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Floristic analysis of Zagatala State Nature Reserve, Azerbaijan

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ABSTRACT The present paper provides information on the results of floristic, taxonomic, and bioecological research carried out in the expedition organized on May 10–16, 2022 in the Zagatala State Nature Reserve and in the surrounding areas (Azerbaijan). During the expedition, 158 species belonging to 56 families and 105 genera of local vegetation were recorded. According to the analysis of life forms, due to the large number of species, trees dominate with 57 species (36.08%), perennials with 63 species (39.87%), and shrubs with 22 species (13.92%). During this research, 19 species included in 18 genera belonging to 15 families included in the Red Book of Azerbaijan were recorded in the territory of the reserve. Species such as *Petasites albus, Anemonastrum narcissiflorum*, *Malva alcea*, *Ajuga pyramidalis*, *Morus alba pendula*, *Arnebia pulchra*, etc., which are not given for this area, including the flora of Azerbaijan, were discovered and included in the list. The issue of the reserve is the preservation of water-retaining, soil-protecting and resort-climate important mountain meadows and forests in separate zones of the north-eastern part of the Greater Caucasus, and the effective use of the richness of the area's vegetation, where research work on international biological problems is carried out.

KEY WORDS Flora; taxonomic analysis; new record; rare; medicinal plants.

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INTRODUCTION

Zagatala district under study is one of the most fascinating regions of Azerbaijan from a naturalistic point of view.

The first floristic research works in the territory of the reserve were conducted by I.N. Beydman in 1935 (Beideman, 1974), and in later periods, the forest flora of the southern slope of the Greater Caucasus was studied by Prilipko (1954).

The first geobotanical research works in Zagatala Reserve were conducted by academician V.J. Hajiyev in 1952–54, and monographs on the vegetation of this area were published by Gadzhiev (1954; 1970). The department was established in the territory of the reserve for the purpose of conducting scientific research in 1950.

Floristic analysis of the area has not been carried out for many years. For this purpose, monitoring of the vegetation of the area was organized, taxonomic analysis was carried out, and rare and endemic species were identified.

MATERIAL AND METHODS

Study area

Zagatala district is located in the north-west of the Republic of Azerbaijan, in the Ganikh-Eyrichay valley in the southern slope of the Greater Caucasus mountain range. It borders the Republic of Georgia to the south, the Republic of Dagestan to the north, Balakan and Gakh regions to the west and east. The north-eastern part of the district is dominated by mountains, and the south and south-western parts by plain relief. The highest point in the area is Mount Guton (3648 m). The climate is mild in the plains and cold in the mountains. The average temperature in January is -1 °C in the plains, -10 °C in the mountains, and the average temperature in July varies between +24 °C and +5 °C, respectively. Every year 600–1600 mm of precipitation falls here. The district is a mountainous area, almost half of which is covered with forests (National atlas of the Republic of Azerbaijan, 2014; Worldweatheronline).

Zagatala State Nature Reserve, located at an altitude of 650–3646 m above sea level, is one of the oldest reserves of our republic. In 1929, the area of the reserve, located in the territory of Zagatala and Balakan administrative districts, in the east of the southern slope of the central part of the Greater Caucasus Mountains, was 47,349 hectares. The main purpose of creating the reserve was to preserve the irreplaceable soil-protecting and water-retaining properties of these forests, to protect the natural complexes, flora and fauna of the southern slope of the Greater Caucasus. The territory consists of forests, subalpine, alpine meadows and high steep cliffs. As the altitude increases, the climate of the reserve changes from a warm temperate climate to a mountain tundra climate. The lower and middle mountain belts (800–2200 m) are covered with beech, hornbeam and oak forests, and as the altitude increases, they are replaced by subalpine rareness, then subalpine meadows (2400 m), then alpine meadows (up to 3200 m) and finally, replaced by subnival and nival belts. The territory has a very complex and sharp relief. Water-rich rivers such as Mazimchay, Balakenchay and Katekhchay originating from the Greater Caucasus flow from the territory. Here, mountains and highlands are cut by deep valleys and rocky river banks. The northern cliffs with sharp peaks are covered with snow most of the year, and the domed mountains in the southern part are covered with alpine meadows.

