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## 12. Elfin - *Loiseleurio-Vaccinietea*

Prodromus

*Loiseleurio-Vaccinietea* EGGLER 1952

*Rhododendro-Vaccinietalia* BRAUN-BLANQUET in BRAUN-BLANQUET & JENNY  
1926

*Rhododendron caucasici* all.nov.

*Lerchenfeldio-Rhododenretum caucasici* ONIPCHENKO & SENNOV 1992

*L.-R.c. oxalidetosum* ONIPCHENKO & SENNOV 1992

*L.-R.c. typicum* ONIPCHENKO & SENNOV 1992

*L.-R.c. pleurozietosum* subass.nov.

*Aconito nasuti-Juniperion* all.nov.

*Aconito nasuti-Juniperetum* ass.nov.

*A.n.-J. typicum* subass.nov.

*A.n.-J. chaerophylletosum rosei* subass.nov.

*Salici kazbekensis-Empetrium nigrae* all.nov.

*Polygono viviparum-Salicetum kazbekensis* ass.nov.

### *Loiseleurio-Vaccinietea, Rhododendro-Vaccinietalia*

The class and order combine Arctic and alpine dwarf scrub communities on poor acidic soils (GRABHERR 1993c). Physiognomic features (i.e., dwarf shrub dominance) are important for diagnosis of this community, since the diagnostic species set is represented by a few species with wide ecological ranges. There are two such species in the study area, *Vaccinium vitis-idaea* and *Empetrum nigrum*. We suggest three new alliances within the order (Table 12.1.).

#### 12.1. *Rhododendron caucasici*

*Rhododendron caucasicum* scrub communities are widespread in the Caucasus (BUSH 1935, GROSSGEIM 1948, GULISASHVILI et al. 1975, BORLAKOV & SABLINA 1985, GADZHEH et al. 1986, IVANOV 1988). Due to many common species we consider this community within the same association (ONIPCHENKO & SENNOV 1992) as *Lerchenfeldio-Rhododenretum caucasici*.

**Table 12.1.**

Diagnostic table of *Loiseleurio-Vaccinietea*

	1	2	3	4	5	6
D.sp. <i>L.-R.c. oxalidetosum</i>						
<i>Oxalis acetosella</i>	V	-	II	-	-	-
<i>Millium effusum</i>	V	-	-	-	-	-
<i>Athyrium distentifolium</i>	V	-	-	-	-	-
<i>Gymnocarpium dryopteris</i>	III	-	-	-	-	-
<i>Brachythecium graciale</i>	II	-	-	-	-	-
<i>Calamagrostis arundinacea</i>	IV	-	I	IV	III	-
D.sp. <i>L.-R.c. typicum</i>						
<i>Sibbaldia procumbens</i>	I	V	I	-	-	I
<i>Gnaphalium supinum</i>	-	IV	I	-	-	I
<i>Sedum tenellum</i>	I	IV	-	-	-	I
<i>Leontodon hispidus</i>	-	II	-	I	I	-
D.sp. <i>L.-R.c. pleurozietosum</i>						
<i>Pleurozium schreberi</i>	-	I	V	II	I	I
<i>Hylocomium splendens</i>	-	I	V	III	II	I
<i>Dicranoweisia crispula</i>	I	II	IV	-	-	-
<i>Dicranum congestum</i>	-	-	III	-	-	I
<i>Peltigera aphthosa</i>	-	-	III	I	I	II
D.sp. <i>Lerchenfeldio-Rhododenretum caucasici</i> , <i>Rhododendron caucasici</i>						
<i>Rhododendron caucasicum</i>	V	V	V	I	I	II
<i>Vaccinium myrtillus</i>	V	IV	V	III	-	I
<i>Solidago virgaurea</i>	V	IV	II	I	-	-
<i>Senecio taraxacifolius</i>	II	III	II	-	-	-
<i>Chamerion angustifolium</i>	IV	III	II	I	-	-
<i>Dicranum scoparium</i>	IV	V	V	III	I	IV
<i>Deschampsia flexuosa</i>	V	V	V	IV	IV	-
<i>Anthoxanthum odoratum</i>	II	V	V	II	III	-
D.sp. <i>A.n.-J. typicum</i>						
<i>Cladonia pyxidata</i>	III	V	III	III	-	V
<i>Hypericum linarioides</i>	-	-	-	III	I	-
<i>Sedum spurium</i>	-	-	-	III	-	-
D.sp. <i>A.n.-J. chaerophylletosum rosei</i>						
<i>Chaerophyllum roseum</i>	-	II	I	-	IV	-
<i>Galium verum</i>	-	-	-	I	IV	-
<i>Primula ruprechtii</i>	-	-	-	I	IV	-
<i>Gentiana septemfida</i>	-	-	-	I	IV	I
<i>Poa longifolia</i>	II	I	I	I	IV	-
<i>Ranunculus oreophilus</i>	I	II	III	I	IV	I
<i>Pedicularis comosa</i>	-	-	-	I	III	II
<i>Geranium sylvaticum</i>	II	II	II	I	III	-
D.sp. <i>Aconito nasuti-Juniperion</i> , <i>Aconito nasuti-Juniperetum</i>						
<i>Seseli alpinum</i>	-	II	III	IV	V	I
<i>Aconitum nasutum</i>	-	-	-	IV	IV	-
<i>Juniperus communis</i>	II	-	II	V	V	-
<i>Abietinella abietina</i>	-	-	-	II	III	-
<i>Betonica macrantha</i>	-	-	-	II	IV	-

