Ecological-geographical analysis of Rosaceae Juss. family of Khakassia flora

Ecological-geographical analysis of Rosaceae Juss. family of Khakassia flora

E V Sazanakova[1], N N Tupitsyna[2] and E M Antipova[2]

[1] N. F. Katanov Khakas State University, Lenina str., 90, Abakan, 655000, Russia
[2] V. P. Astafyev Krasnoyarsk State Pedagogical University, Ada Lebedeva str., 89, Krasnoyarsk, 660017, Russia

E-mail: sazelevik@mail.ru, floranatalka@mail.ru, katusha05@bk.ru

Abstract. The Rosaceae family of the Khakassia region flora includes 102 species and 26 genera. The data of the ecological and geographical analysis show the heterogeneity of the family that has developed with the noticeable influence of the altitudinal zonality. Half of the family species are mountain species (Arcto-Alpine, Alpine, Montana, light conifer-forest, dark conifer-forest and nemoral groups), almost half of them are forest ones (27 species). Species of the light conifer-forest group dominate (17 species). A certain contribution is made by the steppe, forest-steppe, plurizonal, Montana groups. The Arcto-Alpine and Alpine groups constitute together 12 species, anthropochory group consists of 4 species.

1. Introduction

The Rosaceae family of the flora of Khakassia region includes 102 species and 26 genera. The knowledge of the ecological and geographical (belt-zonal) family structure is a necessary condition for understanding the historical basis and genesis [1-9]. The combination of belt-zonal elements reflects the floristic structure of vegetation at the landscape level [10].

2. Results and discussion

All species of the Rosaceae family of the flora of Khakassia region, according to the distribution of their range to certain zones (longitudinal groups) and altitudinal belts (latitudinal groups) are combined into 10 ecological and geographical groups (table 1):

Table 1. Ecological and geographical groups of species of the Rosaceae family.

Ecological and geographical groups	Number of species	% of the total number of species of the family
Arcto-Alpine	4	3,92
Alpine	8	7,84
Montana	12	11,76
Light conifer-forest	17	16,67
Dark conifer forest	4	3,92
Nemoral	6	5,88
Forest-steppe	14	13,73
Steppe	19	18,63

Plurizonal	14	13,73
Anthropochory	4	3,92
Total:	**102**	**100,00**

The Arcto-Alpine Group (AA) includes species (4) growing in the highlands and the tundra zone. This group consists of widespread species: Holarctic (*Dryas punctata* Juz., *Potentilla nivea* L., *Sibbaldia procumbens* L.) and actually Eurasian proper ones (*Potentilla gelida* C.A. Mey.)

The Alpine group (A) includes species (8) that grow in the alpine mountain belt (*Alchemilla anisopoda* Juz., *A. aperta* Juz., *A. cryptocaula* Juz., *A. dasyclada* Juz., *A. sauri* Juz., *Dryas oxyodonta* Juz., *Potentilla biflora* Willd. ex Schltdl., *Sanguisorba alpina* Bunge). This group is very heterogeneous in geographic distribution, including species with both a wide range: P*otentilla biflora* - American-Asian, and with a narrow one: *Alchemilla anisopoda*, *A. cryptocaula*, *A. dasyclada*, *A. sauri* - Altai-Sayan endems. Three species with an Asian type of range: *Alchemilla aperta* - Middle Asian, *Sanguisorba alpina* - Central Asian, *Dryas oxyodonta* - Mongolian-South Siberian. In addition to highlands, *Dryas oxyodonta* is also found in the steppe belt of the Abakan Range, the name of the "reduced Alpines" was fixed to such species. V. I. Kurbatsky [11], A. V. Larionov and others [12] attribute *Dryas oxyodonta* to glacial relics.

