

The Genus *Kobresia* Willd. (Cyperaceae Juss.) in the flora of Mongolia

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Abstract

Taxonomic position of the Mongolian bog sedge species belonging to the genus *Kobresia* is revised. Seven species and one subspecies are recorded in the Mongolian Flora. Identification keys for the species, conspectus of all taxa and data on their habit, ecology and distribution in Mongolia are given. Distribution types are classified. Briefly discussed about history of dispersal of *Kobresia*-species in the Mongolian territory.

Key words: *Kobresia*, Cyperaceae, systematics, Mongolian Flora

Introduction

The genus *Kobresia* belongs to the most advanced tribe Cariceae in the family Cyperaceae, while this genus is primitive in the tribe. About 35 species of this genus are distributed in the temperate to frigid zones of the Northern Hemisphere. Almost all species are found in Asia.

The studies of this genus in the Mongolian flora have been conducted in the frame of flora research, but the detailed study defining the members of the genus is still lacking. Some data on identification of the species, species conspectus, habitat, distribution and edibility are can be found in the works by Grubov (1955, 1982), Yunatov (1968), Ulziikhutag (1985), Gubanov (1996) and others. The present work is a part of an ongoing project for creating the "Flora of Mongolia".

Materials and Methods

The collections of the *Kobresia*-species from the Herbarium of the Institute of Botany, Mongolian Academy of Sciences (UBA) and the Herbarium of the National University of Mongolia (UBU) as well as additional literature data are used for the present study. There are 252 sheets of specimens in total, which were collected by a number of scientists between 1928 and 1997. This study was conducted using traditional methods of plant systematics, i.e. the identification keys to the flora of Mongolia, Siberia, Central Asia and USSR were used to identify species status and to gather information on the species distribution (Sergievskaya, 1935; Egorova, 1967, 1983;

Grubov, 1982; Doronkin, 1990). The nomenclature was followed by Egorova (1983) and her key was partially used for the keys to the species. Distributions of the species in Mongolia are given in Gubanov (1996), ecological group classification is followed as in Ulziikhutag (1989), names and limits of the phytochoria for the distribution type definition are according to those in Takhtajan (1978). Species habitats are described mainly on the basis of collection data. In the following parts, species are listed in alphabetical order. Similarity index of the species is calculated using EstimateS 6.0b1, Statistical calculations with StatSoft 5.5; SPSS programs.

Results

Systematical overview of the genus *Kobresia* in the flora of Mongolia. Species composition of the genus in Grubov (1982) and Gubanov (1996) has been changed as follows. It is revealed that seven species and one subspecies of *Kobresia* occur in the Mongolian Flora. From the Gubanov's list a species, *K. simpliciuscula* (Wahlenb.) Mackenz. is excluded. According to Doronkin (1990), the nominal subspecies of this species is distributed in Europe (Scandinavia, England, Pyrenees and Carpathian mountains) only. Previous data on this species now belongs to *K. simpliciuscula* subsp. *subgolarctica* Egor.

Key to the species and subspecies of *Kobresia*

1. Perigynia utricle like, closed up to middle. Scales and perigynia ca. 10 mm long

- *K. robusta*
 - Perigynia margins free to base. Scales and perigynia shorter than 10 mm. 2.
 2. Abundant bladeless sheaths at the stem base. Stems cylindrical up to tip 3.
 - Basal sheaths bearing blades. Stems triangular up to tip 7.
 3. Stems thick. Basal sheaths broad. Roots more or less thick, hairy 4.
 - Stems slender. Basal sheaths narrow. Roots narrow, hairless 5.
 4. Perigynium enclosing additional 2 to 3 sterile scales *K. sibirica*
 - Perigynium not enclosing additional scales *K. smirnovii*
 5. Inflorescences compound spike. Styles 2 to 3-fid. *K. filifolia*
 - Inflorescences simple spike. Styles 3-fid 6.
 6. Spikelets 2-flowered with 1 pistillate flower and 1 staminate flower. Scales 2.5-3 mm long. Leaves soft. *K. myosuroides*
 - Spikelets many flowered with 1 pistillate flower and 1-4 staminate flowers. Scales 4-5.5 mm long. Leaves not soft. *K. capilliformis*
 7. Inflorescences usually simple spike. 3-10 (13) cm tall plant *K. humilis*
 - Inflorescences compound spike. 10-40 cm tall plant
 *K. simpliciuscula* subsp. *subgolarctica*

