

**REPUBLIC OF AZERBAIJAN**

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**ABSTRACT**

of the dissertation for the degree of Doctor of Philosophy

**FLORA OF THE DARIDAGH AREA AND ITS  
PROSPECTS FOR USE**

Specialty: 2417.01 – “Botany”

Field of science: Biology sciences

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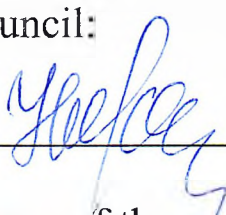
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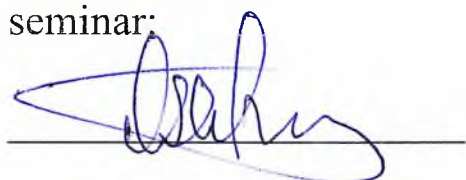
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## INTRODUCTION

**Relevance and degree of completion of the topic.** Azerbaijan's rich natural heritage encompasses its distinctive flora, which is a significant asset<sup>1,2</sup>. The natural and geographical conditions of the Nakhchivan Autonomous Republic have been identified as a primary factor contributing to the proliferation of endemic and relict plant species in this region. The Daridagh area, recognised as a significant centre of speciation within the Autonomous Republic, merits consideration due to its notable biodiversity, encompassing both native and rare species of flora and fauna. The Daridagh region is distinguished by its remarkable floristic richness, a consequence of a combination of geological and structural features, as well as specific microclimatic conditions. The area under consideration is located at the intersection of mountainous and semi-desert zones. Consequently, the region is characterised by the presence of plant species belonging to both low mountain and high mountain flora. This distinguishes it from other regions, thus classifying it as a unique floristic region. These natural zones are of great importance not only for Azerbaijan, but also for the Caucasus region as a whole.

Daridagh is renowned for its mineral springs and healing waters, which have significant potential for utilisation in a variety of fields, including pharmacology and medicine. This underscores the importance of floristic components in these areas. It is hypothesised that the chemical elements contained in the natural hydrothermal waters and thermal springs in the region affect the biochemical composition and metabolic properties of the local vegetation. This creates the basis for the Daridagh flora to become an important object of research not only in terms of ecology, but also in terms of pharmacobotany and phytotherapy<sup>3</sup>.

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<sup>1</sup>Askerov, A.M. The plant world of Azerbaijan / A.M. Askerov, - Baku: Teas Press, - 2016, - p. 444.

<sup>2</sup>Talibov, T.H. Taxonomic spectrum of the flora of the Nakhchivan Autonomous Republic (High-spore, gymnosperm and angiosperm plants) / T.H. Talibov, A.Sh.Ibrahimov, A.M. Ibrahimov, - Baku: Shirvanneshr, -2021.-426 p.

<sup>3</sup>Ibadullayeva S.C. Traditional folk medicine of Azerbaijanis. - Baku-"Savad", 2024, s. 264.

In the contemporary era, in the context of mounting global concerns regarding the escalating impacts of human activity on ecological systems, climate change, biodiversity loss, and the extinction of native species, the significance of regional floristic research has been further accentuated<sup>4</sup>. The impact of global climate change, intensive grazing, soil erosion and other anthropogenic activities on the biodiversity of Daridagh is a subject of concern. The monitoring and assessment of these changes is a pressing scientific direction.

The study of the diversity of the Daridagh flora is of relevance to research in the fields of botany, ecology and biogeography. The floristic composition of the region has not yet been the subject of exhaustive study.

In light of the aforementioned considerations, it was deemed expedient to undertake a comprehensive research initiative within the Daridagh territory. The primary objectives of this research endeavour included conducting a contemporary taxonomic analysis of the Daridaghflora, providing a comprehensive life form and botanical-geographical analysis, conducting a meticulous study of the present state of vegetation cover, and classifying vegetation types according to typological units. Additionally, the research programme encompassed studying the phytocenological structure of select species, examining the contemporary status of rare and endangered species, investigating useful species, determining the productivity of pastures, and identifying opportunities for efficient utilisation and protection.

**Object and subject of research.** The study focused on the analysis of gymnosperm and angiosperm plants that naturally grew in the Daridagh area, which is the highest peak of the Daridagh range in the Nakhchivan Autonomous Republic. The objective of the present study is two fold: firstly, to identify the modern species composition of the plant species included in the Daridagh flora; and secondly, to

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<sup>4</sup>Ibadullayeva, S., Hüseynova, 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

study the ways in which these species can be used efficiently and protected.

**The purpose and tasks of the research.** The primary objective of the present study is to undertake a contemporary taxonomic analysis of gymnosperms and angiosperms present within the Daridagh flora. This analysis will encompass an examination of their life forms and botanical-geographical distribution characteristics. Furthermore, the study will entail a detailed investigation of the current state of vegetation cover and its classification according to typological units. Additionally, the phytocenological structure of select species will be studied. Concurrently, the programme encompasses the study of the present status of rare and endangered species, the investigation of useful species, the determination of pasture productivity, and the formulation of proposals and recommendations for the identification of opportunities for efficient utilisation and protection measures.

In order to achieve the aforementioned objectives, a series of tasks have been established:

- ✓ Providing a modern taxonomic analysis of plants distributed in the flora of Daridagh;
- ✓ Analysis of life forms and botanical-geographical characteristics of the studied species;
- ✓ Classification of vegetation types by typological units;
- ✓ Study of the phytocenological structure of some promising species;
- ✓ Current status of rare and endangered species and clarification of their status;
- ✓ Determination of pasture productivity, identification of opportunities for efficient use and ways of protection.

**Research methods.** A range of contemporary botanical and classical methods were employed during the research. Field observations were conducted in the area, and the composition and structure of the vegetation cover along the expedition routes were studied. The plant species were collected and taxonomically systematized based on the floristic method. The life forms of the species were analysed, and their classification into ecological groups

was carried out according to their ecology. Following the implementation of a botanical-geographical analysis, the geographical distribution areas of the species were determined. The vegetation types (phytocenoses) in the area were determined by means of a phytocenological analysis method, and their species composition was subsequently analysed. Concurrently, the statuses of rare and endangered species were determined, and the populations of some species were analysed and evaluated. The productivity of the vegetation cover was determined by harvesting and model methods.

**Main provisions of the defense:**

1. The compilation of a contemporary taxonomic spectrum of plants distributed in the Daridagh flora using classical methods, and the subsequent assignment of their bioecological characteristics to their distribution zones, will serve as a foundation for future flora writing;
2. The clarification of the status of rare and endangered species in the studied area based on modern categories and criteria serves as a scientific and practical basis for the protection and restoration of the population structure of those species;
3. A comprehensive study of the flora of the Daridagh area provides a foundation for an objective assessment of the bioresource potential of winter pastures, scientific calculation of pasture capacity, and ensuring the efficient use of grazing areas.

**Scientific innovations of the research.** As a consequence of the research that was conducted, for the first time, a taxonomic spectrum of 316 plant species in 180 genera belonging to 44 families distributed in the Daridagh flora was prepared. The life forms, ecological groups, and botanical-geographical analysis of each species were provided.

A comprehensive study of the vegetation of the Daridagh area has been conducted, resulting in the identification of 36 associations belonging to 3 vegetation types, 8 formation classes, and 10 formations.

A total of 46 rare and endangered plant species from 33 genera were identified in the designated study area.

During field studies, the distribution of the species *Hedysarum atropatanum* Bunge ex Boiss. in this area was recorded for the first time, thereby adding a new local area to its regional range.

The populations of the species *H.atropatanum* and *Onobrychis buhseana* Bunge ex Boiss. were assessed, and the average recovery index of individuals, age index, efficiency index, etc. were studied. In the species *H.atropatanum*, the age index was determined to be  $\Delta=0.24-0.59$ ; the efficiency index,  $\omega=0.45-0.74$ . In the species *O. buchseana*, the age index was determined to be  $\Delta=0.28-0.4$ ; the efficiency index,  $\omega=0.42-0.61$ .

For the first time, the capacity of pastures in the Daridagh area was calculated, and the highest pasture capacity per hectare during the winter period (156 heads of small-horned cattle, 52 heads of large-horned cattle) was determined in the fragrant wormwood phytocenosis.

The uses of 134 useful plant species in the Daridagh flora have been classified.

**Theoretical and practical significance of the study.** The species composition of plants distributed in the Daridagh area is of significant scientific value for elucidating the distribution patterns in semi-desert, mountain-xerophyte, and steppe vegetation, and for subsequent large-scale monitoring studies.

The materials of the research and the results obtained can be used in the compilation of monographic collections and determinants, in solving ecological-geographical problems of plant systematics, in the preparation of complex measures for the protection of rare and endangered species, in the use of studied economically important species in agriculture and folk medicine, and in the compilation of regional "Floras".

The materials obtained as a result of the research can be used to determine the flora biodiversity of the Nakhchivan Autonomous Republic, as well as in teaching students of master's and faculty specialties.

