

# Upland Xerophyte Communities of Valley Landscapes of the Upper Reaches of the Chanty-Argun River (Mountainous Chechnya, Eastern Caucasus)

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**Abstract.** The paper discusses the features of plant communities of the upland xerophyte complex of the valley landscape of the upper reaches of the Chanty-Argun River. Regularly repeating and interconnected with environmental factors phytocenoses of the Itum-Kalinsky semiarid basin are noted. The abundance of species, their distribution by elements of the lower and middle mountain relief and communities were determined by experts on the basis of field information. Peculiarities of mountain-steppe communities, factors of their spatial differentiation are revealed. The studied communities are rich in species and are of significant conservation interest. With our research, we sought to emphasize the regional specificity of the studied communities, due to geographical, ecological, cenotic, and historical features.

## 1 Introduction

Arid mountain ecosystems are distinguished by an extremely high degree of spatial heterogeneity. Vertical zonality and climatic features of slopes of different exposure determined the diversity of landscapes and ecosystems. Over a distance of several kilometers vertically and several tens of kilometers horizontally, all transitions are observed from the harsh arid conditions of continental deserts through mountain semi-deserts, steppes, meadows, forests, to the subnival and nival belt. The excess of heat and lack of moisture at the foot of the mountains is replaced by a relative excess of moisture and lack of heat at the tops. Features of the orography of mountainous countries determine the high rates of abiogenic transport in these landscapes [1].

Here, in the upper reaches of the Chanty-Argun River, there is the intermountain Ushkaloy-Itumkala semiarid basin, one of the most interesting areas of wide development of upland xerophytes of the Eastern and Central Caucasus. On the territory of the North Jurassic intramountain structural-erosive depression, in the "rain shadow" of the Lateral Range, along with typical mountain phytocenoses (forest, meadow subalpine, and others), there are communities of upland xerophyte complex. The spatial distribution of the last two

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is subject to the geographical laws of their localization as products of orographic-climatic conditions. The distribution of hemi- and euxerophyte vegetation within the basin is associated with the arid and relatively warm climate of the semi-arid low- and mid-mountain landscapes, as well as the nature of the relief.

All elements of the valley landscape - relief, climate (balance of heat and moisture), geological substrate, surface layer of the atmosphere, vegetation, etc. - are in complex interaction and interdependence, forming a single natural-territorial complex of the basin. The valley of the upper reaches of the Chanty-Argun itself is characterized by a stepped bed and an uneven height of eroded slopes (usually concave).

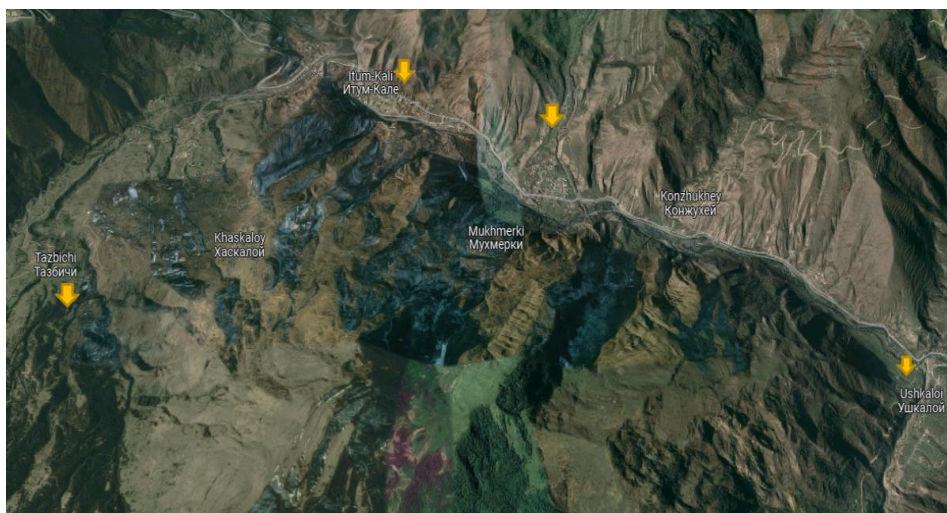
The upland xerophyte vegetation of the Ushkala-Itumkala basin is heterogeneous, it consists of separate formations that differ in floristic composition, structure, and seasonal rhythm of development. The differences are due to the conditions of the habitat, including the nature of the relief and the skeletal nature of the substrate, the composition of the rocks, the exposure and steepness of the slopes, the height of the terrain, and others.

The original belt variants of the upland xerophyte complex of the basin are the mountain-steppe, “**proshibljak**” (Mediterranean vegetation consisting of deciduous, often drought-resistant, shrubs and stunted trees) and “**phryganoid**” (sclerophyte sparse forest, shrub, shrub, thorny grass communities) [2-10]. The latter also includes tragacanthoid (thorn cushion species from the genus *Astragalus*) phytocenoses with the participation of characteristic euxerophytic dwarf shrubs and herbs. In the studied area, they gravitate towards rubble-stony substrates and eroded areas on well-heated slopes [11].

