantholimon nabievii* Lincz.). The Chatkal adyrs and Ungortepa mountain turned out to be especially rich in interesting finds. Analysis of the collected floristic material and literature data on the phytocenology of the Southern spurs of Chatkal ridge confirm the effectiveness of existing methods [1, 62].

Since 2015, research began on the southern territories of Chatkal Range. The latest data from field studies are dated to the beginning of the 80s of the last century (collected by R. S. Vernik and T. Rakhimova). In this regard, special attention was paid to the collection of new floristic material.

According to the results of analysis, the total number of species that qualified as criterion A is 18 taxa of vascular plants. As in the flora of the Badland of Chust-Pap Adyrs [13], species of category Ai are absent. This is due to the fact that the species of Uzbekistan flora presented in official sources of IUCN do not reflect the real picture of the composition of rare species flora of Uzbekistan and contains mostly woody species that are not rare and/or endangered in various local floras of Uzbekistan.

To the category **Aii** we include 3 species, entered in the Red Data Book of Uzbekistan (2009):

Tulipa ferganica Vved. (status 2).

Allochrysa gypsophiloides (Regel) Schischk. (status 3).

Lamyropappus schakaptaricus (B. Fetsch.) Knorring & Tamamsch.

Tulipa ferganica is an endemic of Fergana Valley with growing points on Chatkal, Alay and Turkestan ranges. On the southern spurs of the Chatkal range, it grows along the stony and stony-rocky slopes of the Ungortepa tract. In all studied populations, the species is represented by normal populations, with no more than 10-12 plants per 10x10 m. Seed resumption is observed, which is due to the lack of grazing in the studied areas.

Allochrusa gypsophiloides occurs in single specimens. This is apparently the result of an early intensified harvesting of the roots of the plant for the local food industry.

Lamyropappus schakaptaricus is included by us in Aii category according to the data of the Red Data Book of previous editions [11]. From the last edition of the national Red Data book, the view was excluded due to the lack of reliable information on the presence of the species on the territory of Uzbekistan. In the course of field works this species is a rare plant of Central Asian flora, was found in the southern territories of Chatkal Range.

Lamyropappus genus belongs to the relics of Central Asian flora [8] and was described from the vicinity of the Shakaptar village (Central Asia, Fergana Valley, Kyrgyzstan) - "Western Tien Shan, Namangan, in the valley of Sumsar river, Shakaptar tract, 31 VIII 1902. B. Fedchenko". The classical location of the species is located on the border areas with Uzbekistan. According to published data [27], the species area includes the South-Western part of Balkhash deserts and mountains in the middle reaches of Naryn River (Chatkal and Fergana).

Research of TASH, LE, FRU herbarium materials and studying with the quoted data of the authors of the species [10] show that several specimens of the species may have been collected from the territory of Uzbekistan: "Western Tien Shan, Chatkal Range, north of Kara-Kurgan village, river valley, on chalk outcrops near Namangan, on the road to Shakaptar, variegated strata, 20 VII 1928, N. Dzen-Litovskaya, "8 km to the west from Pishkaran city, variegated strata, 11 VIII 1931, O. Knorring, L. Emme". These samples apparently served as the basis for the inclusion of the species in Uzbekistan flora [29]. The species was included in the first three editions of the Red Data Book of Uzbekistan and was indicated as a rare and endangered species of flora of Uzbekistan with status 2.

In the Uzbekistan part of Fergana Valley, the cited habitats were fully developed in the 1960s – 1970s of the last century and, accordingly, the local populations of the species disappeared in Uzbekistan. However, the species was not excluded from the Red Data Book of Uzbekistan due to the lack of reliable data.

Within the framework of inventory of the flora of the southern slopes of the Kurama Range within Fergana Valley, the adjacent territories of Uzbekistan with Shakaptar village were examined in detail in order to detect species populations in Uzbekistan territory [16]. However, these searches did not give positive results. The northern foothills of Fergana Valley, in particular Chust-Pap Adyrs, have been developed for farmland, and species has not been found on

natural landscapes. According to the results of these investigations, the species was excluded from subsequent editions of the Red Data Book and was not included in the database of Uzbekistan flora [38].

However, the expeditionary investigations in the north of Chartak district of Namangan region of Uzbekistan, in the Sassiksay river basin, showed the presence of a species in the territory of Uzbekistan: "Fergana valley, Chartak district, near the Arbagish village. n02305201520. 23 V 2015. Tojibaev, Naralieva, Karimov".

