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ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

THE FLORA, VEGETATION AND THEIR EFFECTIVE USE OF GARAGUSH MOUNTAIN OF NAKHCHIVAN AUTONOMOUS REPUBLIC

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INTRODUCTION

Relevance of the subject and stage of elaboration: Plants play a major role in protecting the soil cover, cleaning the atmospheric air, regulating the water regime, protecting people's health, increasing labor capacity, and implementing therapeutic and preventive measures in medicine. Therefore, the protection of plants and their natural phytocenoses, which play an indispensable role in human society in nature, an important national task and a matter of national importance[1]. Also, at the modern stage of society's development, in a period when people involve new natural objects in production, comprehensive study of regional flora is great importance. This kind of regional floristic research, which is the basis of the rational use of plant resources, is necessary for the solution of economic problems of many resources, such as the new identification of resources. From this point of view, it is very important to study the natural resources of separate botanical geographic regions of independent Azerbaijan. In particular, the cultivation of flora of Garagush mountain of the Nakhchivan Autonomous Republic is an important and urgent problem.

On June 22, 2009, by the Decree of the Chairman of the Supreme Assembly of the Nakhchivan Autonomous Republic, the Arpachay State Nature Reserve was established, covering the territories along the Daralayaz range (administrative territories of Sharur, Kangarli, Babek and Shahbuz districts) with an area of 68,911 ha[2]. The aim is to protect natural complexes or their components, to maintain ecological balance. The territory of Garagush Mountain is included in the territory of Arpachay SNR.

The Garagush mountain region serves as a summer pasture for cattle from the Sharur and Kangarli regions. From the beginning of May to October, dozens of farms operate in this region. However

[1] Azərbaycan Respublikasında bioloji müxtəlifliyin qorunması və davamlı istifadəsinə dair Milli Strategiya və Fəaliyyət planı. Azərbaycan Respublikası Prezidentinin 2006-cı il 24 mart və 14 fevral 2015-ci il tarixli Sərəncamı ilə təsdiq edilmişdir.

[2] "Arpaçay" Dövlət Təbiət Yasaqlığı. Naxçıvan Muxtar Respublikası Ali Məclisi sədrinin 22 iyun 2009-cu il tarixli 167-III FR nömrəli Fərmanı.

until this time, the possibilities of using the research area as a summer pasture have not been investigated. The area has rich wild ornamental, vegetable, fruit and medicinal plants. Nevertheless, their modern state in nature, their reserves and the possibilities of effective use have not been researched. Furthermore, there are dozens of rare and endangered plants included in the Red Book of the former SSRI, the Republic of Azerbaijan, and the Nakhchivan AR, and the current states of those species in nature has been partially studied, but however, their precise status has not been determined.

Species such as sedge are also of interest*Stipa issaevii S. G. Mussajev & Sadychov*, *Stipa karjaginii S.G. Mussajev & Sadychov*, *Astragalus karakuschensis* Gontsch.,*Astragalus montis - aguilis* Grossh., *Galium achurense* Grossh., *Campanula karakuschensis* Grossh., *Crepis karakuschensis* Czer. described for the first time fromthe study area.

The object and subject of the research: The study of the flora and vegetation of the Garagush mountain area of the Nakhchivan Autonomous Republic, the determination of the taxonomic table of plants by seasons, the study of formations and associations, the registration of rare and endangered species.

The goals and objectives of the research: To clarify the taxonomic composition of the flora in the area of Garagush Mountain of Nakhchivan Autonomous Republic, to classify the detected vegetation by studying its phytocenological characteristics, to differentiate the senosis-forming species (dominant, subdominant, edificator), to identify rare and endangered species.

The following tasks are planned in order to achieve the goal determined while conducting the research:

- Identification, examination and comprehensive analysis of the reserve fund stock of plants spreaded in the Garagush mountain region;
- Compilation of the taxonomic spectrum and conducting a systematic analysis of high-spore, gymnosperm and angiosperm plants spread in the Garagush mountain area;

- Study of the vegetation spread in the Garagush mountain area, description of their formation associations, identification of cenozoic species;
- Analyzing the current situation in vegetation, summer pasturesmaintaining the stability of these areas used as and conducting research for its effective use;
- Endemic, rare and endangered species specification of its modern state and status, efficientresearching ways of use and protection, of coursedrawing up a map scheme of distribution zones;
- Studying the natural resources of some of the wild ornamental, vegetable, fruit and medicinal species in vegetation types, preparing appropriate recommendations and proposals for their efficient use;

Research methods: During the research, according to the plan, taxonomic analysis of the species by families was carried out. At the end of the study, the taxonomic spectrum of the detected species was prepared according to the families and species. Vegetation of the study area was determined according to the indicator plants, and the cenozonic ones of the vegetation were defined, and their formations and associations were described. Classic and modern botanical - floristic, systematic, ecological, aerological, phytocenological and statistical methods were utilized in the process of the research. The photos of formations in phytocenoses, as well as rare species, were taken separately.

The main provisions defended: Compilation of the taxonomic spectrum of high-spore, gymnosperm and angiosperm plants distributed in the territory of Garagush Mountain and carrying out a systematic analysis is the basis for use as a source in writing the flora of the Nakhchivan Autonomous Republic;

- Studying the vegetation spread in the Garagush mountain area, describing their formations and associations, identifying the cenosoil-forming species,efficient use of those areas as summer pasturesreveals its possibilities;
- Determining the current status of endemic, rare and endangered species and drawing up a map scheme of their natural

distribution zones is important from the point of view of species protection;

Wild ornamental, vegetable, fruit in the Garagush mountain the relevant recommendations and suggestions given for the study of the natural resources of some medicinally important species and their effective use are important for the development of various fields of application.

Scientific novelty of the research: For the first time, high-spored, gymnosperm and angiosperm plants were studied and discovered taxa systematic analysis was carried out. The taxonomic spectrum revealed mainly in the study area are represented by 856 species belonging to 89 families and 484 generawhich is 28.3% of the flora of the autonomous republic.

