

## Life Form of Early Spring Plants in Relation to the Altitude and Climate Change

(Bentuk Kehidupan Bagi Tumbuhan Musim Bunga Awal kepada Altitud dan Perubahan Iklim)

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### ABSTRACT

*The purpose of the investigation was to study the early spring plant diversity distributed in different vegetation types and their life forms, in relation to different altitudes. The investigation was carried out in accordance with itinerary method beginning from the shoreline up to the mountain. The results showed that 100% of the totally collected plants from the desert vegetation were therophytes; 100% from steppe vegetation were geophytes; 50 from forest were geophytes and the other 50% were hemicryptophytes. It is concluded that the life forms of early spring plants change depending on the altitude corresponding to changes in the air temperature as well as climatic and edaphic factors.*

*Keywords: Climate changes; ephemerals; geophytes; life form of plants; transect*

### ABSTRAK

*Tujuan penyelidikan ini ialah untuk mengkaji kepelbagaian tumbuhan musim bunga awal yang tertabur dalam jenis vegetasi berbeza dan bentuk kehidupannya dan perhubungan kepada altitud berbeza. Kajian telah dijalankan mengikut kaedah jadual bermula dari tepi pantai hingga ke gunung. Hasil menunjukkan 100% daripada jumlah tumbuhan yang dikumpul dari vegetasi padang pasir adalah reofit; 100% dari vegetasi steppe adalah geofit; 50% dari hutan adalah geofit dan 50% yang lain adalah hemikriptofit. Ia boleh dirumuskan bahawa bentuk kehidupan tumbuhan awal musim bunga bertukar bergantung kepada altitud berkenaan dengan perubahan suhu udara dan juga faktor edafik dan iklim.*

*Kata kunci: Bentuk kehidupan tumbuhan; efemeral; geofit; perubahan iklim; transek*

### INTRODUCTION

An investigation of flora is considered as an important phase of study of the modern global problems like protection of biodiversity. Strategy of such investigations is to gather information about the current structure of the plant communities during the early stages of the vegetation and their reactions to the anthropogenic impacts, consequently climatic changes applying new scientific methods and developing mitigation action plans.

The starting from Caspian Sea shoreline till the lower forest belt of south-eastern slopes of the Great Caucasus is used as winter pasture. Intensive grazing of livestock (small and big horned cattle) continues from October till May, when they move to summer pastures between May and October.

General information about flora and vegetation of north-eastern regions of Azerbaijan has been given by Grossheim (1948); Prilipko (1970) and later on by Shukurov (1999, 2002). Two hundred ninety eight plant species belonging to 56 families were determined only in Samur-Divichi Flat, in the Caspian Sea shore stripe, during the comprehensive floristic studies in the area by Shaxsularov (1994). But no information was available about the life forms of the early spring plants in relation to different altitudes.

Rich plant diversity occurs in the different vegetation types due to very divers physical and geographical conditions beginning from Caspian littoral plants up to forest zones. The investigation was conducted in accordance with itinerary method in the selected study area by providing a classification of different vegetation types, floristic analysis of early spring plant species and interpretation of influence of altitudes on the life forms of the plant species distributed in the area and impact of climate change on the plant diversity of the early spring plants.

### STUDY AREA

The study area begins from Gilazi Tongue in the north-western direction along a horizontal line approximately 65 km long and in the range of 18-20 m below the sea level to 700-800 m above the sea level (Figure 1).

Approximately 1/3 part of Samur-Devechi Lowland of the region is below the sea level. The highest point of the lowland reaches up to 200-215 m in the foot of the front mountain belt in the West. There are different landscapes like littoral, shifting sandy or psammophytic, semi-shifting desert, semi-deserts, steppe, cherno-meadow, forest, naked areas and oasis in the slightly inclined Samur-Devechi



FIGURE 1. Map showing the study area

Lowland. The front mountain belt covers an area from 200-250 m up to 800-1000 m above the sea level.

Lias and Dogger (mid-Jurassic) sediments are changed by less inclined down moving teton and layer sets around Khaldan to eastwards from Babadagh mountain. But lime of Shahdagh zone is changed by mergel layer. The information given by geologists depicts that these sediments have covered clay and sand derivatives belonging to the 3-rd Period (physical geography of the Azerbaijan SSR 1959). The derivatives have considerably spread in the stripe of foothills of the lateral range. These are followed by ancient Caspian terraced sediments in the lowland part of the area. These are gravel piles, conglomerates, sandy stones, clays, crusty limes as well as recent Caspian sediments along with the shore. Major underground wealth of the North-East of Azerbaijan is oil deposits. The investigated route line cuts Siazan oil-field; the largest one in the region. There are cold springs with hydrocarbons and hydrogen sulphide in Chyraggala.