The species grows in the pistachio community. The dominant vegetation is *Pistacia vera* L., *Artemisia tenuisecta* Nevski, etc. The species population consists of uneven-age individuals. Natural germination was discovered due to the lack of overgrazing in the area.

It should be noted that, assessment of species state in the Red Data Book of Uzbekistan (as well as other Central Asian countries) has largely subjective character. The authors of the Red Data Book had scarce material: either previously collected herbarium specimens of the species or geobotanical descriptions of these territories. Usually, repeated investigations, and even more monitoring observations were not conducted, and therefore information on the number and distribution of individuals always requires clarification.

Aiii category includes eight species. All types of this category were found during field work and are of great scientific and practical interest. These include the following:

Onion mountain garlic - *Allium oreoscordum* Vved. (*Amaryliidaceae*)

Onion green flowered - *Allium viridiflorum* Pobed. (*Amaryliidaceae*)

Tatiana's onion - *Allium tatyanae* F.O. Khass. & F. Karim. (*Amaryliidaceae*)

Khanelta onion - *Allium haneltii* F. O. Khass. et R. M. Fritsch (*Amaryliidaceae*)

Kopechnik gypsum - *Hedysarum gypsaceum* Korotkova (*Fabaceae*), as well as three species that we first indicated for the flora of Uzbekistan:

Astragal sprygin - *Astragalus spryginii* Popov (*Fabaceae*)

Cousinia knorring - *Cousinia knorringiae* Bornm. (*Asteraceae*)

Dummy cup Fergana - *Pseudosedum ferganense* Boriss. (*Crassulaceae*)

Allium oreoscordum is one of the rarest species of flora in Uzbekistan. For various reasons, the species is not listed in Red Data Book of Uzbekistan. Apparently the lack of reliable data is considered one of the most important reasons. In Uzbekistan flora the species is included on the basis of collections from the vicinity of Ungortepa (1939-41). Later the species was collected from the left bank of Gavasay, near the Arab village (collection of O. Bondarenko, 1949). Until now, there was no other information. During the field research 2014-2015 we found specimens of the species from the foot of Ungortepa and Karatag. The second place is accepted by us as a new location, since in the existing literature there is no data from this locality. According to

the research results, the species is recommended for involvement in the Red Data Book of Uzbekistan.

Allium viridiflorum was first discovered on the territory of Uzbekistan at the foot of Ungortepa Mount in 2012 [38]. At that time, isolated specimens of plants were found, some of which were planted in the collection of onions of the Institute of the Gene Pool of Flora and Fauna of the AS RUz. In the course of field works in 2015, we identified additional habitats for the species in the vicinity of Ungortepa. According to our calculations, in the Uzbek part of the Chatkal ridge there is one population of a species with more than 100 plants. The current state of the species in this part of the range is determined by the existing conditions of protection.

According to the results of the collected material, an essay was prepared for the 5th edition of the National Red Data Book of the Republic of Uzbekistan.

Allium tatyanae is an endemic of the present KBA. The species has been described as a new species for science from the vicinity of Ungortepa recently [34]. The results of field investigations in the framework of this show a narrow range. The species grows exclusively in rock cracks and screes. The number is not large. In the studied area, no more than 30-35 plants of generative age were found.

Allium haneltii is indicated for Chatkal Range for the first time. The species was described from the vicinity of Chorkesar - Fergana Valley, the Southern slopes of Kurama Range [32]. It was considered a narrow endemic, known from the classical location and the adjacent sections of the Chust-Pap Adyrs [13]. On the territory of KBA there are two separate populations: arbagish and karatagh (vicinity of Kasansay town). In both populations, the species grows on fine-gravelly, gravelly-stony soils with more than 12-15 plants per 10x10 m.