## 2 Research Methodology

The actual material for the work was the data collected by the authors during the reconnaissance expeditionary surveys of mountain landscapes in the upper part of the Chanty-Argun valley (2007-2017) of the Itum-Kalinsky district of the Chechen Republic.

The route method was used to study plant communities in key areas of the upland xerophyte natural complex of the Ushkaloy-Itum-Kala semiarid basin. The research concerned the elucidation of the peculiarities of the composition of the flora, ecological features and the structure of the most pronounced elements of vegetation in the vicinity of the villages of Ushkaloy, Kokadoy, Itum-Kale, Tazbichi (fig.1).



**Fig. 1.** Map of the studied areas of vegetation

### 3 Results and Discussions

The vegetation of the slope surfaces bordering the flat bottom of the arid basin of the Chanty-Argun is differentiated. It is due to the heterogeneity of the relief, exposure and soil-climatic conditions.

A successive change in the vegetation component of landscape belts occurs with an increase in absolute height. Climatic and soil-vegetative differences are especially significant in the lower parts of the slopes of the valley, where there is a noticeable redistribution of heat and moisture over the relief elements, redeposition of surface rocks. In addition, the contrast in the manifestation of local conditions is also associated with the composition of rocks. All this is reflected in the parameters of heat and moisture supply of habitats.

The climatic features of the upper slope surfaces, flowing in the free atmosphere, are smoothed out.

The general regularity of the vegetation cover of the extended Chanty-Argun valley is the widespread development of upland xerophyte communities on insolated, with excess warming up primary slopes of the eastern, southern (and close to it) exposures in the left bank of the river. In the right bank, in conditions of sufficiently moistened landscapes of the western macroslope of the river valley, mesoxerophyte formations of mountain meadow-steppe forbs and grasses predominate.

**Key area number 1.** A complex of meadow-steppe microcommunities and sparse xeromorphic forest-shrub groups. Slope, slightly inclined (4-10°) part of the extended river valley of the river. Chanty-Argun. It is characterized by a significant steppe formation of herbage on loose and well-permeable colluvial-deluvial deposits (near the village of Ushkaloy, h ~ 720 m above sea level).

A small strip (belt) of upland xerophytic vegetation with elements of “proshibljak” (*Berberis vulgaris* L., *Crataegus monogyna* Jacq., *Rhamnus pallasii* Fisch. & C.A. Mey., *Paliurus spina-christi* Mill., *Rosa canina* L., *Spiraea hypericifolia* L. and others) on stony, well-drained soils underlain by a colluvial plume.

As a structural part of the valley biocenosis, it is not always clearly expressed and characterizes the phytogenic-edaphotopic mosaic of the landscape, emphasizes the horizontal differentiation of the coenotic environment and the soil cover of the valley bottom. Uneven density and parcel heterogeneity of this facies are created by isolated tree-shrub groups and grass coenoelements in open areas among boulders and boulders. Their placement within the biocenosis is associated with small unevenness of the microrelief, different thickness of the soil cover, as well as the chaotic placement of coarse rock material here.

Herbal microphytocoenoses form: *Achillea millefolium* L., *Agrimonia eupatoria* L., *Astragalus buschiorum* Galushko, *A. haesitabundus* Lipsky, *Echium vulgare* L., *Festuca valesiaca* Gaudin, *Fragaria viridis* Weston, *Lotus corniculatus* L., *Salvia verticillata* L., *Sedum oppositifolium* Sims, *Teucrium polium* L. and others.

**Tragacanth communities** of thorny astragalus (*Astragalus denudatus* Stev.) on the left bank of the bedrock wall of the Chanty-Argun valley. These thermophyte and euxerophyte communities form the lowest belt of vegetation on the eroded rubble slopes adjacent to the valley floor. Soil and climatic conditions are the most extreme. For example, the Tragacanth occupies rocky and shale outcrops of bedrock, as well as habitats characterized by significant activity of exogenous processes and gravitational erosion.

**Key area number 2.** Tragacanthic (*Astragalus denudatus*) community of xeromorphic appearance with the participation of the bearded vulture (*Astragalus denudatus* – *Bothriochloa ischaemum* (L.) Keng.) on clayey/loamy soil with separate outcrops of shale (near the village of Itum-Kale; h ~ 820 m above sea level). Ledges of the floodplain terrace,

open areas in the lower part of the medium-steep (20-30°) slope with eastern exposure. Slopes of medium steepness (20-30°).

