ORIGINAL ARTICLE

Communities of the *Molinio-Arrhenatheretea* class in the Biysk-Chumysh Upland region (Altai Krai)

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The article reveals the study of the syntaxonomic diversity of meadow vegetation in the Biysk-Chumysh Upland region (Altai Krai) based on the analysis of 230 complete geobotanical descriptions. The levels of hydration and use (grazing, idle land) are proved to be the main ecological factors. The variety of the *Molinio-Arrhenatheretea* class in the Biysk-Chumysh Upland (Altai Krai) is represented by three orders. The *Molinietalia* order is representative of wet meadows, whose floristic composition is mostly comprised of water resistant species. The *Arrhenatheretalia* order is representative of well-hydrated meadows. The *Galietalia veri* encompasses the communities of steppe meadows, the cenoflora of which unites the species of true meadows and meadow steppes.

Keywords: Vegetation; Meadows; Classification; The Biysk-Chumysh Upland

Introduction

The Biysk-Chumysh Upland is divided by a well-developed valley-ravine network and has the characteristics of an undulating plain, the height of which gradually increases from 280-300 m in the north to 350-400 m in the south. The slopes of the ravines have a complex stepped section, indicating several cycles of the erosion network breakthrough (Zyatkova, 1977). The surface of the flat land on the right bank of the Ob river is dissected by the valleys of the rivers that carry water to the Ob from the Biysk-Chumysh Upland. The territory includes the Ob floodplain with tributaries, oxbowx, swampy sandy terraces (Bazilevich, Shavrygin, 1959).

The climate of the Biysk-Chumysh Upland is characterized by continentality. Precipitation amounts to 400-500 mm (165-170 mm out of which account for May - July) (Rozanov, 1959). On the whole, the well-drained territory of the Biysk-Chumysh Upland is the reason for the development of a relatively homogeneous soil cover with very strict and simple interdigitation of soil varieties along the relief elements (zonal soil type on watersheds; hydromorphic types in the valleys; forest soils or eroded variants of zonal soil type along the slopes of erosive forms) (Kravtsova, 1959; Omelyanov, 1973). Most of the territory here is composed of the Lower Quaternary sands, overlaid by a thick blanket of loess loams, except for the ancient terraces of the Ob, where the rocks of the Middle Quaternary age are analogous to the sediments on the Priob plateau. Leached chernozems found on the Biysk-Chumysh Upland and on the right bank of the Chumysh river are especially widespread (Rozanov, 1959).

The information on the vegetation of the Biysk-Chumysh Upland (within the territory of Altai Krai) is scarce and is covered in the works of P. P. Polyakov (1934), V. D. Alexandrova, N. P. Guricheva, L. I. Ivanina (1958), A. V. Ronginskaya (1963), G. G. Sokolova (2002), N. V. Ovcharova, S. M. Yamalov (2013), N. N. Makunina, A. Yu. Korolyuk, T. V. Maltseva (2010).

According to the geobotanical zoning by A. V. Kuminova, T. A. Vagina, E. I. Lapshina (1963) the flat part of the Ob river right bank belongs to the subprovince of the Right-Bank Priob forest steppe, the Biysk-Chumysh forest steppe district. According to the scheme of the geobotanical zoning of Altai Krai (Aleksandrova, Guricheva, Ivanina, 1958), the territory under study belongs to the subzone of the middle forest steppe on leached chernozems and gray forest soils.

The purpose of this work was to identify the syntaxonomic diversity of vegetation of the *Molinio-Arrhenatheretea* class on the Biysk-Chumysh Upland (Altai Krai).

Materials and Methods

The work is based on 230 complete geobotanical descriptions made by N. V. Ovcharova, T. A. Teryokhina, N. V. Elesova on the territory of 5 districts within Altai Krai (Kosikhinskiy, Troitskiy, Zonalniy, Biyskiy, Tselinniy districts) (Figure 1).

Geobotanical descriptions were made on the 10x10 m^2 sites. The contribution of species into the vegetation cover was assessed according to the Braun-Blanquet scale (Mirkin, Naumova, Solomeshch, 2001): r – single samples of the species were found on the site; + - the projective cover of the species accounts for up to 1%; 1 – the species has a projective cover of 1 to 5%; 2 – from 5 to 25%; 3 – from 25 to 50%; 4 – from 50 to 75%; 5 – 75% and more. When compiling synoptic tables, the constancy scale was used: r – 0.1-5%; + – 6-10%; I – 11-20%; II – 21-40%; III – 41-60%; IV – 61-80%; V – 81-100%.

We created a database of geobotanical descriptions, based on the TURBOVEG program (Hennekens, 1996). The classification was carried out with the application of the ecological-floristic approach (Westhoff, van der Maarel, 1973; Dierschke, 1994) using the JUICE 7.0 software package. (Tichý, 2002). The nomenclature of syntaxonomic units is made in accordance with the Code of phytosociological nomenclature (Weber et al., 2000). To define and describe syntaxons, we used diagnostic species, which include a combination of characteristic differential and constant species (Westhoff, van der Maarel, 1973).