Species conspectus of *Kobresia* in the flora of Mongolia. *Kobresia* Willd. 1805, Sp. pl. 4: 205; Benth. et Hook. f. 1883, Gen. Pl. 3: 1071; Clarke, 1883, Journ. Linn. Soc. London (Bot.), 20: 376; Kuk. 1909, in Engl. Pflanzenreich, 38: 33; Ivan. 1939, Bot. Journ. 24, 5-6: 479; T. Koyama, 1961, Journ. Fac. Sci. Univ. Tokyo (Bot.), 8: 79, excl. syn. *Schoenoxiphium* Nees. – *Elyna* Schrad. 1806, Fl. Germ. 1: 155. – *Hemicarex* Benth. 1881, Journ. Linn. Soc. London (Bot.), 18: 376.

Type species: *K. caricina* Willd. (= *K. simpliciuscula* (Wahlenb.) Mackenz.).

1. *K. capilliformis* Ivanova, 1939, Bot. Journ. 24, 5-6: 484; Egorova, 1967, Rast. Centr. Asii, 3: 32; Grubov, 1982, Opred. sosud. rast. Mongol.: 52; Doronkin, 1990, vo Fl. Sib. 3: 32; Gubanov, 1996, Consp. fl. Vnesh. Mongol.: 28. – *K. capillifolia* auct. non. (Decne.) Clarke: Sergievskaya, 1935, vo Fl. USSR, 3: 109, quoad pl. ex Asia Med.

Habitat. Damp and swampy, sometimes in alkaline meadow, river and brook banks, stony

slopes in alpine belt, rarely in middle and upper parts of forest belt.

2. *K. filifolia* (Turcz.) Clarke, 1883, Journ. Linn. Soc. London (Bot.) 20: 381; Sergievskaya, 1935, vo Fl. USSR, 3: 109; Grubov, 1955, Consp. fl. MNR: 81; Egorova, 1967, Rast. Centr. Asii, 3: 33; Grubov, 1982, Opred. sosud. rast. Mongol.: 52; Doronkin, 1990, vo Fl. Sib. 3: 33; Gubanov, 1996, Consp. fl. Vnesh. Mongol.: 28. – *K. gracilis* Meinsh. 1901, Acta Horti Petropol. 18, 3: 276.

Habitat. Damp and swampy waterside and forest meadows, river banks pebbles, stone fields in alpine and forest-steppe belts.

3. *K. humilis* (C.A. Mey. ex Trautv.) Serg. 1935, vo Fl. USSR, 3: 111; Egorova, 1967, Rast. Centr. Asii, 3: 36; Grubov, 1982, Opred. sosud. rast. Mongol.: 53; Gubanov, 1996, Consp. fl. Vnesh. Mongol.: 28.

Habitat. Damp meadows, river banks, springs, steppe slopes, petrophytic forb-fescue steppes in middle montane, rarely alpine belts.

4. *K. myosuroides* (Vill.) Fiori, 1896, Fiori et Paol. Fl. Anal. Ital. 1: 125; Doronkin, 1990, vo Fl. Sib. 3: 33; Gubanov, 1996, Consp. fl. Vnesh. Mongol.: 28. – *K. bellardii* (All.) Degl. 1807, Loisel. Fl. Gall. 2: 626; Sergievskaya, 1935, vo Fl. USSR, 3: 109; Grubov, 1955, Consp. fl. MNR: 81; Egorova, 1967, Rast. Centr. Asii, 3: 31; Grubov, 1982, Opred. sosud. rast. Mongol.: 52.

Habitat. Meadows, larch forest fringes, debris slopes, rocks, waterside pebbles, tundra, bogs, mountain steppes in alpine and forest-steppe belts.