Table 12.1. (continued)

	1	2	3	4	5	6
<i>Bromopsis variegata</i>	-	-	-	II	IV	I
<i>Tortula ruralis</i>	-	-	-	IV	II	-
<i>Cotoneaster integrifolius</i>	I	-	-	III	I	-
<i>Festuca varia</i>	I	II	I	IV	V	-
<i>Rhytidium rugosum</i>	-	-	-	III	IV	III
<i>Senecio aurantiacus</i>	-	I	-	II	IV	I
<i>Campanula collina</i>	-	II	II	V	V	I
D.sp. <i>Salici kazbekensis-Empetrium nigrae</i> , <i>Polygono viviparum-Salicetum kazbekensis</i>						
<i>Polygonum viviparum</i>	-	-	-	-	-	V
<i>Salix kazbekensis</i>	-	-	II	-	-	V
<i>Lloodia serotina</i>	-	I	-	-	-	IV
<i>Helictotrichon versicolor</i>	-	-	I	II	IV	V
<i>Carex umbrosa</i>	-	I	-	I	III	V
<i>Carex sempervirens</i>	-	-	-	-	-	IV
<i>Comicularia muricata</i>	-	-	-	-	-	III
<i>Eritrichium caucasicum</i>	-	-	-	-	-	III
<i>Tortella tortuosa</i>	-	I	-	-	-	III
<i>Anemone speciosa</i>	-	IV	II	-	II	V
<i>Campanula tridentata</i>	-	III	II	-	I	V
<i>Carum caucasicum</i>	-	IV	II	-	II	V
<i>Cetraria cucullata</i>	-	-	-	I	I	V
<i>Thamnolia vermicularis</i>	-	-	-	-	I	V
<i>Cetraria nivalis</i>	-	-	-	I	I	V
<i>Cladonia gracilis</i>	-	I	II	-	I	V
<i>Luzula spicata</i>	-	I	-	-	I	IV
<i>Arenaria lachnidea</i>	-	-	-	I	-	IV
<i>Fissidens osmundoides</i>	-	-	-	-	-	II
<i>Minuartia circassica</i>	-	II	I	II	II	IV
<i>Cladonia mitis</i>	-	III	V	I	I	V
D.sp. <i>Rhododendro-Vaccinietalia</i> , <i>Loiseleurio-Vaccinietea</i>						
<i>Empetrum nigrum</i>	-	IV	V	I	I	V
<i>Vaccinium vitis-idaea</i>	-	III	V	IV	IV	V
Other species						
<i>Alchemilla vulgaris</i> aggr.	II	I	IV	I	II	-
<i>Anthemis cretica</i>	-	IV	IV	-	I	I
<i>Carex atrata</i>	II	IV	-	-	I	I
<i>Cetraria islandica</i>	II	V	V	IV	V	V
<i>Festuca ovina</i>	-	IV	IV	III	V	V
<i>Geranium gymnocaulon</i>	IV	II	I	-	-	-
<i>Myosotis alpestris</i>	-	II	II	III	IV	II
<i>Polygonum bistorta</i>	-	-	II	III	IV	II
<i>Rumex alpestris</i>	IV	II	-	I	-	-
<i>Sanionia uncinata</i>	II	IV	III	IV	IV	I
Syntaxa:						
1 - <i>Lerchenfeldio-Rhododendretum caucasici oxalidetosum</i> ; 2 - <i>L.-R.c. typicum</i> ; 3 - <i>L.-R.c. pleurozietosum</i> ; 4 - <i>Aconito nasuti-Juniperetum typicum</i> ; 5 - <i>A.n.-J. chaerophylletosum rosei</i> ; 6 - <i>Polygono viviparum-Salicetum kazbekensis</i>						

### Floristic features

Except for *Rhododendron caucasicum* and *Senecio taraxacifolium*, other diagnostic species of the association are common boreal species (*Vaccinium myrtillus*, *Solidago virgaurea*, *Chamaenerion angustifolium*, *Dicranum scoparium*, *Deschampsia flexuosa*, *Anthoxanthum odoratum*). As a rule, *Rhododendron caucasicum* is the main dominant, covering more than 50% of the community area.