The main rivers flowing through the territory of the reserve have created beautiful waterfalls reaching a height of 15–20 meters in the middle mountainous part and impenetrable gorges. The soil cover mainly consists of primitive mountain-meadow, mountain-meadow, mountain-meadow-forest and brown forest soil types (Ismayilov, 2013).

Material

From 10 to 16 May 2022 we conducted an expedition to the territory of the Zagatala State Nature Reserve. The material of this research was the flora and vegetation cover that lives in this area.

In order to study these materials, literary sources, specimens of the Herbarium fund and other information were examined; botanical papers of other researchers such as Gadjiye (1970; 2004), Mammadova & Gurbanov (2013), Ibadullayeva et al. (2014), Ibadullayeva & Yusifov (2022), and others are referred to during our work. Floristic (Flora of Azerbaijan, 1950–1961; Grossheim, 1949), taxonomic (Askerov, 2016; Worldfloraonline), bioecological (Serebryakov, 1964; Beideman, 1974) methods, as well as of stationary organization, were used in this research.

RESULTS AND DISCUSSION

According to literature, Zagatala State Nature Reserve is distinguished by its rich flora and vegetation cover with over 1000 recorded plant species.

The basis of the forests is made up of beech, oak, hornbeam, linden, ash, chestnut, walnut, yew, hooked pine and other species.

The species of trees, shrubs and grasses spread in the area are: *Telekia speciosa*, *Veronica gentianoides*, *Acer platanoides*, *A.campestre*, *A. trautvetteri* (*A. heldreichii* subsp. *trautvetteri*), *Dryopteris filix-mas*, *Petasites albus*, *Corylus avellana*, *Fagus orientalis*, *Cotinus coggygria*, *Populus alba*, *P. nigra*, *P. gracilis*, *Rhus coriaria*, *Urtica dioica*, *Viola odorata*, *Alliaria petiolata*, *Viburnum opulus*, *V. lantana*, *Tilia cordata*, *T. heterophylla* (*Tilia americana*), *Myosotis sylvatica*, *Atropa belladonna*,

Euonymus latifolius, *Sorbus aucuparia*, *Diospyros lotus, Allium ursinum*, *Pulsatilla albana*, *Betula raddeana*, *B. pendula*, *Carpinus betulus*, *Gleditsia triacanthos*, *Fraxinus excelsior*, *Prunus divaricata* (*P. cerasifera*), *Hedera maderensis*, *H. pastuchovii, Symphytum asperum*, *Rubus caesius*, *Sambucus nigra*, *S. ebulus*, *Carum caucasicum*, etc. Herbarium samples of more than 150 plant species with various life forms were taken in the area. Among them there are many protected rare, endemic, endangered trees, shrubs, herbaceous plants, such as *Platanthera chlorantha*, *Paeonia mlokosewitschii*, *Rosa zakatalensis*, *Primula juliae*, *Galanthus caucasicus*, etc. In the composition of the area vegetation, 158 species belonging to 56 families and 103 genera were registered. According to the analysis of life forms, due to the large number of species, trees dominate with 57 species (36.2%), perennials with 63 species (39.9%), and shrubs with 22 species (14.9%) (Fig. 1).

During the conducted expeditions, the higher taxonomic units to which the identified plants belong were determined based on modern to taxonomic classification (Table 1).

As it can be seen from the table, the families with the most genera and species: 13 species on 10 genera on the Rosaceae family, followed by Fagaceae 5 on 4, Apiaceae 7 on 5, Pinaceae 5 on 4, Asteraceae 4 on 4, Betulaceae 6 on 4, Pinaceae 4 on 4, Ranunculaceae 4 on 4, Salicaceae 7 on 2, Malvaceae 10 on 3, Fabaceae 5 on 2, Moraceae 4 on 2, Aspleniaceae 5 on 1, Sapindaceae 5 on 1, Viburnaceae 4 on 2, respectively.