For the first time in the territory of Garagush Mountain, the existing vegetation was studied and their structure was investigated at the considering of formation class, formation and association, and the characteristic cenozoic types of vegetation were determined.

During the inspection of species with rare status, 42 familias and 76 species belonging to 62 genera found in the study area were clarified.

For the first time, the modern status and natural resources of some of the wild ornamental, vegetable, fruit and medicinal species in the Garagush mountain area were studied, and relevant recommendations and suggestions were given for their effective use (The Ministry of Ecology and Natural Resources of the Nakhchivan Autonomous Republic, The Ministry of Agriculture of the Nakhchivan Autonomous Republic) .

Theoretical and practical significance of the research: The results of research on flora and vegetation, as well as systematic and taxonomic analyses, information on rare and useful species, can also be used "Flora of Nakhchivan AR", "Flora of Azerbaijan", "Vegetation of Nakhchivan AR", "Useful plants of Nakhchivan AR", at the same time of "Red Book of Nakhchivan AR" and "Red Book of Azerbaijan" in the new editions. As a result of the research, it is useful as a country study material in the teaching of “Biology” and

“Ecology” subjects in the İnstitutions of the Ministry of Education of Nakhchivan AR.

Numerous plant samples collected during the expeditions were handed over to the Herbarium funds of the Bioresources Institute of Nakhchivan Branch of ANAS, Botany Institute of ANAS and Nakhchivan State University, and they play a certain role in their enrichment.

Wild ornamental, vegetable, fruit and medicinal plants are important in the Garagush mountain area study the natural reserve of some of the species and the relevant recommendations for their effective use are of practical importance in the use of plants, which are an inexhaustible natural resource.

Discussion of the work: The main provisions of the dissertation The 1st International scientific and practical conference "Science and education: problems, prospects and innovations" (October 7-9, 2020) CPN Publishing Group, Kyoto, Japan. 2020", The 5th International scientific and practical conference "World science: problems, prospects and innovations" (January 27-29, 2021) Perfect Publishing, Toronto, Canada. 2021, Nakhchivan Teachers' Institute, "Unification of education, research and innovations III Regional Scientific Conference of Doctoral and Masters Students, Nakhchivan April 30, 2021, III International Mediterranean Scientific Research Congress. Cyprus. Nicosia June 17-20, 2021, The XVIII International Scientific Symposium "The Past and Future of the Turkish world" September 25, 2021 Nur-Sultan Kazakhstan, Modern scientific research: achievements, innovations and development prospects Proceedingsof IX international scientific and practical conference Berlin, Germany.

Publications: 9 scientific articles containing the main provisions of the dissertation were published, 7 conference materials were discussed.

Name of the organization where the dissertation work was performed: The dissertation work was performed at the Department of Biology of Nakhchivan State University.

Dissertation volume and structure: Dissertation is written in Azerbaijani and consists of 160 pages. It includes an introduction, the main part of 6 chapters, conclusions, suggestions and

recommendations (total volume with reference - 256 520), a bibliography list of 240 titles and appendices. There are 20 pictures and 13 tables in the dissertation work. The appendices involve the taxonomic composition of the Garagush mountain flora, eco-biological characteristics of rare species, and areal maps of species.

THE MAIN CONTENT OF THE DISSERTATION

I CHAPTER. LİTERATURE REVİEW ON THE RESEARCH OF THE FLORA AND VEGETATİON OF THE GARAGUSH MOUNTAİN AREA İN THE NAKHCHİVAN AUTONOMOUS REPUBLİC

Here, the sources of literature up to 2021 about the department, family, genus and species of the researched field of individual authors were examined and a wide comment was given in the dissertation[3, 4, 5]. As a result, it was concluded that the area of Garagush mountain is under-explored.

II CHAPTER. PHYSİCAL - GEOGRAPHİCAL CONDİTİONS OF THE RESEARCH AREA

2.1. The influence of the climatic conditions of Garagush mountain on the vegetation in the territory of Nakhchivan Autonomous Republic. Here, the types of climate specific to the area have been investigated. Two of the 5 climate types characteristic of Nakhchivan AR were found in the area of Garagush Mountain. These are the second and third climate types, the second climate type is a cold climate with dry and hot summers, and the third climate type is a dry and cool summer.

[3] Talıbov, T.H. Naxçıvan Muxtar Respublikası florasının taksonomik spektri (Ali sporlu, çılpaqtoxumlu və örtülütoxumlu bitkilər) / T.H.Talıbov, Ə.Ş.İbrahimov, Ə.M.İbrahimov, İkinci nəşr, -Naxçıvan: Əcəmi, -2021, -426 s.

[4] Qasımov, H.Z. Naxçıvan Respublikası florasında yabanı tərəvəz bitkilərinin genefondunun öyrənilməsi, bərpası və yeni istifadə imkanları: Biologiya elmləri üzrə fəlsəfə doktorluq diss. avtoreferatı // -Bakı, 2010, -24 s.

[5] Seyidov, M.M. Şahbuz Dövlət Təbiət Qoruğunun florası və bitkiliyi: Biologiya elmləri üzrə fəlsəfə doktorluq diss. avtoreferatı //- Bakı, 2011, -21 s.

2.2. Soil types of Garagush mountain. "Mountain-meadow-desert" lands were formed in the Garagush mountain area. But "grassy - mountain - meadow" soil type is also found.

2.3. Hydrography of Garagush mountain. It mentions the rivers and springs of Garagush mountain, which includes Lizbirchay, Billavachay, Khanbulaga and a number of roadside springs.

2.4. Landscape of Garagush mountain. The formation of the landscape features of the Lizbird geobotanical region was caused by sediments of the Senonian and Turonian periods, and in the Garagush geobotanical region, limestone and sandstone, shale and quartzite sediments of the Cenomanian and Devonian periods were formed. As a result, semi-desert and mountainous steppes with xerophytic bushes are characteristic here. it was determined that mountain xerophytes and weak xerophyte shrub complexes were assimilated in the gray soils of the area broken by dry streams and ravines.

