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SYSTEMATIC ANALYSIS AND ECOLOGY OF HERBACEOUS SPECIES OF THE FAMILY Rosaceae Juss.

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СИСТЕМАТИЧЕСКИЙ АНАЛИЗ И ЭКОЛОГИЯ ТРАВЯНИСТЫХ ВИДОВ СЕМЕЙСТВА Rosaceae Juss.

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Abstract. The present article investigates the herbaceous species of the family Rosaceae Juss. distributed in the flora of the Nakhchivan Autonomous Republic and provides an ecological assessment of these species. Based on the analysis of available literature sources and the results of original field studies, a total of 40 herbaceous species belonging to 9 genera of the family Rosaceae were identified and studied within the regional flora. Among them, 17 species belong to the genus *Potentilla* L., 13 species to *Alchemilla* L., 2 species each to *Sibbaldia* L., *Geum* L., and *Filipendula* Mill. The remaining genera are represented by monotypic taxa, each comprising a single species. The family Rosaceae is of considerable interest due to its high level of biodiversity and significant ecological importance. The results of extensive field investigations indicate that the greatest species diversity of herbaceous Rosaceae taxa is observed up to the middle mountain belt, within the middle mountain belt, and in the subalpine and alpine zones, while the lowest diversity occurs in the lower mountain belt. In modern botanical research, issues related to the reconstruction of botanical-geographical and historical systems, the analysis of species distribution and genesis, and the clarification of distribution (areal) types are of particular importance. The herbaceous species of the family Rosaceae were classified according to their areal types as follows: Holarctic and Asia Minor (7 species each), Western Palaearctic and Northern Atropatene (6 species each), Caucasian areal class (5 species), Near Eastern and Northern Iranian areal classes (3 species each), Palaearctic (1 species), and Central Asian areal class (1 species). For one species, the areal type could not be determined. According to ecological group classification, it was determined that 55% of the herbaceous Rosaceae species are mesophytes, 35% mesoxerophytes, 5% xeromesophytes, 3% hydrophytes, and 2% xerophytes.

Аннотация. Представлено описание травянистых видов семейства Розоцветные (Rosaceae Juss.) флоры Нахчыванской Автономной Республики. Проведён экологический анализ. Выявлено и проанализировано 40 травянистых видов, относящихся к 9 родам семейства Rosaceae, из них — 17 видов относятся к роду *Potentilla* L., 13 видов – к роду *Alchemilla* L., по 2 вида – к родам *Sibbaldia* L., *Geum* L. и *Filipendula* Mill. Остальные роды являются монотипными и представлены одним видом каждый. Семейство Rosaceae представляет значительный интерес как с точки зрения биоразнообразия, так и с позиции его экологической роли. Установлено, что наибольшее видовое разнообразие травянистых

представителей семейства наблюдается до и в пределах среднего горного пояса, а также в субальпийском и альпийском поясах, тогда как наименьшее — в нижнем горном поясе. В современных ботанических исследованиях особую актуальность приобретают вопросы реконструкции ботанико-географических и исторических систем, анализа распространения и генезиса видов, а также уточнения их ареальных типов. Травянистые виды семейства Rosaceae были распределены по ареальным классам следующим образом: голарктический и малоазиатский (по 7 видов), западнопалеарктический и североатропатенский (по 6 видов), кавказский ареальный класс (5 видов), переднеазиатский и североиранский ареальные классы (по 3 вида), палеарктический (1 вид) и среднеазиатский ареальный класс (1 вид). Для одного вида ареальный тип определить не удалось. По экологическим группам установлено, что 55% травянистых видов семейства Rosaceae относятся к мезофитам, 35% — к мезоксерофитам, 5% — к ксеромезофитам, 3% — к гидрофитам и 2% — к ксерофитам.

Keywords: Rosaceae, herbaceous, systematic analysis, geographical class, ecological group, genus.

Ключевые слова: Rosaceae, травянистые, систематический анализ, географический класс, экологическая группа, род.

