



Phytosenological characteristics of *Campanulaceae* juss. Family plants spread in the flora of nakhchivan autonomous republic

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Abstract

Campanulaceae Juss. Family species spread in Nakhchivan Autonomous Republic have been thoroughly studied in 2012-2019 conducted researches. The presented article has been dedicated to the study of the nature of location of each species belonging to *Campanulaceae* family in a separate vegetation type, their spreading in the form of formations, associations and groups. Thus, during the studies it have been clarified that, 2 species [*Campanula latifolia* L., *C. tridentata* Scherb.] of family create formations and association groups. The presence of 6 species [*C. glomerata* L., *C. rapunculoides* L., *C. bononiensis* L., *Asyneuma amplexicaule* (Willd.) Hand. - Mazz., *A. campanuloides* (Bieb. ex Sims) Bornm., *A. rigidum* (Willd.) A. Grossh.] Of family as an edificator species in meadow vegetation type have been found by us during the researches. During the study, the spreading of 2 species [*Michauxia laevigata* Vent. A. pulchellum (Fisch. ET C.A.Mey.) Bornm.] In mountain xerophytic vegetation type, and one of species [*Campanula stevenii* Bieb.] in steppe vegetation type have been found by us. During the studies it have been determined that, 9 species [*C. sclerotricha* Boiss., *C. daralaghezica* (Grossh).Kolak. et Serdj., *C. zangezura* (Lipsky) Kolak. et Serdj., *C. bayerniana* Rupr., *C. coriaceae* P.H. Davis, *C. massalskyi* Fomin, *C. saxifraga* Bieb., *C. karakuschensis* Grossh., *C. propinqua* Fisch. et C.A. Mey] of the family have been found in small microgroups or singly in the rocky and collapsed-sedimented subtype of petrophilous vegetation type.

Keywords: Azerbaijan, Nakhchivan, flora, Campanulaceae family, vegetation type, petrophilous, meadow, formation, association

Introduction

The territory of the Nakhchivan Autonomous Republic is one of the richest places due to its geographical position, nature, fauna and flora diversity in Azerbaijan Republic, as well as in the Caucasus ecological region. The relief and ancient history of autonomous republic territory are among the factors that shape this richness. More than 60 % of 4500 higher plant species distributed in Azerbaijan have been distributed in this region. 176 families, belonging to 908 genera of 3022 plant species have been found in autonomous republic territory, which has a small geographical area. 202 species of these plants are included in the Red Book of the Nakhchivan Autonomous Republic. Plants spread in the territory of the autonomous republic are represented by 16 subtypes, 21 class formations, 310 group formations, 13 semi-group formations, 1700 associations and microgroups belonging to 16 plant types [Talibov T.H., Ibrahimov A.Sh., 2017] ^[8].

The modern territory of Nakhchivan AR occupies an important place in Caucasus due to its genesis and geographical position. The area located on the border of several botanical-geographical regions is included in the flora migration with Caucasus, Central Asia, Front Asia and Iran [Talibov T.H., Ibrahimov A.Sh., 2008] ^[17]. The comprehensive study of *Campanulaceae* family representatives, distinguished by their decorative features, on a scientific basis in the flora of autonomous republic in addition being extremely urgent, is an important issue. One of the most important order is *Campanulales* of *Asternae* superorder of *Asteridae* subclass of *Magnoliopsida* class of *Magnoliophyta* phylum, *Campanulaceae* Juss. Family is included there. *Campanulaceae* is a cosmopolitan family,

includes more than 2,300 species of 80 genera, mostly found in temperate, subtropical, tropical zones and mainly mountainous areas. The existing relationships of the genera and species of *Campanulaceae* family with the flora of Mediterranean and Caucasus indicate that they are ancient species. 52 endemic species of this family are spread merely in Caucasus. Family species also cover the mountainous regions of East Asia and South Africa as the third center of areal diversity. Thus, *Campanulaceae* Juss. Family is one of the typical family of ancient times, all spreading areas are associated with mountainous territory [Novruzov V.S., Aslanova Y.A., 2013] ^[16].