CHAPTER III. MATERIAL AND METHODOLOGY OF THE RESEARCH

Geobotanical analyzes were conducted during the routes organized to Garagush Mountain, the structure and composition of the vegetation, the number of species there, edifiers and dominants, in short, the floristic-geobotanical indicators of the areas were studied, the richness of the flora was studied marked with O.Druden's 5-point scale. The territory of plants and their geographical elements given according by A.A. Grossheim[6], N.N. Portenier[7].

The measurement of experimental areas was carried out with the device "Laser distance measuring telescope" TOMSHCO TM 1000A.

Specification of systematic taxa International Code of Botanical Nomenclature, *Angiosperm Phylogeny Group* (APG I, II, III, IV) and *Pteridophyte Phylogeny Group*- PPGI, ANAS was conducted on the basis of the actual materials in the Herbarium fund of the Institute of

[6] Гроссгейм, А.А. Анализ флоры Кавказа /А.А. Гроссгейм, –Баку: Аз.ФАН СССР, –Т.1, –1936,–259 с.

[7] Портениер, Н.Н. Система географических элментов флоры Кавказа //Ботанический журнал, -Москва: - 2006, -Т. 85, - № 9, -с.126-134.

Bioresources of the Nakhchivan department and the Herbarium fund of Nakhchivan State University.

During the routes, the bioecological characteristics and vegetation types of plant species distrubuted in the territory of Arpachay State

Nature Reserve, including Garagush Mountain, plant formations and associations in different zones, rare and endangered species were studied, and new distribution zones of a number of species were determined in the area.

CHAPTER IV. SYSTEMATIC OVERVIEW OF THE FLORA OF THE GARAGUSH MOUNTAIN AND BIOECOLOGICAL CHARACTERISTICS

4.1.Taxonomic spectrum of flora of Garagush mountain. As a result of the conducted research, flora and vegetation types were studied in the area of Garagush Mountain and we discovered 19 species of *Bryophyta* and *Pteridophyta* are concentrated in 5 genera belonging to 4 families and 5 species in Garagush mountain area. Some of these species were found on the rocks in the forest-shrub zone, while others were found on the rocks in the subalpine zone. 2 species of the *Equisetophyta* family were found in mesophilic meadows and on the edges of springs. The familia of *Ephedraceae* is one of the monotypic families and has only one genus. This genus includes 4 species in the Republic of Azerbaijan, and 3 species in the Nakhchivan MR. In the area of Garagush Mountain, we came across formations of *Ephedra procera* Fisch & C.A. Mey. and *E. distachya* L. in almost many places. *Ephedra* plays a dominant role in some of the described formations. In the research area 3 species were found in the *Pinophyta* division, only *Juniperus communis* L., *J.foetidissima* Willd. and *J. sabina* L. belonging to the genus *Juniperus* L. *Magnoliophyta* division has been determined to have 199 species in 20 families and 108 genera in *Monocotyledoneae* class, and 626 plant species in 49 families and 351 genera in *Dicotyledoneae class* (Table 1).

Table 1

High-spored, Gimnospermae and Angiospermae flora of Garagush mountain division of plants by departments

Divisio		Familia	Genus	Species	Rare types
Bryophyta		13	17	19	-
Pteridophyta (Polypodiophyta)		4	5	5	2
Equisetophyta		1	1	2	-
Gnetophyta		1	1	2	-
Pinophyta (Gimnospermae)		1	1	3	3
Magnoliophyta (Angiospermae)	Classis: Monocotyledoneae	20	109	199	22
	Classis: Dicotyledoneae	49	351	624	49
Total:		89	484	856	76

4.2.Distribution and quantity rations of genera and species of the families included in the Garagush mountain flora. Studies on the research of flora biodiversity, collection of materials, identification and protection of rare species were conducted in the area of Garagush mountain. In the spring, summer and autumn of 2019-2021, expeditions were made to the area on 102 routes in 10 directions, and a large number of herbarium materials were collected. Classic and modern botanical floristic, systematic, ecological, areological, phytocenological, plant resources and statistical methods were used during the research. As a result of the conducted researches, all the taxa included in the flora biodiversity of high-spored, bare-seeded and angiosperm plants in the Garagush Mountain area were determined. *Asteraceae* Bercht. & J. Presl - Asteraceae family ranks first with 56 genera and 106 species. It was concluded that the *Poaceae* Barnhart family of rodents occupies the second place with 53 genera and 86 species. Then *Brassicaceae* Burnett 52 species in 38 genera, *Fabaceae* Lindl. family 16 genera and 48 species, *Lamiaceae* Martinov family 24 genera and 45 species, *Caryophyllaceae* Juss. family 24 genera and 45 species, *Rosaceae* Juss. family consists of 17 genera and 36 species (Table 2). In total, there are 418 species included in 228 genera in those 7

families, which makes up 48,8% of the flora biodiversity identified in the study area.

Table 2

Distribution and amount of genera and species of the dominant families in the Garagush mountain flora

Row №	Familia	Genus	Species
1.	*Asteraceae* Bercht. & J. Presl	56	106
2.	*Poaceae* Barnhart	53	86
3.	*Brassicaceae* Burnett	38	52
4.	*Fabaceae* Lindl.	16	48
5.	*Lamiaceae* Martinov	24	45
6.	*Caryophyllaceae* Juss.	24	45
7.	*Rosaceae* Juss.	17	36

160 families, 910 genera and 3020 species of high-spore, gymnosperm and angiosperm plants were found in the territory of Nakhchivan AR, including 89 families, 484 genera and 856 species in the Garagush mountain area. Thus, the taxa included in the flora biodiversity of high-spore, gymnosperms and angiosperms plants in the area of Garagush mountain of the Daralayaz mountain range make up 55.6 % of the total flora biodiversity of the families of the Autonomous Republic, 53.1 % of genera, and 28.3 % of genera. Species. 37.5 % of the 200 of rare plants present in the territory of the Autonomous Republic in the area of Garagush Mountain.

