BIOGEOGRAPHIA
The Journal of Integrative Biogeography

Biogeographia – The Journal of Integrative Biogeography 2025, 40 (2): a053

https://doi.org/10.21426/B6.47012

Floristic diversity of the Nuratau Mountains: a 150-year retrospective analysis

Natalya BESHKO*, Khabibullo SHOMURODOV, Bekhruz KHABIBULLAEV

Laboratory of Plant Conservation and Ecology, Institute of Botany, Academy of Sciences of the Republic of Uzbekistan, 100125 Tashkent, Uzbekistan

** corresponding author, email: natalia_beshko@mail.ru*

Keywords: Bibliography, biodiversity hotspot, Central Asia, checklist, collector, endemic species, expedition, flora, herbarium, history of research, nature reserve, Pamir-Alay, phytogeography, vegetation, Uzbekistan.

SUMMARY

The Nuratau Mountains located in the central part of Uzbekistan, in the transitional zone between the Mountain Central Asian and Turan phytogeographical provinces, are recognized as one of Key Biodiversity Areas within the Mountains of Central Asia Global Biodiversity Hotspot. These medium-altitude semiarid mountains are identified as one of centers of endemism and priority areas for conservation of plant diversity. This article provides a retrospective review of a 150-year history of scientific exploration of unique flora of this region, highlighting key publications and findings, herbarium collections and collectors. Overall, 1% of herbarium specimens from the Nuratau Mountains were gathered in the 19th century; 69% of all records were made during the 20th century, and 30% of the data were collected since 2000. An essential source of information on the flora of the Nuratau Mountains and the spatial distribution of species is the National Herbarium of Uzbekistan (TASH), which contains over 6,600 specimens from this region or 59% of all occurrence records. According to the most recent assessment, the flora of the Nuratau Mountains includes 1,283 species of vascular plants belonging to 474 genera and 86 families. Of these, 1,180 species from 444 genera and 81 families are native, 32 species are endemic, and 103 species are alien (occasional or introduced). Nevertheless, the flora of Nuratau Mountains is still insufficiently documented, and an actual checklist remains unpublished to date. Comprehensive botanical studies in this region are crucial because of rapidly increasing rates of biodiversity loss and degradation of ecosystems caused by anthropogenic impact.

INTRODUCTION

The Nuratau Mountains, consisting of two parallel medium-altitude semiarid mountain chains with several adjacent insular low ranges, are located in the central part of the Republic of Uzbekistan, between 39°50' and 40°50' N and 65°0' and 67°50' E, and cover an area of about 14,000 km² (Fig. 1). These mountains stretch on approximately 250 km in the sub-latitudinal direction, across the territory of four large administrative regions of Uzbekistan, Jizzakh, Samarkand, Navoi and Bukhara.

In terms of orography, the Nuratau Mountains are the northwestern branches of the Pamir-Alay mountain system. This area hosts numerous endemic and threatened plant species and the majority of Central Asian montane ecosystems and vegetation types (except for alpine ones), including relict walnut-fruit forests. The Nuratau Mountains are one of the oldest mountains in Central Asia and one of the most floristically intriguing regions within the Mountains of Central Asia Global Biodiversity Hotspot (Kamelin 1973, 1990, Tojibaev et al. 2016, 2017, CEPF 2017, Beshko 2020).

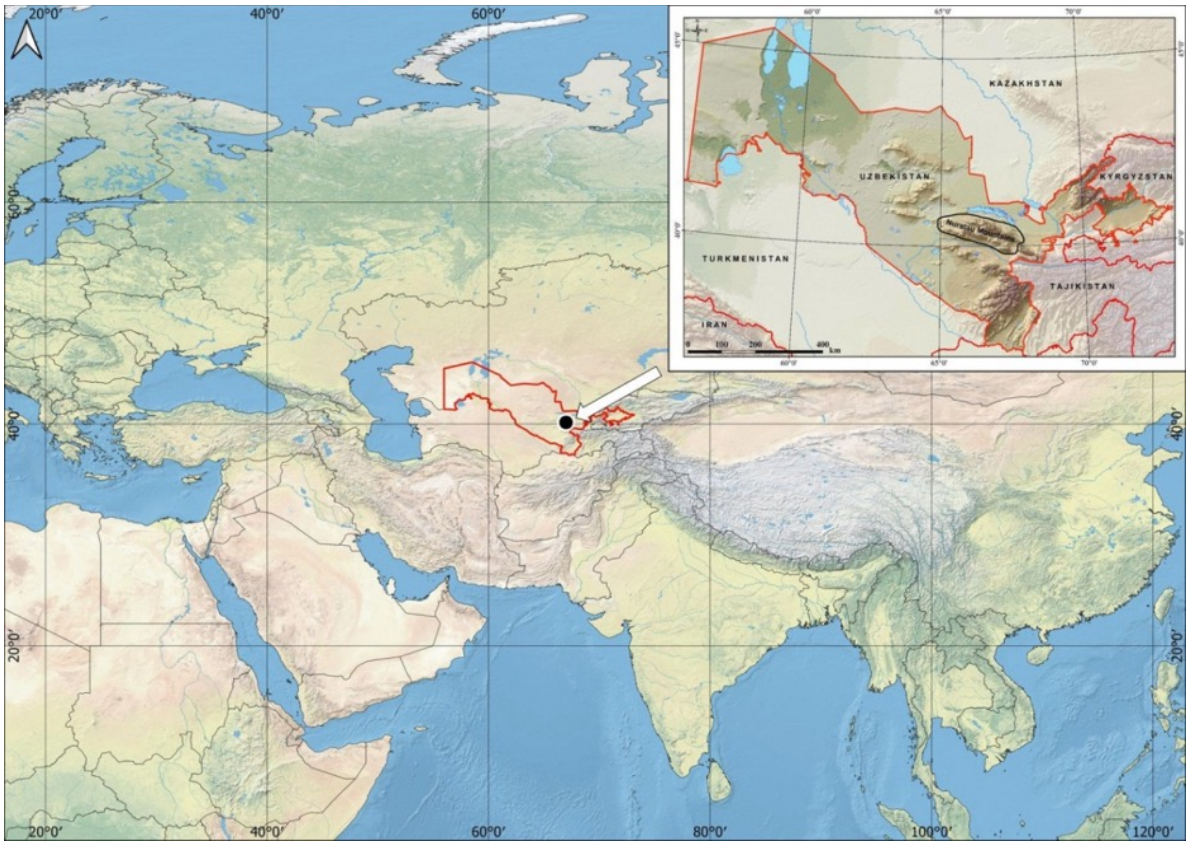

Figure 1. Geographical position of the Nuratau Mountains.

According to the modern scheme of phytogeographical division of Central Asia and Uzbekistan, this territory is considered as the Nuratau phytogeographical district of the Mountain Central Asian Province (Kamelin 1973, 1990, 2021, Tojibaev et al. 2016, 2017, Beshko 2020). Within the Nuratau District, three phytogeographical regions are distinguished: Nuratau, Aktau and Nuratau Relic Mountains (Tojibaev et al. 2016, 2017).

The first region, Nuratau, includes the northern branch of the Nuratau Mountains, represented by the Nuratau Range with the adjacent piedmont plain, so-called Farish Steppe. This is the largest range of the Nuratau Mountains with a highest elevation of 2169 m

above sea level, stretching about 200 km northwest of the town Jizzakh. The Aktau phytogeographical region covers the southern branch of the Nuratau Mountains, extended along the right bank of the Zeravschan River and composed of four smaller ridges, Khobduntau (35 km long, maximal elevation 1672 m above sea level), Karachatau (20 km long, 1101 m), Aktau (about 100 km long, maximal elevation 1993 m), Karatau (50 km long, 1190 m), and the insular remnant mountain Kokchatau (485 m above sea level). The phytogeographical region named Nuratau Relic Mountains encompasses four low remnant mountain ranges situated between the Nuratau Range and the Aydarkul Lake: Pistalitau (40 km, 557 m above sea level), Khanbandytag (476 m above sea level), Balyklytau (581 m above sea level), and Egarbelistag (618 m above sea level) (Fig. 2).

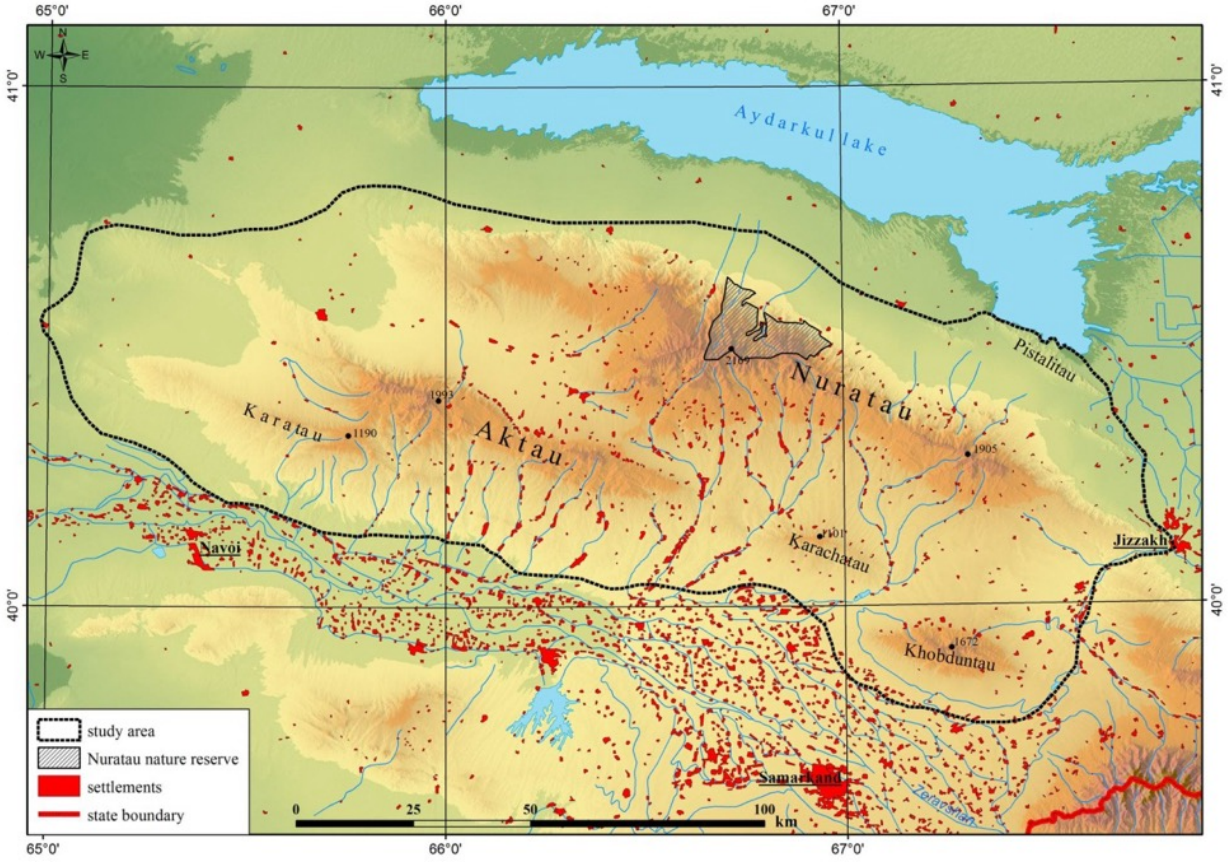

Figure 2. The Nuratau Mountains and Nuratau State Nature Reserve.

