

## Endemic and subendemic species in the early spring flora of the northeastern part of the Lesser Caucasus

Aynur A. Bayramova<sup>1</sup>

Ganja State University, H. Aliyev avenue 429, Ganja, Azerbaijan,  
AZ2000

Farida V. Pashayeva

Azerbaijan State Agrarian University, Ataturk avenue, 450, Ganja,  
Azerbaijan, AZ2000

**Abstract:** Endemism and subendemism of the early spring flora of the north-eastern part of the Lesser Caucasus were studied. In total, early spring flora of the north-eastern part of the Lesser Caucasus is represented by five species of endemics (*Tulipa schmidtii*, *Allium szovitsii*, *Neotorularia eldarica*, *Viola caucasica* and *Primula woronowii*) belonging to five genera and five families, and ten species of subendemics (*Gagea alexeenkoana*, *Tulipa eichleri*, *Lilium ledebourii*, *Ornithogalum sintenisii*, *Scilla caucasica*, *Muscari caucasicum*, *Iris grossheimii*, *Iris demetrii* and *Iris caucasica*) belonging to ten genera and four families. These endemic and subendemic species were characterised according to the study area, occurrence, life forms and geographical elements.

**Keywords:** cryptophyte, endemic, ephemeral, geophyte, subendemic

### INTRODUCTION

Strong influence of human on planet's environment is now generally recognized [Lewis and Maslin, 2015]. As a result of human activity, the planet faces environmental changes such as fragmentation, loss of habitat, spills or releases, various pollutants, and climate change [Camill, 2010]. The study of rare, endemic and subendemic species always was in the focus of the botanical studies. With over 2700 endemic plant taxa, including relic species, the Caucasus region is one of the most beautiful and important biodiversity hotspots in the world [George et al., 2014]. There are 17 mono- or oligotypic endemic or subendemic genera in the flora of the Caucasus [Gagnidze et al., 2002]. Identification and conservation of endemic and subendemic species is a priority for each country [Convention..., 1992].

The northeastern part of the Lesser Caucasus is distinguished for its richness and diversity of vegetation [Gadjiyev et al., 1990]. This is mainly closely related to

the genesis, ways of formation, and physical-geographical conditions of the flora. The northeastern part of the Lesser Caucasus is one of the centers of speciation and is of great importance.

The main reasons for the occurrence of endemics and subendemics in different floristic areas are considered to be long-term isolation of the area, the role of the Caucasian mountains in the process of speciation, the complexity of the area and the conditions of the climate. These shown contribute to the intensive microevolutionary processes. Despite numerous publications on the endemism of the Caucasus, information about the distribution of endemics and subendemics of the Lesser Caucasus is extremely contradictory, sometimes subjective, due to different interpretations of the concept of "endemic". The most complete information about endemism is provided in a number of publications [Novikoff, Hurdu, 2015], including the Caucasus [Kharadze, 1970; Gagnidze 2022], and in Azerbaijan by G.F. Akhundov [1973], S.H. Musayev [2005], Gadjiyev [2008], A.M. Askerov [2014]. Endemics and subendemics found in the early spring flora of the northeastern part of the Lesser Caucasus were identified by us for the first time. In this regard, the main goal was to study the identified species and analyze their characteristics and distribution.

### MATERIAL AND METHODS

The northeastern part of the Lesser Caucasus covers a large area in the western part of Azerbaijan. This area includes certain territories of five administrative districts (Gadabey, Dashkasan (as a whole), mountainous areas included on the northeastern slope of Goygol, Shamkir, Tovuz districts). The research territory is bordered by the plains of Shamkir, Tovuz, Goygol districts to the north, Kalbajar district and the lands of Goranboy district to the east, and partly in the west and south with neighbor country [Gadjiyev et al., 1990]. The area of the northeastern slope of the Lesser Caucasus has a different orographic structure. The Shahdag and Murovdag ridges pass through the southern part of the territory [Gadjiyev, 2004].

Many processes in the area are directly involved in

<sup>1</sup>E-mail: abayramova@rambler.ru

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the soil formation process. Relief indirectly affects the soil formation process by influencing the composition and density of vegetation [Mammadov, 2007]. The thickness and productivity of the soil varies (in plain and mountainous area [Grossheimi, 1948]. Steep peaks, deep valleys, heavily dissected mountain slopes and watersheds are more common in the region. Such an observed relief was formed as a result of long-term joint action of endo-and exogenous processes. The climate of the northeastern slope of the Lesser Caucasus is different depending on the general geographical conditions and changes in relation to the vertical zones. The climatic conditions of the area are formed under the influence of various factors. The study area has a complex geomorphological structure and different types of climate [Ibadullayeva, Yusifov, 2022]. The diversity of the soil-climate and physical-geographical conditions of the Lesser Caucasus create conditions for the development of different types of plant groupings [Grossheim, 1948; Портениер, 2000].