Meadow vegetation of the studied area is used for haymaking and grazing; some meadows represent idle land phytocenoses of various ages. When characterising each syntaxon, the type of use (haying, grazing, idle land) is specifically mentioned.
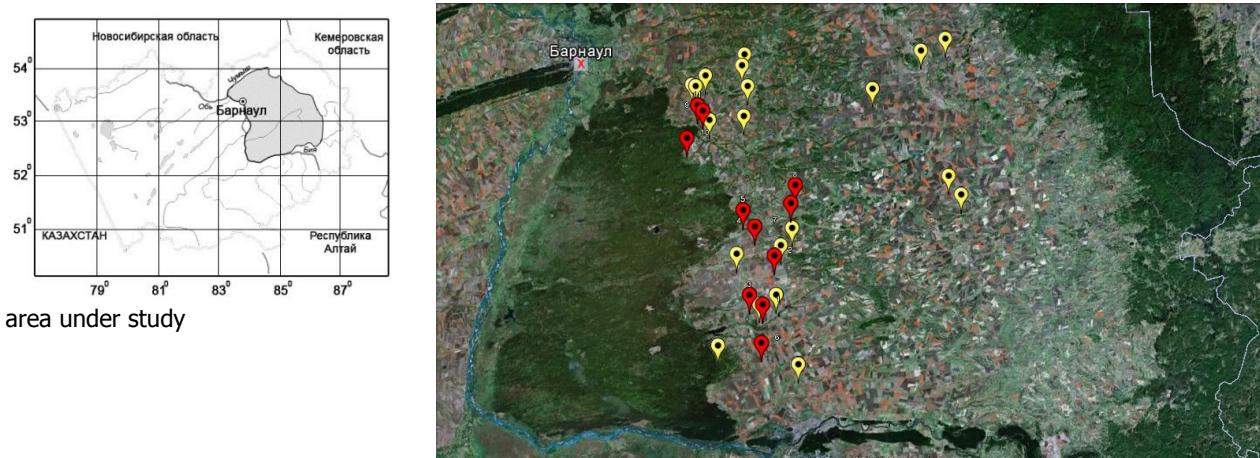
Figure 1. Location of key sites (red dots) and sites where route studies were performed (yellow dots) on the territory of Altai Krai.

Results

Syntaxonomic analysis of the *Molinio-Arrhenatheretea* class communities on the territory of the Biysk-Chumysh Upland (Altai Krai) revealed 1 association, 9 rankless communities of 3 orders. The prodromus features the identified units and their position in the system of higher units, according to the prodromus of the Russian vegetation (Ermakov, 2012) (Table 1).

Prodromus of the *Molinio-Arrhenatheretea* class communities

Class **MOLINIO-ARRHENATHERETEA** R. Tx. 1937
Order ***MOLINIETALIA*** Koch 1926
Potentillion anserinae R. Tx. 1947 alliance
Community ***Agrostis stolonifera***
Order ***ARRHENATHERETALIA*** R. Tx. 1931
Festucion pratensis Sipajlova et al. 1985 alliance
Festuco pratensis-Dactyletum glomeratae Dymina in Maltseva et Macunina 2008 association
Community ***Bromopsis inermis***
Community ***Poa pratensis***
Community ***Agrostis clavata***
Community ***Agrostis tenuis***
Order ***GALIETALIA VERI*** Mirk. et Naumova 1986
Trifolion montani Naumova 1986 alliance
Community ***Poa angustifolia***
Community ***Elytrigia repens***
Community ***Nonea pulla-Poa angustifolia***
Community ***Vicia amoena-Poa angustifolia***

Table 1. Abridged synoptical table of the *Molinio-Arrhenatheretea* class communities.

Syntaxon number	1	2	3	4	5	6	7	8	9	10
Number of descriptions	8	21	12	12	23	8	29	26	20	19
Average number of species per 100 m^2	22	19	16	20	21	16	18	21	22	19
Use	H	P	P	P	P	P	P	H	IL,P	IL,P
D.s. of ***Poa angustifolia*** community										
Poa angustifolia	.	II	II	V$^{2-3}$	I	II	r	II	V^{r-3}	V$^{2-4}$
D.s. of ***Agrostis tenuis*** community										
Pimpinella saxifraga	II	r	.	II	V^{r-3}	.	I	II	.	+
Plantago lanceolata	.	.	+	I	IV	.	.	.	.	.
Trifolium arvense	.	.	.	II	IV	.	.	.	.	.
Lotus ucrainicus	.	.	.	.	III	.	.	.	.	.
D.s. of ***Elytrigia repens*** community										
Elytrigia repens	I	IV	II	III	r	V$^{2-3}$	I	r	r	II
Festuca pseudovina	.	.	+	.	.	III	.	.	.	.
D.s. of ***Agrostis clavata*** community										
Agrostis clavata	.	.	+	.	.	.	V^{r-3}	.	.	.

