

The Geophytes Species in the North-Eastern Region of Great Caucasian (Around Azerbaijan) and Effects of Anthropogenic Factors on Their Diversity and Distribution

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Received: 25/03/2010 Accepted: 18/05/2010

ABSTRACT

In this study, the important effects of anthropogenic factors on geophyte plant vegetation were found out in the Northeastern Region of Great Caucasian (around Azerbaijan) for the period of 1980-2008. In the study area (including five districts), 41 out of 101 geophyte plant species were determined as economically and medicinally important plant taxa. Some results were evaluated based on the reductions in the number of species in the experimental area for the period of 1990-2008 as compared to the period of 1980-1990. The number of plant species to be conserved has reached to 33, which were previously stated as 30. As a result of this reason, the number of unthreatened plant species reduced from 11 to 8. So, how much effective of the anthropogenic factors on this flora of the region have been found out.

Keywords: Azerbaijan, bioecological, anthropogen factors, Great Caucasian.

1. INTRODUCTION

Accelerated industrialisation and accompanied rapid increase in human populations have had adverse effects on natural environments. As a result as well as other living beings humans to have been affected. Nowadays, the environmental issues are no longer confined in national borders but regarded in international platforms. The countries of the world have been congregating on many occasions to discuss the issues on environmental problems [1].

Earth's flora is very rich under the name of geophytes, a kind of plant, which has bulb, tuberous and rhizome. They are specialized by carrying below-ground bodies like bulb, lump and rhizome that store foods. It consists 6.5-7% of these plants on the earth flora. At the end of XIX century scientist started to understand the flora of Azerbaijan. At that time the basic aim of these researches were to investigate the plant species which could be used

for medical purposes. But later combining all these data collected the flora of Azerbaijan was recorded [2].

Today, it is a known fact that anthropogenic factors are the major reasons for the dwindling numbers or extinction of endemic plants of high economic value. In this study, investigated the bio ecological and phytocenological characteristics of geophytes species in the Kuba-Haçmaz region of Azerbaijan Flora Azerbaijan [3]. The coast of the Hazar Sea was studied by Shixamirov [4], he also suggested some conservation methods for dominant species in this area.

Agamirov and Ibadov [5] have determined the conservation methods of endangered endemic *Tulipa L.* species' in Baku region by using cultivation methods. In addition to this they studied bio ecological characteristics and population structures of these species. It has been

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determined that identifying the flora of high mountains of great Caucasian region is an important factor in improvement of livestock. In this study more than 1000 plant species have been identified and characterized Hacıyev [6].

On the basis of conducted investigations the review of the Caucasus geophytes was made up, the taxonomic composition of 22 families, 91 genera involved the 517 species including 125 rare and extinct ones was studied. The species are classified by following life forms: tuberiferous (85 species), bulbotuberiferous (36 species), rhizome (160 species), bulbiferous (236 species). The composition of geophytes was specified for every separate region of the Caucasus [7].

2. MATERIALS AND METHODS

First, we reviewed the literature published between 1900 and 1980 and I conducted herbarium studies in the Botany Institute of Azerbaijan Academy of Sciences to determine the number of geophytes species and their formerly reported distribution in the Kuba-Haçmaz region of Azerbaijan. These screening efforts revealed the existence of 100 geophytes species in the region. Then, I

conducted a four year study between 1980 and 1984 to confirm the presence of the same geophytes species in the previously reported growing areas. Finally, investigated the changes in the diversity and distribution of Kuba-Haçmaz region geophytes during a 27 year period between 1980 and 2008.

In this study, geophyte plant species of area Kuba-Haçmaz are classified which is offered in 2001 by IUCN with "Red Data Book Categories" [8]. When the species are identified, accounted from some works: Azerbaijan Science Academy the Institute of Botanika in the name of V.L. Komarov herbarium, The Flora of Azerbaijan [3] and Vegetative cover of the Azerbaijan SSR [9].

I used a modified form of Borisova [10], Beydeman [11], Mammadov [12] and Rabotnov [13] methods. I formed 10, 1250 m² permanent experimental areas. I divided each permanent experimental area into two equal sections. One section of each permanent experimental area was under the influence of anthropogenic factors while anthropogenic factors had no effect on the other section. Then, formed 10 to 20, 1m² permanent sampling areas in each section (Figure 1).