The Nuratau State Nature Reserve, located in the central part of the Nuratau Range (Figure 2), covers 17,752 hectares with a buffer zone of 22,830 hectares (Ismatov 2013, UNEP-WCMC & IUCN 2025). This is a strictly protected area of Category Ia by IUCN established in 1975 for conservation of ecosystems, flora and fauna of the Nuratau Mountains, especially relict walnut-fruit forests and globally threatened Severtzov's argali sheep (*Ovis ammon* subsp. *severtzovi* Nasonov, 1914) (Kamelin and Korshunova 1990, Ismatov 2013, Beshko 2000, 2011, 2018, 2020, UNEP-WCMC & IUCN 2025).

The flora and vegetation of the Nuratau Mountains attracted the attention of many famous scientists and have been quite extensively studied for over 150 years. Nevertheless, the plant diversity of this region is still insufficiently documented. According to the most recent assessment, the flora of the Nuratau Mountains includes 1,283 species of vascular

plants belonging to 474 genera and 86 families (Beshko 2020); however, a complete actual checklist of flora has not yet been published. In this regard, in 2025 the Institute of Botany of the Academy of Sciences of the Republic of Uzbekistan launched a new research program entitled "Digital Nature. Development of a digital platform for the flora of Central Uzbekistan" and aimed at comprehensive and thorough study and mapping of ecosystems and plant diversity of this region. Therefore, analyzing the botanical surveys conducted here is a highly relevant task.

MATERIALS AND METHODS

This paper is focused on a retrospective review and revision of the botanical research carried out in the Nuratau Mountains and the Nuratau State Nature Reserve, highlighting key publications, findings and shortcomings. We analyzed literary sources on the flora of the Nuratau Mountains, herbarium collections from this region stored in the repositories of TASH, MW and LE (Thiers 2016, Seregin 2025, Virtual herbarium of Komarov Botanical Institute RAS 2025), including those cited in the new "Flora of Uzbekistan" (Sennikov 2016, 2017, 2019, 2022, 2023a, 2023b), digitalized specimens from other herbaria available online at GBIF (2025), as well as information from the online citizen-science platforms Plantarium (2007–2025) and iNaturalist (2025), compiled a dataset with 9,643 records of plant species from the Nuratau Mountains, and analyzed these data by source, collectors and collection years. This analysis will help us to evaluate how sufficiently explored and documented the plant diversity of this region, and identify existing gaps in floristic data.

Maps were created with the QGIS free software (version 3.32.3). The digitalized historical map of the Turkestan military district (1877) was downloaded from the free online cartographic portal (http://www.etomesto.com/).

RESULTS and DISCUSSION

The history of botanical research in Uzbekistan dates back approximately 180 years, and it can be divided into three stages: the reconnaissance surveys of the second half of the 19th century, the systematic geobotanical and floristic studies of the 20th century, and the modern studies of the 21th century based on the molecular phylogenetic methods, biodiversity conservation approach and GIS-technologies.

Botanical studies of the 19th century

In the 19th century, many Russian and foreign botanists and naturalists studied the flora and vegetation cover of Central Asia, including the current territory of Uzbekistan. However, the routes of their expeditions mainly passed through Jizzakh to Samarkand or through Bukhara and the Kyzylkum Desert, or along the rivers Amudarya, Syrdarya and Zeravschan, bypassing the Nuratau Mountains, which remained unexplored for a long time.

The first survey of the landscapes and flora of the Nuratau Mountains was performed in 1869 by the famous naturalist and explorer Aleksei Fedtschenko and his wife, botanist Olga Fedtschenko (Lipsky 1905, Valkova 2006, 2020). During this expedition, Olga Fedtschenko collected a huge volume of herbarium material, based on which numerous new plant species were described. In particular, *Allium cupuliferum* Regel and *Kozlovia paleacea* (Regel & Schmalh.) Lipsky were described on specimens collected by Fedtschenko in May 1869 in the gorges Jizman (also named Juman or Jazmansay on herbarium vouchers) and Yambash on the southern slope of the Aktau Range, in the territory that at the present belongs to the Samarkand Region of Uzbekistan (Fig. 3, Fig. 4 A, B). Gatherings of Olga Fedtschenko currently are kept mainly in the Herbarium of the Komarov Botanical Institute of the Russian Academy of Sciences (LE), with duplicates in the collections of the National Herbarium of Uzbekistan (TASH), the Herbarium of Moscow

State University (MW), and in some European herbaria (B, BM, P, H) (Thiers 2016). Proceedings of this expedition including list of collected plants were published in 24 volumes in 1874–1902 (Fig. 3).

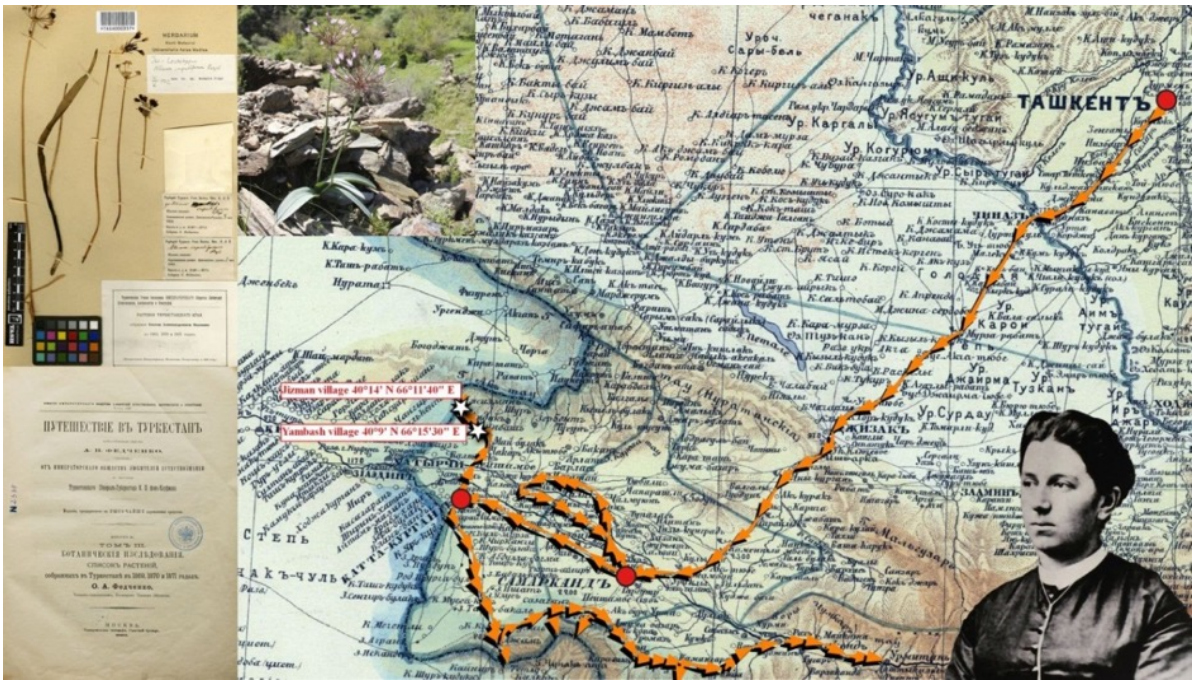

Figure 3. The route of the Fedtschenko's expedition of 1869, shown on the historical map of 1877; isolectotype of *Allium cupuliferum* (TASH000357) collected by Olga Fedtschenko from the gorge Jizman in the Nuratau Mountains and living plants in their natural habitat. Portrait of Olga Fedtschenko (probably near 1888), and title page of *List of plants collected in Turkestan in 1869–1871 by O.A. Fedtschenko* (1902) (source Valkova 2006). Figure layout and photo of living plants by N. Beshko.

In 1873, Russian general and amateur naturalist Nikolay Korolkow collected for the St. Petersburg Botanical Garden some herbarium specimens, living plants, seeds and bulbs from the northern foothills of Nuratau Range (Lipsky 1905). Based on the specimens collected by Korolkow near the village Farish (Porasht), the famous botanist Eduard Regel described a new species of tulips named *Tulipa korolkowii* Regel.

In 1876–1885, Eduard Regel's son, a physician and naturalist Albert Regel, carried out large-scale botanical surveys in Central Asia. He organized numerous expeditions, even to the most remote and unexplored areas, collected and delivered to the Saint Petersburg Botanical Garden an extensive herbarium, which is now preserved in LE, with duplicates in B, K, GOET, H, MW, NY, W, and other major and historic herbaria worldwide. In 1880–1882, the routes of his expeditions crossed the eastern edge of the Nuratau Mountains near Jizzakh several times (Lipsky 1905).

In 1881, French scientists Guillaume Capus and Pierre Gabriel Bonvalot conducted a large-scale expedition through Central Asia, including the surroundings of Jizzakh, Samarkand and Bukhara (Lipsky 1905, Turdiboev et al. 2022). They gathered a significant herbarium material and documented the landscapes and vegetation of the region. Plant specimens collected by Capus and Bonvalot are preserved in the Herbarium of the National Museum of Natural History in Paris (P), with duplicates in LE and other herbaria (Fig. 4 C). Several new species were discovered based on the specimens collected by Capus near Jizzakh, such as *Elwendia capusii* (Franchet) Pimenov & Kljuykov (*Bunium capusii* (Franchet) Korovin) (Kurbonov & Pimenov 2016, Pimenov 2020, Turdiboev et al. 2022).

Figure 4. Historical specimens of *Ziziphora tenuior* L. collected from the Nuratau Mountains and kept at LE (source – Virtual herbarium of Komarov Botanical Institute RAS): A, B – gatherings of Olga Fedtschenko (1869); C – gatherings of Guillaume Capus (1881); D – gatherings of Alexander Michelson (1914); E – gatherings of Mikhail Spiridonov (1915).

From 1887 to 1903, the prominent Russian botanist Vladimir Lipsky conducted extensive field research in Central Asia, focused primarily on mountainous regions. In 1890, Lipsky worked in the surroundings of Jizzakh and the Sanzar River Valley. In the fundamental work, *Flora of Central Asia (1902–1905)*, Lipsky consolidated and systematized all existing at that time data on the flora and vegetation of this huge region, and also provided a detailed description of the history of botanical research, including the routes of the expeditions (Lipsky 1905).