The communities are floristically rich (IVANOV 1988). We registered 107 vascular plant species, 53 bryophytes and 12 lichens in 22 relevés of the association. The mean species numbers per relevé were 22, 7 and 3 respectively. The ratio vascular plants/(bryophytes+lichens) was relatively low (1.6). Vascular plant cover ranged between 30 and 95% (mean 76%), the same values for bryophytes and lichens were 2-90%(27%) and 0-30%(6%) respectively. So the role of bryophytes is considerable in terms of species number and plant cover.

The mean number of vascular plant species was estimated as 3.5, 12.5 and 40.4 for 0.01, 1 and 100 sq.m- plots respectively (ONIPCHENKO & SEMENOVA 1995). Three subassociations can be distinguished within the association (Table 12.2.).

*L.-R.c. oxalidetosum* includes communities of the subalpine zone (2150-2550 m, mean 2410 m), where forest species are well represented (*Oxalis acetosella*, *Athyrium distentifolium*, *Gymnocarpium dryopteris* etc.). The role of lichens is negligible. Typus, or nomenclature type, No. 161/90.

*L.-R.c. typicum* (= *L.-R.c. cetrarietosum islandicae* ONIPCHENKO & SENNOV 1992) includes the communities of the alpine zone (2400-2700 m a.s.l., mean 2630 m). Alpine snowbed and grassland species form the diagnostic set of the subassociation (*Sibbaldia procumbens*, *Gnaphalium supinum*, *Sedum tenellum*, *Leontodon hispidus*). Typus, or nomenclature type, No. 4/89.

*L.-R.c. pleurozietosum* combines communities where moss cover is well-developed (5-90%, mean 39%). Boreal mosses (*Pleurozium schreberi*, *Hylocomium splendens*, *Dicranoweisia crispula*, *Dicranum congestum*) and *Peltigera aphthosa* form the diagnostic set of the subassociation.

Typus, or nomenclature type, No. 168/94.

The association can be considered as a geographical vicarious syntaxon of the *Rhododendretum ferruginei* RÜBEL 1911 of the Alps (*Rhododendro* -

*Vaccinietum* BRAUN-BLANQUET in BRAUN-BLANQUET & JENNY 1926) (HEISELMAYER 1982, ISDA 1985, PIGNATTI et al. 1990, GRABHERR 1993c). There are several common species in both associations (*Vaccinium myrtillus*, *Deschampsia flexuosa*, *Hylocomium splendens*, *Peltigera aphthosa*).

### **Ecological features**

*Rhododendron caucasicum* scrub communities develop within alpine and subalpine zones at altitudes of 2150 to 2700 m a.s.l., mean 2530 m) mainly on steep northern leeward (10-45°, mean 29°) slopes with significant winter snow accumulation. Amount of boulders at the surface varies (0-40%). Soils are acid and humus-rich. We detected from 750 to 2480 viable seeds per sq.m in the soils under the community (SEMENOVA & ONIPCHENKO 1994). *Rhododendron* seeds were rare, while the most common species in the seed bank were *Luzula multiflora*, *Sedum tenellum*, *Phleum alpinum*, *Carex atrata* and *Carex pyrenaica*.

### **12.2. *Aconito nasuti-Juniperion***

The alliance comprises communities where the dwarf form of *Juniperus communis* is the main dominant. It can be considered as the Caucasian vicarious syntaxon of *Juniperion nanae* BRAUN-BLANQUET et al. 1939. Only few species (*Cotoneaster integrifolius*, *Carex sempervirens*) are shared by both syntaxa (GRABHERR 1993). We propose one association within the alliance.

#### *Aconito nasuti-Juniperetum*

### **Floristic features**

The diagnostic set includes *Juniperus communis* and several accompanying species (*Seseli alpinum*, *Aconitum nasutum*, *Abietinella abietina*, *Senecio aurantiacus*), including some common alpine species (*Campanula collina*, *Festuca varia*, *Betonica macrantha*, *Bromopsis variegata*) (Table 12.3.). Two subassociations may be distinguished according to differences in floristic composition.

***A.n.-J. typicum*** combines more "warm" communities occupying mainly south slopes. *Sedum spurium*, *Hypericum linarioides*, *Cladonia pyxidata*

are more frequent in the communities. Typus, or nomenclature type, No. 81/93.

