

REPUBLIC OF AZERBAIJAN

On the rights of the manuscript

ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

**FLORA OF THE LANDSCAPES OF GANIKH-AGRICHAY
VALLEY AND ITS ROLE IN THE ECOSYSTEM
(WITHIN BORDERS OF THE AZERBAIJAN REPUBLIC)**

2426.01 – Ecology

Field of science: Biology

Applicant: **Gunel Rahib Sariyeva**

BAKU – 2021

The work was performed at the Baku State University in the department of Bioecology.


Scientific supervisors: Doctor of Biological Sciences,
professor **Narmina Abel Sadiqova**
Doctor of Biological Sciences,
professor corresponding member of
ANAS: **Elshad Majnun Gurbanov**


Official opponents: Doctor of Biological Sciences,
professor
Sevda Zahid Ahmadova

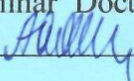
Doctor of Philosophy of Biological
Sciences ass. prof.
Leyli Rashid Melikova

Doctor of Philosophy of Biological
sciences **Shahla Zohrab Jafarova**

Dissertation council BFD 3.03 of Supreme Attestation Commission
under the President of the Republic of Azerbaijan operating at Insti-
tute of Soil Science and Agro Chemistry of ANAS

Chairman of the Dissertation council:  Doctor of
Agrarian sciences, professor corresponding member
of ANAS: **Alovzat Gulush Guliyev**

Scientific secretary of the Dissertation council  Doctor of
Philosophy of Biological sciences **Nigar Ali
Sultanova**

Chairman of the scientific seminar Doctor of Biological sciences,
professor  **Sarah Zulfi Mammadova**

General characteristics of the scientific work

Relevance of the work. As the next step for the implementation of Azerbaijan's obligations under the Convention on Biological Diversity as a country acceding to the Convention, in 2016 by the Presidential Decree dated October 3 approved "National Strategy On the Biodiversity Conservation and Sustainable Use in the Republic of Azerbaijan for 2017-2020". For the protection and sustainable use of biodiversity the most crucial factor is the scientific basis of the measures to be chosen. To carry out the action plan of the strategy several research works are being conducted in the country to study different groups of biodiversity. The dissertation work devoted to the research of flora of the Ganikh-Agrichay valley and its role in the ecosystem also serves this purpose. The **object and subject** of the current dissertation were the research of the interactions of soil and vegetation cover of the Ganikh-Airichay valley with the environment.

The purpose and aims of the study. The purpose of the present study was to study the flora of the Ganikh-Agrichay valley and its role in the ecosystem. To achieve this goal, the following tasks have been set:

- ✓ Analysis of flora of Ganikh-Agrichay valley in terms of floristic, biomorphological, phytogeographical, and endemism;
- ✓ Comparative analysis of floras of Ganikh-Agrichay valley and Ilisu State Nature Reserve;
- ✓ Identification of new plant species and their distribution areas for the study area;
- ✓ A comprehensive study of modern soil cover and vegetation of the area;
- ✓ Investigation of the nature of biocenosis relationships between some plant and animal species that are widely distributed in the study area;
- ✓ Study of phytomass dynamics in *Artemisetum-Ephemerolum* and *Alhagietum-Artemisosum* associations;
- ✓ Study of the energy performance in *Artemisetum-Ephemerolum* and *Alhagietum-Artemisosum* associations;

- ✓ Identification of phytomeliorative importance of plant species for the protection of soils in the plain and foothill zones of the valley;
- ✓ Determination of land cover classes based on the purpose of land use in the study area;
- ✓ Identification of the main environmental factors that negatively affect phytodiversity in the valley area;

Research methods: In the conduction of current research were implemented different empirical and statistical methods.

The main provisions of the defense are as follows:

- The flora of the Ganikh-Agrichay valley makes up 11.7% of the wild flora of the Republic of Azerbaijan;
- Species with national and international protection status have been recorded in the flora of the study area;
- Similarity coefficient for species distributed in the flora of Ganikh-Agrichay valley and Ilisu State Nature Reserve is 31.07%, and for species 16.6%;
- Determined phytomass reserves, growth and energy indicators of *Artemisetum-Ephemerolum* and *Artemisetum-Ephemerolum* associations registered in the territory of Sheki region of the valley;
- It is necessary to carry out phytomeliorative measures in several river valleys and alluvial fans, as well as in the forests of the lower mountain range in the study area;
- Anthropogenic transformation of natural ecosystems in the valley, widespread use of invasive plant species is a real threat to the region's biodiversity.

The scientific novelty of the research. For the first time, we studied the flora of the Ganikh-Agrichay valley in detail and identified 2 variations, 28 subspecies, 505 species of vascular plants grouped by 332 genera, and 92 families within the five vegetation types existing in the area. Geographical coordinates of new distribution areas of 35 species, 3 and subspecies of vascular plants existing in the flora of the republic were determined in the studied area, 5 of them were included in the II edition of the Red Book of AR (2013).

Ecological-socio-economic assessment of the area was carried

out based on the purpose of land use in the valley with the application of remote sensing methods and Reimers formula. The Normalized Difference Index of Vegetation (NDVI) and the area of forests for the 2017 year were calculated in the study area. For the first time, according to the amount of actual atmospheric precipitation the energy balance of biogeocenoses in the valley was compiled, and based on the scientific direction of soil formation energy, quantitative indicators of plants' use of solar energy were determined in different climatic conditions.

The theoretical and practical relevance of the research. The results of the dissertation on "Flora of the landscapes of Ganikh-Agrichay valley and its role in the ecosystem" (within the Republic of Azerbaijan) can be used as a reliable source in the future study on ecology and mapping of species, also in preparation the flora of Azerbaijan and the next edition of the Red Book of Azerbaijan Republic.

The results of the study of flora in the Alazan-Agrichay botanical-geographical region are useful for the enrichment of the Azerbaijan Plant Information Center, created for the first time in Azerbaijan on a private initiative in a virtual space.

Approbation of work. The main provisions of the dissertation work had been discussed at the scientific conference dedicated to the 95th anniversary of BSU (December 10, Baku, 2014); VI Republican Scientific Conference "Actual Problems of Ecology and Soil Science in the XXI Century" dedicated to the 94th anniversary of national leader Heydar Aliyev (May 4-5, Baku, 2017); III International Scientific Conference on "Ecology: Problems of Nature and Society" dedicated to the 110th anniversary of Academician Hasan Aliyev (December 26-27, Baku, 2017); International Scientific-Practical Conference "Fundamental Scientific Research: Theoretical and Practical Aspects" (December 16, Kemerovo, 2019).

It was decided to include several research results of the dissertation on "Flora of the landscapes of Ganikh-Agrichay valley and its role in the ecosystem" (within the Republic of Azerbaijan) to the bachelor subject program "Flora and fauna of Azerbaijan" that is conducted in Bioecology department of the BSU.

Publications. As a result of the conducted research, 14 works were published, reflecting the main provisions and results of the dissertation. However, 4 of these works are conference materials, and 10 are research papers. Two of the research papers had been published in the periodicals included in the AGRIS database. In addition, 4 scientific articles and 1 thesis had been published abroad.

Personal participation of the author: The author set the task in the dissertation, conducted field and laboratory researches, analyzed and summarized the obtained results.

Organization where the dissertation work is performed. The research was carried out in 2012-2017 at the Department of Bioecology, Faculty of Ecology and Soil Science, of the Baku State University.

The volume of the dissertation. The dissertation consists of table of contents, 6 chapters, results, suggestions, bibliography and appendices, and covers a total of 226 computer printed pages. The list of literature consists of 188 sources, of which 74 are Azerbaijani, 114 are foreign literature. The dissertation includes 33 figures, 5 classification schemes, 3 diagrams, 4 graphs, 3 maps, 1 map-scheme and 31 tables. In addition to the dissertation work abstract of flora is given, which reflects the systematic, biomorphological, ecological, phytogeographic analysis and information about new species for the area of the flora of the valley. The total volume of the dissertation is 327.879 characters.

MAIN CONTENT OF THE DISSERTATION

In the introductory part of the dissertation, a brief description of the relevance of the work, the purpose of the research, scientific novelty, scientific and practical significance, the methodology of the conducted research are shown.

The first chapter provides information on the physical and geographical conditions of the Ganykh-Ayrichay valley.

