

Vegetation of the Central Great Caucasus Along W-E and N-S Transects

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The Great Caucasus covers a significant west to east climatic gradient along its main divide (see Chap. 1). The highlands of the western Caucasus are humid (up to 2200 mm of precipitation per year) and dominated by mesophilic taxa, the highlands of the eastern Caucasus are more continental, with dry summers and an increasing fraction of xerophylic taxa (<800 mm of precipitation per year). Half of the annual amount of precipitation falls on the cold season, therefore large areas of mountains are covered by perpetual snow and glaciers. The annual temperature amplitude is small. One of the features of the Caucasus high mountains, which distinguishes this mountain system from other mountains of Europe are sharp climatic and thus, vegetation changes over relatively small distances. An obvious example is a S-N transect along the 'Georgian Military Road'. This transect clearly shows how semi-desert vegetation becomes substituted by steppe, open arid woodland, mesophilous beech forest including the beech forest types with Colchic elements, then high mountain meadows, chiono- and kryophilous herbaceous and relict scrub communities even in snowbeds, and near-glacier micro-habitats. Within this transect local shelter by mountains can create is continental oroxerophilous vegetation islands. Interior valleys are protected from both cold and humid air mass penetration from the north explaining many relict xerophilous species of past xerothermic periods (Kharadze 1948).

The comparative analysis of the vegetation of two different macro-regions of the Great Caucasus, in particular, the western part of the Central Caucasus—Svaneti and Racha-Lechkhumi, and the Eastern part of the Central Caucasus—Kazbegi, indicates a clear difference between both regions. The major western landmark of the considered area is Mt. Ushba (4710 m) in Svaneti region, and major eastern

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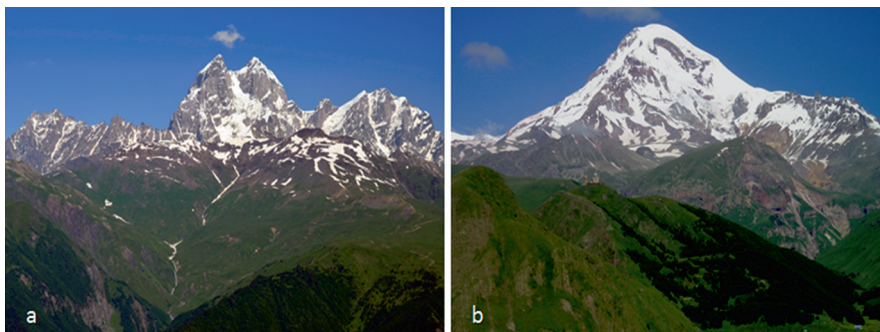


Fig. 2.1 (a) Mt. Ushba (4710 m a.s.l.; the major western landmark of the Central Great Caucasus; Svaneti region) and (b) Mt. Kazbegi (5047 m a.s.l.; the major eastern landmark of the Central Great Caucasus; Kazbegi region) (photos: O. Abdaladze)

landmark is Mt. Kazbegi (5047 m) in Kazbegi region (Fig. 2.1a, b). In the following we first provide a general floristic overview, followed by a description of individual vegetation units (Fig. 2.2).

2.1 Svaneti and Racha-Lechkhumi Regions

In Svaneti and Racha-Letshkhumi, mountain forests are well represented with characteristic Colchis elements. In particular, mountain coniferous forests with *Picea orientalis* and *Abies nordmanniana*, mixed deciduous forests of *Fagus orientalis* with *Rhododendron ponticum*, *Laurocerasus officinalis*, *Ilex colchica*, *Ruscus colchicus* as evergreen undergrowth. Here, as in the Colchis, at the upper tree limit, elfin woodlands ('Krummholz') are formed by *Fagus orientalis*, *Acer trautvetteri*, *Betula litwinowii*. On the southern slopes, *Pinus kochiana* and *Quercus macranthera* are common. In the highlands, shrubs are represented by *Rhododendron caucasicum*, *Salix kazbekensis* (wet slopes), *Juniperus communis* subsp. *hemisphaerica*, *J. sabina* (southern slopes). Subalpine tall herbfields are dominated by *Angelica tatianae*, *Heracleum ponticum*, *Cephalaria procera*, *Valeriana colchica*. The subalpine meadows consist of forbs, in particular, with endemics such as *Ranunculus helenae*, *R. lojkae*, *Pedicularis nordmanniana*, and others. Alpine meadows may exhibit a predominance of *Geranium gymnocaulon*, *Woronowia speciosa*, a plant typical of the Western Great Caucasus (Dolukhanov et al. 1946; Kharadze 1965; Gagnidze 1977; Gagnidze and Kemularia-Natadze 1985; Zazanashvili et al. 2000; Dolukhanov 2010; Margalitadze et al. 2015).