4.3. Life forms and their bioecological characteristics of species included in the main groups of the flora of Garagush mountain. The species included in the main families that make up the biodiversity in the Garagush mountain area were identified, and their life forms and bioecological characteristics were studied. Distribution of Garagush mountain flora according to floristic types was performed according to A.A.Grossheim. 16 families to the Boreal type, 2 families to the Ancient type, 16 families to the Desert type, 16 families to the Mediterranean class belonging to the xerophyte type - 32 families, 16 families to the Front Asian class, 3 families to the Desert type, 23 families to the Caucasian type are

mostly not included and none of the species belonged any families were included to Adventive floristic type[8, 9, 10].

The compilation of General life forms of the family plants included in the flora of Garagus mountain was carried out according to the K.Raunkiyer[11] (Table 3).

Table 3

Distribution of Garagush mountain flora according to vital forms

Row №	Vital forms	Families
1.	Hemicryptophyte	35
2.	Xamephyte	18
3.	Phanerophyte	14
4.	Cryptophyte	11
5.	Terofit	9
6.	Succulent	2

V CHAPTER. PLANT TYPES OF THE GARAGUSH MOUNTAİN AREA AND THE FORMATİONS FORMED BY THEM

5.1. The desert and semi-desert vegetation of the Garagush mountain area. In the territory of the Nakhchivan Autonomous Republic, T.H. Talibov and A.S.Ibrahimov defined 15 plant types. Desert, Semi-desert, Wetland (aguiherbosa). Mountain steppe (gariga), mountain xerophyte (frigana), Shrubland, Arid forest and

[8] Qurbanov, E., Novruzi, N. Qaraquş dağı ərazisində Orobanchaceae Vent. fəsiləsinin nadir növləri //AMEA Naxçıvan Bölməsi. Elmi əsərlər jurnalı. Təbiət və texniki elmlər seriyası. -2021. -№2, -s. 62-66.

[9] Talıbov, T., Novruzi, N. Rare plants including in Asphodelaceae Juss. and Liliaceae Juss. families in the area of Garagush mountain // The 1st International scientific and practical conference “Science and education: problems, prospects and innovations”, Kyoto: - 7-9October, -2020. -p.109- 120.

[10] Новрузи, Н.А., Аббасов, Н.К. Marrubium plumosum (Lamiaceae) – новый вид для флоры Нахичеванской автономной республики // Ботанический журнал, -2021, -Т. 106, -№ 12, -стр. 1227-1229.
DOI: 10.31857/S0006813621120036

[11] Raunkier, C.R. The life form of plants and statistical plant geography /C.R.Raunkier, –Oxford:Clparendon Press, –1934. – p.719. (–p. 48-154)

sparse woodland, Forest (liginosa), Subalpine meadows and tall grasses, Alpine meadows and carpets, Rock-fall (petrophile) considered secondary along with the main vegetation types Sand (psammophilous), Ephemeral-galiant (colored soil vegetation), Gamma (gypsum soil vegetation), Synanthropus (adventive, cosmopolitan, agrophytocenosis, etc.), vegetation formed by ephemeral subtropical vegetation. As a result of the conducted research, the characteristic features of the types of vegetation found in the area of Garagush Mountain were noted (Table 4).

Table 4

Vegetation types and formations of the Garagush mountain area

Row №	Vegetation tipi	Sea level height (in m)	The one that comes across number of formations and associations
1.	Desert and semi-desert vegetation	600-1000 m	2 formations 2 associations
2.	Gammada vegetation Ephemeral-galliant vegetation Psammophyl vegetation	1000-1400 m (1200-1300 m)	3 formassiya 3 associations
3.	Mountain-xerophyte vegetation	1500-1800 m 1500-2000 m	4 formations 8associations
4.	Gariga vegetation	1800-2200 m	2 formations 3 associations
5.	Forest and shrub vegetation	1500-2200 m	8formations 10associations
6.	Subalpine meadows and tall grass	2400-2600 m	3 formations 6 associations
7.	Petrophilous vegetation	2000-2600 m	4 formations 5 associations

Some of the typical desert elements were found in the foothills of Garagush mountain, especially in Gendara and Sariagil zone[12].

[12] Novruzi, N.A. Desert and semi-desert vegetation of Garagush mountain //Euroasian Union of Scientistis. Серия: междисциплинарный Ежемесячный научный журнал.-2021. –v. 1, -№9 (90), -p.4-8. DOI: 10.31618/ESU.2413-9335.2021.1.90

However, it can be argued that desert vegetation is not fully formed, but that desert vegetation constitutes a transition to semi-desert vegetation. There are local saline, ephemeral-gallian (colored soil), gammada (gypsum soil) and sandy areas in Demilar, Jandara, Sariagıl, Ramler and Lizbird valleys of Garagush mountain.

5.2. Gammada (gypsum soil), Ephemeral-galliant (colored soil) and Psammophilous (soil) vegetation. Gamma (gypsum soil) vegetation is widespread in patches of gypsum soils in the foothills and lower mountain belts. It was formed by the dominance of desert-type plants and has its own composition and structure. The basis of the vegetation is small saltbush plants and frigana plants. The main dominant and edifying plants are *Salsola cana* C.Koch, *Salsola tomentosa* (Moq) Spach, *Salsola crassa* Bieb., *Amblyopogon xanthocephalus* (Fisch. et C.A.Mey.) Sosn.etc.