In the research work "Flora of Azerbaijan" by A.A. Grossheim there have been given information about the *Campanulaceae* Juss. Family. The researcher noted that, family contained 34 species belonging to 5 genera, of which 14 species of 4 genera were found in the territory of the Nakhchivan Autonomous Republic [Grossheim A.A., 1935] ^[6]. In the study work "Flora of Azerbaijan" it is shown that, the family contained 61 species of 7 genera, of which 24 species of 4 genera were spread in Nakhchivan AR [Karyagin I.I., 1961] ^[9]. According to A.M. Askerov's book "Conspectus of Azerbaijan flora" [Askerov A.M., 2006] ^[1], 56 species of 7 genera belonging to *Campanulaceae* Juss. Family were spread in the flora of Azerbaijan. "Taxonomic spectrum of the Nakhchivan Autonomous Republic flora" [Talibov T.H., Ibrahimov A.Sh., 2008] ^[18] by T.H. Talibov and A.Sh. Ibrahimov, there have been noted that, there were 23 species belonging to 3 genera (*Asyneuma*, *Campanula*, *Michauxia*) in the territory of the autonomous republic. According to the literature researches, collected herbarium samples and expeditions conducted during 2012-2019, the

species belonging to the *Campanulaceae* family spread in the Nakhchivan Autonomous Republic were thoroughly studied. Over the years, the latest taxonomic composition of the *Campanulaceae* Juss. Family, some additions to genera and species, taxonomic and nomenclature changes have been identified. Based on the results obtained during the research years and literature sources, the species of *Campanulaceae* family: characterization by the species and genera; general regularities of their division into geographical (areological) groups and their geographical elements; attitude to moisture as a result of ecological analysis; ecological groups according to their attitude to light; life forms according to I.Q. Serebryakova and K. Raunkier; modern condition of rare species; spreading regularities on vertical zones; and usage perspectives have been studied comprehensively and on a scientific basis [Nasirova A.S., 2014; 2015; 2016; 2017; 2018; Talibov T.H., Nasirova A.S., 2015; 2016] ^[11, 12].

Material and Methods

The research object is *Campanulaceae* Juss. Family, and plant species belonging to *Campanulaceae* Juss. Family collected by us during field research in the lower, middle and high mountainous areas of Nakhchivan Autonomous Republic were taken as research material. On the identification of studied *Campanulaceae*, "Flora of Azerbaijan" by A.A. Grossheim [Grossheim A.A., 1935] ^[6], A.M. Askerov "Conspectus of Azerbaijan flora" [Askerov A.M., 2006] ^[11], E.M. Gurbanov "Systematics of Higher plants" [Gurbanov E.M., 2009] ^[7], "Flora of Azerbaijan" [Karyagin I.I., 1961] ^[9], T.H. Talibov, A.Sh. Ibrahimov "Taxonomic spectrum of Nakhchivan Autonomous Republic flora" [Talibov T.H., Ibrahimov A.Sh., 2008] ^[17], foreign authors such as, A.A. Kolakovskiy [Kolakovskiy A.A., 1994] ^[10], Biodiversity of Plant Species in Iran [Ghahreman A., Attar F., 1999] ^[4], Damboldt J. "*Campanulaceae*" [Damboldt J., 1978] ^[3] and other research works, botanical studies, methodical instructions on the works of Azerbaijani botanists, as well as monographs and articles on some taxa have been used. The latest taxonomic additions and changes have been carried out in accordance with the factual materials in the Herbarium funds of Botany Institute of ANAS and Bioresources Institute of Nakhchivan Branch of ANAS, International Botanical Nomenclature Code [Greuter W., 2001] ^[5], as well as research works by S.K. Cherepanov [Cherepanov S.K., 1995] ^[2]. The latest nomenclature code [APG IV, 2016] was used as a basis for specifying the systematic structure of the *Campanulaceae* family spread in the flora of Nakhchivan Autonomous Republic, as well as identification keys and tables were used in determining the species.

Results and discussion

In order to study the structure of the ecobiomorph during modern geobotanical research, identification of plant groupings and determining to which group they belong is one of the important issues. During the phylogenetic study of plants, the study of the issues of which plant group they belong to provides a basis for obtaining correct results. At present, there are 17 vegetation types in the biodiversity of Nakhchivan AR [Ibrahimov A.Sh., 2005] ^[18], and in these plant types, the study of the nature of location of each species belonging to *Campanulaceae* family in a separate

vegetation type, their spreading in the form of formations, associations and groups is one of the most important issues. In order to study the regularities of complex phytocenoses formation in nature, first of all, it is necessary to study the dynamics of vegetation groups. From this point of view, the nature of location of each species belonging to the family in a separate vegetation type was determined.