During the study, 19 species included in 18 genera belonging to 15 families listed in the Red Book of Azerbaijan (Red book of the Republic of Azerbaijan flora, 2023) have been registered in the territory of the reserve: 2 species have been categorized as "Near Threatened" (NT); 6 species that are very likely to become extinct in the near future have been categorized as "Endangered" (EN); 5 species are known to occur at a single site, but are not exposed potential threat - these species have been categorized as "Critically Rare" (CR); 6 species are considered to be in high danger of extinction in nature - these species have been categorized as "Vulnerable" (VU). The species of plants such as *Petasites albus*, *Anemonastrum narcissiflorum*, *Malva alcea*, *Ajuga pyramidalis*, *Morus alba pendula*, *Arnebia pulchra*, etc. that were not found in this area, as well as for the flora of Azerbaijan, were discovered and included in the list (Fig. 2).

The species such as *Corylus colurna*, *Hedera pastuchovii*, *Castanea sativa*, *Pterocarya fraxinifolia*, *Zelkova carpinifolia*, *Betula raddeana*, *Taxus baccata*, *Punica granatum*, *Salix caprea*, *Primula juliae*, *Ficus carica* distributed in this area are relict (Askerov, 2014).

The particularly rich flora of our territory has long attracted the attention of scientists, doctors and the population, and many medicinal plants have been and are used for medicinal purposes in folk medicine and medicine. Most of the species collected during the expedition (*Pteridium aquilinum, Ajuga orientalis, Atropa belladona, Lytrum salicaria, Acer platanoides Rododendron caucasucus, Rhododendron luteum, Platanus orientalis, Carum carvi* and etc.) are medicinally important (Fig. 3). Common yew of scientific interest for the flora of Azerbaijan, hooked pine growing in small groves on stony-rocky slopes and ravines and evergreen ornamental plant Caucasian rhododendron (*Rhododendron caucasicum*) and Yellow rhododendron (*Rhododendron lutea*), sometimes called as azalea, "bitter tea" are common in the reserve.

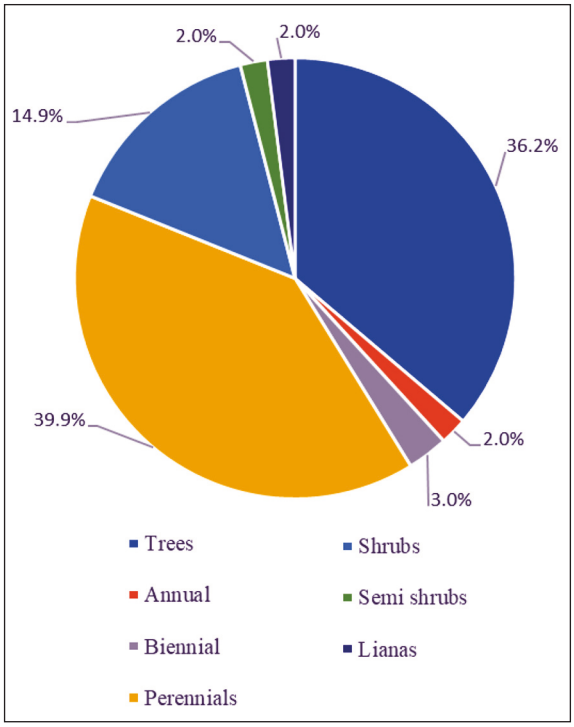


Figure 1. Analysis of area vegetation by life forms.

