

REPUBLIC OF AZERBAIJAN

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ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

**BIOECOLOGICAL PROPERTIES, RESERVES AND
PHYTOCHEMICAL STUDY OF SOME SPECIES OF THE
VALERIANACEAE BATSCH. DISTRIBUTED IN THE FLORA
OF NAKHCHIVAN AUTONOMOUS REPUBLIC**

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INTRODUCTION

Relevance and degree of development of the topic. The plant kingdom consists of exceptionally important organisms, playing a crucial role in the formation of the Earth and, at the same time, being the beginning of the food chain, while also playing an important role in human life¹. Within the plant kingdom, angiosperms or flowering plants occupy a dominant position on Earth thanks to a number of very important adaptive traits they have acquired during the historical-evolutionary process. Currently, flowering plants in the world's flora, which are divided into two classes: monocotyledons and dicotyledons, include more than 250,000 species belonging to more than 300 families and up to 10,000 genera². The class of dicotyledons is several times larger than the class of monocotyledons in terms of the number of taxa.

The modern territory of the Nakhchivan Autonomous Republic holds an important place in the Caucasus due to its genesis and geographical location. The flora of the Nakhchivan AR, spread across the three botanical-geographical zones in the region, and is richer compared to other botanical-geographical areas of Azerbaijan. In this region, which is not very large in terms of territory, 3020 species of higher spore, gymnosperm and angiosperm plants are found, of which the monocotyledon class of flowering plants is represented by 24 families, 159 genera and 578 species, and the dicotyledon class by 87 families, 645 genera and 2268 species³. This amount constitutes 60.4% of the flora of Azerbaijan (≈ 5000).

There are many useful plant groups within the class dicotyledons. Among the families, in addition to fodder plants, there is a wide distribution of plants valued for vitamins, gums, tannins, flavonoids, alkaloids, glucosides, food, essential oils, technical uses, ornamentals,

¹ İbadullayeva, S., Huseynova, İ. An Overview of the Plant Diversity of Azerbaijan [Chapter]: Biodiversity, Conservation and Sustainability in Asia / Editors - Munir Öztürk, Volkan Altay, Recep Efe. Springer, -2021, Volume 1, -p. 431-478.

² www. Plants Portal | Britannica

³ Talıbov, T.H. Naxçıvan Muxtar Respublikası florasının taksonomik spektri (Ali sporlu, çıpaqtoxumlu və örtülütöxumlu bitkilər) /T.H. Talıbov, Ə.Ş. İbrahimov, Ə.M. İbrahimov, – Bakı: Şirvanəşr, – 2021. – 426 s.

medicinal purposes, and fruit and berry plants. Many of them have abundant natural resources and are of industrial importance. In addition to useful plants, there are also many rare, endemic, relict and endangered species included in the “Red Book”. The plants of the *Valerianaceae* Batsch – valerian family that we studied occupy a unique place in the flora of the autonomous republic. Most species of the family, selected for their medicinal value and decorative properties, play an important role in pharmacology and are widely used as medicinal, food, and ornamental plants in many countries^{4, 5, 6}.

During the recent researches, the flora biodiversity of Nakhchivan Autonomous Republic was studied, and the species composition of the flora of the territory was clarified. Thus, the studied species were accepted in these works as *Valerianaceae* Batsch family and the taxonomic structure of the species was analyzed. In these studies, geobotanical analyses, resource assessment of useful species and phytochemical studies were not found^{7, 8}. In the latest nomenclature classification, these species were transferred to the synonymy of the *Caprifoliaceae* Juss. family and were attributed to the subfamily *Valerianoideae* Raf.⁹

Despite the multifaceted nature of the scientific research works conducted so far on the flora and vegetation of the Nakhchivan Autonomous Republic, no research work has investigated the detailed analysis, role in phytocenoses and effective use of the species included

⁴ Mineo, L. *Valeriana officinalis* root extract modulates cortical excitatory circuits in humans / L. Mineo, C. Concerto, D. Patel [et al.] // *Neuropsychobiology*. -2017. V. 75, -p.46–51.

⁵ Becker, A. The anxiolytic effects of a Valerian extract is based on valerenic acid. / A. Becker, F. Felgentreff, H. Schröder [et al.] // *BMC Complement. Altern. Med.* -2014. N. 14, -p. 1-5.

⁶ Дадаев, Х.А., Акилов, Дж.Х., Тогаев, М.К. Валериана лекарственная// *Биология и интегративная медицина*, -2021, no. 1 (48), -pp. 233-249.

⁷ Talıbov, T.H. Naxçıvan MR-in flora biomüxtəlifliyinin müasir vəziyyəti// -Bakı: AMEA Məruzələri, -2002. Cild 58, № 1-2, -s. 148-154.

⁸ İbrahimov, Ə.Ş., Talıbov, T.H. Naxçıvan MR-in təbii bitki ehtiyatları və ondan səmərəli istifadə yolları // - Bakı: *Elm və texnika yenilikləri*” jurnalı. -2000, № 1(4), -s. 12- 23.

⁹ The World Flora Online: [Electron resources]/ www.worldfloraonline.org/

in the subfamily *Valerianoideae*, which are widespread in the flora of the autonomous republic and are distinguished by their medicinal, food and decorative properties. That is why, in addition to being relevant, clarifying the systematic composition of the subfamily *Valerianoideae* in the flora of the autonomous republic, and investigating ways to identify, effectively use, and protect rare species, are of great scientific and practical importance.

In general, upon reviewing the chronology of the history of studying the flora of the Nakhchivan AR, it becomes clear that the plants of the *Valerianaceae* Batsch have been relatively poorly studied, therefore, there is a need for serious study of these plants.

Object and subject of research. The object of the research was the species belonging to the *Valerianaceae* Batsch, which are widespread in the Nakhchivan AR, and study of their current condition. As the subject of research, species with superior usefulness, especially economic value, and distinguished by their medicinal importance were selected, their botanical characteristics, the current state of their natural resources, the role in vegetation types, the reasons for their rarity or extinction were studied, and ways of protection were explored.

Goals and objectives of the research. The main goal of the research work is to clarify the taxonomic composition of species belonging to the valerian family in the biodiversity of the Nakhchivan AR, to study their bioecological characteristics taking into account their distribution zones, and to develop scientific foundations for the role and use of species distinguished by their beneficial properties in the vegetation type. To achieve this goal, the following tasks have been set:

- Development of a taxonomic overview of the *Valerianaceae*, clarification of species composition and analysis;
- Study of the bioecological characteristics of species belonging to the valerian family;
- Determining the role of species belonging to the valerian family in phytocenoses;
- Analysis of the species included in the family according to their distribution in vegetation types and botanical-geographic regions;

➤ Biochemical study and resource assessment of some species belonging to the valerian family, distinguished by their beneficial properties;

➤ Identifying endangered and rare species;

➤ Development of proposals and recommendations for the efficient use, scientific and practical importance and protection of species of the valerian family.

Methods of the research. In the research, using classical and modern botanical floristic, taxonomic, arealological, bioecological, phytochemical and statistical methods, species belonging to the valerian family were specified and their superior beneficial properties investigated. The floras of Azerbaijan and the Caucasus, the Flora Conspectus of the Caucasus, the “*Angiosperm Phylogeny Group - APG IV*” classification, and various websites were used to determine the taxonomy and bioecological characteristics of the species. “IUCN-Version 15.1.” data was used to specify the categories of rare and endangered plants according to the threat criteria.

Main provisions presented to the defense:

1. Compilation of the modern taxonomic spectrum of the valerian family distributed in the territory of the Nakhchivan AR in accordance with “*Angiosperm Phylogeny Group - APG IV*”, and the provision of bioecological characteristics according to distribution zones are a contribution to new publications of floras.