The second chapter explains the history of the study of the flora of the landscapes of the Ganykh-Ayrichay valley, the research methodology.

The third chapter analyzes the floristic, biomorphological,

altitude distribution, phytogeographical, and endemism of the flora of the research object.

The fourth chapter characterizes the natural vegetation and soil cover of the valley.

The fifth chapter analyzes the relationship between plant and animal species in the Ganikh-Agrichay valley, the role of plant species in the plant communities, their phytomeliorative significance, energy indicators of semi-desert phytocenoses.

The sixth chapter analyzes the environmental factors that negatively affect phytodiversity in the study area.

At the end of the dissertation the results obtained, the list of the literature, appendices are given.

Chapter I. characteristics of ecological conditions of Ganikh-Ayrichay valley. The total area of Ganikh-Agrichay valley is 3473.11 km² and covers the plains of Balakan, Zagatala, Gakh, Sheki, Oguz, Gabala, Ismayilli administrative districts within the Republic of Azerbaijan.

The first chapter also provides information on the climate, relief, and geology, hydrography, land cover, fauna, and landscapes of the study area.

Chapter II. scientific and theoretical fundamentals of the study of landscapes flora in Ganikh-Ayrichay valley. Literature review. Although floristic research in the valley began in the 1930s, they did not cover the entire area and were fragmentary. Vegetation of the Balakan-Zagatala plain was studied in 1936 by T.S.Geideman.¹ The author described zonal plain forests, intrazonal semi-desert and wetland vegetation, forests formed in place of felled plain forests, the vegetation of forest gardens, and registered 117 species of higher plants grouped into 35 families and 105 genera.

L.İ. Prilipko gave a brief geobotanical description of the southern slopes of the Greater Caucasus within the territory of Azerbaijan and identified 103 higher plant species belonging to 41

¹ Гейдеман, Т.С. Краткий очерк растительности Закалато - Белоканской низменности // -Баку: Труды Ботанического института АЗФАН СССР, -1940. Т. IX, -с.179-240.

families and 87 genera in the valley.²

Analyzing the multi-volume Flora of Azerbaijan we performed an outcome about the distribution of 384 species of vascular plants in the Alazan-Ayrichay botanical-geographical region.³

Long-stemmed oak and moist alder-willow forests that characteristic for Ganikh-Agrichay valley researched by N.K. Karamov and V.N. Nabiyev.⁴

S.İ. Dmitriyeva studied the area of the valley between Mazimchay and Kishchay, described the floristic composition of weeds in hazelnut orchards, grain and tobacco fields, tea and rose plantations, as well as the main types and sources of weed contamination of arable lands.⁵

In 2000, V.N. Kerimov defended his dissertation for the degree of Doctor of Philosophy on "The borage family of the Sheki-Zagatala region".⁶

The studied area covers the southern slope of the Greater Caucasus, Ganikh-Agrichay valley, and Bozgir plateau.

Although the article of S.H. Musayev and R.A. Fataliyev states that 1100 species of plants are spread in Alazan-Ayrichay botanical-geographical region, the list of envisaged species is not given.⁷

² Прилипко, Л.И. Краткий геоботанический очерк южных склонов Большого Кавказа (в пределах Азербайджана) // -Баку: Труды Ботанического Института. АН Азерб ССР, -1950. Т. XV, -с. 118-145.

³ Флора Азербайджана: [в 8 томах]. -Баку: Изд-во АН Азербайджанской ССР, -т. 1. - 370 с.; т. 2. -317 с.; т. 3. -407 с.; т. 4. -400с.; т. 5. -580 с.; т. 6. -540 с.; т. 7. -648 с.; т. 8. - 676 с. - 1950-1961.

⁴ Керемов, Н.К. Низинные широколиственные леса с господством дуба длинноножкового на Алазано-Автора́нской долине и Худато-Хачмасской низменности // -Баку: Ученые Записки АГУ, Серия геолого-географических наук, -1964. №4, -с.91-95; Nəbiyev, V.N. Alazan-Həftəran vadisində rütubətli qızılbaş-yalanqoz meşə landşaftı // -Bakı: ADU-nun Elmi əsərləri. Geologiya-coğrafiya elmləri seriyası, -1964. №4, -s.77-80

⁵ Дмитриева, С.И. Сорная растительность северо-западной части Алазань-Автора́нской долины (в пределах Азербайджана) и меры борьбы с нею: /Автореф. дисс. ... канд. биол. наук./ -Баку, 1966. -25с.

⁶ Kərimov, V.N. Şəki-Zaqatala bölgəsinin göyzabanları: /B.e.n. ... dis. avtoref./ -Bakı, 2000. -19 s.

⁷ Мусаев, С.Г., Фаталиев, Р.А. Флора Азербайджана: Новые данные // -Баку: Труды Института ботаники НАН Азербайджана, -2004. Т. XXV, -с.16-22

O.H.Mirzayev's article provides detailed information on the ecological condition of tugai forests spread in our republic.⁸

In 2009, Michael Zimmerman studied the species composition, the characteristics of biotopes, the dependence of the distribution of phytocenoses on abiotic environmental factors, the dynamics of vegetation of forests in the center of the Ganikh-Agrichay valley.⁹

N.P. Mehdiyeva informed about the distribution of 127 species of medicinal plants within the Alazan-Ayrichay botanical-geographical region.¹⁰

In R.T.Abdiyeva's book on "List of invasive flora of Azerbaijan" is given information about invasive plants, their habitat, and invasive status that spread in the Ganikh-Agrichay valley.¹¹

Materials and methods. The abundance of plants in phytocenoses was given according to Drude scale, projective cover by Ramenski method, phenology phase by Alekhin¹², life forms by Raunkiaer and Serebryakov¹³ taxonomy, ecological groups of water-marsh plants determined by V.M.Katanskaya¹⁴. Arrangement of flowering plants in families conducted by APG (III) system¹⁵,

⁸ Mirzəyev, O.H. Tuqay meşələri və səhra zonası bitkilərinin müasir vəziyyəti, onların bioloji bərpası // -Bakı: AMEA Botanika institutunun Elmi əsərləri, -2008. XXVIII cild, -s.121-123.

⁹ Zimmermann, M. Ecology and regeneration of forest communities on the alluvial fan near Qakh (Northwestern Azerbaijan): /Diploma thesis in the study program of Landscape Ecology and Nature Conservation/ -Greifswald, 2009. -61p.

¹⁰ Mehdiyeva, N.P. Azərbaycanın dərman florasının biomüxtəlifliyi / N.P. Mehdiyeva. - Bakı: Letterpress, - 2011. - 186 s.

¹¹ Abdiyeva, R.T. Azərbaycanın invaziv florasının siyahısı / R.T Abdiyeva. – Bakı: -2018. - 43 s.

¹² Шенников, А.П. Введение в геоботанику / А.П. Шенников. -Л.: Изд-во. ЛГУ, -1964. -447 с.

¹³ Миркин, Б.М. Введение в современную науку о растительности / Б.М. Миркин, Л.Г. Наумова. - М.: ГЕОС, -2017. -280 с., s.12-15.

¹⁴ Катанская, В.М. Высшая водная растительность континентальных водоемов СССР. Методы изучения / В.М.Катанская. -Л.: Наука, -1981. -185 с.