The richness of the flora and the diversity of vegetation types within the study area are closely related to its complex physical-geographical structure, the stages of its natural-historical development, and its formation under the influence of various floristic regions. The location of the region within the Caucasus ecoregion along major species migration routes has created favorable conditions for the development of a high level of biodiversity. These factors act as the principal ecological and geographical determinants shaping the structural diversity and species richness of the vegetation cover. In the formation of the existing floristic diversity and the development of various plant communities, representatives of the family *Rosaceae* Juss., particularly herbaceous species, play a significant role. From a biomorphological perspective, the family includes species with a wide ecological amplitude, represented by trees, shrubs, subshrubs, and herbaceous life forms. These plants are widely distributed under both natural and cultivated conditions. Riparian zones, as well as moist and marshy habitats, constitute the main ecotopes where herbaceous representatives of the family *Rosaceae* occur with higher frequency.

At the same time, within the regional flora, herbaceous species of the family *Rosaceae* have not yet been comprehensively investigated in a systematic and purpose-oriented manner. In existing studies, the systematic position, ecological characteristics, distribution patterns, and areal types of these species have not been sufficiently summarized, which complicates an objective assessment of the actual role of the family within the regional flora.

In this context, the primary objective of the present original research was to determine the systematic composition of herbaceous species of the family *Rosaceae* Juss., to analyze their biomorphological and bioecological characteristics, and to clarify the types and classes of their distributional ranges, ecological groups, and altitudinal belt distribution. The results of the study contribute to a more comprehensive scientific characterization of these species within the regional flora and provide a reliable basis for future floristic and ecological research.

Material and research methods

The studies were conducted during 2024–2025 in various areas of the Nakhchivan Autonomous Republic. Different localities of the region served as the main study sites, while the research material

was based on published literature sources and empirical data obtained during field investigations. The herbaceous species of the family *Rosaceae* were selected as the primary objects of investigation.

During the research, generally accepted floristic, geobotanical, and bioecological methods, as well as phenological observations, were employed. Species identification, verification of scientific names, and the consideration of nomenclatural changes were carried out based on of relevant publications [4-12].

The determination of geographical elements and the classification of distributional (areal) types were performed according to the schemes proposed by A. A. Grossheim and C. Portenier [1-3].

Recent taxonomic updates were adopted in accordance with the World Flora Online database (<https://about.worldfloraonline.org/>).

Discussion and conclusions of the study

The conducted investigations and the comparative analysis of available literature sources indicate that herbaceous representatives of the family *Rosaceae* occupy a distinct position in the flora of the Nakhchivan Autonomous Republic. It has been established that herbaceous *Rosaceae* taxa within the regional flora are represented by 40 species belonging to 9 genera. These species are predominantly perennial herbaceous plants and are characterized by a high capacity for adaptation to diverse ecological conditions. The systematic analysis of the herbaceous species of the family *Rosaceae* is presented below [4-12].

Rosaceae Juss., nom. cons.

1. Genus: *Agrimonia* L.

1(1) *Agrimonia eupatoria* L.

2. Genus: *Alchemilla* L.

2(1) *Alchemilla amicta* Juz.

3(2) *A. epipsila* Juz.

4(3) *A. erythropoda* Juz.

5(4) *A. grossheimii* Juz.

6(5) *A. orthotricha* Rothm. (*A. holotricha* Juz.)

7(6) *A. persica* Rothm. (*A. axyrepala* Juz.)

8(7) *A. raddeana* (Bus.) Juz.

9(8) *A. retinervis* Bus.

10(9) *A. sedelmeyeriana* Juz.

11(10) *A. sericata* Reichenb.ex Bus.

12(11) *A. sericea* Willd.

13(12) *A. smirnovii* Juz.

14(13) *A. venosa* Juz.

3. Genus: *Comarum* L.

15(1) *Comarum palustre* L.

4. Genus: *Filipendula* Mill.

16(1) *Filipendula ulmaria* (L.) Maxim.

17(2) *F. vulgaris* Moench (*F. hexapetala* Gilib.)

