

On the shrub thickets and shrub steppes in the forest-steppe belt of the South-Eastern Baikal region

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Abstract. Peculiar feature of vegetation in the Dahurian forest-steppe belt is the presence of shrub thickets and shrub steppes. Shrub thickets are dominated by *Armeniaca sibirica*, *Spiraea pubescens*, *S. aquilegifolia*, *Pentaphylloides parvifolia* and *Ulmus macrocarpa*. Density of cover is highly variable from 40 to 90%. Some communities are distinctly dominated by shrubs, in other, named semi-thickets, shrubs and forbs have almost equal projective cover. Usually the semishrub wormwood *Artemisia gmelinii* forms a distinct layer. We recorded more than 50 species in the herbaceous layer of the shrub thickets, all of them with little abundance and small projective cover (10 %). Grasses are not numerous as to both abundance and species diversity. Shrub steppes are characterized by the presence of shrubs, which are more or less evenly scattered over the steppe stand. The most active part has *Armeniaca sibirica*. The species may be a single component of the shrub layer or can occur together with *Pentaphylloides parvifolia*, or with *Spiraea aquilegifolia* and *S. pubescens*, and very rarely with *Ulmus macrocarpa*. The species compositions of shrub thickets and shrub steppes differ not very much. Thus, our studies with inclusion of the actual data support the idea of a close relation between the components of the Dahurian forest-steppe which form a peculiar natural complex.

1 Introduction

The South-East Baikal Region (named Dahuria) is mountain territory with the system of ranges stretching from south-west to north-east, rising up to 1400-1500 m with separate summits of 2000-2500 m. Massive crystalline rocks (granites) and metamorphic schists predominate. The climate of Dahuria is highly continental with a negative mean yearly temperature, a short period without frost and little precipitation (350 mm), which is unevenly distributed over the year.

Two altitudinal belts differ in vegetation cover: the taiga and the forest-steppe. The forest-steppe belt occupies the larger area in this region spreading up to 1000-1500 m above sea level. In this belt forests are restricted to north exposed slopes and are dominated either by *Larix gmelinii* (Rupr.) Rupr. or *Pinus sylvestris* L. or *Betula platyphylla* Sukacz.

Steppes spread mainly on south exposed slopes on mountain-steppe and mountain-steppe primitive soils. The soils are characterized by shallow profile, light mechanical texture, high content of rock debris, low moisture capacity, humus content and soil turfness. On gentle slopes of low ranges steppe occurs also on mountain chernozems.

In Dahuria, herb-grass and herb steppes are prevalent. The species diversity achieves 330 vascular plants; most of them are absent in the Black Sea–Kazakhstan steppe or occur

only in its eastern outskirts. Examples of herbs most notable in cover are *Filifilium sibiricum* (L.) Kitam. (Asteraceae), *Bupleurum scorzonerifolium* Willd. (Apiaceae), *Arctogeron gramineum* (L.) DC. (Asteraceae), *Gypsophila davurica* Turcz. ex Fenzl (Caryophyllaceae), *Stellera chamaejasme* L. (Thymelaeaceae), *Scutellaria baicalensis* Georgi (Lamiaceae), *Adenophora stenanthina* (Ledeb.) Kitag (Campanulaceae), etc. Herbs are represented by 30-35 species in a community, but only 3-4 species in various combinations dominate in a stand.

In the Dahurian mountain steppes the small tight-tufted xerophilous grasses are common, e. g. *Festuca lenensis* Drob. and *Koeleria cristata* (L.) Pers. The large tufted grasses are represented by mesoxerophyte *Stipa baicalensis* Roshev., petroxerophyte *Festuca sibirica* Hack. ex Boiss., mesoxerophyte *Carex pediformis* C. A. Mey., etc. The mesoxerophyte loose-tufted grasses are widespread: *Stipa sibirica* (L.) Lam., *Cleistogenes kitagawae* Honda, *Cleistogenes squarrosa* (Trin.) Keng, *Poa botryoides* (Trin. ex Griseb.) Kom., *Agropyron cristatum* (L.) Beauv.

2 Short characteristic of study area

In the summer of 2007 we made relevés of shrub thickets and shrub steppes near the river mouth of the Kyra into the Onon (a bit to the south of 50° N and slightly to the east of 112° E). This part of the South-East Baikal region overlaps with the southern extremity of the Stanovik Range, which consists of high hills with steep slopes, dissected by valleys of small rivers. Their absolute height is 1200-1300 m asl., their relative high 200-300 m. They are made up by metamorphic schists and granites.

