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Distribution of the Central Asian Genus *Dontostemon* Andrz. ex. C. A. Mey (Brassicaceae Burnett)

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Abstract

This paper presents distributional data of eleven species of the genus *Dontostemon* Andrz. ex. C.A.Mey. (Brassicaceae Burnett.), all of whish are restricted in dispersal to the Central Asian mountain steppe, steppe, desert steppe and desert zones. The genus *Dontostemon* can be reliably considered as typical Central Asian plants and the center of origin of the genus is connected to the Mongolian and Gobi Altai mountains.

Key words: biogeography, distribution, *Dontostemon*, Central Asia.

Introduction

There are 11 species of *Dontostemon* (including *Dimorphostemon pectinathus* and *Nasturtium tibeticum*), mostly growing in the Central Asian mountain steppe, steppe, desert steppe and desert zones (Al-Shehbaz & Ohba, 2000; Zhou *et al*., 2000).

All of these species occur in China, but 9 species in Russia, 7 species in Mongolia, 2 species in India, and 1 species in Japan, Korea, Kazakhstan, Tajikistan and Nepal (Nakai, 1911; Zhou *et al*., 2000; Bush, 1939; Golubkova, 1950; Gubanov, 1996; Hana-Hatazao, 1984; Janarthanam, 1993). Their distribution in the above named countries can be seen in Table 1.

Dontostemon species grow in the forest and forest-steppe as well as in the steppe, desert-steppe and desert zones. Based on the biotopic distribution, it is clear that the species prefer steppe habitats. For example, 6 species occur in the forest-steppe, 5 species in the mountain steppe, 4 species in the steppe, 2 species in the alpine belt, 4 species in the forest and 3 species in the desert zone.

To show the distribution of *Dontostemon* species in botanical-geographical regions of Mongolia (Table 2), we examined the data in the works by Yunatov (1950), Grubov (1955), Ulziikhutag (1989) and Gubanov (1996).

Among these regions, the Gobi Altai mountain desert-steppe where all species of the genus occur, the Depression of the Great Lakes and the Val-

Table 1. Distribution of species of the genus *Dontostemon*

№	Species name \ Countries	China	Russia	Mongolia	India	Japan	Korea	Kazakhstan	Tajikistan	Nepal	Total number of occurences
1	*D. glandulosus*	+	+		+			+	+	+	6
2	*D. dentatus*	+	+			+	+				4
3	*D. pinnatifidus*	+	+	+	+						4
4	*D. crassifolius*	+	+	+							3
5	*D. integrifolius*	+	+	+							3
6	*D. micranthus*	+	+	+							3
7	*D. perennis*	+	+	+							3
8	*D. senilis*.	+	+	+							3
9	*D. hispidus*	+	+								2
10	*D. elegans*	+		+							2
11	*D. tibeticus*	+									1
	Total number of species	11	9	7	2	1	1	1	1	1	
	Percentage	100	81.8	63.6	18.2	9.1	9.1	9.1	9.1	9.1	

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Table 2. Distribution of species of the genus *Dontostemon* in botanical-geographical regions of Mongolia

№	Species name \ Countries	China	Russia	Mongolia	India	Japan	Korea	Kazakhstan	Tajikistan	Nepal	Total number of occurences
1	*D. glandulosus*	+	+		+			+	+	+	6
2	*D. dentatus*	+	+			+	+				4
3	*D. pinnatifidus*	+	+	+	+						4
4	*D. crassifolius*	+	+	+							3
5	*D. integrifolius*	+	+	+							3
6	*D. micranthus*	+	+	+							3
7	*D. perennis*	+	+	+							3
8	*D. senilis*.	+	+	+							3
9	*D. hispidus*	+	+								2
10	*D. elegans*	+		+							2
11	*D. tibeticus*	+									1
	Total number of species	11	9	7	2	1	1	1	1	1	
	Percentage	100	81.8	63.6	18.2	9.1	9.1	9.1	9.1	9.1	

ley of the Lakes are rich in *Dontostemon* species. Among the species, *D. integrifolius, D. perennis* and *D. senilis* most widely distributed in most of the regions (in 9 to 14 regions).

Material and methods

The basic data for this study originated from the distribution maps of the 11 *Dontostemon* species. The map was published in the thesis of Oyuntsetseg (2006) and have been completed with further distributional data, chiefly concerning Mongolia that derived from a critical survey of about 300 herbarium speciments (UBA, UBU, LE, NS, OSBU).