**Approbation and application of the research.** The main results of the research work were presented at various local and international conferences: "Republican Scientific Conference Dedicated to the

95th Anniversary of the Nakhchivan Autonomous Republic” (Nakhchivan, 2019), “International Asian Congress on Contemporary Sciences–V” international scientific conference (Turkey, 2021), “Hodja Akhmet Yassawi 5th International Conference on Scientific Research” international conference (Turkey, 2021), “XII International scientific conference. The modern vector of the development of science” international scientific conference (Philadelphia, 2024), “III International Apitherapy and Nature Congress” international scientific conference (Baku, 2025), as well as at seminars on the results of scientific research work organized by the Department of Biology of Nakhchivan State University and the Faculty Scientific Council (2018-2024).

Fifteen scientific works related to the dissertation have been published, five of which are conference materials from local and international conferences. It is evident that four of the articles have been published in journals that are abstracted and indexed in international databases (AGRIS).

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

**Structure and volume of the work.** The dissertation consists of an introduction (11573 characters), 6 chapters (Chapter I – 20560 characters, Chapter II – 12018 characters, Chapter III – 82501 characters, Chapter IV – 63217 characters, Chapter V – 28847 characters, Chapter VI – 27256 characters), main conclusions (2052characters), suggestions and recommendations (568 characters), a list of 188 used literature. The dissertation consists of 194 pages, including appendices, including 22 tables and 22 figures.

## **CHAPTER I. LITERATURE REVIEW ON THE STUDY OF THE FLORA AND VEGETATION OF THE DARIDAGH AREA**

This chapter of the dissertation provides a detailed explanation of the study of the flora of Daridagh in the Nakhchivan Autonomous Republic.

## Chapter II. OBJECT AND METHODOLOGY OF THE RESEARCH

The research focused on the flora of the Daridagh area of the Nakhchivan Autonomous Republic, specifically on gymnosperm and angiosperm plants. An investigation into the flora of the Daridagh area was conducted over the period from 2018 to 2024.

In the course of analysing species composition, clarifying nomenclature, and determining changes to nomenclature, reference was made to the international nomenclature of A.M. Asgarov<sup>5</sup>, T.H. Talibov and A.Sh. Ibrahimov, "Flora of Azerbaijan"<sup>6</sup>, "Flora of the Caucasus"<sup>7</sup> and "The World Flora Online (WFO)"<sup>8</sup>.

The analysis of life forms was conducted by C.R. Raunkiaer<sup>9</sup> and I.G.Serebryakov<sup>10</sup>. The development of geographical areas and elements was undertaken in accordance with A.A. Grossheim's<sup>11</sup> classification system. The analysis of plants by ecological groups was conducted according to A.R. Shennikov's<sup>12</sup> methodology. Their status was determined based on the 'Red Books' of the Republic of Azerbaijan and the Nakhchivan Autonomous Republic<sup>13</sup>, in

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<sup>5</sup>Askerov, A.M. The flora of Azerbaijan (Higher plants - Embryophyta) / A.M. Asgarov. - Baku: TEAS Press. – 2016. – 443 p.

<sup>6</sup>Flora of Azerbaijan: [in 8 volumes]. – Baku: Publishing House of the Azerbaijan Academy of Sciences. SSR, - vol. 1-8. 1950-1961

<sup>7</sup>Floras of the Caucasus: [in 5 volumes] / Editorial coll. – Moscow: 1952. – p. 744

<sup>8</sup> The World Flora Online (WFO): [electron resources] / Published on the Internet, – 2021. URL: <http://www.worldfloraonline.org>

<sup>9</sup>Raunkiaer, C.R. The life forms of plants and statistical plant geography / C.R.Raunkiaer. – Oxford: Clarendon Press, – 1934, – 729 p.

<sup>10</sup> Serebryakov, I.G. Life forms of higher plants and their study (Field geobotany): [in 3 volumes] / I.G. Serebryakov, – Moscow-Leningrad: USSR Academy of Sciences, – vol. 3, – 1964.– p. 146-205.

<sup>11</sup> Grossgeim, A.A. Analysis of the flora of the Caucasus /A.A. Grossgeim, – Baku: Az.FAN SSSR, –V.1, –1936,–259 p.

<sup>12</sup>Shennikov, A.P. Introduction to Geobotany / A.P.Shennikov. - Leningrad: Publishing house of Leningrad University, - 1964. - 447 p.

<sup>13</sup>Talibov, T.H. The Red Book of Nakhchivan MR (High-spored, bare-seeded and covered-seeded plants) / T.H. Talibov, A.Ş. Ibrahimov, - Nakhchivan: Acami, volume 2, - 2010, -678 p.

accordance with the categories and criteria of IUCN Version 15.1<sup>1415</sup>.

The classification of vegetation types and phytocenological analysis were based on the literature materials of V.V.Alekhine<sup>16</sup>, B.A.Bykov<sup>17</sup>, and V.S.Novruzov<sup>18</sup>. The assessment of the populations of several species was facilitated through the utilisation of literature materials provided by T.A.Rabotnov<sup>19</sup>, L.A.Zhivotovsky<sup>20</sup> and A.A.Uranov<sup>21</sup>. The assessment of the productivity of vegetation cover in the pastures of the Daridagh area was determined using the mowing and model methods based on the methods of I.M. Ponyatovsky<sup>22</sup> and I.V. Larin<sup>23</sup>.

In the classification of useful plants in terms of the perspective of the use of species, a number of literature materials by S.J.Ibadullayeva<sup>24</sup>, A.M. Guliyev<sup>25</sup>, etc. were used.

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<sup>14</sup>Red Book of the Republic of Azerbaijan. Third edition. Rare and endangered flora species. / Group of authors. - Baku: "Imak" publishing house, -2023.- 510 p.

<sup>15</sup> 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.

<sup>16</sup>Alekhine, V.V. Geography of plants (fundamentals of phytogeography, ecology and geobotany). / M.: Uchpedgiz, 1950, p. 420

<sup>17</sup>Bykov, B.A. Geobotany / B.A. Bykov, - Alma-Ata: Science of the Kazakh Academy of Sciences. SSR, -1978. -288 s.

<sup>18</sup>Novruzov, V.S. Fundamentals of Phytocenology (Geobotany). Textbook. /V.S. Novruzov, -Baku: Elm, -2010. - 306 p.

<sup>19</sup>Rabotnov, T.A. Phytocenology / T.A. Rabotnov, - Moscow: Moscow State University, - 3rd ed. -1992. -352 s.

<sup>20</sup>Zhivotovsky, L. A. Ontogenetic state, effective density and classification of populations // Ecology, - 2001. No. 1. - P. 3-7

<sup>21</sup>Uranov, A.A. Age spectrum of phytosenopopulations as a function of time and energetic processes // Biol. Sci.2.-1975. -p. 7-34.

<sup>22</sup>Ponyatovskaya, V.M. Accounting for the abundance and features of the distribution of species in natural plant communities // Field geobotany, Moscow; Leningrad: Nauka, v.3, 1964. pp.209-285

<sup>23</sup>Larin, I.V. Selected Works / I.V. Larin, - Moscow: Kolos, - 1978. - 432 p.

<sup>24</sup>Ibadullayeva, S. Ethnobotanical research in Azerbaijan (Goygol region) / S.Ibadullayeva, M.Shahmuradova, - Baku: TAHSIL, - 2015. - 222 p.

<sup>25</sup>Guliyev, A.M. Honey-bearing plants of Azerbaijan / A.M. Guliyev. - Baku: Afpoligraf, - 2014. - 351 p.

## CHAPTER III. FLORISTIC ANALYSIS OF THE DARIDAGH AREA

### 3.1. Taxonomic spectrum of plants of the Daridagharea.

Following the processing of literature data and expedition materials, 316 plant species belonging to 180 genera and 44 families were identified as part of the Daridagh flora (Table 1)<sup>26,27</sup>.

Table 1

Taxonomic spectrum of plants distributed in the flora of Daridagh

№	Family	Number of type	Percentage of total number	Number of species	Percentage of total number
1	2	3	4	5	6
1.	<i>Brassicaceae</i> Burnett.	26	14.44	38	12
2.	<i>Asteraceae</i> Giseke	25	14	44	13.9
3.	<i>Poaceae</i> Barnhart	18	10	40	12.65
4.	<i>Lamiaceae</i> Martinov	14	8	26	8.21
5.	<i>Apiaceae</i> Lindl.	10	5.55	16	5.1
6.	<i>Amaranthaceae</i> Juss.	10	5.55	12	3.8
7.	<i>Boraginaceae</i> Juss.	8	4.43	10	3.2
8.	<i>Caryophyllaceae</i> Juss.	7	3.8	10	3.2
9.	<i>Fabaceae</i> Lindl.	7	3.8	34	10.8
10.	<i>Rosaceae</i> Juss.	6	3.3	9	2.85
11.	<i>Papaveraceae</i> Juss.	4	2.2	8	2.53
12.	<i>Liliaceae</i> Juss.	3	1.7	5	1.6
13.	<i>Polygonaceae</i> Juss.	3	1.7	4	1.27
14.	<i>Plantaginaceae</i> Juss.	2	1.11	2	0.63
15.	<i>Asparagaceae</i> Juss.	2	1.11	3	0.95
16.	<i>Iridaceae</i> Juss.	2	1.11	3	0.95

<sup>26</sup>Heyderova, A. Taxonomical spectrum of Daridagh mountain of the Nakhchivan Autonomous Republic / A.Heyderova, D.Ganbarov // International Journal of Botany Studies. Impact Factor: RJIF 5.12. - Volume 5; Issue 3, - 9 June 2020, - p. 287-291.