	Family	Genus	Species
1	SAPINDACEAE	*Acer* L.	*A. platanoides* L.
2			*A. campestre* L.
3			*A. trautvetteri* Medw.
4			*A. velutinum* Boiss.
5			*A. hyrcanum* Fisch. & C.A. Mey.
6	DRYOPTERIDACEAE	*Dryopteris* Adans.	*D. filix-mas* (L.) Schott
7	DENNSTAEDTIACEAE	*Pteridium* Gled.ex Scop.	*P. aquilinum* (L.) Kuhn *(P. tauricum* (C. Presl) V.I. Krecz. ex Grossh.)
8	ERICACEAE	*Rhododendron* L.	*R. caucasicum* Pall.
9			*R. lutea* Sweet.
10	VIBURNACEAE	*Viburnum* L.	*V. opulus* L.
11			*V. lantana* L.
12		*Sambucus* L.	*S. nigra* L.
13			*S. ebulus* L.
14	CORYLACEAE	*Corylus* L.	*C. avellana* L.
15			*C. colurna* L. (*C. iberica* Wittm. ex Kem.-Nath.)
16	ANACARDIACEAE	*Cotynus* Mill.	*C. coggygria* Scop.
17		*Rhus* L.	*R. coriaria* L.
18	SALICACEAE	*Populus* L.	*P. alba* L.
19			*P. nigra* L.
20			*P. gracialis* Grossh
21		*Salix* L.	*S. alba* L.
22			*S. caprea* L.
23			*S. babilonica* L.
24			*S. purpurea* L.
25	TAMARICACEAE	*Tamarix* L.	*T. meyeri* Bunge
26			*T. smyrnensis* Bunge (*T.hohenackeri* Bunge)
27			*T. ramosissima* Ledeb.
28	URTICACEAE	*Urtica* L.	*U. dioica* L.
29			*U. urens* L.
30	VIOLACEAE	*Viola* L.	*V. odorata* L.
31			*V. arvense* Murray
32	BRASSICACEAE	*Alliaria* Scop.	*A. petiolata* (M. Bieb.) Cavara & Grande (*A. officinalis* Andrz. ex DC.)
33		*Pachyphragma*	*P. macrophyllum* (Hoffm.) N. Busch
34	EBENACEAE	*Diospyros* L.	*D. lotus* Lour.
35	OLEACEAE	*Fraxinus* L.	*F. excelsior* L.
36	ORCHIDACEAE	*Platanthera* Rich.	*P. chlorantha* (Custer) Rchb.
37		*Dactylorhiza* Neck. ex Nevski	*D. romana* subsp. *georgica* (Klinge) Soo ex Renz & Taunbenheim (*D. flavescens* (K. Koch) Holub)
38		*Limodorum* Boehm.	*L. abortivum* (L.) Sw.
39	AMARYLLIDACEAE	*Allium* L.	*A. ursinum* L.
40		*Galanthus* L.	*G. alpinus* Sosnowsky *(G. caucasicus*

41	COLCHICACEAE	*Colchicum* L. *(Merendera* Ramond)	*C. raddeanum* (Regel) K. Perss. (*M. raddeana* Regel)
42	LILIACEAE	*Gagea* Salisb.	*G. fragifera* (Vill.) Ehr. Bayer & G. Lopez (*G. anisanthos*)
43		*Lilium* L.	*L. monadelphum* M. Bieb.
44	MALVACEAE	*Malva* L.	*M. silvestris* L.
45			*M. neglecta* Wallr.
46			*M. alcea* L.
47			*M. transcaucasica* Sosn.
48		*Althaea* Grantz	*A. hirsute* Sieber ex Steud.
49			*A. cannabina* L.
50		*Tilia* L.	*T. rubra* subsp. *caucasica* (Rupr.) V. Engl. (*T. caucasica* Rupr.)
51			*T. cordata* Mill.
52			*T. americana* L. (*T. heterophylla* Vent).
53			*T. platyphyllos* Scop.
54	BORAGINACEAE	*Arnebia* Forssk.	*A. pulchra* (Willd. ex Roemer & Schultes) J. Edmondson
55		*Myosotis*	*M. sylvatica* Hoffm.
56			*M. alpestris* F.W. Schmidt
57		*Symphytum* L.	*S. asperum* Lepech.
58	ARALIACEAE	*Hedera* L.	*Hedera pastuchovii* Woronow
59			*Hedera helix* L.
60	ELAEAGNACEAE	*Hyppophae* L.	*H. rhamnoides* L.
61	ASPLENIACEAE	*Asplenium* L. *(Ceterach, Phyllitis)*	*A. trichomanes* L.
62			*A. septentrionale (*L.) Hoffm.
63			*A. ruta muraria* Pappe et Rawson
64			*A. ceterach* L. (*Ceterach officinarum* DC.)
65			*A. scolopendrium* L. (*Phyllitis scolopendria* (L.) Newman)
66	FABACEAE	*Gleditsia* L.	*G. triacanthos* L.
67		*Trifolium* Tourn. ex L.	*T. alpestre* L.
68			*T. pratense* L.
69			*T. fontanum* Bobrov
70			*T. medium* L.
71	SANTALACEAE	*Viscum* L.	*V. album* L.
72	CAMPANULACEAE	*Campanula* L.	*C. alpestris* All.
73			*C. tridentata* Shreb.
74			*C. rapunculoides* L.
75			*C. lactiflora* M. Bieb.
76	PINACEAE	*Pinus* L.	*P. sylvestris* subsp. *hamata* Steven (*P. kochiana* Klotzsch ex. K. Koch)
77		*Abies* Hill	*A. nordmanniana* (Stev.) Spach.
78		*Cedrus* Trew.	*C. libani* A. Rich.
79		*Larix* Hill.	*L. sibirica* Ledeb.
80	PAEONIACEAE	*Paeonia* L.	*P. mlokosewitschii* Lomakin (= *P. daurica* subsp. *mlokosewitschii* (Lomakin) D.Y. Hong)