Montana group (Mon) includes mountain common belted species (12) that grow both in the highlands and in the lower zones of the mountains (in the dark, mountain taiga and forest-steppe), mainly within the mountain systems. All species are Asian, mainly (5) Middle Asian: *Alchemilla bungei* Juz., *A. krylovii* Juz., *A. lipschitzii* Juz., *A. sibirica* Zamelis, *Potentilla asiatica* (Th. Wolf.) Juz. There are two species with areas concentrated in the Altai-Sayan mountain country (*Alchemilla diglossa* Juz., *Rosa oxyacantha* M. Bieb.), 1 species with the ranges in Central (*Spiraea alpina* Pall.) and North (*Cotoneaster uniflorus* Bunge) Asia, 3 species - Euro-Siberian (*Alchemilla gracilis* Opiz, *A. integribasis* Juz., *A. leiophylla* Juz.).

The light conifer-forest group (CF) includes species (17) that grow in forest communities formed by larch and pine in the light conifer-forest and forest-steppe belts, as well as in shrubs, rocky outcrops, debris, etc. Undoubtedly, in this ecological-geographical group species of wide distribution lead (16 species), mainly Eurasian (10 species): Eurasian proper - 7 species: *Agrimonia pilosa* Ledeb., *Cotoneaster laxiflorus* J. Jack. ex Lindl., *Filipendula ulmaria* (L.) Maxim., *Potentilla chrysantha* Trevir., *Rubus saxatilis* L., *Spiraea media* Schmidt, *S. salicifolia* L. and Euro-Siberian - 3 types: *Crataegus chlorocarpa* Lenne et K. Koch., *C. sanguinea* Pall., *Spiraea chamaedryfolia* L., as well as holarctic - 5 species: *Dasiphora fruticosa* (L.) Rydb., *Rosa acicularis* Lindl., *Rubus arcticus* L., *R. matsumuranus* H. Lev. et Vaniot, *Sanguisorba officinalis* L. Species of the North (*Spiraea flexuosa* Fisch. ex Cambess.) and Middle Asian (*Potentilla evestita* Th. Wolf) spread are presented by one species.

The dark conifer forest group (DC) combines species (4) of the mountain taiga belt. All types of widespread distribution are holarctic (*Rubus chamaemorus* L., *R. humulifolius* C.A. Mey.) and Eurasian: Eurasian proper (*Sorbus sibirica* Hedl.) and Euro-Siberian (*Rubus idaeus* L.).

The nemoral group (Nem) includes species (6) corresponding to large-leaved and coniferous-large-leaved forests growing in the forest and forest-steppe zones. 4 species with a wide range type, 2 of which are actually Eurasian: *Fragaria vesca* L., *Padus avium* Mill., and the other half are Euro-Siberian: *Fragaria moschata* (Duchesne) Weston, *Rosa majalis* Herrm. Asian species (2) are represented by Eastern (*Waldsteinia ternata* (Stephan) Fritsch) and North Asian (*Sorbaria sorbifolia* (L.) A. Braun) species.

The forest-steppe group (FS) includes species characteristic of the forest-steppe and steppe belts (14). 8 species from the entire composition inhabit Eurasia: *Filipendula stepposa* Juz., *Fragaria viridis* (Duchesne) Weston, *Potentilla argentea* L., *P. bifurca* L., *P. canescens* Besser, *P. humifusa* Willd. ex Schltdl., *Rosa spinosissima* L., *Spiraea crenata* L.; 5 species are found in Asia; 4 species - in the North (*Potentilla flagellaris* Willd. ex Schltdl., *P. fragarioides* L., *P. longifolia* Willd. ex Schltdl., *P. tanacetifolia* Willd. ex Schltdl.), 1 species - in the Eastern Asia (*Spiraea sericea* Turcz.). *Potentilla arenosa* (Turcz.) Juz. is a kind from the American-Asian type of range.