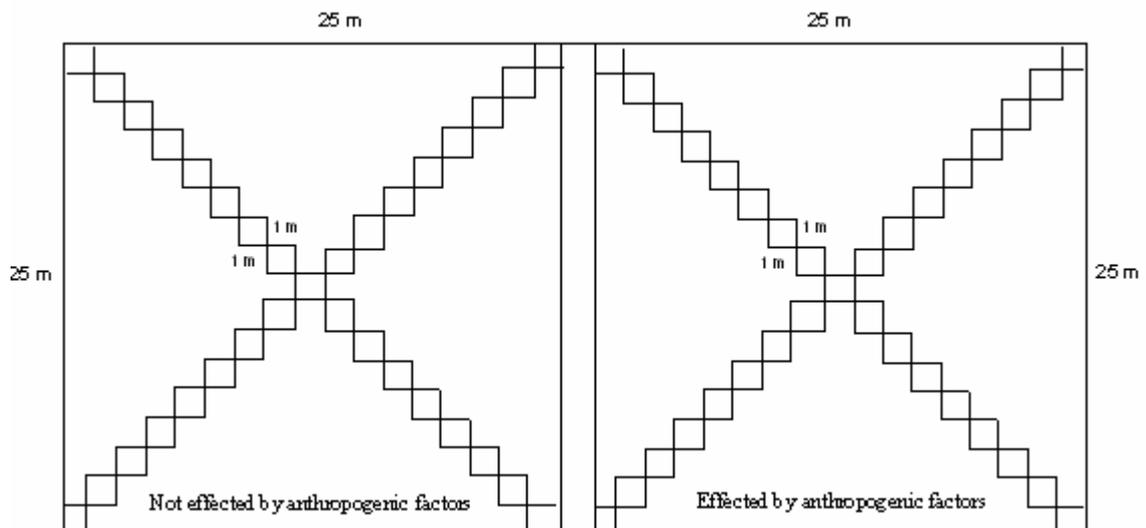


Figure 1. Schematic view of an experimental area.

Through several periodic visits I made within a year, I identified geophytes species and counted their numbers to determine the mean number of geophytes species in the permanent experimental areas.

3. RESULTS AND DISCUSSION

The permanent experimental areas showed some differences from each other in terms of climate and soil conditions. Different characteristics of some permanent experimental areas (Figure 2). Can be summarized as following:

Experimental Area 1: This area is in the north of Şuduk Village, Kuba City. The area has an elevation of 1200 m,

a slope of 30° and contains red-brown forest soil. Half of the area (25 m²) is covered with trees and the other half (25 m²) is a deforestrated land.

Experimental Area 2 : This area is a relief plain in the north of Melikler Village, Deveci City. The area has an elevation of 17m and covered with earth-brown soil. One half of the area is a active farmland and the other half is an inactive farmland.