Formation: *Salsoleta canae*

Association: *Salsola cana + Salsola ericoides+ Kochia prostrata + Artemisia scoparia + Artemisia absinthium + Leontice minor + Capparis spinosa + Atraphaxis spinosa + Stachys inflata + Euphorbia seguieriana + Stipa barbata +Aegilops cylindrica*

Ephemeral-galyant (colored soil) vegetation is one of the phytocenoses that is very characteristic for the vegetation of Nakhchivan Autonomous Republic. This type of vegetation is common in calcareous soils with red, green, yellow, blue and other shades of color. Ephemeral vegetation belongs to winter pastures. Feed cost is high only in rainy spring and autumn.

Formation: *Ceratocephaleta incurvea*

Association: *Ceratocephala incurva + Caccinia macranthera + Cousinia cynaroides Carthamus + oxyacanthus + Geranium tuberosum + Tribulus terrestris + Eryngium campestre + İxiolirion tataricum + Gagea reticulata + Aegilops cylindrica*

Sandy (psammophilous) vegetation was found as a local vegetation in the area of Garagush mountain, in Gendara and Lizbirt river-valley. In the meadow-like phytocenosis formed by vegetation, the following formation and association have been formed:

Formation: *Alhagieta pseudoalhagae*

Association: *Alhagi pseudoalhagi + Atriplex tatarica + Artemisia absinthium + Puccinellia bulbosa + Juncus littoralis + Halocnemum strobilaceum + Euphorbia humifusa + Salicornia europaea + Chenopodium rubrum + Phragmites australis + Ceratocarpus arenarius*

5.3. Mountain xerophyte (phrygana) vegetation. Mountain - xerophyte (freegana) vegetation covers a large part of the middle mountainous area, developing at heights of 1500-2000 m in the Nakhchivan AR plain. This type of vegetation is found in the mid-mountain zone where it connects with the semi-desert. This type of vegetation occupies almost half of the total area in the Garagush mountain area. At the same time, it is found in the form of small glades in forest-steppe and even meadow-shrub areas at altitudes of 1500-1800 m

Formation: *Atraphaxis spinosa* L.

Formation: *Acantholimon festucaceum* (Jaub. et Spach) Boiss.

5.4. Mountain-steppe (gariga) vegetation. Mountain-steppe (gariga) vegetation forms a zonation in the area of Garagush mountain, covering heights of of approximately 1800-2200 m above sea level.Ephemera and ephemeroids are widespread in phytocenoses here. This vegetation type has its own species composition, indicator and dominant plants[13].

Zygophyllum atriplicoides Fisch & C.A. Mey. and *Zygophyllum fabago* L. belonging to the genus *Zygophyllum* L. of the family *Zygophyllaceae* R.Br., *Tribulus terrestris* L. belonging to the genus *Tribulus* L., *Atraphaxis spinosa* L., *Atraphaxis angustifolia* Jaub. & Spach, *Fabaceae* Lindl. *Astracantha aurea* (Willd.) Podlech, *Astracantha barba - carpina (Al. theodorii* Fed. & Rzazade) Podlech, *Astracantha karjaginii* (Boriss.) Podlech, *Astragalus* L., belonging to the genus *Astragalus aznabjurticus* Grossh., *Astragalus karakuschensis* Gontsch., *Astragalus lagurus* Willd., *Astragalus montis - aguilis* Grossh., *Astragalus nachitchesvanicus* Rzazade, *Rhamnaceae* Juss., *Paliurus* Hill of the tribe. belonging to the genus *Paliurus spina -*

[13] Novruzi, N.A. Qaraquş dağının dağ kserofit (friqana) və dağ-bozqır (qariqa) bitkiliyi //The XVIII İnternational Scientific Symposium “The Past and Future of the Turkie world”. -Nur-Sultan/ Kazakhistan: - 25 september, -2021. - P. 189-192.

christi Mill., *Rhamnus* L. belonging to the genus *Rhamnus cathartica* L., *Juniperus communis* L., *Juniperus foetidissima* Willd. belonging to the genus *Juniperus* L. of the *Cupressaceae* S.F.Gray family belongs to this group of species.

5.5. Forest and shrub vegetation. Forests in this zone are mixed and have a combination of different forest plants. *Crataegus, pyrus, rosa* and *berberis* species are among the dominant tree and shrub plants in the forest as well as *Fraxinus excelsior* L., *Acer campestre* L., *Quercus macranthera* Fisch. & C.A. May. ex Hohen also attract attention.

The formations replace each other as the river rises. In the area of Garagush mountain, the formations of semi-desert, mountain desert (gariga) and mountain xerophyte (frigana) vegetation, which are typical for the area and are mainly dominated by xerophytic tree and shrub species, are as follows:

1. Formation: *Tamarixeta*
2. Formation: *Berberieta*
3. Formation: *Caraganeta*
4. Formation: *Ephedreta*
5. Formation: *Acantholimoneta*
6. Formation: *Globularieta*
7. Formation: *Centranthuseta*
8. Formation: *Stipaeta*

The arid and sparse forests combined with the steppe characteristic of Nakhchivan AR are also characteristic of the research area forming the following formations[14]:

1. Formation: mixed forest with the dominance of species of *Crataegus* and *Juniperus foetidissima* Willd. (*Junipereta*)
2. Formation: mixed forest with the dominance by *Juniperus sabina* L. and Berberis (Berberieta)
3. Formation: mixed forest with the dominance by *Juniperus sabina* L., *Quercus ibrerica* Stev. and *Acer* (Acereta)

[14] Novruzi, N.A. Qaraquş dağının meşə və kolluq bitkiliyi //The XXIV İnternational Scientific Symposium“Multidisciplinary Research in the Modern World” dedicated to the 85th anniversary of Farman Karimzada. Proceedıngs. - Tbilisi: -26 Mart, -2022. - P. 116-121.