2.2 Kazbegi Region

The picture changes dramatically in the eastern part of the Central Great Caucasus—the Kazbegi region (Figs. 2.2, 2.3 and 2.4). It completely lacks the dark coniferous forests, the Colchis-type undergrowth, and the beech and alpine

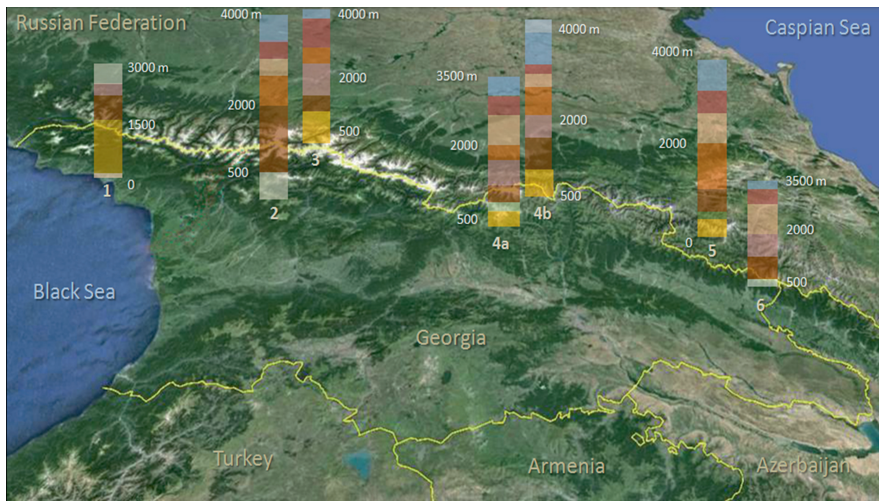


Fig. 2.2 Main patterns of vegetation belts along the Great Caucasus range. **1 The Western Great Caucasus (South macroslope, Apkhazeti)**—0–20 m: Littoral vegetation (*Pinus brutia* subsp. *pitiusa*, *Cistus tauricus*, *Arbutus andrachne*, *Alnus barbata*, *Matteuccia struthiopteris*); 20–1400 m: Colchis forest (Deciduous trees: *Carpinus caucasica* (= *C. betulus*), *Castanea sativa*; *Fagus orientalis*) with lianas & evergreen understory (*Ilex colchica*, *Hedera colchica*, *Ruscus hypophyllum*, *Rhododendron ponticum*, etc.); 1400–2000 m: Coniferous forest (*Pinus kochiana*, *Abies nordmanniana*, *Picea orientalis*) & deciduous forest (*Fagus orientalis*) with evergreen shrub understory; 2000–2300 m: Subalpine crooked stem forest (*Betula litwinowii*, *Acer trautvetteri*, *Fagus orientalis*, *Quercus macranthera*) ('Krummholz'); Tall herbaceous vegetation (*Heracleum ponticum*, *H. mantegazzianum*, *Angelica silvestris*); Shrubs (*Rhododendron caucasicum*, *Corylus colchica*); 2300–2800 m: Alpine meadows (*Carex pontica*, *Geranium gymnocaulon*, *G. platypetalum* *Brachypodium rupestre*); **2 The Central Great Caucasus (South macroslope, Svaneti region)**—0 to 500 m: Black Sea coastal & Colchic lowland vegetation; Tea plantations; *Eucalyptus* & *Cryptomeria* plantings; 500–1900 m: Mixed deciduous forest; Dark coniferous (*Abies nordmanniana*, *Picea orientalis*) & deciduous (*Fagus orientalis*) forests with evergreen understory; *Quercus iberica* & *Pinus kochiana* forests on dry south-facing slopes; 1900–2500 m: Subalpine crooked stem forest (*Fagus orientalis*, *Acer trautvetteri*, *Sorbus caucasigena* = *S. aucuparia*) with tall herbaceous vegetation; Grass & forb meadows; *Rhododendron caucasicum* thickets; 2500–2750 m: Low alpine meadows dominated by *Geranium gymnocaulon*; "Alpine carpets"; 2750–3200 m: Upper alpine meadows (dense tussock communities) mainly dominated by *Festuca varia* subsp. *woronowii*; 3200–4000 m: Subnival & nival vegetation patches on scree & rocks; Cryptogams; **3 The Central Great Caucasus (North macroslope, Baksan valley-Mt. Elbrus area)**, High mountains of the Central Great Caucasus prevent humid air penetration into this area; high peaks with permanent snow cover strengthen the continentality of the local climate, which causes xerophytization in all the vertical zones—450–700 m: Steppe & Semidesert (*Salvia canescens*, *Berberis vulgaris*); 700–1200 m: Forest-steppe & Steppe (*Carpinus orientalis*, *C. caucasica*); 1200–2200 m: Pine (*Pinus sylvestris*) & birch (*Betula litwinowii*) forests; Here and there *Juniperus* spp. & *Berberis* communities & Secondary steppes; 2200–2600 m: Fragments of steppe; Subalpine meadows; Subalpine crooked stem birch & pine forests; Evergreen prostrate shrub *Rhododendron* communities; 2600–3400 m: Alpine meadows; "Alpine carpets"; Scree & rock vegetation; 3400–4000 m: Subnival & nival vegetation patches on scree & rocks; Cryptogams; **4a The Central Great Caucasus (South macroslope, Mtskheta-Cross Pass region)**—400–600 m: Semidesert (*Artemisia lerchiana*, *Salsola ericoides*, *Gamanthus pilosus*); Steppe (*Stipa stenophylla*); Open woodland derivatives (*Pistacia mutica*, *Juniperus* spp. & *Pyrus* spp.); Thorn scrub or Shibliak-like vegetation (*Paliurus spina-christi*, *Rhamnus pallasii*, *Spiraea hypericifolia*); 600–800 m: Foothill deciduous forest (*Quercus iberica*, *Carpinus orientalis*,