<sup>27</sup>Heydarova, A.R. Taxonomic composition of the *Lamiaceae* Lindl. family distributed in the flora of Daridagh of the Nakhchivan Autonomous Republic // – Nakhchivan: Scientific Works of the Central Botanical Garden of the Azerbaijan National Academy of Sciences, - 2020, volume: XVIII, - pp. 28-31

Table 1 continuation

1	2	3	4	5	6
17.	<i>Malvaceae</i> Juss.	2	1.11	3	0.95
18.	<i>Ranunculaceae</i> Juss.	2	1.11	3	0.95
19.	<i>Geraniaceae</i> Juss.	2	1.11	2	0.63
20.	<i>Rubiaceae</i> Juss.	2	1.11	2	0.63
21.	<i>Tamaricaceae</i> Link.	2	1.11	2	0.63
22.	<i>Hypericaceae</i> Juss.	1	0.55	4	1.27
23.	<i>Scrophulariaceae</i> Juss.	1	0.55	4	1.27
24.	<i>Amaryllidaceae</i> J.St. – Hil.	1	0.55	3	0.95
25.	<i>Cupressaceae</i> Gray.	1	0.55	3	0.95
26.	<i>Euphorbiaceae</i> Juss.	1	0.55	3	0.95
27.	<i>Asphodelaceae</i> Juss.	1	0.55	2	0.63
28.	<i>Plumbaginaceae</i> Juss.	1	0.55	2	0.63
29.	<i>Resedaceae</i> Martinov	1	0.55	2	0.63
30.	<i>Solanaceae</i> Adans.	1	0.55	2	0.63
31.	<i>Zygophyllaceae</i> R.Br.	1	0.55	2	0.63
32.	Families represented by one genus and one species	13	7.15	13	8.19
Total:		180	100	316	100

A study of the local flora revealed the presence of 26 *Brassicaceae* Burnett genera, 25 *Asteraceae* Giseke genera, 18 *Poaceae* Barnhart genera, 14 *Lamiaceae* Martinov genera, 10 *Apiaceae* Lindl genera, 10 *Amaranthaceae* Juss genera, 8 *Boraginaceae* Juss genera, 7 *Caryophyllaceae* Juss genera, 7 *Fabaceae* Lindl genera, and 7 *Rosaceae* Juss genera. The entity under discussion is characterised by six distinct gender classifications<sup>28,29</sup>.

<sup>28</sup>Heydarova, A.R. History of studying the vegetation of the Daridagh massif of the Nakhchivan Autonomous Republic // Materials of the republican scientific conference dedicated to the 95th anniversary of the Nakhchivan Autonomous Republic. –Nakhchivan: - 2019,- pp. 278-280

<sup>29</sup>Heyderova, A. Floristic analysis of the species concerning the *Astragalus* L. type spread in the Daridagh area./ A.Heyderova, D.Ganbarov, A.Ibragimov [et al.]. // European Academic Research. Impact Factor: 3.4546 (UIF) DRJI Value: 5.9 (B+). - Volume VI, Issue 12, - March 2019, - p.6745-6752.

The number of genera included in other families varies between 1-4 and constitutes 27.13% of the flora of this area<sup>30,31</sup>.

**3.2. Analysis by life forms.** The analysis of the main life forms of species belonging to the Darıdag flora is shown in Figures 1 and 2.

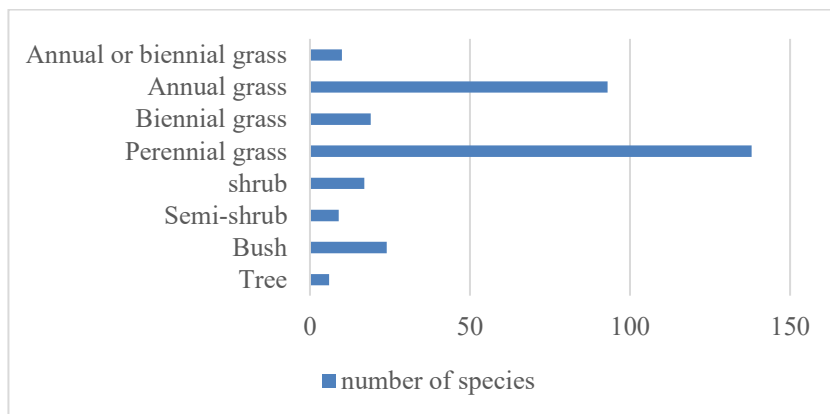


Figure 1. Life forms of species included in the Darıdag flora (based on the system of I.G. Serebryakov)

Perennial herbs account for 138 species (43.7%) of the total plant life forms, according to the I.G. Serebryakov system. In comparison, annual herbs account for 93 species (29.4%) of the total plant life forms, indicating that they possess a greater number of species than other life forms. In the designated study area, shrubbery is represented by 24 species (7.6%), biennial herbs by 19 species (6.1%), shrubs by 17 species (5.37%), annual or biennial herbs by 10

<sup>30</sup>Heydarova, A.R. Floristic analysis of the *Caryophyllaceae* family (*Caryophyllaceae* Juss.) distributed in the Darıdag flora of the Nakhchivan Autonomous Republic // – Turkey: Hodja Akhmet Yassawi 5th International Conference on Scientific Research – 2021, 5-6 November, - p.114-115

<sup>31</sup>Heydarova, A.R. Spring vegetation of the *Brassicaceae* family (*Brassicaceae* Burnett.) distributed in the flora of Darıdag // – Nakhchivan: Nakhchivan State University Scientific Works Series of Natural and Medical Sciences, - 2019, No. 3 (100). - pp.13-16.

species (3.1%), subshrubs by 9 species (2.84%) and trees by 6 species (1.89%).

In accordance with the classification system devised by C. Raunkier, hemicryptophyte plants are represented by 142 species (45%), therophyte by 100 species (31.6%), phanerophyte by 30 species (9.5%), chamephyte by 26 species (8.22%), and cryptophyte plants by 18 species (5.68%).

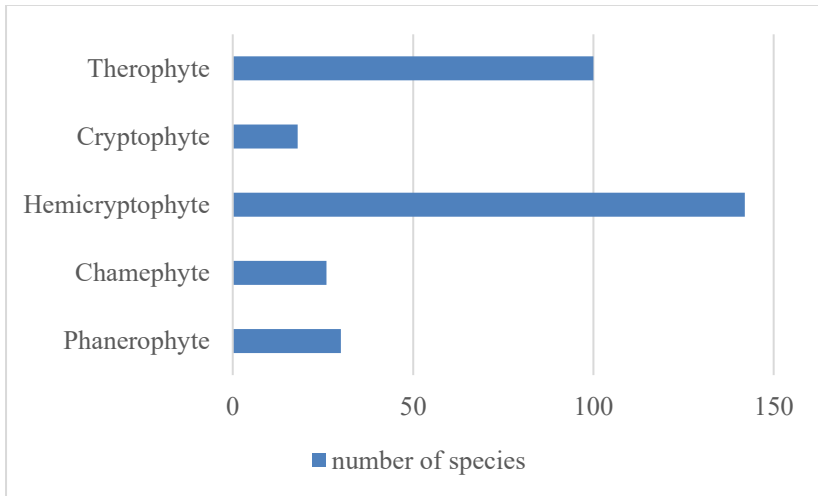


Figure 2. Life forms of species included in the Daridagh flora (based on the system of C. Raunkier)

**3.3. Botanical-geographical analysis.** In determining the geographical types of the flora of Daridagh, the study area, 63 species of Mediterranean origin (19.94%), 39 of Caucasus (12.31%), 27 of Iran-Turanian origin (8.54%), 25 of Atropatan origin (8.2%), 23 of Iran origin (7%), 23 of Asia Minor origin (7.27%), 22 of Europe origin (6.96%), 19 of Palearctic origin (6%), 11 of Asia Minor origin (3.48%), 9 of Holarctic origin (2.84%), 8 of West and East Asia origin (2.53%), and 6 of Central Asia origin (2%) were identified. The study area also contains other geographical elements, represented by 1-5 species (Table 2).

Table 2

Distribution of species included in the Daridagh flora by  
geographic areal types and elements

№	Geographic areal types	№	Geographic elements	Number of species	Percentage of total number
1.	Ancient	1	Hyrcan	1	0.31
		2	Ancient Mediterranean	1	0.31
		3	Asia Minor	11	3.48
2	Boreal	4	Holarctic	9	2.84
		5	Paleoartic	19	6
		6	Europe	22	6.96
3	Steppe	7	Pannon-Sarmatian	2	0.63
		8	Sarmatian	4	1.26
4	Xerophile	9	Mediterranean	63	19.94
		10	Central Asia	6	2
		11	Front Asia	23	7.27
		12	Middle Asiya	5	1.58
		13	West and East Asia	8	2.53
		14	Atropatan	25	8.2
		15	Iran	23	7
		16	Iran-Turanian	27	8.54
5	Desert	17	Turanian	2	0.63
		18	Eastern Transcaucasia	2	0.63
6	Caucasus	19	Albanian	1	0.31
		20	Caucasus	38	12
7	Adventive			1	0.31
8	Geographical range type unknown			23	7.27
	Total			316	100

Of the real types in the Daridagh flora, xerophilous elements are more dominant (56.96%), followed by boreal elements (15.8%). The geographical distribution of the species is further illustrated by the representation of the Caucasus, which accounts for 39 species (12.31%), 13 species (4.1%) of which are classified as 'ancient', 6 species (2%) of which are designated as 'steppe', 4 species (1.26%)

of which are categorised as 'desert', and 1 species (0.31%) of which is considered 'adventive'. It is acknowledged that a number of species remain to be the subject of detailed study. Of the species examined, 23 (7.27%) were found to comprise unknown geographical types<sup>32</sup>.