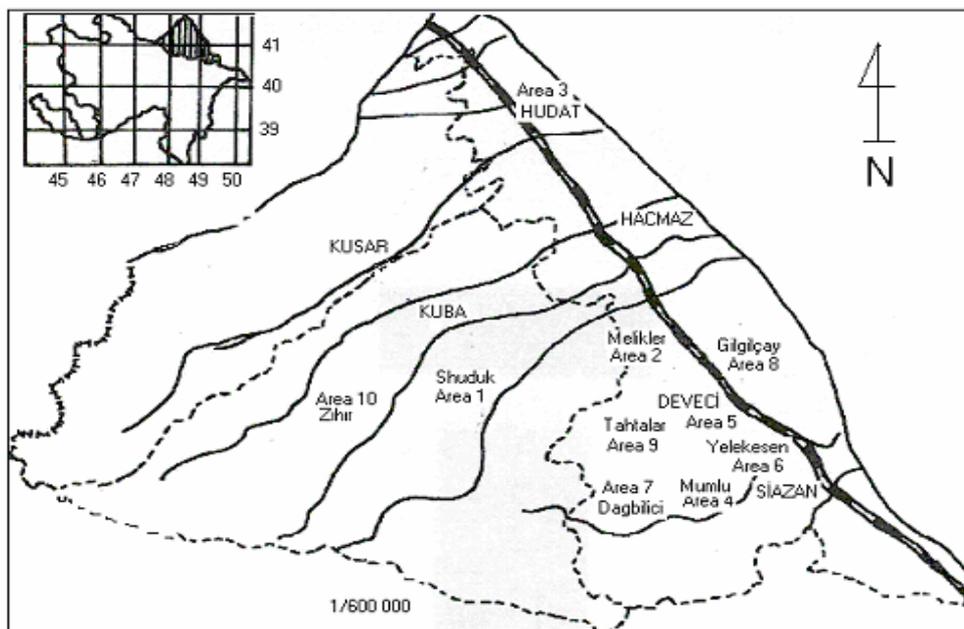


Figure 2. Location of the permanent experimental areas.

Experimental Area 3: This area is a grass covered relief plain in the north of Hudat Town, Haçmaz City. Half of the area (25 m²) is a active farmland and the other half (25 m²) is an inactive farmland.

Experimental Area 4: This area is called Beyazıt and is in the south of Mumlu Village, Deveci City. The area has an elevation of 450 m, a slope of 15° and contains light gray soil. Half of the area (25 m²) is a active pasture and the other half (25 m²) is used for farming.

Experimental Area 5: This area is called Kuru Dere and is in the south of Deveci City center. The area has an elevation of 100 m, a slope of 45° and contains ash-gray soil. Half of the area (25 m²) is a active pasture and the other half (25 m²) is an inactive farmland.

Experimental Area 6: This area is in the east of Yelesesen Village, Deveci City. The area has an elevation of 350 m, a slope of 30° and contains ash-gray soil. Half of the area (25 m²) is used as pasture and grass in the other half (25 m²) is moved regularly.

Experimental Area 7: This area is in the north of Dagbilici Village, Deveci City. The area has an elevation of 450 m, a slope of 20° and contains light brown soil. Half of the area (25 m²) is used as pasture and grass in the other half (25 m²) is moved regularly.

Experimental Area 8: This area is in the south of Gilgicay Village, Siazan City. The area has an elevation of 15 m, a slope of 5° and has yellowish clayey soil. Half of the area (25 m²) is used as pasture and the other half (25 m²) is plowed for farming.

Experimental Area 9: This area is in the south of Tahtalar Village, Deveci City. The area has an elevation of 100 m and a slope of 10°. Half of the area (25 m²) is used as pasture and the other half (25 m²) is used for farming.

Experimental Area 10: This area is in the north of Zihir Village, Kuba City. The area has an elevation of 1500 m, a slope of 45° and contains dark brown-black soil. Half of the area (25 m²) is used as pasture and grass in the other half (25 m²) is moved regularly.

During the course of the study, I collected 101 different geophytes species at various growing stages from the region. I delivered this herbarium to the Botany Institute of Azerbaijan Academy of Sciences in the name of Azerbaijan V. L. Komarov. The number of geophytes species in 1 m² permanent sampling areas ranged between 1 and 5. My twenty-year observations in the permanent experimental areas showed that in areas where anthropogenic factors were not present the number of plants in 1m² area increased rapidly. However, in the other areas where anthropogenic factors were dominant, not only the number of plants decreased but some species became extinct. For example, *Galanthus caucasicus* (Baker.) Gross numbers increased rapidly in inactive areas, but they completely vanished in areas used as pasture. *Fritillaria lutea* Mill. numbers proliferated in inactive areas whereas this species gradually disappeared in plowed farmlands. *Galanthus caspius* (Rupr.) Ggrossh, numbers increased in inactive pastures while a gradually decrease was observed in active pastures (Table 1).

Furthermore, 2 of 100 previously recorded species, *Arum ambispathum* Stev. Ex. Ledeb and *Gladiolus communis* L., probably became extinct because I was not able to find these two species during my 27-year study. On the other hand, I recorded 3 new species from the area. These new species were *Merendera sabolifera* Fisch. Et Mey, *Muscari leucostomum* Varan Ex. Gzera and *Bongardia chrisoganum* Boiss.