Result and Discussion

Analysis of the Geographical Range

We defined the geographical range of the genus *Dontostemon*, considering the works mainly by Takhdajan (1974, 1978), Grubov (1963, 1978) and Ulziikhutag (1989, 2003). We overlaid the distribution ranges of every species on the map. We then analyzed the distribution of the species. In case if the range of a given species is on the boundary of geographical ranges of the many species or in the center of them, then primary or secondary geographical range of the species must have originated there.

The northern border of the geographical range

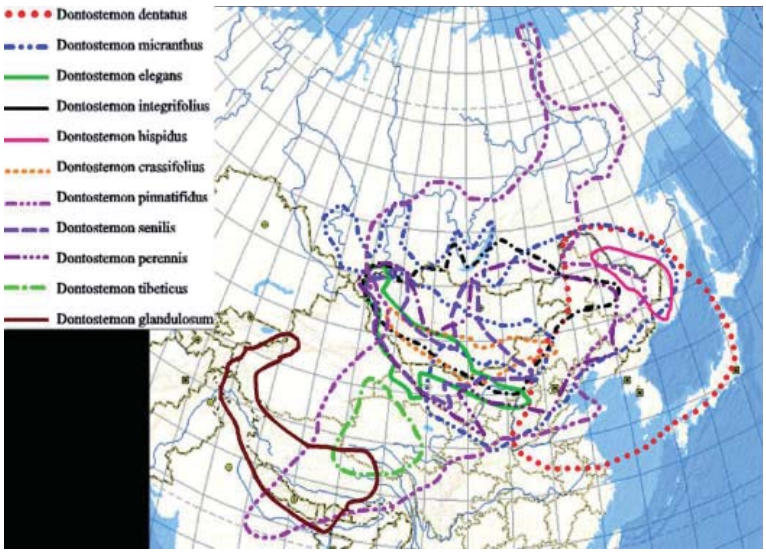

Figure 1. Geographical ranges of species of the genus *Dontostemon*

Table 3. Geographical distribution of the genus *Dontostemon* (by Takhtajan, 1978)

	Zone	*Sub-zone*	*Species name*	*Altitude (m)*	*Habitats*
HOLARCTIC	BOREAL	Circumboreal /Asia/	*D. micranthus*	900-3300	Forest-steppe, mountain steppe, steppe, river valley
			D. pinnatifidus	1100-4600	
			D. integrifolius	200-1700	
			D. glandulosus	1900-5300	
		Eastern Asia	*D. dentatus*	200-1900	mountain steppe, river valley
			D. hispidus	200-400	
	Ancient Mediterranean	Central Asia	*D. crassifolius*	1000-1300	Desert-steppe, desert
			D. elegans	1000-1500	
			D. perennis	1300-1400	
			D. senilis	300-1500	
			D. tibeticus	3200-5200	High mountain

of the genus *Dontostemon* reaches to the end of Lena River, the eastern border to Korean Peninsula and Japanese Islands, the southern border to the Uttar and Pradish in India and the western border to Kashmir and Sikkim in India (Figure 1).

Boundaries of the geographical distribution of *D. crassifolius, D. elegans, D. perennis, D. senilis, D. micranthus, D. pinnatifidus* and D. *integrifolius* are restricted cross mostly in Central Asia. Therefore it can be concluded that the Central Asia might be the historic distribution area of these species. The geographical ranges of *D. dentatus, D. hispidus, D. glandulosus* and *D. tibeticus* also similar with those of other species (Table 3).

Cluster analysis based on the growth habit, ecological groups and distribution of all species of the genus *Dontostemon* was made. As a result, the species was divided into three groups (Figure 2). This result is supported also by the morphological, anatomical, karyological and molecular biological studies.

The first group includes *D. crassifolius, D. elegans, D. perennis* and *D. senilis*, which are Central Asian perennial species, growing at the altitude between 300 and 1500 m, in desert steppe and desert habitats.

The second group encompasses *D. micranthus, D. pinnatifidus, D. integrifolius* and *D. glandulosus*, the Asian annual or biennial species growing at the altitude between 200 and 3300 m, in forest-steppe, steppe and river valleys; *D. dentatus* and *D. hispidus* are East Asian annual or biennial species growing at the altitude between 200 and 1900 m, in mountain steppe and river valleys.

The third group involved only *D. tibeticus*, annual or biennial species growing at the altitude between 3200 and 5200 m, in alpine meadow and rocky slopes, distributed in Chinese Gansu, Cinkhay and Tibet (Shizang).

