The Russian Caucasus Xerophyte Gene Protection

R S Magomadova¹, M A-M Astamirova¹, A S Abdurzakova¹, E Sh Dudagova¹, S A Israilova¹, Kh R Khanayaev¹, B A Khasueva¹

¹Natural faculty
Chechen State Pedagogical University
Grozny, Russia

Abstract. The paper provides a scientific and practical justification of the need to preserve the flora gene pool. International and federal legal documents justifying the need for drawing up and keeping Red Lists are specified along with the Methodical Recommendations for Keeping Red Lists, considering by the constituent entities of the Russian Federation in the preparation of relevant regional publications. The total number of the Russian Caucasus xerophytes is specified – 1,018 vascular plant species (ferns, gymnosperms, angiosperms) belonging to 291 genera and 65 families; a consolidated list of species included in the Red Lists of the Russian Federation and 10 subjects of the Russian Caucasus is given, including 368 species (155 genera and 54 families), 118 of which are protected at the federal level. For the flora of each of the entities considered, the total number of xerophilic species, their representation in federal and regional publications, as well as the percentage of species included in the regional Red Lists are indicated. In the study area, 76 endemic and 17 relict species need protection. Three promising areas have been identified where federal-level SPNRs can be arranged to preserve xerophilic floristic complexes.

1. Introduction
Xerophytes are a part of biological diversity, a specific group of plants formed as a result of adaptive evolution under the action of one of the most critical environmental factors – water deficiency. This factor caused a spectrum of adaptations, as a result of which, among systematically different groups of species, a great variety of adaptive anatomical and morphological structures and physiological features emerged that allowed them to withstand unfavorable environmental conditions of water deficiency, from almost complete drying and falling into suspended animation to an extremely short vegetation period in ontogenesis. These species currently account for about a quarter of the Russian Caucasus flora, occupying their specific ecological niches, where, along with a lack of water, other environmental factors also act – high insolation, stony, sandy, clayey, and salty substrates, climatic features, altitude, etc. [1].

2. The research object and techniques
The research object was the xerophyte species of the Russian Caucasus flora. The paper is based on the field research performed in the territory of the Russian Caucasus in 2009-2019; as a result of the research, as well as an analysis of the herbarium fund and literature sources, an extensive herbarium material has been collected. To draw up an annotated list of the flora studied, the herbarium funds of the Russian Federation and scientific institutions of the North Caucasus have been studied. The flora specifics were determined by typical comprehensive analysis. The scientific and theoretical basis of
the study is the monotypic concept of the species. Latin names are given according to the S.K. Cherepanov summary [2], except for some taxa in the rank of genus, adopted in the Flora of the North Caucasus [3].

3. Results and discussion

The Russian Caucasus flora is original due to the peculiarities of its historical development. Its gene pool has been formed in the course of a long evolution and currently ensures the possibility of the existence of species populations in the present-day physical and geographical environment. However, this environment undergoes significantly anthropological changes, which leads to the extinction of not only local populations but also entire plant associations.

Preserving the gene pool of the flora, especially the regional one, is extremely important. On the one hand, this is associated with insufficient knowledge of the beneficial properties of most plants, and on the other hand, with the possibility of using the gene pool of the flora to create economically valuable plant species and varieties. In most cases, regional floras carry information about the area history in the past geological epochs, and the complete preservation of their phytodiversity is of great theoretical importance.

The species extinction is natural. Each species lives for a certain period and, ultimately, disappears. Such dying species are also found in the Russian Caucasus flora. However, the species extinction is largely accelerated by humans. Human economic activities – developing new cultivable surfaces, massive procurement of medicinal feedstock, intensive grazing – are the main factors leading to a strong reduction in the ranges of many plant species and, ultimately, the extinction of some of them.

The gene pool protection is based on the need to preserve the flora in its entirety for scientific and practical purposes. Its protection is an indispensable condition for the rational use of plant resources and the reconstruction of the vegetation cover. In the rich and diverse Russian Caucasus flora, not all species are equally threatened with extinction or a significant reduction in their range. Therefore, for practical protection purposes, we have identified a part of the flora, the list of which includes 368 species.

Currently, to solve the problem of protecting rare plant (and animal) species, a system of their protection at the federal and regional levels has been developed. The protective measures algorithm is as follows: creating a list of plants to be protected; including the protected species in the regional (or federal) Red List; creating reserves in places of the greatest concentration of plants requiring protection.