Hedysarum gypsaceum is another important finding from the territory of this KBA. The species is described by Korotkova from Kyrgyzstan territory. According to S.S. Kovalevskaya (1986: 306) species grows on the southern territories of the Kurama Range and the southern territories of Chatkal Range within Fergana Valley. In the Flora of Uzbekistan [10] the species was included according to the only collection of M.M. Nabiyeu, dating back to 1951: "Chartak district, Naritan s/s. On the slopes of gypsum clay at an altitude of 800-900 m. 06 VI 1951. Nabiyeu". All other herbarium specimens stored in TASH belong to Kyrgyzstan territory: "The Chatkal Range tract area of Jida-say Adyr. n0219. 16 V 1950. Arifkhanova", "Fergana Valley. Neighborhood tract Jida-say. n0842, 899, 940. 22 V 1952. Arifkhanova, Gringoff", "On the road from Jida-Bulak to Tashkumir. n01056. 07.24.1949 Chevrenidi". This is the entire list of herbarium collections regarding this species, which undoubtedly demonstrates the scientific and practical importance of the data provided for identifying the southern spurs of Chatkal ridge as KBA.

In the investigation area no more than 150 specimens were found of the species. Population consists of individuals of different ages, seed regeneration is observed, which is also

due to the lack of grazing.

The following three types of Aiii category are new additions to Uzbekistan Flora, because according to all available data they were not indicated for the territory of the country.

Astragalus spryginii was previously known from the border areas of the Republic of Kyrgyzstan. The collection of the Central Herbarium contains more than 12 000 samples of the *Astragalus* L. genus. Of these, more than 7000 were collected from the territory of Uzbekistan. In the course of entering these collections into the database, six new *Astragalus* species were discovered for Uzbekistan flora [38]. As a result of field research, another species of the genus from the section *Xiphidium* Bunge - *A. spryginii* Popov was found on the southern spurs of the Chatkal range.

Among the shrubs and semishrubs of the *Xiphidium* section *A. spryginii* Popov is well distinguished by bare beans and set. According to R.S. Vinogradova [6] species grows on the western territories of Tien Shan - Mogoltau, Chatkal range (the basin of the Kasansay river within Kyrgyzstan) and the Fergana range. It is indicated for the flora of Tajikistan [22] and Kyrgyzstan [18]. The mention in the flora of Uzbekistan [7] should be considered not valid, since the third volume of the edition *A. spryginii* was cited as a species likely to grow in Uzbekistan, since known from the southern territories of Mogoltau, now belonging to Tajikistan. However, subsequent studies did not reveal this species from adjacent territories to Tajikistan.

The new finding of the species refers to the southern territories of Chatkal range bordering Kyrgyzstan: "*Fergana valley, the southern territories of Chatkal range, the foothills in the vicinity of the Arbagish village. n^o2305201517. 23 V 2015. Tojibaev, Naraliyeva, Karimov*".

Cousinia knorringiae. Genus *Cousinia* Cass. is one of the largest in *Asteraceae* family [37]. Genus in Central Asia is represented by more than 263 species [29]. A large number of species are narrow local endemics. Some of them were described on the basis of single collections and mainly growing on poorly studied border areas [36]. Accordingly, for these species there are very scarce materials. These species include *C. knorringiae*.

The latest data on morphology, taxonomy and geography of species belongs to A. Sennikov [36], where the species is listed as a narrow endemic of Kyrgyz flora. Our data obtained in the framework of these studies significantly expand the range of the species. On the southern territories of Chatkal range, *C. knorringiae* was found at the foot of the Ungortepa Mountain: "*Fergana valley, Yangikurgan district, the base of the Ungortepa Mountain. n^o2405201517. 24 V 2015. Tojibayev, Naraliyeva, Karimov*".

Pseudosedum ferganense is the following type of Aiii category of KBA flora of the Southern territories of Chatkal range.

Pseudosedum (Boiss.) A. Berger genus belongs to the category of oligotype genera of *Crassulaceae* DC family. According to <http://www.theplantlist.org>, 14 taxa are registered. Genus is predominantly distributed in Central

Asia. Ten species grow here [20, 21]. Two species - *P. affine* (Schrenk ex Fisch. & C.A. Mey.) A. Berger and *P. multicaule* (Boiss. & Buhse) Boriss. marked for northern China (Annual Check-list, 2013). Two distinct species grow in northern Iran - *P. acutisepalum* C.-A. Jansson, *P. koelzii* C.-A. Jansson.

In the territory of Central Asia, the main species diversity falls within the territory of Tajikistan - 7 species [4] and Uzbekistan - 4 species [3]. During the study of herbaric samples of the Central Herbarium of the Plant and Animal Gene Pool Institute of the Academy of Sciences of the Republic of Uzbekistan (TASH) and the flora inventory of the Uzbek part of the southern part of Chatkal range, a previously unknown species of the genus *Pseudosedum* was discovered for the flora of Uzbekistan.