5. Genus: *Fragaria* L.

18(1)**Fragaria magna* Thuill. [*F. ananassa* (Duch.) auct.]

6. Genus: *Geum* L.

19(1) *Geum rivale* L.

20(2) *G. urbanum* L.

7. Genus: *Potentilla* L.

- 21(1) *Potentilla adenophylla* Boiss. & Hohen.
- 22(2) *P. agrimonioides* Bieb.
- 23(3) *P. anserina* L.
- 24(4) *P. argaea* Boiss. & Bal.
- 25(5) *P. argentea* L.
- 26(6) *P. canescens* Bess.
- 27(7) *P. crantzii* (Crantz) G.Beck ex Fritsch
- 28(8) *P. cryptophila* Bornm.
- 29(9) *P. gelida* C.A. Mey.
- 30(10) *P. lomakinii* Grossh.
- 31(11) *P. obscura* Willd.
- 32(12) *P. pedata* Willd. ex Hornem.
- 33(13) *P. pimpinelloides* L.
- 34(14) *P. recta* L.
- 35(15) *P. reptans* L.
- 36(16) *P. supina* L.
- 37(17) *P. szovitsii* Th.Wolf

8. Genus: *Poterium* L.

- 38(1) *Poterium polygamum* Waldst. & Kit.

9. Genus: *Sibbaldia* L.

- 39(1) *Sibbaldia parviflora* Willd.
- 40(2) *S. semiglabra* C.A. Mey.

The analysis of herbaceous species of the family *Rosaceae* by genera in the studied area is presented in Table 1.

Table 1

ANALYSIS OF HERBACEOUS SPECIES OF THE FAMILY *Rosaceae* BY GENERA

<i>Genera</i>	<i>Number of species</i>	<i>Percentage of the total (%)</i>
<i>Agrimonia</i> L.	1	2,5
<i>Alchemilla</i> L.	13	32,5
<i>Comarum</i> L.	1	2,5
<i>Filipendula</i> Mill.	2	5
<i>Fragaria</i> L.	1	2,5
<i>Geum</i> L.	2	5
<i>Potentilla</i> L.	17	42,5
<i>Poterium</i> L.	1	2,5
<i>Sibbaldia</i> L.	2	5
<i>Total:</i>	40	100

Based on the data presented in Table 1, the genus *Potentilla* L. predominates in terms of species richness. This genus includes 17 species, accounting for 42.5% of the total number of species. The second most represented genus is *Alchemilla* L., with 13 recorded species, representing 32.5% of the total. The remaining genera are comparatively less represented in terms of species number. Specifically, the genera *Filipendula* Mill., *Geum* L., and *Sibbaldia* L. are each represented by 2 species, corresponding to 5% of the total species number. The genera *Agrimonia* L., *Comarum* L., *Fragaria* L., and *Poterium* L. are monotypic and each is represented by 1 species (2.5%). Their limited distribution within the study area is associated with narrower ecological requirements and

specific associations with certain phytocoenoses. Based on the data presented in Table 1, the genus *Potentilla* L. predominates in terms of species richness. This genus includes 17 species, accounting for 42.5% of the total number of species. The second most represented genus is *Alchemilla* L., with 13 recorded species, representing 32.5% of the total. The remaining genera are comparatively less represented in terms of species number. Specifically, the genera *Filipendula* Mill., *Geum* L., and *Sibbaldia* L. are each represented by 2 species, corresponding to 5% of the total species number. The genera *Agrimonia* L., *Comarum* L., *Fragaria* L., and *Poterium* L. are monotypic and each is represented by 1 species (2.5%). Their limited distribution within the study area is associated with narrower ecological requirements and specific associations with certain phytocoenoses [5, 10].

The classification of plants into ecological groups is of great importance for the study of floristic composition, the explanation of vegetation formation, and the analysis of the bioecological characteristics of different geographical regions. The herbaceous (non-woody) species of the family Rosaceae are mainly divided, according to their moisture requirements, into hydrophytes, mesophytes, xerophytes, xero-mesophytes, and meso-xerophytes (Figure 1).