Table 1. Mean number (\pm SD) of *Galanthus caucasicus* (Baker.) Grossh., *Fritillaria lutea* Mill. and *Galanthus caspius* (Rupr.) Crossh. in 1m² of the permanent experimental area (Area 1, 2 and 3).

OY*	Sections					
	Not affected by anthropogenic factors (Forest)			Affected by anthropogenic factors (Deforested)		
	GCB**	FLM***	GCR****	GCB	FLM	GCR
1980	16 \pm 0.319	16 \pm 0.119	29 \pm 0.219	8 \pm 0.961	8 \pm 0.074	11 \pm 0.116
1981	21 \pm 0.163	26 \pm 0.074	33 \pm 0.116	7 \pm 0.219	3 \pm 0.017	9 \pm 0.213
1982	24 \pm 0.017	31 \pm 0.105	42 \pm 1.273	5 \pm 0.494	-	8 \pm 0.114
1983	29 \pm 0.112	34 \pm 0.068	46 \pm 0.113	3 \pm 0.916	-	7 \pm 0.219
2002	8 \pm 0.008	6 \pm 0.211	4 \pm 0.024	1 \pm 0.113	1 \pm 0.019	-
2003	9 \pm 0.016	9 \pm 0.061	5 \pm 0.113	-	2 \pm 0.03	-
2004	12 \pm 0.211	11 \pm 0.142	7 \pm 0.076	1 \pm 0.008	1 \pm 0.028	1 \pm 0.012
2005	11 \pm 0.113	13 \pm 0.108	8 \pm 0.098	1 \pm 0.027	1 \pm 0.015	2 \pm 0.016
2006	14 \pm 0.167	12 \pm 0.126	11 \pm 0.108	3 \pm 0.089	3 \pm 0.118	-
2007	14 \pm 0.085	15 \pm 0.208	10 \pm 0.092	3 \pm 0.127	3 \pm 0.183	-
2008	12 \pm 0.115	13 \pm 0.181	9 \pm 0.085	4 \pm 0.015	2 \pm 0.124	1 \pm 0.057

*Observation Years, ***Galanthus caucasicus* (Baker.) Grossh., ****Fritillaria lutea* Mill. and *****Galanthus caspius* (Rupr.) Cross

Finally, I prepared a condition list for the 41 of 101 economically valuable geophytes species of the Northeast Great Caucasian Region by evaluating the changes in their abundance and distribution during the 27-year study period (Figures 3, 4).

In this list, I classified a species as the species which is in the danger of extinction and requires protection or the species which is abundant and does not require special precautions (Table 2).

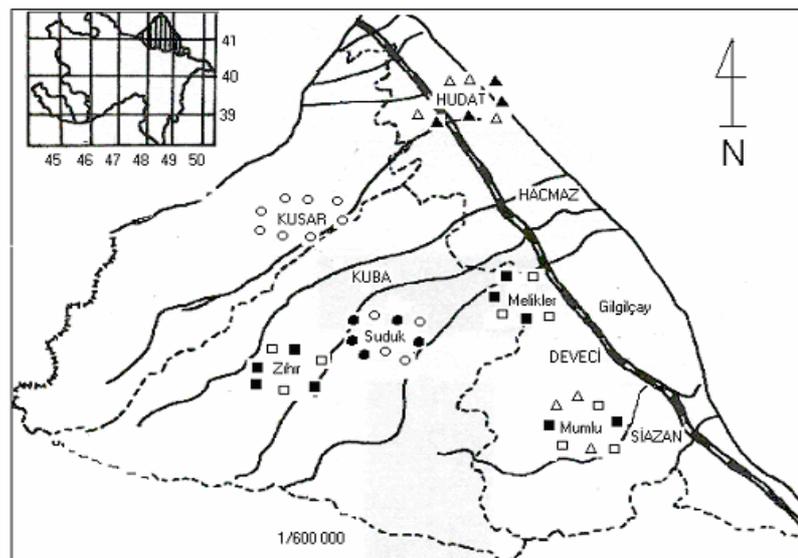


Figure 3. Previous (1900 - 1980) and recent (1980 - 1990) distribution of some geophytes species in the North-eastern Great Caucasian, around Azerbaijan. *Galanthus caucasicus* (Baker) Grossh (●- New distribution area, ○- Old distribution area), *Fritillaria lutea* Mill.(■- New distribution area, □- Old distribution area), *Galanthus caspius* (Rupr) Grossh (▲- New distribution area, △- Old distribution area).