Michauxia laevigata Vent. Species was found in mountain-xerophyte vegetation type together with *Atraphaxis spinosa* species near Kilid (17.06.2015), Pazmari (10.06.2015) villages of Ordubad region and Akhura village of Sharur region by us. In addition to mentioned two species in vegetation type, a mixture of different perennial grasses was also found in plant community. In the composition of formation: *Artemisia fragrans* Willd., *Euphorbia marschalliana* Boiss., *Centranthus longifolius* Stev., *Astracantha microcephala* (Willd.), *Eremopyrum triticeum* Nevski, *Eremopyrum orientale* Spach., *Aegilops umbellulata* Zhuk, *Paronychia kurdica* Boiss., *Eremostachys macrophylla* Montbr. auch. Ex Benth. Species were also found [Fig. 1]. The species was also found solitarily in the petrophilous vegetation type. *Michauxia laevigata* is a milky, juicy, beneficial plant that can be eaten raw in its early stages of development.

Asyneuma pulchellum (Fisch. ET C.A.Mey.) Bornm. Species was distributed on dry rocks, rocky slopes, in areas covered with friganoid plants in middle and subalpine mountain zone of Nakhchivan mountainous botanical-geographical region. The species was found in mountain-xerophyte vegetation type near Paraga, Dirnis, Nasirvaz, Nusnus villages of Ordubad region, Bichenak, Ayrinj villages of Shahbuz region, Arafsa, Lakatag, Boyahmed villages of Julfa region.

The presence of *Campanula rapunculoides* L. species in communities in meadow vegetation type in Arafsa village of Julfa region, Nursu village, Batabat massive of Shahbuz region, Mazra, Unus villages of Ordubad region was discovered by us. The species together with various plants form a mixed high-grasses unity in Pazmari village of Ordubad region. *Campanula rapunculoides* participates as an edificator species to the communities of 18-20 plant species. In floristic composition: *Phleum pratense* L., *Dactylis glomerata* L., *Avena fatua* L., *Chaerophyllum macrospermum* (Willd. ex Spreng.) Fisch ET C.A. Mey., *Trifolium pratense* L., *Phlomis cancellata* Bunge, *Nepeta cataria* L. species and others were found [Fig. 2]. In addition, the species was found in the forest, as individually or in groups, under the trees *Quercus macranthera* Fisch. ET C.A. Mey. Ex Hohen. *Fraxinus excelsior* L., *Acer ibericum* Bieb. Species and *Crataegus*, *Rosa*, *Prunus* genera.



Fig 1: *Michauxia laevigata* Vent.



Fig 2: *Campanula rapunculoides* L.

Significant ornamental formations of *Campanula latifolia* L. species in the form of high-grasses unity were discovered by us in forest vegetation type in Batabat massive. These phytocenoses mainly develop in the lowlands and swampy areas in the broad-leaved oak forests. These formations cover 95-100% of the soil surface. As the species itself is abundant in the formation, the species composition is poor. 12-14 plant species are found in such high grasses unity, characteristic species are: *Phragmites altissimus* (Benth.), Mabile, *Typha latifolia* L., *Senecio racemosus* (Bieb.) DC. Some formations of the species have been found in the forest together with trees and shrubs belonging to the genera *Crataegus*, *Rosa*, *Quercus* [Fig. 3].

The main dominant plant species of the *Campanuleta* formation found in the Darabogaz area around Kuku were: *Smirniopsis aucherii* Boiss. And *Campanula latifolia* L. Such communities were formed in high grasses form within subalpine meadows. Trees and shrubs were gradually found towards the edges of high grasses formation, the height of the plants was between 1, 5-2, 5 m. Within the phytocenosis, *Campanula latifolia* formed pure clusters [Fig. 4].