The first scientist who crossed the Nuratau Range in its central part was the famous Russian entomologist and explorer Dmitry Glazunov, who in 1892 travelled through the Ukhum Pass and the present territory of the Nuratau State Nature Reserve, and also surveyed the Sentobsay Gorge. During this expedition, Glazunov gathered a zoological collection and herbarium, which is currently preserved at LE (Lipsky 1905, Zakirov 1969, 1971, Beshko 2020).

Botanical studies of the 20th century

The period of systematic exploration of the plant diversity of Central Asia began in 20th century, since a series of comprehensive soil-geobotanical expeditions to the Amudarya and Syrdarya river basins organized in 1908–1916 under the leadership of soil scientist N.A. Dimo and botanist B.A. Fedtschenko. In particular, during springtime of 1911, the expedition of N.A. Dimo studied the Pistalitau Range and collected a significant amount of herbarium. In 1913, E.P. Korovin conducted a detailed survey of the western part of the Nuratau Mountains and later published a paper titled "*Plant Formations of the Nurata Valley*" (1923) based on his findings (Zakirov 1969, 1971, Beshko 2020). Several new plant species were described based on the herbarium material gathered by Korovin in 1913 from this region, including *Parrya nuratensis* Botsch. & Vved. endemic to the Nuratau Mountains and *Cousinia pseudolanata* Popov ex Tscherneva, rare local endemic to the Aktau Range (Tojibaev et al. 2022).

In 1913–1914, a botanist from St. Petersburg A.I. Michelson conducted field research in the Nuratau Mountains within the framework of above-mentioned soil-geobotanical expeditions, he crossed the Nuratau Range through the Ukhum Pass and collected several herbarium specimens (Fig. 4 D). In 1915, B.A. Fedtschenko gathered some herbarium material in the Nuratau Range, while M.V. Kultiasow and M.D. Spiridonov studied the flora and vegetation of the Pistalitau Range. (Zakirov 1969, 1971, Beshko 2020) (Fig. 4 E). Based on the data obtained during this expedition, Kultiasow later published "*An Essay on the Vegetation of the Pistalitau Mountains*" with a checklist of 148 plant species (Kultiasow 1923). Herbarium specimens collected during this period by A.I. Michelson, M.D. Spiridonov, and B.A. Fedtschenko are preserved at LE, while M.V. Kultiasow's gatherings are stored at TASH.

In the 1920s–1930s, the Central Asian State University in Tashkent (currently the National University of Uzbekistan) organized a series of large-scale expeditions throughout Central Asia focused on floristic and geobotanical studies essential for land cadaster and agricultural development, especially, assessment and mapping of pastures, identification of resources of useful plants. A.I. Vvedensky, V.P. Drobow, M.G. Popov, E.P. Korovin, M.V. Kultiasow, M.M. Sovetkina, and other leading botanists of that time participated in these studies. The results of expeditions were summarized in a series of special reports and provided the data for the first geobotanical map of Uzbekistan (Zakirov 1969, 1971, Beshko 2020). Within the framework of these studies, M.G. Popov investigated the flora of the southern branch of the Nuratau Mountains in 1925–1926. Later, several new species were described on the herbarium specimens collected by Popov, including the subendemics *Phlomoides sogdiana* (Pazij & Vved.) Salmaki, *Silene paranadena* Bondarenko & Vved.,

Lepidium botschantsevianum Al-Shehbaz (*Stroganowia angustifolia* Botsch. & Vved.), and rare local endemics to the Aktau Range *Astragalus nuratensis* Popov (Fig. 5) and *Ferula nuratavica* Pimenov, as well as endemic to the Nuratau Mountains Arctium pallidivirens (Kult.) S.López, Romasch., Susanna & N.Garcia (*Anura pallidivirens* (Kult.) Tscherneva) (Tojibaev et al. 2022).

Figure 5. Type specimen and *locus classicus* of rare endemic *Astragalus nuratensis* (TASH001753) collected by Mikhail Popov from the Aktau Range in 1926, and a living plant in its natural habitat (photo by N. Beshko).

In 1929, S.N. Kudrjaschev conducted an expedition to the Khobduntau and Karachatau Ranges in the southern branch of the Nuratau Mountains and studied the flora and vegetation, particularly aromatic and rubber-bearing plants. The data obtained were published in the "*Vegetation of the Khobduntau and Karachatau Mountains*" (Kudrjaschev, 1930), including a checklist of 228 plant species recorded during the field survey for these two small isolated ranges.

In 1928–1930, the geobotanist M.M. Sovetkina, a leading specialist in rangelands of Central Asia, surveyed the pastures of the Jizzakh administrative district, including the eastern part of the Nuratau Mountains. The results of this research were published in the work "*The Vegetation of the Southern Part of the Hungry Steppe in the Jizzakh Region*" (1930). During this period, the soil and vegetation of the Nuratau Mountains were also studied by L.A. Berezin (Zakirov 1969, 1971, Beshko 2020).

In 1931–1932, the geobotanical team of the All-Union Institute of Fodder, which included Sh.M. Agabobyan, M.L. Kasimenko, and others, carried out inventory and mapping of natural pastures and hayfields in the Farish and Jizzakh administrative districts (Zakirov 1969,

1971, Beshko 2020). The rare narrow endemic to the Nuratau Range *Phlomoides anisochila* (Pazij & Vved.) Salmaki was described by a specimen collected during this expedition (Tojibaev et al. 2022) (Fig. 6).

In 1932, the botanist from Komarov Botanical Institute O.E. Knorring surveyed the Nuratau Mountains under the assignment of the Institute of Rubber and Gutta-Percha. Based on the materials of this expedition, she published the article "*The Vegetation of the Nuratau Mountains*" in 1934. In 1951, O.E. Knorring, together with L.I. Tsvetkova, revisited the Nuratau Mountains, focusing their research on the Aktau Range (Zakirov 1969, 1971, Beshko 2020).

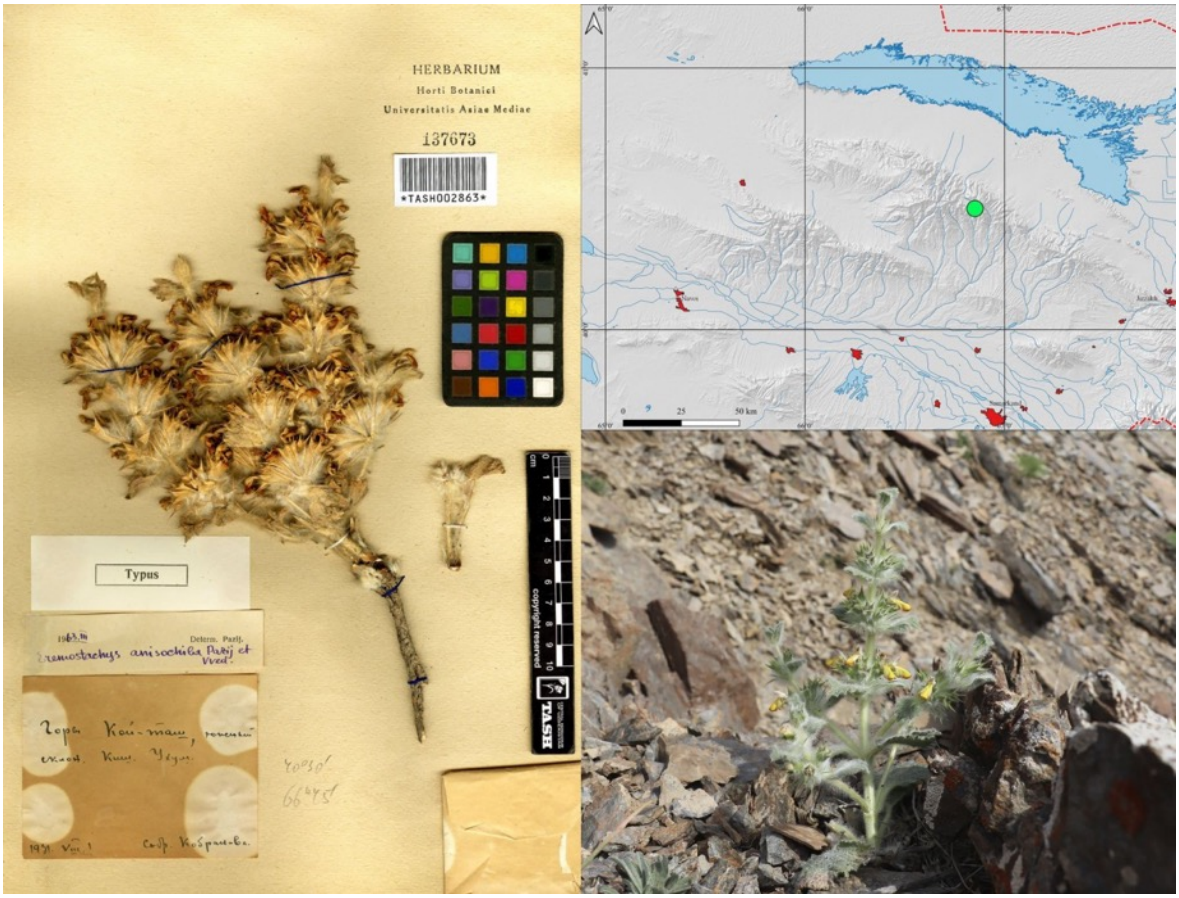

Figure 6. Type specimen and *locus classicus* of rare endemic *Phlomoides anisochila* (TASH001753) collected by Kobranova from the Nuratau Range in 1931, and a living plant in its natural habitat (photo by N. Beshko).

Additionally, in the early 1930s, studies on weedy plants and the development of control measures were carried out at the Gallaorol Experimental Station of Cereal Crops, located in the eastern part of the Nurata Valley. Within the framework of these studies, a large amount of herbarium specimens was gathered from the Khobduntau Range and the southern foothills of the Nuratau Range.