Kuba-Haçmaz region stretching around the Northeast of Great Caucasian in Azerbaijan has one of the richest floras [7,9]. In this area, high economic value plants such as geophytes represented by 101 species [14-16]. The anthropogenic factors of these plant species has been major interesting areas for the scientists [17-20]. Plant ecology is an essential branch of science for protection of endangered plant species as well as getting information about vegetations. The study of geophytes in north east of Caucasian (near Azerbaijan region) is a good example

this kind of studies. This research includes herbarium and literature reviews till 1980's as well as field research data collected during the period of between 1980–2008. Although there were 100 geophytes species before 1980 in the corresponding region, *Arum albispatum* and *G. communis* *Merb.* have been totally extinct now. But 3 new species (*M. sabolifera* Fisch. et Mey., *M. leucostomum* Woron, ex. Gzern. and *B. chrisoganum* Boiss,) have reported in that area.

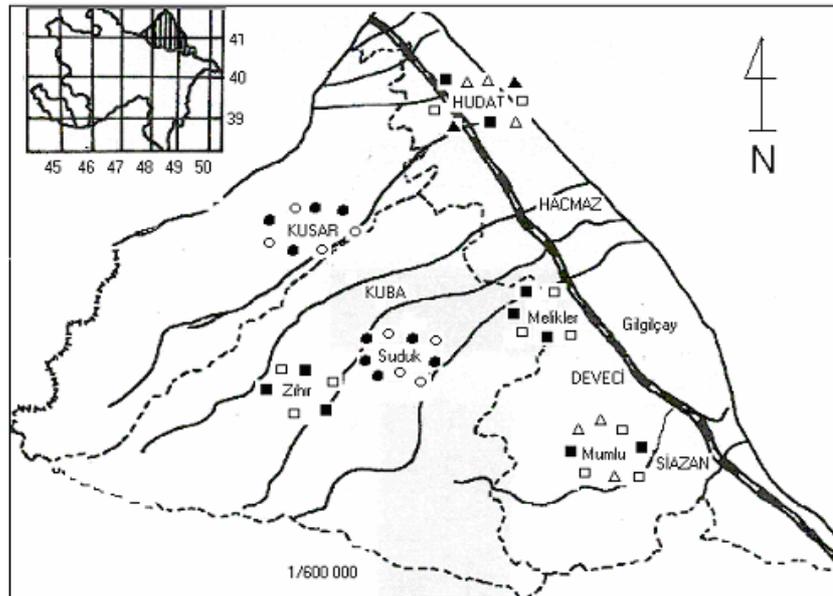


Figure 4. Previous (1980 - 1990) and recent (1990 - 2008) distribution of some geophytes species in the North-eastern Great Caucasian, around Azerbaijan. *Galanthus caucasicus* (Baker) Grossh (●- New distribution area, ○- Old distribution area), *Fritillaria lutea* Mill. (■- New distribution area, □- Old distribution area), *Galanthus caspius* (Rupr) Grossh (▲- New distribution area, △- Old distribution area).

So the number of species rises to 101, among them 41 of them are economically important geophytes species were selected and new conservation methods were determined for them. In addition, during the period of 1980–1990, thirty geophytes species deserved in situ conservation however eleven geophytes species did not need this type of conservation. Because of the increase in anthropogenic factors during 1990–2008 years in the region, 3 other species were offered for in situ conservation (Table 2). In

order to conserve these reported species four gene management zones were offered to governmental offices Figure 5. Areas in the Northeast Great Caucasian, around Azerbaijan must be protected to prevent the loss of geophytes plants which have economic value is necessary. Researches showed that the geophytes species were distributed in north east part of Caucasian (the low and middle mountain zones of Azerbaijan) because of suitable climatic and soil conditions in this area for these species.