Popov (1957) argued that *D. dentatus* originated from Manchuria, *D. perennis* from Siberia-Mongolia, *D. pinnatifidus* and *D. integrifolius* from Daurian-Mongolian regions. This conclusion meets well with the results of our study.

We revealed the fact that the distribution of the genus is patchy, although it is dense in certain

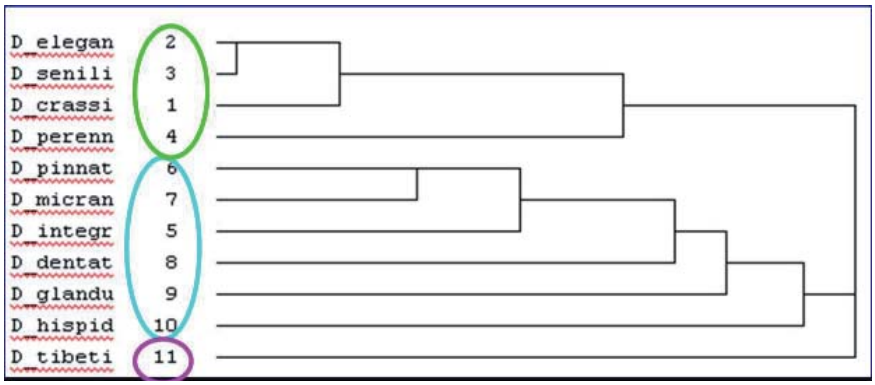

Figure 2. Cluster analysis by the growth habit, ecological groups and distribution of species of the genus *Dontostemon* (number of the plant is given next to the names)

areas of Asia, and is related to the age difference of the plants in the genus and it is an interesting finding for the evolution of *Dontostemon*.

Furthermore, the result of the cluster analysis confirms the Takhtajan's (1966) scheme of the evolution of vascular plants, which suggested that perennials gave rise to annuals. Therefore, we propose that Central Asian arid region might be the center of the origin or at least distributional center of the *Dontostemon* species.

Origin and distribution of the genus Dontostemon Andrz. ex. C. A. Mey

In the evolutionary process, Brassicaceae plants in Central Asia passed through cryo- and xeromorphogenesis. The species of high mountains originated in the mountainous region, which blocked the Central Asian desert from the south to the west (Ebel, 1999).

Phylogeny of the genus *Dontostemon* is not well known, as for other genera of the family Brassicaceae. The Mediterranean province has always been treated as the center of origin for this family (Grubov, 1963).

During the Neogene, herbaceous perennials were predominant. The genus *Dontostemon* is relict of the Early Tertiary period and the annuals and biennials originated in the Quaternary period. It has been speculated that hemi-cryptophytes such as *D. perennis* could have survived after the Last Ice Age of the Quaternary period (Jamsran, 1999; Ebel, 1999). Our originally determined criteria for the historical center of geographical range, such as the overlap of distribution ranges of the species and the dominance of perennials, which are primitive and xerophytes (54.5% of the species) are confirmed the Central Asian geographical ranges. Therefore, we conclude that the Central Asia can be the center of origin of the genus *Dontostemon*.

We hypothesise that Mongolian and Gobi Altai Mountain Ranges are the evolutionary center of the genus *Dontostemon,* because six species that distribute in the center of the historic geographical ranges in Central Asia concentrate in the mountain steppe, steppe and desert-steppe zones in Mongolia.

The results of our study is in accord with the Komarov's (1903) conclusion, which suggested that the center of origin for the genera *Dontostemon, Stipa, Caragana, Oxytropis and Astragalus* is Central Asia because continental climate in this area was caused by the formation of high mountains and a rise of new species was intensified in the resulting dry environments.

Furthermore, the Central Asian species (*D. crassifolius, D. elegans, D. perennis* and *D. senilis*) are conservative relicts as they grow in specific habitats and unique environments, such as steppe, desert steppe and desert.

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Хураангуй

Энэхүү судалгаанд Төв Азийн уулын хээр, хээр, цөлөрхөг хээр, цөлийн бүс нутагт голлон тархсан *Dontostemon* төрлийн 11 зүйл ургамлын тархалтыг авч үзсэн болно.

Үүнээс *Dontostemon* төрлийн олон наст зүйлүүдийн тархалтын өтгөрөл нь Монгол орны уулархаг хээр, цөлөрхөг хээр, цөлийн бүсэд төвлөрч байгаа учраас Монгол Алтай, Говийн Алтай, тэдгээрийн хавь нутаг нь энэ төрлийн түүхэн хөгжлийн цөм байсан гэж үзэх боломжтой байна.

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