On the hills, steppe vegetation of herb-grass and herb communities predominates. At the lower parts of slopes *Filifilium sibiricum* determines the aspect. Notably in these communities are also *Artemisia monostachya* Bunge ex Maxim. and the grasses *Festuca lenensis*, *Poa botryoides*, *Koeleria cristata*, sporadically *Festuca sibirica*. The species number is about 40 in a community and general projective vegetation cover about 50-60%.

On the slopes and hill tops with high content of rock debris, the low herb (10-15 cm high) petrophytic communities spread, dominated by *Arctogeron gramineum*, *Pulsatilla tenuiloba* (Turcz.) Juz., *Eremogone capillaris* (Poir.) Fenzl, often with abundant *Artemisia monostachya* and *Phlojodicarpus sibiricus* (Steph. ex Spreng.) K.-Pol. (Fig. 1). Total species diversity in these communities also achieves 40 species. General projective cover is 40-50%.

On the flat stony-debris of hill tops, the communities of *Orostachys spinosa* (L.) C. A. Mey. with *Arctogeron gramineum* occupy small areas (5x10 m², 10x10 m²). Their general projective cover is less than in other types of steppe, only 35-40% and the species number is lower as well (30 species).

Shrub communities can be found in both, the Stanovik Range and the whole South-Eastern Baikal Region. It has to be noted, that mesophilous shrubs as *Betula fusca* Pall. ex Georgi and species of *Salix* may form a separate closed layer in larch forest, or closed

coenoses bordering on forests and spreading in river valleys or arising as secondary ones. We shall not consider these coenoses in this paper. Our subject are the shrub thickets composed of more xerophilous steppe species (Fig. 2).

3 Shrub thickets

Shrub thickets dominated by *Armeniaca sibirica* (L.) Lam., *Spiraea pubescens* Turcz., *S. aquilegifolia* Pall., *Pentaphylloides parvifolia* (Fisch. ex Lehm.) Sojak. (all *Rosaceae*) and *Ulmus macrocarpa* Hance (*Ulmaceae*) are a peculiar feature of the plant cover in Dahuria. They are restricted to broad gullies, depressions on slopes, and also to rather stony parts of slopes with rock outcrops, i.e. to sites with the most favorable moisture conditions as compared with sites occupied by steppes. Shrub thickets are 60-120 cm high.

The 18 recorded coenoses include 74 species. About 20 species were found in 50 % of the relevés, but only 10 species are of high constancy, among those the shrub *Armeniaca sibirica*, semishrub *Artemisia gmelinii* Web. and bunchgrass *Stipa sibirica* present in all, the shrub *Ulmus macrocarpa* and sedge *Carex pediformis* absent in one, *Spiraea aquilegifolia* and *S. pubescens* in two and finally the small bunchgrass *Koeleria cristata*, dwarf semishrub *Artemisia frigida* Willd. and herb *Lespedeza davurica* (Laxm.) Schindl. in three of the relevés.

The density of cover is highly variable from 40 to 90 % depending on presence of large stones and stony-outcrops. Some communities are distinctly dominated by shrubs (Fig. 3, 4), in other (named semi-thickets) shrubs and forbs have almost equal projective cover (Fig. 5). The abundance of shrubs varies in the same range as total vegetation cover, from 30 to 85 %.

In the shrub layer of these communities four species (*Armeniaca sibirica*, *Spiraea pubescens*, *S. aquilegifolia* and *Ulmus macrocarpa*) play an almost equal role in the vegetation. Sometimes a fifth shrub (*Pentaphylloides parvifolia*) occurs, however not in large quantities. Locally, coenoses with the dominance of two or three of the shrub species occur.

Usually the layer of semishrub wormwood *Artemisia gmelinii* of 40-50 cm high is distinct. Its cover is 10-20 % under closed shrub canopies and 5 % in more open communities. Sometimes the lower dwarf semishrub *A. frigida* (20-25 cm) joins *A. gmelinii*, but always with low abundance (not more than 5 %).