Amoria hybrida	I	II	I	I	I	.	III	II	.	.

D.s. of **Festuco pratensis-Dactyletum glomeratae** association

Dactylis glomerata	V	V	III	II	r	II	V	V$^{2-4}$	r	I

D.s. of **Nonea pulla-Poa angustifolia** community

Nonea pulla	II	r	II	II	r	I	.	+	IV	II

D.s. of **Vicia amoena-Poa angustifolia** community

Vicia amoena	II	.	+	II	+	III	I	II	II	V^{r-4}
Filipendula vulgaris	.	.	.	+	r	.	I	I	II	V
Phlomoides tuberosa	I	.	+	.	.	.	.	r	II	IV
Fragaria viridis	.	r	.	II	r	.	.	+	III	IV
Trommsdorfia maculata	.	r	.	.	.	.	.	.	II	IV

D.s. of **Molinio-Arrhenatheretea** class

Trifolium pratense	IV	III	II	III	V	IV	II	V	+	.
Stellaria graminea	IV	IV	III	II	IV	I	V	III	II	II
Vicia cracca	V	III	III	.	IV	I	III	III	III	+
Achillea millefolium	II	II	III	I	II	.	II	I	II	II
Phleum pratense	II	IV	III	II	I	II	III	IV	.	I
Galium mollugo	I	+	+	+	III	IV	II	IV	I	II
Leucanthemum vulgare	III	II	+	.	II	.	IV	IV	II	I
Plantago media	II	I	II	III	I	I	.	r	III	I
Ranunculus polyanthemos	II	II	.	+	+	.	II	I	I	+
Agrostis gigantea	I	.	.	.	.	.	.	r	.	.
Festuca pratensis	IV	r	.	I	+	I	.	II	.	.
Lathyrus pratensis	II	.	.	.	r	.	.	r	.	.
Carum carvi	.	.	.	I	r	I	.	+	.	.

D.s. of **Festuco-Brometea** class

Medicago falcata	III	II	III	IV	II	IV	II	II	V$^{2-3}$	V
Centaurea scabiosa	I	r	I	I	r	III	III	I	III	V
Galium verum	I	r	.	III	I	.	II	II	IV	IV

Onobrychis arenaria	IV	.	II	II	.	.	II	II	.	.
Veronica spicata	.	+	.	+	.	.	.	r	III	I
Adonis vernalis	.	.	.	.	.	.	.	.	II	II
Dracocephalum thymiflorum	.	.	+	.	I	.	.	r	I	III

D.s. of **Trifolio-Geranietea** class

Crepis tectorum	II	II	III	II	r	I	II	III	r	+
Agrimonia pilosa	.	+	+	II	II	IV	II	+	II	II
Veronica chamaedrys	II	II	.	.	IV	.	II	II	r	+
Origanum vulgare	.	I	.	.	r	I	.	.	+	+
Hypericum perforatum	I	I	.	.	IV	I	III	III	+	I
Anthemis tinctoria	.	.	.	.	II	.	.	r	.	.

D.s. of **Stellarietea media** class

Convolvulus arvensis	V	IV	III	V	III	II	IV	V	II	I
Chenopodium album	II	.	.	+	.	.	.	r	I	.
Conyza canadensis	.	I	I	I	r	III	.	.	.	.
Matricaria recutita	.	+	.	.	.	IV	.	r	.	.
Sisymbrium loeselii	II	.	I	+	.	.	.	.	.	.
Lathyrus tuberosus	I	IV	II	+	.	.	.	.	.	.
Pastinaca sylvestris	I	.	.	+	.	.	.	+	.	.
Cirsium arvense	II	.	.	.	.	.	r	.	.	.

<div align="center">D.s. of Artemisietea vulgaris class</div>

Berteroa incana	II	V	IV	V	III	V	III	V	V	III
Potentilla argentea	IV	V	V	IV	III	V	V	III	V	II
Artemisia sieversiana	I	III	III	II	I	III	III	.	II	+
Achillea asiatica	I	I	II	III	IV	V	II	II	I	II
Linaria vulgaris	II	III	II	II	III	IV	+	III	.	+
Echium vulgare	.	III	III	I	IV	III	V	IV	IV	III
Urtica dioica	.	+	II	.	.	.	.	.	.	.
Melandrium album	III	I	.	.	r	.	I	II	r	.
Cichorium intybus	II	I	.	II	I	.	I	II	r	.
Picris hieracioides	.	.	.	+	.	.	.	.	.	.
Nonea rossica	II	r	.	III	+	.	.	I	.	I
Melilotus officinalis	I	.	.	II	r	.	.	.	.	.
Bunias orientalis	II	.	+	II	.	.	.	I	.	.
Carduus crispus	.	r	+	II	.	.	.	+	+	.
Melilotus albus	I	.	.	+	.	.	.	+	.	.