Table 2. Distribution Of Geophyte Species In The Northeastern Great-Caucasian (Around Azerbaijan) Between 1980-1990 And 1980-2008

Family, Genus, Species	1980-1990			1980-2008		
	New species in the region	The species which doesn't require precautions	The species which is in the danger of extinction and requires protection	New species in the region	The species which doesn't require precautions	The species which is in the danger of extinction and requires protection
1	2	3	4	5	6	7
LILIACEAE Hell.						
Allium L.						
<i>A. albidum</i> Fisch..ex Bess.			*			*
<i>A. atroviolaceum</i> Boiss.		*			*	
<i>A paradoxum</i> (Bieb.)G.Don.			*			*
Fritillaria L.						
<i>F. lutea</i> Mill.			*			*
Gagea Salisb.						
<i>G. chanae</i> Grossh..			*			*
Merendera Ram.						
<i>M. elchleri</i> (Regel) Boiss.		*				*
<i>M. sobolufera</i> Fisch.et Mey.	*		*			*
Muscari Mill.						
<i>M. leucostomum</i> Woron. ex Gzern.	*		*			*
<i>M. pallens</i> (Bieb.) Fisch.			*			*
<i>M. azovitsianum</i> Baker.		*			*	
<i>M. tenuiflorum</i> Tausch.			*			*
Ornithogalum L.						
<i>O. pyrenaicum</i> L.		*			*	
<i>O. schischicini</i> Krasch.		*			*	
<i>O. schmalhausenii</i> Albov		*			*	
<i>O. sintenisii</i> Freyn			*			*

Table 2. Distribution Of Geophyte Species In The Northeastern Great-Caucasian (Around Azerbaijan) Between 1980-1990 And 1980-2008

1	2	3	4	5	6	7
<i>O. tenuifolium</i> Guss.			*			*
Puschkinia Adam.						
<i>P. scilloides</i> Adam.			*			*
Scilla L.						
<i>S. sibirica</i> Haw.			*			*
Tulipa L.						
<i>T. bibersteiniana</i> Schult. et.Schult.			*			*
<i>T. eichleri</i> Regel.			*			*
IRIDACEAE Lindl.						
Crocus L.						
<i>C. adami</i> J. Gay		*			*	
<i>C. speciosus</i> Bieb.			*			*
Gladiolus L.						
<i>G. imbricatus</i> L.			*			*
<i>G. kotschyanus</i> Boiss.			*			*
<i>G. segetum</i> Ker. –Cravl.			*			*
AMARILIDACEAE Lindl.						
Galanthus L.						
<i>G. caucasicus</i> (Baker.) Crossh.		*				*
<i>G. caspicus</i> (Rupr.) Crossh.		*				*
ARACEAE Neck.						
Arum L.						
<i>A. elongatum</i> Stev.		*			*	
BERBERIDACEAE Forret et.Gray						
Bongardia C.A.M.						
<i>B. chrysogonum</i> Boiss.	*		*			*
ORCHIDACEAE Juss.						
Ohyris L.						
<i>O. oestrifera</i> Bieb.			*			*
Orchis L.						
<i>O. amblyoloba</i> Nevski			*			*
<i>O. caspia</i> Trautv			*			*
<i>O. mascula</i> L.			*			*
<i>O. palustris</i> Jacq.			*			*
<i>O. picta</i> Loisel.			*			*

Table 2. Distribution Of Geophyte Species In The Northeastern Great-Caucasian (Around Azerbaijan) Between 1980-1990 And 1980-2008

<i>O. purpurea</i> Huds.			*			*
<i>O. simia</i> Lam.			*			*
Loroglossum L.C.Rich.						
<i>L. formosum</i> (Stev.) Gamus et.Berg.			*			*
Coeloglossum Hartm.						
<i>C. viride</i> (L.) Hartm.			*			*
Cephalanthera L.C.Rich.						
<i>C. rubra</i> (L.) Rich.			*			*
RANUNKULACEAE Juss.						
Ficaria Dill.						
<i>F.ledebourii</i> Grosshet.Schischk		*			*	

The high mountain zones in the region (3500–4000 meters) is covered always with snow, the lower regions (up to 400 meters) is composed of salty and sandy soil

structures that is not appropriate for geophytes. In this zone some geophytes species from *Gladiolus* and *Merenderal* genus can be found