2. Determining the status and limiting factors of the species *Valeriana erotica* Christenh. & Byng (syn. *Centranthus longiflorus* Steven, 1829 – long-flowered centranth), *Valeriana alliarifolia* Adams. and *Valerianella amblyotis* Fisch. & C.A. Mey. included in the valerian family, taking into account their natural state, is essential for protecting their populations and accelerating the future recovery process;

3. The biologically active substances obtained during the phytochemical analysis of some species belonging to the valerian family, distinguished by their superior beneficial properties, allow these species to be used as medicinal plants.

Scientific innovations of the research. For the first time in the region, 2 genera, 17 species belonging to *Valerianoideae* Raf. –

Valerian sub-family of the *Caprifoliaceae* – Honeysuckle family were determined. In general, taxonomic overview of the *Caprifoliaceae* Juss. – Honeysuckle family (syn. *Valerianaceae* Batsch - Valerian family) was compiled. The role of family representatives in the formation of the flora and vegetation of the region was identified, phytogeographic analysis conducted, phytocenological characteristics studied, their bioecological, ecobiomorphological, and biochemical composition of some species analyzed, and rare and endangered species specified as well as the distribution patterns across altitudinal zones studied. New plant groupings (formations) belonging to 6 species and 22 new distribution areas for 8 species were discovered for the flora biodiversity of the Nakhchivan AR. The modern phytocenological classification of species in the alpine and subalpine zones is presented, and the type, subtype, formations and associations they form are determined. Their distribution, species composition, structure, and interactions between components were studied, and their coenosis formers were recorded. Species belonging to valerians in the areas of the studied zones exposed to anthropogenic and natural impacts were identified, and appropriate proposals and recommendations developed for their protection. Species belonging to the valerian family, distributed in the territories of the autonomous republic from the lower to the upper mountain belts, were studied using experimental research methods. Maps of the ranges of 16 species by region were compiled for the first time, showing precise distribution areas by botanical-geographical regions. For the first time, 5 components were identified from the flowers of the garlic-leaved valerian plant. A new substance– isoalantolactone – for the plant was obtained from the roots of the long-flowered valerian, collected during its flowering phase, a new substance for plants – achillin sesquiterpene lactones – was obtained from its flowers during the flowering phase.

Theoretical and practical significance of the research. The results of the study of the family valerian, which forms the flora and vegetation of the Nakhchivan AR, considered one of the main phytocomponents of petrophilous and hygrophytic vegetation, will be reflected in the re-development of the taxonomic spectrum of the flora

of Azerbaijan and the Nakhchivan AR and in the publications of the new “Red Book” of the Nakhchivan Autonomous Republic.

The results of the study are a source that will be used in the development of plant systematics, determinants, and regional programs on environmental protection, as well as in the teaching process in biology-profile faculties of secondary and higher schools and in the development of working programs on systematics. The medicinal and decorative properties of the representatives of the family can be widely used in pharmacy and landscaping.

Plant samples collected during the research were transferred to the Herbarium Funds of the Institute of Botany and the Institute of Bioresources (Nakhchivan) of the Ministry of Science and Education of the Republic of Azerbaijan, playing a certain role in their enrichment.

Approbation and appliacion. The main provisions of the dissertation work are presented at the local and international conferences such as International conference on “The impact of climate change on plant biodiversity” (Baku, 2017); International Scientific Conference “New Challenges in Ensuring Sustainability of Biodiversity (COP29) Green World and Human Health” (Nakhchivan, 2024); XIII International Scientific Conference “Development of science in the XXI century” (Dortmund, 2024), “Karabakh 4th International scientific research congress” (Baku, 2024), as well as at the general meeting of Nakhchivan State University and the Scientific seminar of the Institute of Botany, MSERA.

The main sections of the dissertation are reflected in 11 published articles (3 of them abroad) and 4 theses (1 abroad).

The name of the institution where the dissertation work was performed. The dissertation was implemented at the Department of Biology of Nakhchivan State University.

Structure and scope of work. The dissertation is 153 pages and consists of an introduction, 6 chapters, results, suggestions and recommendations, and a list of 151 references. The total volume of the dissertation consists of 184256 symbols (introduction – 11623 symbols, Chapter I– 13954 symbols, Chapter II– 34580 symbols, Chapter III – 49900 symbols, Chapter IV -21870 symbols, Chapter

V– 22065 symbols, Chapter VI – 26480 symbols, results – 2829 symbols, proposal and recommendations-955 symbols). The work used 11 tables, 22 maps-schemes, and 45 images.

CHAPTER I. LITERATURE REVIEW ON THE STUDY OF THE *VALERIANACEAE* BATSCH

In this chapter of the dissertation, literature materials were examined and the changes that have occurred so far in the taxonomic composition of the genera and species belonging to the *Valerianaceae* Batsch. in the territory of the Nakhchivan AR were comparatively analyzed.

CHAPTER II. PHYSICAL AND GEOGRAPHICAL CONDITIONS OF THE STUDY AREA, MATERIALS AND METHOD

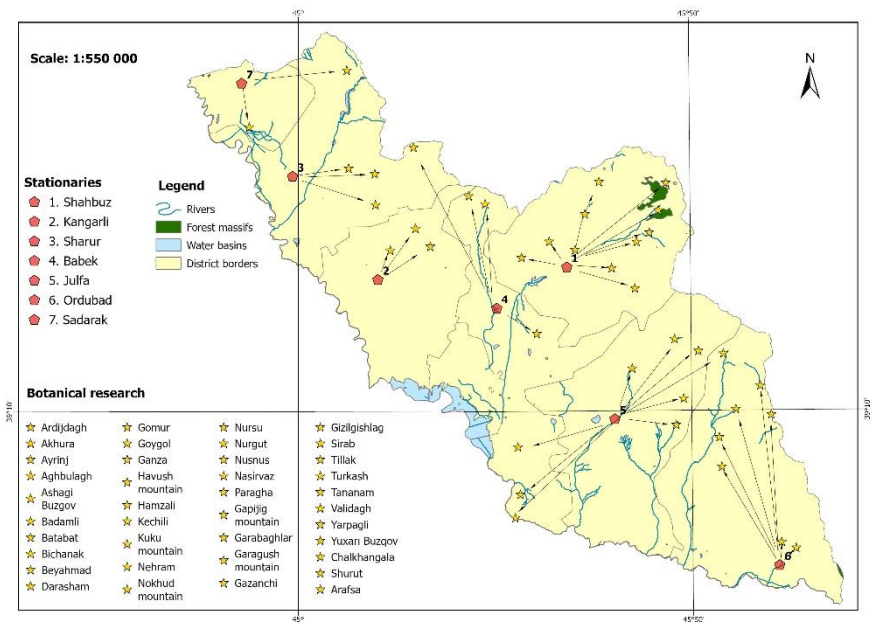
2.1. Physical and geographical conditions of the area. The geographical conditions, relief, climatic conditions, landscape types, etc. of the study area were investigated. During the years when the research was conducted, meteorological data from the Hydrometeorology Department of the Ministry of Ecology and Natural Resources of the Nakhchivan Autonomous Republic for 2016-2017 was also obtained (Tab.1).

As can be seen from the table, the maximum air temperature in summer during the study years was very high (39.5°C in 2007, 42.0°C in 2008, and 38.5°C in 2009). It should be noted that starting in 2019, the thickness of the annual snow cover has been decreasing year by year, which indicates possible degradation of the vegetation cover due to low precipitation.