The main task of the Federal Red List is monitoring and protecting the species of greatest risk and those of international importance. The powers of the Red Lists of the federation entities cover the protection of the regional significance species, including the federal significance ones. This work is performed in a coherent manner, which allows changing the status of the species from federal to regional and vice versa if required [4].

Several documents of international and federal significance form the legal basis for creating and keeping the Red Lists. These are, primarily, the Convention on Biological Diversity [5] ratified by the Russian Federation in 1995; Strategic Plan for the Conservation and Sustainable Use of Biodiversity for 2011-2020 [6]; Targets of the Conservation and Sustainable Use of Biodiversity [7]; Decree of the Government of the Russian Federation On the Red List of the Russian Federation dated February 19, 1996; Federal Law on Environmental Protection No. 7-FZ dated January 10, 2002; The Strategy for the Protection of Rare Species of Animals, Plants, and Fungi approved by Order of the Ministry of Natural Resources of Russia No. 323 dated 4/6/2004; the Russian Federation Strategy and Action Plan for the Conservation of Biological Diversity [8], etc.

The Ministry of Natural Resources of the Russian Federation has prepared special Methodical Recommendations for Keeping the Red List of a Constituent Entity of the Russian Federation [9] determining the main actions on keeping the regional Red Lists, their regulatory and legal support, scientific and methodological foundations of their drawing up, the procedure for including the protected objects, the structure of the lists of protected species, design, publication, and distribution of
the Red Lists, and special measures for the protection and restoration of flora and fauna species included in the Red Lists.

These recommendations define the criteria by which the animal or plant species are included in the regional Red Lists, one of which is “... narrowly endemic and endemic species that make up the specifics of natural and climatic zones within the administrative territory, as well as naturally rare species inhabiting the range border” (p. 10). In the case of narrow-range species, one can talk about the preservation of the global gene pool within the federal constituent entity. It is believed that the larger the region, the more important it is for nature protection. The exception is some relatively small regions with exceptional biodiversity and an abundance of endemic species, including the Russian Caucasus.

The Russian Caucasus comprises 9 constituent entities of the Russian Federation – the Krasnodar Territory, the Republic of Adygea, the Stavropol Territory, the Karachay-Cherkess Republic, the Kabardino-Balkar Republic, the Republic of North Ossetia - Alania, the Republic of Ingushetia, the Chechen Republic, and the Republic of Dagestan, as well as the southern territories of the Rostov region and the Republic of Kalmykia (Fig. 1).

The flora of the listed entities differing in soil, climatic, and other conditions comprises 65 to 317 xerophilic species, among which there are many rare, relict, endemic, as well as scientifically and economically valuable species subject to strict protection. For the flora of each of the entities under consideration, the total number of xerophilic species, their representation in federal and regional publications, as well as the percentage of species (of the total number of xerophytes in specific areas) included in the regional Red Lists are specified (Table 1).

![Figure 1. Administrative Division of the Russian Caucasus Territory.](image-url)

In the study area, 76 endemic and 17 relict species recommended for inclusion in the regional Red List need protection. Three promising areas have been identified where federal-level SPNRs can be arranged to preserve xerophilic floristic complexes, which are shown in Figure 2.
Figure 2. The System of the Russian Caucasus SPNRs, on the Territory of which Xerophilic Phytocenoses and Floristic Complexes are Located.

1. The first territory is the Stavropol Upland. Reserves of xerophilic complexes are concentrated in the Stavropol, Beshpagshir, and Prikalausky Heights. Here are the habitats of xerophilic endemic species *Psephellus annae* and *Erodium stevenii*, as well as a number of xerothermic relics: *Alyssum obtusifolium*, *A. rostratum*, *Artemisia caucasicai*, *Astragalus albicaulis*, *Calophaca wolgarica*, *Caragana mollis*, *Crambe koktebelica*, *C. pinnatifida*, *Crocus speciosus*, *Globularia punctata*, *Iberis taurica*, *Linum tauricum*, *Medicago cancellata*, *Scabiosa isetensis*, *S. micrantha*, *S. rotata*, *Sternbergia colchiciflora*, *Tetradiclis tenella*, *Th. daghestanicus*, *Th. pallasianus*, etc. The mentioned geographical territories belong to the xerothermal flora refugia, where the interglacial flora remains have been preserved [1, 10].