¹⁵ An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG III // -London: Botanical Journal of the Linnean Society, -2009. Vol. 161, Is. 2, -p.105-121. URL: <http://onlinelibrary.wiley.com/doi/10.1111/j.1095-8339.2009.00996.x/full>

working names of plants by theplantlist (2013) database¹⁶, phytogeographical analysis clarified by A.A.Grossheym¹⁷ and N.N.Portenier¹⁸. Identification of plants species conducted by Flora of Azerbaijan (1951-1961)¹⁹, Flowers of Turkey²⁰, Rothmaler Exkursionflora von Deutschland, Gefäßpflanzen Atlasband²¹, and Mountain flowers and trees of Caucasia²². Similarity index of genera and families that recorded in the flora of valley and Ilisu Reserve calculated by Jakkard index²³, the amount of phytomass in phytocoenosis by F.F.Titlyanova's method²⁴. Geographical coordinates of vegetation plots recorded by GPS Garmin (E-Trex) device. Several species of diurnal butterflies collected in the study area were identified by V.V.Tshikolovets's²⁵ field guide, birds by Collin's Bird Guide²⁶, amphibians, and reptiles according to the "Guide of amphibians and reptiles spread in Azerbaijan"²⁷. Land Cover classes of the study area determined by QGIS program

-
- ¹⁶ The Plant List. Version 1.1. Published on the Internet: [Electronic resource] -1st January, 2013. URL: <http://www.theplantlist.org>.
- ¹⁷ Гроссгейм, А.А. Флора Кавказа: [в 7 томах]. / А.А.Гроссгейм. –Москва: Изд-во АН СССР, -т. I-VII. -1939-1967.
- ¹⁸ Портениер, Н. Н. Система географических элементов Флоры Кавказа // –Москва: Ботанический журнал, -2000. т.85, №9, -с. 94-98; Портениер, Н.Н. Методические вопросы выделения географических элементов Флоры Кавказа //–Москва: Ботанический журнал, -2000, т. 85, №6, -с. 36.
- ¹⁹ Флора Азербайджана: [в 8 томах]. -Баку: Изд-во АН Азербайджанской ССР, -т. 1. - 370 с.; т. 2. -317 с.; т. 3. -407 с.; т. 4. -400с.; т. 5. -580 с.; т. 6. -540 с.; т. 7. -648 с.; т. 8. -676 с. - 1950-1961.
- ²⁰ Pils, G. Flowers of Turkey (a photo guide) / G. Pils. -Vienna: -2006. -448p.
- ²¹ Rothmaler Exkursionflora von Deutschland, Gefäßpflanzen Atlasband / Herausgeber E.Jäger. –Berlin: Springer Spektrum, -2013. -822 p.
- ²² Shetekauri, S. Mountain flowers and trees of Caucasia, illustrated field guide / S.Shetekauri, M.Jacoby&T.Shetekauri. -Exeter: Pelagic Publishing, -2009. -395 p.
- ²³ Jaccard, P. Distribution de la flore alpine dans le Bassin des Dranses et dans quelques regions voisines // -Lausanne: Bull. Soc. Vaudoise sci. Natur., -1901. V. 37, №140. -p. 241-272.
- ²⁴ Титлянова, А.А. Сукцессии в травянистых экосистемах /А.А.Титлянова, А.Д. Самбуу. -Новосибирск, Изд-во. СО РАН, -2016. -191с., s.52-53.
- ²⁵ Tshikolovets, V.V. Butterflies of Eastern Europe, Urals and Caucasus, an illustrated guide / V.V.Tshikolovets. –Totnes: -2003. -176p.
- ²⁶ Svensson, L. Collins Bird Guide, 2 nd edition / L.Svensson, K.Mullarney, D.Zetterstrom. -İver: Pemberley Books.-2010. -448 p.
- ²⁷ Azərbaycanca yayılmış suda-quruda yaşayanların və sürünənlərin təyinedicisi / S.Q.Cəfərova, S.B.Əhmədov, S.N.Bünyatova [və b.]. -Bakı: Bakı nəşriyyatı, -2014. -148 s.

application and Normalized Difference Vegetation Index (NDVI) calculated by the formula: $NDVI = (NIR - Red) / (NIR + Red)$ ²⁸.

Mechanical components of sampled soils analyzed by N.A.Kachinski²⁹; total humus and nitrogen by I.V.Tyurin³⁰; full water pressure by D.I.Ivanov, total phosphorus and potassium by rentgenospectral method³¹. The naming of soils in Latin is provided according to the WRB system.³²

Monthly vegetation growth calculated V.R.Volobuev's empirical method, amount of accumulated energy in plants determined by A.P.Garayzadeh's information.³³ Radiation balance is given by A.M.Shikhlini.³⁴

Chapter III. Analysis of flora of Ganikh-Agrichay valley.

Floristic analysis. The territory of Ganikh-Agrichay valley coincides with the territory of the Alazan-Ayrichay botanical-geographical region within the Republic of Azerbaijan. As a result of continuous floristic research conducted by us in the Ganikh-Agrichay valley in 2013-2017, we can say that 505 species, 28 subspecies, and 2 variations of vascular plants grouped by 92 families, 331 genera were registered in the area. Of all species, 10 belong to *Sporophyta* and 525 *Spermatophyta*. Of the species belonging to the phylum Spermatophyta, 4 belong to the division Gymnospermae and 521 to the division Angiospermae. Of the flowering plants, 126 species belong to the class *Monocotyledonae*, and 395 species belong to the class *Dicotyledonae*. According to A.M. Askerov's information,

²⁸ Weier, J. & Herring, D. Measuring Vegetation: [Electronic resource] -August 30, 2000. URL: <https://earthobservatory.nasa.gov/Features/MeasuringVegetation/>

²⁹ Качинский, Н.А. Механический и микроагрегатный состав почвы, методы его изучения / Н.А.Качинский. -Москва: Изд-во Ак. наук СССР, -1958. -191с., s.100-106.

³⁰ Практикум по агрохимии / Под ред. В.Г.Минеева. -М.: Изд-во МГУ,-1989. -304 с., s.39-46; s.56-58.

³¹ Аринушкина, Е.В. Руководство по химическому анализу почв / Е.В.Аринушкина. - Москва: Изд-во Московского университета, -1970. -488 с.

³² Azərbaycan torpaqlarının morfogenetik diaqnostikası, nomenklaturası və təsnifatı / M.P.Babayev, V.N.Nəsənov, Ç.M.Cəfərova [və b.]. -Bakı: Elm, -20

³³ Волобуев, В.Р. Введение в энергетику почвообразования / В.Р.Волобуев. -М. «Наука», -1974. -127 с., s.56; s.100-108.

³⁴ Шыхлинский, Э.М. Тепловой баланс Азербайджанской ССР / Э.М. Шыхлинский. - Баку, -1969. -340 с., s.152-153.

there are 4557 species in the wild flora of the Republic of Azerbaijan, which is more than 70% of the natural flora of the Caucasus (6350 species).³⁵ According to this source, the flora of the study area is 11.7% of the wild flora of the Azerbaijan Republic. The following families are represented in the flora of the valley by a large number of genera and species: *Poaceae* (64 species, 12%), *Compositae* (42 species, 3 subspecies; 8%), *Leguminosae* (44 species, 3 subspecies; 9%), *Cyperaceae* (24 species, 2 subspecies; 5%), *Lamiaceae* (21 species 4%), *Rosaceae* (16 species, 1 subspecies; 3%), *Boraginaceae* (16 species, 1 subspecies; 3%), *Brassicaceae* (15 species, 3 %), *Ranunculaceae* (13 species, 3 %), *Caryophyllaceae* (13 species, 3 %) (Figure 1)

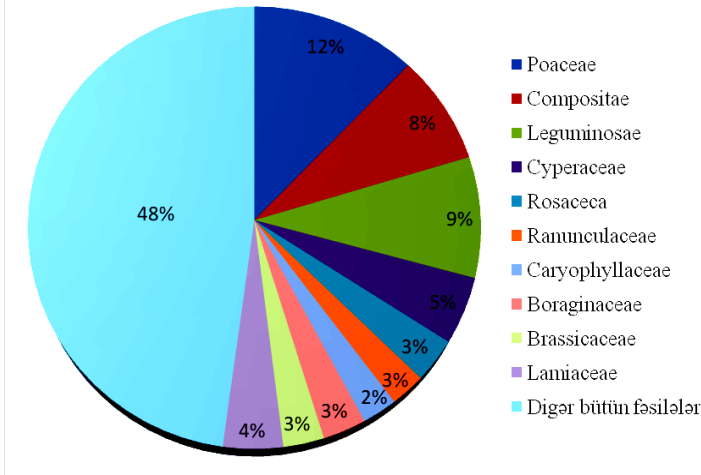


Figure 1. The spectrum of families recorded in the valley

Species and subspecies belonging to the above-mentioned dominant families make up 52.7% of the total flora of the valley. Other seasons, represented by 1-12 species, make up 48% of the total flora.

The genera represented by many species in the area are *Carex* (11 species, 1 subspecies), *Trifolium* (11 species, 1 subspecies), *Medicago* (8 species), *Geranium*, *Galium*, *Euphorbia*, *Ranunculus*, *Vicia* (7 species each).