Fig 3: *Campanula latifolia* L. In Batabat massiv



Fig 4: *Campanula latifolia* L. in Darabogaz area

Various grassy alpine carpets were spread in snow-covered neighborhoods of Shahbuz, Julfa, Ordubad districts, and rarely in gravelly rocks in Nakhchivan AR. Alpine carpets

with *Campanula tridentata* Scherb. Species have been found by us in mountainous slopes at an altitude of 3000-3100 m above sea level. *C. tridentata* species formations being as dominant plant have been found in the class formation of high mountainous alpine meadow near Nusnus village in Ordubad region and Demirlidagh plateau of Julfa region. *Campanula tridentataosum* formation was usually dense and short, covered 90-100% of the soil surface [Fig. 5].

In the formation content formed by *Campanula glomerata* L. species in meadow area in Khazinadara territory of Arafsa village of Julfa region, components such as: *Trifolium arvense* L., *Trifolium pratense* L., *Lotus corniculatus* L., *Filipendula ulmaria* L. (Maxim), *Ranunculus arvensis* L., *Melilotus albus* Medik., *Achillea millefolium* L., *Galium verum* L., *Rumex acetosa* L., *Xanthoxalis corniculata* L., *Papaver orientale* L., *Hordeum bulbosum* L., *Dactylis glomerata* L., *Nepeta cataria* L., *Alopecurus aequalis* Sobol. Species were detected. The species have also been found solitarily or as part of different vegetation groups in Garagush mountain of Kangarli region, Ayriinj, Kuku, Nursu, Bichenak villages, Agdaban peak and Batabat area of Shahbuz region, Arafsa village of Julfa region, Paraga, Dirnis, Mazra villages of Ordubad region [Fig. 6].



Fig 5: *Campanula tridentata* Scherb. On alpine carpets of Damirlidagh plateau



Fig 6: *Campanula glomerata* L. in Khazinadara territory

Asyneuma amplexicaule (Willd.) Hand.-Mazz species was spread in bushes and meadows of upper and subalpine zone, in Nakhchivan mountainous botanical-geographical region. *Asyneuma amplexicaule* species was found solitarily in plant community in bushes-meadows vegetation type in Paraga village of Ordubad region and Bichenak villages of Shahbuz region.

Asyneuma campanuloides (Bieb. ex Sims) Bornm. Species was found in upper forest zones, mountainous meadows, forests and steppes. The species was found by us in meadow

vegetation type in Bichanak village and Batabat massive of Shahbuz region.

Asyenuma rigidum (Willd.) A. Grossh. Species was spread in forest boundaries of subalpine zone in Nakhchivan mountainous botanical-geographical region. The species was found in forest vegetation type of Bichenak village of Shahbuz region and Lakatagh village of Julfa region.

Campanula bononiensis L. species was spread in steppe vegetation type in forest edges, meadows, bushes, glades, ravines, limestone areas, river banks and along roadsides. The plant grouping formed by *Campanula bononiensis* species was first discovered by us near Nursu village of Shahbuz region, components such as: *Taraxacum montanum* C.A. Mey. DC., *Alchemilla persica* Rothm. *Plantago media* L., *Carum carvi* L. species were notified in plant community [Fig. 7].

Campanula stevenii Bieb. Species was found in dry meadows and mountain steppes, as well as on grassy cliffs in subalpine and alpine zones. *Campanula stevenii* was recorded as an edifier species in meadow-steppe vegetation type on the rocks in Khazinadera area of Arafsa village, Berdik mountain of Julfa region, meadow area around the lakes of Batabat, Darabogaz area of Shahbuz region, meadow area near Nusnus village of Ordubad region. The grain-bean-bellflower formation discovered by us in Berdik Mountain covered 85-90 (100) % of the soil surface. In the formation of the phytocenosis, 25-30 plant species were identified, important species in the floristic composition were notified: *Hordeum bulbosum* L., *Roemeria hybria* L., *Pyrethrum balsamita* (L.) Willd., *Primula macrocalyx* Bunge, *Lotus corniculatus* L., *Astragalus cornutus* Pall. [Fig. 8].



Fig 7: *Campanula bononiensis* L.



Fig 8: *Campanula stevenii* Bieb.