2. The second promising territory to arrange protected areas is the Cretaceous spurs of the Pastbishchny Khrebet system (Borgustan, Dzhinalsky, Kabardin, Darinsky), as well as Kavminvod laccoliths. To date, there is not a single area with the status of a reserve or botanical reserve there; there is a single complex reserve Kumagorsky (Mineralovodsky district). The laccolithic mountains Beshtau, Byk, Verblyud, Dzhutsa, Zheleznaya, Zmeika, Zolotoy Kurgan, Lysaya, Mashuk, Medovaya, Ostraya, Razvalka, Tupaya, Sheludiyava, Yutsa, Kinzhal, Kukurtly have been declared natural monuments [11]. From the protection efficiency point of view, natural monuments are ineffective; their status should be raised to at least botanical reserves, and in some areas, a protected regime should be introduced. Such promising areas are Mount Beshtau, as well as the Borgustan Ridge from Mount Medvedka to Mount Monakhova Peshchera [12].

Among the endemic species, this area is inhabited by the local endemic of the Dzhinalskiy Ridge – *Elytrigia dshinalica* and those with wider ranges such as *Asphodeline tenuior*, *Centauraea scirpszinskii*, *Crambe cordifolia*, *Galanthus angustifolius*, *Genista angustifolia*, *Gypsophila globulosa*, *Haplophyllum ciscaucasicum*, *Papaver albertii*, *P. paczoskii*, and *Xathobrychis vassilczekoi*. There are also numerous xerothermal relics such as *Artemisia caucasicai*, *A. salsoloides*, *Asphodeline lutea*, *A. taurica*, *Astracantha aurea*, *Caragana frutex*, *Caragana grandiflora*, *C. mollis*, *Chamaecytisus wolfii*, *Clausia aprica*, *Crambe koktebelica*, *Hedysarum sericeum*, *H. tauricum*, *Lamira echinocephala*, *Leopoldia tenuiflora*, *Linum tauricum*, *Matthiola
caspica, Muscari szovitsianum, Ononis pusilla, Papaver ocellatum, Prometheus pilosum, Rhus coriaria, Rinderia tetrapsis, Roemeria refracta, Sedum stoloniferum, Sternbergia colchiciflora, Thymus daghestanicus, and Th. Markhotensis [13].

3. The third promising, most saturated with endemic species area is Vnutrigorny Dagestan. It is the habitat of local endemics such as Allium mirzajevii, Astragalus fissularis, Cephalaria charadzeae, Convolvulus ruprechtii, Festuca primae, Hedysarum daghestanicum, Jurinea ruprechtii, Limoniopsis oweriniti, Muehlenbergella oweriniana, Onobrychis daghestanica, Psephellus andinus, P. boissieri, P. czerepanovii, P. galushkoi, Pulsatilla andina, Scabiosa gumbetica, Scutellaria daghestanica, S. glanulosa, Seseli alexeenkoi, Soosnovskaia ruprechtii, and Tanacetum akinfievii. Euryendemics are also numerous: Allium gunibicum, Alyssum andinum, A. daghestanicum, Artemisia daghestanica, Asperula alpina, Campanula daghestanica, Cephalaria daghestanica, Festuca rupestris, Iris timofejewii, Matthiola daghestanica, Cephalaria daghestanica, Scutellaria daghestanica, S. raddeana, and Stipa daghestanica.

Regional Red Lists have been published in all regions, the protected plant species of which contain a considerable number of xerophytes. In general, 368 xerophilic species have been taken under protection in the regions, of which 118 are protected at the federal level.

Table 1. List of Protected Xerophytes of the Russian Caucasus Flora.

| Red Lists of the RF and the Federation Entities/year of publication | RF2008 | RA2012 | KT2017 | RR2014 | KC2013 | ST2013 | RK2014 | KB2000 | NO1999 | RI2006 | CR2007 | RD2009 |
|-------------------------------------------------------------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Total                                                      | 118   | 45     | 159    | 24     | 45     | 151    | 34     | 55     | 42     | 61     | 84     |
| Total xerophilic species of Russian Caucasus flora in the Red Lists | 192   | 119    | 369    | 48     | 102    | 317    | 65     | 79     | 105    | 88     | 158    | 176    |
| % xerophytes in the total number of protected species        | 61    | 38     | 43     | 50     | 44     | 48     | 48     | 48     | 52     | 48     | 39     | 48     |