³⁵ Əsgərov, A.M. Azərbaycanın bitki aləmi / A.M.Əsgərov. -Bakı: -2016. -443 s., s.127

In the study area, we identified a new distribution area for 35 species and 3 subspecies of vascular plants in biotopes such as wetlands, forests, semi-deserts, agrobiocenoses, and alluvial fans.³⁶

The identification of new areas of vascular plants in the valley is because the flora of the region has not yet been studied in detail, the transformation of natural ecosystems, and the dynamics of vegetation. 8 (1.5%) of the total species registered in the flora of the study area were included in the 1st edition of the Red Book of AR, and 20 species (3.7%) were included in the 2nd edition of the Red Book of AR. (Table 1).

It should be noted that in the Flora of Azerbaijan (1951-1961) and the second edition of the Red Book of the Azerbaijan Republic, only one area of distribution was indicated for the muslim iris and common globularia species.³⁷ In the flora of Azerbaijan states distribution of *Iris spuria subsp. musulmanica* (Fomin) Takht. = *Iris musulmanica* Fom. in swampy and saline meadows in the territory of Nakhchivan AR³⁸; and *Globularia vulgaris* L. distributed on limestone slopes in the middle mountain belt in the territory of Khanlar (now Goygol) region in the Lesser Caucasus.³⁹

Distribution of flora by vegetation belts. The study area occupies mainly lowland area and partly foothill and low mountainous zone. Lowland areas cover 159-432 m.a.s.l, the foothills 433-568 m.a.s.l and low mountainous cover 569-1181 m.a.s.level. The minimum altitude at which we sampled plant species was the area 180 m.a.s.level and the maximum was 735 m. a.s.level. This section of the dissertation provides examples of the most common species in the plains, foothills, and lowlands.

³⁶ Сарыева, Г.Р. Анализ флоры Ганых-Агричайской долины (В пределах Азербайджанской Республики) // -Москва: Международный журнал прикладных и фундаментальных исследований, -2018. №1, -с.115-120.

³⁷ Azərbaycan Respublikasının Qırmızı Kitabı, nadir və nəslə kəsilməkdə olan bitki və göbələk növləri, II nəşr. –Bakı: “Şərq-Qərb” nəşriyyatı, -2013. -667s., s.168; s.562.

³⁸ Флора Азербайджана: [в 8 томах]. -Баку: Изд-во АН Азербайджанской ССР, -т.2, -1952. -317 с., s. 221.

³⁹ Флора Азербайджана: [в 8 томах]. -Баку: Изд-во АН Азербайджанской ССР, -т.7, 1957. -648 с., s.595.

Table 1.
Plant species included in the Red Books of AR registered in the flora of Ganikh-Agrichay valley

	Latin names of the species (http://www.theplantlist.org)	Common name	Red Book of AR 1989	Red Book of AR 2013 (IUCN National crit.)	New locations in the valley (g.c.)
1.	<i>Allium ursinum</i> L.	Bear garlic		VUA2c+3c	
2.	<i>Castanea sativa</i> Mill.	Sweet chesnut	+	VU A2c+3cd	
3.	<i>Celtis australis</i> subsp. <i>caucasica</i> (Willd.) C.C.Towns. = <i>Celtis</i> <i>caucasica</i> Willd.	Caucasian hackberry		NT	
4.	<i>Cotoneaster saxatilis</i> Pojark.	-	+	EN B2ab(ii,iii, iv, v)	N41°04'24.56" E47°22'00.78" and surrounding areas
5.	<i>Diospyros lotus</i> L.	Caucasian persimmon	+	VU D2	
6.	<i>Dianthus capitatus</i> J. St.-Hil.= <i>D.subulosus</i> Conrath & Freyn	-		NT	N40°46'34.43" E48°12'13.76"
7.	<i>Globularia vulgaris</i> L.	Common globe daisy		VU D2	N41°05'58.53" E47°21'09.35"
8.	<i>Hedera pastuchovii</i> Woronow	Pastuchov Ivy	+	NT	
9.	<i>Iris spuria</i> subsp. <i>musulmanica</i> (Fomin) Takht. = <i>Iris musulmanica</i> Fom.	-		NT	N41°20'50.19" E46°41'55.59"
10.	<i>Pinus sylvestris</i> var. <i>Hamata</i> Steven.	Koch's pine		NT	
11.	<i>Pistacia atlantica</i> Desf. = <i>Pistacia mutica</i> Fisch. & C.A.Mey.	Wild pistachio		NT	N41°19'40.63" E46°42'26.82" and surrounding areas

Followed by table 1

12.	<i>Primula algida</i> Adams.	Chilly primula		VU A2c+3c	
13.	<i>Pterocarya pterocarpa</i> Kunth. ex I.IIjinsk.	Caucasian wingnut		VU D2	
14.	<i>Punica granatum</i> L.	Pomegranate	+	VU B1 ab (i, ii, iii, v)+2ab (i, ii, iii, v)	
15.	<i>Pyracanta coccinea</i> M. Roem.	Scarlet firethotn	+	VU B1 ab (iii)+2ab (iii)	
16.	<i>Pyrola rotundifolia</i> L.	Round-leaved wintergreen		CR B1ab(i,ii,iii,iv,v)	
17.	<i>Rhododendron luteum</i> Sweet	Yellow azalea	+	CR B2ab (ii,iii,iv,v)	
18.	<i>Rhus coriaria</i> L.	Tanner's sumach		VUA2c+3c	
19.	<i>Crocus speciosus</i> M.Bieb.	Autmm flowering crocus		VU B1 ab(iii)+2ab(iii)	
20.	<i>Tulipa eichleri</i> Regel	Eyxler daplaləsi	+	VU A2c+3c	

Phyto-geographical analysis of the flora. According to the results of phytogeographical analysis, it can be said that the modern flora of the valley is formed by the species belonging to the following geographical types: Ancient III period forest (23 species 4.3%), Boreal (188 species 35.8%), Desert (12 species 2.2%), Caucasus (36 species 6.9%), Ancient Mediterranean (208 species 39%), Steppe (7 species 1.3%), Adventive (28 species 5.4%), Unidentified species (22 species 4.2%), Cosmopolitan species (7 species 1.3%).

Grouping of flora by life forms. The flora of the valley was grouped according to Raunkier's system of life forms and it was determined: 78 species of phanerophytes (14.7%), 18 species of chaemophytes (3.3%), 162 species of hemicryptophytes (30.3%), 81 species of cryptophytes (15, 1%), 196 species (36.6%) of therophytes.

Analysis of endemism. G.F. Akhundov noted only one endemic species *Tulipa eichleri* Regel. In Alazan-Agrichay botanical-geographical region and expressed the opinion that this species belonging to the desert geographical area type crossed the Bozgir plateau to the valley area.⁴⁰

According to A.M. Askerov, 7 species of subendem plants there were identified in the study area.⁴¹

Comparison of the floras of the study area and the Ilisu State Nature Reserve. The flora of the Ilisu State Nature Reserve firstly was studied in detail by Abdullayeva in 1996. She registered 500 species of plants grouped into 76 families and 290 genera in the reserve. The number of taxa forming the modern flora of the Ganikh-Agrichay valley and Ilisu Nature Reserve is 959 and 857, respectively. The total number of common genera for the two areas being compared is 147, and the number of species is 143. The floristic similarity coefficient of both areas is 31.07% for genera and 16.6% for species.

⁴⁰ Ахундов, Г.Ф. Эндемы флоры Азербайджана: /Автореф. дисс. ... к.б.н./ -Баку, 1974. -44с.

⁴¹ Əsgərov, A.M. Azərbaycan florasının subendəmləri // -Bakı: AMEA-nın xəbərləri, (biologiya və tibb elmləri), -2014. Cild 69, № 1, -s.81-91.

Chapter IV. Characteristics of vegetation and soil cover of Ganikh-Agrichay valley. As a result of expeditions conducted to the area during 2013-2017, we can say that the modern natural vegetation of the valley is composed of semi-desert, meadow, wetland, forest, and shrub vegetation types.

Semi-desert vegetation type. It was registered in Ganikh-Agrichay valley in Sheki (Gudula village), Gakh (Lalali village), Zagatala (Kapanakchi, Danachi villages) districts. It is represented by 2 formation classes, 4 formations, 5 associations.

Chal-meadow vegetation. The chal-meadow vegetation is mainly recorded in the form of spots (175-180 m.a.s.l.) within semi-desert and arid rare forest around Lalali and Almali villages of Gakh region of the valley on slopes with a low inclination and in the depressions of the relief on the meadow-swamp and alluvial-meadow soils in Ayrichay riverbed (Sheki region). The chal-meadow vegetation is grouped into 2 class formations, 4 formations, and 9 associations.