<div align="center">D.s. of Polygono arenastri-Poetea annuae class</div>

Taraxacum officinale	III	II	I	III	II	.	II	II	r	+
Amoria repens	I	III	III	II	II	V	I	II	r	.
Plantago major	I	.	.	.	.	.	.	r	.	.

Note. D.s. – diagnostic species, highlighted with colour. Use: IL – idle land, P – pasture, H – hayfield. Syntaxons: 1 – community **Bromopsis inermis**; 2 – community **Agrostis stolonifera**; 3 – community **Poa pratensis**; 4 – community **Poa angustifolia**; 5 – community **Agrostis tenuis**, 6 – community **Elytrigia repens**; 7 – community **Agrostis clavata**; 8 - association **Festuco pratensis-Dactyletum glomeratae**, 9 – community **Nonea pulla**-**Poa angustifolia**; 10 – community **Vicia amoena-Poa angustifolia.**

<div align="center">MOLINIO-ARRHENATHERETEA class</div>

Diagnostic species: *Achillea millefolium, Agrostis gigantea, Bromopsis inermis, Carum carvi, Dactylis glomerata, Elytrigia repens, Festuca pratensis, Geranium pratense, Lathyrus pratensis, Leucanthemum vulgare, Phleum pratense, Plantago media, Poa pratensis, Ranunculus polyanthemos, Stellaria graminea, Trifolium pratense, Vicia cracca.*

The **Molinio-Arrhenatheretea** class encompasses secondary post-forest meadows of the Eurasia temperate zone on relatively rich non-saline soils. Communities are formed as a result of deforestation (broad-leaved, mixed, coniferous forests) with a subsequent mowing or grazing use of the territory. For this reason, the basis of the grassstand is comprised of species adapted to restore phytomass after regular disposal – mowing or grazing.

The range of the class covers the whole of Western, Central and Eastern Europe, most of Russia from the western borders to the Far East (Tüxen, Preising, 1951; Dierschke, 1995, 1997; Schaminee et al., 1996 Ermakov et al., 1999; Matuszkiewicz, 1984; Mucina et al., 1993; Korolyuk, Kipriyanova, 1998; Rodwell et al., 2007; Janišova et al., 2007; Vegetace…, 2007; Korolyuk, Makunina, 2000, 2001; Makunina, Maltseva, 2003; Lashinskiy, 2009; Averinova, 2010; Yamalov, 2011, etc.). The class communities are well represented in the Transbaikal and Yakutia regions. In the south of the Far East, it is replaced by the East Siberian Far Eastern vicariant classes **Calamagrostietea langsdorffii** Mirkin in Akhtyamov et al. 1985 (Akhtyamov, 1995; 2000; Anenkhonov, 2003) and **Arundinello anomalae – Agrostietea trinii** Ermakov et Krestov 2009 (Ermakov, Krestov, 2009).

In the territory under study, the class is represented by three orders **Molinietalia**, **Arrhenatheretalia**, **Galietalia veri**, which comprise wet, real and steppe meadows respectively.

MOLINIETALIA Koch 1926 order

Diagnostic species: *Agrostis stolonifera, Potentilla anserina.*

The order comprises wet meadows, which floristic composition is characterised by the dominance of water resistant species. On the gradient of environmental conditions, on one side, they border on the well-hydrated meadows of the **Arrhenatheretalia** order, and on the communities of eutrophic high sedge and grass bogs of the **Magnocaricetalia** order (**Phragmiti-Magnocaricetea** class) on the other side. Only one community of meadows is assigned to this order in the **Potentillion anserinae** alliance system.

Potentillion anserinae R. Tx. 1947 alliance

It unites the communities of plants resistant to grazing and trampling, growing on waterlogged soils in the conditions of intensive grazing. It is formed in depressions along the banks of ponds, rivers, and streams on annually flooded habitats (Passarge 1964; Ellmauer, Mucina, 1993; Vegetace.., 2007; Grigoryev et al., 2002; Cherosov et al., 2005).

<div align="center">Agrostis stolonifera community</div>

Diagnostic species: *Agrostis stolonifera.*

It comprises communities with intensive grazing use. They are common for low habitats with moderate soil moistening in the Kosikhinskiy district.

The projective cover of the grassstand varies from 55 to 75%. Despite the anthropogenic load, the species range of the communities remains rather high and averages 19 species per 100 m^2. The height of the grassstand is 65 cm on average.