5. *K. robusta* Maxim. 1883, Bull. Acad. Sci. Petersb. 29: 218; Grubov, 1982, Opred. sosud. rast. Mongol.: 52; Gubanov, 1996, Consp. fl. Vnesh. Mongol.: 28. – *K. sargentiana* Hemsl. 1894, in J. Linn. Soc. (London) Bot. 30: 139.

Habitat. Sandy soils of larch forests in forest belt.

6. *K. sibirica* (Turcz. ex Ledeb.) Boeck. 1875, Linnaea 39: 7; Grubov, 1955, Consp. fl. MNR: 81; id. 1982, Opred. sosud. rast. Mongol.: 52; Doronkin, 1990, vo Fl. Sib. 3: 34; Gubanov, 1996, Consp. fl. Vnesh. Mongol.: 28. – *K. schoenoides* auct. non (C.A. Mey.) Steud.: Sergievskaya, 1935, vo Fl. USSR, 3: 106, quoad pl. Sibir.

Habitat. Damp meadows, bogs, larch forests, brook banks pebbles, debris and stone fields in alpine and forest belts.

7. *K. simpliciuscula* subsp. *subgolarctica* Egor. 1983, Novosti syst. vyssh. rast. 20: 83; Doronkin,

1990, vo Fl. Sib. 3: 34; Gubanov, 1996, Consp. fl. Vnesh. Mongol.: 28. – *K. simpliciuscula* auct. non (Wahlenb.) Mackenz.: Sergievskaya, 1935, vo Fl. USSR, 3: 110, excl. pl. Caucas; Grubov, 1955, Consp. fl. MNR: 81; Egorova, 1967, Rast. Centr. Asii, 3: 37; Grubov, 1982, Opred. sosud. rast. Mongol.: 53; Gubanov, 1996, Consp. fl. Vnesh. Mongol.: 28.

Habitat. Meadows, swampy fields, damp tundra, stony slopes in alpine and forest belts.

8. *K. smirnovii* Ivanova, 1939, Bot. Journ. 24, 5-6: 480; Grubov, 1955, Consp. fl. MNR: 81; Egorova, 1967, Rast. Centr. Asii, 3: 34; Grubov, 1982, Opred. sosud. rast. Mongol.: 53; Doronkin, 1990, vo Fl. Sib. 3: 35; Gubanov, 1996, Consp. fl. Vnesh. Mongol.: 28. – *K. schoenoides* auct. non (C.A. Mey.) Steud.: Sergievskaya, 1935, vo Fl. USSR, 3: 106, quoad pl. e Dshung. Alatau et Tar.

Habitat. Meadows, meadow slopes, soddy stone fields in alpine belt.

Habits. Sedge family members are mostly

polycarpic herbs, belonging to perennials according to the Serebryakov's (1964) classification and hemicryptophytes according to Raunkiaer's (1907) classification (Egorova, 1999). Based on the shoot characters of *Carex*, Alexeev (1996) distinguished seven life forms (habits): 1) false tufts; 2) true tufts; 3) tussocks; 4) rhizomate with underground shoots, not branching in a vegetation period; 5) rhizomate with underground shoots, branching in a vegetation period; 6) creeping rhizomate with ascending shoots; 7) stolon-rhizomate.

On the basis of principle used by Alexeev, we are proposing a classification of life forms of Mongolian *Kobresia*-species, which divided into three types (Table 1). In the classification, we considered shoot characters of bog sedges, which being easy and clear to use.