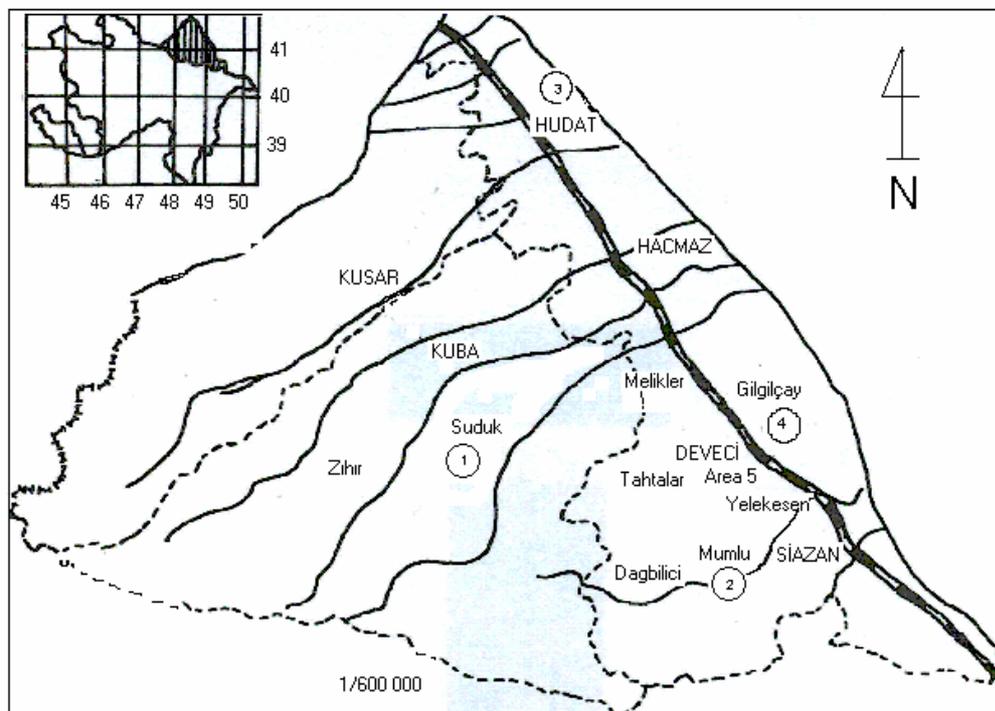


Figure 5. Areas in the Northeast Great Caucasian, around Azerbaijan must be protected to prevent the poss of geophytes plants which have economic value is necessary.

- 1- 5 ha around Şah Koma high plateau in north of Şuduk village which belongs to Kuba city centre.
- 2- 3 ha in east of Mumla village which belongs to Deveci centre.
- 3- 3 ha in north of Hudat country which belongs to Haçmaz city centre.
- 4- 3 ha between Şahran and Gilgili çay village which belongs to Deveci centre.

4. CONCLUSIONS

In this study, the important effects of anthropogenic factors on geophyte plant vegetation were found out in the Northeastern Region of Great Caucasian (around Azerbaijan) for the period of 1980-2008. In the study area (including five districts), 41 out of 101 geophyte plant species were determined as economically and medicinally important plant taxa. In addition, three new and need to be conserved plant species (*Merendera sabolifera* Fisch. et Mey., *Muscari leucostomum* Woron, ex. Gzern. and *Bongardia chrysogonum* Boiss.) were recorded for the study area. Some results were evaluated based on the reductions in the number of species in the experimental area for the period of 1990-2008 as compared to the period of 1980-1990. Thus, three geophytic plant species (*Merendera elchleri* (Regel) Boiss., *Galanthus caucasicus* (Baker.) Crossh. and *Galanthus caspicus* (Rupr.) which were not considered as threatened in the period 1980-1990 have needed to conserve from destructive activities such as urbanization, road building, construction new fabrics, prospecting petroleum and etc. The number of plant species to be conserved has reached to 33, which were previously stated as 30. As a result of this reason, the number of unthreatened plant species reduced from 11 to 8. So, how much effective of the anthropogenic factors on this flora of the region have been found out.