Fig. 2.2 (continued) *C. caucasica*; 800–1000 m: Middle mountain forest (*Quercus iberica*, *Q. pedunculiflora*, *Ulmus foliacea*, *Carpinus caucasica*); Beech forest is additive with evergreen understory (*Laurocerasus officinalis*, *Ilex colchica*, *Hedera pastuchovii*); Degraded riparian forest (*Populus nigra*, *Salix australis*) along riv. Aragvi; 1000–1600 m: Upper mountain deciduous forest (*Fagus orientalis*, *Carpinus caucasica*, *Quercus iberica*); Beech forest in places mixed with *Picea orientalis* (this is the eastern border of spruce distribution in the Greater Caucasus); Derivates of deciduous forest (*Q. iberica*, *Fraxinus excelsior*, *Pyrus caucasica*, *Populus tremula*, *Corylus avellana*) at the upper layer of this zone, Thickets of *Rhododendron luteum*; 1600–1900 m: Derivates of subalpine forest (*Acer trautvetteri*, *Betula litwinowii*, *Sorbus caucasigena* = *S. aucuparia*, *Populus tremula*); Derivates of subalpine tall herbaceous vegetation (*Gadellia lactiflora*, *Senecio othonnae*); 1900–2500 m: Subalpine meadows dominated by: *Nardus stricta*, *Cynosurus cristatus*, *Deschampsia caespitosa*, *Trifolium trichocephalum*, *Geranium ibericum*, *Betonica macrantha*; Snowbed vegetation on moist areas (*Galanthus platyphyllus*, *Fritillaria latifolia*, *Dactylorhiza* spp.); Rock vegetation (*Campanula hypopolia*); 2500–3000 m: Alpine meadows dominated by: species of *Alchemilla*, *Sibbaldia parviflora*, *Kobresia macrolepis*, *Poa longifolia*, on south-facing slopes—*Festuca varia* subsp. *woronowii*, on north-facing slopes—*Rhododendron caucasicum*; Along streams: *Primula auriculata*, *Caltha polypetala*, species of *Batrachium*; “Alpine carpets”; >3000 m: Subnival vegetation patches on screes & rocks; Cryptogams; **4b The Central Great Caucasus (North macroslope, Cross Pass—Kazbegi—Chmi)**—4000 to 3700 m: Nival vegetation on screes & rocks—Individuals of *Cerastium kasbek* & *Alopecurus laguroides*; Cryptogams; 3700–3000 m: Subnival vegetation patches on screes & rocks (*Tripleurospermum subnivale*, *Anthemis iberica*, *Delphinium caucasicum*, *Saxifraga exarata* subsp. *moschata*, *S. sibirica*, *S. flagellaris*, *Draba supranivalis*, *Cerastium kasbek*, *Alopecurus glacialis*, *A. laguroides*, *Nepeta supina*, *Pseudovesicaria digitata*); 3000–2750 m: Upper alpine meadows (*Carex tristis*, *Festuca varia* subsp. *woronowii*, *Nardus stricta*); “Alpine carpets” (*Campanula biebersteiniana*, *Carum caucasicum*, *Veronica gentianoides*, *Sibbaldia semiglabra*, *Poa alpina*, *Festuca supina*, *Pedicularis crassirostris*, *Taraxacum stevenii*, *T. porphyranthum*, *Gnaphalium