Ecology. Bog sedges are mainly adapted to frigid habitats and mostly occur in high altitudes. They play dominating role in forming cryoxerophytic meadow, the special vegetation type,

Table 1. Habit types of *Kobresia*-species in the flora of Mongolia

Habit types	Species
dense tufts	<i>K. capilliformis</i> , <i>K. myosuroides</i> , <i>K. sibirica</i> , <i>K. smirnovii</i>
loose tufts	<i>K. humilis</i> , <i>K. robusta</i>
rhizomate	<i>K. filifolia</i> , <i>K. simpliciuscula</i> subsp. <i>subgolarctica</i>

named "bog sedge meadow", which occupies the extra continental interiors of the high altitudes in Asia (Munkhbayar, 1988). Bog sedge meadows are more widespread in southern treeless slopes in Khangai and Mongol-Altai mountain ranges, as well as in higher elevated areas of Gobi-Altai mountain range. Bog sedges grow in diverse habitats in alpine belt, such as different types of meadows (alpine, waterside, steppy, swampy), debris and stony slopes, brook bank pebbles and sand, bogs (mostly herbaceous) and dryad tundra. *Kobresia*-species can be considered as a habitat generalist in high mountains. They go down along the southern slopes to the larch forests (mostly

fringes), meadows in willow groves, damp meadows at end of the valleys, watered by brooks and streams, swampy meadows in forest belt, steppy slopes and stone fields in steppe belt of the mountains.

It was difficult to classify the habitat generalists into ecological groups. Basing on the predominant occurrence of the plants (collection data), four ecological groups were distinguished (Table 2). It should be noted that Mongolian bog sedges prefer habitats with certain amount of moisture, such as meadows, bogs and forests.

Distribution in the vertical belts. *Kobresia*-species grow mainly in high mountains of Asia, a

Table 2. Ecological groups of *Kobresia*-species in the flora of Mongolia

Ecological groups	Species
mesophytes	<i>K. filifolia</i> , <i>K. humilis</i> , <i>K. sibirica</i> , <i>K. simpliciuscula</i> subsp. <i>subgolarctica</i>
mesopetrophytes	<i>K. capilliformis</i> , <i>K. myosuroides</i>
mesoxerophytes	<i>K. robusta</i>
mesopsychophytes	<i>K. smirnovii</i>

few of them are found in arctic and subarctic regions and high mountains of Northern Hemisphere. In Mongolia, they occur in all mountain ranges, at 850-3200 m altitude, according to the present comprehensive data and they grow in alpine, mountain forest and mountain steppe belts (Table

3).

Distribution in the botany-geographical regions of Mongolia. Bog sedges have been found in 13 botany-geographical regions in Mongolia (Table 4), among which as a rule, the mountainous regions like Khangai, Mongol Altai,

Table 3. Species distribution in vertical belts of mountains in Mongolia

Vertical belts	Species
Alpine	<i>K. capilliformis</i> , <i>K. filifolia</i> , <i>K. humilis</i> , <i>K. myosuroides</i> , <i>K. sibirica</i> , <i>K. simpliciuscula</i> subsp. <i>subgolarctica</i> , <i>K. smirnovii</i>
Mountain forest	<i>K. capilliformis</i> , <i>K. filifolia</i> , <i>K. myosuroides</i> , <i>K. robusta</i> , <i>K. sibirica</i> , <i>K. simpliciuscula</i> subsp. <i>subgolarctica</i>
Mountain steppe	<i>K. filifolia</i> , <i>K. humilis</i> , <i>K. myosuroides</i>

Khentii, Khuvsgul and Gobi Altai are involve higher species diversity of *Kobresia*.

Distribution types. The geographical ranges of all species of *Kobresia* lie within the limits of the Holarctic Kingdom. Based on the distribution data, four types and seven sub-types of distribution are distinguished. Four species belong to Iran-Turanian-Siberian, two to Asiatic-North American, one to Asiatic and one to Holarctic types (Table 5).

Relationships among *Kobresia*-species in the

flora of Mongolia. To reveal the relationships among the species made a cladistic analysis by some morphological characters, life forms and distribution types. The characters, which could show evolutionary trends, were chosen.