From 1934 to 1938, the Kenimekh Complex Expedition, led by prominent expert in phytosociology I.I. Granitov, explored the southwestern part of the Kyzylkum Desert, Kenimekhchul, and the western piedmonts of the Nuratau Mountains. The mission of this expedition was a comprehensive study the climate, soil, vegetation, flora and fauna of this region. Expedition team, including I.A. Tyshchenko, E.N. Kharchenko, Z.A. Klimovskaya, V.S. Tarasevich, and others, collected a huge amount of herbarium specimens from the western part of the Karatau and Aktau

Ranges (kept at TASH). After the completion of the Kenimekh Expedition, I.I. Granitov continued studies of the flora and vegetation of this region; the results of his long-term research have been summarized in the two-volume monograph "*The Vegetation Cover of the Southwestern Kyzylkum*" (1964, 1967), which lists 580 species from 290 genera and 55 families for the flora of the Southwestern Kyzylkum (including Kenimekhchul and the western piedmonts of the Nuratau Mountains) (Zakirov 1969, 1971, Tojibaev et al. 2019, 2020, Beshko 2020). The monograph contains an essay of the history of botanical research, description of the physiographical and environmental conditions of the region, provides the analysis of the flora and vegetation, and a scheme of phytogeographical division of the territory, as well as the assessment of the influence of humans and wildlife on the vegetation. Based on collections made during the Kenimekh Expedition, the rare local endemic *Iris hippolyti* (Vved.) Kamelin, one of the rarest *Juno* irises of Uzbekistan, was described (Tojibaev et al. 2022) (Fig. 7).

From 1934 to 1941, A.I. Vvedensky and V.P. Botschantzev performed field surveys in the Nuratau Mountains and discovered the rare local endemic *Salvia submutica* Botsch. & Vved. (Fig. 8). Furthermore, the rare species *Seseli turbinatum* Korovin and the endemic *Cousinia botschantzevii* Juz. ex Tscherneva were described based on collections made by V.P. Botschantzev in 1938 (Tojibaev et al. 2022).

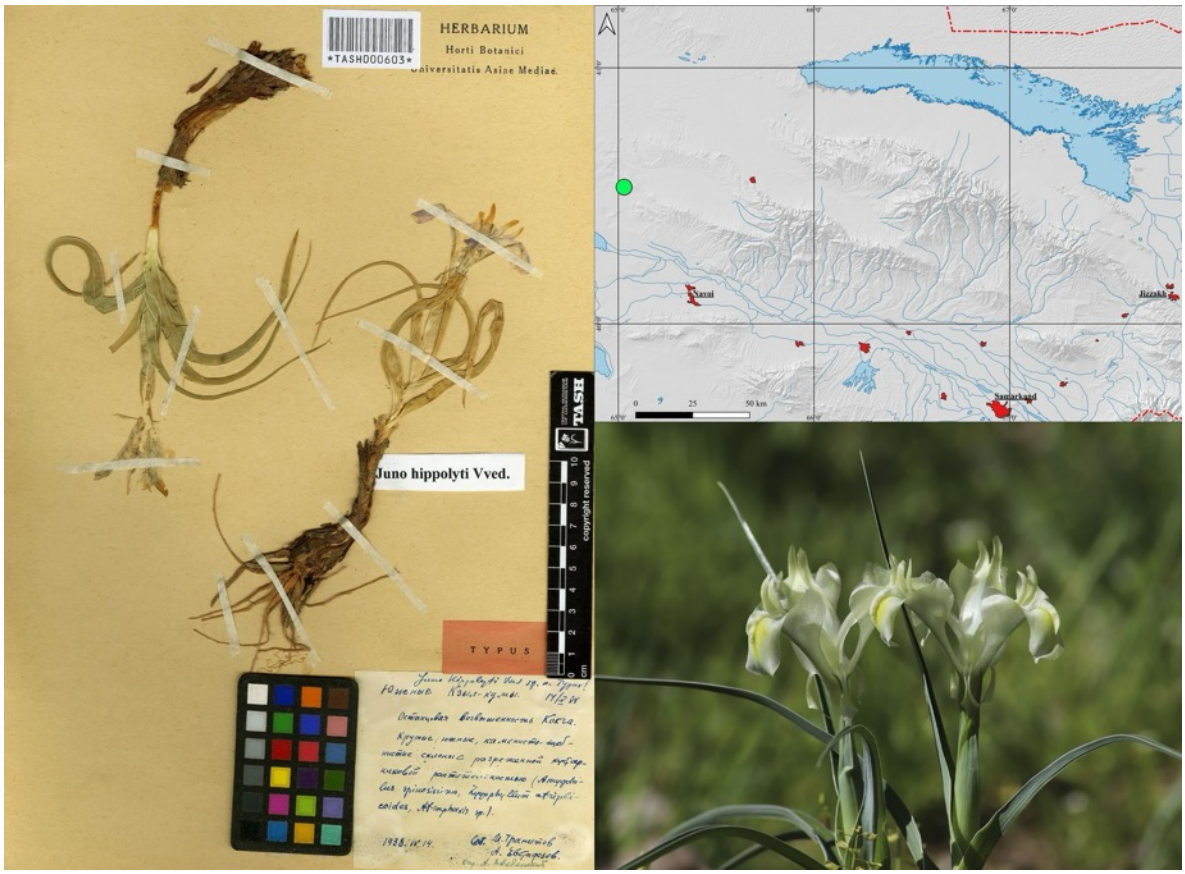

Figure 7. Type specimen and *locus classicus* of rare endemic *Iris hippolyti* (TASH000603) collected by Ippolit (Hippolyte) Granitov and his assistant A. Evstafiev in 1938, and living plants in ex-situ collection of the Institute of Botany in Tashkent (photo by N. Beshko).

Figure 8. Type specimen and *locus classicus* of rare endemic *Salvia submutica* (TASH002972) collected by Victor Botschantzev from the Nuratau Mountains in 1934, and living plant in its natural habitat (photo by N. Beshko).

In 1937, within the framework of an expedition of the Committee of Sciences of the Uzbek SSR, E.M. Demurina and E.E. Korotkova carried out detailed geobotanical studies across the western part of the Turkestan Range and its western spurs (including the Nuratau, Aktau, Khobduntau, and Karachatau Ranges), and collected approximately 10,000 herbarium specimens. The results were published more than 30 years later in the posthumous monograph by E.M. Demurina, "*Vegetation of the Western Part of the Turkestan Range and Its Spurs*" (Demurina 1975). For the Uzbek part of the Turkestan Range, Malguzar Range, and Nuratau Mountains, the monograph provides a typology and description of the vegetation illustrated by a schematic map, and a general checklist of 1,139 plant species, with information on altitudinal zones and habitats but without data on geographic distribution or herbarium citations. A general list of endemics from the entire study area (51 species) is also provided. Several new species were described based on the materials of this expedition, including endemics *Dianthus helenae* Vved. (Fig. 9) and *Lappula nuratavica* Nabiev & Zakirov (Tojibaev et al. 2022).

In 1940–1941, P.A. Gomolitsky, G.D. Dolgikh, A. Arkhireev, G. Protopopov, V. Gromakov, S. Lepeshkin, I.F. Momotov, and V.I. Bukasov studied the vegetation of the current territory of Farish and Gallaorol districts of the Jizzakh Region and collected a significant amount of herbarium material (preserved in TASH). Based on a sample collected by I.F. Momotov in 1941 in the Farish District, the rare narrow endemic of the Nuratau Range, *Lepidium olgae* (R.M.Vinogr.) Al-Shehbaz & Mumm., was described, while the rare endemic *Oxytropis pseudorosea* Filim. was discovered from the gatherings by S. Lepeshkin (Tojibaev et al. 2022).

In 1944, M.G. Popov compiled a map of pastures of the Samarkand Region, which at that time included the entire territory of the Nuratau Mountains. In 1954–1955, materials on flora and vegetation were collected by L.S. Gaevskaya, M.A. Rish, E.S. Krasnopolsky, A.K. Ernazarov, and G.G. Petrovich during the study of the pastures of the Samarkand Region conducted by the All-Union Institute of Fodder (Zakirov 1969, 1971, Beshko 2020).

Significant contributions to the accumulation of floristic data on the Nuratau Mountains were made by the faculty and students of Samarkand State University. From 1937 to 1943, the Department of Botany at Samarkand University was headed by the prominent Uzbek botanist, Academician K.Z. Zakirov. He conducted large-scale studies throughout the Zeravshan River Basin and published a two-volume monograph titled "*Flora and Vegetation of the Zeravshan River Basin*" (Zakirov 1955, 1961). This book includes a synopsis of 2,588 species (with references to herbarium collections), summarizing data on several phytogeographical regions of Mountain Central Asian and Turan provinces within the Zeravshan River Basin. Among these, 372 species were listed for the southern branch of the Nuratau Mountains. K.Z. Zakirov collected a significant herbarium material stored in TASH, LE and the Herbarium of Samarkand University, and discovered a number of new species, including the endemics (*Acantholimon nuratavicum* Zakirov, *Phlomis nubilans* Zakirov), and the subendemic *Phlomis linearifolia* Zakirov. Additionally, other scientists described several new species based on Zakirov's collections, as the endemic *Jurinea zakirovii* Iljin (Fig. 10) and the subendemic *Silene paranadena* Bondarenko & Vved. (Tojibaev et al. 2022).

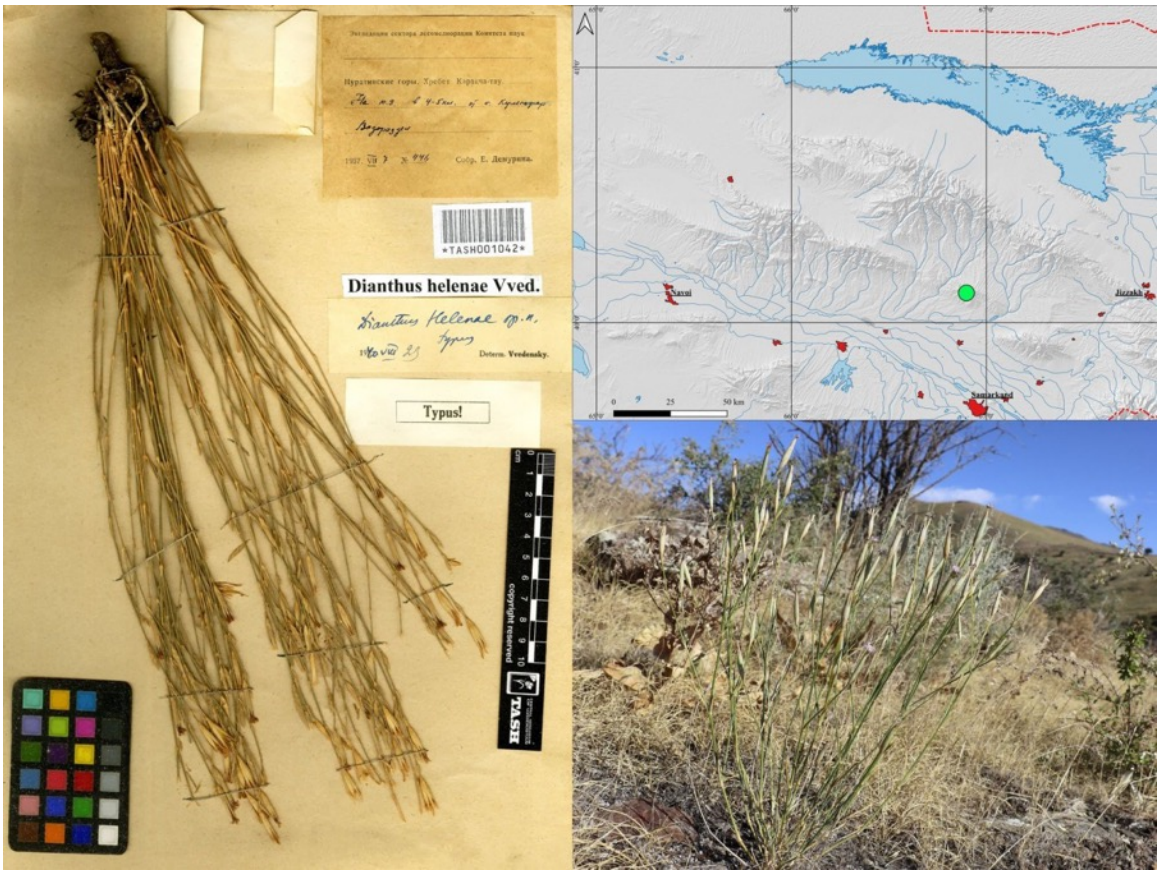

Figure 9. Type specimen and *locus classicus* of endemic *Dianthus helenae* (TASH001042) collected by Elena Demurina from the Nuratau Mountains in 1937, and living plant in its natural habitat (photo by N. Beshko).