**3.4. Ecological groups.** The analysis of the flora of Daridagh was conducted on the basis of the water and humidity requirements of plants. The classification system developed by A.R.Shennikov was utilised for the distribution of plants according to ecological groups (Table 3).

In the flora of Daridagh, xerophytic plants predominate over other species, with a total of 193 species documented (61.1%). The mesoxerophytic flora is represented by 69 species (21.8%), while the xeromesophytic flora is represented by 54 species (17.1%).

Table 3

Ecological groups of species included in the Daridagh flora

№	Ecological groups	Number of species	Percentage of total number
1	Xerophyte	193	61.1
2	Xeromesophyte	54	17.1
3	Mesoxerophyte	69	21.8
	Total	328	100

The species found in the Daridagh flora are divided into main ecological groups based on their salt tolerance: euhalophytes, mesohalophytes, halophobes, and pseudohalophytes (Table 4).

In the designated study area, halophobic plants are represented by 276 species (87.34%), euhalophyte and pseudohalophyte by 15 species (4.75%), and mesohalophyte plants by 10 species (3.16%).

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<sup>32</sup>Heyderova, A. Biomorphological characteristics of the species in the *Caryophyllaceae* Juss. family distributed in Daridagh flora// - Philadelphia.USA: XII International scientific conference. The modern vector of the development of science. -21-22 March 2024, - p. 27-33.

Table 4

Ecological groups of species included in the Daridagh flora according to salinity

№	Ecological groups	Number of species	Percentage of total number
1	Euhalophyte	15	4.75
2	Mesohalophytes	10	3.16
3	Pseudohalophyte	15	4.75
4	Halophobe	276	87.34
	Total	316	100

**3.5. Conservation of rare and endangered species.** Studies on the rare and endangered species included in the Daridagh flora were evaluated in accordance with the “Red Books” of the Republic of Azerbaijan and the Nakhchivan Autonomous Republic, as well as the IUCN Version 15.1 categories and criteria. The statuses of these species were then determined (Figure 3).

A total of 46 rare and endangered plant species belonging to 33 genera were discovered in the study area.

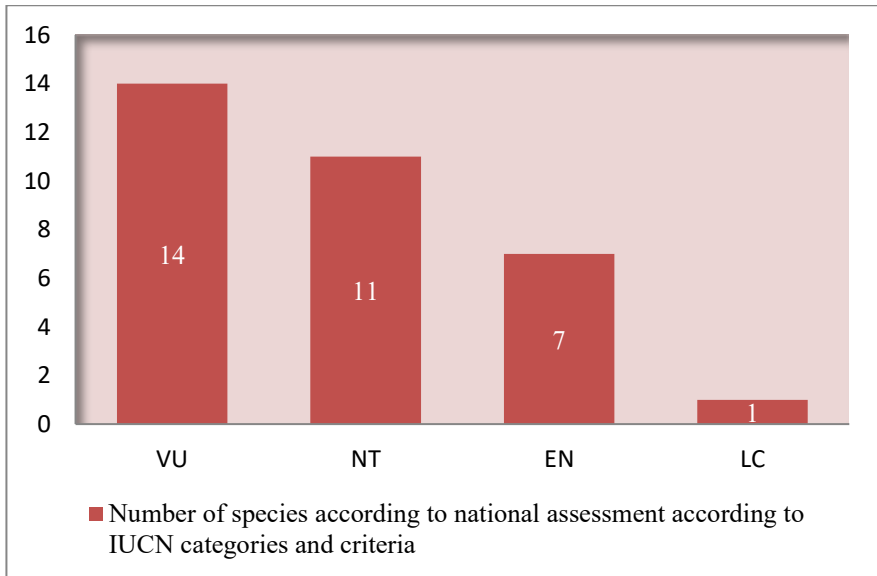


Figure 3. Rare and endangered species distributed in the flora of Daridagh based on the “Red Book” of the Republic of Azerbaijan

## CHAPTER IV. THE ROLE OF PLANTS DISTRIBUTED IN THE DARIDAGH AREA IN PHYTOCENOSES

The vegetation of the Daridagh area has been the subject of detailed research by the present authors, and 36 associations belonging to 3 vegetation types, 8 formation classes, and 10 formations have been identified for the area.

**4.1. Semi-desert vegetation.** The study area, situated at an altitude of 800-1200 m above sea level in the Daridagh region, is distinguished by the presence of plant species characteristic of semi-desert vegetation. The flora of this region comprises a variety of plant species, including those belonging to the genera *Stipa* L., *Artemisia* L. and species such as *Festuca valesiaca* Schleich. ex Gaudin, *Poa bulbosa* L.

In the plain areas at the foot of Daridagh, ephemeral saline wormwood fields cover a wide area and appear in several formations. Of particular interest are the *Artemiseta fragrans* and *Salsoleta dendroidanae* formations<sup>33</sup>.

***Artemiseta fragrans.*** The formation extends over a substantial area, encompassing the plain and reaching altitudes of up to 1200 metres in the vicinity of Daridagh. Within the formation, instances of pure wormwood are observed, along with instances of mixed associations comprised of various species of fragrant wormwood. In all cases, the wormwood species acts principally as an edificator.

**The saline-wormwood (*Artemisia fragrans* + *Salsola nodulosa*).** The saline-wormwood association is relatively widespread in the lower plain parts of the area. The total design cover of the vegetation is no greater than 30%. The total height of the vegetation is recorded as not exceeding 25-30 cm. The species richness is comparatively low, with an average of only 11-12 species recorded per 100 m<sup>2</sup>. In this grouping, *Artemisia fragrans* Willd. and *Salsola nodulosa* (Moq.) Iljin act as edifying species.

***Variiegated ephemeral wormwood (*Artemisia fragrans* + *Tulipa biflora* + *Allium rubellum* + *varioherbosa*).*** The group is found in

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<sup>33</sup>Heyderova, A.R. Characteristics of semi-desert vegetation type of the Daridag region // Bulletin of Science and Practice. – 2024, T10 № 4, - p. 75-82.

relatively less saline and relatively stony areas, mainly in relatively clayey stony-gravelly areas on exposed slopes with a slope of 5-30<sup>0</sup>. (Table 5).

Table 5

Phytocenological structure and species composition of the  
*ephemeral-variegated-wormwood* association

№	Species name	Abundance, point	Height in cm	Tier
1	<i>Artemisia fragrans</i> Willd.	2-3	20-30	I
2	<i>Stipa lessingiana</i> Trin.&Rupr.	2	35-40	I
3	<i>Medicago minima</i> (L.) Bartal.	1	6-7	III
4	<i>Erodium cicutarium</i> (L.) L'	1	8-10	III
5	<i>Achillea millefolium</i> L.	1-2	20-25	II
6	<i>Filago pyramidata</i> L.	1-2	6-8	III
7	<i>Glaucium elegans</i> Fisch. & C.A.Mey.	1	8-9	III
8	<i>Nepeta meyeri</i> Benth.	1-2	15-20	II
9	<i>Poa bulbosa</i> L.	1	10-12	II
10	<i>Hordeum murinum</i> subsp. <i>leporinum</i> (Link) Arcang.	1	10-18	II
11	<i>Alhagi pseudalhagi</i> (M.Bieb.) Fisch.	1-2	18-20	II
12	<i>Anthemis candidissima</i> Willd. ex Spreng.	1-2	10-15	II
13	<i>Achillea tenuifolia</i> Lam.	1-2	18-20	II
14	<i>Allium rubellum</i> M.Bieb.	1-2	18-20	II
15	<i>Gagea commutata</i> K.Koch	1-2	10-12	II
16	<i>Tulipa biflora</i> Pall.	2	9-10	III
17	<i>Fritillaria gibbosa</i> Boiss.	1-2	8-15	III
18	<i>Íris caucasica</i> Hoffm.	1-2	4-5	III

The total vegetation cover of the project is not greater than 40-45%. The species richness of the vegetation is comparatively low, and is generally comprised of a mere 15-20 species per 100 m<sup>2</sup>.

The composition of the association's project cover is as follows: 10-15% consists of ephemeral plants, 15-20% consists of wormwood, and 8-10% consists of representatives of various grasses.

**Variegated - wormwood - saline (varioherboso + artemioso + salsoletum dendroideae).** The main edificators of this association are *Artemisia fragrans* Willd. and other species. The grouping includes 19 species, and the abundance of the species *Salsola dendroides* Pall. as an edificator can be estimated at 2-3 points. The design cover of the vegetation varies between 50-55%.

