Analysis of Oreoxerophite Flora within Chechnia

M A Taisumov, M U Umarov, M A-M Astamirova, A S Abdurzakova, R S Magomadova, E R Baybatyrova

Academy of Sciences of the Chechen Republic, Etc. M. Esambaeva, 13, Grozny, 364024, Russia
Chechen State Pedagogical University, st. Kievskaya, 33. Grozny, 364037, Russia

E-mail: musa_taisumov@mail.ru

Abstract. The article provides information on xerophilous vegetation and its classification from the point of view of ecology, physiology and morphology. The localization of the oeroxerophyte belt above the forest belt along river valleys and in the arid basins of the republic was noted. The vegetation cover here is complex and consists of numerous microgroups, which differ sharply from each other in their coenotic character, since they develop in arid conditions on mountain slopes characterized by a wide variety of microrelief elements. The belt is not continuous, it is located in spots in a chain of arid basins located between the Skalisty and Lateral ridges; the most significant areas are in the upper reaches of the Sharo-Argun and Chanty-Argun, but it reaches its greatest development within arid basins, occupying all the southern mountain slopes. A classification of xerophytes in the flora of the Russian Caucasus has been developed. The most important representatives of oeroxerophytes of various substrates and plant communities are indicated.

1. Introduction
The vegetation cover of the highlands obeys the laws of vertical zoning. In the Caucasus mountains, many researchers, above the upper forest boundary, distinguish the following plant belts: oeroxerophytes, subalpine, alpine, subnival, and nival [1, 2].

Xerophytes are a part of biological diversity, a special group of plants formed as a result of adaptive evolution in the direction of action of one of the most important environmental factors of the external environment - water scarcity. This factor caused a whole fan of adaptations, the result of which was the emergence of a wide variety among systematically different groups of species of adaptive anatomical and morphological structures and physiological characteristics, which made it possible to endure unfavorable conditions of moisture deficit in the external environment, from almost complete drying out and falling into anabiosis to an extremely short contraction, growing season during ontogenesis. These species currently make up about a quarter of the flora of the Russian Caucasus, occupying their own specific ecological niches, where, along with a lack of moisture, other environmental factors also act - increased insolation, stony, sandy, clay and saline substrates, climatic features, altitude and etc.

By solving the most acute global ecological problem of our time, associated with the study, assessment and conservation of biodiversity, important theoretical and practical results are achieved that allow tracing the prospects for the development and operation of phytobiota. Within the framework of the study of the above group of plants, it is relevant to complete inventory of the flora of...
xerophytes and, on this basis, to carry out its multicomponent analysis according to systematic, phytoecenotic, biomorphological and chorological parameters, to obtain information about the presence of relict and endemic species, and their localization. This information will serve as the basis not only for further theoretical phloro
genetic constructions, but also for solving problems of species protection and rational use of plant resources.

Due to the non-specificity of adaptations, the division of plants into groups of xerophytes often causes difficulties, but, nevertheless, the main directions adaptations: in the deserts of the temperate zone, this is xerophytization and ephemerization, in the highlands - cryophilization and sclerification. Xerophytization and sclerification are derivatives of arid evolution in general, and cryophilization (and with it psychrophitization) are mountain evolutionary directions associated with orogenesis [3].

Based on the above, we have developed a classification of xerophytes in the flora of the Russian Caucasus, which is based on the following principles:

1. Evolutionary. There are three groups of xerophytes, the evolution of which is confined to different hypsometric territories, which is associated not least with the effect of the temperature factor:
   - Plain (plantes planitieris) - plants adapted to habitat on plains, lowlands and foothills with a large amount of positive average annual temperatures (thermoxerophytes);
   - Mid-mountain (plantes montanis mediis) - plants that live in mid-mountains with an average sum of positive average annual temperatures (cryoxerophytes);
   - Alpine (plantes montanis altis) - plants that live in high mountains with a low sum of positive average annual temperatures (cryomesoxerophytes).