Table 1.
 Meteorological data of the Hydrometeorological Department for 2016-2018

Months	2016			2017			2018		
	Temperature C	Humidity %	Precipitation mm	Temperature C	Humidity %	Precipitation mm	Temperature C	Humidity %	Precipitation mm
	average			average			average		
I	-10,8	90	11,6	-9,9	82	10,0	-7,9	87	16,6
II	-1,1	80	10,1	-1,5	77	22,0	4,6	76	11,6
III	7,2	70	25,4	11,5	69	25,0	7,7	72	30,8
IV	10,9	73	70,2	16,4	65	15,8	10,9	69	37,4
V	19,5	64	25,9	17,4	67	34,0	18,7	63	12,6
VI	23,5	61	24,9	23,3	55	10,4	22,9	61	32,2
VII	25,4	56	9,6	27,3	55	25,0	26,7	55	12,0
VIII	26,2	57	8,4	27,4	48	4,4	24,6	61	32,2
IX	23,9	57	-	22,2	62	23,2	19,6	67	64,8
X	15,4	69	39,8	14,9	69	8,1	15,6	70	7,0
XI	6,3	75	40,4	8,0	71	5,4	7,9	79	36,7
XII	0,0	79	24,6	-0,1	79	14,0	3,6	80	11,2

2.2. Materials and methods of the research. The plant species belonging to the *Valerianaceae* Batsch. were selected as the object of research and the plant species belonging to the valerian subfamily were collected by us during field research in the low, middle and high mountainous zones of the Nakhchivan AR. Field research on the study of species belonging to the valerian subfamily in the Nakhchivan AR was carried out in a planned and consistent manner during the months and seasons of 2016-2018, taking into account the relief, soil and vegetation of the area. During the research period, a total of 93 regular expedition routes were carried out, each at least 4-5 times a year, completely covering the separate zones of the autonomous republic's regions, and more than 150 herbarium specimens were collected and identified. GPS data of each species was also taken during the expeditions (map-scheme 1). A "MBS-2" microscope with 16x magnification was used to identify differences based on the morphological characteristics of the collected samples.



Map-scheme 1. Botanical route for the study of the family *Valerianaceae*

The determination of parts of *Valerianaceae* Batsch. family were carried out according to A.A.Grossheim “Flora of Azerbaijan”¹⁰, “Flora of the USSR”¹¹, E.A. Gurbanov’s “Systematics of higher plants”¹², A.M.Askerov’s “The plant world of Azerbaijan”¹³, T.H. Talibov, Ə.Sh. Ibrahimov’s and A.M. Ibrahimov’s “Taxonomic spectrum of the flora of the Nakhchivan Autonomous Republic”¹⁴ and other works. Recent taxonomic additions and changes have been made

¹⁰ Флора Азербайджана: [в 8-х т.] / Под Ред. Колл. - Баку: АН Азерб. ССР, Т.8, -1961, - 690 с.

¹¹ Флора СССР: [в 30 - х т.] / Под Ред. Колл. -М.-Л.: Наука, -Т. XXIII, -1958. -776 с.

¹² Qurbanov, E.M. Ali bitkilərin sistematikası/ E.M. Qurbanov, -Bakı: “Bakı Universiteti”, -2009. - 420 s.

¹³ Əsgərov, A. M. Azərbaycanın bitki aləmi / A. Əsgərov. - Bakı: TEASPRES, - 2016. - 444 s.

¹⁴ Talibov, T.H. Naxçıvan Muxtar Respublikası florasının taksonomik spektri (Ali sporlu, çıpaqtoxumlu və örtülütoxumlu bitkilər) /T.H. Talibov, Ə.Ş. İbrahimov, Ə.M. İbrahimov, - Bakı: Şirvanəşr, - 2021. - 426 s.

in accordance with the factual materials in the Herbarium collections and the latest nomenclatural division¹⁵. The medicinal properties of plants were analyzed according to the works of S.J. Ibadullayeva and R.A. Alakbarov, “Medicinal Plants”¹⁶ and others. The systematization of geographical elements was carried out according to A.A. Grossheim¹⁷ and N.N. Portenier¹⁸. Works of C.C. Raunkaier¹⁹, I.G. Serebryako²⁰ was used in determining the life forms of species, works by A.P. Sennikov²¹ and others in the analysis of ecological groups. Rare and endangered species were assessed according to the categories and criteria of “IUCN-Version 15.1.”²².

The reserves of some plants has been assessed²³, and individual biologically active substances were identified from aboveground and underground parts of plant samples using modern chemical, chromatographic and spectral research methods^{24,25}.

¹⁵ An update of the *Angiosperm Phylogeny Group* classification for the orders and families of flowering plants: APG IV / comp. by J.W. Byng, M.W. Chase, M.J.M. Christenhusz [et al.] // *Bota. Jour. of the Linn.Soci.*, –2016. V. 181 (1). – p. 1-20.

¹⁶ İbadullayeva, S.C. Dərman bitkiləri (Etnobotanika və fitoterapiya) / S.C.İbadullayeva, R.Ə. Ələkbərov, - Bakı: Təhsil EİM, -2013, -331 s.

¹⁷ Гроссгейм, А.А. Анализ флоры Кавказа / А.А. Гроссгейм, -Баку: Аз. ФАН СССР, Т.1, -1936. -259.

¹⁸ Портениер, Н.Н. Методические вопросы выделения географических элементов флоры Кавказа // *Бот. журн.*, –2000, т.85, №6, –с.76-84.

¹⁹ Raunkaier, C. The life form of plants and statistical plant geography / C. Raunkaier, – Oxford: Clarendon Press, –1934. – p. 48-154.

²⁰ Серебряков, И.Г. Жизненные формы высших растений и их изучение (Полевая геоботаника): [в 3 - х т.] / И.Г.Серебряков, – М.- Л.: АН СССР, - т. 3, – 1964. - 181 с.

²¹ Шенников, А.П. Введение в геоботанику / А.П.Шенников, – Л.: Изд-во. ЛГУ, – 1964. –447 с.

²² IUCN. The Guidelines for Using the IUCN Red List Categories and Criteria at Regional and National Levels: Version 15.1. / –SP: IUCN. –2022. – 113 pp.

²³ Ресурсоведение лекарственных растений: (учебно-методическое пособие для вузов)/ Под ред. проф. В.В.Негробов –Воронеж: «ВГУ» –2015.–57с.

²⁴ Попова, М., Банкова, В. Современные методы экстракции и выделения натуральных продуктов// *BMC Chemistry*, -2023. V. 17, 68, -р. 1-2.

²⁵ Платонов, И.А. Хроматографические методы анализа: учебное пособие / И.А. Платонов, Е.А. Новикова, В.И. Платонов. – Самара: Издательство Самарского университета, -2021. – 96 с.

CHAPTER III. STUDY OF THE FAMILY VALERIANACEAE BATSCH DISTRIBUTED IN THE IN THE NAKHCHIVAN AUTONOMOUS REPUBLIC

The family *Valerianaceae* Batsch., one of the main application-oriented families of flora biodiversity in the territory of the Nakhchivan Autonomous Republic is classified as the sub-family *Valerianoideae* Raf. of the family *Caprifoliaceae* Juss. of the order *Dipsacales* Juss. ex Bercht. & J.Presl. according to this modern nomenclature division²⁶, and 17 species combined in 2 genera (*Valerian* L. and *Valerianella* Mill.) belonging to the family were found in the territory of the AR.