4. Formation: mixed forest with the dominance by *Juniperus foetidissima* Willd. and *Pyrus Caucasica* Fed. (Pyreta)

We encountered similar formations in the Salakhan area, which are as follows:

Forest-shrub vegetation type

Formation class: Evergreen shrubs

1. Formation: *Junipereta*
2. Formation: *Ephedraeta*
3. Formation: *Roseta*
4. Formation: *Onobrycheta*
5. Formation: *Berberieta vulgarae*

5.6. Subalpine meadows and high-altitude vegetation. Subalpine meadows and high – altitude vegetation cover 2400-2600 m altitude with phytocenoses forming a transition to the subalpine zone after forests. In the territory of Garagush mountain, there are only subalpine meadows similar to "Mesophilic subalpine meadows mixed with forest meadows" and "Dry subalpine meadows and meadow - steppe"

Formation class: Subalpine meadows[15]

1. Formation: *Polygonieta avicullariae* (*Polygonieta*)
2. Formation: *Poeta*
3. Formation: *Thymueta*

5.7. **Petrophilic (rock-sedimentary) vegetation.** The petrophilic (rock-slump) type of vegetation is common in all mountainous zones of the autonomous republic. Plants growing on stony and gravelly slopes and rocks are of scientific and practical importance as well-adapted forms to adverse environmental conditions. Among them, there are rare endemic, endangered, ornamental, essential medicinal, food, and many economically important species. The study of these plants requires special attention and research because they are promising species for the use of stony-gravel areas. Rocks in one form or another are present in all parts of Garagush Mountain. There are species that are specific to these rocky areas.

[15] Novruzi, N.A. Qaraquş dağı ərazisinin subalp çəmənləri və hündürotluq bitkilik tipləri //AMEA Naxçıvan Bölməsı. Elmi Əsərlər. Təbiət və texniki elmlər seriyası. –Naxçıvan: "Tusi", -2021.-№4, -c. 17, -s.12.

Formation class: Dry grain subalpine meadows[16]

1. Formation: *Daphneta transcaucasicaea*

Association: *Daphne transcaucasica + Campanula karakuschensis + Campanula coriacea + Valerianella uncinata + Stachys inflata + Stachys rhomboidalis + Ranunculus repens + Potentilla agrimonioides + Pedicularis wilhelmsiana + Ornithogalum montanum*

2. Formation: *Eremureta spectabilis*

Association: *Eremurus spectabilis+Melilotus officinalis + Lotus corniculatus + Astragalus prilipkoanus +Hordeum bulbosum +Cynodon dactylon+Phleum phleoides + Stipa hohenackeriana + Campanula glomerata + Diphelypaea tournefortii + Hypericum formosissimum + Althaea hirsuta + Verbascum pyramidatum + Valeriana tiliifolia*

Association: *Eremurus spectabilis+ Astragalus tribuloides + Lotus caucasicus + Medicago caucasica + Brachypodium rupestre + Elytrigia repens + Hordeum violaceum + Aegilops cylindrica + Plantago atrata + Plantago lanceolata + Stachys rhomboidalis + Reseda lutea + Ranunculus arvensis*

3. Formation: *Carumeta caucasicum*

Association: *Carum caucasicum + Althaea hirsuta + Alyssum calycinum + Arabis caucasica + Bellevalia montana + Carlina vulgaris Astragalus karakuschensis + Vicia varia+ Poa violacea)*

4.Formation: *Potentilleta reptane*

Association: *Potentilla reptans+ Potentilla agrimonioides + Prangos ferulacea + Rumex acetosa + Ranunculus caucasica + Origanum vulgare + Mentha longifolia + Geranium tuberosum + Allium pseudoflavum + Taraxacum officinale + Arum nordmannii + Lathyrus pratensis + Astragalus glycyphylloides + Elytrigia heidemaniae + Bromus scoparius+Festuca chalcophaea*

[16] Novruzi, N.A. Petrophıle (rocky-gravel) plant type of Garagush mountaın. Modern scıentıfıc research: achıevements, ınnovatıons and development prospects //Proceedings of IX İnternational scientific and practical conference,-Berlin:-20-22 february, -2022. - P. 45-50.

VI CHAPTER. EFFECTİVE USE OF BİOLOGİCAL RESOURCES OF THE FLORA AND VEGETATİON OF GARAGUSH MOUNTAİN AND PROTECTİON OF RARE, ENDANGERED SPECİES

6.1. Effective utilization of useful species of families included in the flora of Garagush Mountain. In this paragraph of the chapter, the annual supply volume of *Crataeugus pentagina*and *Pyrus salicifolia* Pall. was calculated by mathematical formulas. The total area of the selected species distributed in the research area, its productivity, utilization possibilities were determined and the mathematical formula given by I.A.Krylova and A.I.Shreter in 1971 was used to calculate its natural resources (biological, exploitation, annual supply volume).

$$M = \frac{\sum V}{n}$$

It was found that the average productivity of one tree of *Crataeugus pentagina*is 15.2±0.87 kg/ha, and that of *Pyrus salicifolia* Pall. is 19.2±0.83 kg/ha. Accordingly, the annual supply volüme of *Crataeugus pentagina*is 8 t 435.25 kg, and that of *Pyrus salicifolia* Pall. is 11 t 332.15 kg (Table 5-6).

As a result of the research, 30 species of wild fruit plants belonging to 4 seasons and 13 genera in the Garagush mountain area can be considered as application-oriented perspective species. A final list of wild food fruit plants has been compiled. Among the fruit plants that are widely used as food plants by the population in the Garagush mountain area: *Amelanchier ovalis* Medik., *Cotoneaster melanocarpus* Fisch. ex Blytt, *Crataegus meyeri* Pojark., *Crataegus orientalis* Pall. ex Bieb., *Malus orientalis* Uglitzk., *Pyrus salicifolia* Pall., *Rosa canina* L., *Rosa rapinii* Boiss. Honey., *Sorbus graeca* (Spach) Lodd. ex Schauer, *Cerasus avium* (L.) Moench, *Cerasus microcarpa (*C.A.Mey.) Boiss., *Prunus divaricata* Ledeb., *Celtis caucasica* Willd. etc. species belong.

