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Life forms and ecological groups of the flora of the Absheron peninsula

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Abstract: Life forms of plants reflect their adaptability to environmental conditions and are units of the ecological classification of plants that characterize groups with similar adaptive traits. The study of the regional flora and its floristic complexes cannot be complete without an analysis of life forms, an environmental group in relation to moisture, and since this is important for solving both theoretical and practical issues. The flora of the Absheron Peninsula was studied in 2012-2019 and about 890 species belonging to 430 genera, 83 families were recorded. Based on the results, among the life forms grassy polycarpic herbs and hemicryptophytes prevail. According to the location of the families, the spectrum of therophytes mainly coincides with the general spectrum; therefore, the Absheron flora can be called as the theophyte flora. The representative ecological group in relation to moisture in the flora of the Absheron Peninsula is mesophytes. In relation to the intensity of illumination three groups of plants were distinguished: heliophytes, sciophytes, hemiheliophytes. Heliophytes play a dominant role.

Key Words: *geophytes, helophytes, hydrophytes, morphological group, phanerophytes, plant, therophytes*

INTRODUCTION

The Absheron peninsula is one of the most attractive territories of Azerbaijan, which drew attention of florists since 18s century. Detailed studies were carried out and a significant number of plant herbaria were collected by S.G. Gmelin [1774] and L.B. Marschall [1895]. The floral study of the peninsula, apparently, began with the collections of K.A. Meyer during 1829-1830 years (based on herbarium data, LE!!). Most herbarium materials collected at that time were from the immediate vicinity of Baku city. But despite the research done over the course of this century, no special summary were compiled. In the middle of the 19th century, floristic studies were carried out mainly by German scientists. One of them was K. Koch, who visited Absheron during the expedition to the Caucasus from 1843 to 1844, and collected numerous herbarium materials [1846]. Later N.K. Seidlitz studied the plant cover of Absheron by the application of floristic and geobotanic approach [1857]. The first work on the flora of Absheron was published by P.V. Schwann-Guriysky [1928]. This was a brief guide to the determination of plants based on literary data.

The remarkable publication on the flora of peninsula came out by I.I. Karyagin [1952]. Currently this is a key summary over the past 67 years and the only guide to the flora of the region. The herbarium specimens collected since the 2nd half of XX century expand our knowledge on the flora and vegetation of the territory. As a result of numerous expeditions organized by scientists many new localities of taxa for Absheron and Azerbaijan were found and currently kept in the herbarium of the Institute of Botany of the ANAS (BAK!!) and V.L. Komarov Botanical Institute of Russian Academy of Sciences (LE!!).

In recent years, the flora of peninsula has been studied in detail by local scientists and experts [Ismayilov, 2000; Mustafayeva, 2006]. The study of flora is limited not only to search for new species, but also to investigate the growth dynamics of plant species known for this territory. The purpose of this work is to study the changes in the flora of Absheron based on published literature and newly collected herbarium specimens, to clarify the taxonomic composition and bioecological features of the flora that is recorded for the area.

MATERIAL AND METHODS

The study of the Absheron flora was carried out from 2012 to 2019 by the route method, in combination with the sampling method (Fig. 1). The study territory is characterized by mountainous, desert and semi-desert relief Agburun, Ilkhy-dag, Baku Ears mountain, that possess mosaic vegetation, and variegated phytocenoses. In accordance with the adopted methodology, field observations were done every season. The collected herbarium materials are stored in the Herbarium at the

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Department of Geobotany of Moscow State University named after M.V. Lomonosov (MW) and in the Herbarium of the Institute of Botany of the ANAS (BAK).

Types of biomorphs, ecological groups were distinguished according to the classification of C. Raunkiaer [Raunkiaer, 1934; Serebryakov, 1964; Yurtsev, 1976; Babaev, 2003; Walter, Straka, 1970]. Intensity of illumination was studied according to Shennikov [1964].

We determined the plants according to available literature [Ali-zade et al., 2019; Flora Azerbaijan, 1950-1961; Karjagin, 1952; Parslow, Bennallick, 2017; Werier, 2017; Zernov et al., 2015].

Figure 1. The map of collection places in Absheron Peninsula.

RESULTS AND DISCUSSION

The analysis of the life forms of the species of the flora of the peninsula according to the K. Raunkier system revealed that theophytes dominate in the studied territory, comprising 433 species (48.7% of the total number of species), hemicrythophytes with 241 species (27.1%), geophytes with 116 species (13.1%) shares 2nd and 3rd places respectively. Thus, in total 790 species (88.8%) have a grassy life form. Trees and shrubs account for 27 species (3.1%). Chamephytes account for species (5.2%). Hydrophytes (species) and helophytes (15 species) are represented with a small number of species (Fig. 2).