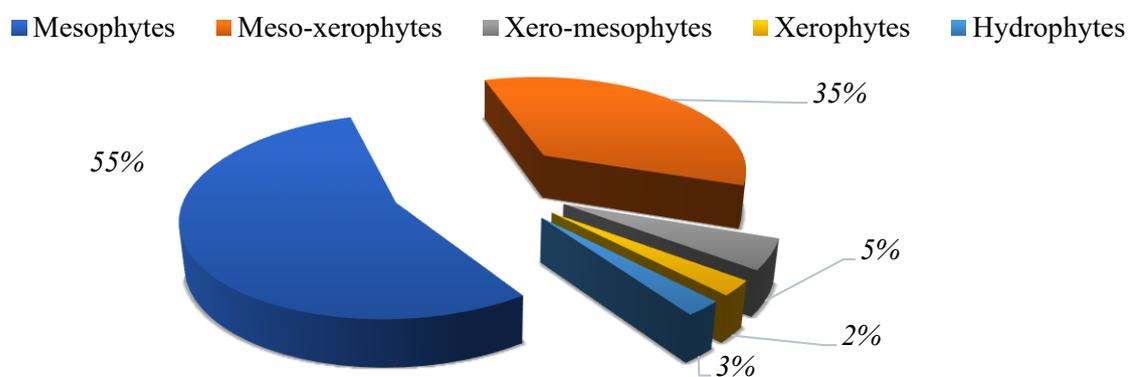


Figure 1. Distribution of herbaceous (non-woody) species of the family *Rosaceae* according to ecological groups

As shown in the figure, the distribution of herbaceous (non-woody) species of the family *Rosaceae* among ecological groups in the studied area is uneven in character, which is closely related to the natural–geographical and climatic conditions of the region. Among the ecological groups, mesophytes predominate, accounting for 55% of the total species composition. Meso-xerophytes are less abundant compared to mesophytes and constitute 35% of the total flora.

Xero-mesophytes account for 5% of the total flora and are mainly represented by species that occur in mesophytic habitats but are tolerant to short-term drought conditions. Hydrophytes and xerophytes are represented by a low proportion (2,5%), which is associated with the limited distribution of water bodies and permanently moist habitats, as well as the restricted occurrence of typical arid landscapes within the area. The presence of species belonging to limited-distribution areal classes reflects the influence of microclimatic and relief factors on floristic diversity, especially in mountainous areas. Herbaceous species distributed in mountainous and high-mountain zones are mainly characterized by regional and local areal types, indicating that these areas represent florogenetically important centers. Among the herbaceous species of the family *Rosaceae*, taxa belonging to regional areal classes such as the Caucasus, Asia Minor, Northern Atropatene, Western Asia, and Northern Iran are also widely represented. This confirms that the Caucasus–Atropatene floristic province is rich in species diversity and endemism (Figure 2).