Figure 10. Type specimen and *locus classicus* of rare endemic *Jurinea zakirovii* (TASH003615) collected by Qodir Zakirov from the Nuratau Mountains in 1941, and living plants in their natural habitat (photo by N. Beshko)

From the 1950s to the 1980s, the Institute of Botany of the Academy of Sciences of Uzbekistan performed large-scale studies in the Nuratau Mountains and the adjacent piedmont plains focused mainly on the vegetation of pastures and its improvement and restoration. Thus, in 1951–1960, N.S. Zaprometova and I.V. Novikova conducted geobotanical surveys in the western part of Nuratau Range, within the Nurata administrative district. The vegetation of the Aktau and Karatau ranges was studied by I.F. Momotov and A.D. Li in 1955–1957 and by M.I. Pryakhin in 1963–1967. From 1961 to 1966, the Samarkand botanist K. Khaydarov conducted field geobotanical studies in the western part of Nuratau and the Aktau ranges, described the vegetation and its seasonal dynamics, and gathered a substantial herbarium material (stored in TASH and the Herbarium of Samarkand University). In 1964, field studies in the Nuratau Mountains were conducted by T.I. Zuckerwanik (Zakirov 1969, 1971, Beshko 2020).

Between 1956 and 1958, large-scale geobotanical and floristic studies were carried out in the Nuratau Range by P.K. Zakirov and A.D. Li, who collected a significant volume of herbarium specimens and produced approximately 250 descriptions of plant communities. Based on the research findings, P.K. Zakirov compiled a vegetation map of Nuratau Range and published the monographs "*Vegetation Cover of the Nuratau Mountains*" (Zakirov 1969) and "*Botanical Geography of the Nuratau Range and Low Mountains of Kyzylkum*" (Zakirov 1971), which provide detailed descriptions of the flora and vegetation of this region. In particular, a checklist of flora of the Nuratau Range with 686 species from 335

genera and 62 families, including 20 endemics, was published for the first time in the "*Vegetation Cover of the Nuratau Mountains*" (Zakirov 1969). In this book, Zakirov provided flora statistics, data on pasture yield, a typology and description of vegetation, classified into 10 vegetation types, 28 formations, and 105 associations, evaluated the human impact on the vegetation of Nuratau, and included a scheme of ecological series of the main plant communities.

In the monograph "*Botanical Geography of the Nuratau Range and Low Mountains of Kyzylkum*" (Zakirov 1971), P.K. Zakirov published a comprehensive list of the flora of Nuratau Range, the adjacent insular ranges, and the low relic mountains of Kyzylkum, comprising 983 species from 412 genera and 65 families. Of these, 679 species from 329 genera and 63 families were reported for Nuratau Range, and 154 species from 92 genera and 27 families are listed for the Pistalitau Range and adjacent insular low mountains. The book also contains a detailed analysis of the flora, a description of altitudinal zonation, a geobotanical zoning scheme, a classification of the vegetation, and schematic vegetation maps (including 33 mapping units identified for the Nuratau Range). P.K. Zakirov also studied the plant resources of the Nuratau Range (together with T. Norbobaeva) (Zakirov 1974).

Several new species were described on the herbarium material collected by P.K. Zakirov from Nuratau, for example, the rare subendemic *Astragalus leptophysus* Vved. (Tojibaev et al. 2022).

In 1971, R.V. Kamelin and V.P. Botschantzev, leading Russian specialists in Central Asian flora from Komarov Botanical Institute, together with I.V. Belolipov and other researchers from the Tashkent Botanical Garden, conducted a two-week collection mission to the Nuratau Mountains, and gathered herbarium material and seeds of wild plants. Based on the results of this expedition, R.V. Kamelin published the article "*An Account to the Knowledge of the Flora of the Nuratavian Mountains*" (Kamelin 1973), which contains a list of 157 new records to the flora of the Nuratau Mountains and description of three new species, including two narrow endemics, *Lagochilus olgae* Kamelin and *Silene nuratavica* Kamelin, and *Scaligeria vvedenskyi* Kamelin (currently accepted name is *Elaeosticta vvedenskyi* (Kamelin) Kljuykov, Pimenov & V.N. Tikhom.). R.V. Kamelin also provided the information on the flora the Nuratau Mountains in monographs entitled "*Florogenetic Analysis of the Native Flora of the Mountainous Middle Asia*" (Kamelin 1973), "*The Kuhistan District of Mountainous Middle Asia*" (Kamelin 1973), and "*The Flora of Syrdarya Karatau*" (Kamelin 1990). In "*The Flora of Syrdarya Karatau*" (Kamelin 1990), R.V. Kamelin estimated the flora of the Nuratau Mountains (with the adjacent insular ranges) at 1,172 species from 475 genera and 84 families, with 62 endemics.

During the 1950s–1980s, numerous short-term botanical excursions were conducted in the Nuratau Mountains by T.A. Adylov, L.L. Bulgakova, A.I. Vvedensky, E.V. Kljuykov, E.E. Korotkova, I.G. Levichev, M.G. Pimenov, U.P. Pratov, U. Rakhmankulov, and other Uzbek and Russian researchers. As a result of these collection missions, several new species were discovered. For example, the narrow endemic of Nuratau Range *Allium svetlanae* Vved. was described from gatherings made by A.I. Vvedensky in the Ustuksay valley in 1956 (Fig. 11), another endemic of Nuratau, *Dracocephalum nuratavicum* Adylov, was described from specimen collected by L.L. Bulgakova from Sentobsay Gorge in 1983 (Tojibaev et al. 2022). The extremely rare narrow endemic of the Karatau Range *Autumnalia inopinata* Pimenov was described by M.G. Pimenov from collections made in 1986 near the Karakarga Pass (Pimenov 2020).

Figure 11. Type specimen and *locus classicus* of rare endemic *Allium svetlanae* (TASH000466) collected by Aleksei Vvedensky from the Nuratau Mountains in 1956, and living plants in their natural habitat (photo by N. Beshko).

After the establishment of the Nuratau Nature Reserve in 1975, its scientific staff, E.N. Korshunov (1978–1979), E.A. Mukhina (1980–1982), L.M. Petrochenko and N.G. Fominykh (1983–1984), and N.Yu. Beshko (1992–2024), carried out inventory of the flora and vegetation of this protected area, as well as monitoring of populations of endemic and rare plant species. These researchers gathered a significant herbarium collection from the territory of nature reserve, its buffer zone and adjacent areas, which is currently preserved in the office of the Nuratau Nature Reserve and in the National Herbarium of Uzbekistan (TASH). A preliminary unpublished checklist of the flora compiled in the 1980s and provided in the annual scientific reports of the Nuratau Nature Reserve, included 503 plant species (Kamelin and Korshunova 1990). In 1990s–2000s, this checklist was expanded significantly as a result of further floristic inventory performed by N.Yu. Beshko. Thus, 775 species from 347 genera and 74 families are reported in the PhD thesis of N.Yu. Beshko (Beshko 2000).

Botanical studies of the 21th century

Since 2000, botanical studies in Uzbekistan have been revitalized. In this period, four new endemic species (*Acantholimon zakirovii* Beshko, *Allium aktauense* F.O.Khass. & Esankulov (Fig. 12), *Allium habibii* F.O.Khass. and *Astragalus saidii* F.O.Khass. & Esankulov) were discovered and several new important works on the flora of the Nuratau Mountains were published. For example, an updated checklist of the flora of the Nuratau Nature Reserve with 820 species from 385 genera and 81 families was published in 2011 in the 7th volume of "*Proceedings of the Nature Reserves of Uzbekistan*" (Beshko 2011). After

this publication, and several new records for the flora of the Nuratau Nature Reserve and the Nuratau Mountains were found (Beshko 2015, 2017, 2022). The actual checklist of the flora of the Nuratau Nature Reserve was published online on the Plantarium website (Beshko 2017–2025); it includes 843 species of vascular plants, 32 of which are listed in the Red Data Book of Uzbekistan (Khassanov 2019). Thus, currently the plant diversity of the Nuratau Nature Reserve is studied and documented quite comprehensively.

