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10. Snowbeds - *Salicetea herbaceae*

Prodromus

Salicetea herbaceae BRAUN-BLANQUET 1948

Hyalopoetalia ponticae ord.nov.

Hyalopoion ponticae RABOTNOVA & ONIPCHENKO all.nov.

Ranunculetum brachylobi POKARZHEVSKAYA & ONIPCHENKO ass.nov.

Hyalopoo ponticae-Pedicularietum nordmanniana RABOTNOVA &
ONIPCHENKO ass.nov.

Saxifragion sibiricae all.nov.

Saxifragetum sibiricae ONIPCHENKO & LUBEZNOVA ass.nov.

S.s. typicum subass.nov.

S.s. primuletosum amoenae subass.nov.

S.s. saxifragetosum moschatae subass.nov.

Hyalopoetalia ponticae

This order combines alpine communities developing on siliceous rock on acid soils with considerable snow accumulation (snowbeds) and a short vegetation season. Some species of *Salicetea herbaceae* are typically found here (*Gnaphalium supinum*, *Sibbaldia procumbens*, *Cerastium cerastioides*, *Polytrichum sexangulare*, and *Kiaeria starkei*) (Table 10.1.). The class is a well-studied syntaxon in Europe (BRAUN-BLANQUET 1975, DIERSSEN 1984, SANDRA *et al.* 1988, ENGLISCH 1993). The diagnostic set of our order includes such Caucasian species as *Taraxacum stevenii*, *Sedum tenellum*, *Hyalopoa pontica*. The order can be considered as a geographical vicarious syntaxon of *Salicetalia herbaceae* BRAUN-BLANQUET 1926. We distinguish two alliances in the order, namely *Hyalopoion ponticae* (alpine closed "carpet"- like communities) and *Saxifragion sibiricae* (open rock and scree communities). The first alliance is the *typus* (nomenclature type) of the order. The system of Caucasian snowbed communities represented here is based on our previous invalid publication (ONIPCHENKO *et al.* 1987, 1992).

10.1. *Hyalopoion ponticae*

Synonym: *Sibbaldion* RABOTNOVA 1987 in ONIPCHENKO *et al.* 1987 p.p., *Sibbaldenion* ONIPCHENKO 1992 (ONIPCHENKO *et al.* 1992).

The alliance unites the original Caucasian snowbed communities, which are known in Russian literature as "alpine carpets" (alpiyskie kovry) due to their low and dense plant cover (NARINYAN 1962; MIKELADZE 1960). The alliance can be considered as a geographical vicarious syntaxon of *Salicion herbaceae* BRAUN-BLANQUET 1926, which occurs in Europe up to the Balkans. (BRAUN-BLANQUET 1975). The absence of dwarf *Salix*-species in the Caucasian communities is their main floristic distinction from Alpic vicarious syntaxa. Diagnostic species of the alliance include *Carex pyrenaica*, *Pedicularis nordmanniana*, *Minuartia aizoides*, *Carex atrata*, *Luzula multiflora* and *Potentilla crantzii* (Table 10.1.).

Two associations are proposed in the alliance according to their floristic and ecological peculiarities. Typus, or nomenclature type, is *Hyalopoo ponticae-Pedicularietum nordmannianae*

10.1.1. *Ranunculetum brachylobi*

Floristic features

The association combines communities with *Ranunculus brachylobus* as a prominent dominant. *Corydalis conorhiza* and *Geranium gymnocaulon* are other diagnostic species (Tables 10.1., 10.2.). Floristic richness of this syntaxon is low. We registered only 39 vascular plant species, 15 bryophytes and 4 lichens in 10 releves of the association (Table 10.2.). Floristic similarity between releves is high and average numbers of species per releve was 16, 3 and 1 for vascular plants, bryophytes and lichens respectively. Vascular plant cover is dense (45-80%, mean 65%), while the bryophyte cover is poorly developed (from less than 1% to 30%, mean 7%). The role of lichens is negligible.

Typus, or nomenclature type, is releve No. 55/80.

Ecological features

The communities occupy leeward (mostly northern and eastern) slopes in the alpine and subnival zone within the elevation range 2700 to 3200 m (mean 2850 m). The steepness of the slopes ranges between 0° and 30° (mean 14°). Stones cover up to 40% (mean 17%).