The group of the **Molinio-Arrhenatheretea** class meadow species (*Dactylis glomerata, Stellaria graminea, Trifolium pratense, Phleum pratense*) is encountered with high constancy. The proportion of species of the **Trifolio-Geranietea** class forest edge and woodland communities (*Agrimonia pilosa, Hypericum perforatum, Origanum vulgare, Veronica chamaedrys*) is not high. A noticeable part of the grass stand is a group of synanthropic herbaceous species of the **Artemisietea vulgaris** class (*Berteroa incana, Echium vulgare, Arctium tomentosum, Artemisia sieversiana*, etc.). A significant role in the floristic composition belongs to species of the **Polygono arenastri-Poetea annuae** class that withstand trampling and high pasture load – *Amoria repens, Taraxacum officinale*. When trampling is reduced or stopped, meadow species of the **Molinio-Arrhenatheretea** class insinuate into the community.

It differs from other communities in a more mesophytic composition and a higher proportion of meadow species, which indicates the formation of natural vegetation, but pasture load blocks restoration.

ARRHENATHERETALIA order

Diagnostic species of the order = diagnostic species of the class.

The order is characteristic of the well-hydrated meadows in the temperate zone of Eurasia. The grass stand is based on typical mesophytes that participate in the class communities. Habitats are most often characterized by rich soils and moderate moistening. On the gradient of humidification, as the leading differentiating factor of the **Molinio-Arrhenatheretea** class meadows, communities of the **Arrhenatheretalia** order border on the wet meadows of the **Molinietalia** order on the one side and on the steppe meadows of the **Galietalia veri** order on the other side.

In the classification by dominants traditional for Soviet geobotany, the order corresponds in its volume to the class of "true" meadow formations that were the object for many researchers of meadow vegetation in the USSR (Shennikov, 1923, 1938; Alekhin, 1925; Balandin, 1929; Nitsenko, 1955; Nomokonov, 1959, 1962; Sabardina, 1957, etc.).

Mesophytes that are included in the diagnostic combination of the **Molinio-Arrhenatheretea** class – *Achillea millefolium, Dactylis glomerata, Elytrigia repens, Phleum pratense, Poa pratensis, Ranunculus polyanthemos, Trifolium pratense, Vicia cracca, etc*. – dominate in the floristic composition of the order communities.

In the studied area, all the communities of the order are assigned to the central **Festucion pratensis** alliance.

Festucion pratensis Sipajlova et al. 1985 alliance

Diagnostic species of the alliance = diagnostic species of the order.

 The alliance is typical for hayfields or mowing and grazing communities with a low pasture load. The grass stand is dominated by grasses *Agrostis gigantea, Alopecurus pratensis, Bromopsis inermis, Dactylis glomerata, Festuca pratensis, Phleum pratensis, Poa pratensis*. Besides, such herbs as *Geranium pratense, Lathyrus pratensis, Leucanthemum vulgare, Vicia cracca* actively participate in the composition of the alliance communities. It includes the most typical communities of the **Molinio-Arrhenatheretea** class. In the conditions of forest and forest-steppe zones, the communities occupy upland and floodplain habitats.

According to the Soviet classification by dominants, tall grass meadows formation group include the following formations: bromegrass, bromegrass-quackgrass meadows, foxtail and red-tailed fescue meadows (Shennikov, 1938). Associations of this alliance, determined by the Braun-Blanquet method, basically coincide in volume with the formations listed.

The alliance was first described in Ukraine (Sipaylova et al., 1985). According to its initial interpretation, it unites meadow communities on rich soils in Eastern Europe and Siberia and is a vicariant of the **Arrhenatherion elatioris** Luquet 1926 alliance in Western Europe (Balevičienė et al., 1998; Bulokhov, 2001; Kuzyarin, 2008; Bulokhov, Kharin, 2008; Kuzemko, 2009; Averinova, 2010).

The alliance includes 4 communities and one association.

Bromopsis inermis community

Diagnostic species: *Bromopsis inermis*.

The community encompasses meadows common for upland habitats with moderate soil moistening. They are spread throughout the Biysk-Chumysh Upland (within the territory of Altai Krai). These communities are caracterised by a haying mode of use.

The projective cover of the grass stand varies from 60 to 100%. The number of species per 100 m^2 averages 22 (from 19 to 31 species). The height of the grass stand is 65 cm on average.

The community is characterized by a constant dominance of *Bromopsis inermis* and active participation of the **Molinio-Arrhenatheretea** class (*Dactylis glomerata, Vicia cracca, Festuca pratensis, Stellaria graminea, Trifolium pratense*), **Festuco-Brometea** class (*Onobrychis arenaria, Medicago falcata*) species. The participation of synanthropic species is not significant: only *Potentilla argentea* and *Convolvulus arvensis* are frequently encountered.

The **Brometum inermis** is distinguished from the close communities of the **Convolvulo arvensis** association by a larger range of species, a smaller proportion of synanthropic species and a higher proportion of meadow ones.

Poa pratensis community

Diagnostic species: *Poa pratensis*.