3.1. Study of the genus *Valeriana* L. Six species belonging to the genus *Valeriana* L. were recorded in the territory of the Nakhchivan AR. Leaves are pinnately divided, or entire, opposite on the stem and small flowers are arranged in cyme, usually densely. Calyx toothed or lobed, often with indistinct auricles or small teeth, sometimes with pinnate plates. The flowers of these species are either regular or irregular in structure. The corolla is usually small, funnel-shaped, with the tube sometimes convex or spur-shaped at the base. The number of stamens attached to the corolla tube is 3. In rare cases, there is only one stamen. The column is thread-shaped, divided into 2-3 part at the top. The inferior ovary is three-chambered, one of which produces fruit, while the other two do not. The fruit achene also contains a pappus for wind dispersal.

3.2. Study of the genus *Valerianella* Mill. 11 species of the genus *Valerianella* Mill. were recorded in the territory of the Autonomous Republic. The stem of species belonging to this genus is relatively dichotomously divided and furcately branched, annual herbaceous plants. The calyx is usually small, crown-shaped, toothed, sometimes with one long curved tooth, properly indeterminately toothed or oblique. The corolla is regular, funnel-shaped, five-lobed, with 3 stamens. The fruit is three-lobed, one of which is fruit-bearing and the other two are sterile.

²⁶ The World Flora Online: [Electron resources]/ www.worldfloraonline.org/

3.3. Distribution patterns and life forms of species belonging to the genera *Valeriana* L. and *Valerianella* Mill. across vertical belts

When studying the distribution pattern of species belonging to the genus *Valeriana* L., it was found that species belonging to this genus mainly spread from areas starting from 1300 m a.s.l. to higher zones and that their biotopes are mainly in rocky-pebble zones together with petrophilous plants. Most of the species belonging to the *Valerianella* Mill. are annual plants and grow in the Nakhchivan plain and the Nakhchivan mountainous botanical-geographic region. Thus, valerian species can spread to zones of 650-2000 m above sea level in the autonomous republic. The life forms of species belonging to both genera of the family were studied according to C.R. Raunkaier²⁷ and I.G. Serebryakov²⁸.

It has been found that species of the genus *Valerianella* have therophytic life forms, meaning that these species do not have overwintering shoots (Tab. 2). Not much difference was observed in the distribution of species belonging to the genus *Valeriana* according to C.Raunkier. Thus, most of them were classified as hemicryptophytes. According to I.G.Serebryakov, there were six species of sub-shrub in the division. In the study conducted according to their geographical areas, 5 species were distributed in the Mediterranean Sea, 4 - the Caucasus, 2 - Asia Minor, 2 - Iran, and one species in each of the Eastern Mediterranean, Northern Iran, Iran-Turanian, and European-Siberian geographical areas.

By ecological group, mesophytes were represented by 5 species, mesoxerophytes by 11, and xerophytes by only one species - *Valeriana erotica*. According to its beneficial properties, it was classified as species with feed importance -13, medicinal -2, decorative and food -1 species.

²⁷ Raunkaier, C.R. The Life Form of Plants and Statistical Plant Geography / C.R. Raunkaier, -Oxford: Clarendon Press, -1934. -p.48-154.

²⁸ Серебряков, И.Г. Жизненные формы высших растений и их изучение. В кн. "Полевая геоботаника"/ И.Г. Серебряков, -Москва-Ленинград: Изд. АН СССР, т. 3, -1964. -с. 146-205.

Table 2.

Bioecological characteristics of species belonging to the genera *Valeriana* L. and *Valerianella* Mill.

S №	Name of species	Life form		Geographical areas	Ecological group
		According to Raunkier	According to Serebryakov		
1.	<i>Valeriana leucophaea</i>	Hemicryptophyte	Subshrub	Caucasus	Mesophyte
2.	<i>Valeriana alliariifolia</i>	Hemicryptophyte	Subshrub	Asia Minor	Mesophyte
3.	<i>Valeriana alpestris</i>	Hemicryptophyte	Subshrub	Caucasus	Mesophyte
4.	<i>Valeriana sisymbriifolia</i>	Hemicryptophyte	Subshrub	Eastern Mediterranean	Mesophyte
5.	<i>Valeriana officinalis</i>	Hemicryptophyte	Subshrub	Europe-Siberia	Mesophyte
6.	<i>Valeriana erotica</i>	Hemicryptophyte	Subshrub	Mediterranean Sea	Xerophyte
7.	<i>Valerianella uncinata</i>	Therophyte	Annual herbs	Caucasus	Mesoxerophyte
8.	<i>Valerianella oxyrrhyncha</i>	Therophyte	Annual herbs	Mediterranean Sea	Mesoxerophyte
9.	<i>Valerianella sclerocarpa</i>	Therophyte	Annual herbs	Mediterranean Sea	Mesoxerophyte
10.	<i>Valerianella cymbocarpa</i>	Therophyte	Annual herbs	Iran	Mesoxerophyte
11.	<i>Valerianella plagiostephana</i>	Therophyte	Annual herbs	Mediterranean Sea	Mesoxerophyte
12.	<i>Valerianella szovitsiana</i>	Therophyte	Annual herbs	Northern Iran	Mesoxerophyte
13.	<i>Valerianella dentata</i>	Therophyte	Annual herbs	Mediterranean Sea	Mesoxerophyte
14.	<i>Valerianella amblyotis</i>	Therophyte	Annual herbs	Iran-Turanian	Mesoxerophyte
15.	<i>Valerianella coronata</i>	Therophyte	Annual herbs	Caucasus	Mesoxerophyte
16.	<i>Valerianella lasiocarpa</i>	Therophyte	Annual herbs	Iran	Mesoxerophyte
17.	<i>Valerianella leiocarpa</i>	Therophyte	Annual herbs	Asia Minor	Mesoxerophyte

CHAPTER IV. THE ROLE OF THE VALERIANACEAE BATSCH IN THE VEGETATION COVER OF THE NAKHCHIVAN AUTONOMOUS REPUBLIC

It is possible to prepare a classification by studying the vegetation where species of both genera are found in the Nakhchivan AR, and organize the protection of useful and rare species by identifying changes in the phytocenosis (Fig. 1-2).

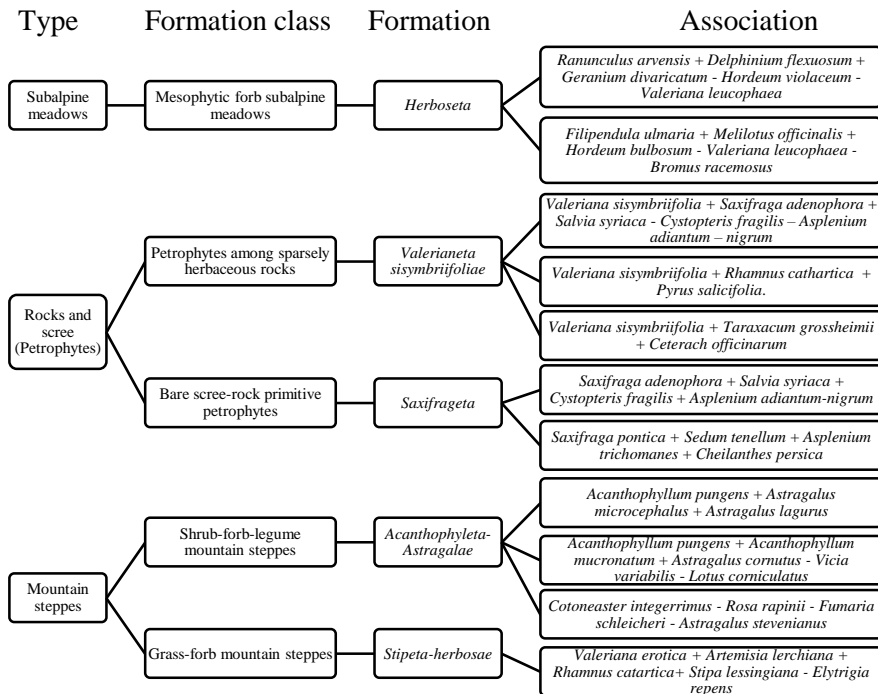


Figure 1. Classification scheme of plant groupings where species of the genus *Valeriana* L. and *Valerianella* L. are distributed in the territory of Nakhchivan AR

During the course of the research, the structure of the vegetation where the species exist was studied using geobotanical methods, and their role in phytocenoses, formations and associations they form were

determined²⁹. It was determined that the species occur in 6 vegetation types, 10 formations, and 24 associations.