The analysis of the endemic flora was carried out in 2020-2022, using the route and stationary method. During this period, 46 field trips were conducted in different directions. The study was carried out in early spring (February, March, April) in different districts. Collected herbarium specimens were identified based on available literature [Flora..., 1950-1961; Conspectus..., 2003-2012] and deposited to the the herbarium of the Institute of Botany of MES (BAK), Azerbaijan State Agrarian University and Ganja State University.

## RESULTS AND DISCUSSION

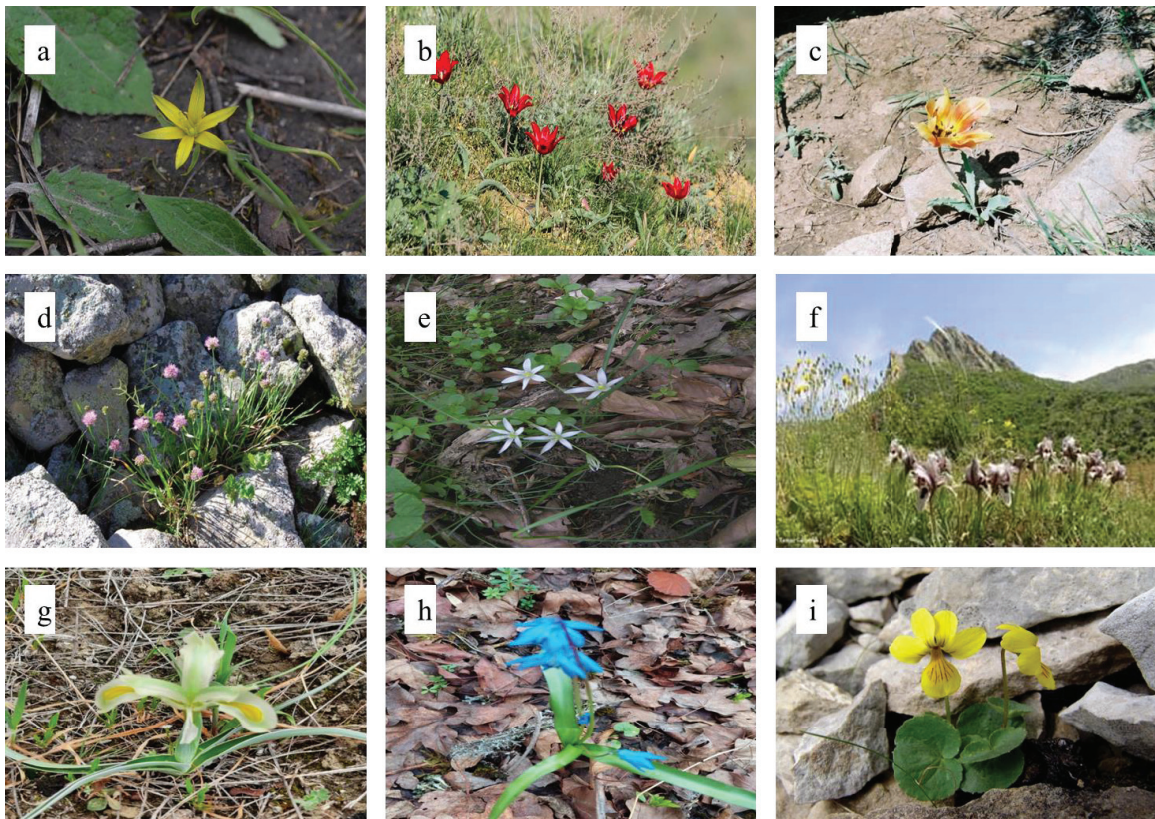
As a result of the conducted research, five species of endemics belonging to five families and five genera and 10 species of subendemics belonging to four families and 10 genera are found in the northeastern part of the Lesser Caucasus. Species belong to Liliaceae Juss., Alliaceae J. Agardh, Hyacinthaceae Batsch ex Borkh., Iridaceae Juss., Orchidaceae Juss., Brassicaceae Burnett, Violaceae Batsch and Primulaceae Vent families (Tab. 1).

The endemic species shown in table 1, despite their low occurrence, play a key role in the formation of autochthonous and allochthonous flora. As a result of the research it was determined that Liliaceae, Iridaceae, Hyacinthaceae families are represented by quite isolated and highly specialized endemics and subendemics in the Lesser Caucasus. The genera *Lilium* L., *Allium* L., *Scilla* L., *Muscari* Mill, *Iris* L., *Primula* L., *Viola* L. are rich in endemics and subendemics. *Tulipa* L., *Gagea* Salisb., *Ornithogalum* L., *Cephalanthera* Rich., *Neotorularia* Hedge & J. Leonard genera are mainly represented by critical species.