The community comprises meadows common for upland habitats with moderate soil moistening. They are spread in Kosikhinsky and Zonalniy districts. It unites the communities used as pasture, less often as hayfields with irregular mowing mode. The boundaries between the communities of mowing and grazing use are fuzzy. The communities easily transform into each other when the mode of use is changed.

The projective cover of the grass stand varies from 60 to 75%. The number of species per 100 m^2 averages 16. The height of the grass stand is 55 cm on average.

A group of meadow species of the **Molinio-Arrhenatheretea** class (*Phleum pratense, Vicia cracca, Achillea millefolium, Galium boreale, Bromopsis inermis,* etc.) is highly constant. A noticeable part of the grass stand is a group of meadow steppe species of the **Festuco-Brometea** class (*Medicago falcata, Poa angustifolia, Onobrychis arenaria*). The short grass group is represented by *Amoria repens, Taraxacum officinale, Poa pratensis*.

The community is closest to the **Poa angustifolia** one, however differs from it in its floristic composition which is less xerophytic due to less drained habitats

Agrostis tenuis community

Diagnostic species: *Agrostis tenuis, Lotus ucrainicus, Pimpinella saxifraga, Plantago lanceolata, Trifolium arvense.*

The community comprises meadows spread in upland habitats with moderate soil moistening. They are described in Troitskiy and Kosikhinskiy districts in the more depressed areas and are used as pastures.

The average number of species on the site is 21. The average height of the grass stand is 55 cm. The projective cover of the grass stand varies from 70 to 100%.

A group of meadow species of the **Molinio-Arrhenatheretea** class (*Poa pratensis, Pimpinella saxifraga, Stellaria graminea, Trifolium pratense, Vicia cracca, Achillea asiatica*, etc.) and pasture species of the **Polygono arenastri-Poetea annuae** class (*Amoria repens, Taraxacum officinale*) are highly constant in the floristic composition. The proportion of synanthropic biennial and perennial species of the **Artemisietea vulgaris** class remains significant in the composition of the grass stand (*Echium vulgare, Artemisia absinthium, Berteroa incana, Linaria vulgaris*, etc.).

It differs from other idle land communities in a relatively low proportion of annual and biennial weeds, representing the initial stages of progressive successions after the disturbances of the **Stellarietea mediae** class as well as in an increase in the proportion of meadow species of the **Molinio-Arrhenatheretea** class and species of forest edges and woodlands of **Trifolio-Geranietea** (*Hypericum perforatum, Veronica chamaedrys, Agrimonia pilosa* and others).

Agrostis clavata community

Diagnostic species: *Agrostis clavata, Amoria hybrida.*

The community encompasses meadows formed in the conditions of normal and excessive moistening, confined to more acidic soils. They are described in Kosikhinskiy district and are used as pastures.

The average number of species on the site is 18. The average height of the grass stand is 60 cm. The projective cover of the grass stand varies from 70 to 90%.

A group of meadow species of the **Molinio-Arrhenatheretea** class (*Dactylis glomerata, Stellaria graminea, Poa pratensis, Bromopsis inermis, Galium mollugo, Leucanthemum vulgare, Phleum pratense*) is highly constant. The synanthropic fraction of cenoflora includes species of the **Artemisietea vulgaris** and **Stellarietea mediae** classes (*Echium vulgare, Potentilla argentea, Berteroa incana, Convolvulus arvensis, Artemisia sieversiana*). Pasture species of the **Polygono arenastri-Poetea annuae** class are encountered with low constancy and abundance.

It differs from other communities by a more mesophytic composition of species of the **Molinio-Arrhenatheretea** class, which is associated with the specificity of more hydrated habitats.

Festuco pratensis-*Dactyletum glomeratae* Dymina in Maltseva et Macunina 2008 association

Diagnostic species: *Dactylis glomerata.*

The community comprises dry meadows, spread in the conditions of sufficient moistening in all areas of the Biysk-Chumysh Upland (Altai Territory). They are located on meadow and meadow chernozem soils on smooth slopes. The mode of use is haying.

The projective cover of the grass stand varies from 70 to 100%. The number of species per 100 m^2 averages 29. The height of the grass stand is 65-70 cm on average.

Besides cocksfoot – *Dactylis glomerata,* other grasses, mainly rootstock loose-bunch grasses (*Poa pratensis, Festuca pratensis, Phleum pratense)* take a significant part in the formation of the grass cover. A group of meadow species of the **Molinio-Arrhenatheretea** class (*Agrostis tenuis, Galium mollugo, Phleum pratense, Trifolium pratense, Leucanthemum vulgare*) is highly constant. A notable part of the stand is composed of synanthropic species of the **Stellarietea mediae** class (*Berteroa incana, Convolvulus arvensis, Echium vulgare*, etc.).

It differs from other studied communities by the predominance of meadow grasses. The association has a wide range in Siberia, its communities are widespread in the subtaiga and forest steppe regions of the Ob-Yenisei interfluve, the subtaiga forest steppe belt of Salair, Kuznetsk Alatau, Western and Eastern Sayan (Dymina, 1989; Makunina, Maltseva, 2003).