The communities occur mainly in the southern part of the reserve near the Main Caucasian Range (Murudzhu, Klukhor, Alibek, Chuchkhur), where snow

Table 10.1.
Diagnostic table of *Salicetea herbaceae*

	1	2	3	4	5
<i>D.sp. Ranunculetum brachylobi</i>					
<i>Ranunculus brachylobus</i>	V	-	-	-	-
<i>Corydalis conorrhiza</i>	IV	I	-	-	-
<i>Geranium gymnocaulon</i>	II	-	-	-	-
<i>D.sp. Hyalopoo ponticae-Pedicularietum nordmannianae</i>					
<i>Catabrosella variegata</i>	I	V	-	I	I
<i>Nardus stricta</i>	I	IV	-	-	-
<i>Stereocaulon alpinum</i>	I	III	I	I	I
<i>Desmatodon latifolius</i>	I	III	-	I	I
<i>Carex oreophila</i>	-	II	-	-	-
<i>D.sp. Hyalopoion ponticae</i>					
<i>Carex pyrenaica</i>	V	III	-	-	-
<i>Pedicularis nordmanniana</i>	V	IV	-	I	-
<i>Minuartia aizoides</i>	IV	IV	I	-	-
<i>Carex atrata</i>	IV	V	II	II	I
<i>Luzula multiflora</i>	III	II	-	-	-
<i>Potentilla crantzii</i>	IV	II	-	-	-
<i>D.sp. Saxifragion sibiricae, Saxifragetum sibiricae</i>					
<i>Saxifraga sibirica</i>	-	-	V	IV	III
<i>Minuartia imbricata</i>	I	-	V	II	IV
<i>Matricaria caucasica</i>	III	I	II	V	III
<i>Veronica telephiifolia</i>	I	-	I	IV	IV
<i>Murbeckiella huetii</i>	-	-	I	III	II
<i>Draba scabra</i>	-	-	III	I	II
<i>D.sp. S.s. primuletosum amoenae</i>					
<i>Primula amoena</i>	I	-	V	I	I
<i>Lloydia serotina</i>	-	-	IV	-	-
<i>Festuca ovina</i>	I	II	V	-	I
<i>Anemone speciosa</i>	-	-	IV	-	-
<i>Polytrichastrum alpinum</i>	I	-	IV	II	I
<i>Cetraria islandica</i>	I	I	IV	-	-
<i>Myosotis alpestris</i>	-	-	III	I	-
<i>Luzula spicata</i>	-	-	IV	I	-
<i>Veronica gentianoides</i>	I	-	IV	I	-
<i>Alchemilla vulgaris aggr.</i>	-	I	III	I	-
<i>Valeriana alpestris</i>	-	-	III	-	-
<i>Peltigera rufescens</i>	I	-	III	I	-
<i>Carex sempervirens</i>	-	-	III	-	I
<i>Arenaria lychnidea</i>	-	-	III	-	I
<i>Vaccinium vitis-idaea</i>	-	-	III	-	-
<i>Dicranoweisia crispula</i>	I	-	III	I	I
<i>Sanionia uncinata</i>	I	I	III	I	-
<i>Distichium capillaceum</i>	-	-	III	-	-
<i>Pedicularis crassirostris</i>	-	-	II	-	-
<i>Isopterygiopsis pulchella</i>	-	-	II	-	-

Table 10.1. (continued)

	1	2	3	4	5
D.sp. <i>S.s. saxifragetosum moschatae</i>					
<i>Saxifraga moschata</i>	-	-	II	-	V
<i>Senecio karjaginii</i>	-	-	I	-	IV
<i>Potentilla gelida</i>	-	-	II	-	IV
D.sp. <i>Hyalopoetalia ponticae</i>					
<i>Taraxacum stevenii</i>	V	V	V	II	I
<i>Sedum tenellum</i>	IV	II	II	IV	II
<i>Hyalopoa pontica</i>	IV	IV	III	III	I
<i>Polytrichum piliferum</i>	III	III	II	III	II
D.sp. <i>Salicetea herbaceae</i>					
<i>Gnaphalium supinum</i>	V	V	II	III	I
<i>Sibbaldia procumbens</i>	V	V	II	II	-
<i>Cerastium cerastioides</i>	I	I	I	II	I
<i>Kiaeria starkei</i>	-	-	-	I	-
<i>Polytrichum sexangulare</i>	II	II	I	I	I
Other frequent species					
<i>Campanula tridentata</i>	III	III	IV	I	I
<i>Carum caucasicum</i>	III	V	V	I	I
<i>Cladonia pyxidata</i>	III	IV	IV	III	I

Syntaxa:

1 - *Ranunculetum brachylobi*, 2 - *Hyalopoo ponticae-Pedicularietum nordmannianae*, 3 - *Saxifragetum sibiricae primuletosum amoenae*, 3 - *S.s. typicum*, 4 - *S.s. saxifragetosum moschatae*

accumulation is especially significant. They often occupy slopes under long-lived snowfields and have ample melt water supply during the whole or main part of a vegetation season. It seems that *Ranunculus brachylobus* shares some ecological properties with the Alpic *Ranunculus glacialis* which grows in the extreme "snowbed" environment (MOSER *et al.* 1977).

10.1.2. *Hyalopoo ponticae-Pedicularietum nordmannianae*

Synonym: *Hyalopoo ponticae-Pedicularietum crassirostris* RABOTNOVA 1987 in ONIPCHENKO *et al.* 1987 p.p.