**Artemisia - variegated - thorny - wormwood (Artemisetum + variofructoso + caraganoso + achillosum).** The grouping includes more than 25 species in total. The composition includes species such as *Artemisia fragrans* Willd., *Capparis spinosa* var. *herbacea* (Willd.) Fici, *Achillea tenuifolia* Lam., *Erodium cicutarium* (L.) L' Her, *Allium rubellum* M.Bieb., *Senecio vernalis* Waldst. & Kit, *Onobrychis subacaulis* Boiss., *Poa bulbosa* L., *Ziziphora tenuior* L., *Euphorbia seguieriana* Neck.. The projected vegetation cover of the area varies between 65-75%.

**Type: Classification of semi-desert vegetation**

Formation class: Saline wormwood

Formation: Fragrant wormwood (*Artemiseta fragrans*)

1.Ass. *Artemisia fragrans* Willd.

2.Ass. *Artemisia fragrans* + *Tulipa julia* + *Allium rubellum* + *varioherbosa*

3.Ass. *Artemisia fragrans* + *Suaeda microphylla*

4.Ass. *Artemisia fragrans* + *Salsola dendroides* + *S.nodulosa*

5.Ass. *Artemisetum* + *variofructoso* + *caraganoso* + *achillosum*

6.Ass. *Artemisetum* + *variofructoso* + *astragaluso* + *achillosum*

Formation: Tree-shaped salinity (*Salsoleta dendroideae*)

1.Ass. *Salsola dendroides* + *S.nodulosa*

2.Ass. *Salsoletum* + *artemisoso* + *varioherbosum*

**4.2.Mountain-xerophytic vegetation.** This phenomenon is particularly evident in areas situated between 1200 and 1300 metres above sea level, extending up to 1600 metres above sea level. In the course of the study, the following formation classes were included in the mountain-xerophytic vegetation type: thorny shrubs, monodominant tragacanth xerophytic shrubs, cushion-shaped

xerophytic shrubs, semi-shrubby phrygana, and mixed shrubs. These classes encompassed a total of six formations and 16 associations<sup>34</sup>.

**Thorny shrubs.** Indeed, these phytocenoses are a mixture of semi-desert vegetation and true mountain-xerophyte plants, extending upwards and along the edges of the valleys, on dry, clayey and stony infertile soils, especially in low hilly areas, and accepting other xerophyte shrubs and wormwood. The composition of thorny phytocenoses is primarily characterised by the presence of xerophyte shrubs, including *Prunus fenzliana* Fritsch, *Atraphaxis angustifolia* Jaub. & Spach., *Zygophyllum atriplicoides* Fisch. & C.A.Mey, *Caragana grandiflora* DC. and *Rhamnus pallasii* Fisch. & C.A.Mey. (Table 6).

Table 6

Phytocoenological structure and species composition of thorny shrub formation

№	Species name	Abundance, point	Height in cm	Tier
1	2	3	4	5
1	<i>Zygophyllum atriplicoides</i> Fisch. & C.A. Mey.	3-4	75-90	I
2	<i>Prunus fenzliana</i> Fritsch	2-3	200-300	I
3	<i>Rhamnus pallasii</i> Fisch. & C.A.Mey.	3-4	90-150	I
4	<i>Atraphaxis spinosa</i> L.	4-5	40-95	I
5	<i>Isatis iberica</i> Steven.	1-2	15-20	III
6	<i>Isatis ornithorhynchus</i> N.Busch	1-2	15-18	III
7	<i>Hedysarum formosum</i> Fisch. & C.A. Mey. ex Basin.	2-3	20-50	II
8	<i>Roemeria refracta</i> DC.	2-3	35-40	II
9	<i>Gladiolus atrovioleaceus</i> Boiss.	1	45-60	II
10	<i>Bromus japonicus</i> subsp. <i>japonicus</i>	1-2	25-30	III
11	<i>Stipa lessingiana</i> Trin. & Rupr.	2	30-35	III
12	<i>Nonea rosea</i> Link.	1-2	6-15	IV
13	<i>Senecio vernalis</i> Waldst. & Kit	3-4	20-50	II
14	<i>Ajuga orientalis</i> L.	2-3	10-15	IV
15	<i>Íris caucasica</i> Hoffm.	1	6-8	IV

<sup>34</sup>Heyderova, A.R. Mountain-xerophytic vegetation type found in Daridagh // Bulletin of Science and Practice. – 2024, T10 № 7, - p. 49-60.

Table 6 continuation

1	2	3	4	5
16	<i>Muscari caucasicum</i> (Griseb.) Baker	1	5-10	IV
17	<i>Tulipa biflora</i> Pall.	1-2	6-8	IV
18	<i>Odontarrhena muralis</i> (Waldst. & Kit.) Endl.	1-2	10-15	IV
19	<i>Ziziphora tenuior</i> L.	2-3	8-15	IV
20	<i>Euphorbia marschalliana</i> Boiss.	2-3	5-8	IV

**Mixed bushes.** This particular formation class consists of xerophytic plants and is characterised by a diverse array of xerophytic shrubs. It is situated at an altitude ranging from 1200 to 1500 metres above sea level.

**Mixed shrubs with various herbs.** The Daridagh area, situated on brown mountain soils on mountain slopes at an altitude of 1200-1600 m above sea level, is characterised by mixed shrubby cenoses comprising various herbs. The phytocenosis is composed of 35 species, of which 10 species are shrubs (28.56%), 1 species is a semi-shrub (2.86%), 1 species is a shrub (2.86%), 2 species are semi-shrubs (5.72%), and 21 species (60%) are perennial and biennial plants. It is notable that the vast majority of the species (35 species) within the phytocenosis are ecologically xerophytic elements. The design cover of grass polycarpia in the phytocenosis is 60-70%. The composition of the formation comprises solely one association.

**Xerophytic thickets with monodominant tragacanth.** The plant species that comprise this class are tragacanth plants, which are present in most parts of the autonomous republic. Tragacanth plants are predominantly comprised of species belonging to the genus *Astragalus* L.

**Cushion-shaped plants.** The group of cushion-shaped xerophytic shrubs includes such diminutive species as *Acantholimon karelinii* Bunge, *A.araxanum* Bunge, *Astragalus microcephalus* subsp. *microcephalus* vø *A.karjaginii* (Boriss.) Podlech. The total vegetation cover typically varies between 45-50% and 60-70%, contingent on the exposure of the area in question.

**Acantholimonosum - tragacanth - thyme.** The phytogrouping includes the following species: *Acantholimon araxanum* Bunge, *Astragalus karjaginii* Boriss., *A.microcephalus* subsp.

*microcephalus*, *Thymus armeniacus* Klokov & Des.-Shost., *Th.kotschyanus* Boiss. & Hohen.. The total project cover of the phytocenosis varies between 70-80%.

**Type: Classification of mountain-xerophytic vegetation.**

Formation class: *Astragaleta tragacanthus*

Formation: Pure *Astragaleta*

Association:

1. *Astragaletum microcephalus* subsp. *microcephalus*;
2. *Astragaletum caraganae*;
3. *Astragaletum prilipkoanus*;
4. *Astragaletum beckerianus*

Formation class: Thorny bushes

Formation: *Zygophylleta atriplicoidae*

Association:

1. *Zygophylletum* + *varioherboso* + *peganosum*
2. *Zygophylletum*+*graminoso*+*reaumuroso* + *atraxosum*

Formation: *Caraganea grandiflorae*

Assosiasiya:

1. *Caragana grandiflora*
2. *Caraganetum*+*varioherboso*+*zygophyllosum*
3. *Caraganetum* + *varioherboso*+*graminosum*

Formation class: Pillow-shaped xerophytic shrubs

Formation: *Astragaletum acantholimonosum*

Association:

1. *Acantholimonetum araxanum*
2. *Acantholimonetum astragalosum*
3. *Astragaletum microcephala*
4. *Acantholimonetum artemisom*

Formation class: Half bush friganas.

Formation: *Thymeta kotschyanus*

Association:

1. *Thymus kotschyanus*
2. *Thymetum*+*astragaloso*+*acantholimonosum*

Formation class: Mixed shrubs

Formation: *Variofruticosetum* + *varioherbosum*

Association: *Variofruticosetum* + *varioherboso* + *graminesum*

**4.3. Steppe vegetation.** In the Daridagh region, steppe flora predominates, extending over a greater expanse compared to other regions. In the Daridagh area, particularly at elevations ranging from 1500 to 1900 metres above sea level, these species are predominantly represented by locally prevalent cereal-miscellaneous mountain xerophytic vegetation. The cereal-miscellaneous mountain xerophytic steppes that are present in these areas are primarily formed on steppe-like brown and grey-brown soils. In the context of cereal-miscellaneous mountain-xerophytic groupings, cereal plants emerge as the predominant species in regions characterised by fine soil. However, in the stony-gravelly areas of the region, the dominance of representatives of various types of herbaceous vegetation is manifest, and the previous stratification gradually changes (Table 7)<sup>35</sup>.