81	ASPARAGACEAE	*Danae* Medik.	*D. racemosa* (L.) Moench
82		*Yucca* L.	*Y. gloriosa* L.
83	LAURACEAE	*Laurus* L.	*L. nobilis* L.
84	PLATANACEAE	*Platanus* L.	*P. orientalis* L.
85	ASTERACEAE	*Bellis* L.	*B. perennis* L.
86		*Tanacetum* L.	*T. coccineum* (Willd.) Grierson (*Pyrethrum carneum* (Willd.) Worosch.)
87		*Telekia* Baumg.	*T. speciosa* (Schreb.) Baumg.
88		*Petasites* Mill.	*P. alba* (L.) Gaertn.
89	FAGACEAE	*Quercus* L.	*Q. robur subsp. pedunculiflora* (K. Koch) Menitsky (*Q. longipes* Steven)
90			*Q. iberica* M. Bieb.
91		*Fagus* L.	*F. orientalis* Lipsky
92		*Castanea* Mill.	*C. sativa* Mill.
93		*Pterocarya* Kunth	*P. fraxinifolia* (Lam) Spach (*P. pterocarpa* (Michx.) Kunth ex Dippel)
94	ROSACEAE	*Prunus* L.	*P. cerasifera* Ehrh.
95			*P. mahaleb* L.
96			*P. laurocerasus* L. (*Laurocerasus officinalis* M. Roem.)
97		*Rubus* L.	*R. caesius* Bojer
98		*Armeniaca* Scop.	*A. vulgaris* Lam.
99		*Cydonia* Mill.	*C. oblonga* Mill.
100		*Rosa* L.	*R. damascena* Herrm.
101			*R. zakatalensis* Gadzh.
102		*Pyracantha* M.Roem.	*P. coccinea* M. Roem.
103		*Sorbus* L.	*S. aucuparia* Kom
104		*Pyrus* L.	*P. sailcifolia* Pall.
105		*Malus* Mill.	*M. orientalis* Uglitzk.
106		*Mespulis* L.	*M. germanica* L.
107	BIGNONIACEAE	*Catalpa* Scop.	*C. bignonioides* Walter
108		*Campsis* Lour.	*C. radicans* (L.) Bureau (*Tecoma radicans* (L.) Duhamel)
109	ULMACEAE	*Zelkova* Spach	*Z. carpinifolia* (Pall.) Dippel
110		*Ulmus* L.	*U. glabra* Huds.
111	BETULACEAE	*Carpinus* L.	*C. betulus* L.
112		*Betula* L.	*B. raddeana* Trautv.
113			*B. pendula* Roth
114			*B. litwinowii* Doluch.
115		*Alnus* Mill.	*A. glutinosa subsp. barabata* (C.A. Mey.) Yalt. (*A. barbata* C.A. Mey.)
116		*Corylus* L.	*C. colurna* L.
117	MORACEAE	*Morus* L.	*M. alba* L.
118			*M. nigra* L.
119			*M. rubra* L.
120			*M. alba pendula* Sudw.
121		*Ficus* L.	*F. carica* L.