The shrub layer (1.2-1.8 m high) of the communities, in addition to the dominant, is composed of individual rare woody forms (*Cotoneaster integerrimus* Medik., *C. meyeri* Pojark., *Crataegus microphylla* K. Koch, *Berberis vulgaris* L., *Crataegus monogyna* Jacq., *Rhamnus pallasii* Fisch. & C. A. Mey., *Paliurus spina-christi* Mill., *Rosa canina*, *Spiraea hypericifolia*). The abundance indicators of these species increase in representatives of this group with increasing height (closer to the next belt of “proshibljak” vegetation).

The herbal component is represented by euxerophilic loose soddy grasses (*Bromopsis riparia* (Rehmann) Holub, *Elytrigia gracillima* (Nevski) Nevski, *Melica transsilvanica* Schur, *Phleum phleoides* (L.) H. Karst., *Stipa capillata* L.) and forbs (*Allium saxatile* M. Bieb. or *paniculatum*, *Artemisia chamaemelifolia* Vill., *Aster amellus* L., *Astragalus captiosus* Boriss., *Galatella dracunculoides* (Lam.) Nees, *Hylotelephium caucasicum* (Grossh.) H. Ohba, *Inula aspera* Poir., *Odontites vulgaris* Moench, *Onosma setosa* Ledeb., *Sempervivum pumilum* M. Bieb., *Thalictrum foetidum* L., *Teucrium orientale* L., *Verbascum thapsus* L., *Veronica propinqua* Boriss., etc.), as well as primitive shrubs (*Teucrium polium*, *Thymus marschallianus* Willd.). Low grasses and dwarf shrubs play a subordinate role.

**Key area number 3.** Prickly cushions on shales, which are represented by sparse tragacanth (total projective cover 10-15%) on weathering products of dense rock. They occupy medium and steeply inclined (from 30 to 40-45°) forms of erosion-denudation relief at the base of the slopes (lower third). Insolated areas of the south-south-eastern exposure of the erosional terrace of the root wall of the valley. It does not have its own sediment cover, the soils are not developed. The largest massifs are on the left bank, between the villages of Ushkala and Kokada (h ~ 730-750 m above sea level).

The floristic composition of this peculiar type of vegetation, in the form of open groups, is composed of a small number of characteristic, including xero-petrophytic species: *Allium saxatile*, *Artemisia campestris* L., *Astrodaucus orientalis* (L.) Drude, *Crepis sonchifolia* (M.Bieb.) C.A. Mey., *Elytrigia gracillima* (Nevski) Nevski, *Galium verum* L., *Melica transsilvanica* Schur, *Melilotus officinalis* (L.) Lam., *Onobrychis bobrovii* Grossh., *Onosma setosa* Ledeb., *Polygonum convolvulus* L., *Salvia canescens* C.A. Mey., *Scrophularia rupestris* M. Bieb. ex Willd., *Scutellaria raddeana* Juz., *Sedum subulatum* (C.A. Mey.) Boiss., *Silene saxatilis* Sims, *Trisetum rigidum* (M. Bieb.) Roem. & Schult., *Verbascum thapsus* L.

**Key area number 4.** “Shibljak” vegetation in the form of xerophytic light woodlands in the medial part of insolated sloping and moderately steep (20-40°) slopes. It is represented by sparse woody and herbaceous vegetation, which is formed in a relatively warm climate and insufficient moisture. In the low-mountain transeluvial landscape, it occupies a belt above the tragacanth. The “Shiblyak” complex is most pronounced in the area of the valley between the village Ushkaloy and Kokada (h ~ 800-840 m above sea level).

Thermophilic sparse upland xerophyte woody groups are characterized by low density; the height of the tree-shrub layer is 2.0-2.5 m. Among them are slope grass communities on fragmented mountain-steppe stony soils and products of destruction of rocks.

The number of edificatory species of the described woody thickets is small: *Berberis vulgaris* L., *Celtis glabrata* Steven ex Planch., *Cotoneaster meyeri* Pojark., *Crataegus monogyna* Jacq., *Ephedra procera* Fisch. & C.A. Mey., *Rhamnus pallasii* Fisch. & C.A. Mey., *Paliurus spina-christi* Mill., *Rosa canina* L., *Spiraea hypericifolia* L., *Ulmus minor* Mill. A.I. Galushko [8] also cites *Cerasus incana* (Pall.) Spach, *Colutea orientalis* Mill., *Cotinus coggygria* Scop., *Cotoneaster integerrimus* Medik.

Grass species of the low-mountain steppe complex are widely represented: *Veronica propinqua* Boriss.

**Key area number 5.** Mountain plant communities (*Botriochloa ischaemum* + *Herbae stepposae*) on soddy, thin mountain-chestnut gravelly soils underlain by clay shales. These mountain communities are thermophytic, dry variants of mountain-steppe vegetation, often with the participation of xerophilic deciduous shrub forms. They are characterized by different completeness of the tiered structure.