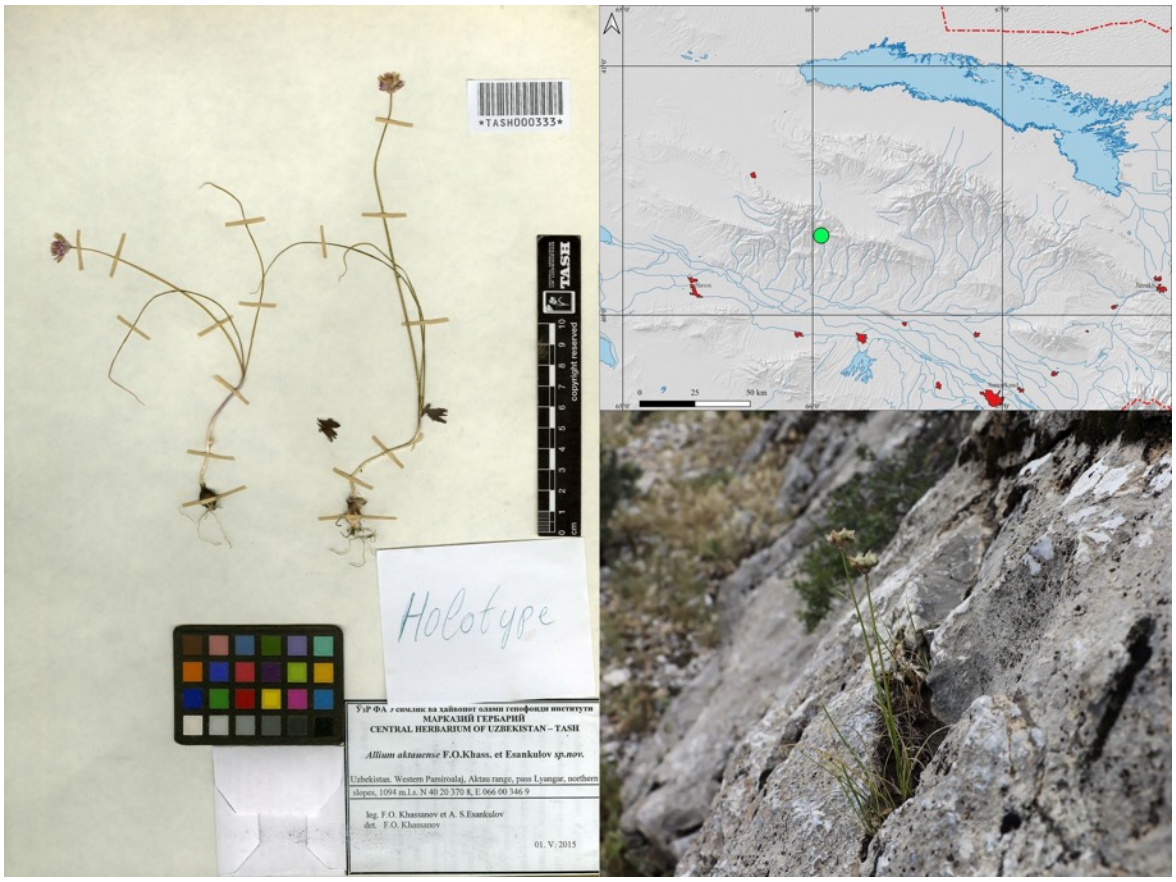

Figure 12. Type specimen and *locus classicus* of rare endemic *Allium aktauense* (TASH000333) collected by Furkat Khassanov and Alijon Esankulov from the Aktau Range in 2015, and living plants in their natural habitat (photo by N. Beshko).

In 2016, A.R. Batoshov compiled a checklist of the flora of remnant low mountains of the Southeastern Kyzylkum adjacent to the Nuratau, which includes 781 species from 355 genera and 69 families, 412 of which were reported for this area for the first time (Batoshov 2016).

Between 2013 and 2020, the Institute of Botany of the Academy of Sciences of Uzbekistan performed the inventory of flora of Jizzakh, Samarkand, Kashkadarya, Navoi, and Bukhara administrative regions within the framework of state grants. Based on the data obtained, a series of books titled "*The Cadastre of the Flora of Uzbekistan*" was published. For the flora of Jizzakh Region, 1,991 species of vascular plants from 106 families and 617 genera were identified, including 50 species listed in the Red Data Book of Uzbekistan (Tojibaev et al. 2021). The flora of Samarkand Region comprises 1,687 species of vascular plants from 573 genera and 95 families, with 53 species included in the Red Data Book (Tojibaev et al. 2018). In Navoi Region, 1,561 species of vascular plants from 534 genera and 90 families were recorded, including 51 rare and endangered

nationally red-listed species (Tojibaev et al. 2019). The synopsis of the flora of Bukhara region contains 764 species of vascular plants from 339 genera and 66 families, including 25 species listed in the Red Data Book (Tojibaev et al. 2020). These studies provided the following data on species diversity in the Nuratau Mountains (Table 1).

According to the data published by N.Yu. Beshko in the illustrated monograph "*Flora of Central Asia: the Nuratau Mountains*" (Beshko 2020), the flora of this territory counts 1,283 species of vascular plants from 474 genera and 86 families, of which 1,180 species from 444 genera and 81 families are native, while 103 species are naturalized aliens. The monograph includes statistics and an analysis of the flora of the Nuratau Mountains and descriptions of 335 species, supplemented with photographs. Unfortunately, a complete checklist of flora is not provided in this book.

A number of recent studies have been focused on the investigation of spatial distribution, ecology, population trends and demographic structure of certain endemic and threatened species of the flora of the Nuratau Mountains (representatives of the genera *Iris*, *Lagochilus*, *Salvia*, *Tulipa*, and others), and assessment of their conservation status according to the IUCN Red List Categories and Criteria, and analyzing the endemic fraction of the flora (Tojibaev and Beshko 2015, Abduraimov et al. 2015, 2020, Akhmedov 2018, Beshko 2018, Akhmedov et al. 2022, 2023, Turdiev et al. 2023, Volis and Beshko 2023, Orsenigo et al. 2022, Fenu et al. 2022, 2023, 2024, Baikov et al. 2024). According the most actual data (Volis and Beshko 2023), there are 32 species strictly endemic to the Nuratau Mountains, of which 20 species occur in the Nuratau Nature Reserve, and 18 are listed in the Red Data Book of Uzbekistan (Khassanov 2019). The total number of nationally red-listed species in the flora of Nuratau Mountains is 47 (Khassanov 2019).

Table 1. Distribution of plant species in the Nuratau Mountains by administrative and phytogeographical regions.

Administrative Regions	**Phytogeographical regions**		
	Nuratau	**Aktau**	**Nuratau Relic Mountains**
Bukhara	-	205	-
Jizzakh	1139	563	619
Navoi	972	842	-
Samarkand	1004	816	-
Total	1205	907	621

Contribution of conservation projects to the study of plant diversity of the Nuratau Mountains

In addition to the research conducted by academic institutions and universities, over the past 25 years, Uzbekistan has implemented several international conservation projects, which included studies of the plant diversity of the Nuratau Mountains. In 2001–2007, the UNDP/GEF medium-scale project "*Establishment of the Nuratau-Kyzylkum Biosphere Reserve as a Model for Biodiversity Conservation in Uzbekistan*" was carried out in the region. The project involved a comprehensive study of ecosystems within the area encompassing the Nuratau Range, the adjacent piedmont plain, the Aydar-Arnasay lake system, and the southeastern part of the Kyzylkum Desert. The vegetation map and the checklist of flora of the planned biosphere reserve have been compiled within the framework of this project. The checklist with 1,180 species from 456 genera and 90 families was published by N.Yu. Beshko in the article "*Flora of the Planned Nuratau-Kyzylkum Biosphere Reserve*" (Beshko 2002).

In 2009–2013, the UNDP/GEF project "*Strengthening the Sustainability of the National*

Protected Area System by Focusing on Nature Reserves" was implemented in Uzbekistan. Within the framework of this project, "*Recommendations for Expanding the Protected Area System in Uzbekistan*" were developed and published (Ismatov 2013). Priority areas for biodiversity conservation were identified based on internationally recognized criteria, such as representativeness, uniqueness, the presence of threatened and vulnerable species and communities, and the degree of ecosystem preservation. Based on these criteria, the Nuratau Mountains were identified among key areas for plant diversity conservation in Uzbekistan, and an expansion of the Nuratau Nature Reserve was recommended (Ismatov 2013).

In 2016–2017, within the framework of the CEPF project "*Mountains of Central Asia: Biodiversity Hotspot*", 36 Key Biodiversity Areas (KBAs) were identified in the mountains and piedmonts of Uzbekistan. The Nuratau Range was listed among five priority Key Biodiversity Areas. A list of 301 key (threatened and endemic) plant species meeting international criteria of KBA was compiled for Uzbekistan, including three globally threatened species and 32 endemics that occur in the Nuratau Mountains (CEPF 2017).

The main sources of the floristic data

An essential source of information on the flora of the Nuratau Mountains and the spatial distribution of species is the National Herbarium of Uzbekistan (TASH), which contains over 6,600 specimens from this region or 59% of all occurrence records (Fig. 13), including 102 type specimens (Tojibaev et al. 2022). The herbarium of the Nuratau Nature Reserve has 1,326 specimens, while the herbarium LE contains over 410 specimens from the Nuratau Mountains, MW collection holds 274 specimens, and the Herbarium of Samarkand University holds only 28 specimens. An analysis of herbarium data shows that the main collectors of material from this area are N.Yu. Beshko (1,831), V.P. Botschantzev (215), P.A. Gomolitsky (114), E.M. Demurina (272), P.K. Zakirov (315), N.S. Zaprometova (668), R.V. Kamelin (168), O.E. Knorring (107), E.P. Korovin (415), S.N. Kudrjaschev (253), M.V. Kultiasow (122), I.F. Momotov (369), M.G. Pimenov (130), M.G. Popov (134), and K. Khaydarov (239).

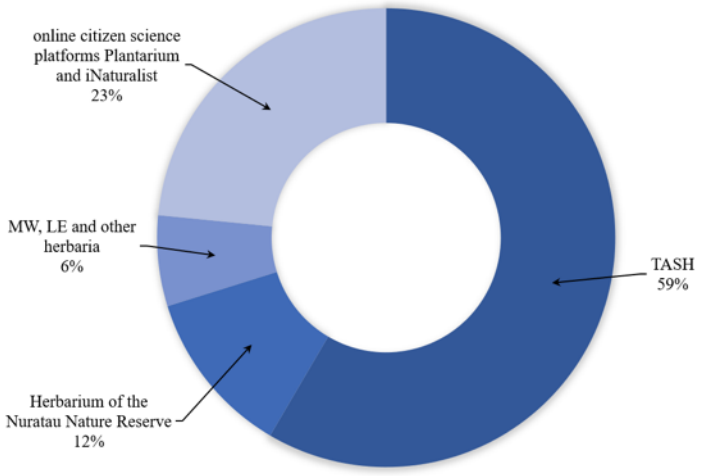

Figure 13. Main data sources on the flora of the Nuratau Mountains.