122	LYCOPODIACEAE	*Huperzia* Bernh.	*H. selago* (L.) Bernh. ex Schrank et Mart.
123	WOODSIACEAE	*Woodsia* R. Br.	*W. alpina* (Bolton) Gray
124	TAXACEAE	*Taxus* L.	*T. baccata* L.
125	RHAMNACEAE	*Frangula* Mill.	*F. alnus* Mill.
126	RANUNCULACEAE	*Aquilegia* L.	*A. olympica* Boiss.
127		*Aconitum* L.	*A. nasutum* Fisch. ex G. Don
128		*Pulsatilla* Mill.	*P. albana* Bercht. et Presl
129		*Anemonastrum* Holub	*Anemonastrum narcissiflorum* (L.) Holub (*Anemone narcissiflora*)
130	PAPAVERACEAE	*Corydalis* DC.	*C. alpestris* C.A. Mey.
131	BUXACEAE	*Buxus* L.	*B. sempervirens* L. (*B.colchica* Pojark.)
132	PRIMULACEAE	*Primula* L.	*P. algida* Adams
133			*P. juliae* Kusnez.
134	CANNABACEAE	*Celtis* L.	*C. caucasica* Willd.
135	CELASTRACEAE	*Euonymus* L.	*E. latifolius* (L.) Mill.
136			*E. europaeus* L.
137			*E. leiophloeus* Steven
138	APIACEAE	*Carum* L.	*C. caucasicum* Boiss.
139			*C. carvi* L.
140		*Astrantia*	*A. maxima* Paıl.
141		*Chaerophyllum* L.	*C. aureum* L. (*C. maculatum* Willd. ex DC.)
142			*C. roseum* M. Bieb.
143		*Anthriscus*	*A. cerefolium* Hoffm. (*A. longirostris* Bertol.)
144		*Angelica*	*A. tatianae* Bordz.
145	ONAGRACEAE	*Epilobium* L.	*E. algidum* M. Bieb.
146			*E. palustre* L. (*E. alpinum* L.)
147	SCROPHULARIACEAE	*Scrophularia* L.	*S. minima* M. Bieb.
148			*S. lateriflora* Trautv.
149		*Veronica* L.	*V. gentianoides* Vahl
150	OROBANCHACEAE	*Verbascum* L.	*V. phlomoides* L.
151		*Phelipaea* Tourn. ex L.	*P. coccinea* (M. Bieb.) Poir.
152		*Rhynchocorys* Griseb.	*R. elephas* (L.) Griseb.
153	SOLANACEAE	*Atropa* L.	*A. beladonna* L. (*A. caucasica* Kreyer)
154	LYTHRACEAE	*Lythrum* L.	*L. salicaria* L.
155		*Punica* L.	*P. granatum* L.
156	LAMIACEAE	*Ajuga* L.	*A. pyramidalis* L.
157			*A. orientalis* L.
158			*A. chamaepitys* subsp. *chia* (Screb.) Arcang. (*A. pseudochia* Desjat.-Shost.)

Table 1. Taxonomic spectrum of plants collected from the study area.