A rather large percentage of therophytes can be explained, first of all, by the large semi-desert area on the territory of the Absheron Peninsula, as well as the presence of synanthropic (segetal and ruderal) annuals in the Absheron flora. According to the location of the families, the spectrum of therophytes mainly coincides with the general spectrum; therefore, the Absheron flora can be not only quantitatively, but also qualitatively called the theophyte flora. Among the therophytes in the leading positions of the family, Poaceae (80), Amaranthaceae (47), Compositae (44), Fabaceae (38), Brassicaceae (37), Caryophyllaceae (27). Among hemicryptophytes, Compositae (53) families occupy a leading position with a wide species composition, Poacae (36), followed by Fabaceae (24), Brassicaceae (20), Apiaceae (20), Caryophyllaceae (13), Plantaginaceae (11), Boraginacaea (8), and families with less than 5 species. Among the chamaphites, families occupy the leading place Amaranthaceae (17), Fabaceae (6), Lamiaceae (4), Polygonaceae and Compositae (3), Ephedraceae, Nitrariceae, Rosaceae and Solonaceae (2). Tamaricaceae, Rutaceae, Frankeniaceae, Cistaceae, Convolvulaceae, Cactaceae are represented by only one species.

A different picture among geophytes, where the spectrum of the leading families is represented by monocotyledonous, such as Poaceae (14), Cyperaceae (13), Asparagaceae (8) and dicotyledonous, such as Compositae, Lamiaceae and Juncaceae (7), Boraginaceae and Liliaceae (5), Orchidaceae, Polygonaceae, Caryophyllaceae, Amarylliaceae, Fabaceae and Orobanchaceae (4), Brassicaceae and Rubiaceae (3), Equisetaceae (2), Malvaceae, Primulaceae, Apocynaceae, Convolvulaceae (2), Iridaceae (1), etc.

Among the phanerophytes, the families Rosaceae (6), Tamaricaceae (4), Fabaceae (3), Anacardiaceae, Oleaceae, Cupressaceae (2 of each), Moraceae, Ulmacaea, Simarubaceae, Rhamnaceae, Elaeagnaceae, Pinaceae, Lythraceae, Caprifoliaceae are represented with only one species.

The aqueous biomorph (hydrophytes) were 13 species, (1.4%) including: *Najas marina* L., *Zannichellia major* Boenn., *Potamogeton pusillus* L., *P. crispus* L., *P. perfoliatus* L., *Lemna minor* L., *L. gibba* L., *Zostera noltii* Hornem., *Ranunculus trichophyllum* (Chaix) Bosch., *Ceratophyllum demersum* L., *Zannichellia palustris* L., *Z. palustris* ssp. *pedicellata* (Wahlenb. & Rosén) Hook. f., *Ruppia maritima* L.

Helophytes (marsh plants) were represented with a small group of species (1.3%) – *Typha caspica* Pobed., *T. laxmannii* Lepech., *T. grossheimii* Pobed., *T. domingensis* Pers., *T. angustifolia* L., *Potamogeton trichoides* Cham. et Schl., *Stuckenia pectinatus* (L.) Börner, *Triglochin maritimum* L., *Carex riparia* Curt., *Rumex pulcher* L., *R. palustris* Smith., *Nasturtium officinale* W.T. Aiton.

Thus, the analysis of the life forms of the Absheron

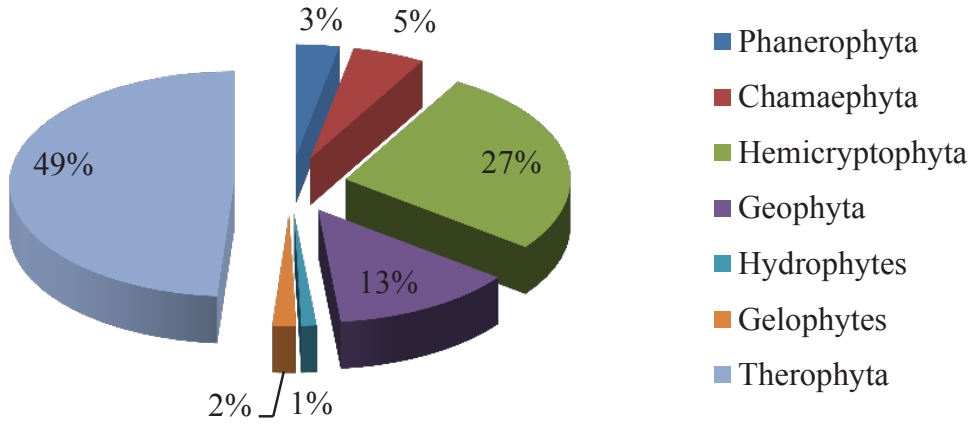

Figure 2. The spectrum of life forms according to C. Raunkier (1934).

Peninsula reflects the regional specificity of the flora, is consistent with the features of the relief, soil and climatic conditions and the diversity of vegetation in the study area.