They occupy moderately sloping landforms (20-30°) at the base of the slopes, descending in the form of narrow overgrown ledges to the lower terrace (h ~ 820-830 m above sea level). Their largest arrays are confined mainly to the lower parts of the slopes and are found in the form of bands of the facies belt, small areas or spots among other phytocenoses.

Types of active floristic nucleus: *Astragalus captiosus* Boriss., *A. galegiformis* L., *A. haesitabundus*, *Coronilla varia* L., *Galium verum* L., *Jurinea arachnoidea* Bunge, *Stipa pulcherrima* K. Koch, *Veronica orchidea* Crantz, etc.

In the composition of this type of vegetation, species are noted that are common with low-mountain steppe phytocenoses.

**Key area number 6.** Low-mountain rich forb-grass communities on moderately inclined (20-30°) slopes of western points in the right-bank part of the Chanty-Argun valley. The soils are mountain-steppe, thin, small-stone, underlain by clay shales. Such habitats are well-drained, characterized by significant stepping of the herbage (near the village of Itum-Kale; h ~ 810-830 m above sea level).

The vegetation cover is characterized by a smooth change of facies series in the direction of the slopes. One-two-layer herbage is formed by steppe/mountain-steppe species from the group of mesothermal mesoxerophytes. The total projective cover is high – 80-90%.

Types of active floristic nucleus: *Alcea rugosa* Alef., *Alyssum alyssoides* (L.) L., *Arenaria serpyllifolia* L., *Astragalus captiosus* Boriss., *Galium verum* L., *Inula aspera* Poir., *Jurinea arachnoidea* Bunge, *Medicago glutinosa* M. Bieb., *Origanum vulgare* L., *Phlomis tuberosa* L., *Salvia verticillata*, *Scabiosa ochroleuca* L., *Stachys atherocalyx* K. Koch, *Teucrium orientale* L., *Teucrium polium* L., *Trifolium campestre* Schreb.,

The cereal component is represented by dry steppe species: *Bromopsis riparia* (Rehmann) Holub, *Elytrigia gracillima* (Nevski) Nevski, *Festuca valesiaca*, *Melica transsilvanica* Schur, *Phleum phleoides* (L.) H. Karst.

**Key area number 7.** Mid-mountain forb-grass (steppe) communities on mountain meadow-steppe soils of humus type. They occupy flattened slope surfaces of southern orientation (near the village of Tazbichi). The use of the herbage is for haymaking.

At an altitude of ~1250-1300 m above sea level, the appearance of these mesothermal oligodominant herbalists is determined by the types of belt vegetation.

The herbage is dominated by mesoxerophytic species, including *Betonica macrantha* K. Koch, *Centaurea abbreviata* (K. Koch) Hand.-Mazz., *Clinopodium vulgare* L., *Cruciata laevipes* Opiz, *Dianthus caucaseus* Sm., *Gentianella biebersteinii* (Bunge) Holub, *Gentiana septemfida* Pall., *Geranium sanguineum* L., *Leontodon hispidus* L., *Origanum vulgare* L., *Ranunculus oreophilus* M. Bieb., *Salvia verticillata*, *Scabiosa caucasica* M. Bieb., *Trollius ranunculinus* (Sm.) Stearn and other meadow-steppe species – inhabitants of warm, unevenly humidified ecotopes.

Of the grasses, *Agrostis tenuis* Sibth., *Bromopsis variegata* (M. Bieb.) Holub, *Koeleria albovii* Domin, *Festuca pratensis* Huds. are common, the latter species always predominating.

Regardless of the exposure and steepness, slope exposures of clay shales are quite well developed in the middle mountain belt. They are occupied by open groups of xero- and chasmopetrophyton from *Dianthus cretaceus* Adams, *Gypsophila elegans* M. Bieb.,

*Plantago atrata* Hoppe, *Rumex hastifolius* M. Bieb., *Sedum spurium* M. Bieb., *Silene saxatilis* Sims, *Veronica gentianoides* Vahl, *V. propinqua* Boriss.

## 4 Conclusions

The upland xerophytic complex of the Ushkaloy-Itumkala semiarid intramountain basin occupies significant areas in the lower and middle mountain steppe belts, where it is distinguished by the greatest diversity of habitable habitats on the southern, eastern and intermediate slopes.

Xerophytic vegetation is heterogeneous. The differences relate to the ecological and biological characteristics of plant formations, floristic composition, structure, and seasonal rhythm of the development of individual communities and groups. They are due to the complexity and dissection of the relief, habitat conditions: microclimate, degree of stony substrate, soil moisture, and others. The most typical and large in area formations of upland xerophytes are confined to rocky-scrub outcrops, clayey, mountain-steppe and primitive skeletal soils of insolated slopes.

The coenotic diversity and variety of developed habitats of the complex is not as high as the originality of its components.

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