**A.n.-J. *chaerophylletosum rosei*** represents communities developing mainly on west or east slopes. Several species prefer the habitats and can be considered as diagnostic (*Chaerophyllum roseum*, *Galium verum*, *Primula ruprechtii*, *Gentiana septemfida* etc.). Typus, or nomenclature type, No. 95/94.

The communities of the association are floristically rich. We registered 129 vascular plant species, 46 bryophytes and 13 lichens in 20 relevés. Average species numbers per relevé were 23, 7 and 8 species correspondingly. Cover of vascular plants (mainly *Juniperus*) ranges within 70-100% (mean 88%), the same values for bryophyte and lichen cover are 1-70%(24%) and 0-30%(6%) respectively.

### **Ecological features**

The communities are commonly found in the alpine and subalpine zones at an altitude between 2300 and 2840 m (mean 2510 m), but as a rule they occupy only small areas within these zones. They occur on slopes with various aspects (but never on the northern slopes!) and steepness (2°-35°, mean 16°). As a rule, the communities develop as stripes along the ridge tops, slope bends and transition zones between lee and windward slopes. Snow depth often corresponds to the height of *Juniperus communis* shrubs (20-40 cm), because frost and winds kill exposed branches in winter.

#### **12.3. *Salici kazbekensis-Empetrium nigrae***

The alliance combines so-called "dwarf shrub heaths" (SHIFFERS 1953). Their position in the floristic classification is not obvious. Species of *Carici rupestris-Kobresietea bellardii* and *Juncetea trifidi* are very well represented in the communities, so it is possible to consider the alliance within these classes (ISBIRDIN, personal communication). However, in our work we describe it within *Loiseleurio-Vaccinietea* due to the physiognomic features (dwarf shrub dominance) and high frequency of *Empetrum nigrum* and *Vaccinium vitis-idaea* (Table 12.1., 12.3.). We propose one association within the alliance.







*Polygono viviparum-Salicetum kazbekensis*

**Floristic features**

The diagnostic set of the association includes several groups of species. First, *Salix kazbekensis* (dominant). Second, such common alpine species as *Campanula tridentata*, *Carum caucasicum*, *Carex umbrosa*. Third, a good deal of *Carici rupestris*- *Kobresietea bellardii* (*Polygonum viviparum*, *Lloydia serotina*) and *Juncetea trifidi* (*Helictotrichon versicolor*, *Luzula spicata*, *Eritrichium caucasicum*, *Anemone speciosa* etc.) among the vascular plant species as well as fruticose lichens (*Cetraria cucullata*, *C.nivalis*, *Cladonia gracilis*, *C.mitidis*, *Thamnolia vermicularis*).

Floristic richness of the communities is moderate. We registered 71 vascular plant species, 39 bryophytes and 14 lichens in 11 relevés (Table 12.4.). The mean values per relevé were 23, 7 and 8 species correspondingly. Vascular plant cover ranges between 35% and 75% (mean 50%), the same values for bryophytes and lichens were 1-30%(7%) and 15-50%(35%) respectively. So the role of lichens is very important in term of plant cover as well as species number. Typus, or nomenclature type, No. 108/95

**Ecological features**

The community occupies mainly steep ( $5^{\circ}$ - $30^{\circ}$ , mean  $23^{\circ}$ ) northern slopes within the alpine zone (altitude range 2600-2860 m, mean 2710 m). It occurs on ridge tops and windward slopes where thin winter snow cover does not provide adequate protection from deep freezing to the soil. On the other hand, northern exposure leads to low solar radiation. Due to such a stressful environment, the communities have low production. Stones cover up to 30% (mean 10%) of the soil surface.