Fig.: 1 - 8

- Fig. 1: Forest-steppe belt. Steppes with *Arctogeron gramineum*.
- Fig. 2: Forest-steppe belt.
- Fig. 3: Shrub thickets (*Armeniaca sibirica*, *Ulmus macrocarpa*, *Spiraea aquilegifolia*) with herbs (*Filifolium sibiricum*, *Pulsatilla turczaninovii*) and semishrub *Artemisia gmelinii*.
- Fig. 4: Shrub thickets (*Armeniaca sibirica*, *Spiraea aquilegifolia*, *Ulmus macrocarpa*) with semishrub *Artemisia gmelinii*.
- Fig. 5: Shrub semi-thicket (*Armeniaca sibirica*, *Spiraea pubescens*, *S. aquilegifolia*, *Ulmus macrocarpa*) with semishrub *Artemisia gmelinii*, grasses (*Koeleria cristata*, *Poa botryoides*) and herbs (*Allium senescens*, *Pulsatilla turczaninovii*).
- Fig. 6: Shrub steppe: grass (*Koeleria cristata*, *Stipa sibirica*)-herbs (*Filifolium sibiricum*, *Potentilla tanacetifolia*, *Pulsatilla turczaninovii*) with *Armeniaca sibirica* and *Pentaphylloides parvifolia*.
- Fig. 7: Shrub steppe: grass (*Festuca lenense*, *Koeleria cristata*)-herbs (*Pulsatilla tenuiloba*, *Filifolium sibiricum*, *Ptilotrichum dahuricum*, *Lespedeza davurica*) with *Armeniaca sibirica*.
- Fig. 8: Shrub steppe: semishrub (*Artemisia gmelinii*)- grasses (*Stipa baicalensis*, *S sibirica*, *Agropyron cristatum*) with *Spiraea aquilegifolia*, *Armeniaca sibirica*.

We recorded more than 50 species in the herbaceous layer under the shrubs, but only with little abundance and small projective cover (up to 10 %). Of the 50 species we will name only five, which are found in more than 50 % of the relevés: *Potentilla tanacetifolia* Willd. ex Schlecht., *Filifolium sibiricum*, *Rhaponticum uniflorum* (L.) DC., *Pulsatilla turczaninovii* Kryl. & Serg. and *Saussurea salicifolia* (L.) DC., and six with occurrence in 30-40% of the relevés: *Clematis hexapetala* Pall., *Lespedeza davurica*, *L. juncea* (L. fil.) Pers., *Polygonatum sibiricum* Delaroché, *Saposhnikovia divaricata* (Turcz.) Schischk. and *Allium senescens* L.

Grasses are not numerous as to both abundance (their projective cover is at most 5-10 %) and species diversity. *Stipa sibirica* participates in all relevés; highly constant are also *Koeleria cristata*, *Cleistogenes kitagawae*, *Agropyron cristatum*, and, less often, *Poa botryoides*. Also the Cyperaceae *Carex pediformis* is constantly present in small abundances.

4 Shrub steppes

For the first time the term “shrub steppe” was used by S. I. KORZHINSKY (1888) in relation to shrub thickets in stony sites. Later the concepts “shrub steppe” and “shrub thickets” were separated from each other. Shrub steppes are characterized by the presence of shrubs more or less evenly scattered over the steppe stand (KUMINOVA 1938, LAVRENKO 1954, 1956, KARAMYSHEVA 1961, SAFRONOVA 1963, 1967). They are restricted to soils of light texture (scree, stony, sand, sandy-loam, light clay).

In the study area the shrub steppes are rarer than shrub thickets. They are found mainly on concave, higher parts of gentle slopes, exposed to the south, south-east or south-west and with stony-scrub primitive soils. Physiognomically shrub steppes are inconspicuous in the landscape on account of smaller height of shrubs (60-80 cm on average) and small number of shoots.

Within the shrub steppes the grass-herb type predominates (Fig. 6, 7), while the herb-grass and grass-herb-wormwood types (Fig. 8) are not often found. The general projective cover of shrub steppes is 50-60%, sometimes up to 70%.