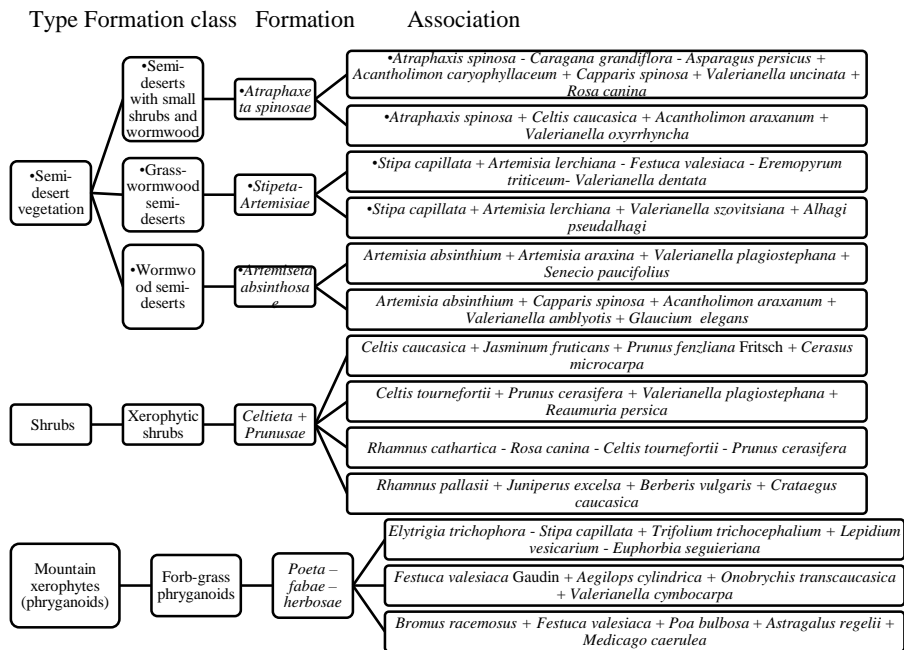


Figure 2. Classification scheme of plant groups where species of the genus *Valeriana* L. and *Valerianella* L. are distributed in the territory of Nakhchivan AR (continued)

CHAPTER V. RARE SPECIES OF THE VALERIANACEAE BATSCH FAMILY, THEIR CURRENT STATUS AND OPTIMAL CONSERVATION METHODS

In recent years, due to global warming, the natural condition of almost all species, especially annual and biennial plants, has reached

²⁹ Talibov, T.H., Mahmudova, U.M. The Role of Species Including in *Valerianella* genus in phytocenoses in the area of Nakhchivan Autonomous Republic// Bulletin of Science and Practice, -2020. № 6(7), -p. 50-58.

even more dangerous levels as a result of a sharp decrease in snow cover and precipitation. The degradation of biodiversity due to various reasons and the threat of species extinction are serious issues of concern to the world community. For this reason, some measures are being taken in a number of countries to prevent this, including the creation of reserves, national parks, and sanctuaries. Taking into account the special role of forests in regulating the water regime, measures such as intensifying forest restoration work, creating artificial lakes and reservoirs, and finally, collecting seed materials of rare and useful plants as a preventive measure are being implemented.

Valeriana erotica Christenh. & Byng - long-flowered valerian is widespread in the Mediterranean region, the Caucasus, the villages Akhura and Havush of Sharur district of the Nakhchivan AR, in the area called “Red Stone” in the village Chalkhanagala of Kangarli district, around the villages Gulshanabad and Yukhari Buzgov of the Babek district.

This species was included in the Red Book of the Nakhchivan AR due to the small number and population, the limiting impact of ecological, anthropogenic and zoogenic factors³⁰, and special protection and restoration measures were developed for its effective and sustainable use. As a sensitive species that is distributed in limited areas and subject to negative impacts, its areas of distribution in the Arpachay State Nature Reserve are taken under special control and currently its natural populations are protected. However, as a mesophytic plant, the species' natural condition has reached critical levels due to recent sharp changes in climatic factors, in particular, a sharp decrease in snow cover and precipitation in general. Therefore, considering its limited distribution areas and population number, and the constant decline of its natural resources, it has been assessed as Vulnerable - VU C2a(i) status.

³⁰ Talıbov, T.H. Naxçıvan Muxtar Respublikasının Qırmızı Kitabı (Ali sporlu, çılpaqtoxumlu və örtülütöxumlu bitkilər) /T.H.Talıbov, Ə.Ş.İbrahimov, – Naxçıvan: nəşriyyat yeri – 2010. – 677 s.

Based on observations conducted over the past 4 years, as well as expert assessments, it has been determined that the species has reduced its distribution area and numbers by approximately 50%. Studies have shown that the localities in Sharur and Kangarli districts are more exposed to anthropogenic impacts due to their very unstable and unfavorable location, especially as they are located on the continuous movement of sheep herds (Fig. 3).



Figure 3. Distribution locality of long-flowered valerian

However, the area of settlement of the long-flowered valerian in the Akhura-Havush zone is relatively stable and in the form of a long strip, it is approximately less than $2 \times 5 = 10 \text{ km}^2$. There are 4 relatively densely located localities here, which, being located along the main roadside, can be brought to a critical state, especially due to road expansion and other anthropogenic or random factors, and the taxon may even become extinct in the short term in the future. A serious impact by beekeepers who settled in that zone from early spring to early September was also noted. Beekeepers have been observed collecting the beautifully colored flowers of the long-flowered valerian for decorative purposes. In addition, given the extreme variability of climatic factors and the difficulty of predicting them,

extreme fluctuations in population number can be expected in the future depending on climatic factors. For this reason, seed material of the species should be collected and donated to a gene bank, propagated in botanical gardens, and reintroduced to suitable areas in their distribution zone. Thus, it was considered appropriate to include the long-flowered valerian in the Endangered – EN B1ab(i,ii,iii) + 2ab(i,ii,iii) status as a vulnerable species that is distributed in limited areas or zones, is subject to negative impacts, and its number dynamics continue to decline, making it close to extinction and included by us in the III edition of the Red Book of the Republic of Azerbaijan³¹ (Map-scheme 2).