Floristic features

The association combines snowbed communities where short rosette and dwarf trailing plants (*Sibbaldia procumbens*, *Minuartia aizoides*, *Gnaphalium supinum*, *Taraxacum stevenii*) and *Nardus stricta* dominate. The diagnostic species set includes *Catabrosella variegata*, *Nardus stricta*, *Stereocaulon alpinum*, *Desmatodon latifolius* and *Carex oreophila*. The diagnostic species of the alliance, the order and the class are abundant and frequent (Table 10.2.). The association can be considered as the Caucasian vicarious

syntaxon of *Salicetum herbaceae* (Rübel) BRAUN-BLANQUET 1913 (BRAUN-BLANQUET 1975).

Its overall floristic richness is low. We registered 36 vascular plant species, 13 bryophytes and 6 lichens in 10 relevés. The mean values per relevé were 15, 3 and 2 species correspondingly. More detailed study of floristic richness showed that average numbers were 5.1, 11.3 and 18.0 vascular plant species in 0.01, 1 and 25 sq. m - plots (ONIPCHENKO & SEMENOVA 1995). The values are among the lowest for alpine communities. The only other community with so few species is the alpine fen. Vascular plant cover is dense (25-95%, mean 68%) and cover of mosses is higher than in the previous association (1-60%, mean 22%).

The nomenclature type (typus) is relevé No. 31/83.

A similar association (*Pediculario crassirostris* - *Sibbaldietum semiglabrae* Bedoshvili 1988) was described from the Lagodekh reserve (the East Caucasus) (BEDOSHVILI 1988b). Due to lower precipitation and different bedrock composition, the soils are less acidic there. Among diagnostic species of the association there are some species (*Plantago saxatilis*, *Chamaescadium acaule*) which prefer soils with higher pH. These species, as well as *Pedicularis crassirostris*, are practically absent from our association.

Ecological features

The communities occupy depressions and bottoms of nival and glacial cirques (corries) with heavy winter snow accumulation (4 metres and more). They are typical for the alpine and lower part of the subnival zone (altitude range 2720-3150 m, mean 2720 m). They prefer gentle slopes of various exposures and flat areas (from 0° to 10°, mean 3.5°). Bare soil and boulder cover is low.

The communities have a short vegetative season (about 2 - 2.5 months) from July to September. Aboveground vascular plant **biomass** is about 130 g/sq.m, belowground - 940 g/sq.m. Corresponding values for dead plant material are 180 and 590 g/sq.m (ONIPCHENKO 1990). Annual production was estimated as 200 g/sq.m. Most of the aboveground biomass is concentrated within the 0-1 cm layer and the height of most plants does not exceed 2-3 cm. Soil **seed bank** is abundant. We detected 2810 viable seeds/sq.m for the snowbed communities in Mt. M.Khatipara (SEMENOVA & ONIPCHENKO 1994).

Table 10.2.