Wetland vegetation. The distribution of wetland vegetation in the Ganikh-Agrichay valley is being intrasonal and formed in lakes and ponds, water reservoirs, and depressions of the relief as a result of rising groundwater levels and river floodings. This type of vegetation is represented by 2 class formations, 12 formations, and 14 associations.⁴²

Forest vegetation. Forest vegetation is the potential type of vegetation formed in the Ganikh-Agrichay valley. Although mainly plain forests are well developed here, mountain forests have also been formed there under favorable ecological conditions. The forest vegetation type is grouped into 4 formation classes, 11 formations, 13 associations.⁴³ The area of forests in the study area is 550.81 km². This figure is equal to 15.9% of the total area of the Ganikh-Agrichay valley, and 0.005% of the total forests in the country.

Shrublands. Shrub vegetation was formed in the valley in the

⁴² Sarıyeva, G.R. Qanıx-Əyriçay vadisinin su-bataqlıq bitkiliyi (Azərbaycan Respublikası daxilində) // -Gəncə: AMEA-nın Gəncə bölməsinin xəbərlər məcmuəsi, - 2014. № 55, -s.3-6.

⁴³ Sarıyeva, G.R. Qanıx-Əyriçay vadisində meşələrin müasir vəziyyətinin təhlili // -Bakı: Gənc tədqiqatçı jurnalı, -2018. IV cild, №1, -s.189-194.

river cones, plains, and foothills, represented by 3 formation classes, 8 formations, and 8 associations.⁴⁴

As a result of the research, we can say that the most widespread vegetation type in the valley is shrublands, and the least widespread is chal-meadow vegetation.

Characteristics of soil cover. According to the legend of "Soil map-scheme of Ganikh-Agrichay valley", 8 soil types, 47 soil subtypes and species, 2 land complexes (typical alluvial meadow-forest and saline meadow-swamp are spread in the area. According to the legend of the map-scheme, the land area was calculated by us :

1. Civilized mountain-black - 819 ha (0.26%);
2. Mountain-brown-meadow - 38166 ha (12.36%);
3. Brown mountain-forest - 3370 ha (1.09%);
4. Mountain-brown - 63,036 hectares (20.42%);
5. Alluvial meadow-forest - 72965 ha (23.64%);
6. Alluvial-meadow - 81120 ha (26.27%);
7. Meadow-swamp - 9945 ha (3.22%);
8. Meadow - 31630 ha (10.25%);
9. Land complexes - 7688 ha (2.49%).

The total area of the research objects is 308739 ha.

The most common soils in the study area are alluvial-meadow soils, which make up 26.27% of the total area. The second most widespread are alluvial-meadow-forest lands, which make up 23.64% of the total area (4212.58 ha). Cultivated mountain-black and brown mountain-forest lands are the least common in the area at 1.35%.⁴⁵

Chapter V. The role of various plant species spread at the study area in the ecosystem. Types of the biocenosis interactions among some plant and animal species in the Ganikh-Agrichay valley. The most common forms of interactions among living organisms in biocenoses are trophic and phoric relationships.

⁴⁴ Saryyeva, G.R., Qurbanov, E.M. Qanix-Əyriçay vadisində formalaşmış arid seyrək meşə və kolluq landşaftlarının fitosenoloji quruluşu // -Bakı: Bakı Universitetinin xəbərləri. Təbiət elmləri seriyası, -2016. №2, -s.44-51.

⁴⁵ Saryyeva, G.R. Qanix-Əyriçay vadisinin allüvial-çəmən və allüvial-çəmən meşə torpaqlarının səciyyəsi // -Bakı: Azərbaycan Aqrar Elmi, -2018. №3, -s.164-167.

In this chapter of the dissertation discussed patterns of trophic and phoric relationships among vascular plants and animal species such as *Polyommatus agestis*, *Maniola jurtina*, *Vanessa atalanta*, *Argynnis paphia*, *Triturus karelinii*, *Pelophylax ridibundus*, *Bufo verrucosissimus*, *Testudo graeca*, *Tetrax-tetrax*, *Serinus pusillus*, *Carduelis carduelis*, *Aquila heliaca* registered in several biocenoses of the study area.⁴⁶

Some of the abovementioned animal species *Triturus karelinii* Strauch, 1870, *Bufo verrucosissimus* Pallas, 1814, *Testudo graeca* Linnaeus, 1758, *Tetrax-tetrax* Forster, 1814, *Aquila heliaca* were included in the 2nd edition of the Red Book of the Azerbaijan Republic.⁴⁷

The role of plant species in phytocoenoses. In this part of the dissertation are given examples of phoric interactions among parasitic plants and their hosts in the phytocenoses of the study area.

Phytomeliorative importance of plant species. Restriction of grazing in shrubs formed in relatively high and gravelly and parts of alluvial fans to prevent the destructive activity of floods recommended laying green strips of such species as *Salix purpurea* L., *Populus nigra* L., *Cotinus coggygria* Scop., *Frangula alnus* Mill. Bearded alder plays an important role in combating erosion on the river banks in the plains and in drying out excessively wet areas.

Tugay forests protect the slopes of river beds from erosion and avalanches. Due to its strong root system, it is very resistant to floods, so it is recommended to plant *Salix alba* L. along the banks of large rivers in the plains. It is advisable to use *Quercus iberica*, *Fagus orientalis* Lipsky., *Corylus avellana* L. species in strengthening mountain slopes. In the consolidation of landslide-rocky slopes in the study area *Rhus coriaria* L., *Jasminum fruticans* L., *Celtis australis* subsp. *caucasica* (Willd.) C.C.Towns. = *Celtis caucasica* Willd., *Onobrychis cyri* Grossh, *Chrysopogon gryllus* (L.) Trin.; in the prevention of erosion on clayey and rocky slopes *Atraphaxis spinosa*

⁴⁶ Qurbanov, E.M., Sarıyeva, G.R., Abbasov, A.Ş. Qanıx-Əyriçay vadisində yayılmış bəzi borulu bitki növlərinin ekosistemdə rolu // -Lənkəran: Lənkəran Dövlət Universitetinin Elmi Xəbərləri, Təbiət elmləri bölməsi, -2018. №1, -s.127-133.

⁴⁷ Azərbaycan Respublikasının Qırmızı Kitabı, nadir və nəslə kəsilməkdə olan heyvan növləri II nəşr. -Bakı:“Şərq-Qərb” nəşriyyatı, -2013. -518 s.

L., *Capparis spinosa* L., *Bassia prostrata* (L.) Beck. = *Kochia prostrata* (L.) Schrad, *Reaumuria alternifolia* (Labill.) Britten. = *Reaumuria hypericoides* Willd.; in dry foothills and sub mountainous areas *Pistacia atlantica* Desf. = *Pistacia mutica* Fisch. & C.A.Mey., *Elaeagnus angustifolia* L. are promising species of particular importance. In strengthening the gravel river branches in the valley area *Pyracanta coccinea* M. Roem., *Juniperus oxycedrus* L., *Cotinus coggygria* Scop., *Elaeagnus rhamnoides* L.A.Nelson = *Hippophae rhamnoides* L. *Colutea armena* Boiss. & Huet.; in the reinforcement of arid slopes *Rhamnus pallasii* Fisch.& C.A.Mey, *Ulmus minor* Mill. = *Ulmus suberosa* Monech., *Paliurus spina-christi* Mill. are important species.

Dynamics of total phytomass in *Artemisetum-Ephemerium* and *Alhagietum-Artemisosum* associations. The total phytomass of *Artemisetum-Ephemerium* and *Alhagietum-Artemisosum* associations was studied in April, May, June, and October in 2015-2016.

The *Artemisetum-Ephemerium* plant community, which productivity depends mainly on atmospheric precipitation and air temperature, is characterized by its species diversity, especially in the spring months. While the total mass of wormwood increases from spring to autumn, the phytomass of ephemerals decreases.