Damp, saline, cockleshell-sandy, sandy, desert and semi desert, brown, gray and brown, steppe brown, black, chestnut and mountainous and forest soils have originated on the routine. According to Figurovskiy (1926), the present Samur-Devechi Plain and shore plains which escaped from the water due to gradual ebb tide have got hot and dry climate. Hot and dry climate of the plain regions has negatively affected onto the rich subtropical vegetation cover of the bordering foothill zones and climate of these regions gradually changed into the present-day state. During the last decade little differences have been noticed in the ambient air temperature and amount of the rainfall. So, mean annual temperature of ambient air of Sumgayit town was 15.8°C for 2001 year, but 14.5°C for

2011 (reduction 1.3°C). Similarly in Quba region mean annual temperature for 2001 was 12.5°C, but in 2011 it was 10.6°C (temperature has dropped down by 1.9°C).

#### MATERIAL AND METHODS

Our aim here was to study the current state of sustainable forms in the early spring vegetation of South-Eastern slopes of the Great Caucasus and the areas beginning from the Caspian Seashore to the lower forest belt as well as their natural vegetation types found in nature. The observations were made on routine basis in desert, steppe and forest vegetation types in the area starting from the seashore to the front mountain belt in March 2011. Geobotanical methods were used in the study of the early spring flora of the area. The investigation was carried out by using transect method on 4 pilot sites each 10000 km<sup>2</sup>. As the nature does not wake up entirely in March only some flowering plants were observed. We identified higher flowering plants on the basis of multivolume 'Flora of Azerbaijan' (1950-1961). Vegetation cover details of the collected herbarium materials was evaluated for different purposes. However as the cover of the vegetation and species information has not reached up to the peak point it was impossible to give complete information concerning the structure of phytocenosis. Classification of Raunkaier (1934), Serebryakov (1964) and Govaerts et al. (2000) were used in the analysis of vital forms of plants. However as Raunkaier and Serebryakov's classification is used more widely, the vital forms are presented according to these classifications (Raunkaier 1934; Serebryakov 1964).

In order to determine the vegetation types, early spring plant populations of the region 1 m<sup>2</sup> plots were

laid using transect method in the chosen pilot area (Phil 2001). Altitude and coordinates of the studied areas were identified by means of a Global Positioning System device.

## RESULTS AND DISCUSSION

One of the basic results obtained by us was that by studying life forms, morphology, taxonomy and species diversity of the early spring plants in relation to altitude, climate and edaphic factors occurring in the different vegetation formations (sandy deserts, steppe and forest) starting from shoreline up to front zones of mountains the distribution pattern of the plants was determined.

Diversity of spring plants decreases with increasing elevation, corresponding to decrease in air temperature. The diversity also decreases in the shifting sandy deserts near shoreline due to instability of the soil.

Early spring plants collected from different plant communities are given in Table 1.

The plants collected in the area belong to 13 species from 7 families. According to the species richness of the families; Liliaceae (5 species, 38% of the total number of species) is on the first place; Asteraceae and Iridaceae Families (2 species or 15% of the total number) are on the second place; they are 8% of the total number of species being one species in each of other 4 families (Figure 2) The reason for late start of flowering of all early spring plants in March 2011 has been a drop in the ambient air temperature compared with 10 years earlier.

Increasing elevation influences the life forms of plants as well, so that it changes from therophytes to hemicryptophytes through geophytes (Figure 3). Due to unsuitable environmental conditions some desert plants have a very short life cycle, growing quickly, producing seeds and then dying, whereas in steppe and forest habitats climatic and edaphic conditions improve depending on the elevation and plants have a longer life cycle and underground organs (i.e. bulbous root system) remain alive.