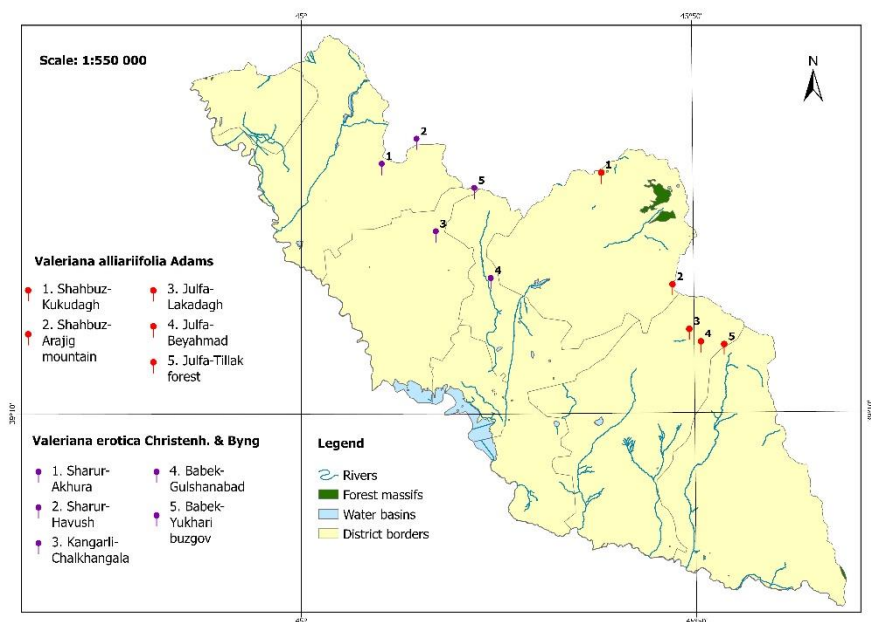
Valeriana alliarifolia Adams - garlic-leaved valerian is one of the interesting species of the genus *Valeriana* L. and is widespread in the Andes, South America, temperate zones of North America, throughout Eurasia, including in the territory of Nakhchivan AR, Shahbuz district Kukudagh (Dereboghaz), Julfa district the mountain Arajig (Khazinadere) and Ordubad district Nurgut village surrounding, in subalpine zones, on the edges of springs, rocky areas. This species is listed in the Red Book of the AR as a species in danger of extinction in nature and included in the status of “*Vulnerable*” - VU A3bc by T.H.Talibov and A.Sh.Ibrahimov as a sensitive species that is distributed in a limited area or places and is subject to negative impacts. As a sensitive species that is distributed in a limited area or areas and is subject to negative impacts, all areas of its distribution in the territory of the Zangazur National Park named after Acad. Hasan Aliyev have been taken under special control and, while protecting its natural populations, restrictions have been placed on its collection.

Its characteristic distribution areas around Gur Bulag in the Dereboghaz area near the village Kuku of Shahbuz district are strictly protected and all anthropogenic activities are restricted there (Map-scheme 2).

In the 13 years since the second edition of the Red Book, significant changes have occurred in the study area. Based on our expert

³¹ Azərbaycan Respublikasının Qırmızı Kitabı. Flora: [3 cilddə] / Red. Hey.–Bakı: “İmak”, –c.3. –2023. –507 s.

assessment of the areas where the garlic-leaved valerian is distributed in the Nakhchivan AR, it was found that the species does indeed exist in not very large populations. However, it has become clear that it is not currently in danger of extinction, but is vulnerable due to recent climate changes and increasing anthropogenic pressure in nature. This species reproduces by seeds and rhizomes, so in cases of severe moisture shortages, rhizomes allow the plant to re-grow the following year, but if this shortage persists, then the species becomes extinct in that area.



Map-scheme 2. Map of the occurrence localities of *Valeriana eratica* Christenh. & Byng and *Valeriana alliarifolia* Adams species in the Nakhchivan AR

Because it is a medicinal plant with essential oils, it is sometimes collected in large quantities by enterprises engaged in the production of medicinal plants in the autonomous republic and used instead of medicinal valerian.

However, following recent research, it was determined that protecting this species was no longer recommended. Thus, we

discovered a new distribution zone of the garlic-leaved valerian in a small group on the edge of a spring in a sparse forest in the village Beyahmad of Julfa district (N 39°15'40"; E 45°54'10"; H=2110 m). This species, as mentioned, grows in small groups as a mesophytic plant on rocky, humid places along the banks of rivers and springs. According to our observations, although the population number is limited in all areas where the species is distributed, its distribution area is large and its natural resources are not under threat. Considering that new distribution zones of *Valeriana alliarifolia* were discovered in the area and that this species is not currently under serious threat, it was not considered appropriate to include the species in the new edition of the Red Book.

Since these species are included in the Red Book of the Nakhchivan AR, necessary measures for their special protection and restoration have been developed by the Ministry of Ecology and Natural Resources of the Nakhchivan AR for their effective and sustainable use.

It should be noted that since the species *Valerianella cymbocarpa* C.A. Mey. and *Valerianella coronata* (L.) DC. included in the genus *Valerianella* are annual plants, their growth in unfavorable areas with stony and rocky soil, lack of humus, and exposure to severe drought have placed them in a critical situation. Especially in the last 3 years, the continuous severe drought has caused a decrease in the number of the species in the areas where it is distributed, especially in pastures and hayfields. In 2023, due to severe drought in Paradash area of Julfa district, the meadows where *Valerianella coronata* was most abundant could not be mowed and were instead grazed by flocks of sheep. Therefore, both species should be classified as Lower Risk (LR) or Least Concern (LC). It should be assigned the status of a species that is not currently endangered and does not require protection, but which is important to be kept under relative control. The second important condition is that seed materials of those species are collected, transferred to gene banks and stored in herbarium funds.

The main zones for monitoring endangered species of the semifamily in the Nakhchivan AR should be considered the Arajig foothills in Julfa district and Goydagh foothills in Paradash zone.

Because the river Bashkendchay, which is active in this zone with snow, spring, and rain, decreases starting in early May and completely becomes standing in June, and the area thus enters the dry season. At this time, annual plants cannot bloom or, even if they do bloom, cannot produce normal seeds because they have not received moisture since early spring.

CHAPTER VI. RESERVES OF SOME USEFUL SPECIES BELONGING TO THE VALERIAN FAMILY AND ANALYSIS OF THEIR BIOCHEMICAL CHARACTERISTICS

Since plants are the primary carriers of biologically active substances, the discovery of plants rich in these compounds and the exploration of their applications — including the extraction of plant-based biologically active substances, their study using modern techniques, the determination of their biological significance, and the assessment of reserves — hold great scientific and economic importance and remain highly relevant. Most plants, either whole or in separate parts, are used as various medicinal preparations (galenic and neogalenic). Preparations based on these substances are successfully used in medical practice to treat a number of serious diseases.

The biological reserves of the species *Valeriana officinalis* L., *V. alliariifolia* Adams and *Valerianella uncinata* (M.B.) Dufur., *V. sclerocarpa* Fisch. et C.A.Mey., *V. lagiostephana* Fisch. et C.A.Mey. in the study area were calculated for 3 regions, taking into account their medicinal, food and other beneficial properties (Table 3).

The species *Valeriana officinalis* and *V. alliariifolia* were somewhat more abundant than other species in terms of their reserves, amounting to 2.45-3.72 kg, respectively. Considering the small distribution area of the species and its low reserve, no exploitation reserve assessment was conducted.

Two species of the genus *Valeriana* (*V. erotica* and *V. alliariifolia*) were taken for phytochemical studies. Both aboveground and underground parts of each plant were collected and prepared for analysis.

Table 3.