In addition to the biomorphological spectrum, ecological spectrum of the flora was considered. An ecological group or ecological types are a collection of plants of different life forms, living in similar environmental conditions with a number of common attributes. The following ecological plant groups were identified with respect to moisture availability (Table):

1) xerophytes − plants of dry habitats. Sclerophytes are considered as xerophytes in this work, since succulents are absent in the native Absheron flora. This plant possess a number of adaptive signs and properties, can tolerate overheating and dehydration, such as: *Stipa arabica* Trin. et Rupr., *S. capensis* Thunb., *Petrorhagia saxifraga* (L.) Link., *Sterigmostemum caspicum* (Lam.) Kuntze., *Astragalus tribuloides* Del., *A. asterias* Steven. etc.

2) xeromesophytes − a group of plants that have a deep root system, intense transpiration and low resistance to dehydration and overheating (hemixerophytes): *Achillea arabica* Kotschy., *Artemisia scoparia* Waldst. & Kit., *A. fragrans* Willd., *Stipa lessingiana* Trin. et Rupr., *Linum nodiflorum* L., *L. austriacum* L. etc.

3) mesoxerophytes − a group of plants growing under conditions of a short-term lack of moisture in the soil (stipaxerophytes): *Bromus squarrosus* L., *Cannabis sativa* L., *Koeleria macrantha* (Ledeb.) Schult., *Rosa canina* L. etc.

4) mesophytes − plants that live in conditions with a more or less sufficient, but not excessive amount of water in the soil: *Oxalis corniculata* L., *Geranium rotundifolium* L., *G. molle* L., *Vicia sativa* L., *Euphorbia maculata* L., *Malva sylvestris* L., *M. nicaeensis* All., *Bifora radians* M. Bieb. etc.

5) mesohygrophytes − plants of elevated, but not stagnantly moistened habitats: *Geranium robertianum* L., *Potentilla reptans* L., *Sedum pallidum* M. Bieb., *Thlaspi arvense* L., *Ranunculus repens* L., *Myosurus minimus* L. etc.

6) hygrophytes − plants of excessively moistened habitats, with excess air humidity, growing both in the littoral part of the reservoir and on abundantly moistened soil far from the reservoir: *Epilobium hirsutum* L., *Samolus valerandi* L., *Veronica anagallis-aquatica* L., *Ranunculus marginatus* d'Urv., *R. sceleratus* L., *Suaeda*

Table. The ratio of environmental groups in relation to the moisture of the substrate.

Ecological group	Number of species	% of the number of species of the whole flora
Xerophytes	265	29,7
Xeromesophytes	144	16,1
Mesoxerophytes	119	13,5
Mesophytes	271	30,7
Mesohygrophytes	40	4,4
Hygrophytes	35	3,9
Hydatophytes	16	1,8
Total	890	100

altissima (L.) Pall., *S. maritima* (L.) Dumort. etc.

7) hydrophytes − plants, fully or mostly, immersed in water: *Ranunculus trichophyllum* (Chaix) Bosch., *Potamogeton pusillus* L., *P. crispus* L., *Ruppia maritima* L., *Lemna minor* L., *L. gibba* L., *Nasturtium officinale* W.T. Aiton. etc.

A group of mesophytes (271) dominate among the ecological group with respect to moisture in the flora of Absheron Peninsula. At first glance, it is unexpected, desert vegetation prevails among other vegetation types. Such a range of ecological groups becomes understandable if we take into account that the greatest species richness is noted not in the desert and semi-desert, but in mesophyte habitats.

Species gravitating to the mesophyte type (mesophytes proper, xeromesophytes, mesoxerophytes and mesogygrophytes) are 568 (64.5%), aquatic and gravitating to the water type, including mesogyrophytes, 90 species (10.2%), the bulk of which are found in the Absheron peninsula. But the group of xerophytes is not small, confined to the steppe, saltwart and ruderal communities, includes 261 species (29.7%).

In relation to the intensity of illumination in the flora of the Absheron Peninsula, we distinguished three groups of plants (Fig. 3.): heliophytes − species that grow in full sunlight; sciophytes − plants of shady habitats; hemigeliophytes (shade tolerant) − a group of species that can tolerate periodic shading.

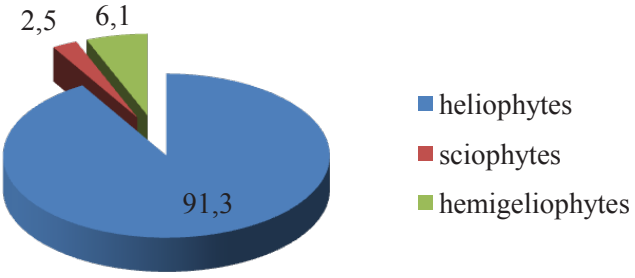

Figure 3. The ratio of ecological groups with respect to light in the flora of the Absheron Peninsula: 1 – heliophytes; 2 – hemigeliophytes; 3 – sciophytes.