Table 5

Natural reserve of *Crataeugus pentagina* in the area of Garagush mountain by zones

Zones	Number of trees in 1 ha (number)	Average weight of fruit on 1 tree, kg.	Common area,ha	Productivity, 1 ha/ kg	Natural resources, t.		
					Biological reserve	Operating reserve	Annual supply volume
Lizbirt valley	18	13	25	234	5 t 850 kq	2 t 925 kq	1t 16,25kq
Khanbulagi	26	14	35	364	12 t 740kq	6 t 370kq	2 t 66,5kq
Salakhan	30	15	42	450	18t 900 kq	9 t 450kq	4 t 252,5kq
Total:			102		37t 490 kq	18 t 745kq	8 t 435,25kq

Table 6

Natural reserve of *Pyrus salicifolia* Pall. in the area of Garagush mountain by zones

Zones	**Number of trees in 1 ha (number)**	**Average weight of fruit on 1 tree, kg.**	**Common area,ha**	**Productivity, 1 ha/ kg**	**Natural resources, t.**		
					Biological reserve	**Operating reserve**	**Annual supply volume**
Lizbirt valley	23	14	25	322	8t 050kq	4 t 025kq	1t 811,25kq
Khanbulagi	27	19	35	513	17t 955kq	8t 977,5kq	4t 39,9kq
Salakhan	29	20	42	580	24t 360kq	12t180kq	5t481kq
Total:			102		50t365 kq	25t182,5kq	11t 332,15kq

6.2. Biological reserves of Garagush mountain vegetation and possibilities of efficient utilization."The State Program on efficient use of summer and winter pastures and hayfields and prevention of

desertification in the Republic of Azerbaijan" was approved by Decree No. 222 of the President of the Republic of Azerbaijan Ilham Aliyev dated May 22, 2004. that the structure of the fodder required to ensure the development of animal husbandry in the country is not in accordance with the norms, its composition is dominated by natural fodder, pastures and pastures, including forestscausing overcrowding with herds. In turn, this leads to the degradation of foothill slopes, water-holding forest areas, the intensification of destructive floods, and the gradual depletion of underground and surface water resources.

According to research there is no mowing areas in the Garagush mountain area. Pastures and forest-shrub zones are over burdened with herds of animals. In Nakhchivan Autonomous Republic, according to the norms, it is possible to keep 1-4 sheep per hectare in winter pastures, and 1-8 sheep in summer pastures. İn particular, it is possible to graze 4-5 small-horned animals per hectare in subalpine meadows and high-altitude vegetation, and 2-3 head of small-horned animals in desert and semi-desert vegetation.

Wild vegetation plants are aslo collected and used by the population in the vegetation in the Garagush mountain area (Table 7).

The flowering phases of plants in the Garagush Mountain area are 800-2600 m s.d.h since it is intermittent, the bee families kept here can be continuously supplied with pollen and nectar.

Table 7

Vegetable plants of Garagush Mountain

Row №	**Vegetation type**	**Vegetable plants**
1	2	3
1.	Desert vegetation	*Scorzonera rigida* Aucher ex DC., *Capsella bursa - pastoris* (L.) Medik., *Chenopodium album* L., *Ch. foliosum* Aschers., *Spinacia tetrandra* Stev., *Salicornia europaea* L.
2.	Semidesert vegetation 1000-1200 m	*Capparis spinosa* L. (*C. herbacea* Willd.), *Achillea tenuifolia* Lam., *Allium rubellum* Bieb. (*A. syntamanthum* C.Koch), *Scorzonera rigida* Aucher ex DC.,*Geranium tuberosum* L. *Eryngium campestre* L.,*Atriplex tatarica* L. (A. arazdajanica Kapell.) *Chenopodium strictum* Roth.

continuation table 7

1	2	3
3.	Mountain xerophyte (firgana) vegetation 1200-1500 m	*Prangos acaulis* (DC.) Bornm., *Capparis spinosa* L. (*C. herbacea* Willd.), *Allium atroviolaceum* Boiss.(*A. firmotunicatum* Fomin), *A. rubellum* Bieb. (*A. syntamanthum* C.Koch)
4.	Mountain-steppe vegetation 1500-2300 m	*Teucrium chamaedrys* L., *Eryngium caucasicum* Trautv., *Ziziphora tenuior* L., *Echinops sphaerocephalus* L. (*E. daghestanicus* İljin; *E. erevanensis* Mulk.), *Taraxacum officinale* Wigg.
5.	Forest and shrub vegetation 1650 - 2450 m 1200-2500 m	*Ornithogalum brachystachys*C.Koch , *Rumex acetosella* L.(*R. multifidus* L.), *Filago vulgaris* Lam., *Scorzonera latifolia* (Fisch. & C.A. Mey.) DC. *Malva sylvestris* L.
6.	Meadow vegetation	*Filago vulgaris* Lam., *Tragopogon graminifolius* DC., *T. latifolius* Boiss., *Potentilla reptans* L. *Taraxacum officinale* Wigg., *Scorzonera rigida* Aucher ex DC., *Vicia anatolica* Turrill, *Mentha longifolia* (L.) Huds., *Rumex acetosa* L.
7.	Petrophilous vegetation	*Bifora radians* Bieb., *Chaerophyllum crinitum* Boiss., *Falcaria vulgaris* Bernh. [*F. sioides* (Wib.) Asch.], *Rumex acetosa* L., *Oxyria digyna* (L.) Hill, *Allium schoenoprasum* L.

Therefore, it is appropriate to keep about a thousand bee families in this zone[17].