In the study area, *Tulipa eichleri* Regel is a rare species of Azerbaijan belongs to the “Vulnerable” category and accessed as A2c +3c. *T. schmidtii* is a rare species belongs to the “Near Threatened” category and accessed as NT. *Lilium ledebourii* is rare in the category “Endangered”, accessed as A2c, Caucasian endemic. *Scilla caucasica* (Fig. 1a) belongs to “Endangered” category (EN B2ab (i,ii,iii)) and Caucasian endemic species, *Iris grossheimii* and *I. demetrii* belong to “Vulnerable” category (A2c +3cd), but *I. caucasica* to “Near Threatened” category (NT).

**Table 1.** Endemics and subendemics of the early spring flora of the northeastern part of the Lesser Caucasus.

Family	Species	Flowering	endemic	subendemic
Liliaceae	<i>Gagea alexeenkoana</i> Miscz.	III-IV		+
	<i>Tulipa eichleri</i> Regel	III-V		+
	<i>Tulipa schmidtii</i> Fomin	III-IV	+	
	<i>Lilium ledebourii</i> Boiss.	IV-VI		+
Alliaceae	<i>Allium szovitsii</i> Regel	III-IV	+	
Hyacinthaceae	<i>Ornithogalum sintenisii</i> Freyn	III-V		+
	<i>Scilla caucasica</i> Miscz.	III-IV		+
	<i>Muscari causicum</i> (Griseb.) Baker	III-V		+
Iridaceae	<i>Iris grossheimii</i> Woronow ex Grossh.	III-IV		+
	<i>Iris demetrii</i> Achv. & Mirzoeva	III-IV		+
	<i>Iris caucasica</i> Hoffm.	III-IV		+
Orchidaceae	<i>Cephalanthera caucasica</i> Kraenzl.	IV		+
Brassicaceae	<i>Neotorularia eldarica</i> (Grossh.) V.E. Avet.	IV-V	+	
Violaceae	<i>Viola caucasica</i> Kolenati	III-V	+	
Primulaceae	<i>Primula woronowii</i> Losinsk.	III-VI	+	



**Figure 1.** Endemics and subendemics of the Lesser Caucasus: a. *Gagea alexeenkoana* b. *Tulipa eichleri* c. *Tulipa schmidtii* d. *Allium szovitsii* e. *Ornithogalum sintenisii* f. *Scilla caucasica* g. *Iris grossheimii* h. *Iris caucasica* i. *Cephalanthera caucasica*.

*Viola caucasica* referred to “Endangered” category (B2ab(1,III,IV)), rare species of Azerbaijan [Bayramova, Rzayeva, 2021]. There are many disputed issues by some researchers regarding the status of the listed species [Askerov, 2014]. Thus, with some exceptions, most species are treated as independent taxa. This is related to the diagnostic variability of some signs of those species. Most of the endemic species, except for the lower mountain zone, are almost singly found in the middle and high mountain zone. In the Lesser Caucasus, five species out of 30 endemic species and 10 species out of 48 subendemic species are found in the early spring flora.

Comparative analysis of the geographical elements including the habitat types of the species was carried out in order to determine the geographical structure of the floristic complexes in the early spring flora. Modern range of species of Caucasian origin can be considered a reserve for the protection of the local gene pool. Due to the richness of the species composition, the Caucasian complex is one the important hotspots. Caucasian elements are very diverse both in terms of ecological

characteristics and distribution. Endemic species can be divided into the Caucasian element, and subendemic species into the Iran-Turanian, Mediterranean and Caucasian complexes [Portenier, 2000].

As a result of the analysis of the distribution of endemic and subendemics in altitudinal zones, it was determined that the largest number of them is concentrated in the middle mountain zone. In the upper mountain zone, endemics are slightly less, and in the lower mountain zone, the percentage of occurrence is lower. Other migratory species are also found in the middle zone. Among the endemics discovered by us *Neotorularia eldarica* is annual, therophyte and *Tulipa schmidtii*, *Allium szovitsii* are bulbous perennials, cryptophytes, *Viola caucasica* is taproot perennial, hemicryptophyte (ephemeroid), *Primula woronowii* is perennial hemicryptophyte herb. Among subendemics *Gagea alexeenkoana*, *Tulipa eichleri*, *Lilium ledebourii*, *Ornithogalum sintenisii*, *Scilla caucasica*, *Muscari causicum* are bulbous perennials, cryptophytes (geophytes), *Iris grossheimii*, *I. demetrii*, *I. caucasica* are short-rhizomatous perennials, cryptophytes,

*Cephalanthera caucasica* is rhizomatous perennial, cryptophyte (geophyte) herb forming tubes.