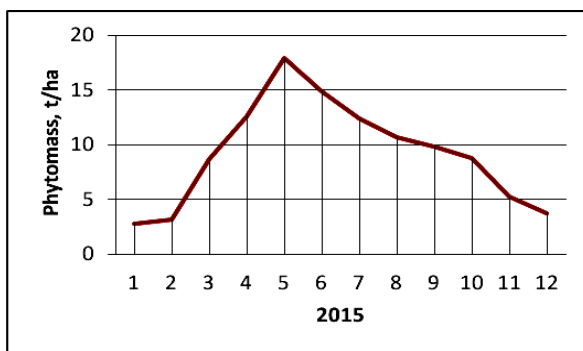
The amount of precipitation in 2015 was 543.7 mm, and in 2016 it was 960.3 mm. Such a sharp difference in meteorological indicators over the years is reflected in the accumulation of phytochemicals. Thus, in relatively dry 2015, the phytomass reserve of *Artemisetum-Ephemerium* association was 11090.0 g / m² the year, and in 2016 it was 13061.0 g / m² in the year of heavy rains. The annual stock of phytomass in the *Alhagietum-Artemisosum* association was 11752.0 and 10730.0 (g / m²), respectively.

Energy indicators of *Artemisetum-Ephemerium* and *Alhagietum-Artemisosum* associations. V.R. Volobuyev notes that the growth and decay of perennial plants is a very complex issue and has not been sufficiently studied to date.⁴⁸ Comprehensive researches in phyto and agrophytocenoses in Azerbaijan in this field were

⁴⁸ Волобуев, В.Р. Введение в энергетику почвообразования / В.Р.Волобуев. -М. «Наука», -1974. -127 с., -с.7-9.

carried out by S.A. Aliyev, Y.A. Zeynalov, and A.M. Kerimov. It was carried out by A.M. Karimov on the gray-meadow lands formed in the Kur-Araz lowland.⁴⁹ To determine the growth and fragmentation of plant mass, the method of analysis of the dynamics of plant mass on the differential curve proposed by V.R. Volobuyev was used. The difference of this method is that with its help it is possible to determine the growth of the plant and its disintegration rate for each month of the year based on actual indicators of the dynamics of phytomass. Graphs 5.5.1 and 5.5.2 show the dynamics of two complex processes that are antagonistic to each other over time - accumulation and decomposition in *Artemisetum-Ephemerolum* and *Alhagietum-Artemisosum* phytocenoses. It is clear from Figure 5.5.1 that the intensity of plant accumulation in the *Artemisetum-Ephemerolum* community exceeds its decay rate by May. In the second half of the year, on the contrary, this process ends with the exceed of accumulation of decay in the biocenosis.

It was determined that the growth of the *Artemisetum-Ephemerolum* association in 2015-2016 was 16.0 t / ha and 25.55 t / ha respectively.



⁴⁹ Алиев С.А. - Экология и энергетика биохимических процессов превращения органического вещества почв. Баку «Элм», 1978, 253 с.; Зейналов Ю.А. Энергетика почв и фитоценозов полынно-эфемерового сообщества и люцерны в условиях Восточной Ширвани// “Изв.АН Азерб.ССР, серия биол.наук», 1979, №6, с.57-64; Кәримов А.М., Мәммәдова Ҷ.А., Новрузова С.С. Salyan düzü boz-çәмән torpaqların su-istilik rejimi, ekoenergetik sәciyyәsi vә energetik balansının qurulması // AMEA-nın Gәncә Bölmәsinin Xәbәrlәр Mәcmuәsi, №3 (69), 2017, s.-104-113.

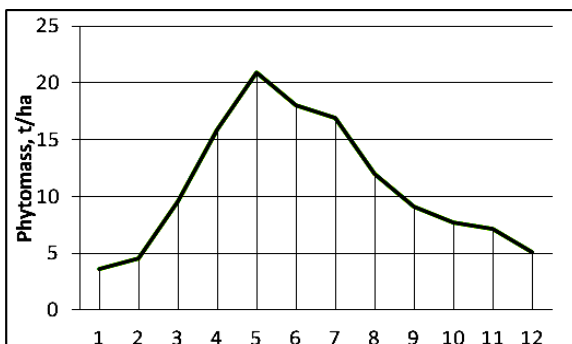


Figure 1. Dynamics of accumulation and decay of phytomass (above and underground, t / ha, in 2015-2016) in *Artemisetum-Ephemerisum* association

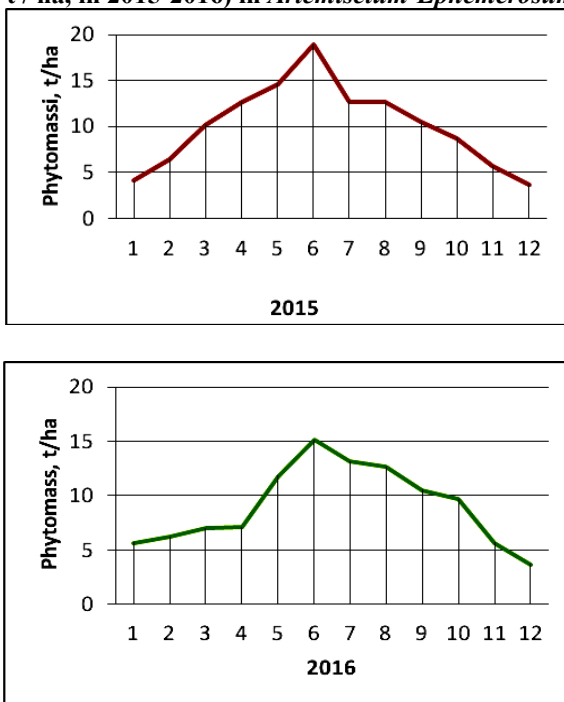


Figure 2. Dynamics of accumulation and decay of phytomass (above and underground, t / ha, in 2015-2016) in *Alhagietum-Artemisosum* association

To determine the energy stored in plant growth, it is important to know the energy stored in 1 gram of dry plant mass. According to

the calorimetric indicators of A.P. Garayzadeh, per gram of dry mass of *Artemisetum-Ephemerisum* association has been accumulated 5015 cal. energy, and 5420 cal. in per gram of dry mass of *Alhagietum-Artemisusum* association.⁵⁰

Referring to the calorimetric indicators of the camelthorn, it was determined that while the *Alhagietum-Artemisusum* association accumulated 121.0 and 107.3 kJ of energy per year (2015-2016, respectively), 316.4 and 231.6 kJ of energy was accumulated in the growth of phytomass.

374.2 and 269.9 kJ of energy was accumulated in the decomposed part of the phytomass during the year (2015-2016, respectively).⁵¹

To obtain quantitative indicators of biological productivity of natural coenoses, firstly necessary to determine the energy used for soil formation, in this case, the well-known formula of academician V.R. Volobuyev (1.) was used.:

$$Q = R \cdot a = R e^{\frac{1}{mKn}} \quad (1)$$

Here, Q - is the energy used to form the soil, kcal / cm² per year; R - radiation balance of the earth's surface, kcal / cm² year; a - indicator of solar energy use of biogeocenosis; Kn - relative humidity coefficient; m – an indicator of biological activity of biogeocenosis (2,13); ℓ is a natural logarithm. The relative humidity coefficient was calculated as the ratio of atmospheric precipitation to possible evaporation (2):

$$K_n = \frac{\text{йавынты, П}}{\text{мцмкцн бухарланма } E_n} \quad (2)$$

Amount of atmospheric precipitation (P) – was pointed on data of meteorological station of the Ministry of Ecology and Natural Resources of the Republic of Azerbaijan operating in Sheki region for 2015 and 2016; radiation balance (R) - was adopted according to

⁵⁰ Волобуев, В.Р. Введение в энергетику почвообразования / В.Р.Волобуев. -М. «Наука», -1974. -127 с., -s.56.

⁵¹ Сарыева, Г.Р. Продуцирование и энергетические показатели биоеоценозов полупустынь Ганых-Айричайской долины Азербайджана // - Нижневартовск: Бюллетень науки и практики, -2020. Т. 6, №9, -с. 74-87.

A.M. Shikhlin'sky⁵², possible evaporation (E_n) - was calculated according to V.R. Volobuyev's formula of (3.):

$$E_n = 50 R^{0,6} \quad (3)$$

The relative humidity coefficient is calculated in formula 5.5.2. is less than the unit in 2015 ($K = <1$) 0.79; In 2016, it was larger than the unit ($K = >1$) and was 1.39 in conditions of extreme humidity. The amount of possible evaporation is calculated according to the formula 5.5.3. and taking into account its dependence only on the radiation balance, the value of the potential evaporation for the Sheki area of the study area was estimated at 687 mm.