6.3. Protection of rare and endangered species. The territory of the Nakhchivan Autonomous Republic, which has a mysterious and unique nature, is considered one of the oldest regions in terms of its origin and formation. When examining the geological background of the area, it becomes clear that tropical forests existed here. However, later, as a result of sharp climate change, continental drift and other geological processes, the modern soil-climate and corresponding

[17] Novruzi, N., Talıbov, T. The plants of Garagush mountaın produce nectar and flower powder //The 5th International scientific and practical conference "World science: problems, prospects and innovations". Toronto:-January 27-29, -2021. p.151-160.

biodiversity emerged in the region. Therefore, the modern territory of Nakhchivan AR occupies an important place in the Caucasus with its genesis and geographical location. On June 22, 2009, by the Decree of the Chairman of the Supreme Assembly of the Nakhchivan Autonomus Republic, the Arpachay State Nature Reserve was established, covering the territories along the Daralayaz range (adminstrative territories of Sharur, Kangarli, Babek and Shahbuz districts) with an area of 68 211 ha. The goal is to protect natural complexses or their components, to maintain ecological balance. The territory of Garagush mountain is located exactly within the boundaries of Arpachay SNR. The search for existing rare plants in this area and their condition in the area was studied.

As a result of the conducted researches and the analysis of literature materials, the rare and endangered species existing in the Garagush mountain area have been identified. Based on the literature, those species and their respective statuses are mentioned.

There are 2 species belonging to 2 families and 2 genera of Phylum of Pteridophyte, 3 species belonging to one family and one genus of Angiosperms, 22 species belonging to 11 families and 18 genera Classes of Monocotyledoneae, 49 species belonging to 28 families and 41 genera Classes of Dicotyledonous rare species in the Garagush mountain area. In total, 76 rare plant species belonging to 42 families and 62 genera were studied in the research area[18,19].

RESULTS

1. For the first time, the taxonomic spectrum of the Garagush mountainous area of Nakhchivan AR was revealed and in general, higher spore, gymnosperm and angiosperm plants were represented by 856 species belonging to 89 families and 484 genera field of study.

[18] Novruzi, N.A.Современное состояние редких растений относящихся к семейству Астровых на территории Гарагушской горы. //POLISH JOURNAL OF SCIENCE. -2020.-№ 34. -v.2, -p. 4-6.

[19] Novruzi, N.A. Rare Types Including Iridaceae Juss. of The Garagush Mountain. // Bulletin of Science and Practice. Scientific Journal. -2021, -Volume 7, -İssue 7. -№7. –p.19-23.

2. For the first time, the structure of existing plant species was studied in the territory of Garagush Mountain and their structure was studied at the level of formation class, formation and association, and dominant and subdominant species were determined.In addition to desert and semi-desert plants found locally in the Garagush mountain area, there is saline, ephemeral-gallian (colored soil), gamma (gypsum soil) and psammophilous (sandy) vegetation.

3. 8 formations and 10 associations were found in the area of Garagush Mountain in the semi-desert, mountain desert (gariga) and mountain xerophyte (frigana) vegetation, which are characteristic ofthe area and dominated by xerophyte tree and shrub species.Arid and sparse forests combined with the steppe were also characteristic of the study area, and 4 formations (Junipereta, Berberieta, Acereta, Pyreta) and 8 associations characteristic of this vegetation were identified.

4. 2 formations (*Junipereta, Ephedraeta*) and 2 associations "Evergreen shrubs" formation class and 3 formations (*Roseta, Onobrycheta, Berberieta vulgarae*) and 5 associations of "Deciduous shrubs" formation class belonging to the forest-shrub plant type. The "Subalpine meadows" formation class, which functions as summer pastures, includes 3 formations (*Polygonieta, Poeta, Thymueta*) and 6 associations of forest-shrub plants.

5. Species living on limestone rocks and stable outcrops were noted in the high mountain zone, 4 formations (*Daphneta transcaucasicaea, Eremureta spectabilis, Carumeta caucasicum, Potentilleta reptane*) and 5 associations belonging to the "Dry-grained subalpine meadow" formation class were found.

6. Distribution of 76 species belonging to 42 families and 62 genera found in the study area during the inspection of species with rare status in the areaplaces and conditions are defined. Rare species: Critically Endangered - CR-7 species, Endangered - EN - 2 species, Vulnerable - VU - 28 species, Endangered - NT -20, Low Risk - LR - 18 species are attributed with marked statuses.

7. For the first time, the modern status and natural resources of some wild ornamental, vegetable, fruit and medicinal species were studied in the Garagush mountain area. In the region, 30 species of

wild fruit plants belonging to 4 families and 13 genera can be considered as promising application-oriented species.

SUGGESTIONS AND RECOMMENDATIONS

For the first time, the results of research on the flora and vegetation of the Garagush mountain area, including systematic and taxonomic analyses, information on rare and useful species can be used "Flora of Nakhchivan AR", "Flora of Azerbaijan", "Vegetation of Nakhchivan AR" , "Nakhchivan AR" books in the new editions of "Red Book of Nakhchivan AR" and "Red Book of Azerbaijan". The results of the research can be used as regional study material in the teaching of "Biology" and "Ecology" in AR institutions of the Ministry of Education in Nakhchivan.

Some of the wild ornamental, vegetable, fruit and medicinal species in the Garagush mountain area are included in the category of rare plants. Most of the rare species belong to geophytes and the main task in their conservation is to collect rare species in the Botanical Garden of the Nakhchivan branch of ANAS and to preserve them in ex situ conditions, and also to return the reproduced species to the region, in the future it is possible to protect the gene pools where they grow and to introduce similar new areas.

For the first time, the modern status and natural resources of some of the wild decorative-vegetable, fruit and medicinal species in the Garagush mountain area were studied. For their effective use, those species should be included in the territory of Arpachay SNR, their development dynamics in nature should be controlled, and their collection and use in pastures should be prohibited.

The vegetation of Garagush Mountain, especially the subalpine meadows used as summer pastures, is in critical condition. The main reason is the continuous severe drought and heat in the last 3 years, and on the other hand, irregular and excessive grazing of livestock. Therefore, the territory of Garagush mountain should be taken under special control and protection work should be strengthened.

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