**Table 12.3.**  
*Aconito nasuti-Juniperetum*

Relevé No.	0 0 1 0 0 1 1 0 0 0 0	0 0 0 0 0 1 1 0 0 0 0
	81 77 23 62 64 33 53 20 88 33	14 11 50 91 95 69 47 71 82 32
Year	93 94 95 94 95 94 94 95 93 95	94 94 94 94 94 94 94 94 93 94
Altitude (* 10)	2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 2 2 2 2 2 2 2
	35 45 40 30 40 55 84 50 50 60	41 55 65 35 40 68 42 55 75 50
Steepness	25 15 3 30 10 30 2 20 3 30	10 30 2 5 3 30 10 35 20 10
Sxposition	se se s se nw e s s e sw	sw w w nw w se sw ne se w
V.p. cover	95 90 90 90 90 90 85 95 70 90	85 70 95 # 90 95 90 90 80 85
Bryophyte cover	5 40 40 + 40 10 4 5 40 30	70 50 20 30 30 30 5 10 10 15
Lichen cover	3 2 5 0 + 1 20 + 5 30	3 20 5 5 0 5 2 3 20 +
Stone cover	20 30 3 + 2 + 0 3 40 +	+ + 5 + 1 0 2 + 20 +
D.sp. A.n.-J. typicum		
<i>Cladonia pyxidata</i>	1 + + + + +	
<i>Hypericum linarioides</i>	+ + + + +	+
<i>Sedum spinum</i>	2 + + + 1 1 +	
D.sp. A.n.-J. chaerophylletosum rosei		
<i>Chaerophyllum roseum</i>		+ + + + + + + +
<i>Galium verum</i>		+ + + + 1 + + 1
<i>Primula ruprechtii</i>	+ 1	+ + + + + + + +
<i>Gentiana septemfida</i>		+ + + + + + + +
<i>Poa longifolia</i>	1	1 + 1 + 1 1 1
<i>Ranunculus oreophilus</i>		+ + + + + + + 1
<i>Pedicularis comosa</i>		+ + + + + + + +
<i>Geranium sylvaticum</i>	+ +	+ + 1 + + +
D.sp. Aconito nasuti-Juniperion, Aconito nasuti-Juniperetum		
<i>Seseli alpinum</i>	+ + + + + + 1 +	+ + + + + + + 1 1
<i>Aconitum nasutum</i>	+ + 1 + + + +	1 + + 1 1 1 + +
<i>Juniperus communis</i>	5 4 5 5 4 4 4 5 4 4	4 3 5 5 4 4 4 4 4 4
<i>Abietinella abietina</i>		+ 1 2 + 1 1
<i>Betonica macrantha</i>		1 1 1 1 + 1 + +
<i>Bromopsis variegata</i>	+ + + + + +	+ + + + 3 + +
<i>Tortula ruralis</i>	1 + + + 1 + 3	1 + + + + 1
<i>Cotoneaster integrifolius</i>	1 + + + 1 1 1	+ + + + + +
<i>Festuca varia</i>	+ + + + + + 1	+ 1 + 1 + + 1 + + +
<i>Rhytidium rugosum</i>	1 1 + + + +	1 + 2 + + + 1 1
<i>Senecio aurantiacus</i>	+ + + + + +	+ + + + + + + +
<i>Campanula collina</i>	+ + + + + + + 1	+ 2 + + + + 1 1 +
D.sp. Rhododendro-Vaccinietalia, Loiseleurio-Vaccinietea		
<i>Empetrum nigrum</i>	2	1
<i>Vaccinium vitis-idaea</i>	2 2 2 1 + 2 2 2	2 2 2 2 3 2 2 +
Other species		
<i>Agrostis vinealis</i>	+ + + +	+ + + + 1
<i>Alchemilla caucasica</i>		+ 1 + + + + +
<i>Alchemilla vulgaris aggr.</i>	+ + + +	+ 1 + + + +
<i>Anemone speciosa</i>		+ + + + + + + +
<i>Antennaria dioica</i>		+ + + +
<i>Anthemis marshalliana</i>	+ + + +	+ + + +
<i>Anthoxanthum odoratum</i>	+ + + +	+ 1 + + + + + +



**Table 12.3.** (continued)

Relevé No.	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Year	81	77	23	62	64	33	53	20	88	33	14	11	50	91	95	69	47	71	82	32		
	93	94	95	94	95	94	94	95	93	95	94	94	94	94	94	94	94	94	93	94		
<i>Rosa marschalliana</i>			+				+			+												
<i>Sanionia uncinata</i>			2	+		+	2	1	2	+	1	3	2		+	3	+	1	1			
<i>Saxifraga kolenatiana</i>		+				+			1	+												
<i>Taraxacum stevenii</i>								+			+	+					+	+				
<i>Thymus nummularius</i>							+			+								+	+			
<i>Trifolium ambiguum</i>																			+			+
<i>Vaccinium myrtillus</i>			3			+	+	1	2													
<i>Veronica gentianoides</i>						+	+			+	+	+	+									
<i>Vicia cracca</i>	+																+	+				
<i>Viola altaica</i>		+		+	+	+					+	1	1					+	1			

Sporadic species (number of relevé in parenthesis, abundance is shown after ":"), unless it is not "+",

Braun-Blanquet scale)