The calculation of energy consumption in biogeocenosis based on climate and phytoproductivity indicators of biogeocenosis with the help of the basic formula of soil formation 1 allowed to determine the following dependence::

$$V = Q^n \quad (4)$$

Here, V – is the annual increase of phytomass in natural coenoses, n - is the parameter that is related to the relative humidity coefficient (Kn) (formula 5 and 6.):

$$\lg n = 0,45 + 0,085 Kn, Kn < 1 \quad (5)$$

$$\lg n = 0,45 + 0,056 Kn, Kn > 1 \quad (6)$$

In 2015-2016, it was determined that the energy used for evaporation was 147.7 and 294.0 (kJ). Their maximum values were 33.56 and 55.31 (kJ) in June, and their minimum values were 2.65 kJ in December 2015 and 4.51 kJ in January 2016.

By determining the energy used for total evaporation and adding it to the energy accumulated in the growing mass of the biocenosis, it is possible to determine the energy used for soil formation in the biogeocenosis. Thus, in the *Artemisetum-Ephemerium* association in 2015, 483.7 kJ was used for soil formation, 336.2 kJ for biological processes in the soil, 0.78% of energy was used relative to the process of soil formation in plant mass. In 2016, these energy expenditures were as follows: 831.5 kC

⁵² Шыхлинский, Э.М. Тепловой баланс Азербайджанской ССР / Э.М. Шыхлинский. - Баку, -1969. -340 с., -s.152-153.

of energy used for soil formation, 528.9 kJ for plant mass growth, 0.64% relative to the process of soil formation in plant mass.

In *Alhagietum - Artemisium* association, the energy used for soil formation in 2015-2016 was 464.1, and 525.7 (kJ). At the same time, the energy used for biological processes was 316.4 and 231.6 (kJ), and the relative share of plant formation in relation to soil formation was 0.68 and 0.44 (%).

According to Q.Sh.Mammadov, the total area of typical gray (12870 ha), gray-brown (4770 ha), alluvial-meadow (27540 ha) soil types spread in Ganikh-Agrichay valley of Sheki region is 45180 ha. (Table 2).⁵³

Table 2.
Productivity of biogeocenosis by soil types in Sheki region and indicators of energy accumulated in them by soil types

№	Soil type	Area, ha	Productivity to the total area, tons	Energy accumulation in the total area, kC
1	Typical gyay	12870	$1,21 \cdot 10^5$	$2,65 \cdot 10^6$
2	Gray-brown	4770	$4,5 \cdot 10^4$	$9,84 \cdot 10^5$
3	Alluvial-meadow	27540	$2,6 \cdot 10^5$	$5,68 \cdot 10^6$
4	Total:	45180	$4,21 \cdot 10^5$	$9,32 \cdot 10^6$

When the calculated productivity of natural plant mass is applied to the territories of these soil types, as can be seen from Table 5.5.2, $1,21 \cdot 10^5$ tons in typical gray soils, $4,5 \cdot 10^4$ tons in gray-brown soils, and wider in alluvial-meadow soils. $2,6 \cdot 10^5$ t was collected in phytomass during the year. In general, it is estimated that there are $4,21 \cdot 10^5$ tons of plant mass in Ganikh-Agrichay valley.

According to the calorimetric indicators of phytomass (average 5200 cal / gram), in ephemeral-wormwood and camelthorn-wormwood associations generally accumulated $9,32 \cdot 10^6$ kJ of energy in the valley. In terms of soil types, these indicators were separate: $2,65 \cdot 10^6$ kJ in typical gray soils, $9,84 \cdot 10^5$ kJ in gray-brown soils, and $5,68 \cdot 10^6$ kJ in alluvial-meadow soils.

⁵³ Məmmədov, Q.Ş. Azərbaycanca torpaq islahatı hüquqi və elmi-ekoloji məsələlər / Q.Ş.Məmmədov. –Bakı: Elm, -2002. -411 s., s.-377.

In our calculations, referring to the formula 5.5.1 0.55 or 55% of the radiation balance entering the Earth surface in 2015 (49.9 kcal / cm² per year) and in 2016 0.71 or 71% (average 0.63 or 63%) energy was received and spent on the formation of phytomass, and on average 37% was left unused by plants.

Chapter VI. Environmental factors that negatively affect phytodiversity in the study area. Anthropogenic factors. The total area of the Ganikh-Agrichay valley is 3473.11 km². 61% (2131 km²) of the total area are arable lands, 17% (605 km²) are settlements, 1% are water reservoirs (3.11 km²), 21% (734 km²) are natural areas. (Figure 1.).

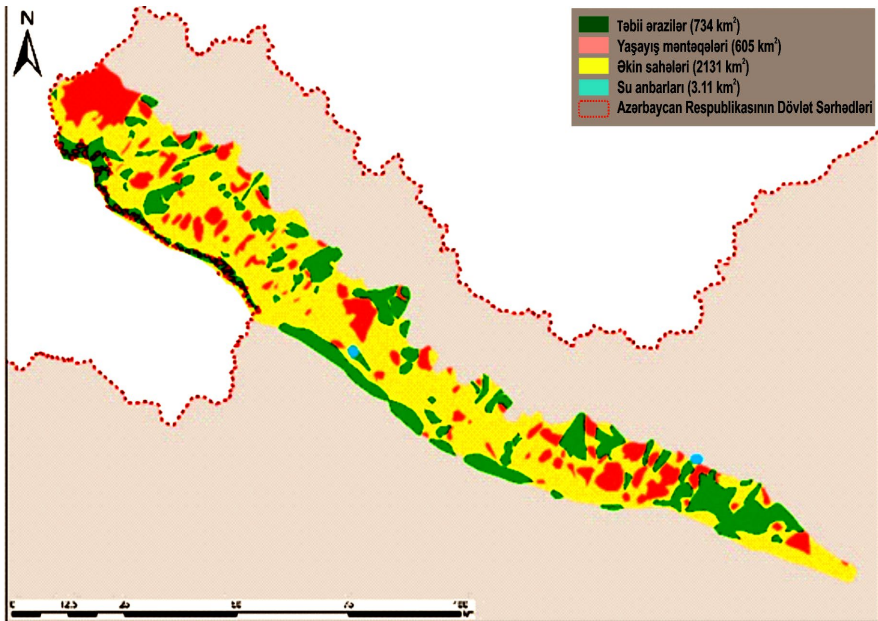


Figure 3. Map of the land cover classes in Qanikh-Agrichay valley

According to N.F. Reimers, to maximize the ecological, socio-economic benefits in a given area when using natural resources, the ratio of transformed ecosystems to natural ecosystems should be

40%: 60%, ie 2 : 3.⁵⁴ Based on the figures presented above, we conclude that this ratio has been significantly violated in our study area and is approximately 80% : 20%, ie 4 : 1.⁵⁵ Anthropogenic transformation of natural ecosystems is a major factor that directly leads to a decrease in phytodiversity. Depending on the purpose of the industrial enterprises located in its territory, the Ganikh-Agrichay valley is one of the least polluted regions in the country with hazardous waste.

The amount of hazardous waste released into the environment from industry, agriculture, households, and vehicles are up to 25,000 tons per year. In the villages Danachi and Lalali of Zagatala rayon, salinization of the soil cover of semi-desert areas, the predominance of halophyte plants such as *Bassia prostrata* (L.) Beck.=*Kochia prostrata* (L.) Schrad, *Reaumuria alternifolia* (Labill.) Britten., *Atriplex verrucifera* M. Bieb.=*Halimione verucifera* (M.B.) Aell, a sharp decrease in the project cover of the phytocenosis were observed. In the scientific literature, less than 10% of the projective cover in semi-desert phytocenoses is considered an indicator of environmental disaster.⁵⁶

Invasive plants. The most dangerous factor for the vegetation of the valley is the human factor. However, invasive species such as *Ailanthus altissima* (Mill.) Swingle, *Erigeron canadensis* L., *E.bonariensis* L., *Eupatorium cannabinum* L., *Ambrosia artemisiifolia* L., *Amaranthus albus* L., *A.retroflexus* L., *Xanthium stromarium* L., *X.spinosum* L., *Euphorbia humifusa* Schlecht, *E.maculata* L., *Amorpha fruticosa* L., *Robinia pseudoacacia* L., *Eleusine indica* (L.) Gaertn., *Phytolacca americana* L. are also among the main negative factors for phytodiversity of the study area.