Steppe group (S) includes species (19), widely distributed in zonal steppes. This group consists of mountain steppe and proper steppe subgroups. In the steppe group, Asian species dominate (16), almost half of which are Central Asian (7): *Dasiphora parvifolia* (Fisch. ex Lehm.) Juz., *Potentilla acaulis* L., *P. ornithopoda* Tausch, *P. sericea* L., *P. soongarica* Bunge, *Sibbaldianthe adpressa* (Bunge) Juz., *Spiraea trilobata* L., equally (3 species) of North Asian: *Chamaerhodos erecta* (L.) Bunge, *Potentilla approximata* Bunge, *P. tergemina* Sojak, Mongolian-South Siberian: *Coluria geoides* (Pall.) Ledeb., *Potentilla conferta* Bunge, *P. ozjorensis* Peschkova and endemic: *Potentilla elegantissima* Polozh., *P. jenisseensis* Polozh. et W. Smirn., *P. martjanovii* Polozh. The steppe group contains 2 Holarctic species: *Potentilla elegantissima* Polozh., *P. jenisseensis* Polozh. et W. Smirn., *P. martjanovii* Polozh. and 1 species: *Spiraea hypericifolia* L. with the Eurasian areal proper.

The plurizonal group (P) includes species (14) of azonal habitats: meadow, marsh, riverine, coastal and aquatic, and for the most part contains species with a wide range, namely with a Euro-Siberian range - 7 meadow species: *Alchemilla hebescens* Juz., *A. monticola* Opiz, *A. orbicans* Juz., *A. pachyphylla* Juz., *A. rigescens* Juz., *A. subcrenata* Buser, *Filipendula denudata* (J. Presl. et C. Presl.) Fritsch, with holarctic - 5 species, of which 2 species of coastal and wetland: *Comarum palustre* L., *Geum rivale* L. and 3 meadow species: *Geum aleppicum* Jacq., *Potentilla anserina* L., *P. paradoxa* Nutt. ex Torrey et Gray; with cosmopolitan - coastal-water species *Potentilla norvegica* L. and 1 meadow species - endemic to the Altai-Sayan highland country *Alchemilla omalophylla* Juz.

Anthropochory group (An) includes species (4), which appeared due to human activity. Two species with a cosmopolitan area: *Cerasus fruticosa* Pall., *Microcerasus tomentosa* (Thunb.) Eremin et Juschev. 1 species from Euro-Siberian - *Geum urbanum* L., 1 - from East Asian - *Malus baccata* (L.) Borkh.

The ratio of ecological-geographical and arealogical groups of the Rosaceae family is presented in figure 1.

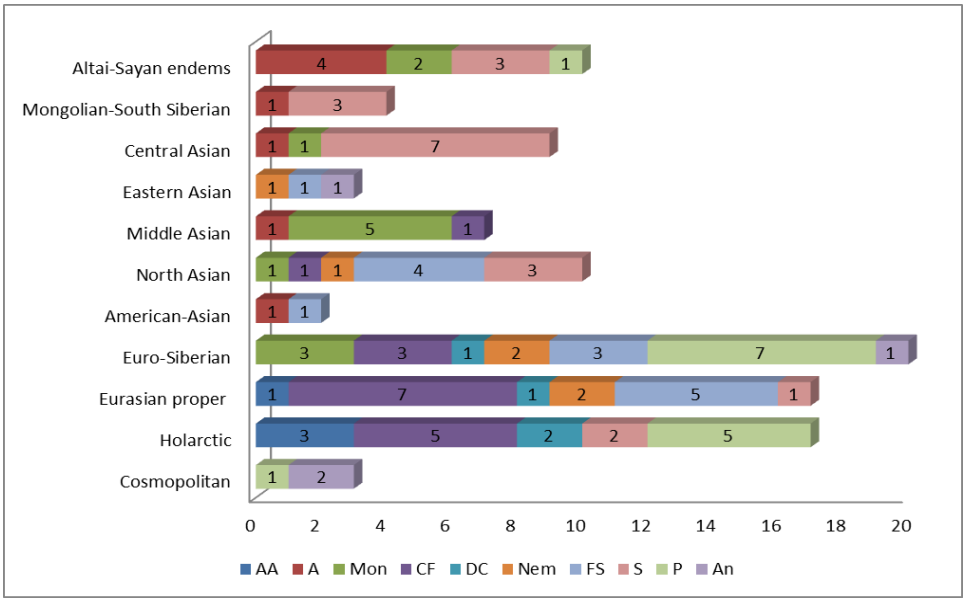

Figure 1. Conjugated analysis of the ecological-geographical and arealogic groups of the Rosaceae family species.