TABLE 1. Location and habitat of early spring plants. A, B, C and D are label of the sampling plot, as labeled in the map

#	Habitat and plant community	Early spring plants found
A	Shifting sandy deserts Ephemeral	<i>Alyssum desertorum</i> (Stapf.) Botsch <i>Erodium cicutarium</i> (L.) L'Her.)
B	<i>Artemisetum scoparia</i> semi-shifting sandy deserts	<i>Calendula persica</i> C.A.Mey <i>Senecio vernalis</i> Waldst. & Kit <i>Veronica arvensis</i> L.
C	Gariga type of <i>Paliuretum spina-christi</i> steppe	<i>Gagea alexeenkoana</i> Miscz <i>Gagea chanae</i> Grossh <i>Iris reticulata</i> M.B. <i>Crocus adami</i> J. Gay <i>Ornithogalum sintenisii</i> O. sintenisii Freyn <i>Merendera trygyna</i> (Stev. ex Adams.) Stapf
D	<i>Quercusetum pubescens</i> forests	<i>Scilla siberica</i> Haw <i>Primula woronowii</i> Losinsk

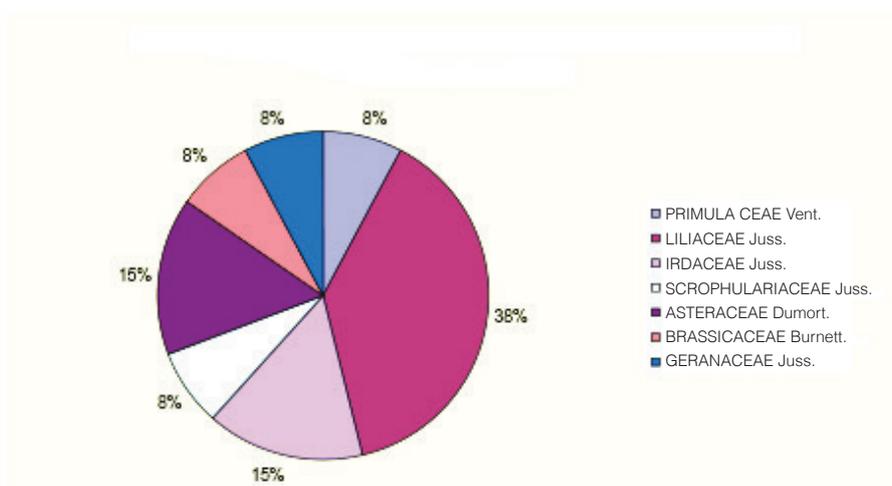


FIGURE 2. Percentage distribution of the early spring plants on family basis

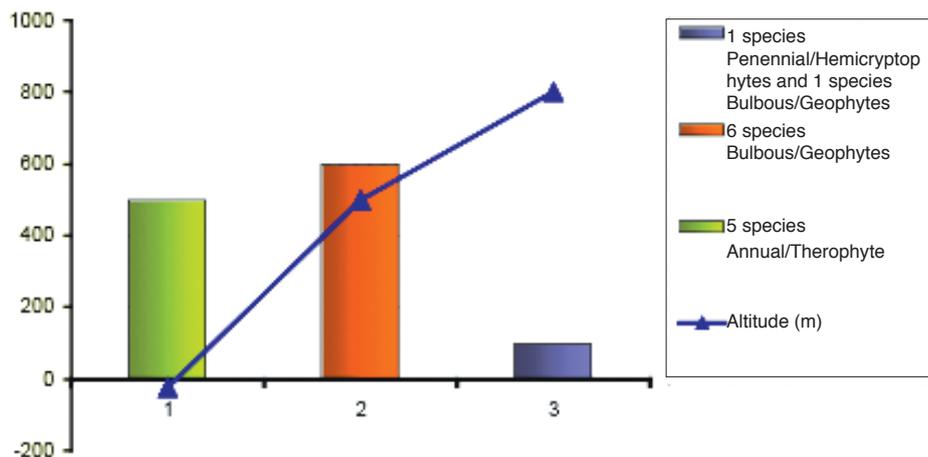


FIGURE 3. Variations in the life forms of the early spring plants depending on altitude

During the study of early blossoming spring plant materials collected from nature, brief information about the associated vegetation is presented.

#### EPHEMEROUS SHIFTING SANDY DESERTS

The area is called Yashma and Gilazi warrens. In the wet soil influenced by salty sea water along the seashore a *Juncetum littoralis* and *Juncetum acutus* associations are distributed. Just after this association the ephemeral desert type vegetation is found on shifting sandy soils towards onshore. The plot was 25 m below the sea level and the soil consisted of sand and cockle-shell. *Alyssum desertorum* and *Erodium cicutarium* plants were in the flowering stage. The level of disturbance is high and vegetation has been strongly influenced by both natural and the factors related to hunting, grazing, fishing and other activities.