Hyalopoion ponticae

Releve No.	0	0	0	0	0	1	0	0	1	1	0	0	0	1	0	0	0	0	1	0	
Year	50	55	2	5	2	57	3	23	03	82	45	11	44	38	22	31	6	17	32	8	
Year	80	80	87	87	83	90	83	83	94	94	94	83	94	94	88	83	91	94	94	83	
Altitude (* 10)	2	2	2	2	3	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2	
	80	80	92	82	20	90	70	70	80	85	85	75	15	72	95	85	90	80	80	75	
Steepness	10	25	30	3	10	25	0	30	5	5	3	0	3	2	3	5	2	5	2	10	
Exposition	w	n	sw	se	e	ne	-	ne	ne	ne	sw	-	se	ne	e	ne	se	s	w	n	
Vascular plant cover	50	70	50	70	70	70	70	45	80	70	80	95	30	80	70	70	25	70	70	90	
Bryophyte cover	1	1	5	30	5	10	3	1	5	10	1	10	60	30	1	30	30	1	50	5	
Lichen cover	+	0	5	0	0	+	0	+	+	+	1	1	3	2	5	5	25	0	1	1	
Stone cover	30	15	40	15	20	15	0	10	10	15	15	5	1	1	1	5	15	20	5	2	
Bare soil	0	0	0	0	0	0	0	0	3	5	10	1	5	5	10	1	1	10	5	3	
Lichen species number	1	0	3	0	0	2	0	2	1	0	2	0	1	2	1	3	4	0	4	1	
Bryophyte species number	1	1	3	1	1	5	1	0	6	7	4	3	2	6	2	4	4	3	2	1	
Vascular pl. sp. number	18	17	15	14	15	11	10	21	17	23	16	18	8	18	13	17	13	18	17	13	
<i>D.sp. Ranunculetum brachylobi</i>																					
<i>Ranunculus brachylobus</i>	3	4	3	3	2	3	3	2	2	2											
<i>Corydalis conorrhiza</i>	1	1	1	2	+		+		+	+											
<i>Geranium gymnocaulon</i>	+	+					2	1													
<i>D.sp. Hyalopoo ponticae-Pedicularietum nordmannianae</i>																					
<i>Catabrosella variegata</i>										+	1	+	+	1	1	1		2	+	1	
<i>Nardus stricta</i>										+	1	2		2		2	+	+	1	1	
<i>Stereocaulon alpinum</i>				+			+				+		1	1		1	2		+		
<i>Desmatodon latifolius</i>										+	+	1		2	+				+		
<i>Carex oreophila</i>											1	2			+				+		
<i>D.sp. Hyalopoion ponticae</i>																					
<i>Carex pyrenaica</i>	+	+	1	2	1	1		1	+	2				1		2	+		+	1	
<i>Pedicularis nordmanniana</i>	+	+	+	1	+	+		+	1	2	+	1		+	+	2	+		+	1	
<i>Minuartia aizoides</i>	1	1		+	+			1	2	2	2	1	+	+	2	1		+	1		
<i>Carex atrata</i>	+		+		1	+	2	+	1	+	+	1	+	+	1	+	1	+	+	+	
<i>Luzula multiflora</i>		+	1	2				1	+	+				+	+					1	
<i>Potentilla crantzii</i>	1	+			2	r	2	1	+	+	1							1		2	
<i>D.sp. Hyalopoetalia ponticae</i>																					
<i>Taraxacum stevenii</i>	2	1	1	1	3	2	2	+	2	2	2	2		2	3	2	1	2	2	2	
<i>Sedum tenellum</i>	+		1	1	+	+		+	+	+	+		+				+	+			
<i>Hyalopoa pontica</i>	+		2	2	2	2		+	1	+	+		+	+	2	1	1			1	
<i>Polytrichum piliferum</i>	+		1	2		1			+	+	+	2	1	1		2	2				
<i>D.sp. Salicetea herbaceae</i>																					
<i>Gnaphalium supinum</i>	1	+	2	2	2	1		1	+	1	+	2	+	+	+	2	r	+	1	2	
<i>Sibbaldia procumbens</i>	1	1	1	+	2	2	2	2	3	3	3	4	2	4	3	3	2	1	4	4	
<i>Cerastium cerastioides</i>				+										+					+		
<i>Polytrichum sexangulare</i>					2	+				2	+		4	1							
Other species																					
<i>Anthemis cretica</i>									+	+	+						+				
<i>Anthoxanthum odoratum</i>			1						1	+	+	+	+		+				+		
<i>Campanula tridentata</i>	+	+			+				+	1	1	r			1	1	1		+		
<i>Carum caucasicum</i>		+	+	1	+				2			+	+		+	3	+	+	+	1	+

Table 10.2. (continued)

Releve No.	0	0	0	0	0	1	0	0	1	1	0	0	0	1	0	0	0	0	1	0	
Year	50	55	2	5	2	57	3	23	03	82	45	11	44	38	22	31	6	17	32	8	
Year	80	80	87	87	83	90	83	83	94	94	94	83	94	94	88	83	91	94	94	83	
<i>Carum meifolium</i>	+						2			+	+				+						
<i>Cladonia pyxidata</i>	+		2				+		+	+	+			1	2	1	+			+	+
<i>Festuca ovina</i>														+	1		+			+	
<i>Matricaria caucasica</i>	+	+	+	+	1															+	
<i>Phleum alpinum</i>								1	+		1		+							+	+
<i>Polytrichum juniperinum</i>			1				1	1		1						2	2			3	2
<i>Sanionia uncinata</i>																					+

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

Agrostis vinealis (45/94, 22/88), *Alchemilla vulgaris* aggr. (17/94:1), *Anthemis marshalliana* (132/94), *Bartramia ithyphylla* (182/94), *Blindia acuta* (182/94), *Brachythecium* sp. (182/94), *Brachythecium velutinum* (22/88), *Briza marcowiczii* (182/94, 31/83), *Bryum imbricatum* (6/91), *Campanula collina* (17/94), *Carex umbrosa* (132/94), *Cetraria islandica* (23/83), *Chamaescidium acaule* (12/83:1), *Cladonia elongata* (6/91), *Cladonia gracilis* (31/83), *Cladonia mitis* (6/91:1, 132/94), *Crocus scharojanii* (182/94), *Deschampsia flexuosa* (11/83:1, 31/83:1), *Dicranoweisia crispula* (157/90), *Dicranum congestum* (31/83), *Draba hispida* (2/87), *Draba sibirica* (50/80), *Euphrasia ossica* (138/94, 132/94), *Festuca brunnescens* (11/83, 17/94:r), *Gagea fistulosa* (11/83, 17/94), *Gentiana pyrenaica* (11/83, 132/94), *Grimmia sessitana* (17/94), *Leontodon hispidus* (23/83), *Lescurea radicata* (157/90), *Lophozia* sp. (103/94, 138/94), *Minuartia imbricata* (103/94), *Peltigera rufescens* (2/87), *Poa alpina* (50/80), *Pohlia gracilis* (2/87), *Pohlia nutans* (45/94, 6/91), *Pohlia obtusifolia* (182/94), *Polytrichastrum alpinum* (55/80), *Primula amoena* (55/80:1), *Pseudoleskea incurvata* (103/94, 182/94), *Racomitrium canescens* (138/94, 132/94:2), *Rhododendron caucasicum* (23/83), *Rumex alpestris* (3/83), *Senecio taraxacifolius* (55/80, 157/90:r), *Taraxacum confusum* (44/94:1), *Tortula ruralis* (17/94), *Veronica gentianoides* (23/83), *Veronica telephiifolia* (2/87).