3. Conclusion

Thus, the data of ecological and geographical analysis of species of the family Rosaceae Juss. flora of Khakassia region shows the diversity of the family, formed under the influence of altitudinal zonation. Half of the species of the family belong to mountain species (51 species, 50.00 %) (arctic-alpine, alpine, montana, light conifer-forest, dark conifer-forest and nemoral groups), including the majority

of species (13 species, 12.75 %) of the genus *Alchemilla*: *A. anisopoda*, *A. aperta*, *A. bungei*, *A. cryptocaula*, *A. dasyclada*, *A. diglossa*, *A. gracilis*, *A. integribasis*, *A. krylovii*, *A. leiophylla*, *A. lipschitzii*, *A. sauri*, *A. sibirica*. In the flat steppe part of Khakassia region 33 species grow (32.36%), for the most part these are the genera *Potentilla*, *Chamaerhodos*, *Coluria* and others, of which in the steppe (19 species, 18.63 %) and forest-steppe (14 species, 13.73 %) ecological-geographical groups. Naturally, the prevalence of forest (27 species, 26.47 %) of the species complex (light-coniferous forest, dark coniferous forest, nemoral), dominated by species of light coniferous-forest group (17 species, 16.67 %), which is consistent with the data for flora The Yenisey Sayans [9]. A certain contribution is made by the steppe (19 species, 18.63 %), forest-steppe (14 species, 13.73 %), the plurizonal (14 species, 13.73 %), Montana (12 species, 11.76 %) groups, the Arctic-Alpine and Alpine together constitute 12 species (11.76 %), anthropochoric - 4 species (3.92 %).

Acknowledgements
The reported study was funded by Russian Foundation for basic Research, Government of Krasnoyarsk Territory, Krasnoyarsk Regional Fund of Science, to the research project 18-44-240006 “Natural and urbanized flora of the Yeniseysk Siberia”.

References
[1] Krasnoborov I M 1976 *High-altitude flora of the Western Sayan* (Novosibirsk: Science)
[2] Kuvaev V B 1980 *The altitude distribution of plants in the mountains of Putoran* (Leningrad: Science)
[3] Kuminova A V 1960 *Vegetation cover of Altai* (Novosibirsk: Science)
[4] Malyshev L I 1965 *High-altitude flora of the Eastern Sayan* (Moscow; Leningrad: Science)
[5] Yurtsev B A 1968 *Flora Suntar-Hayat: Problems of the history of high-altitude landscapes of North-Eastern Siberia* (Leningrad: Science)
[6] Malyshev L I and Peshkova G A 1984 *Features and genesis of the flora of Siberia (Cisbaikalia and Transbaikalia)* (Novosibirsk: Science)
[7] Polozhy A V 1965 On the meaning and methods of studying the history of flora *Bulletin of Sib. Dep. Academy of Sciences of the USSR* **2(8)** 3-9
[8] Revushkin A S 1988 *Altai Alpine Flora* (Tomsk: Publishing house of Tomsk university)
[9] Stepanov N V 2016 *Vascular plants of the Yenisei Sayan* (Krasnoyarsk: Siberian Federal University)
[10] Sheremetova S A 2016 *Flora of the Tom River Basin: composition, structure, transformation, spatial organization* (Kemerovo)
[11] Kurbatsky V I 2007 Relict elements in the flora of the Republic of Khakassia *Measurement System based on materials of Herbarium named after M.A. P. N. Krylov of Tomsk state university* **98** 25-32
[12] Larionov A V, Ermakov N B and Polyakova M A 2015 *Steppe vegetation of Khakassia: diversity and ecology* (Abakan: Publishing house of Katanov Khakass State University)