2. Anatomical-morpho-physiological. According to this principle, all xerophytes of the studied flora, according to the classification of P.A. Henkel [4], are subdivided into 5 groups:
   - Euxerophytes (plantae euxerophytis) are true xerophytes that can tolerate deep dehydration. Subdivided into proper euxerophytes (plantae euxerophytis xero) and cryoxerophytes (plantae euxerophytis cryo);
   - Hemixerophytes (plantae hemixerophytis) - plants with a highly developed deeply ramified root system;
   - Refugioxerophytes (plantae refugioxerophytis) - desert ephemera (plantae ephemeros) and ephemeroids (plantae ephemeroideis), the latter are subdivided into spring ephemeroideis (ephemeroides vernalis) and autumn ephemeroideis (ephemeroides autumnalis), avoiding drought;
   - Stipaxerophytes (plantae stipaxerophytis) - narrow-leaved grasses with curling leaves when the heat comes, with a powerful root system;
   - Succulents (plantae succulentis) are plants that store moisture in fleshy organs with a developed water-storing parenchyma. Subdivided into stem succulents (plantae caulis succulentis) and leafy succulents (plantae foliis succulentis). Leafy succulents are subdivided into xerophilic (plantae foliis succulentis: xero) and cryophilic (plantae foliis succulentis: cryo);

Poikyloxerophytes are not included in the classification, since they are absent among the higher vascular plants in the study area;

3. Edaphic. According to their habitat, mainly on a certain substrate, xerophytes are divided into 5 groups:
   - Soloxerophytes (plantes solixerophytis) - living on a developed soil cover, usually in the steppes;
   - Calcixerophytes (plantes calcixerophytis) - preferring limestone substrates. These can be limestone outcrops or carbonate fine earth;
   - Arenoxerophytes (plantes arenixerophytis) - inhabitants of sandy substrates, including open sands, dunes, coastal dunes;
   - Acidixerophytes (plantes acidixerophytis) - species that live on outcrops of acidic rocks. These are mainly upland xerophytes, mostly petrophets;
   - Argyloxerophytes (plantes argyloxerophytis) - species that live on outcrops of clay, clay hills and slopes;
- Haloxerophytes (plantae haloxerohytis) - inhabitants of saline substrates - salt licks and salt marshes, including clay and sand. Three subgroups are distinguished among them: euhalophytes, crinoghalophytes and glycohalophytes (according to the classification of AA Shakhov [5, 6].

It should be noted that in many cases there is no strict distinction between the designated types of xerophytes, since some species can exhibit tolerance and occur at different altitudes and substrates, which is due to their ecological plasticity.

![Figure 1. The classification scheme of xerophytes in the flora of the Russian Caucasus.](image)

2. Materials and research methods
The object of the study was the flora of the oreoxerophytes of Chechnya. As a result of research, extensive herbarium material has been collected. To compile an annotated list of flora, the herbarium funds of the V.I. V.L. Komarov (LE), as well as the herbarium of other institutions: Dagestan State University (LENU), Mining Botanical Garden of the Dagestan Scientific Center of the Russian Academy of Sciences (DAG), Ingush State University (INGU), Kabardino-Balkar State University named after I. H.M. Berbekov (KBHG-AUBSN), Stavropol State University (SPI), Chechen State Pedagogical University. The scientific and theoretical basis of the work is the monotypic concept of the species. Latin names are given in accordance with S.K. Cherepanov [7], except for the names of some taxa in the rank of genus, adopted in the «Flora of the North Caucasus» [8].

3. The discussion of the results
The belt of oreoxerophytes (mountain xerophytes) covers areas occupied by xerophilous vegetation. It extends above the forest belt, represented by arid depressions and arid southern slopes located beyond the Rocky Range. Xerophilous vegetation is especially clearly represented along Chanty-Argun (in the Ushkaloi-Itum-Kale region and further up the river gorge), to a lesser extent along Sharo-Argun. Its elements are also found along the Gekhi and Fortanga rivers. The vegetation of xerophytes sharply differs from that of the lower and higher belts (forest and subalpine). Here are the remains of
vegetation from a drier (xerothermal) era, preserved in the most protected places with the least rainfall and on slopes warmed by the sun. A variety of plant groups is characteristic. In the arid basin along the Chanty-Argun, vast areas are occupied by shiblyak, in places difficult to pass - thorny shrub thickets mainly from *(Paliurus spina-christi)* [9, 10].