1 RF – the Russian Federation; RA – the Republic of Adygea; KT – the Krasnodar Territory; RR – the Rostov region (Azov, Kagalnitsky, Zernograd, Egorlysky, Tselinsky, Peschanokopsky, Veselovsky (southern part), Bagaevsky (southern part) districts); KC – the Karachay-Cherkess Republic; ST – the Stavropol Territory; RK – the Republic of Kalmykia (Yashultinsky, Gorodovikovsky districts); KB – the Kabardino-Balkarian Republic; NO – the Republic of North Ossetia-Alania; RI – the Republic of Ingushetia; CR – the Chechen Republic; RD – the Republic of Dagestan

f – species included in the Federal Red List of the Russian Federation (2008)
r – species included in the regional Red Lists of the Federation entities
4. Conclusion

The Russian Caucasus flora of xerophytes is represented by 1,018 species of vascular plants (ferns, gymnosperms, angiosperms) belonging to 291 genera and 65 families. They are represented mainly by euxerophytes. The Red List of the Russian Federation and 10 constituent entities of the Russian Caucasus includes 368 species (155 genera and 54 families), 118 of which are protected at the federal and regional levels.

The considered floras of the Russian Caucasus entities differing in soil, climatic, and other conditions comprise 65 to 317 xerophilic species, among which there are many rare, relict (16), endemic (76), as well as scientifically and economically valuable species subject to strict protection. For the flora of each of the entities under consideration, the total number of xerophytes in specific areas, as well as the percentage of species (of the total number of xerophytes in specific areas) included in the regional Red Lists are specified.

Three promising areas have been identified where federal-level SPNRs can be arranged to preserve xerophilic floristic complexes.

5. References

[1] Taysumov M A, Magomadova R S 2017 Xerophytes of the Russian Caucasus: general characteristics, classification and multicomponent analysis (Makhachkala) 225 p
[2] Cherepanov S K 1995 Vascular Plants of Russia and Neighboring States (SPb.: Mir and family) 95 990 p
[3] Galushko A I 1980 Flora of the North Caucasus (Rostov: RGU) 1978-1980 T 1 1978 317 p T 2 1980 350 p T 3 1980 327 p
[4] Prisyazhnyuk V E 2010 General results of work in the field of maintaining the regional Red Data Book in Russia (assessment of the last 10 years of work) Problems of maintaining the Red Data Books of the subjects of the Russian Federation. Materials of the International Seminar (November 10-11, 2010, Kurgan) pp 13-21
[5] 1992 Convention on Biological Diversity (Rio de Janeiro) 23 p
[6] Strategic plan for conservation and sustainable use of biodiversity for 2011-2020 and the Aichi targets for conservation and sustainable use of biodiversity Conference of the Parties to the Convention on Biological Diversity, tenth meeting (Nagoya) 17 p
[7] 2014 Strategy and Action Plan for the Conservation of Biological Diversity of the Russian Federation (M) 256 p
[8] 2006 Guidelines for maintaining the Red Book of the constituent entity of the Russian Federation (M) 20 p
[9] Ivanov A L, Ivanov A A, Chimonina I V 2010 Endemics and relics of the flora of the Stavropol Upland and their significance for constructing a model of florogenesis in the central part of the North Caucasus (Stavropol: SSU Publishing House) 147 p
[10] Krokhmal A G 2006 Spatial structure of specially protected natural areas of the North Caucasus South of Russia: ecology, development 4 pp 63-68
[11] Ivanov A L, Utenkova S N 2003 Endemics and relics of cretaceous ridges and laccoliths of the Caucasian Mineral Waters and their significance for constructing a model of florogenesis in the central part of the North Caucasus (Stavropol: SSU Publishing House) 203 p
[12] Taysumov M A, Magomadova R S, Abdurzakova A S, Astamirova M A-M, Israilova S A, Khasueva B A, Khanaeva Kh R 2017 Analysis of the endemism of the flora of xerophytes in the Russian Caucasus (South of Russia: Ecology, Development) Vol 12 1 pp 199-205
[13] Taysumov M A, Magomadova R S, Abdurzakova A S, Astamirova M A-M, Khasueva B A, Umaeva A M 2017 Analysis of the relict nature of the xerophyte flora of the Russian Caucasus Bulletin of the Dagestan State Pedagogical University series "Natural and Exact Sciences" T 11 1 pp 64-73