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2 monocotyledonous plant and biogeographical analysis
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ABSTRACT

The composition of monocotyledonous geophytes of the Fergana Valley, one of the most densely populated regions of Middle Asia, consisting of 206 species, 27 genera, and 10 families was documented. Among them, four species were detected for the first time in the Uzbekistan flora and eight species were added to the composition of the mountain ridges surrounding the valley. The major families are *Amaryllidaceae* (84; 40.77%), *Liliaceae* (63; 30.58%), *Iridaceae* (22; 10.67%), and *Asphodelaceae* (13; 6.46%). The flora is dominated by the Mountain Middle Asian elements—136 species that are 67% of all monocotyledonous geophytes of the Fergana Valley. Forty-five species are endemic or subendemic species of the Fergana Valley. Twenty-two species of them are included in *The Red Data Book of the Republic of Uzbekistan* (2009).

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Q3 Introduction

The Fergana Valley is an intermountain trough covering an area of about 22,000 km². Including the surrounding mountains, it covers up to 80,000 km² and is located mostly in Uzbekistan, Kyrgyzstan, and Tajikistan. The valley is rimmed by mountain ridges: the Kurama and Chatkal in the northwest, the Fergana in the northeast, and the Turkestan and Alay in the south. The surrounding ridges reach 5000 m above sea level. There are deserts and sites with high salinity (solonchaks) in the central parts.

The Fergana Valley is one of the most densely populated regions of Middle Asia. One of the major issues in the Fergana Valley is the conservation of natural landscapes. For centuries, the valley ecosystems have entirely been under the pressure of anthropogenic impacts. Before the beginning of the 20th century, the impact of economic activities was inconsiderable due to low population density and traditional land use techniques. But, for the last decades, the human impact on the environment has grown considerably and resulted in diminished local plant diversity, landscape monotony, and extinction of populations of endemic and rare

species. A striking example is the current status of highland pastures of the Betagalik tracts of the Kurama Ridge, the mid-mountain parts of the Chadak, Chorkesar River basins. Invasive species are becoming critical (Mahkamov 2009). The main threats to the plant diversity of the Fergana Valley are the degradation and loss of important habitats and desertification as a result of anthropogenic impacts. The negative impacts of anthropogenic factors especially affect the populations of geophytes. The situation is aggravated by the fact that the Fergana Valley currently has only one preserve (The Sari-Chelek Preserve, Kyrgyzstan) and four national natural sanctuaries with a total area of 3000 hectares. Those specially protected natural territories are where a representative portion of the local biodiversity gene bank could be preserved.

The botanical study of the Fergana Valley has a long history. In 1892, Korzhinsky attempted to study the distribution of vegetation in the Fergana Valley. He published the results of his observations in a little essay under the name of “Fergana” (1892). Subsequent studies were also devoted to the study of the vegetation cover in different parts of the region (Afanasiev 1956; Bondarenko 1956; Drobov 1925; Knorring and Minkvits 1912 and etc.). The most significant work, devoted to the investigation of the Fergana Valley vegetation, is the monograph by Arifkhanova (1967). In her work, she managed to generalize the results of previous studies and show the vegetative diversity of the Fergana Valley at that time.

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In contrast to the definition of geobotanical studies, the investigation of floral diversity received little attention. Despite the fact that botanical studies were carried out for more than one hundred years, there was no single list of plants species for the Fergana Valley and no list of threatened or endemic species. Arifkhanova (1967) mentioned 2625 species. However, she did not publish a checklist, and what is more, those data have significantly become out of date. The taxonomic research in the last two decades has considerably extended the list of the valley flora with new species to the flora of Kyrgyzstan (Lazkov and Sultanova 2011) and Uzbekistan (Tojibaev and Karimov 2011; Tojibaev 2009a, 2009b); the new species to science (Khassanov and Fritsch 1994, 2008; Tojibaev 2009a, 2009b, 2010); and even a new monotypic genus (Pimenov et al 2011).

This study was implemented as a project for the development of a new botanical-geographical regionalization scheme of Uzbekistan (Tojibaev et al 2016) and for the creation of a united database of plant diversity in the country (Tojibaev et al 2014). Our research found 84 species of *Allium* L. in the flora of the Fergana Valley. By Khassanov (2008), in the mountainous territory of Middle Asia (Mountainous Middle Asian Province—according to Kamelin 1973), 137 species are known.

This means that in such a small area as the Fergana Valley, there are more than 60% of all species of *Allium* of Mountainous Middle Asia. According to Vvedensky (1941), Uzbekistan's flora includes 20 species of *Eremurus* M. Bieb. Taking into account the latest findings obtained by Tojibaev (2008, 2009a, b), the total number of species of this genus is 26. Of these, 13 species grow in the Fergana Valley, and all of them are endemic to the Mountainous Middle Asian Province. Similar examples can be given with respect to the species of the following genera: *Tulipa* L., *Gagea* Salisb., *Juno* Tratt, etc. The primary goal of this study is to illuminate the Fergana Valley flora as one of the little-studied areas in Middle Asia. At the first stage of the research, it was decided to identify the composition of wild geophytes which in the Fergana Valley vegetation are represented by a great number of endemic and endangered species. Therefore, the main purpose of our work is to make a list of geophytes occupying the territory of the Fergana Valley, to carry out a geographical analysis, and to determine the significance of the Central Asian endemic geophytes.