The typical shiblyak is most clearly represented in the arid basin along the river. Chanty-Argun (between Ushkala and Itum-Kale). On the southern slopes, thickets of thorny and other shrubs are widespread here: *Astragalus denudatus = Tragacantha denudata*, *A. aureus = T. aurea*, *A. caucasica = T. caucasica*. Overgrowths of *Berberis vulgaris* and *Spiraea hypericifolia* are found throughout the entire basin. Among them, *Cerasus incana* is often found in Chanty-Argun, *Cotoneaster integerrimus*, and *C. meyeri*, and *Rhamnus pallasii* is ubiquitous. In some places, there are small stands of *Cotinus coggyria*, less often *Celtis glabrata*. Small thickets of *Colutea orientalis* are common on the rocks. There are also *Ephedra procera*, *Crataegus monagyna*, *Juniperus oblonga*, *Amelanchier ovalis*, and the typically steppe species *Amygdalus nana* [9, 10].

In addition to shrubs, there are many grasses and shrubs in the arid hollows. There are especially a lot of representatives of the family of lucidaceae - *Salvia daghestanica*, *S. kaznetzovii*, *Thymus daghestanicus*, *Teucrium chamaedrys*, *T. polium*, *Nepeta biebersteiniana*, rarely *Hyssopus angustifolius* and *Betonica ossetica*. *Astragalus haesitabundus*, *Onobrychis bobrivii = Xanthobrychis bobrovii*, *Cleome daghestanica*, *Medicago daghestanica*, *Convolvulus lineatus*, *Linum orientale*, *Alexitoxicum funebre*, *Onosma armeniaca*, *Dianthus cretaceus*, *Muscaria palequa*, *Veron. Many Gallium ruthenicum*, *Botriochloa ischaemum*, *Stipa capillata*, *S. caucasica*. *Koeleria gracilis*, *Festuca valesiaca*, *Medicago falcata*, *Chondrilla juncea*, *Herniaria besseri = H. incana*, *Scleranthus annuus*, *Euphorbia szovitsii* are widespread. On rocky places, *Parietaria judaica*, *Sropheulia rupestris*, *Galium brachyphyllum*, *Onosma caucasica*, *Campanula sarmatica*, *Rumex hastifolius*, etc. are common. The listed grasses and dwarf shrubs are found in thinned variants of the scabard and on glades, rarely forming typically friganoid groups. *Fumana procumbens*, *Stipa caucasica*, *Psephellus prokhanovii*, *Hypericum asperuloides*, *Gentiana grossheimi*, *Campanula andina*, *Symphyandra pendula*, *Gypsophila tenuifolia* grow from mountain xerophytes on the rocks of the Rocky Range [9, 10].

Although the arid basins have some similarity in the vegetation cover, each of them differs in a specific original set of species. On the whole, the oeroxerophyte belt is of particular interest, since it covers territories that are refugia, the flora of which is especially rich in relict and endemic species [9, 10].

The oeroxerophyte belt is located south of the Rocky Range, along the river valleys above the forest belt. he xerophilous vegetation, concentrated in arid basins, the largest of which is Itum-Kalinskaya along the river. Argun. Smaller depressions are located along the rivers. Gekhi and Sharo-Argun. In these depressions, large areas are occupied by shrub thickets - shiblyak, as well as freegan, consisting of shrubs and semi-shrubs - *Tragacanta aurea*, *T. denudata*, *Thymus daghestanicus*, *Scutellaria oreophila*, *Hyssopus angustifolius*. Shiblyak is represented by thickets of *Paliurus spina-christi* with the participation of *Spiraea hypericifolia*. Thickets of *Berberis vulgaris* with an admixture of *Cerasus incana* and *Rhamnus pallasii* are common. In the Itum-Kalinskaya arid basin, the shiblyak includes *Colutea orientalis* and *Celtis glabrata* [9-12].