Reserves of some species of the genera *Valeriana* L. and *Valerianella* Mill. distributed in the territory of Nakhchivan AR

Name of species	Districts and GPS coordinates	Area occupied, ha	Number of individuals in 1 m ²	Average weight of the aboveground part of 1 individual (dry), g	Density of reserve, g/m ²	Biological reserve, kg
1	2	3	4	5	6	7
<i>Valerianella uncinata</i> (M.B.) Dufr.	Shahbuz d. Badamli village surrounding GPS: 39°26'18"N 45°31'01"E	35	8,4±1,7	5,1±1,4	42,84±5,3	1,50±06,2
<i>Valerianella sclerocarpa</i> Fisch. et C.A.Mey	Shahbuz d. Ayrinj village surrounding GPS: 39°25'42"N 45°35'21"E	17	5,2±1,2	11,0±1,4	57,20± 8,1	0,97±02,6
<i>Valerianella plagiostephana</i> Fisch. et C.A.Mey	Ordubad d. Kilit village surrounding GPS: 38°51'31"N 46°07'26"E	10	6,7±1,0	18,4±1,8	123,28±11,9	1,23±03,2
<i>Valeriana officinalis</i> L.	Julfa d. Khazinadere surrounding GPS: 39°18'01"N 45°48'32"E	12	3,5±1,2	36,6±3,5	128,10±15,8	1,54±05,3
	Julfa d. Arajig mountain foothill GPS: 39°20'51"N 45°48'42"E	8	3,1±0,5	--/--	113,46±13,6	0,91±02,0
	Total:	20	-	-	-	2,45±06,3

Table 3 continued

1	2	3	4	5	6	7
<i>Valeriana alliarifolia</i> Adams	Shahbuz d. Kukudagh (Derebog haz) surrounding GPS: 39°33'39"N 45°37'43"E	11	3,1±1,1	50,8±7,5	157,48±20,5	1,73±05,6
	Julfa d. Lakatagh village surrounding GPS: 39°17'18"N 45°49'41"E	14	2,8±0,5	--/--	142,24±17,1	1,99±03,9
	Total:	25	-	-	-	3,72±07,5
TOTAL		107	-	-	-	9,87±3,9

Compounds obtained from different parts of *Valeriana erotica* species were identified and components from different groups were determined in the sum of extractives. Accordingly, a total of 4 components were identified from the flowers of the plant (Table 4, Fig. 4).

Table 4
Identification of individual substances obtained from the flowers of the long-flowered valerian species by gas chromatography-mass spectrometry

№	Name of substance	Retention time	Formula
1	Hexadecanoic acid, methyl ester	14,01	C ₁₇ H ₃₄ O ₂
2	2-Cyclohexen-1-one, 3-(3-hydroxybutyl)-2,4,4-trimethyl	18,11	C ₁₃ H ₂₂ O ₂ monoterpene
3	2(1H)- Naphthalenone, octahydro-4a,7,7-trimethyl-, trans-22-cyclohexane -1-on, 3-(3-hydroxybutyl) -2,4,4- trimethyl -	18,19	C ₁₃ H ₂₂ O bicyclic monoterpene
4	Azuleno [4,5-b] furan-2,7-dione, 3,3a,4,5,9a,9b-hexahydro-3,6,9-trimethyl-, [3R-(3α,3aβ,9aβ,9bα)]-Achillin	19,35	C ₁₅ H ₁₈ O ₃ Guaianolide-type lactone

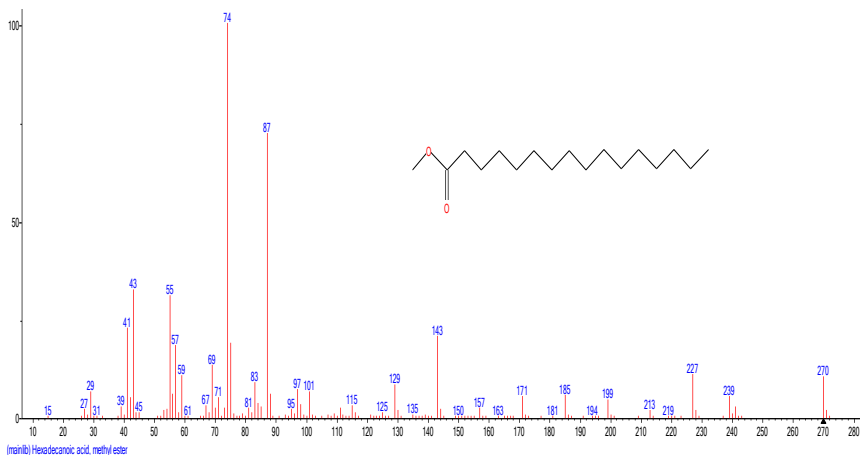


Figure 4. Methyl ester of hexadecanoic acid obtained from the flowers of the long-flowered valerian species

As a result of the identification of individual substances obtained from the roots of the species *Valeriana erotica* by gas chromatography-mass spectrometry, 4 substances were obtained (Tab. 5, Fig. 5-6)³².

Table 5
Identification results of individual substances extracted from the root of *Valeriana erotica* species by Gas Chromatography-Mass Spectrometry

№	Name of the substance	Retention time	Formula
1	Octanoic acid, 6-oxo-8-phenyl-, phenyl ester	14,14	C ₂₀ H ₂₂ O ₃
2	Naphtho(2,3-b) furan-2(3H)-one, decahydro-8a-methyl-3,5-bis(methylene)-, (3aR-(3aα,4aα,8aβ,9aα)-(Isoalantolactone)	14,61	C ₁₅ H ₂₀ O ₂
3	10-Epoxy-4-methoxy-7-methyl-8-(3,4-methylenedioxyphenyl)-spiro (5,5) undeca-1,4-dien-3-one	15,25	C ₂₀ H ₂₀ O ₅
4	Diisooctyl phthalate	23,17	C ₂₄ H ₃₈ O ₄

³² Talibov, T.H., Mammadova, U.M., Alasgarova, A.N. Study of chemical composition of the roots and flowers of the *Valeriana erotica* Christenh. & Byng by gas chromatography-mass spectrometric method//Journal Izvestiya GGTU, -2024. № 3(019), -p.83-89.

The roots and aerial parts of the study subject, *Valeriana alliariifolia*, were extracted with acetone. The resulting biologically active compounds were fractionated using column chromatography, and their component compositions were identified by Gas Chromatography-Mass Spectrometry³³ (Tab. 6).

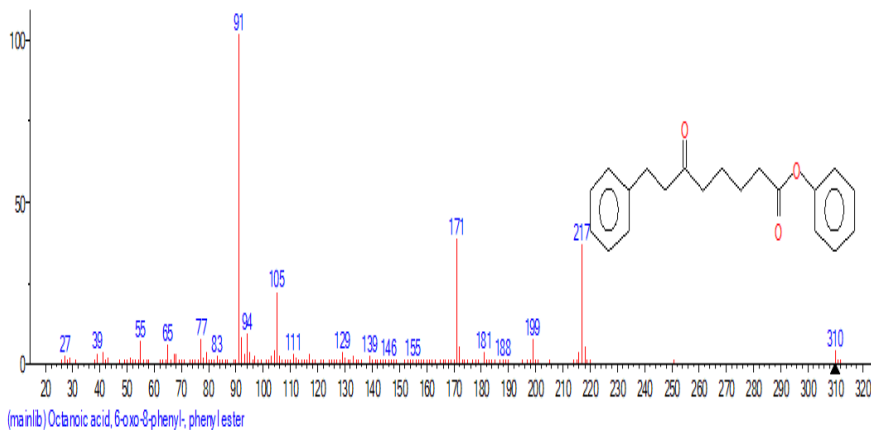


Figure 5. Octanoic acid, 6-oxo-8-phenyl-, phenyl ester

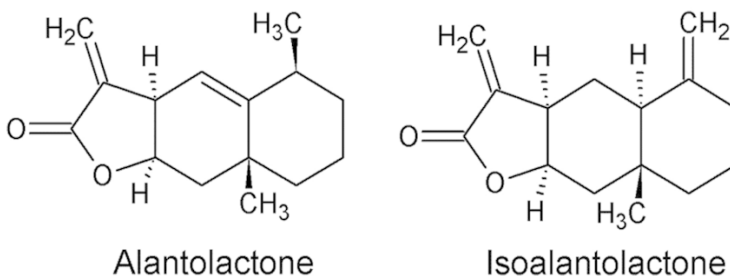


Figure 6. Isoalantolactone, a new substance extracted from the roots of *Valeriana erotica*

³³ Mammadova, U., Zulfugarova, P., Alasgarova, A. Chemical composition of the aerial part of *Valeriana alliariifolia* Adams. //Bulletin of Science and Practice, - 2023. V. 9, №7, -p. 32-38.