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

50/80 - 20.07, 5, Baduk; 55/80 - 20.07, 8, Baduk; 2/87 - 16.08, 25, Alibek; 5/87 - 16.08, 15, Alibek; 2/83 - 16.07, 12, Kichi-Murudzhu; 157/90 - 19.08, 9, Khutyy; 3/83 - 16.07, 15, Kichi-Murudzhu; 23/83 - 27.08, 16, Ullu-Murudzhu; 103/94 - 21.07, 12, Goralykol; 182/94 - 09.09, 12, Kichi-Murudzhu; 45/94 - 11.07, 9, Kyshkadzher; 11/83 - 24.08, 16, M.Khatipara; 44/94 - 11.07, 25, Kyshkadzher; 138/94 - 31.07, 15, Mukhu; 22/88 - 18.08, 16, Gidam; 31/83 - 31.08, 16, M.Khatipara; 6/91 - 03.08, 9, M.Khatipara; 17/94 - 08.07, 9, Azgek; 132/94 - 30.07, 16, Mukhu; 8/83 - 20.08, 15, M.Khatipara

The most common species in the seed bank were *Gnaphalium supinum*, *Sibbaldia procumbens* and *Taraxacum stevenii*.

The communities in depressions are very dependent on snowbank regime and may be susceptible to climate change. They have not been particularly stable during the Holocene as demonstrated by pollen and phytolith analysis (PAVLOVA & ONIPCHENKO 1992, BLINNIKOV 1994).

10.2. *Saxifragion sibiricae*

The alliance combines open alpine and subnival snowbed communities on rocks and moist screes. There exists some floristic similarity between these communities and *Chaerophyllion humilis* and *Murbeckiellion huetii* (*Thlaspietea rotundifolii*), but in the former the species of *Salicetea herbaceae* as well as *Hyalopoetalia ponticae* are well represented. Therefore we treat these communities within *Salicetea herbaceae*, where they form one association (ONIPCHENKO *et al.* 1992).

Saxifragetum sibiricae

Floristic features

The diagnostic species set of the association is represented by the species of cold, wet and open habitats, namely *Saxifraga sibirica*, *Minuartia imbricata*, *Matricaria caucasica*, *Veronica telephiifolia*, *Murbeckiella huetii*, and *Draba scabra*. Most of them are also common in *Hyalopoo ponticae*-*Oxyrietum digynae* (*Thlaspietea rotundifolii*, see Table 3.1.). Several typical species (*Oxyria digyna*, *Chamerion dodonaei*, *Alopecurus ponticus*) of that association are however practically absent from *Saxifragetum sibiricae*. This gives us a basis for distinguishing these two syntaxa in spite of their significant floristic similarity.

We describe 3 subassociations within the association.

S.s. *primuletosum amoenae* represents rock communities developing on steep (30°-80°) mainly northern slopes within the alpine and subnival zones (2800-3120 m a.s.l.). The communities are relatively rich (144 species in 10 relevés!) due to great variation in microhabitat conditions. The diagnostic set is large and includes species adapted to temporary freezing. The most common diagnostic species are *Primula amoena*, *Lloydia serotina*, *Anemone speciosa*, *Festuca ovina*, *Polytrichastrum alpinum*, *Luzula spicata*.

Table 10.3.