78 species of vascular plants were registered in 12 relevés of shrub steppes. All five shrub species, forming shrub thickets, take part also in the cover of shrub steppes. Their projective cover is up to 5-15 %. The shrub *Armeniaca sibirica* is most important and participates almost in all communities of shrub steppes that we met in the region. It may be a single component of the shrub layer or grow together with *Pentaphylloides parvifolia*, or *Spiraea aquilegifolia* and *S. pubescens*, and very rarely with *Ulmus macrocarpa*

Herbs cover 30-40 % of the surface. They are represented by 53 species. Only one species, *Filifilium sibiricum*, participates in all communities as an edificatory species. Its projective cover is 10-20 % on average. This species plays a significant role in the plant cover of steppes in Siberia and Mongolia. Almost in all coenoses *Allium tenuissimum* L. and *Ptilotrichum dahuricum* Peschkova are present with usually small projective cover but sometimes forming aspect. Eight further species have high degrees of constancy occurring in 75-80 % of the relevés (*Potentilla tanacetifolia*, *Rhaponticum uniflorum*, *Saussurea salicifolia*, *Haplophyllum dauricum* (L.) G. Don fil., *Scutellaria baicalensis*, *Lespedeza davurica*, *Leibnitzia anandria* (L.) Turcz., *Potentilla leucophylla* Pall.). Their cover is rather low, mostly not more than 5 %, sometimes for *Potentilla tanacetifolia* and *Scutellaria baicalensis* up to 10%. *Bupleurum scorzonerifolium*, *Polygala tenuifolia* Willd., *Polygonum angustifolium* Pall., *Stellera chamaejasme*, *Pulsatilla tenuiloba*, *P. turczaninovii* participate in 50 % of relevés, the last two often being dominants. The remaining 37 species are rare.

In the shrub steppes of the southern part of Stanovik Range, the bunchgrasses are pronouncedly distinguished. They cover from 10-20 % to 40-50 % of the relevé surfaces. In all coenoses, the most notable role belongs to *Koeleria cristata*, usually together with *Stipa sibirica*, rarely with *Festuca lenensis*. Sometimes *Stipa baicalensis* is dominant. Characteristic but little abundant are grasses as *Cleistogenes kitagawae* and *Poa botryoides*. Very rare are *Cleistogenes squarrosa* and *Festuca sibirica*, which are widely distributed southward, in Mongolia.

In shrub steppes always one or another species of wormwood can be found. Rather often *Artemisia monostachya* plays a notable role, especially in the South-East Baikal Region. *Artemisia gmelinii* is common in shrub growths, as it was said earlier, but it is a rare component of steppes coenoses. *Artemisia frigida* is rather characteristic of Mongolian steppes. In Dahuria its occurring is connected with overgrazing. Two further wormwoods *Artemisia commutata* Bess. and *Artemisia macilenta* (Maxim.) Krasch. have single occurrences in the shrub steppe.

5 Conclusion

The comparison of species composition of shrub thickets and shrub steppes shows that their differences are not so large (Tab. 1). Only 5 species are present exclusively in shrub communities (*Patrinia sibirica* (L.) Juss., *Polygonatum odoratum* (Mill.) Druce, *P. sibiricum*, *Thalictrum appendiculatum* C. A. Mey., *Vicia popovii* Nikiforova) and 6 only in shrub steppes (*Astragalus tenuis* Turcz., *Oxytropis mixotrichae* Bunge, *Phlojodicarpus sibiricus*, *Pulsatilla multifida* (G. Pritz.) Juz., *P. tenuiloba*, *Sanguisorba officinalis* L.). Four more species (*Allium anisopodum* Ledeb., *Chamaerhodos erecta* (L.) Bunge, *Echinops latifolius* Tausch, *Potentilla semiglabra* Juz.) occur not in our relevés, but they can also grow in shrub steppes. Seven species in relevés of shrub steppes (*Amblynotus rupestris* (Pall. ex Georgi) M. Pop. Ex Serg., *Androsace incana* Lam., *Dendranthema zawadskii* (Herbich) Tzvel., *Dianthus versicolor* Fisch. ex Link, *Leontopodium leontopodioides* (Willd.) Beauverd, *Potentilla verticillaris* Steph.) can take part in shrub thickets in other places.

Tab. 1: Number of species separated by functional types in shrub thickets and shrub steppe.

	shrubs	semi shrubs	dwarf semi shrubs	herbs	grasses	other graminoids	all species
only in shrub thicket				9			9
only in shrub steppe				13			13
in both	5	1	2	45	10	2	65

Thus, our studies with the actual data added support the idea that the components of the Dahurian forest-steppe are closely related with each other and thus form a peculiar natural complex (DULEPOVA 1993).

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6 References

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