Table 7  
Structure and species composition of cereal-diverse steppe vegetation

№	Species name	Abundance, point	Height in cm	Tier
1	2	3	4	5
1	<i>Festuca sclerophylla</i> Boiss. ex Bisch.	2-3	70-150	I
2	<i>Thinopyrum intermedium</i> subsp. <i>intermedium</i>	1-2	45-75	I
3	<i>Teucrium orientale</i> L.	2	12-27	III
4	<i>Stipa ehrenbergiana</i> Trin. & Rupr.	2	40-60	II
5	<i>Stipa capillata</i> L.	2-3	35-65	II
6	<i>Prangos ferulacea</i> Lindl.	1-2	40-70	I
7	<i>Koeleria pyramidata</i> (Lam.) P.Beauv.	2-3	15-60	II
8	<i>Koeleria macrantha</i> (Ledeb.) Schult.	1-2	15-30	III
9	<i>Trisetum flavescens</i> (L.) P.Beauv.	3	35-75	I
10	<i>Thymus kotschyanus</i> Boiss & Hohen.	3-4	8-16	IV

<sup>35</sup>Heyderova, A.R. Characteristics of steppe vegetation of Daridag // Bulletin of Science and Practice. – 2025, T11 № 3, - p.64-74.

Table 7 continuation

1	2	3	4	5
11	<i>Agropyron cristatum</i> (L.) Gaertn.	1-2	35-47	II
12	<i>Scutellaria sevanensis</i> Sosn. ex Grossh.	1-2	15-18	IV
13	<i>Dianthus cretaceus</i> Adams	2	15-38	III
14	<i>Centaurea virgata</i> subsp. <i>squarrosa</i> (Boiss.) Gugler.	2-3	25-55	II
15	<i>Tanacetum aureum</i> var. <i>Aureum</i>	1	10-15	IV
16	<i>Tanacetum kotschyi</i> (Boiss.) Grierson	1-2	16-25	IV
17	<i>Prangos uloptera</i> DC.	1	30-35	III
18	<i>Pastinaca glandulosa</i> Boiss. & Hausskn	1-2	25-30	III
19	<i>Ziziphora clinopodioides</i> var. <i>biebersteiniana</i> Grossh.	3	10-25	IV
20	<i>Ziziphora tenuior</i> L.	2-3	25-30	III
21	<i>Allium woronowii</i> Misch. ex Grossh.	1	5-10	IV
22	<i>Filipendula vulgaris</i> Moench	14-5	35-40	III
23	<i>Onobrychis transcaucasica</i> Grossh.	4	40-55	II
24	<i>Medicago lessingii</i> Fish. & C.A.Mey. ex. Kar.	3-4	20-75	I
25	<i>Astragalus arguricus</i> Bunge	1-2	25-30	III
26	<i>Astragalus echinops</i> Aucher.ex. Boiss.	1-2	25-30	III
27	<i>Galium verum</i> L.	1-2	30-35	III
28	<i>Senecio vernalis</i> Waldst. & Kit.	4-5	13-60	II
29	<i>Thymus armeniacus</i> Klokov & Des.-Shost.	1-2	10-25	IV
30	<i>Hedysarum atropatanum</i> Bunge. ex Boiss.	1	10-20	IV

### **Type: Classification of steppe vegetation**

Formation class: Mountain xerophytic steppes with cereals and various herbs

Formation: *Stipeta capillatae*

Association:

1. *Stipa capillata*

2. *Stipa capillata* + *Festuca valesiaca* + *varioherbosum*
3. *Stipa capillata* + *Atraphax spinosa* + *varioherbosum*
4. *Stipa capillata*+*Thymuskotschyanus* + *Astragalus arguricus*
5. *Stipa capillata* + *Festuca sclerophylla* + *Thymus kotschyanus* + *varioherbosum*
6. *Varioherboso*+*graminoso*+*fructosum*
7. *Varioherboso* + *graminoso* + *Stipa capillata*
- 8 *Varioherboso*+*graminoso*+*Pastinac glandulosa*
9. *Festuca sclerophylla* + *varioherboso* + *Stipa capillata*

Formation class: Gariga-type steppes

Formation: *Varioheboso*+*fructosum*

Association:

- 1.*Spiraea crenata* + *Rhamnus pallasii* + *varioherbosum*
- 2.*Fructoso*+*varioheboso*+*festucetum*
- 3.*Fructoso* + *Thymus kotschyanus* + *Festuca valesiaca* + *Astragalus beckerianus*+ *A.cicer*

## CHAPTER V. ASSESSMENT OF CENOPOPULATIONS OF SOME SPECIES

In recent years, there has been an increasing tendency to utilise population and ontogenetic approaches in the evaluation of useful plant species. For the purpose of this study, populations of the rare and protected plant species *Hedysarum atropatanum* Bunge ex Boiss., which are found within the main phytocenological groups in the Daridagh area, and *Onobrychis buhseana* Bunge ex Boiss., which is used as a fodder plant, were recorded. Furthermore, their ecophytocenotic characteristics and ontogenetic features were studied.

**5.1. Study of the demographic structure and density of the SP of the species *Hedysarum atropatanum* Bunge ex Boiss.** The studied cenopopulations of the *H.atropatanum* species were recorded in two formations in the mountainous-xerophytic vegetation type and one in the steppe vegetation type. The projective cover and species abundance level were determined for the corresponding groupings. Consequently, the *Varioherboso* + *graminoso* + *Stipa capillata*

phytocenosis exhibited the highest species abundance in terms of composition.

In order to ascertain the cenopopulation indicators of the *H.atropatanum* species over the course of several years, five cenopopulations were identified and the subject of two-year study<sup>36</sup>. The assessment of the cenopopulations in which the studied *H.atropatanum* species is distributed was carried out on the basis of the ontogenetic structure. The ontogenesis of *H.atropatanum* species is subject to variation in accordance with ecological conditions experienced in differing annual periods, as illustrated by the diagrams (Figure 4-5).

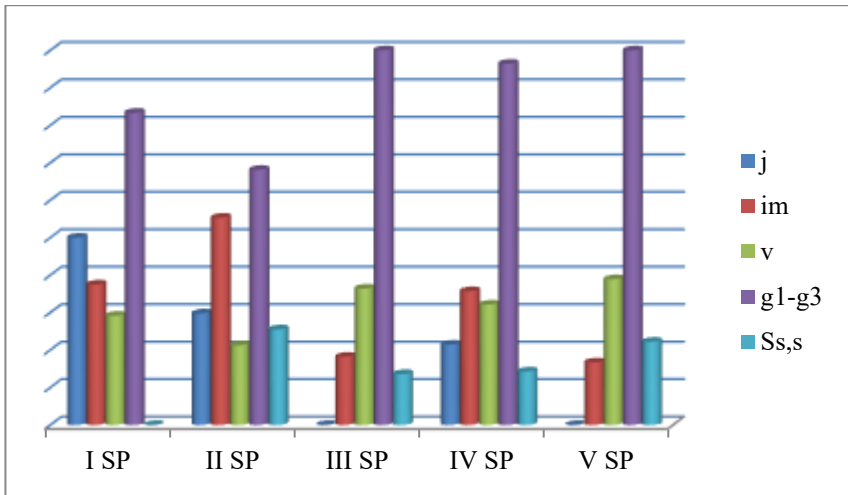


Figure 4. Dynamics of ontogenesis of the species *Hedysarum atropatanum* Bunge ex Boiss. in 2021

The research yielded findings that the age index of *H.atropatanum* exhibited variation within the range of  $\Delta=0.24-0.59$ , while the

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<sup>36</sup>Heyderova, A.R. Study of the ontogenetic structure and density of the cenopopulation of *Hedysarum atropatanum* Bunge ex Boiss. flora of Daridagh //Bulletin of Science and Practice. – 2024, T10 № 8, - p. 27-35.

efficiency index demonstrated variability within the range of  $\omega=0.45-0.74$ .

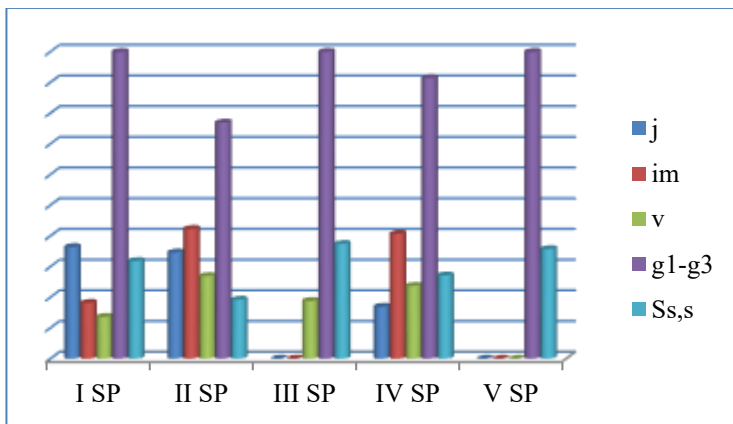


Figure 5. Dynamics of ontogenesis of the species *Hedysarum atropatanum* Bunge ex Boiss. in 2022

**5.2.Ontogenetic structure of cenopopulations of the species *Onobrychis buhseana* Bunge ex Boiss.** The objective of the present study was to investigate the ontogenetic structure of the species *Onobrychis buhseana* Bunge ex Boiss. in various ecological and cenic conditions in the Daridagh area.

The identified cenopopulations of the *O.buhseana* species were recorded in four formations, especially in the mountainous-xerophytic vegetation type, and one formation in each of the semi-desert and steppe vegetation types. The projective cover and species abundance formed by the aforementioned groupings were determined. Consequently, the phytocenosis *Variofruticosetum+varioherboso+graminesum* was determined to have the highest species abundance in terms of composition.