Saxifragetum sibiricae

Releve No.	0 0 0 0 0 1 0 1 0 1	1 0 1 0 0 1 0 0 1 0	0 0 0 0 0 1 0 0 0 0	0 0 0 0 0 1 0 0 0 1	15 17 18 19 12 51 38 36 55 12	86 86 86 86 87 90 89 89 90 86
Year	91 91 89 91 91 95 91 95 89 95	90 86 90 91 91 90 81 95 90 95	90 86 90 91 91 90 81 95 90 95	90 86 90 91 91 90 81 95 90 95	86 86 86 86 87 90 89 89 90 86	86 86 86 86 87 90 89 89 90 86
Altitude (* 10)	2 3 2 3 2 2 2 2 2 2	2 3 2 3 3 3 3 3 3 2	2 3 2 3 3 3 3 3 3 2	2 3 2 3 3 3 3 3 3 2	3 3 3 3 3 2 3 3 3 3	3 3 3 3 3 2 3 3 3 3
Steepness	96 12 80 10 95 88 10 80 80 95	70 05 95 10 25 05 10 10 90 90	70 05 95 10 25 05 10 10 90 90	70 05 95 10 25 05 10 10 90 90	40 50 60 75 15 90 54 50 15 28	40 50 60 75 15 90 54 50 15 28
Exposition	50 70 40 45 60 80 30 75 40 80	35 35 15 15 5 15 15 20 15 0	35 35 15 15 5 15 15 20 15 0	35 35 15 15 5 15 15 20 15 0	5 45 20 ? 30 15 40 10 10 2	5 45 20 ? 30 15 40 10 10 2
Vascular plant cover	nw nw nw nw n nw ne nw nw ne	20 10 20 20 15 7 15 5 20 2	20 10 20 20 15 7 15 5 20 2	20 10 20 20 15 7 15 5 20 2	s sw se se sw ne s ne se w	s sw se se sw ne s ne se w
Bryophyte cover	3 5 10 5 5 5 1 1 1 1	5 0 2 1 3 2 1 2 2 1	5 0 2 1 3 2 1 2 2 1	5 0 2 1 3 2 1 2 2 1	5 1 3 1 5 2 30 10 5 3	5 1 3 1 5 2 30 10 5 3
Lichen cover	5 2 5 5 5 1 1 1 1 1	- - - - + + + + +	- - - - + + + + +	- - - - + + + + +	3 - + + + + + + 5 - +	3 - + + + + + + 5 - +
Stone cover	75 85 20 70 80 90 80 90 60 90	60 90 80 50 95 50 95 80 90 50	60 90 80 50 95 50 95 80 90 50	60 90 80 50 95 50 95 80 90 50	90 99 95 99 95 95 70 50 90 95	90 99 95 99 95 95 70 50 90 95
Bare soil	0 0 10 + 0 0 0 0 0 0	20 0 0 40 0 10 0 10 0 50	20 0 0 40 0 10 0 10 0 50	20 0 0 40 0 10 0 10 0 50	0 0 0 0 0 0 0 0 30 0 0	0 0 0 0 0 0 0 0 30 0 0
Number of lichens	9 11 4 5 9 3 2 2 3 1	0 0 0 2 2 0 0 1 2 1	0 0 0 2 2 0 0 1 2 1	0 0 0 2 2 0 0 1 2 1	0 0 1 0 1 1 1 3 0 0 3	0 0 1 0 1 1 1 3 0 0 3
Number of bryophytes	9 12 10 6 6 19 4 13 11 10	2 1 3 3 1 1 0 3 3 6	2 1 3 3 1 1 0 3 3 6	2 1 3 3 1 1 0 3 3 6	2 0 4 3 3 3 1 0 4 1	2 0 4 3 3 3 1 0 4 1
Number of vasc.plants	28 19 27 24 27 28 16 29 14 21	17 5 12 6 13 15 15 7 9 9	17 5 12 6 13 15 15 7 9 9	17 5 12 6 13 15 15 7 9 9	11 8 12 10 14 7 6 8 11 15	11 8 12 10 14 7 6 8 11 15
<i>D.sp. Saxifragion sibiricae, Saxifragetum sibiricae</i>						
<i>Saxifraga sibirica</i>	+ 1 1 + + + + + 1 1	+ + + + + + + + +	+ + + + + + + + +	+ + + + + + + + +	+ + + + + + + + +	+ + + + + + + + +
<i>Minuartia imbricata</i>	1 1 1 + + + 2 1 2 +	1 + + + 2 1 2 +	1 + + + 2 1 2 +	1 + + + 2 1 2 +	1 + + + + + + + + +	1 + + + + + + + + +
<i>Matricaria caucasica</i>	+ + + +	+ + r + + 1 + + + +	+ + r + + 1 + + + +	+ + + + + + + + +	+ + + + + + + + +	+ + + + + + + + +
<i>Veronica telephifolia</i>	+ +	+ + + + 1 + + + +	+ + + + 1 + + + +	+ + + + + + + + +	+ + + + + + + + +	+ + + + + + + + +
<i>Murbeckiella huetii</i>	+ +	+ + + + + + + + +	+ + + + + + + + +	+ + + + + + + + +	+ + + + + + + + +	+ + + + + + + + +
<i>Draba scabra</i>	+ 1 1 1 +	+ + + + + + + + +	+ + + + + + + + +	+ + + + + + + + +	+ + + + + + + + +	+ + + + + + + + +
<i>D.sp. S.s. primuletosum amoena</i>						
<i>Primula amoena</i>	1 1 2 2 1 2 + 2 +	1 2 2 1 2 + 2 +	1 2 2 1 2 + 2 +	1 2 2 1 2 + 2 +	+ + + + + + + + +	+ + + + + + + + +
<i>Lloydia serotina</i>	+ + + + 1 1 + + +	+ + + + 1 1 + + +	+ + + + 1 1 + + +	+ + + + 1 1 + + +	+ + + + + + + + +	+ + + + + + + + +
<i>Festuca ovina</i>	+ + + + + + + + +	+ + + + + + + + +	+ + + + + + + + +	+ + + + + + + + +	+ + + + + + + + +	+ + + + + + + + +
<i>Anemone speciosa</i>	+ + + + + + + + +	+ + + + + + + + +	+ + + + + + + + +	+ + + + + + + + +	+ + + + + + + + +	+ + + + + + + + +
<i>Polytrichastrum alpinum</i>	+ + + + + 1 + + +	+ + + + + 1 + + +	+ + + + + 1 + + +	+ + + + + 1 + + +	+ + + + + + + + +	+ + + + + + + + +
<i>Cetraria islandica</i>	1 + + + 1 + + +	1 + + + 1 + + +	1 + + + 1 + + +	1 + + + 1 + + +	+ + + + + + + + +	+ + + + + + + + +
<i>Myosotis alpestris</i>	r + + r + + + +	r + + r + + + +	r + + r + + + +	r + + r + + + +	+ + + + + + + + +	+ + + + + + + + +
<i>Luzula spicata</i>	+ r + + + + +	+ r + + + + +	+ r + + + + +	+ r + + + + +	+ + + + + + + + +	+ + + + + + + + +