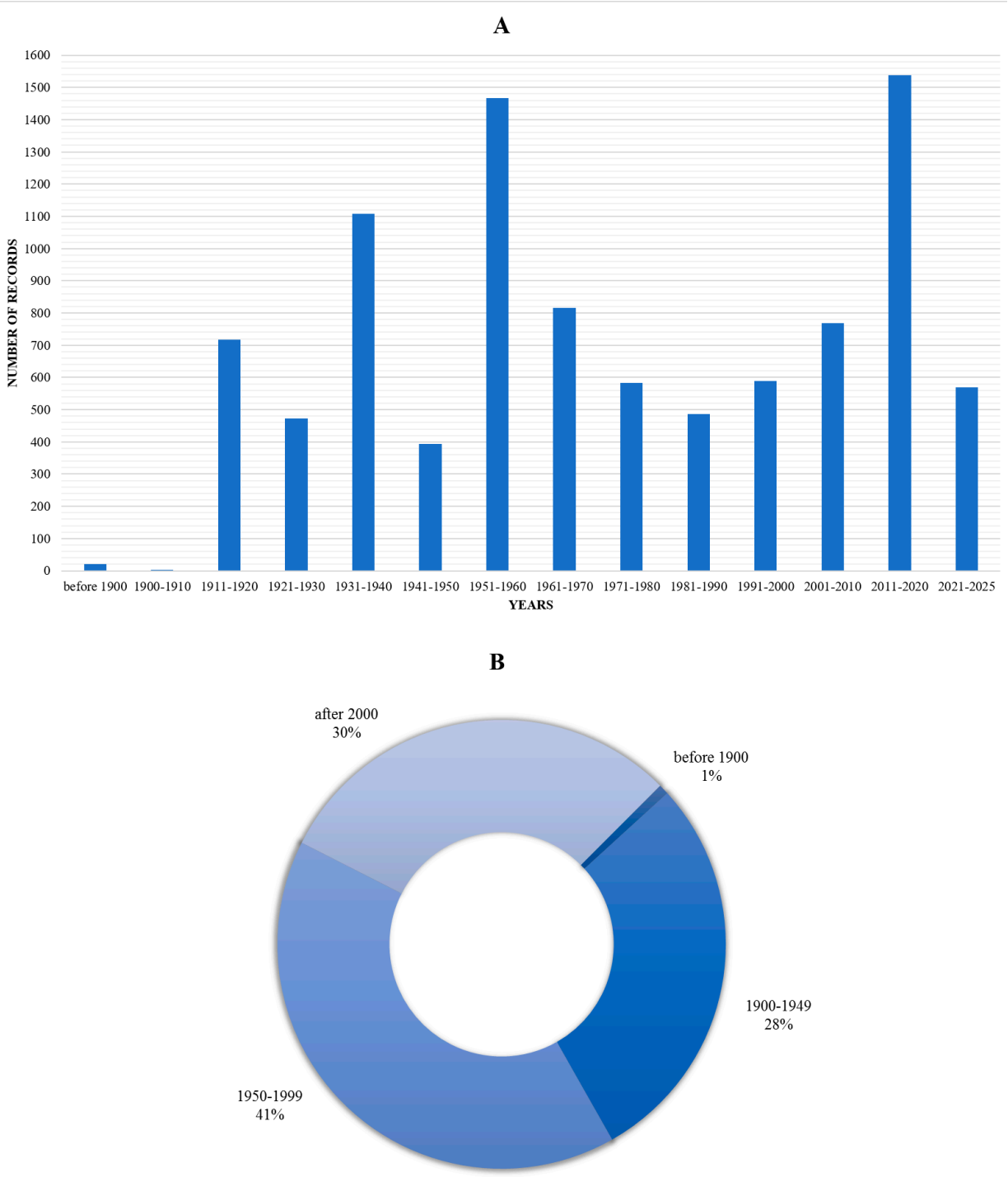

Figure 14. Temporal trends in floristic data collection.

In addition to scientific publications and herbarium collections, online citizen science platforms iNaturalist (iNaturalist 2025) and Plantarium (Plantarium 2007–2025) also are significant sources of information on the flora of the study area that together account for 23% of all occurrence records (Fig. 13). Specifically, the Plantarium website features over 1,050 observations for more than 400 plant species from the Nuratau Mountains, with over 900 observations from the Nuratau Range. The majority of these occurrence records belong to

the territory of the Nuratau Nature Reserve and its buffer zone, including 532 observations of 290 species from the Hayatsay Gorge, 96 records of 63 species from the Madjrumsay Gorge, 39 observations of 23 species from the Gurdara Gorge, etc. Similarly, the iNaturalist website provides over 1,500 observations for 487 plant species from the Nuratau Mountains, including over 500 observations of 240 species from the territory of the Nuratau Reserve.

An analysis of the temporal trends in floristic data accumulation (by decades) showed that the most active collection missions were conducted in the Nuratau Mountains in 1911–1920, 1931–1940, 1951–1970 and 2011–2020 (Fig. 14 A). Overall, 1% of herbarium specimens from the Nuratau Mountains were gathered in the 19th century; 69% of all records were made during the 20th century (28% – in the first half, and 41% – in the second half of the 20th century), and 30% of the data were obtained since 2000, with the advent of the IT-era, when the traditional collection of herbarium material was supplemented by the occurrence records of living plants from online platforms (Fig. 14 B).

CONCLUSIONS

An analysis of the available sources on the flora and vegetation of the Nuratau Mountains shows that, despite a long history of botanical research, a significant volume of herbarium material, and numerous publications, including modern ones, the flora of Nuratau Mountains is still insufficiently studied and documented, and an actual checklist remains unpublished to date.

The territory of the Nuratau Mountains has been affected by human activity since ancient times, and the vegetation has been noticeably transformed. Historically, the main anthropogenic threats were overgrazing and clear-cutting of trees and shrubs for fuel wood by local people. But since 2000, the negative impact of mining operations, agriculture, tourism, infrastructure and industry on ecosystems and biodiversity of Uzbekistan has rapidly and significantly increased (National Strategy for Biodiversity Conservation, 2019–2028). These threats together with climate change and desertification can led to irreversible biodiversity loss and degradation of ecosystems of the Nuratau Mountains in the near future. Considering this region as one of the key biodiversity areas of Uzbekistan and Central Asia, rich in endemic and endangered plant species, and recognized as one of priority areas for protection, and taking into account existing and prospective threats, comprehensive botanical studies are crucial.

At the present, the accumulation of floristic data has significantly increased, which is associated, among other factors, with the emergence of online platforms. In this regard, in 2025 the Institute of Botany of the Academy of Sciences of the Republic of Uzbekistan launched a new research program focused on thorough study of plant diversity and ecosystems of this region, including revision of all available floristic and geobotanical data, large-scale field surveys, mapping and analysis of species spatial distribution based on 5x5 km grid cells, publication of complete synopsis of the vascular flora of the Nuratau Mountains, investigation of the biogeographic patterns and endemism phenomena of the study area through molecular phylogenetic analysis, classification, condition assessment and mapping of ecosystems, as well as the assessment of extinction risk of endemic and threatened species using IUCN Red List Categories and Criteria. These studies will help to fill existing gaps in the knowledge of plant diversity of this region and develop effective measures for its conservation in the context of climate change and increasing anthropogenic impact.

ACKNOWLEDGEMENTS

This research was conducted within the framework of the state research program "*Digital Nature. Development of a digital platform for the flora of Central Uzbekistan*", implemented by the Institute of Botany of the

Academy of Sciences of the Republic of Uzbekistan for the period 2025–2029, and Grant No. PRIM 01-73 "*The modernization of the Institute of Botany of the Academy of Sciences of the Republic of Uzbekistan*", funded under the MUNIS Project, supported by the World Bank and the Government of the Republic of Uzbekistan. The statements do not necessarily reflect the official position of the World Bank and the Government of the Republic of Uzbekistan. The authors express their sincere gratitude to all colleagues and institutions who contributed to this study, providing invaluable support in data collection, analysis, and interpretation.

REFERENCES

Abduraimov, O. & Shomurodov, H.F. (2015) The ontogenesis and ontogenetic structure of *Tulipa micheliana* Th. Hoog (Liliaceae) coenotic populations in Uzbekistan. UAE Journal of Novel Applied Sciences, 4 (10), 1089–1096.

Abduraimov, O.S., Shomurodov, H.F., Daniyarov S.A., et al. (2020) The ontogenesis and ontogenetic structure of coenopopulations of *Tulipa korolkowii* Regel in Uzbekistan. Journal of Botanical Research, 2 (4), 7–11.

Akhmedov, A., Beshko, N., Keldiyorov, X., et al (2023). Ontogenetic structure of populations of *Phlomis nubilans* (Lamiaceae) in Uzbekistan under drought climate. Ekologia (Bratislava), 42 (4), 349–353. DOI: 10.2478/eko-2023-0039

Akhmedov, A., Nomozova, Z., Umurzakova, Z., et al. (2022) N. Assessment of the current condition of populations of the Red List species *Salvia submutica* Botsch. & Vved. (Lamiaceae) in Nuratau mountain range, Uzbekistan. Ekologia (Bratislava), 41 (4), 322-328.

Akhmedov, A.K. (2018) Ontogenetic structure and condition of cenopopulations of rare and endemic species of the genus *Lagochilus* Bunge (Lamiaceae Lindl.) in the flora of Uzbekistan. PhD abstract. Tashkent, 46 pp.

Baikov, K.S., Baikova, E.V., Turdibaev, O.A., et al. (2024). Ecological monitoring of the range of the endemic species *Salvia submutica* (Lamiaceae). Bulletin of SGUGiT, 3, 83–96. DOI: 10.2478/eko-2022-0033

Batoshov, A.R. (2016) Flora of South-East Kyzylkum Relic Mountains. DSc thesis. Tashkent, 258 pp.

Beshko, N. (2018) Endemic plants of the Nuratau mountains (North-Western Pamir-Alay). Uzbek. Biol. Journ. 4, 13–18.

Beshko, N.Yu. (2000) Flora of the Nuratau Nature Reserve. PhD abstract. Tashkent, 26 p.

Beshko, N.Yu. (2000) Flora of the planned biosphere reserve Nuratau-Kyzylkum. In: Biodiversity conservation on the protected areas of Uzbekistan, pp. 21–43. Chinor ENK, Tashkent.

Beshko, N.Yu. (2000) New data on rare plant species of the Nuratau Reserve. In: Biodiversity conservation on the protected areas of Uzbekistan, pp. 17–20. Chinor ENK, Tashkent.

Beshko, N.Yu. (2011) Flora of vascular plants of the Nuratau Reserve. In: Proceedings of nature reserves of Uzbekistan, 7, pp. 19–78. Chinor ENK, Tashkent.

Beshko, N.Yu. (2012) Problems of conservation of the plant diversity of the Nuratau Mountains. In: Actual Problems of Plant Ecology. Proceedings of the Republican Scientific Conference, pp. 41–43. Tashkent.

Beshko, N.Yu. (2015) *Acantholimon zakirovii* Beshko (Sect. *Staticopsis* Boiss., Plumbaginaceae), a new species from north-western Pamir-Alay. Turczaninowia, 18 (1), 19–26.

Beshko, N.Yu. (2017–2025). Flora of the Nuratau Nature Reserve. In: Plantarium: Open Online Atlas of Plants and Lichens of Russia and Adjacent Countries. Digital resource available at: https://www.plantarium.ru/page/flora/id/1046.html

Beshko, N.Yu. (2020) Flora of Central Asia: the Nuratau Mountains. Korea National Arboretum, Pocheon, Republic of Korea.

Beshko, N.Yu. (2022) New floristic findings in the Nuratau Nature Reserve. Scientific Bulletin of the Andijan State University, 4(64), 28–31.