The status of the cenopopulations where the species is distributed has been analysed and assessed based on their ontogenetic structure indicators.

The ontogenesis of the *O.buhseana* species, which exhibits variations under the influence of environmental conditions in different years, is reflected in the diagrams (Figure 6 - 7).

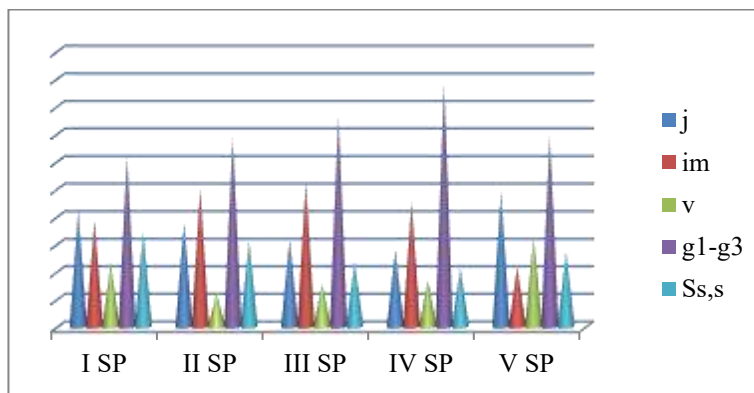


Figure 6. Dynamics of ontogenesis of the species *Onobrychis buhseana* Bunge ex Boiss. in 2022

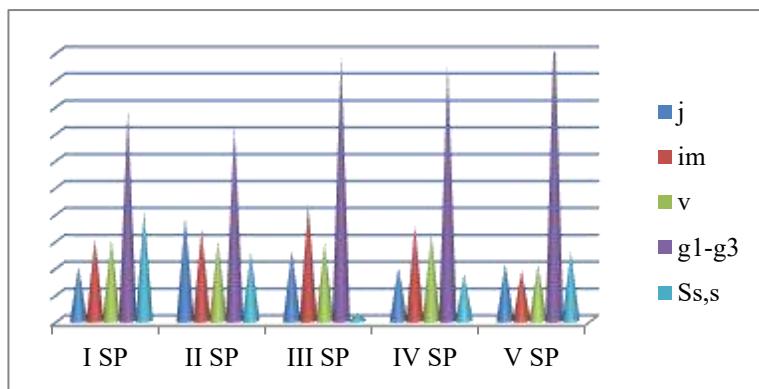


Figure 7. Dynamics of ontogenesis of the species *Onobrychis buhseana* Bunge ex Boiss. in 2023

The results of the studies conducted provide a basis for determining the age index of the *O.buhseana* species to be  $\Delta=0.28-0.4$ ; the efficiency index  $\omega=0.42-0.61$ .

## CHAPTER VI. EVALUATION OF PRODUCTIVITY IN DARIDAGH WINTER PASTURES AND PROSPECTS OF USE OF USEFUL PLANT SPECIES

In the context of the study, the productivity indicators of the vegetation cover formed in the Daridagh winter pastures were determined. Concurrently, useful plant species were selected for their

practical, economic, and multifarious significance, and these were then systematically analysed.

**6.1. Scientific and practical aspects of the use of species distributed in the Daridagh flora.** A total of 134 useful plant species have been identified in the flora of Daridagh, constituting 42.4% of the total flora. A total of 60 species of plant are utilised for foraging purposes, 58 species are employed in the field of medicine, 51 species are consumed as food, 38 species are used for decorative purposes, 24 species are essential oils, 16 species are used in the production of dyes, 10 species are honey-producing, 10 species are used in technical applications, 8 species are rich in vitamins, and 2 species are toxic.

Forage species constitute 18.67% of the total flora. The following plants are included in this category: *Eremopyrum bonaepartis* (Spreng.) Nevski, *Bothriochloa ischaemum* (L.) Keng., *Koeleria eriostachya* Pancic, *Alhagi pseudalhagi* (M.Bieb.) Fisch., *Astragalus fabaceus* M.Bieb., *Scutellaria darriensis* Grossh., *Achillea millefolium* L., *Crepis pulchra* L., *Ferula persica* Willd., *Visnaga daucoides* Gaertn.

The study area is home to 58 species of medicinal plants, accounting for 18.35% of the total flora. The following species of plants are among those under consideration: *Matricaria chamomilla* L., *Carduus nutans* subsp. *leiophyllus* (Petrovic) Stoj. & Stef., *Marrubium vulgare* L., *Camphorosma monspeliaca* L., *Reaumuria persica* Boiss., *Hypericum perforatum* L., *Juniperus communis* L., *Rosa canina* L., *Falcaria vulgaris* Bernh. and others<sup>37</sup>. A total of 16.14% of the flora is comprised of species that are of significant importance in relation to food. Examples of these include plants such as *Asparagus persicus* Baker, *Avena fatua* L., *Filipendula vulgaris* Moench, *Potentilla recta* L., *Geranium tuberosum* L., *Brassica rapa*

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<sup>37</sup>Heydarova, A.R. Medicinal plants belonging to the family *Asteraceae* Dumort. distributed in the Daridagh territory // – Nakhchivan: Nakhchivan State University Scientific Works Series of Natural and Medical Sciences, - 2020, No. 3 (104). - pp.52-55.

L., *Sisymbrium septulatum* DC., *Rumex scutatus* L., *Chaerophyllum aureum* L., *Prangos uloptera* DC., etc. A total of 38 species of ornamental plants have been identified in the local flora of Daridagh. It is estimated that ornamental plant species account for 12% of the total flora. Examples of such plants include *Gagea commutata* K.Koch, *Fritillaria gibbosa* Boiss., *Tulipa julia* K.Koch, *Íris caucasica* Hoffm., *Gladiolus atroviolaceus* Boiss., *Koeleria macrantha* (Ledeb.) Schult., *Avenula pubescens* (Huds.) Dumort., and *Papaver rhoeas* L. The analysis revealed that essential oil species constituted 7.59% of the total flora within the designated study area. The following species of plant have been identified: The following species are included in this study: *Capsella bursa – pastoris* (L.) Medik., *Salvia glutinosa* L., *Zygophyllum fabago* L., *Alcea rugosa* Alef., *Thymus kotschyanus* Boiss. & Hohen., *Ziziphora tenuior* L., *Achillea tenuifolia* Lam., *Falcaria vulgaris* Bernh. and *Laser trilobum* (L.) Borkh.. In the designated study area, dye plants constitute 5.06% of the indigenous flora. The most significant dye plants commonly found in the flora of Daridagh include the following: *Rheum ribes* L., *Hypericum perforatum* L., *H.scabrum* L., *Gagea commutata* K.Koch, *Prunus microcarpa* C.A.Mey., *Rosa canina* L., *Reseda lutea* L., *Reseda luteola* L., *Ísatis bungeana* Seidl. and *Rubia rigidifolia* Pojark. Amongst the economically significant flora, those producing honey constitute 3.16% of the area's plant life. The most significant of these are *Pyrus salicifolia* Pall., *Onobrychis transcaucasica* Grossh., *Erodium cicutarium* (L.) L' Her, *Rosa canina* L., *Nepeta meyeri* Benth. and *Tragopogon graminifolius* DC. In the realm of technical plant species, notable examples include *Juniperus communis* L., *Dactylis glomerata* L., *Bromus scoparius* L., *Lolium perenne* L. and *Peganum harmala* L., amongst others. A proportion of 3.16% of the total flora is accounted for by technical plants. A total of 2.53% of the flora is constituted by vitamin-rich plants. Examples of these include *Eryngium campestre* L., *Taraxacum* sect. *taraxacum* F.H.Wigg, *Allium woronowii* Misch. ex Grossh, etc. It is estimated that poisonous species account for 0.63% of the total flora.

**6.2. Productivity and use of winter pastures in the Daridagh area.** In the course of the scientific research undertaken, the productivity level, forage quality and pasture capacity of the phytocenoses included in the Daridagh flora were subjected to a comprehensive evaluation, underpinned by contemporary methodological approaches<sup>38</sup>.

In the course of the study, the primary phytocenoses that were present in the winter pastures of the Daridagh area were identified, and an analysis was conducted of their productivity levels by comparing the indicators obtained in different years (Table 8).

Table 8

Productivity of phytocenoses in winter pastures of the Daridagh area (s/ha)

Years	Phytocenoses					
	Saline -fragrant wormwood		Small-leaved seepweed-fragrant wormwood		Variegated - ephemeral - fragrant wormwood	
	Wet	Dry	Wet	Dry	Wet	Dry
2021	7,9±1,4	5,2±0,9	9,6±1,7	6,3±1,1	10,8±1,9	7,1±1,3
2022	8,8±1,6	5,8±1,1	11,4±2,0	7,4±1,3	12,7±2,2	8,3±1,4
2023	10,3±1,9	6,7±1,2	10,2±1,8	6,6±1,2	11,9±2,1	7,8±1,4
Total	9,0±1,6	5,9±1,1	10,4±1,8	6,8±1,2	11,8±2,1	7,7±1,4

The chemical composition indicators of forage plants in winter pastures were determined in order to assess their nutritional value (Table 9).