Specimens of the species were collected by us from the southern territories of Chatkal Range: “*Fergana Valley, Chartak district, foothills in the vicinity of Arbagish village. n^o2305201513. 23 V 2015. Tojibayev, Naraliyeva, Karimov*”. According to our field data, the vicinity of Arbagish is not the only place of growth of the species on the territory of Uzbekistan. In addition to this locality, the species was found in the vicinity of Ungortepa within the limits of the present KBA and around the Chorkesar Mountains of Kurama Range.

P. ferganense occupies a separate position in the genus system. It belongs to the monotype section of *Tuberaria* Boriss with tuberiform thickened, egg-shaped roots. It occurs in rock cracks.

All Aiii species, found on the territory of the KBA are candidates for inclusion in the Red Data Book of Uzbekistan. During the field research, the necessary data were obtained for entering these species into the National Red Data Book. Subsequently, a constant record of the number of individuals and monitoring of the state of populations is required. More than 65% of them are represented by narrow ranges and 40% are new finds for the flora of Uzbekistan.

To the Aiv category we attribute 7 species:

Astragalus nematodes Bunge ex Boiss., *Echinops knorringianus* Iljin, *Oxytropis gymnogyne* Bunge, *Schrenkia vaginata* (Ledeb.) Fisch. et C.A. Mey., *Phlomoideis isochilla* (Pazij et Vved.) Adylov, Kamelin et Makhm., *Phlomoideis nuda* (Regel) Adylov, Kamelin et Makhm., *Lagochilus knorringianus* Pavlov, *Lepidium paniculatum* (Regel et Schmalh.) Al-Shehbaz, *Rhinopetalum stenanterum* Regel.

It does not go beyond the boundaries of the Mountain Central Asian province and thus are contenders for this category. They all grow in single or small groups. All these species represent a great environmental interest due to their rarity. Special attentions are the species - *Phlomoideis nuda* and *Lagochilus knorringianus*, since were identified during the course of these studies and there was no information about the growth of these rare species in the area.

4. Conclusions

In total, a large amount of factual material has been accumulated on rare and other conservation species of flora of Southern territories of Chatkal Range within the Republic of Uzbekistan. More than 60% of scientific data are new and significantly expand the existing data on the geography, ecology, phytocenology of these species. The results show the original composition of the flora of the southern territories of Chatkal range within the Republic of Uzbekistan. The total number of species is estimated at 450-500 species. Most of the data presented is new and obtained exclusively in the framework of this project. The previously disappeared *Lamyropappus schakaptaricus* and three species new to the flora of Uzbekistan have been identified from the modern territory of Uzbekistan. Based on the collected material, the green-flowered onion is included in the fifth edition of Red Data Book. For other species, recommendations have been prepared for the next edition of the National Red Data Book. All data is entered into the database FLORUZ. For all species (herbarium specimens and new field gatherings), GPS coordinates were identified and points marked on the map, including populations of endangered species and valley endemics. This allowed us to create vector layers of floristic GIS maps using data from a century ago. For all species, GPS coordinates were determined and points were mapped, including populations of endangered species, endemics of the valley, and KBA Southern territories of Chatkal ridge. The obtained data will significantly expand the existing ideas about geography, ecology of species and complement the database on the flora of Uzbekistan being developed [38]. Outputs of 2015 are an important continuation of research on the allocation of KBA in the Republic of Uzbekistan and a continuation of the experience of using the geographical coordinates of herbarium specimens to isolate the KBA in Central Asia. Further investigations will focus on monitoring the populations of the Mountain Central Asian elements and endemics of Fergana Valley, the number of major dominants and changes in the composition of the flora. All revealed changes should be included in the database and reflected in the GIS maps.

Obtained results will serve as a basis for further research on monitoring populations of Mountain-Middle Asian elements and endemics of Fergana Valley, the number of major dominants and changes in the composition of the flora. All revealed changes should be included in the database and reflected in GIS maps.

The southern part of the Chatkal mountain range was first identified as a Key Botanical Territory. During the field experiments, endemics of the Fergana Valley, endemic species of the flora of Uzbekistan, plants listed in the Red Book of Uzbekistan, rare species in need of protection and endemic species of Mountain Central Asia were identified.

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