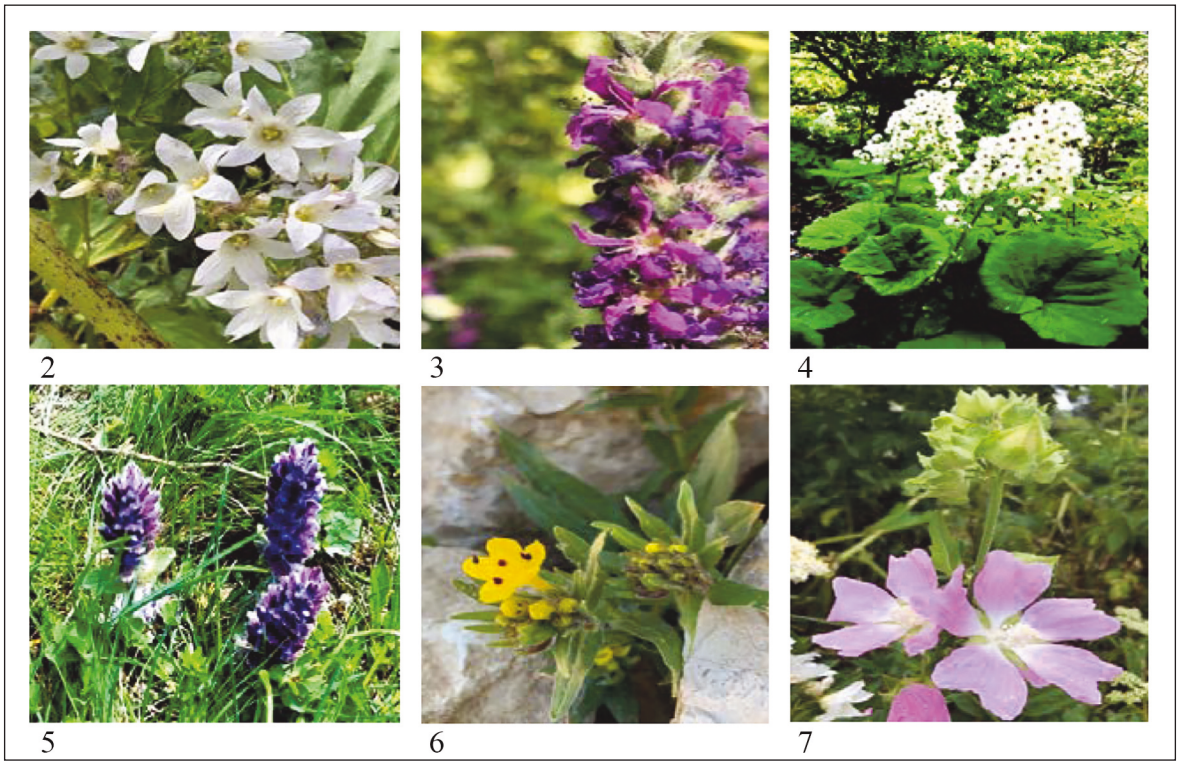
The lower boundaries of the Reserve have descended in many places to the surroundings of the city, towns and villages. Therefore, rare plants of the reserve planted in gardens, parks, roadsides are often found. It is commendable that the areas where rare and endemic species are locally more widespread are protected within the reserve for the improvement and natural regeneration of the forest ecosystem in the region.

The study and importance of medicinal plants spread in our republic is not limited to those mentioned. In the years of independence, studies on the search for new medicinal plants, their raw material sources, natural reserves and effective use has been continued. Important scientific and scientific-experimental results obtained during many years of research once again prove that the medicinal plants of the region are numerous, their chemical composition is rich in biologically active substances, and the reserves of medicinal raw materials are inexhaustible. For the favorable use of these invaluable resources of our territory, it is important and urgent to carry out in-depth and comprehensive study of local flora and vegetation on a scientific basis and to conduct research on the application perspectiveness of useful plants.