*Achillea millefolium* (50/94, 95/94), *Aconitum orientale* (14/94), *Aetheopappus caucasicus* (82/93), *Alopecurus glacialis* (88/93), *Amblystegium varium* (20/95), *Anthemis cretica* (11/94, 82/93), *Arenaria lychnidea* (153/94, 33/95), *Astrantia maxima* (147/94, 32/94), *Barbilophozia barbata* (123/95, 153/94), *Barbilophozia hatcheri* (95/94), *Barbilophozia lycopodioides* (64/95), *Bartramia ithyphylla* (33/95), *Botrychium lunaria* (133/94, 95/94), *Brachythecium albicans* (71/94), *Brachythecium reflexum* (82/93), *Brachythecium starkei* (133/94), *Bryum caespiticium* (33/95), *Bryum capillare* (153/94, 71/94), *Bryum subelegans* (20/95), *Campanula tridentata* (91/94), *Carex atrata* (50/94), *Carex digitata* (64/95), *Carex humilis* (91/94), *Cephalozia* sp. (95/94), *Cetraria cucullata* (153/94, 14/94), *Cetraria nivalis* (153/94, 14/94), *Cetraria pinastri* (50/94), *Chamaesciadium acaule* (88/93), *Chamerion angustifolium* (64/95:1, 33/95:2), *Cicerbita racemosa* (95/94), *Cladonia gracilis* (91/94), *Cladonia* sp. (153/94, 11/94), *Clinopodium vulgare* (20/95), *Coeloglossum viride* (91/94), *Corydalis conorhiza* (77/94), *Dianthus cretaceus* (71/94), *Dicranum spadiceum* (153/94:2, 88/93), *Draba siliquosa* (33/95), *Equisetum hyemale* (123/95), *Euphrasia ossica* (88/93, 82/93), *Eurhynchium pulchellum* (33/95), *Fritillaria lutea* (50/94, 91/94), *Gentiana pyrenaica* (11/94, 82/93), *Gentiana verna* (88/93), *Gymnadenia conopsea* (91/94), *Heracleum asperum* (95/94), *Koeleria eriostachya* (133/94), *Lamium album* (62/94), *Lathyrus cyaneus* (91/94, 147/94), *Lescurea mutabilis* (33/95), *Lescurea saxicola* (64/95, 50/94:1), *Linum hypericifolium* (88/93, 147/94), *Lophozia* sp. (95/94, 71/94), *Luzula spicata* (82/93), *Macrotomia echioides* (32/94), *Mnium stellare* (71/94), *Orthotrichum rupestre* (14/94), *Orthotrichum speciosum* (33/95), *Orthotrichum stramineum* (169/94), *Paraleucobryum enerve* (64/95), *Peltigera aphthosa* (64/95, 91/94), *Peltigera malacea* (88/93), *Peltigera* sp. (153/94, 11/94), *Phleum phleoides* (133/94, 147/94), *Plagiomnium cuspidatum* (20/95), *Plantago atrata* (91/94, 82/93), *Polygala alpicola* (33/95, 14/94), *Polygonatum verticillatum* (77/94), *Polypodium vulgare* (77/94), *Polytrichastrum alpinum* (88/93, 82/93:1), *Polytrichum commune* (82/93:1), *Polytrichum juniperinum* (33/95, 82/93), *Polytrichum piliferum* (153/94, 88/93), *Potentilla brachypetala* (77/94), *Primula algida* (11/94), *Primula veris* (20/95), *Pterigynandrum filiforme* (123/95), *Ptilidium ciliare* (153/94), *Rhodobryum roseum* (95/94:1), *Rhododendron luteum* (20/95), *Rosa tomentosa* (88/93), *Rumex alpestris* (81/93), *Saxifraga moschata* (77/94, 88/93), *Scabiosa caucasica* (133/94, 147/94), *Sempervivum caucasicum* (33/95, 71/94), *Sempervivum pumilum* (88/93), *Seseli libanotis* (62/94), *Silene vulgaris* (64/95), *Solidago virgaurea* (88/93), *Taraxacum officinale* aggr. (91/94, 95/94), *Thamnolia vermicularis* (11/94), *Thesium alpinum* (88/93), *Trifolium hybridum* (91/94, 95/94), *Trifolium polypheyllum* (82/93), *Triisetum flavesens* (50/94), *Urtica dioica* (11/94), *Valeriana alpestris* (123/95), *Veratrum album* (95/94).

Date (day.month), size (sq.m) and location of the relevées.

81/93 - 22.08, 4, M.Khatipara; 77/94 - 16.07, 6, Bol.Khatipara; 123/95 - 29.08, 12, Nazalykol; 62/94 - 15.07, 12, Bol.Khatipara; 64/95 - 12.07, 10, Baduk; 133/94 - 31.07, 8, Mukhu; 153/94 - 04.09, 24, Oriuchat; 20/95 - 04.07, 10, Alibek; 88/93 - 26.08, 10, M.Khatipara; 33/95 - 07.07, 15, Chuchkhur; 14/94 - 07.07, 15, Azgek; 11/94 - 07.07, 15, Azgek; 50/94 - 12.07, 10, Kyshkadzher; 91/94 - 20.07, 12, Goralykol; 95/94 - 20.07, 10, Goralykol (D.Sukhova); 169/94 - 06.09, 12, Nazalykol; 147/94 - 04.09, 30, Oriuchat; 71/94 - 16.07, 7, Bol.Khatipara; 82/93 - 23.08, 15, M.Khatipara; 32/94 - 11.07, 12, Kyshkadzher.