Among the oeroxerophytes of the study area, calciphilic species are represented by 82 species, including *Juniperus sabina*, *Ephedra procera*, *Stipa caucasica*, *Rumex hastifolius*, *Minuartia biebersteinii*, *Silene spargulifolia*, *S. linearifia*, *Petroccla hoeftiana*, *Gypsophila acutimetolia*, *Medicago daghestanica*, *Astracantha aurea*, *A. denudatus*, *Mandenovia komarovii*, *Onosma armeniaca*, *daghestanica*, *Campanula argunensis*, *Psephellus prokhanovii* etc. [12].

The steppe formations are formed by such representatives as *Stipa lessingiana*, *S. pulcherrima*, *Elytrigia stipifolia*, *Silene compacta*, *Draba styralis*, *Rosa pulverulenta*, *Astragalus galegiformis*, *Goniolimon tataricum* and many others - only 93 in
4. Conclusion

Thus, the oeroxerophyte belt is localized above the forest belt along river valleys and in arid basins of the republic. The vegetation cover here is complex and consists of numerous microgroups, which differ sharply from each other in their coenotic character, since they develop in arid conditions on mountain slopes characterized by a wide variety of microrelief elements. The belt is not continuous, it is located in spots in a chain of arid basins, between the Rocky and Side ridges, the most significant areas are in the upper reaches of the Sharo-Argun and Chanty-Argun, but this belt reaches its greatest development within the arid hollows, occupying all the southern mountain slopes.

In this belt, thorny cushion biomorphs are widespread, which form such species as *Astracantha aurea, A. denudata, A. caucasica*, covering most of the slopes of arid basins; less often, in the eastern part - *A. caspica, A. microcephala*; in Dagestan - *Dendrobrychis cornuta*. The outcrops of parent rocks are associated with polydominant phytocenoses with the participation of *Juniperus sabina*, which also include other shrubs (*Ephedra procera, Spiraea hypericifolia, Berberis vulgaris*), herbaceous plants (*Nepeta biebersteiniana, Teucrium orientalis, some Salvia caneshestanus*, Thymicus and others) geophytes and theophytles, about 80 species in total.

In the arid basins of the Eastern Caucasus, the composition of upland xerophytes is determined by parent rocks. On limestone slopes, shiblyak from *Ephedra procera, Spiraea hypericifolia, Rhamnus pallasii, Dendrobrychis cornuta*, etc. is developed, from herbaceous plants - *Convolvulus ruprechtii, Salvia daghestanica, Scabiosa gumbetica*, etc., mainly on the slopes of acidic rocks - *Paliurus spinachristi, Astragalus aureus*, from the herbaceous *Stipa daghestanica, Limoniopsis overinii, Salvia beckeri*, etc.

5. References

[1] Grossheim A A 1948 Vegetation cover of the Caucasus (M.: Publishing house MOIP) 267 p
[2] Shkhagapsoev S Kh 2003 Analysis of the petrophytic floristic complex of the western part of the Central Caucasus (Nalchik: Publishing Center El-Fa) 220 p
[3] Agakhanyants O E 1981 Arid mountains of the USSR (M.: Mysl) 270 p
[4] Henkel P A 1975 Plant physiology (M.: Education) 335 p
[5] Shakhov A A 1950 Adaptation to soil salinity in plants *Plants and environment* (M.-L.) pp 116-141
[6] Shakhov A A 1956 Salt tolerance of plants (M.) 552 p
[7] Cherepanov S K 1995 Vascular Plants of Russia and Neighboring States (SPb.: Mir and eemya) 95 990 p
[8] Galushko A I 1978-1980 Flora of the North Caucasus (Rostov: RGU) T 1 317 p T 2 350 p T 3 327 p
[9] Galushko A I 1975 Vegetation cover of Checheno-Ingushetia (Grozny: Chechen-Ingush book publishing house) 118 p
[10] Taysumov M A 2019 Trees and shrubs of the Chechen Republic (Makhachkala) 305 p
[11] Umarov M U, Taisumov M A 2011 Abstract of the flora of the Chechen Republic (Grozny) 152 p
[12] Taysumov M A, Omarkhadzhieva F S 2012 Analysis of the flora of the Chechen Republic (Grozny: AN Chechen Republic) 320 p