Examples of petrophilic plants in the flora of Nakhchivan AR mainly grew in Nehram, Nehram-Darasham, Validagh, Daridagh, Ashabu-Kahf, Nahajirdagh, Alinja castle, Berdikdagh, Ilanlidagh, Babek castle. Among rocky plants were found endemic, rare, relict, medicinal, decorative, agricultural importance species. *Campanulaceae* family

species spread in the territory of Autonomous Republic, were mainly found on rocks and collapsed-sedimented slopes. Among the representatives of the family, 6 species [*C. sclerotricha* Boiss., *C. daralaghezica* (Grossh.) Kolak. et Serdj., *C. bayerniana* Rupr., *C. coriaceae* P.H. Davis, *C. massalskyi* Fomin, *C. saxifraga* Bieb., *C. karakuschensis* Grossh.] have been found in the form of small microgroups or singly in the rocky subtype of petrophilous vegetation type, 2 species [*C. zangezura* (Lipsky) Kolak. et Serdj., *C. propinqua* Fisch. et C.A. Mey.] in collapsed-sedimented subtype of petrophilous vegetation type in small microgroups form or singly.

Campanula sclerotricha Boiss. Species was found in shady cliffs and gardens in low mountainous zones. The species have been found in the area called Sulu duz (2000 m) of Tivi village, Nurgut and Nasirvaz villages of Ordubad region in petrophilous vegetation type.

Campanula daralaghezica (Grossh.) Kolak ET Serdjukova species was found in upper subalpine meadows, and sometimes in rocky cracks in alpine zones of petrophilous vegetation type. The species was found singly in the rocks near Nusnus and Pazmari villages of Ordubad region [Fig. 9].

Campanula zangezura (Lipsky) Kolak ET Serdjukova was spread in rocky cracks, stony-destroyed outcrops and valleys from the middle and subalpine zone to the alpine zone [Fig. 10]. The distribution of species in petrophilous vegetation type have been found in Gapijig and Soyug mountains of Ordubad region. The mentioned species completely dominated in the formation in Soyugdagh.



Fig 9: *Campanula daralaghezica* (Grossh.) Kolak. Et Serdj.



Fig 10: *Campanula zangezura* (Lipsky) Kolak. Et Serdj.

Campanula bayerniana Rupr. Was found in rocky areas in Middle Mountain and subalpine zones. The species was discovered by us in petrophilous vegetation type in Kuku village, Batabat massive of Shahbuz region, Khazinadare area of Julfa region, Kotam valley of Ordubad region [Fig. 11]. In the content of plant community fern species have also been found.

Campanula coriacea P.H. Davis species was found in limestone rocks, along river valleys in middle mountain zone of Nakhchivan mountainous botanical-geographical region. The species have been found on the rocks of Ardijdagh of Sadarak region, Garagush mountain of Kangarli region, together with *Daphne transcaucasica* Pobed. and a number of *Bryophyta* species in petrophilous vegetation type [Fig. 12].



Fig 11: *Campanula bayerniana* Rupr.



Fig 12: *Campanula coriacea* P.H. Davis

Campanula massalskyi Fomin species was spread in limestone rocks in middle mountain zone of Nakhchivan mountainous botanical-geographical region. This species have also been found in petrophilous vegetation type in Darasham area near Nehram village of Babek region.

Campanula saxifraga Bieb. Was found in petrophilous vegetation type in Vaykhir village of Babek region, Arazin, Gulustan villages and Gelingaya area of Julfa region and Gapijig mountain of Ordubad region.

Campanula karakuschensis Grossh. Was spread on dry limestone rocks of Garagush Mountain near Chalkhangala village in middle mountain zone of Nakhchivan mountainous botanical-geographical region. The species

was also found in petrophilous vegetation type on rocks near Akhura village of Sharur region, Nohuddag and Darasham areas [Fig. 13]. Moss species such as *Sibbaldia parviflora* Willd. And *Turbinatum argentum* were also found in the formation content.

Campanula propinqua Fisch. ET C.A. Mey. Was found in gravel and clay slopes, sedimented areas, along dry riverbeds and gardens in lower and middle mountain zone of Nakhchivan plain and Nakhchivan mountainous botanical-geographical region. The species have been found in petrophilous vegetation type in Gulustan village of Julfa region, Kilid area of Ordubad region, in the river valley of Kuku and Garababa villages of Shahbuz region [Fig. 14].