Beshko, N.Yu., Tojibaev, K.Sh., Batoshov, A.R. (2013) Tulips of the Nuratau Mountains and South-Eastern Kyzylkum (Uzbekistan). Stapfia: Reports, 99, 198–204.

Beshko, N.Yu., Sharipova, V.K., Shomurodov, Kh.F. (2017) Floristic findings on the Nuratau and Zeravshan mountain ridges (Uzbekistan). Turczaninowia 20 (3), 20–26. DOI: https://doi.org/10.14258/turczaninowia.20.3.3

CEPF (2017) Mountains of Central Asia Biodiversity Hotspot: Ecosystem Profile. CEPF, Switzerland.

Demurina, E.M. (1975) Vegetation of the western part of the Turkestan Range and its spurs. Fan Publishers, Tashkent.

Fenu, G., Al-Rammahi, H.M., Cambria, S., et al. (2022) Global and Regional IUCN Red List Assessments: 14. Italian Botanist, 14, 81–94. DOI: 10.3897/italianbotanist.14.97176

Fenu, G., Cambria, S., Giacò, A., et al. (2023). Global and Regional IUCN Red List Assessments: 16. Italian Botanist, 16, 121–133. DOI: 10.3897/italianbotanist.16.115947

Fenu, G., Caccianiga, M., Khabibullaev, B.S., et al. (2024) Global and Regional IUCN Red List Assessments: 17. Italian Botanist, 18, 141–153. DOI: 10.3897/italianbotanist.18.139285

GBIF (2025) Global Biodiversity Information Facility. Digital resource available at: https://www.gbif.org

iNaturalist (2025) Digital resource available at: https://www.inaturalist.org/

Ismatov A.T. (ed.) (2013) Recommendations for Protected Areas System Development in Uzbekistan. UNDP, Ministry of Agriculture and Water Resources, Main Department of Forestry, GEF. Baktria Press, Tashkent.

Kamelin, R.V. (1973) Florogenetic Analysis of the Native Flora of Mountainous Middle Asia. Nauka, Leningrad.

Kamelin, R.V. (1973) An Account to the Knowledge of the Flora of the Nuratavian Mountains. Botanicheskii Zhurnal, 58 (5), 625–637.

Kamelin, R.V. (1979) Kuhistan District of the Mountainous Middle Asia. Botanical-Geographical Analysis. Nauka, Leningrad.

Kamelin, R.V. (1990) Flora of the Syrdarya Karatau. Nauka, Leningrad.

Kamelin, R.V. (2021) Floristic division of Soviet Middle Asia. Turczaninowia, 24(4), 5–11. DOI: 10.14258/turczaninowia.24.4.1

Kamelin, R.V. & Korshunova, E.N. (1990) Nuratau Nature Reserve. In: Nature Reserves of the USSR. Reserves of Middle Asia and Kazakhstan, pp. 233–245. (Ed. by V.E. Sokolov and E.E. Syroechkovsky). Mysl, Moscow.

Khassanov, F.O. (Ed.) (2019) Red Data Book of Uzbekistan 1. Plants. Tasvir Publishers, Tashkent.

Kudrjaschev, S.N. (1930) Vegetation of the Khobduntau and Karachatau Mountains. In: Proceedings of Central Asian State University, 8 (13), pp. 1–68. Tashkent.

Kultiasow, M.V. (1923) Essay on the vegetation of the Pistalitau Mountains. In: Proceedings of the Turkestan Scientific Society, 1, pp. 89–102. Tashkent.

Kurbonov, A. & Pimenov, M.G. (2016) The Umbelliferae of northern Tajikistan: annotated checklist. *Aegopodium–Galagania*. Botanicheskii Zhurnal, 101(10), 1220-1239.

Lipsky, V.I. (1905) Flora of Central Asia, i.e., Russian Turkestan, and the Khanates of Bukhara and Khiva. Part III. Botanical Collections from Central Asia. Gorold, St. Petersburg.

National Strategy for Biodiversity Conservation in the Republic of Uzbekistan for the period of 2019–2028. Digital resource available at: https://lex.uz/docs/4372841

Orsenigo, S., Cambria, S., Khabibullaev, B.S., et al. (2022) Global and Regional IUCN Red List Assessments: 13. Italian Botanist, 13, 85–94. DOI: 10.3897/italianbotanist.13.86714

Pimenov, M.G. (2020) Updated checklist of the Umbelliferae of Middle Asia and Kazakhstan: nomenclature, synonymy, typification, distribution. Turczaninowia, 23 (4), 127–257. DOI: 10.14258/turczaninowia.23.4.12

Plantarium (2007–2025) Plants and Lichens of Russia and Adjacent Countries: Open Online Atlas and Plant Identifier. Digital resource available at: https://www.plantarium.ru/

Rakhimova, T., Rakhimova, N., Beshko, N., et al. (2021) Current state of coenopopulations of some rare endemic species in Navoi Region, Uzbekistan. Ekologia (Bratislava), 40(4), 357–363. DOI: 10.2478/eko-2021-0037

Sennikov, A.N. (Ed.) (2016) Flora of Uzbekistan, vol. 1. Navro‘z Publishers, Tashkent.

Sennikov, A.N. (Ed.) (2017) Flora of Uzbekistan, vol. 2. Navro‘z Publishers, Tashkent.

Sennikov, A.N. (Ed.) (2019) Flora of Uzbekistan, vol. 3. Ma’naviat Publishers, Tashkent.

Sennikov, A.N. (Ed.) (2022) Flora of Uzbekistan, vol. 4. Fan Publishers, Tashkent.

Sennikov, A.N. (Ed.) (2023a) Flora of Uzbekistan, vol. 5. Fan Publishers, Tashkent.

Sennikov, A.N. (Ed.) (2023b) Flora of Uzbekistan, vol. 6. Ma’naviat Publishers, Tashkent.

Seregin, A. (2025) Moscow University Herbarium (MW). Version 1.385. Lomonosov Moscow State University. Occurrence dataset. Digital resource available at: https://doi.org/10.15468/cpnhcc

Thiers, B. (2016) Index Herbariorum: a global directory of public herbaria and associated staff. Digital resource available at: https://sweetgum.nybg.org/science/ih/

Tojibaev, K.Sh. & Beshko, N.Yu. (2007) Cadastre of Rare and Endemic Plants of Jizzakh and Navoi Regions of the Republic of Uzbekistan. In: Biodiversity of Uzbekistan – Monitoring and Use, pp. 200–208. Chinor ENK, Tashkent.

Tojibaev, K.Sh. & Beshko, N.Yu. (2015) Reassessment of diversity and analysis of distribution in *Tulipa* (Liliaceae) in Uzbekistan. Nordic Journal of Botany, 33, 324–334.

Tojibaev, K.Sh., Beshko, N.Yu., Popov, V.A. (2016) Botanical-Geographical Zoning of Uzbekistan. Botanicheskii Zhurnal, 101 (10), 1105–1132.

Tojibaev, K.Sh., Beshko, N.Yu., Popov, V.A., et al. (2017) Botanical Geography of Uzbekistan. Korea National Arboretum, Pocheon, Republic of Korea.

Tojibaev, K.Sh., Beshko, N.Yu., Kodirov, U.Kh., et al. (2018) Cadastre of the Flora of Uzbekistan: Samarkand Region. Fan Publishers, Tashkent.

Tojibaev, K.Sh., Beshko, N.Yu., Shomurodov, Kh.F., et al. (2019). Cadastre of the Flora of Uzbekistan: Navoi Region. Fan Publishers, Tashkent.

Tojibaev, K.Sh., Beshko, N.Yu., Shomurodov, Kh.F., et al. (2020) Cadastre of the Flora of Uzbekistan: Bukhara Region. O’qituvchi, Tashkent.

Tojibaev, K.Sh., Beshko, N.Yu., Esankulov, A.S., et al. (2021) Cadastre of the Flora of Uzbekistan: Jizzakh Region. Zamin Nashr, Tashkent.

Tojibaev, K., Beshko, N., Mirzalieva, D., et al. (2022). Type Collection of the National Herbarium of Uzbekistan (TASH). Institute of Botany of the Academy of Sciences of the Republic of Uzbekistan. Occurrence dataset. Digital resource available at: https://www.gbif.org/dataset/0c1237c3-be8c-498b-bb2d-d5cf3c930dec

Turdiboev, O.A., Rouhan, G., Allamurotov, A.L. et al. (2022) Contribution of French explorers to the study of Middle Asian flora: the herbarium collections by Guillaume Capus (1857–1931). Adansonia, ser. 3, 44 (22), 229–301. DOI: 10.5252/adansonia2022v44a22

Turdiev, D.E., Selyutina, I.Yu., Gaziev, A.D. et al. (2023) Distribution and Assessment of the Condition of Rare Species of *Oxytropis* DC. in the Flora of Uzbekistan. Flora and Vegetation of Asian Russia, 3, 255–270. DOI: 10.15372/RMAR20230304

UNEP-WCMC & IUCN (2025). Protected Planet: The World Database on Protected Areas (WDPA) and World Database on Other Effective Area-based Conservation Measures (WD-OECM). Digital resource available at: https://www.protectedplanet.net

Valkova, O.A. (2006) Olga Aleksandrovna Fedtschenko, 1845–1921. Nauka, Moscow.

Valkova, O.A. (2020) Olga Fedtschenko – explorer of the Turkestan region: on the 175th anniversary. IOP Conferencce Series: Earth and Environmental Science, 579, 012176. DOI: 10.1088/1755-1315/579/1/012176

Virtual herbarium of Komarov Botanical Institute RAS (2025) Digital resource available at: https://en.herbariumle.ru/

Volis, S. & Beshko, N. (2023) How to preserve narrow endemics in view of climate change? The Nuratau Mountains as the case. Plant Diversity of Central Asia, 2(2), 82–101. DOI: 10.54981/PDCA/vol2_iss2/a3

Zakirov, K.Z. (1961, 1962) Flora and vegetation of the Zeravschan River basin. Vol. 1–2. Publishing House of the Academy of Sciences of the Uzbek SSR, Tashkent.

Zakirov, P.K. (1969) Vegetation cover of the Nuratau Mountains. Fan Publishers, Tashkent.

Zakirov, P.K. (1971) Botanical geography of the low mountains of Kyzylkum and the Nuratau Range. Fan Publishers, Tashkent.

Zakirov, P.K. & Norbobaeva, T. (1974) Useful plants of the Nuratau Range. In: Distribution and natural resources of useful plants of Uzbekistan, pp. 163–197. Fan Publishers, Tashkent.

Submitted: 13 March 2025

First decision: 17 April 2025

Accepted: 24 October 2025

Published online: 2 December 2025

Edited by Lorenzo Peruzzi