For Table 10.3.

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

Alchemilla sericea (102/95, 113/95), *Alectoria echalybeiformis* (2/91), *Anastrophyllum minutum* (1/91, 43/89), *Anthemis marshalliana* (12/87), *Anthoxanthum odoratum* (150/90:1), *Aster alpinus* (138/90), *Astragalus levieri* (10/91), *Barbilophozia hatcheri* (52/89), *Blepharostoma trichophyllum* (102/95), *Blindia acuta* (52/89), *Brachythecium glaciale* (113/95), *Bryum capillare* (113/95), *Campanula saxifraga* (2/91), *Campylium stellatum* (43/89, 52/89), *Cephalozia pleniceps* (1/91, 3/91), *Cerastium purpurascens* (3/91, 10/91), *Cerastium undulatifolium* (18/86, 155/90), *Ceratodon purpureus* (56/95:1), *Cetraria ericetorum* (18/86, 38/89), *Cicerbita racemosa* (102/95), *Cirsium obvallatum* (113/95), *Cladonia gracilis* (43/89), *Comicularia muricata* (1/91, 2/91), *Cruciata laevipes* (12/86), *Cystopteris fragilis* (113/95), *Desmatodon latifolius* (75/95), *Dicranum spadiceum* (155/90), *Draba hispida* (43/89), *Draba rigida* (150/90, 156/90), *Draba sibirica* (27/81), *Dryopteris filix-mas* (156/90:r, 153/90:r), *Empetrum nigrum* (102/95, 138/90:3), *Encalypta alpina* (102/95), *Epilobium* sp. (151/90), *Erigeron alpinus* (156/90:r, 12/86), *Erigeron caucasicus* (15/86), *Eunomia rotundifolia* (38/89, 12/86), *Euphrasia ossica* (2/91), *Euphrasia petiolaris* (128/95), *Eurhynchium pulchellum* (102/95), *Gentiana pyrenaica* (102/95, 52/89), *Grimmia affinis* (18/86), *Grimmia elatior* (19/86), *Grimmia incurva* (3/91, 10/91), *Grimmia laevigata* (19/86), *Grimmia montana* (113/95), *Grimmia pulvinata* (2/91), *Gymnomitron concinnatum* (1/91, 2/91), *Gymnomitron* sp. (102/95), *Hedysarum caucasicum* (128/95), *Helictotrichon versicolor* (128/95), *Hieracium macrolepis* (150/90), *Huperzia selago* (43/89, 2/91), *Hydrogymmia mollis* (128/95:1), *Hygrohypnum duriusculum* 128/95:1), *Hypnum cupressiforme* (2/91), *Hypnum revolutum* (2/91, 18/86), *Jungermannia* sp. (10/91), *Kobresia schoenoides* (12/91), *Koeleria eriostachya* (10/91), *Leontodon hispidus* (150/90:1, 27/81), *Lescurea saxicola* (102/95:1), *Lophozia excisa* (3/91), *Lophozia* sp. (102/95), *Minuartia aizoides* (43/89:1), *Minuartia circassica* (1/91, 2/91:r), *Minuartia recurva* (1/91, 12/86), *Mnium thomsonii* (102/95), *Myurella tenerima* (12/87), *Oxyria digyna* (153/90:1, 151/90), *Pedicularis condensata* (2/91:r), *Pedicularis nordmanniana* (150/90), *Peltigera aphthosa* (3/91), *Peltigera canina* (113/95), *Peltigera* sp. (128/95), *Philonotis fontana* (128/95:1), *Phleum alpinum* (113/95, 150/90), *Plagiochila porelloides* (52/89, 128/95), *Plagiothecium denticulatum* (113/95, 128/95), *Poa alpina* (43/89, 150/90), *Poa caucasica* (52/89), *Pogonatum umigerum* (102/95, 75/95), *Pohlia drummondii* (52/89), *Pohlia minor* (12/91), *Pohlia nutans* (102/95), *Pohlia obtusifolia* (16/91), *Polygonum viviparum* (10/91, 2/91), *Polytrichum juniperinum* (3/91, 43/89), *Potentilla divina* (2/91:r, 12/87), *Pseudoleskea incurvata* (113/95:1, 75/95), *Psora* sp. (1/91), *Radula lindbergiana* (128/95), *Ranunculus oreophilus* (102/95), *Rhizomnium punctatum* (128/95), *Sagina saginoides* (156/90:r), *Salix kazbekensis* (113/95), *Schistidium rivulare* (128/95:1), *Silene lychnidea* (12/86), *Solorina crocea* (3/91), *Sphenolobus minutus* (102/95), *Trifolium polyphyllum* (12/87), *Tritomania exsecta* (52/89), *Tritomania quinqueidentata* (1/91, 3/91), *Viola altaica* (1/91:r, 15/86).