**Table 12.4.**

*Polygono viviparum-Salicetum kazbekensis*

Releve No.	40	29	11	44	33	51	53	101	107	108	110
Year	83	83	84	89	91	94	94	94	95	95	95
Altitude (* 10)	270	275	275	275	275	265	270	260	260	275	286
Steepness	30	20	20	30	20	30	30	20	20	5	30
Exposition	ne	e	ne	w	nw	nw	nw	ne	n	nne	n
Vascular plant cover	40	35	50	50	70	40	50	50	50	75	40
Bryophyte cover	1	3	15	1	30	2	5	5	5	5	10
Lichen cover	50	40	25	40	15	40	50	20	40	20	40
Stone cover	3	30	5	1	10	1	1	30	5	1	20
<i>D.sp. Salici kazbekensis-Empetion nigrae, Polygono viviparum-Salicetum kazbekensis</i>											
<i>Polygonum viviparum</i>	+	+	+	+	1	+	+	1	1	+	
<i>Salix kazbekensis</i>	2	2	2	3	+	1	2	2	4	2	
<i>Lloydia serotina</i>	+		+	+	+			+	+	+	
<i>Helictotrichon versicolor</i>	1	+	1	1	1	+		+	+	+	
<i>Carex umbrosa</i>	+		1	1	+	+	+	1	+	1	
<i>Carex sempervirens</i>		1	1	1	1		+	1	1		
<i>Cornicularia muricata</i>	1	1	+						1	+	
<i>Eritrichium caucasicum</i>	+		+					+	+	+	
<i>Tortella tortuosa</i>	+	1		+	+			+			+
<i>Anemone speciosa</i>	1	1	1	1	1	1	+	+	+	+	+
<i>Campanula tridentata</i>	1	+	1	1	1	1	1	1	1	2	1
<i>Carum caucasicum</i>	+	+	+	1	1	+	+	1	+	+	+
<i>Cetraria cucullata</i>	1	1	+		+	1	1	+	1	1	1
<i>Thamnolia vermicularis</i>	2	1	+	2	1	1	1	+	1	1	1
<i>Cetraria nivalis</i>	1	1	+			+	+	+	1	1	1
<i>Cladonia gracilis</i>	+	1	+	+		+	+	+	+	+	
<i>Luzula spicata</i>	+	+	+	+		+			+	+	+
<i>Arenaria lychnidea</i>	+	r	+	1					+	+	+
<i>Fissidens osmundooides</i>				+				+			+
<i>Minuartia circassica</i>	1	1	+	1		+	+		+	+	
<i>Cladonia mitis</i>	2	1	1	2		2	3	2	2	1	2
<i>D.sp. Rhododendro-Vaccinietalia, Loiseleurio-Vaccinietea</i>											
<i>Empetrum nigrum</i>	3	1	2	+	1	3	3	3	2	+	+
<i>Vaccinium vitis-idaea</i>	1	1	1	1	1	1	1	1	1	1	1
Other species											
<i>Bryum imbricatum</i>					+				+		+
<i>Cetraria islandica</i>	2	2	2	2	2	2	2	2	2	1	2
<i>Cladonia pyxidata</i>	1	1	1	1	2	+		+		+	+
<i>Dicranum scoparium</i>			2		1	1	1		+	+	1
<i>Draba scabra</i>					1			+			+
<i>Euphrasia ossica</i>		+	+	+				+	+	1	+
<i>Festuca ovina</i>	1	1	1	1	1	1	+	1	+	2	+
<i>Gentiana pyrenaica</i>		+	+	+				+	+		+
<i>Huperzia selago</i>	+						+	+			
<b>Table 12.4. (continued)</b>											
Releve No.	40	29	11	44	33	51	53	101	107	108	110
Year	83	83	84	89	91	94	94	94	95	95	95
<i>Myosotis alpestris</i>		+		+	+					+	
<i>Pedicularis comosa</i>		+		+					+	+	
<i>Pedicularis condensata</i>				+					+	+	+
<i>Peltigera aphthosa</i>	+		+	+							