#### ARTEMISETUM SCOPARIA HALF-SHIFTING SANDY DESERTS

This habitat is a transition habitat between shifting and steady sandy or dry-clayey deserts. It is 20-23 m below the sea level. There are mainly 3 species found in this zone *Artemisium scoparia* formation: *Calendula persica*; *Senecio vernalis* and *Veronica arvensis*. *Veronica arvensis* is more often occurring in this habitat than the other two species. The main human activities that have great impact on vegetation are excessive pasturing in the territory, construction of highway roads and wind turbines as alternative energy source.

#### ARTEMISETUM LERCHIANA CLAYEY-SANDY DESERTS

This vegetation is found in the Western part of the 'C' study area. Only *Veronica arvensis* plant species occur in this habitat. A transect was laid to study density of the early spring plants found in this habitat. In spite of *Artemisia lerchiana* abundance in each quadrat reached up to 30-40

m in the vegetation cover formed by these but it doesn't go up beyond 10%, because the plants are in the beginning of the vegetation. Though the area is excessively pastured *Artemisia lerchiana* forms dense of sprouts.

#### GARRIGUE TYPE OF PALIURETUM SPINA-CHRISTI STEPPES

The area is located in the front mountainous belt and approximately 450-500 m above the sea level. Six species of early spring plants include: *Gagea alexeenkoana*; *Gagea chanae*; *Iris reticulata*; *Crocus adami*; *Ornithogalum sintenisii* and *Merendera trygyna* - mostly formed by domination of *Paliuretum spin-christi* species of garrigue type. *Arum* species with new leaves under bushes were also observed in this habitat. It is also necessary to note that *Crocus adami* and *Merendera trygyna* species are starting to flower in the middle of February. Nearly 2-3 *Iris reticulata* and *Crocus adami* occur in each quadrat. Plants of the area have faced anthropogenic effects due to oil-extracting activities. Only one *Iris reticulata* plant was registered on the edge of the road in a small area around an oil field in the period of the observation, although there were 1-2 plants growing here in each m<sup>2</sup> of the same area 2 years ago. This explains that *Iris reticulata* species are collected (root digging) for decoration purposes by the people nearby.

#### QUERCUSETUM PUBESCENS FORESTS

These forests lie 700-800 m above the sea level in the eastern part of the Great Caucasus. Major species is *Quercus pubescens*. Together with sulphur smelling water, there are also some springs which are slightly polluted by oil. During the collection only *Sicilla siberica* and *Primula woronowii* were observed as flowering in the areas where snow had melted. The area is used as a sanatorium as well; most of the area is contaminated with wastes.

Natural condition of the mountains depends on their geographical situation, direction and altitude of the

mountain range as well as location of rocks, precipices and slopes. Climate and vegetation cover in the mountains do not change gradually as in the plains, they depend on the altitude above the sea level. If average annual temperature decreases 6°C when moving 1300 km from the south towards the north in the plain (in the Northern Hemisphere), the average annual temperature in the mountains decreases by 5-6°C for each km we go up in vertical elevation. When elevation increases amount of precipitation and energy of sun changes. Land surface becomes hotter during the day-time and frosts often occur in the nights even it strongly snows in summer. The precipitation generally falls in the middle part of high mountains. Vegetation cover also changes depending on climate in relation to the vertical zonality. The mountains possess 3 steps; low mountainous, middle mountainous (1000-2500 m above the sea level) and high mountainous steppes (areas higher than upper boundaries of forests). Upper boundaries of zones depend on latitude of the area, direction of the mountain range and slopes as well as total climatic condition. Low mountainous vegetation resembles the neighboring plain vegetation zone. Individual peculiarities of the vegetation cover of the mountainous areas including the studied area can be regarded as vertical zonality. Mountainous features of the area, expositions of the slopes, soil characteristics, landslides and local characteristics of wind significantly affect the species depending upon the belts.

An irrational environment in the sandy deserts of the seashore stripe (Figure 1) results in a quick drying of sandy soils when hot days begin, but annual plants get a chance by using short rotational condition in the early spring.

#### ACKNOWLEDGEMENT

This study has been carried out by the support from the Science Development Fund of Azerbaijan Republic (EIF-2010-1(1)-40/26-3).

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Received: 10 March 2013

Accepted: 12 May 2013