1. Life form: 0 = tufts, 1 = creeping rhizomate

2. Distribution: 0 = more wide, 1 = not spread far away from the center of origin (mainly in Iran-Turanian region)

3. Height : 0 = tall (15-60 cm), 1 = small (3-15 cm)

Table 4. Distribution of the species in botany-geographical regions of Mongolia

Botany-geographical regions	<i>K. capilliformis</i>	<i>K. filifolia</i>	<i>K. humilis</i>	<i>K. myosuroides</i>	<i>K. robusta</i>	<i>K. sibirica</i>	<i>K. simpliciuscula</i> subsp. <i>subgolarctica</i>	<i>K. smirnovii</i>	total
Khuvsgul		•		•		•	•		4
Khentii		•		•		•	•		4
Khangai	•	•	•	•	•	•	•	•	8
Mongol Daurian		•							1
Great Khyangan				•					1
Khovd		•	•	•				•	4
Mongol Altai	•	•	•	•			•	•	6
Middle Khalkha		•							1
East Mongolia		•							1
Depression of Great Lakes				•					1
Valley of Lakes			•						1
East Gobi									0
Gobi Altai		•	•	•			•		4
Zuungarian gobi				•			•		2
Transaltai gobi									0
Alashan gobi									0
total	2	9	5	9	5	3	6	3	

Table 5. Distribution types of the species

species	distribution	
	type	sub-type
<i>K. capilliformis</i>	Iran-Turanian-Siberian	Central Asiatic-Siberian
<i>K. filifolia</i>	Asiatic	North Asiatic-Eastern Asiatic-Mongolian
<i>K. humilis</i>	Iran-Turanian-Siberian	Central Asiatic-Turkestanian-Khangai
<i>K. myosuroides</i>	Holarctic	Circumpolar
<i>K. robusta</i>	Iran-Turanian-Siberian	Central Asiatic-Khangai
<i>K. sibirica</i>	Asiatic-North American	Arctic-Siberian-North American
<i>K. simpliciuscula</i>	Asiatic-North American	Arctic-Siberian-Mongolian-
subsp. <i>subgolarctica</i>		North American
<i>K. smirnovii</i>	Iran-Turanian-Siberian	Central Asiatic-Siberian

4. Inflorescence: 0 = large, branched, with many spikes, 1 = not branched, with a few spike

5. Number of flowers in a spike: 0 = many (up to 7), 1 = few (not more than 2)

6. Perigynia margins: 0 = free, 1 = more or less closed

7. Perianth segments: 0 = present, 1 = absent

8. Number of stigma: 0 = three, 1 = two

According to the cluster diagram, the species are divided into three groups (Fig. 1).

The first group includes itself: *K. sibirica*, second group: *K. smirnovii*, third group: other species. This grouping meets the Egorova's (1983) system in some way. She grouped *K. humilis* and *K. simpliciuscula* subsp. *subgolarctica* in the same section and other five species (except *K. robusta*) in another section. *K. sibirica* and *K. smirnovii* were grouped in the same subsection of the last.

Dispersal of the *Kobresia*-species in the territory of Mongolia. Revealing the origin center of a taxon using palaeo-botanical methods is difficult, as herbaceous plant parts are non-resistant during the fossilization. Therefore, taxon

concentration method is used more often. It is based on the idea that more species occur in the area where the genus is originated (Alekhin *et al.*, 1961).

More than 90% of the total species of *Kobresia*, are found in Asia, mainly in the Himalayas and Hengduan Mountains in China. The area is not only the center of density, but also the center of diversity of *Kobresia*, thus it is considered as the center of the distribution of the genus.

The common ancestor of *Kobresia* and its closely related genus *Schoenoxiphium* was brought to Eurasia from the Gondwanaland and differentiated in the Himalayas and Hengduan Mountains. In the early Tertiary, *Kobresia* probably began to originate in the Himalayas and the genus reached its greatest speciation with the lifting of this mountain range. The species dispersed along the mountains in the Northern Hemisphere to Europe and Siberia, furthermore to eastern Canada and Colorado (Zhang *et al.*, 1995).