supinum*, *Alchemilla sericea*, *A. chlorosericea*, *Chamaescidium acaule*); 2750–2500 m: Low alpine meadows (*Nardus stricta*, *Carex tristis*, *Kobresia* spp., mostly on south-facing slopes—*Festuca varia* subsp. *woronowii*); On north-facing slopes—*Rhododendron caucasicum* thickets; Prostrate elfin scrub dominated by *Dryas caucasica*; 2500–1900 m: Subalpine meadows (*Hordeum violaceum*, *Bromopsis variegata*, *Agrostis planifolia*, *Deschampsia caespitosa*); On north-facing slopes—subalpine park-like forest (*Betula litwinowii*, *B. raddeana*, *Populus tremula*, *Sorbus caucasigena* = *S. aucuparia*, *Salix caprea*, *S. kazbekensis*), crooked-stem birch timberline & prostrate evergreen scrub (*Rhododendron caucasicum*, *Vaccinium vitis-idaea*, *Daphne glomerata*, *Linnaea borealis*); Rock pine forest (*Pinus kochiana*, *Berberis vulgaris*, *Rosa didoensis*); Xerophytic scrub (*Juniperus communis*, *Spiraea hypericifolia*); Derivates of tall herbaceous vegetation (*Heracleum asperum*, *H. leskovii*, *Senecio rhombifolius*, *Lilium monadelphum* subsp. *georgicum*); On south-facing slopes—Tragacanth steppe (*Astragalus denudatus*, *A. captiosus*, *A. kazbekii*); Rock & scree vegetation (*Saxifraga juniperifolia*, *Draba bryoides*, *Onosma caucasica*); 1900–1500 m: Rock vegetation (*Campanula darialica*, *C. ossetica*); Rock pine forest (*Pinus kochiana*); Xerophytic scrub (*Juniperus communis*, *Spiraea hypericifolia*); 1500–800 m: Tragacanth steppe (*Astragalus denudatus*); Steppe & Secondary meadows; <800 m: Semidesert (*Artemisia lerchiana*, *A. sosnowskyi*); Steppe (*Stipa stenophylla*); **5 The Eastern Great Caucasus (North macroslope, Dagestan-Chechenya-Ingushetya)** (according Murtazaliev 2009)—<400 m: Wormwood & grass steppe on foothills, in places with saline halophytic communities & hemixerophytic shrubwoods (shibliak-like vegetation) as well as oak open woodlands; 400–600 m: Oak & oak-hornbeam forests on foothills; 600–1000 m: Hornbeam-beech forests; In middle-mountain zone (chiefly in hollows): mountain xerophytic communities & shibliak-like vegetation (*Paliurus spina-christi*, *Spiraea* spp., *Crataegus* spp., *Rosa* spp., etc.), in places on north-facing slopes pine forests (*Pinus kochiana* = *P. sylvestris* subsp. *hamata*); 1000–1900 m: Secondary and steppe meadows on foothills; Mountain xerophytic communities & steppe meadows on south-facing slopes; Pine-birch forests & secondary meadows on north-facing slopes in middle-mountain zone; 1900–2500 m: Forest vegetation & steppe meadows (in middle-mountain zone) & forest with subalpine meadows at the upper part; Rock & scree vegetation;