GALIETALIA VERI Mirk. et Naumova 1986 order

Diagnostic species: *Amoria montana, Astragalus danicus, Centaurea scabiosa, Filipendula vulgaris, Fragaria viridis, Galium verum, Medicago falcata, Phleum phleoides, Phlomoides tuberosa, Poa angustifolia, Rosa majalis, Seseli libanotis, Stipa pennata, Thalictrum minus, Veronica spicata.*

The order unites the communities, cenoflora of which combines species of true meadows and meadow steppes, that is usually called steppe meadows in the literature (Shennikov, 1938). The climate changing, steppe meadows transform into meadow steppes. Thus, steppe meadows are ecotones between true meadows and meadow steppes.

A specific feature of the communities in this order is the simultaneous growth of typically meadow species of the **Molinio-Arrhenatheretea** class and the **Arrhenatheretalia** order (*Achillea millefolium, Bromopsis inermis, Elytrigia repens, Festuca pratensis, Geranium pratense, Lathyrus pratensis, Trifolium pratense, Vicia cracca*, etc.) together with meadow steppe species of the **Festuco-Brometea** Br.-Bl. et Tx. 1943 class (*Amoria montana, Centaurea scabiosa, Filipendula vulgaris, Festuca pseudovina, Galium verum, Poa angustifolia, Phleum phleoides, Phlomoides tuberosa, Medicago falcata,* etc.).

On the humidification gradient, communities of the order border on well-hydrated meadows of the **Arrhenatheretalia** order on one side and on the communities of the **Festuco-Brometea** class, uniting xerothermic and hemixerothermic steppe communities on the other side. The diagnostic combination of the **Galietalia veri** order consists mainly of steppe and meadow steppe species, which are also used to diagnose the **Festuco-Brometea** class (and its more mesophytic wing – the **Festucetalia valesiacea** order), which, in this case, act as differentiating species, separating the **Galietalia veri** steppe meadows from meadows of the **Arrhenatheretalia** order. Communities of the **Galietalia veri** order are distinguished from typical steppe communities of the **Festuco-Brometea** class by the presence of mesophilic meadow species of the **Molinio-Arrhenatheretea** class.

The communities we studied are classified as part of the central **Trifolion montani** alliance.

Trifolion montani Naumova 1986 alliance

Diagnostic species of the alliance = Diagnostic species of the order.

It is the central alliance of the order, comprising its most typical communities.

The alliance includes 4 communities.

Poa angustifolia community

Diagnostic species: *Poa angustifolia*.

The community encompasses steppe meadows, widespread in the conditions of insufficient moistening in all areas of the Biysk-Chumysh Upland (within the territory of Altai Krai). Habitats are located on elevated relief features. They are used as pastures.

The projective cover of the grass stand varies from 50 to 90%. The number of species per 100 m^2 averages 20. The height of the grass stand is 55 cm on average.

The physiognomy of the community is determined by the dominance of the narrow-leaved bluegrass – *Poa angustifolia*. A group of meadow mesophytes of the **Molinio-Arrhenatheretea** class (*Bromopsis inermis, Achillea asiatica, Trifolium pratense*) is highly constant and abundant. A significant proportion of the grass stand is composed of the group of meadow-steppe species of the **Festuco-Brometea** class (*Medicago falcata, Galium verum, Centaurea scabiosa*, etc.). Synanthropic species of the **Artemisietea vulgaris** class (*Berteroa incana, Potentilla argentea, Nonea rossica*) are encountered with relatively high constancy (III-V points).

It differs from the close **Poa pratensis** community by a more xerophytic floristic composition due to more drained habitats.

Elytrigia repens community

Diagnostic species: *Elytrigia repens*, *Festuca pseudovina*.

It encompasses steppe meadows, which physiognomy is determined by the dominance of the Eurasian species *Elytrigia repens*. They are common for abandoned arable lands, on the edges of fields, along field roads, near villages in Kosikhinskiy district. The community use is grazing.

The projective cover of the grass stand varies from 55 to 70%. The number of species per 100 m^2 averages 16. The height of the grass stand is 45 cm on average.

Meadow species of the **Molinio-Arrhenatheretea** class (*Galium mollugo, Trifolium pratense, Poa pratensis*, etc.) participate in the composition of the grass stand. A group of ruderal species of the **Artemisietea vulgaris** class (*Achillea asiatica, Berteroa incana, Potentilla argentea, Linaria vulgaris*) is active. Meadow-steppe species of the **Galietalia veri, Festuco-Brometea** order (*Medicago falcata, Centaurea scabiosa, Vicia amoena*) are highly constant. A significant part of the grass stand is composed of synanthropic species of the **Stellarietea mediae** class (*Matricaria recutita, Conyza canadensis, Convolvulus arvensis*), **Artemisietea vulgaris** class (*Berteroa incana, Achillea asiatica, Echium vulgare*, etc.). *Amoria repens* resistant to trampling and grazing is rather frequent. The share of apophytes is high.