The observed majority of heliophytes were 814 species (91.5%). The hemigeliophyte group was 15 times smaller - 6.1%. Sciophytes include 22 species (2.5%), which are common in forest communities of the Absheron peninsula: *Asplenium scolopendrium* L., *A. trichomanes* L., *A. ruta-muraria* L., *Anogramma leptophyllum* (L.) Link., *Pteris vittata* L., *Adiantum capillus-veneris* L., *Polystichum aculeatum* (L.) Roth. ex Mert., *Equisetum telmateia* Ehrh., *Cephalanthera damasonium* (Miller) Druce., *Anacamptis papilionacea* (L.) R.M. Bateman, Pridgeon & M.W. Chase., *Orchis simia* Lam., *Ophrys sphegodes* ssp. *mammosa* (Desf.) Soó ex E. Nelson., *Cerastium glomeratum* Thuill., *Silene vulgaris* (Moench) Garcke. etc. The occurence of many sciophytes is extremely low, so half of them can be classified as rare, and ferns are likely to have disappeared on the territory of Absheron.

Thus, the analysis of life forms showed the dominant position belongs to grassy polycarpic herbs (51.1%) and hemicryptophytes (27.1%). The share of woody life forms is 8.3%, respectively, of phanerophytes and chamefites – 3 (5.3%). The increasing role of monocarpics or therophytes (48.7%), as a consequence of the aridity of the territory and synanthropization of the flora, is due to the disturbance of the vegetation cover. In relation to humidity, mesophytes prevail with 271 species (30.7%), heliophytes with 814 species (91.5%).

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Abşeron yarımadasının florasının həyatı formaları və ekoloji qrupları

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Bitkilərin həyat formaları onların ətraf mühit şəraitinə uyğunlaşmasını əks etdirir və oxşar uyğunlaşma əlamətləri olan bitki qruplarını xarakterizə edən ekoloji təsnifat vahidləridir. Regional floranın və onun floristik komplekslərinin öyrənilməsi bitkilərin həyat formalarının, rütubətə və işığa olan tələbatına görə təhlili olmadan tam ola bilməz və bu həm nəzəri, həm də praktik məsələlərin həlli üçün vacibdir. 2012-2019-cu illər ərzində Abşeron yarımadası tərəfimizdən tədqiq olunur. Burada 83 fəsilə, 430 cins və 890 növ olduğu müəyyənləşdirilmişdir. Həyat formalarının təhlili polikarp ot bitkilərinin və hemikriptofitlərin üstünlük təşkil etdiyini göstərdi. Floranın fəsilə tərkibi və terofitlərin spektri əsasən ümumi spektrlə üst-üstə düşür, buna görə də Abşeron yarımadasının florası yalnız kəmiyyət baxımından deyil, həm də keyfiyyətcə terofit florası adlandırıla bilər. İlk baxışdan bu gözlənilməz olsa da, Abşeron yarımadasının florasında rütubətə tələbat baxımından daha çox təmsil olunan ekoloji qrup mezofitlərdir. Abşeronun florasında işığa münasibətinə tələbata görə bitkilərin üç qrupunu fərqləndirilmişdir: heliofitlər, stilofitlər, hemiheliofitlər. Bunlardan

heliofitlər florada dominant rol oynayır.
Açar sözlər: *geofitlər, helofitlər, hidrofitlər, morfoloji qrup, fanerofitlər, bitki, terofitlər*

Жизненные формы и экологические группы флоры Апшеронского полуострова

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Жизненные формы растений отражают их адаптивность к условиям окружающей среды и являются единицами экологической классификации растений, которые характеризуют группы растений со сходными адаптивными признаками. Изучение региональной флоры и ее флористических комплексов не может быть полным без анализа жизненных форм, а также экологических групп по отношению к абиотическим факторам среды, что имеет важное значение для решения как теоретических, так и практических вопросов. Флора Апшеронского полуострова была изучена в 2012-2019 гг. В ходе исследования зарегистрировано 890 видов, относящихся к 430 родам, 83 семействам. На основании полученных результатов среди жизненных форм преобладают травянистые поликарпатические травы и гемикриптофиты. По расположению семейств спектр терофитов в основном совпадает с общим спектром, следовательно, флору Апшерона можно назвать флорой терофитов. Ведущей экологической группой по отношению к воде во флоре Апшеронского полуострова являются мезофиты. По отношению к свету выделены три группы: гелиофиты, скиофиты и полугелиофиты. Гелиофиты играют доминирующую роль.
Ключевые слова: *геофиты, гелофиты, гидрофиты, морфологическая группа, фанерофиты, растения, терофиты*