<i>Peltigera rufescens</i>	+	+		+			
<i>Pohlia cruda</i>	+	+		+	+		
<i>Polygonum bistorta</i>	+			+	+		+
<i>Polytrichastrum alpinum</i>			+	+	+		+
<i>Polytrichum juniperinum</i>	+			+		1	
<i>Polytrichum piliferum</i>	+						+
<i>Potentilla gelida</i>	+	+		1			+
<i>Rhododendron caucasicum</i>	1		+		+		+
<i>Rhytidium rugosum</i>				2	1	1	+
<i>Taraxacum stevenii</i>	+	+	+	+	+		1
<i>Trifolium polyphyllum</i>	1		1				+
<i>Veronica gentianoides</i>	+	+	+				+

Sporadic species (number of releve in parenthesis, abundance is shown after ":"; unless it is not "+", Braun-Blanquet scale)

*Aethopappus caucasicus* (29/83), *Alchemilla caucasica* (29/83:1), *Androsace albana* (11/84), *Antennaria dioica* (40/83, 11/84:1), *Anthemis cretica* (40/83, 11/84), *Astragalus levieri* (29/83:1), *Bartramia ithyphyllea* (29/83, 33/91), *Blepharostoma trichophyllum* (110/95), *Brachythecium albicans* (44/89), *Bromopsis variegata* (29/83), *Bryoria bicolor* (108/95), *Bryum torquescens* (29/83), *Campanula ciliata* (29/83), *Campanula collina* (40/83:1), *Campanula saxifraga* (29/83), *Campylium radicale* (11/84), *Carex atrata* (33/91), *Carex caryophyllea* (101/94:1), *Carex* sp. (33/91), *Cerastium purpurascens* (33/91), *Ceratodon purpureus* (108/95), *Cetraria laevigata* (40/83:2, 11/84), *Chamaesciadium acaule* (29/83), *Cladonia rangiferina* (40/83), *Climaciump dendroides* (33/91), *Coeloglossum viride* (44/89), *Desmatodon latifolius* (33/91, 108/95), *Dicranum bergeri* (53/94:1), *Dicranum bonjeanii* (33/91), *Dicranum congestum* (44/89), *Dicranum spadiceum* (101/94:1), *Distichium capillaceum* (33/91, 110/95), *Erigeron alpinus* (29/83, 108/95), *Eurhynchium pulchellum* (11/84), *Gentiana biebersteinii* (40/83, 29/83), *Gentiana septemfida* (29/83), *Gentiana verna* (29/83), *Gnaphalium supinum* (29/83), *Hedysarum caucasicum* (44/89), *Hylocomium splendens* (51/94, 107/95), *Hypnum cupressiforme* (107/95), *Hypnum imponens* (29/83:1), *Hypnum revolutum* (11/84), *Isopterygiopsis pulchella* (110/95), *Kobresia capilliformis* (33/91), *Kobresia schoenoides* (44/89, 110/95:1), *Lepidozia reptans* (44/89), *Luzula multiflora* (33/91:r), *Minuartia imbricata* (11/84, 33/91), *Mnium thomsonii* (110/95), *Oxytropis kubanensis* (11/84, 108/95), *Paraleucobryum enerve* (40/83, 29/83), *Pedicularis caucasica* (29/83), *Pedicularis nordmanniana* (11/84, 33/91), *Peltigera* sp. (33/91:r), *Pleurozium schreberi* (101/94, 107/95), *Poa nemoralis* (33/91), *Polygonatum umigerum* (108/95), *Pohlia elongata* (44/89), *Primula algida* (29/83), *Primula meyeri* (11/84), *Ptilidium ciliare* (101/94), *Ranunculus oreophilus* (44/89, 33/91:1), *Rhinanthus minor* (44/89, 101/94:r), *Saelania glaucescens* (11/84, 110/95), *Sanionia uncinata* (33/91), *Saxifraga kolenatiana* (33/91), *Sedum tenellum* (29/83, 11/84), *Senecio aurantiacus* (33/91), *Seseli alpinum* (51/94, 107/95), *Sibbaldia procumbens* (11/84), *Sphenolobus minutus* (51/94, 110/95), *Vaccinium myrtillus* (11/84), *Valeriana alpestris* (29/83:1, 33/91:2), *Viola altaica* (44/89, 107/95), *Weissia* sp. (108/95).

Date (day.month), size (sq.m) and location of the releves.

40/83 - 06.09, 25, M.Khatipara; 29/83 - 31.08, 25, M.Khatipara; 11/84 - 01.09, 15, M.Khatipara; 44/89 - 01.09, 25, M.Khatipara; 33/91 - 16.08, 8, Nazalykol; 51/94 - 12.07, 12, Kyshkadzher; 53/94 - 12.07, 12, Kyshkadzher; 101/94 - 21.07, 12, Goralykol; 107/95 - 05.08, 25, Mukhu; 108/95 - 05.08, 12, M.Khatipara; 110/95 - 18.08, 16, M.Khatipara.