Material and methods

Study area

According to botanical-geographical classification, the Fergana Valley mountain territory comes under the Mountain Middle Asian Province and consists of three regions: the Fergana (the South Chatkal, Sari-Chelek, Arslonbob, Ketmen-Tepe districts); the Fergana-Alay (the West Alay and East Alay districts); and the Akhangaran (Akhangaran, Arashan, and Chorkesar districts). Mogoltau, the Kuhistan Region (Zarafshan and Turkestan Ridges), is extensive in total area, and within the Fergana Valley is represented by a part of North Turkestan district that includes the northern slopes of the Turkestan Ridge (Kamelin 1973; Tojibaev et al 2016). The Turan desert province is in the flat part of the valley.

The xerophilous versions of almost all types of Middle Asian vegetation are represented here. The large parts of vegetation types combine both the arid (desert) types: the halophilous, psammophilous, xerophilous, and gypsophilous subshrubs and the group of damp types with fruit tree, walnut tree, and coniferous tree forests.

The following abbreviations for floristic region and floristic districts are accepted in the flora list (Appendix 1) and geographic position of the Fergana Valley (Figure 1):

Floristic region: West Tian-Shan—WT, Pamir-Alay—PA, Mountain Middle Asian—MMA, Middle Asian—MA, Mediterranean—MED, Palearctic—PAL.

Floristic districts: Arashan district—Arash., Arslonbob district—Arsl., East Alay district—East-AL, East Fergana district—East-Fer., West Alay district—West-AL, Kayrakkum-Yazyavan district—Kayr-Yaz., Kurama district—Kur., Mogoltau district—Mog., Sari-Chelek district—S-Chel., North Turkestan district—North-Turk., Chorkesar district—Chork., South Chatkal district—South-Chatk.

Research devoted to the identification of geophytes of the Fergana Valley was conducted from 2008 to 2012. Field data collection began in the spring of 2008 in the Kurama Range foothills, and later there were studies carried out in the southern slopes of the Kurama Range (Chadaksay and Chorkesar). Since 2011, the flora was investigated for the purpose of botanical and geographical region characterization of Uzbekistan and the creation of a database of plant diversity. Therefore, this study will cover all ranges surrounding the Fergana Valley.

During the period of study, more than 2100 herbarium samples were collected, identified, and deposited in TASH. Previously collected samples were reexamined. As a result of this work, more than 1500 herbarium specimens belonging to 10 families—Liliaceae, Xanthorrhoeaceae, Iridaceae, Orchidaceae, Asparagaceae, Ixiolirionaceae, Colchicaceae, Amaryllidaceae, Araceae, Hemerocallidaceae—were reexamined at TASH. Data on herbarium vouchers in TASH and those collected by the authors were entered into the database. Thus, a database for all herbarium geophytes was established for the Fergana Valley.

Specimens were identified primarily using the “Flora of Uzbekistan” (1941–1963); “Flora of Kyrgyzstan” (1950–1970); “Flora of Tajikistan” (1957–1991); and “Conspectus Florae Asiae Media” (1963–1993). For the species of *Allium* (Khassanov 2008), *Gagea* (Levichev 1999), and *Tulipa* (Tojibaev and Beshko 2014), appropriate literature was used.

The checklist of plant taxa contains the names of families, genera, species, distribution on mountain ridges, and botanical-geographic classification.

New records for the Uzbekistan flora are indicated (*Allium lutescens*, *Allium petraeum*, *Eremurus altaicus*, and *Iris alberti*). They are triple asterisked in the flora list (***). New records have also been discovered for the Chatkal (*Allium chinense*); Fergana (*Allium galanthum* and *Allium tianschanicum*); and Kurama (*Allium eriocolium*, *Allium tschimganicum*, *Iris loczyi*, and *Iris songarica*) ridges and Mogoltau (*Allium popovii*).

During field research, live material was collected (bulbs, rhizomes, tubers, and geophyte seeds) which helped to create the live collection of geophytes in the Botanic Garden of the Institute of Plant and Animal Life Gene Bank.

Results and discussion

The checklist of geophytes was based on the author's personal collections (2008–2012); herbarium material kept in TASH since 1908 (over 20,000 specimens); the latest publications on new species to science, and processing of monographs and includes 13 families, 29 genera, and 206 species (Table 1).

The monocotyledonous geophytes of the Fergana Valley come under two subclasses of Taktajyan's system (1997)—Liliidae Takht. (12 families, 27 genera, and 204 species) and Aridae Takht. (1 family, 2 genera, and 2 species). The morphologically variable families are Amaryllidaceae (86 species; 41.74%); Liliaceae (63; 30.58%); Iridaceae (22; 10.78%), and Xanthorrhoeaceae (14; 6.96%). These four families constitute 89.90% of all species (185 species). Each of the remaining families includes one to three species (26 species; 12.93%). The genera with the highest number of species are

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