We assume that increasing higher altitude aridity, coupled with decreasing temperatures during the Tertiary was the main reason of their dispersal to the north. According to Zhang *et*

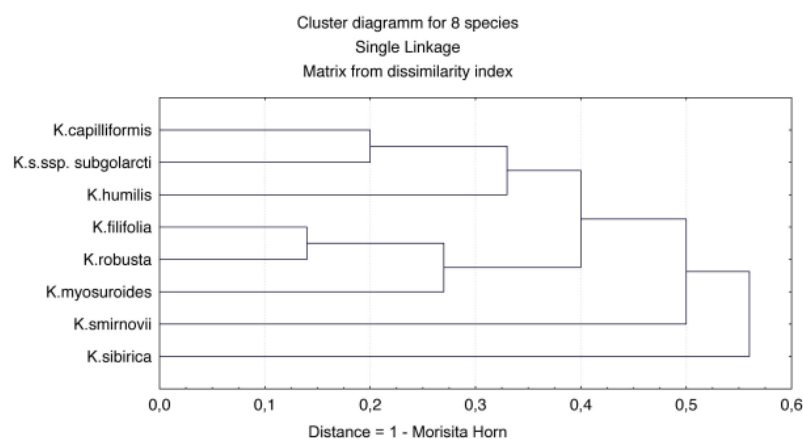


Figure 1. Relationships of *Kobresia*-species in the flora of Mongolia

al. (1995), there were three paths of the species dispersal, namely: to the east, to the north and to the west. The *Kobresia*-species probably came to Mongolia through eastern or Siberian path. After the first glaciations in Quaternary, Khangai mountain range became the second dispersal center of the species in Mongolia. At present time all species in the Mongolian flora are distributed in Khangai region. As Khangai mountain range was not completely covered by ice during the second glaciations in Quaternary (Tsegmid, 1969), plants in this area could survive, comparing to Mongol Altai, which is also rich in *Kobresia*-species. After the second glaciations, they seem to be dispersed to other mountainous areas, especially to Mongol Altai, Khentii, Khuvsgul and Gobi Altai.

Conclusions

There are seven species and one subspecies of *Kobresia* in the Mongolian Flora. The most common habit type among the Mongolian bog sedges is dense tufts, and most species are mesophytes. Almost all species occur in alpine belt and Khangai mountain forest-steppe (all species) and Mongol Altai mountain steppe (six species) regions are rich in *Kobresia*-species. *K. myosuroides* and *K. filifolia* are most widespread species in the territory of Mongolia (in nine botany-geographical regions). Analysis of distribution range showed that almost all species found in Mongolia are distributed in Central Asia and Siberia. Khangai mountain range might be the second dispersal center of *Kobresia*-species in Mongolia. *K. sibirica* and *K. smirnovii* possess most primitive characters among the species.

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Хураангуй

Энэхүү өгүүлэлд Монголын ургамлын аймагт тохиолдох бушилзын (*Kobresia* Willd.) төрлийн ангилалзүйн судалгааны дүнг багтаав. Одоогоор 7 зүйл, 1 дэд зүйл бүртгэгдээд байгаагийн олонх нь нягт дэгнүүлт амьдралын хэлбэрт хамаарч буй бол экологийн бүлгээр ангилахад чийгсэг бүлэг давамгайлж буй нь тогтоогдов. Бушилзын зүйлүүд Монгол орны уулархаг нутгуудаар ургах ба өндөршлийн бүс бүслүүрийн хувьд таг, уулын ой, уулын хээрийн бүслүүрүүдэд тархана. Тус орны ургамал-

газарзүйн 13 тойрогт тохиолдохоос Хангай, Монгол-Алтайн тойргуудад хамгийн олон зүйл тэмдэглэгдсэн байна. Зүйлүүдээс *K. myosuroides*, *K. filifolia* хамгийн өргөн тархалттай. Аралын хэв шинжээр нь ангилахад Иран-Туран-Сибирийн 4, Азийн 1, Ази-Умард Америкийн 2, Голарктикийн тархалттай 1 зүйл байна. Гималайн нуруунд үүссэн гэж үздэг бушилзын төрлийн ургамлын Монгол дахь тархалтын төв нь Хангайн нуруу хэмээн үзэх үндэстэй. Монголд тархсан бушилзын зүйлүүдээс хамгийн энгийн бүтэцтэй, үүсэл гарлын хувьд эртнийх нь *K. sibirica* ба *K. smirnovii* зүйлүүд юм.

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