Table 6

Study of the roots and aerial parts of the species of garlic-leaved valerian by gas chromatography-mass spectrometry

Retenti on time (RT)	Peak area (%)	Peak height (%)	Atomic unit (A/H)	Name of the substances
1.412	39.15	37.07	1.76	Methylene chloride
1.792	57.69	60.22	1.64	Trichloromethane
2.097	0.14	0.15	1.53	Carbon tetrachloride
2.548	1.09	0.83	2.25	Carbonic acid ethyl, methyl ester
6.596	1.93	1.73	1.91	Ethane, 2-chloro-1,1-diethoxy

RESULTS

1. As a result of the research, it was found that in the territory of the Nakhchivan AR, the genus *Valeriana* L., which belongs to the subfamily of the Valerian, is represented by 6 species, and the genus *Valerianella* Mill. by 11 species. According to the regularity of the distribution of species across vertical zones, it was found that species of the genus *Valeriana* are mainly distributed in the Nakhchivan mountainous and high mountainous areas (1300-3161 m above sea level), while species of the genus *Valerianella* in the Nakhchivan plain and mountainous botanical-geographic zones (650-2000 m above sea level), and their biotopes are mainly rocky and gravelly areas.

2. Both the life forms and geographical genesis of the species of both genera have been investigated, and it has been determined that, according to C. Raunkiear, the species of the genus *Valerianella* are therophytes, and the species of the genus *Valeriana* are hemicryptophytes. According to I.G. Serebryakova, species of the genus *Valerianella* are annual herbs, while species of the genus *Valeriana* have a shrubby life form. The study conducted according to the geographical area type revealed that the the species were distributed as: Mediterranean Sea - 5, the Caucasus - 4, Asia Minor - 2, Iran - 2, and the Eastern Mediterranean, Northern Iran, Iran-

Turanian, and European-Siberian geographical areal classes with one species each.

3. For the first time, the phytocenological characteristics of species belonging to the genera *Valeriana* and *Valerianella*, which are widespread in the territory of the Nakhchivan AR, were studied and the composition of the plant groups formed by them was analyzed. The participation of the species in the formation of 10 formation classes, 10 formations and 24 associations in 6 vegetation types (subalpine meadows, rocks and scree (petrophytes), shrubs, mountain steppes, mountain xerophytes (phryganoids) and semi-desert vegetation) was revealed.

4. The current status of the species *Valeriana erotica* Christenh. & Byng (syn. *Centranthus longiflorus* Steven) in nature and the impact of limiting factors were assessed and included in the III edition of the Red Book of the Republic of Azerbaijan with the status “Endangered” -EN B1ab(i,ii,iii) + 2ab(i,ii,iii) [Red Book of the RA, 2023].

5. For the first time, five terpenoid compounds were individually identified from the species of garlic-leaved valerian collected from the territory of Nakhchivan AR, and a total of eight components were identified from the roots and flowers of the long-flowered valerian plant. A new substance— isoalantolactone – for the plant was obtained from the roots of the long-flowered valerian, collected during its flowering phase, a new substance for plants – achillin sesquiterpene lactones – was obtained from its flowers during the flowering phase.

PROPOSAL AND RECOMMENDATIONS

1. As a sensitive species, distributed in limited areas and subject to negative impacts (critical drought and anthropogenic impact), the distribution areas of species *Valeriana erotica* Christenh. & Byng (syn. *Centranthus longiflorus* Steven) in the Arpachay SNS should be taken under special control, and its populations should be protected.

2. The species *Valerianella cymbocarpa* C.A. Mey. and *Valerianella coronata* (L.) DC. should be classified as “Lower Risk

(LR)” or “Least Concern (LC)”. It should be assigned the status of a species that is not currently endangered and does not require protection, but which is important to be kept under relative control. It is recommended to take the species under the control in Arajig foothills in Julfa district and Goydagh foothills in Paradash zone and include in the new edition of the Red Book of the Nakhchivan Autonomous Republic;

3. The introduction of sesquiterpene compounds obtained from *Valeriana erotica* and *Valeriana alliariifolia* species for use in the preparation of medicinal products, along with the analysis of their antimicrobial, anthelmintic and cytotoxic effects is proposed.

Published works on the topic of the dissertation:

1. Talıbov, T.H., Mahmudova. Ü.M. Naxçıvan Muxtar Respublikasında yayılan *Valerianaceae* Batsch, nom.cons. fəsiləsinin sistematik tərkibi //AMEA Biologiya və Tibb Elmləri Bölməsi, AMEA Dendrologiya İnstitutu. “İqlim dəyişkənliyinin bitki biomüxtəlifliyinə təsiri” mövzusunda Beynəlxalq Elmi Konfransın məruzələr toplusu, -Bakı: -19-21 sentyabr, -2017, -s.315-323.

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6. Mammadova, U., Zulfugarova, P., Alasgarova, A. Chemical composition of the aerial part of *Valeriana alliarifolia* Adams. //Bulletin of Science and Practice, -2023. V. 9, №7, -p. 32-38.

7. Talıbov, T.H., Məmmədova, Ü.M. Naxçıvan MR-də *Valerianodeae* Raf. yarımfəsiləsinə aid növlərin şaquli qurşaqlar üzrə yayılma qanunauyğunluğu, həyati formaları və bioekoloji xüsusiyyətləri //Azərbaycan Botanika Jurnalı, -2023. №2/2, -s. 3-38.

8. Talıbov, T.H., Mammadova, U.M., Alasgarova, A.N. Study of chemical composition of the roots and flowers of the *Valeriana erotica* Christenh. & Byng by gas chromatography-mass spectrometric method//Journal Izvestiya GGTU, -2024. № 3(019), -p.83-89.

9. Talıbov, T.H., Mammadova, U.M. Phytocoenological characteristics of species belonging to the genus *Valeriana* L. distributed in Nakhchivan Autonomous Republic // “Development of science in the XXI century” XIII International scientific conference- Dortmund: 25-26 april, -2024. -s.11-16.

10. Talıbov, T.H., Məmmədova, Ü.M. Naxçıvan MR-də *Valerianoidea* Raf. yarımfəsiləsinə aid növlərin istifadə imkanları// Qarabağ IV Beynəlxalq Elmi araşdırmalar Konqresi, -Bakı: -08-09 april. -2024. -s. 140-145.

11. Talıbov, T.H., Mammadova, U.M. Naxçıvan MR ərazisində yayılmış pişikotular yarımfəsiləsinin mühafizə statuslu növləri// Biomüxtəlifliyin dayanıqlığının təmin edilməsində yeni çağırışlar (COP29), “Yaşıl dünya və insan sağlamlığı” adlı Beynəlxalq elmi-praktiki konfrans. -Naxçıvan: -3-4 iyun, -2024. -s. 19.

The defense will be held on June, 30 2025 at 11⁰⁰ at the meeting of the Dissertation Council ED 1.26 operating at the Institute of Botany of the Ministry of Science and Education of the Republic of Azerbaijan

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