The community is an advanced stage of a progresssive succession of vegetation. It is close to associations of idle lands of Western and Eastern **Convolvulo arvensis-Elytrigietum repentis** Felföldy 1943 (Arepieva, 2012) and **Pastinaco sylvestris-Elytrigietum repentis** Ishbirdin in Ishbirdin et al. 1988. However, the communities that we described differ from them by a higher constancy of meadow species of the **Molinio-Arrhenatheretea** class in the floristic composition, as well as by the presence of *Festuca pseudovina* in the cenoflora.

Nonea pulla-Poa angustifolia community

Diagnostic species: *Poa angustifolia*, *Nonea pulla*.

The community comprises steppe meadows, common in the conditions of insufficient moistening in Kosikhinskiy district. Communities are not used; in rare cases, limited grazing is observed.

The projective cover of the grass stand varies from 60 to 100%. The number of species per 100 m^2 averages 22. The height of the grass stand is 50 cm on average.

The core of the floristic composition is composed of meadow steppe species of the **Galietalia veri** order and **Festuco-Brometea** class (*Medicago falcata, Scabiosa ochroleuca, Phleum phleoides, Centaurea scabiosa, Galium verum*). Meadow mesophytes of the **Molinio-Arrhenatheretea** class are less represented, only *Poa pratensis* and *Vicia cracca* have constancy class III.

A noticeable part of the grass stand is composed of species of the **Artemisietea vulgaris** and **Stellarietea mediae** classes (*Nonea pulla, Berteroa incana, Potentilla argentea, Echium vulgare, Achillea millefolium, Convolvulus arvensis*).

They differ from other communities by a more xerophytic composition.

Vicia amoena-Poa angustifolia community

Diagnostic species: *Poa angustifolia, Vicia amoena, Filipendula vulgaris, Fragaria viridis, Phlomoides tuberosa, Trommsdorfia maculata*.

The community comprises steppe meadows widespread in the conditions of insufficient moisture in Tselinniy, Kosikhinskiy districts. The territory is not used at all or limited grazing is observed.

The projective cover of the grass stand varies from 70 to 100%. The number of species per 100 m^2 averages 22. The height of the grass stand is 50 cm on average.

A group of meadow steppe species of the **Festucetalia valesiace** order, **Festuco-Brometea** class (*Centaurea scabiosa, Medicago falcata, Scabiosa ochroleuca, Galium verum, Phleum phleoides*) is highly constant. Meadow species of the **Molinio-Arrhenatheretea** class (*Rumex acetosa, Dactylis glomerata, Elytrigia repens, Leucanthemum vulgare, Plantago media*, etc.) and species of the **Artemisietea vulgaris** class (*Dracocephalum thymiflorum, Echium vulgare*, etc.) take a significant share in the grass stand.

It differs from other communities by the predominance of steppe and meadow steppe species and represents the most advanced stage towards the formation of meadow steppes of the **Festuco-Brometea** class.

Conclusion

The meadow phytocenoses of the *Molinio-Arrhenatheretea* class are represented by three orders (*Molinietalia, Arrhenatheretalia, Galietalia veri*), which comprise wet, true and steppe meadows, respectively. The syntaxonomic analysis of the studied area revealed 1 association, 9 rankless communities, which are characterized by leading environmental factors (humidification gradient) and the level of use (grazing, haying, idle land).

The *Molinietalia* order encompasses wet meadows, which are mostly formed in the northern part of the Biysk-Chumysh Upland, in the floristic composition of which water-resistant species predominate. Only one community of meadows (the **Agrostis stolonifera** community) is assigned to this order in the *Potentillion anserinae* alliance system. The *Potentillion anserinae* alliance unites the

communities that are resistant to grazing, trampling of plants growing on waterlogged soils in the conditions of intensive grazing. It is encountered in depressions along the banks of ponds, rivers and streams. The *Arrhenatheretalia* order comprises well-hydrated meadows. The core of the grass stand is composed of typical mesophytes that participate in the communities of the class. Habitats are most often characterized by rich soils and moderate moistening. In the studied area, all the order communities are assigned to the central *Festucion pratensis* alliance. The alliance unites hayfields, or mowing and grazing communities with a low pasture load. The communities of this alliance occupy the upland and flood plain habitats of the Biysk-Chumysh Upland.

The *Galietalia veri* order encompasses the communities which cenoflora comprises species of true meadows and meadow steppes. A specific feature of this order communities is the simultaneous growth of typically meadow species of the *Molinio-Arrhenatheretea* class and the *Arrhenatheretalia* order and meadow steppe species of the *Festuco-Brometea* class.

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