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

1/91 - 29.07, 9, M.Khatipara; 3/91 - 29.07, 9, M.Khatipara; 43/89 - 01.09, 10, M.Khatipara; 10/91 - 04.08, 8, M.Khatipara; 2/91 - 29.07, 6, M.Khatipara; 102/95 - 19.08, 14, Azgek; 12/91 - 04.08, 6, M.Khatipara; 113/95 - 19.08, 24, M.Khatipara; 52/89 - 01.09, 25, M.Khatipara; 128/95 - 29.08, 30, Nazalykol; 150/90 - 18.08, 9, Baduk; 5/86 - 09.08, 10, M.Khatipara; 156/90 - 19.08, 25, Khuty; 16/91 - 04.08, 4, M.Khatipara; 32/91 - 17.08, 12, Nazalykol; 138/90 - 17.08, 9, Khadzhibey; 27/81 - 14.08, 10, Chuchkhur; 56/95 - 10.07, 25, Epchik; 153/90 - 19.08, 20, Baduk; 75/95 - 13.07, 9, Baduk; 15/86 - 13.08, 25, Goralykol; 17/86 - 13.08, 25, Kyshkadzher (A.Sennov); 18/86 - 13.08, 100, Kyshkadzher; 19/86 - 13.08, 25, Kyshkadzher; 12/87 - 17.08, 15, Alibek; 151/90 - 19.08, 25, Baduk; 38/89 - 18.08, 6, Kyshkadzher (N.Lubeznova); 36/89 - 18.08, 6, Kyshkadzher (N.Lubeznova); 155/90 - 19.08, 25, Baduk; 12/86 - 13.08, 50, Goralykol (I.Pavlova)

The role of bryophytes is very important. The ratio vascular plants / (bryophytes + lichens) is the lowest among all studied syntaxa of the reserve (0.9).

The nomenclature type, or *typus*, No. 10/91.

S.s. *typicum* combines alpine and subnival snowbed plant communities on screes. It does not have diagnostic species of its own, but typically lacks diagnostic species of other subassociations. The nomenclature type (*typus*) is releve No. 16/91.

S.s. *saxifragetosum moschatae* represents subnival snowbeds (2900-3750 m a.s.l.) on slopes of varying steepness (2° - 45°) and aspect. Floristic richness is relatively low. *Saxifraga moschata*, *Senecio karjaginii* and *Potentilla gelida* form the diagnostic set of the subassociation. The species indicate that the substrate is rather stable. The nomenclature type (*typus*) is releve No. 18/86.

Overall, we registered 93 vascular plant species, 64 bryophytes and 20 macrolichens in 30 releves of the association. Mean number of species per releve was however rather low (15, 5 and 2 species correspondingly). More detailed study of floristic richness showed that average numbers were 4.6, 14.8 and 30.6 vascular plant species in 0.01, 1 and 100 sq.m - plots (ONIPCHENKO & SEMENOVA 1995). Vascular plant cover ranges from less than 1% to 40% (mean 10%), that of bryophytes - from less than 1% to 20% (mean 3%). The role of lichens is small.

Ecological features

The communities are commonly found in the alpine and subnival zone within the elevation range of 2700 to 3750 m (mean 3110 m). They occupy slopes of various exposure and steepnesses (0-80°). Bare soil, rocks and boulders cover a significant portion of the community area (50-99%).

The considerable snow accumulation and high altitude position of this community shortens the vegetation season. On the other hand, there is no water shortage during the season and plants can develop quickly.

We detected about 8080 seeds/sq.m in the soil seed bank of the communities on Mt. M.Khatipara (SEMENOVA & ONIPCHENKO 1994). About half of the bank consists of *Saxifraga sibirica* seeds. *Carex pyrenaica*, *Cerastium cerastioides*, *Luzula multiflora*, *Murbeckiella huetii* and *Sedum tenellum* were other important components of the seed bank.