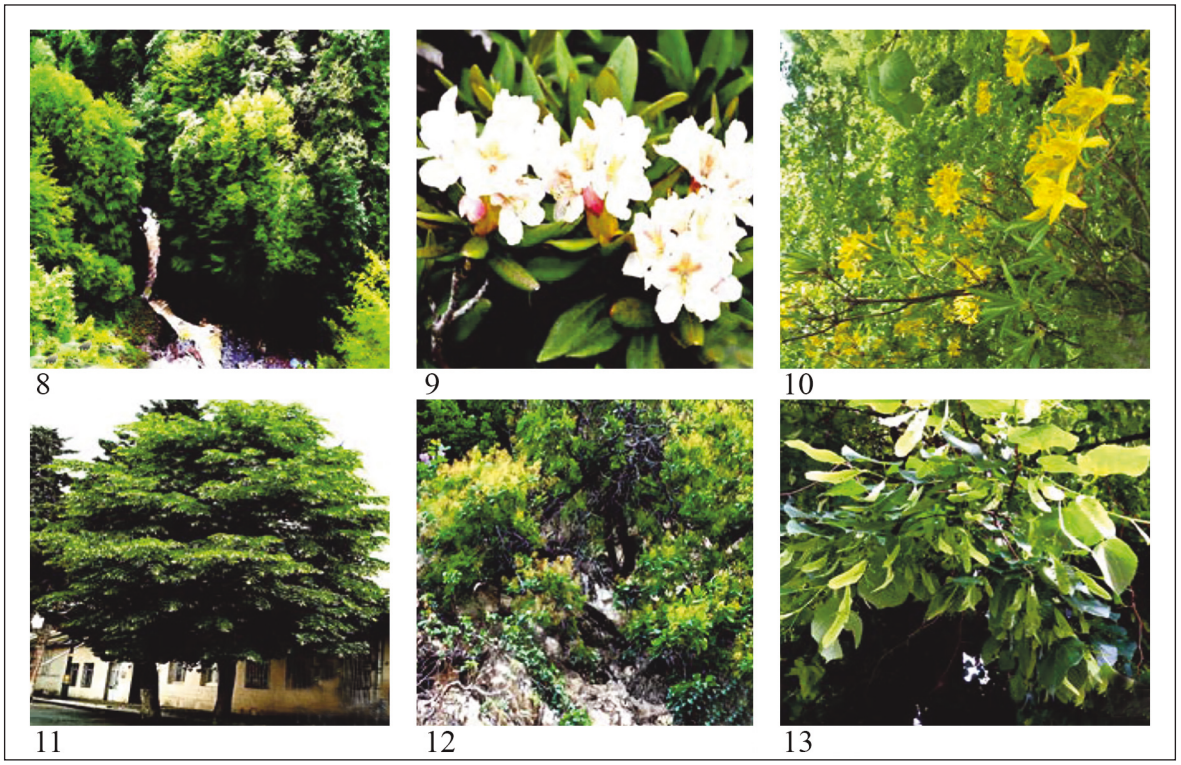
CONCLUSIONS

During the research conducted in the Zagatala State Nature Reserve and the surrounding areas, 158 medicinal, rare, endemic, important for greening, and ornamental gardening included in 56 families and 105 genera were recorded. According to the analysis of life forms, due to the large number of species in the area flora, trees dominate with 57 species (36.08%), perennials with 63 species (39.87%), and shrubs with 22 species (13.92%). Species recorded during the study *Petasites albus, Anemonastrum narcissiflorum*, *Malva alcea*, *Ajuga pyramidalis*, *Morus alba pendula*, *Arnebia pulchra* and the phytocoenoses formed by them were newly added to the flora of the reserve.

In the territory of the reserve, 19 species included in 18 genera belonging to 15 families listed in the Red



Figures 2–7. New records from Zagatala State Nature Reserve, Azerbaijan. Fig. 2: *Campanula lactiflora*. Fig. 3: *Lythrum salicaria*. Fig. 4: *Petasites albus*. Fig. 5: *Ajuga pramidalis*. Fig. 6: *Arnebia pulchra*. Fig. 7: *Malva alcea*.



Figures 8–13. Other botanical species from Zagatala State Nature Reserve, Azerbaijan. Fig. 8: Mixed forest coenosis. Fig. 8: *Rhododendron caucasica*. Fig. 9: *Rhododendron luteum*. Fig. 10: *Acer platanoides*. Fig. 11: *Cotinus coggygria*. Fig. 12: *Tilia cordata* Mill.

Book of Azerbaijan have been registered. The listed *Corylus colurna*, *Hedera pastuchovii*, *Castanea sativa*, *Pterocarya fraxinifolia*, *Zelkova carpinifolia*, *Betula raddeana*, *Taxus baccata*, *Punica granatum* are relict species; *Primula juliae, Salix caprea*, *Primula juliae*, *Ficus carica* are endemic species.

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