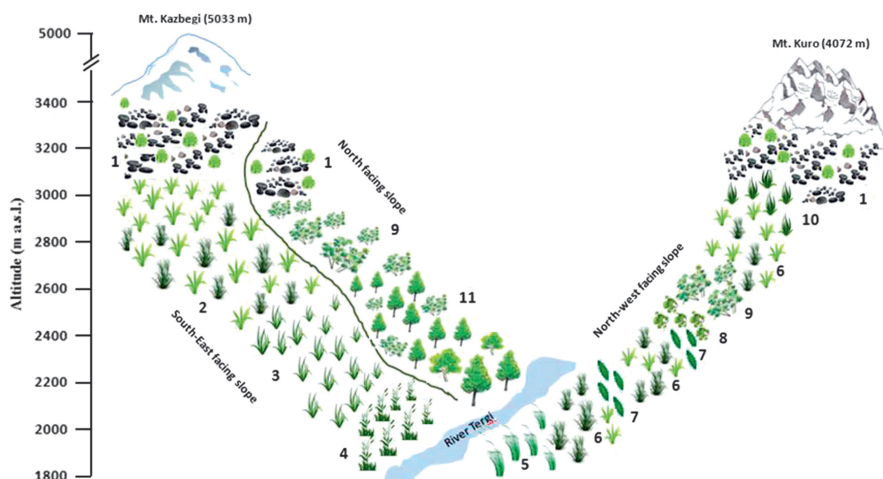


Fig. 2.3 Vegetation distribution on two main altitudinal transects (vill. Gergeti-Mt. Kazbegi: 1800–5047 m; vill. Stepantsminda-Mt. Kuro: 1800–4072 m) in the Kazbegi region (the Central Great Caucasus). 1 Subnival vegetation patches (*Tripleurospermum subnivale*, *Scrophularia minima*, *Nepeta supina*, etc.), 2 *Festuca supina*-*Carex tristis*-*Kobresia macrolepis*, 3 *Kobresia macrolepis*-*Kobresia persica*-*Polygonum viviparum*, 4 *Bromopsis variegata*-*Agrostis tenuis*-*Scabiosa caucasica*-*Trifolium alpestre*, 5 *Hordeum violaceum*-*Poa pratensis*-*Anthriscus nemorosa*-*Heracleum asperum*, 6 *Festuca varia* subsp. *woronowii*-*Carex meinshauseniana*, 7 *Dryas caucasica*-*Deschampsia caespitosa*, 8 *Sibbaldia semiglabra*-*Taraxacum stevenii*, 9 *Rhododendron caucasicum*, 10 *Festuca supina*-*Carex tristis*, 11 *Betula litwinowii*, *Sorbus caucasigena*

maple elfin woodland. The *Betula litwinowii* forests are mixed with *B. pendula* and the East-Caucasian species *B. roddeana*. Mono- and polydominant thickets of subalpine tall herbaceous vegetation are rare and confined to small populations in forest clearings, under a canopy of birch forests, and along stream banks. Tall herb species are nested among grass hillocks of *Festuca varia* subsp. *woronovii*, *Bromopsis variegata*, etc.

On the lateral ridges stretching northward from the main divide, subalpine slopes are largely covered by grassland with *Kobresia persica*, *K. macrolepis*, *Festuca*

Fig. 2.2 (continued) 2500–3000 m: Subalpine & alpine meadows with *Rhododendron* & *Vaccinium* shrubbery on North-facing slopes (in the western part); Meadows (in the more dry eastern part); >3000 m: Subnival vegetation patches on screes & rocks; Cryptogams; **6 The Eastern Great Caucasus (South macroslope, Lagodekhi National Park area)**—200–500 m: Riv. Alazani floodplain forest & lowland forests (*Alnus barbata*, *Quercus pedunculiflora*, *Ulmus foliacea*, *Acer velutinum*, *Pterocarya fraxinifolia*, Lianas: *Smilax excelsa*, *Clematis vitalba*, *Hedera helix*, *H. pastuchowii*, *Vitis sylvestris*); 500–1000 m: Deciduous forests (*Quercus iberica*, *Carpinus caucasica*, *Fagus orientalis*, *Acer laetum*, *Castanea sativa*, *Staphylea pinnata*); 1000–1800 m: Deciduous forests (*Fagus orientalis*, *Tilia begoniifolia*); 1800–2500 m: Subalpine open woodlands & crooked stem forest near the upper limit (*Betula litwinowii*, *Acer trautvetteri*, on South-facing slopes *Quercus macranthera*); Subalpine tall herbaceous vegetation (*Heracleum sosnowskyi*, *Telekia speciosa*, *Gadellia lactiflora*); Meadows; 2500–3050 m: Alpine meadows; “Alpine carpets”; Rock & scree vegetation; >3050 m: Subnival vegetation patches on screes & rocks; Cryptogams