⁵⁴ Реймерс, Н.Ф. Охрана природы и окружающей человека среды: Словарь-справочник / Н.Ф.Реймерс. – М.: Просвещение, -1992. -317с.

⁵⁵ Sariyeva, G.R., Sadigova, N.A., Bayramov, E.R. Major negative effects on plant diversity in Ganikh-Agrichai Valley (within the borders of Azerbaijan Republic) // -Gillingham: European Journal of Biology and Medical Science Research, -2018. Vol. 6, No.1, -p.1-6.

⁵⁶ Голубев, Г.Н. Геоэкология / Г.Н.Голубев. -М.: Изд-во ГЕОС, -1999. -338 с.

RESULTS

1. There were registered 505 species, 28 subspecies, and 2 variations of vascular plants grouped by 92 families and 332 genera in the flora of Ganikh-Agrichay valley. Of the total species registered in the study area, 8 species (1.5%) were included in the I edition of the Red Book of AR, 20 species (3.7%) in the II edition of the Red Book of AR, 4 species of trees and 3 species of shrubs, has a global protection status. Moreover, new distribution areas of vascular plants belonging to 35 species and 3 subspecies had been identified in the valley.
2. Species and subspecies belonging to the dominant families (*Poaceae*, *Compositae*, *Leguminosae*, *Cyperaceae*, *Lamiaceae*, *Rosaceae*, *Boraginaceae*, *Brassicaceae*, *Ranunculaceae*, *Caryophyllaceae*) make up 52.7% of the total flora of the valley.
3. According to the legend of "Soil map-scheme of Ganikh-Agrichay valley", 8 soil types, 47 soil subtypes and species diversity, 2 soil complexes (typical alluvial meadow-forest and saline meadow-swamp) are spread in the area. The modern vegetation of the study area consists of semi-desert, chal-meadow, water-marsh, shrubland, and forest vegetation types.
4. In the *Artemisetum-Ephemerolum* association energy spent on soil formation in 2015-2016, amounted to 483,7 and 831,5 kJ; 336,2 and 536,6 kJ on biological processes in the soil, energy stored in plant mass relative to soil formation was 0,78% and 0,64%.
5. In the *Alhagietum-Artemisetum* association, energy spent on soil formation in 2015-2016 amounted to 464,1 and 525,7 (kJ); 316.4 and 231.6 (kJ) on biological processes in the soil, and energy stored in plant mass relative to soil formation was 0,68 and 0,44 (%).
6. Studies have shown that anthropogenic impacts and invasive plant species are the main environmental factors that negatively affect phytodiversity in the valley. However, the ratio of the area of transformed and natural ecosystems in the Ganikh-Agrichay valley is about 80 % : 20%, ie 4 : 1.

SUGGESTIONS

It was decided to include several research results of the dissertation on "Flora of the landscapes of Ganikh-Agrichay valley and its role in the ecosystem" (within the Republic of Azerbaijan) to the bachelor subject program "Flora and fauna of Azerbaijan" that is conducted in Bioecology department of the BSU.

List of scientific works published on the subject of the dissertation

1. Sarıyeva, G.R. Qanıx-Əyriçay vadisində yayılmış dağ və düzən meşə bitkiləri // BDU-nun 95 illik yubileyinə həsr olunmuş elmi konfransın materialları, -Bakı: -10 dekabr, -2014, -s.49-51.
2. Sarıyeva, G.R. Qanıx-Əyriçay vadisinin su-bataqlıq bitkiliyi (Azərbaycan Respublikası daxilində) // -Gəncə: AMEA-nın Gəncə bölməsinin xəbərlər məcmuəsi, -2014. № 55, -s.3-6
3. Sarıyeva, G.R., Qurbanov, E.M. Qanıx-Əyriçay vadisində formalaşmış arid seyrək meşə və kolluq landsaftlarının fitosenoloji quruluşu // -Bakı: Bakı universitetinin xəbərləri, təbiət elmləri seriyası, -2016. №2, -s.44-51
4. Sarıyeva, G.R. Qanıx-Əyriçay vadisində yayılmış Yarım səhra bitkilik tipi // Ümummilli lider Heydər Əliyevin anadan olmasının 94 illiyinə həsr olunmuş «XXI əsrdə Ekologiya və torpaqsünəslıq elmlərinin aktual problemləri» VI respublika elmi konfransının materialları, -Bakı: -4-5 may, -2017, -s.182-183
5. Sarıyeva, G.R., Sadiqova, N.A., Abbasov, A.Ş. Qanıx-Əyriçay vadisində yayılmış bəzi bitki və heyvan növləri arasında qarşılıqlı əlaqələrin xarakteri // Akademik Həsən Əliyevin 110 illik yubileyinə həsr olunmuş «Ekologiya: təbiət və cəmiyyət problemləri» mövzusunda III beynəlxalq elmi konfransın materialları, Bakı: -26-27 dekabr, -2017, -s.282-284
6. Сарыева, Г.Р. Анализ флоры Ганых-Агричайской долины (В пределах Азербайджанской Республики) // -Москва: Международный журнал прикладных и фундаментальных исследований, -2018. №1, -с.115-120.

7. Sariyeva G.R., Sadigova, N.A., Bayramov, E.R. Major negative effects on plant diversity in Ganikh-Agrichai Valley (within the borders of Azerbaijan Republic) // -Gillingham: European Journal of Biology and Medical Science Research, -2018. Vol. 6, No.1, -p.1-6.
8. Sariyeva, G.R. Qanıx-Əyriçay vadisinin allüvial-çəmən və allüvial-çəmən meşə torpaqlarının səciyyəsi // -Bakı: Azərbaycan Aqrar Elmi, -2018. №3, -s.164-167.
9. Qurbanov, E.M., Sariyeva, G.R., Abbasov, A.Ş. Qanıx-Əyriçay vadisində yayılmış bəzi borulu bitki növlərinin ekosistemdə rolu // -Lənkəran: Lənkəran Dövlət Universitetinin Elmi Xəbərləri, Təbiət elmləri bölməsi, 2018. №1, -s.127-133.
10. Sariyeva, G.R. Qanıx-Əyriçay vadisində meşələrin müasir vəziyyətinin təhlili // -Bakı: Gənc tədqiqatçı jurnalı, 2018. IV cild, №1, -s.189-194.
11. Sariyeva, G.R. Qanıx-Əyriçay vadisinin Yarım səhra bitkiliyi və torpaq örtüyünün səciyyəsi // -Gəncə: AMEA-nın Gəncə bölməsinin xəbərlər məcmuəsi, -2018. №2 (72), -s.28-36.
12. Сарыева, Г.Р., Садыгова, Н.А. Разнообразие семейства осоковых (Cyperaceae) во флоре Ганых-Агричайской долины (Азербайджанская Республика) // Сборник Международной научно-практической конференции «Фундаментальные научные исследования: теоретические и практические аспекты», -Кемерово: -16 декабря, -2019, -с.147-150. URL: file:///G:/Sbornik_11_NI_16_12_19.pdf
13. Сарыева, Г. Р. Сравнительная характеристика флор Ганых-Айричайской долины и Илисуйского природного заповедника (Азербайджан) // - Нижневартовск: Бюллетень науки и практики, -2020. Т.6, №2, -с.55-59. URL: <https://doi.org/10.33619/2414-2948/51/05>
14. Сарыева Г. Р. Продуктивное и энергетические показатели биогеоценозов полупустынь Ганых-Айричайской долины Азербайджана // - Нижневартовск: Бюллетень науки и практики, -2020. Т.6, №9, с.74-87. URL: <https://doi.org/10.33619/2414-2948/58/08>

The defense of dissertation will be held «28 12 2021 at 11 at the meeting of the Dissertation Council BFD 3.03 of One-time Supreme Attestation Commission under the Azerbaijan National Academy of Sciences, Institute of Soil Science and Agrochemistry.

Address: AZ 1073, Azerbaijan Republic, Baku city, M.Rahim avenue 5. e-mail: tai.amea@mail.ru

The dissertation is accessible in the library of the Institute of Soil Science and Agrochemistry of ANAS.

Electronic versions of the dissertation and its abstract are available on the official website defterxana@tai.science.az.

The abstract was sent to the required addresses on "26" 11 2021.