Fig 13: *Campanula karakuschensis* Grossh.



Fig 14: *Campanula propinqua* Fisch. ET C.A. Mey.

As a result of the research, the existing classification of *Campanulaceae* family species according to vegetation type in the biodiversity of Nakhchivan AR have been given. It was found that, representatives of the family were distributed in mountain-xerophyte (friganoid), meadow, steppe, forest, petrophilous vegetation types (Table 1).

Table 1: Analysis of vegetation types of *Campanulaceae* family spread in Nakhchivan AR

№	Name of species	Vegetation types				
		Mountain-xerophyte	Meadow	Steppe	Forest	Petrophilous
1.	<i>Campanula glomerata</i> L.		+			
2.	<i>Campanula latifolia</i> L.		+		+	
3.	<i>Campanula rapunculoides</i> L.		+			
4.	<i>Campanula bononiensis</i> L.		+			
5.	<i>Campanula sclerotricha</i> Boiss.					+
6.	<i>Campanula daralaghezica</i> (Grossh.)Kolak. ET Serdj.					+
7.	<i>Campanula zangezura</i> (Lipsky) Kolak. ET Serdj.					+
8.	<i>Campanula bayerniana</i> Rupr.					+
9.	<i>Campanula coriacea</i> P.H. Davis					+
10.	<i>Campanula massalskyi</i> Fomin					+
11.	<i>Campanula saxifraga</i> Bieb.					+
12.	<i>Campanula tridentata</i> Scherb.		+			
13.	<i>Campanula karakuschensis</i> Grossh.					+

14.	<i>Campanula propinqua</i> Fisch. ET C.A. Mey.					+
15.	<i>Campanula stevenii</i> Bieb.			+		
16.	<i>Asyneuma amplexicaule</i> (Willd.) Hand. - Mazz.		+			
17.	<i>Asyneuma campanuloides</i> (Bieb. ex Sims) Bornm.		+			
18.	<i>Asyneuma rigidum</i> (Willd.) A. Grossh.		+			
19.	<i>Asyneuma pulchellum</i> (Fisch. et C.A.Mey.) Bornm.	+				
20.	<i>Michauxia laevigata</i> Vent.	+				

Conclusions

Thus, during the geobotanical researches the phytocenoses and rare associations formed by *Campanulaceae* family species spread in the territory of Nakhchivan Autonomous Republic have been studied, their modern phytocenological classification have been given, studying the species composition of the associations, the cenozformation agents have been identified. Based on the results of the research, it was determined that, *Campanulaceae* family species were most often found as plant communities, formations in alpine and subalpine zones, solitarily on the rocks, and as various plant groups in high-grasses meadows of forest surrounding. During the studies it have been determined that, mainly *Campanula latifolia* L., *C. tridentata* Scherb. Species of the family create formations and association groups. There have been found formations: *C. latifolia* L. species in forest and meadow vegetation type; *C. tridentata* Scherb. Species in alpine carpets of meadow vegetation type.

The presence of *C. glomerata* L., *C. rapunculoides* L., *C. bononiensis* L., *Asyneuma amplexicaule* (Willd.) Hand. - Mazz., *A. campanuloides* (Bieb. ex Sims) Bornm. *A. rigidum* (Willd.) A. Grossh. Family representatives as an edificator species in meadow vegetation type have been found by us during the researches.

During the study, the spreading of *Michauxia laevigata* Vent. *A. pulchellum* (Fisch. ET C.A.Mey.) Bornm. Species in mountain xerophytic vegetation type, and *Campanula stevenii* Bieb. Species in steppe vegetation type have been found by us. During the studies it have been determined that, 9 species [*C. sclerotricha* Boiss., *C. daralaghezica* (Grossh).Kolak. et Serdj., *C. zangezura* (Lipsky) Kolak. et Serdj., *C. bayerniana* Rupr., *C. coriaceae* P.H. Davis, *C. massalskyi* Fomin, *C. saxifraga* Bieb., *C. karakuschensis* Grossh., *C. propinqua* Fisch. et C.A. Mey] of the family representatives were found in small microgroups or singly in the rocky and collapsed-sedimented subtype of petrophilous vegetation type.

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