The load of pastures was calculated based on the grazing capacity formula. The number of livestock per hectare in winter pastures exhibited variation depending on the productivity of the phytocenoses. In this regard, the grazing capacity per hectare in the fragrant wormwood phytocenoses during the winter period was high,

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<sup>38</sup>Heydəröva, A.R. Assessment of the productivity of main forage plants in the pastures of the Daridagh area // III. International Apitherapy and Nature Congress. - Bakı, Azərbaycan. - 21-23 november 2025, - p. 508-516.

and was determined as 156 heads for small-horned animals and 52 heads for large-horned animals.

Given the relatively low productivity levels observed in the arboreal saline phytocenosis, the pasture capacity per hectare was calculated to be 130 heads for small ruminants and 43 heads for cattle.

Table 9

Biochemical indicators of the main forage plants distributed  
in winter pastures

№	Plant species	Hygroscopic moisture in %	In absolute dry matter, %					Deviation
			Crude protein	Crude cellulose	Crude oil	Crude ash	NFE	
1	<i>Artemisia fragrans</i> Willd.	9,35	12,14	34,82	3,42	11,26	29,01	0,8±1,4
2	<i>Salsola nodulosa</i> (Moq.) Iljin	7,48	13,67	33,94	2,57	13,72	30,10	0,6±1,3
3	<i>Agropyron cristatum</i> (L.) Gaertn.	7,21	11,38	36,75	2,64	8,86	41,16	0,7±1,5
4	<i>Poa pratensis</i> L.	8,54	10,92	31,48	2,31	9,08	42,67	0,6±1,4
5	<i>Onobrychis transcaucasica</i> Grossh.	8,73	17,02	32,94	2,88	10,74	41,0	0,5±1,2

In the hairy sedge phytocenosis, productivity was at its lowest level, thus resulting in pasture capacity that was lower than in other phytocenoses. Consequently, the population of small-horned animals was determined to be 108 per hectare, and the population of large-horned animals was determined to be 36 per hectare.

## CONCLUSIONS

1. The research resulted in the first compilation of the taxonomic spectrum of the Daridagh flora, determining that the study area is

home to 316 species belonging to 180 genera and 44 families. The *Asteraceae* family was found to be dominant with 44 species, followed by *Poaceae* with 40 species, *Brassicaceae* with 38 species, *Fabaceae* with 34 species, *Lamiaceae* with 26 species, *Apiaceae* with 16 species, *Amaranthaceae* with 12 species, *Caryophyllaceae* with 10 species, *Boraginaceae* with 10 species, *Rosaceae* with nine species, and *Papaveraceae* with eight species. The number of species belonging to the other 33 families varies between one and five, totalling 69 species.

2. The analysis of life forms revealed that 138 species (43.7%) were perennial herbs, 93 (29.4%) were annual herbs, 24 (7.6%) were biennial herbs, 19 (6.1%) were shrubs, 17 (5.37%) were shrubs or biennial herbs, 10 (3.1%) were annual or biennial herbs, 9 (2.84%) were subshrubs, 6 (1.89%) were trees, 142 (45%) were hemicryptophytes, 100 (31.6%) were therophytes, 30 (9.5%) were phanerophytes, 26 (8.22%) were xamephytes, and 18 (5.68%) were cryptophytes.
3. As demonstrated in the analysis of geographical areal types, the xerophilous areal type consists of 180 species, the boreal areal type consists of 50 species, the Caucasian areal type consists of 39 species, the ancient areal type consists of 13 species, the steppe areal type consists of 6 species, the desert areal type consists of 4 species, and the adventive areal type consists of 1 species. The determination of the area type for 23 species remains to be ascertained. The analysis of ecological groups has revealed the presence of 193 species of xerophytes, 69 of mesoxerophytes, and 54 of xeromesophytes.
4. The research undertaken resulted in the identification of 46 rare and endangered species in 33 genera within the Daridagh flora. The status of these species was then analysed.
5. For the first time, the vegetation of the Daridagh area was studied in detail, and 3 vegetation types, 8 formation classes, 10 formations, and 36 associations were identified for the area.
6. The results of the population assessment of select useful plants distributed in the Daridagh area indicate that the *Hedysarum atropatanum* Bunge ex Boiss. species exhibited a range of values

for the parameters of delta ( $\Delta$ ) and omega ( $\omega$ ), with values ranging from 0.24 to 0.59 and from 0.45 to 0.74, respectively. Similarly, the *Onobrychis buhseana* Bunge ex Boiss. species demonstrated a range of values for delta ( $\Delta$ ) and omega ( $\omega$ ), with values ranging from 0.28 to 0.4 and from 0.42 to 0.61, respectively.

7. Based on the research conducted, the species found in the Daridagh flora were classified as follows: fodder (60); medicinal (58); food (51); decorative (38); essential oils (24); dyes (16); honey (10); technical (10); vitamins (8); and poisonous (2). The pasture capacity of the pastures was calculated, and it was scientifically substantiated that the fragrant wormwood phytocenosis had the highest indicator in the winter period (156 heads of small-horned cattle and 52 heads of large-horned cattle per hectare).

## RECOMMENDATIONS

1. As the Daridagh area is home to many rare and endangered species, protected areas should be established there and the populations should be constantly monitored;

2. It is proposed that the species found in the Daridagh flora be used to restore fodder reserves and prevent degradation. These areas could then be used as winter pastures to promote agricultural development and greening;

3. To produce environmentally friendly products, it is recommended that species with abundant natural resources are procured and consumed.

### List of published scientific works on the topic of the dissertation:

1. Heyderova, A. Floristic analysis of the species concerning the *Astragalus* L. type spread in the Daridagh area/ A.Heyderova, D.Ganbarov, A.Ibragimov [et al.]. // European Academic Research. - 2019, vol. VI, is. 12. - p.6745-6752.

2. Heyderova, A.R. History of the study of the vegetation of the Daridagh massif of the Nakhchivan Autonomous Republic // Materials of the republican scientific conference dedicated to the 95th anniversary of the Nakhchivan Autonomous Republic. – Nakhchivan: - 2019, - p. 278-280
3. Heyderova, A.R. Spring vegetation of the *Brassicaceae* Burnett. family spread in the Daridagh flora // – Nakhchivan: Nakhchivan State University Scientific Works Nature and Medical Sciences Series, - 2019, No. 3 (100). - pp.13-16.
4. Heydarova, A.R. Medicinal plants belonging to the family *Asteraceae* Dumort. distributed in the Daridagh territory // – Nakhchivan: Nakhchivan State University Scientific Works Series of Natural and Medical Sciences, - 2020, No. 3 (104). - pp.52-55.
5. Heydarova, A.R. Taxonomic composition of the family *Lamiaceae* Lindl. spreading in the Daridagh flora of the Nakhchivan Autonomous Republic // – Nakhchivan: Scientific Works of the Central Botanical Garden of the Azerbaijan National Academy of Sciences, - 2020, volume XVIII, - pp. 28-31
6. Heyderova, A., Ganbarov, D. Taxonomical spectrum of Daridagh mountain of the Nakhchivan Autonomous Republic // International Journal of Botany Studies,-2020, - Volume 5, Issue 3. - p. 287-291.
7. Heyderova, A.R. Taxonomic composition and life forms of the *Asteraceae* Dumort. family spreading in Daridagh area // Bulletin of Science and Practice. – 2020,- Volume 6, Issue 6. - p. 68-72.
8. Heydarova, A.R. Taxonomic composition and bioecological characteristics of the *Papaveraceae* family (*Papaveraceae* Juss.) distributed in the Daridagh flora of the Nakhchivan Autonomous Republic // International Asian Congress on Contemporary Sciences -V,– Turkey: 1-2 June, -2021. - p.1031-1037.
9. Heydarova, A.R. Floristic analysis of the *Caryophyllaceae* family (*Caryophyllaceae* Juss.) distributed in the Daridagh flora of the Nakhchivan Autonomous Republic // Hodja Akhmet Yassawi 5th International Conference on Scientific Research,– Turkey: 5-6 November, – 2021.- p.114-115.

10. Heyderova, A. Biomorphological characteristics of the species in the *Caryophyllaceae* Juss. family distributed in Daridagh flora// XII International scientific conference. The modern vector of the development of science. - Philadelphia.USA: -21-22 March, - 2024. - p. 27-33.
11. Heyderova, A.R. Characteristics of semi-desert vegetation type of the Daridagh region // Bulletin of Science and Practice. – 2024, v. 10, No. 4. - p. 75-82.
12. Heyderova, A.R. Mountain-xerophytic vegetation type found in Daridagh // Bulletin of Science and Practice. – 2024, v. 10, No. 7. - p. 49-60.
13. Heyderova, A.R. Study of the ontogenetic structure and density of the cenopopulation of *Hedysarum atropatanum* Bunge ex Boiss. flora of Daridagh // Bulletin of Science and Practice. – 2024, v. 10, No. 8. - p. 27-35.
14. Heyderova, A.R. Characteristics of steppe vegetation of Daridagh // Bulletin of Science and Practice. - 2025, v. 11, No. 3. - p. 64-74.
15. Heyderova, A.R. Assessment of the productivity of main forage plants in the pastures of the Daridagh area// III International Apitherapy and Nature Congress. - Baku: - November 21-23, - 2025. - p.508-516.



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