Microevolutionary process and climatic conditions in the Lesser Caucasus lead to the formation of a large number of endemic taxa in the area. The study of the nature of the preservation of endemic species in different habitats showed that most of them grow in the alpine and subalpine zone, rock crevices, meadows, stony and gravelly foothills, stony areas. In contrast, *Lilium ledebourii*, *Iris demetrii*, *Primula woronowii* are found in humid places in the middle and high mountain zones, in shady forests, on the banks of rivers, in bushwoods, on the edges of lakes and ponds. However, it should be noted that some species occur in two or more community types and such species are considered important. Analysis of the distribution and habitats of these species allows identifying several large centers of concentration of endemics. It should be noted that more than half of the Lesser Caucasus endemics are related by origin. Endemics and subendemics are mainly of Iranian, Iberian, Turanian and Albanian origin. Endemics of Hirkan, Dagestan and Asia Minor origins are not found here [Bayramova, 2015].

In the study area, the endemic species associated with the Iberian center are characteristic of the southern macroslope of the Caucasus range, but sometimes they enter the northern part in suitable habitats. These include *Scilla caucasica*, *Ornithogalum sintenisii* and others. A number of species are also characterized by limitation in the northern macroslope. These are endemics with different origins and phylogenetic relationships. *Allium szovitsii*, *Gagea alexeenkoana* can be shown.

Thus, as a result of the analysis of literature data, herbarium materials and research conducted, the endemic and subendemic species of the early spring flora of the Lesser Caucasus was determined and characterised. These species belong mostly to xerophytes according to ecological groups, and to perennial herbs according to their life forms. Assessment of the species in need of protection, development of a system of additional measures for the protection of endemic and subendemic species in their natural habitats are recommended.

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### **Kiçik Qafqazın şimal-şərq hissəsinin erkən yaz florasının endemik və subendemik növləri**

**Aynur A. Bayramova**

*Gəncə Dövlət Universiteti, H.Əliyev prospekti 429, Gəncə, Azərbaycan*

**Fəridə V. Paşayeva**

*Azərbaycan Dövlət Aqrar Universiteti, 450, Atatürk prospekti, Gəncə, AZ2000, Azərbaycan*

Kiçik Qafqazın şimal-şərq hissəsinin erkən yaz florasının endemizmi və subendemizmi tədqiq edilmişdir. Ümumilikdə, Kiçik Qafqazın şimal-şərq hissəsinin erkən yaz florası beş cins və beş fəsiləyə aid olan beş növ endemik (*Tulipa schmidtii*, *Allium szovitsii*, *Neotorularia eldarica*, *Viola caucasica* və *Primula woronowii*), on cinsə və dörd fəsiləyə aid on növ subendemik (*Gagea alexeenkoana*, *Tulipa eichleri*, *Lilium ledebourii*, *Ornithogalum sintenisii*, *Scilla caucasica*, *Muscari caasicum*, *Iris grossheimii*, *Iris demetrii*, *Iris caucasica* və *Cephalanthera caucasica*) ilə təmsil olunur. Bu endemik və subendemik növlər tədqiq olunan ərazi, rast gəlməsi, həyat formaları və coğrafi elementlərə görə səciyyəvləndirilmişdir.

**Açar sözlər:** *kriptofit, endemik, efemer, geofit, subendemik*

**Эндемичные и субэндемичные виды  
ранневесенней флоры северо-восточной части  
Малого Кавказа**

**Айнур А. Байрамова**

Гянджинский государственный университет, пр. Г.Алиева 429,  
Гянджа, Азербайджан, Az2000

**Фарида В. Пашаева**

Азербайджанский Государственный Аграрный Университет,  
пр. Атаюрка 450, Гянджа, Азербайджан, Az2000

В статье приведены результаты исследования пяти видов эндемиков (*Tulipa schmidtii*, *Allium szovitsii*, *Neotorularia eldarica*, *Viola caucasica* и *Primula*

*woronowii*) принадлежащих к пяти семействам и пяти родам, а также десяти видов субэндемиков (*Gagea alexeenkoana*, *Tulipa eichleri*, *Lilium ledebourii*, *Ornithogalum sintenisii*, *Scilla caucasica*, *Muscari caucasicum*, *Iris grossheimii*, *Iris demetrii*, *Iris caucasica* и *Cephalanthera caucasica*) из четырех семейств из десяти родов. Для изученных видов даны места распространения в исследованных районах, их жизненные формы и принадлежность к географическим элементам.

**Ключевые слова:** криптофит, эндемик, эфемер, геофит, субэндемик