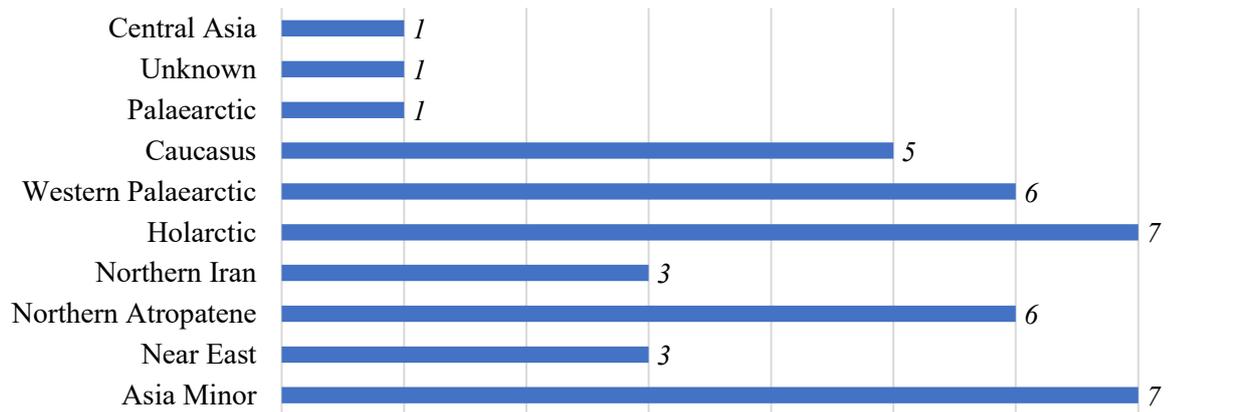


Figure 2. Distribution of herbaceous (non-woody) species of the family *Rosaceae* Juss. according to geographical areal classes

The herbaceous species of the family *Rosaceae* are represented at different levels across geographical areal types. Among these elements, Holarctic and Asia Minor taxa predominate, each characterized by seven species. The Western Palaeartic and Northern Atropatene areal classes are represented by six species each. Species belonging to the Caucasian areal class occupy an intermediate position with five species, indicating the presence of taxa adapted to mountainous relief and local ecological conditions. The Near Eastern and Northern Iranian areal classes are each represented by three species, suggesting the existence of floristic connections with these regions, although they do not play a leading role.

The lowest representation is observed in the Central Asian and Palaeartic areal classes, each represented by a single species. This pattern may be explained by the limited adaptation of herbaceous *Rosaceae* species to the continental and sharply contrasting climatic conditions of Central Asia. According to our investigations, the areal type and class of one species (*Potentilla obscura*) could not be determined. Due to the complex relief of Azerbaijan, and particularly of the Nakhchivan Autonomous Republic, several altitudinal belts have formed, which constitute the basis of floristic diversity in the region. Owing to their ecological plasticity, the herbaceous species of the family *Rosaceae* are distributed across different altitudinal belts. These species are most widely represented in foothill, lower-mountain, and middle-mountain zones, indicating that moderately humid conditions and moderate temperatures are optimal for their development. In particular, meadows and forest edges are considered the main biotopes for herbaceous representatives of the family *Rosaceae* (Figure 3).

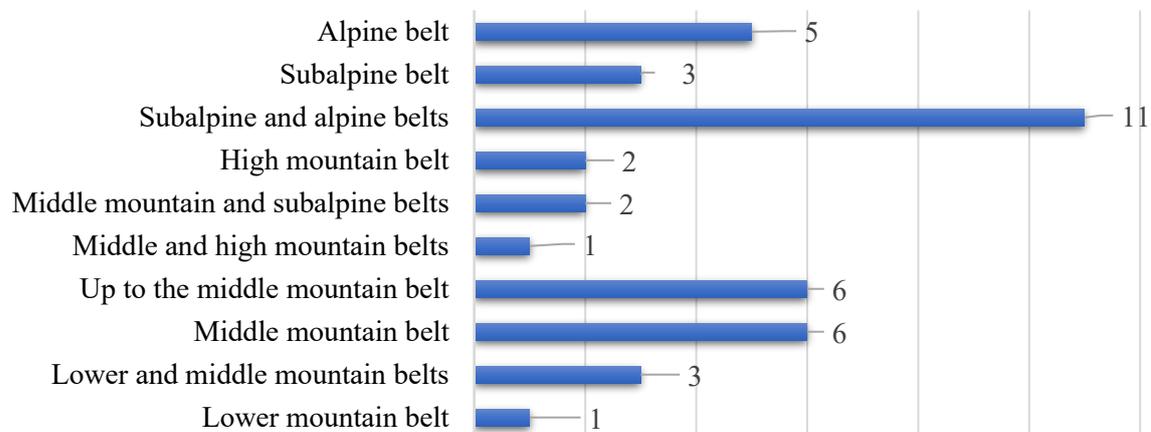


Figure 3. Distribution of herbaceous species of the family *Rosaceae* across altitudinal belts

The presented diagram clearly illustrates the distribution of the studied species across altitudinal belts. Based on the conducted investigations, it has been established that the herbaceous species of the family Rosaceae in the flora of the Nakhchivan Autonomous Republic are distributed over a wide altitudinal range, from the lower mountain belt to the alpine belt.