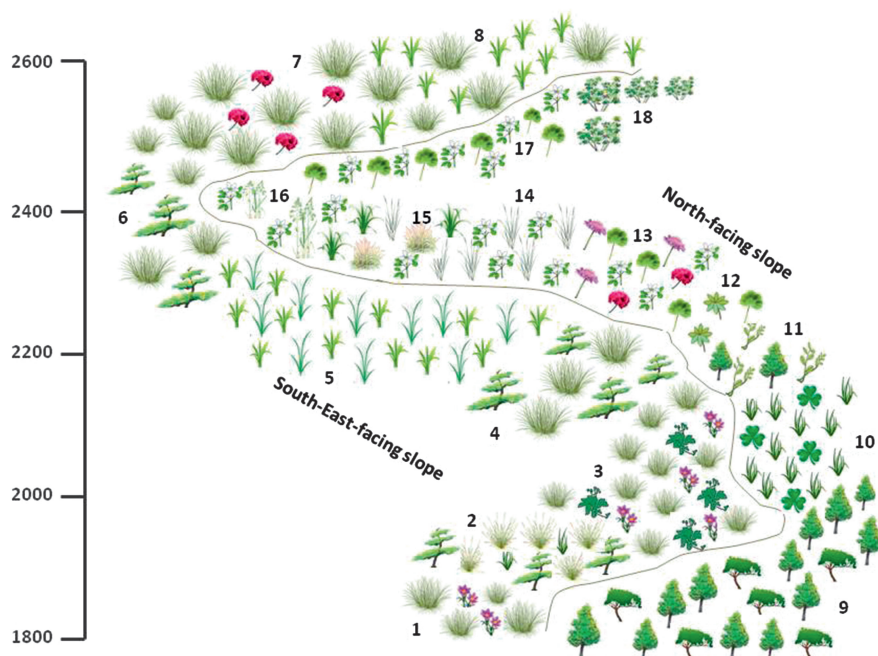


Fig. 2.4 Vegetation distribution on altitudinal transect of mountain Kolteshi (1800–2600 m) in the Kazbegi region (the Central Great Caucasus). 1 *Festuca ovina*-*Pulsatilla violacea*, 2 *Juniperus communis*-*Artemisia sosnowskyi*-*Festuca valesiaca*, 3 *Festuca ovina*-*Pulsatilla violacea*-*Onobrychis petraea*, 4 *Festuca varia*-*Juniperus communis*, 5 *Koeleria luerksenii*-*Carex buschiorum*, 6 *Festuca varia*-*Juniperus communis*, 7 *Festuca varia*-*Betonica macrantha*, 8 *Festuca varia*-*Carex tristis*, 9 *Betula litwinowii*-*Sorbus caucasigena*, 10 *Kobresia macrolepis*-*Trifolium alpestre*, 11 *Salix kasbekensis*-*Betula litwinowii* (seedlings), 12 *Trollius ranunculinus*-*Geranium ibericum*, 13 *Anemone fasciculata*-*Scabiosa caucasica*-*Betonica macrantha*-*Geranium ibericum*, 14 *Agrostis planifolia*-*Anemone fasciculata*, 15 *Agrostis planifolia*-*Kobresia macrolepis*-*Nardus stricta*-*Anemone fasciculata*, 16 *Helictotrichon pubescens*-*Anemone fasciculata*-*Deschampsia caespitosa*, 17 *Anemone fasciculata*-*Geranium ibericum*, 18 *Rhododendron caucasicum*

ovina and other fescues, with participation of *Carex buschiorum*, *Alchemilla caucasica*, and *Koeleria luerksenii*. Continentality increases from the west to the east. Alpine vegetation in the Elbrus region (the lateral north Ridge), shows stony talus slopes, subalpine grassland with *Kobresia schoenoides* and *K. macrolepis* alternatively with moss and lichen dryad communities with *Dryas caucasica*, *Salix kasbekensis*, and *Vaccinium vitis-idaea* (Sakhokia 1983; Zazanashvili et al. 2000; Nakhutsrishvili 1999, 2003, 2013; Nakhutsrishvili et al. 2005, 2006; Abdaladze et al. 2015).

Flat terrain in the upper alpine belt in the Mt. Elbrus region is strongly influenced by deep winter freezing and cryogenic processes acting on raw soils with fragmented lichen-moss communities only; physiognomically and ecologically similar to alpine tundra (Tumadjanov 1980).

Plant Diversity in the Central Great Caucasus: A
Quantitative Assessment

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