ACKNOWLEDGEMENTS

The authors would like to thank Prof. Dr. Tofik Mammadov, director from Mardacan Arboretum Academi of Science Azerbaijan, for her excellent help of this study.

REFERENCES

- [1] Lapin, P.I., Gogina, E.E., Matsenko, A.E., Plotnikova, L.S., Prilipko, L.I., Skvortsov, A.K. "Rare and vanishing species of natural flora of the USSR". *Nauka Pres*, Moscova (1983).
- [2] Serdyukov, B.V. "Decorative grassy plants florae of caucasus", *Metsniereba Pres*, Tbilisi (1972).
- [3] Sosnovskiy, D.I. "Flora of Azerbaijan", No. 2. Akad. *Nauk Azerb. SSR Press*, Baku (1952).
- [4] Shixamirov, M.G. "River basin of Samur Plants in Caucasus region", region *İzvestiya Akademii Nauk Azerbaydjanskoy SSR* (Seriya Biologiceskix Nauk) 1: 26-32 (1975).
- [5] Agamirov, U.M., Ibadov, O.V. "The wild Tulipa species of Apsheron in Azerbaijan", *İzvestiya Akademii Nauk Azerbaydjanskoy SSR* (Seriya Biologiceskix Nauk) 2: 21-24 (1972).
- [6] Hacıyev, V.D. "Vegetation of high mountainous lands in Caucasus Region", *İlm Press*, Baku (1970).
- [7] Ibadov, O.V. "The Geophytes of the Caucasus (Taksonomy, Spreading, Morfology, Anatomy, Introduktion, Use and Protection)", *İlm Press*, Baku (2002).
- [8] IUCN, "IUCN Red List Categories and Criteria", Version 3.1, Gland, IUCN Species Survival Commission IUCN (2001).
- [9] Prilipko, L.I. "Vegetative cover of the Azervajdzhansky SSR", *İlm Pres*, Baku (1970).
- [10] Borisova, T.A. "Determination of plants reserve for using drug production and making distribution maps", *Nauka Press*, Leningrad (1961).
- [11] Beydeman, I.I. "Technique of studying phenology of plants and vegetative communities", *Nauka (The Siberian branch). Press*, Novosibirsk (1974).
- [12] Mammadov, R.M. "The Bioecological Properties of Geophyte Species in the Northeastern Region of Great Caucasian (Around Azerbaijan) and Their Protection", PhD Thesis, Baku (1988).
- [13] Rabotnov, T.A. "Length development learning of herbaceous plant". *Russian Journal Botany*, 37: 24-28 (1996).
- [14] Mammadov, R.M. "Geophytes of Kuba -Haçmaz Region", *J. Azerb. Tabiiyati*, 5: 26- 27 (1982).
- [15] Mammadov, R.M. "Ornithogalum L. Species of Kuba-Haçmaz and their preservation", *Dokladi Akademii Nauk Azeibaydjanskoy SSR* (Seriya Biologiceskix Nauk), 5: 31-34 (1983).
- [16] Mammadov, R.M. "Rare and being extinct species of Muscari Mill". *İzvestiya Akademii Nauk Azerbaydjanskoy SSR* (Seriya Biologiceskix Nauk), 141-43 (1984).
- [17] Mammadov, R.M. "New distribution areas of Bongardia chrysogonum Boiss. And Merendera sobolufera Fisch. et Mey. Species", *Dokladi Akademii Nauk Azeibaydjanskoy SSR* (Seriya Biologiceskix Nauk), 5: 75-76, (1985).
- [18] Mammadov, R.M., Sahranc, B. "Some Geophytes, Determined in autumn in the Center of Muğla", *Turkish Journal Ecology*, 12: 13-18 (2003).
- [19] Mammadov, R.M., Sahranc, B., Makasçı, A. "Ecologic features species Orchis L. of Muğla province and their conservation". *Afyon Kocatepe University Journal of Science*, 5, 37-46, (2005).
- [20] Varol, O., Mammadov, R.M. "Some Geophytes of Muğla Vilayet (sw Turkey)", *Russian Journal Botany* 91: 235-243 (2006).