The lower and middle mountain belts mainly comprise relatively humid areas that are more exposed to anthropogenic influence. Within these belts, species such as *Comarum palustre*, *Potentilla adenophylla*, *P. supina*, and *Fragaria magna* are distributed. *Agrimonia eupatoria* and *Filipendula ulmaria* are particularly distinguished as widely distributed species in the middle mountain belt under mesophytic and meso-xerophytic conditions.

The middle mountain belt and adjacent areas represent one of the richest zones in terms of species diversity. In this belt, species such as *Filipendula vulgaris*, *Geum urbanum*, *Potentilla argentea*, *P. canescens*, *P. obscura*, *P. pedata*, *P. recta*, and *P. reptans* have been recorded.

The transition zone from the middle mountain belt to the subalpine belt is of particular ecological significance. In this zone, species such as *Alchemilla epipsila*, *Filipendula vulgaris*, *Geum rivale*, and *Potentilla anserina* are observed.

The subalpine belt represents one of the main centers of distribution for species of the family Rosaceae, especially those belonging to the genera *Alchemilla* and *Potentilla*. Within this belt, *Alchemilla amicta*, *A. erythropoda*, *A. grossheimii*, *A. orthotricha*, *A. persica*, *A. raddeana*, *A. sericata*, *A. smirnovii*, as well as *Potentilla agrimonioides*, *P. argaea*, *P. crantzii*, *P. cryptophila* and *Sibbaldia parviflora* are widely distributed.

The high-mountain belt is relatively poorly represented in terms of species richness. This zone is mainly inhabited by species of Northern Atropatene origin, such as *Potentilla lomakinii* and *P. pimpinelloides*, indicating their regional endemic characteristics.

Thus, as a result of the conducted studies, the systematic composition of the herbaceous species of the family Rosaceae occurring in the flora of the Nakhchivan Autonomous Republic has been determined, and the altitudinal belts, ecological groups, geographical areal types, and areal classes of these species have been investigated. The results of the study constitute an important scientific basis for further research on the herbaceous species of the family Rosaceae distributed within the region.

Results

During the conducted investigations, the flora of the Nakhchivan Autonomous Republic was found to include 40 herbaceous (non-woody) species of the family Rosaceae belonging to 9 genera. Among these, 17 species belong to *Potentilla* L., 13 species to *Alchemilla* L., 2 species to *Sibbaldia* L., 2 species to *Geum* L., and 2 species to *Filipendula* Mill. The remaining genera are monotypic, each represented by a single species.

Analysis of ecological groups revealed that 55% (22 species) of the herbaceous Rosaceae species are mesophytes, 35% (14 species) are meso-xerophytes, 5% (2 species) are xero-mesophytes, 2,5% are hydrophytes (1 species), and 2,5% (1 species) are xerophytes.

According to the analysis of geographical areal types, 7 species (17.5%) belong to the Holarctic and Asia Minor areal classes, 6 species (15%) to the Western Palaearctic and Northern Atropatene classes, 5 species (12.5%) to the Caucasian areal class, 3 species (7.5%) to the Near Eastern and Northern Iranian areal classes, 1 species (2.5%) to the Palaearctic areal class, and 1 species (2.5%) to the Central Asian areal class. The areal type of *Potentilla obscura* remains undetermined.

The distribution of herbaceous species of the family Rosaceae occurring in the flora of the Nakhchivan Autonomous Republic was investigated according to altitudinal belts. It was established that 1 species occurs in the lower mountain belt, 3 species in the lower and middle mountain belts, 6 species up to the middle mountain belt, 6 species in the middle mountain belt, 1 species in the middle

and high mountain belts, 2 species in the middle mountain and subalpine belts, 2 species in the high mountain belt, 3 species in the subalpine belt, 5 species in the alpine belt, and 11 species in both the subalpine and alpine belts.

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