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ARTICLE

Additions to the vascular flora of Mongolia - IV

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Abstract: *The article presents updates on the new species recorded in the "Conspectus of the Vascular Plants of Mongolia" (Urgamal et al. 2014), and three articles published "Additions to the Vascular Flora of Mongolia – I, II, III (2013, 2014, 2016)" listed as new for the Mongolian floristic novelties and reported as well. The aim of this article is to officially report new records for vascular plants from Mongolia, and this includes the data in total, 28 species (with 2 infraspecies) from 19 genera and 12 families. In addition, Cerastium alpinum, Dianthus repens, Draba alpina, Eritrichium tianschanicum, Gastrolychnis violascens, Iris oxypetala, Papaver chakassicum, Papaver lapponicum, Potentilla turczaninowiana, Stellaria depressa (10 species) were newly recorded in the list of vascular flora of Mongolia. The newly added species come under the following families and genera: Caryophyllaceae (5 species), Ranunculaceae (4 species), and Rosaceae (4 species) families and Potentilla (4 species), Geranium (3 species), and Iris (3 species) genera. The most recent additions to the following phyto-geographical regions of Mongolia are: Mongolian Altai (9 species), Khovd (7 species), and Khangai (6 species) regions.*

At present, 3191 taxa (including 134 subspecies and 34 varieties) of vascular plants, representing over 684 genera from 108 families, 39 orders, 12 classes, includes 5 divisions, and 3 superclades (Ferns, Gymnospermae and Angiospermae) are registered in Mongolia. Since the last conspectus (Urgamal et al. 2014) was published, 1genera, 64 species and subspecies have been newly added to the flora of Mongolia. The newly recorded 5 species are "endemic"and 9 species are "sub-endemic" to Mongolia. Therefore, currently a total of 125 species (3.91%) are "endemic", and 532 species (16.65%) are "sub-endemic" to the vascular flora of Mongolia, respectively.

Keywords: *New records; endemic; sub-endemic; phyto-geographical region; vascular flora; Mongolia;*

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INTRODUCTION

Mongolia's plant kingdom is rich and very diverse. Flora and vegetation research in Mongolia began in the 19th century by researchers who were engaged in the study of the flora of Central Asia. In 1859, a Russian scientist Maximovich made a list of plant species of Amur, which included the vascular plant species of Mongolia for the first time [24]. Later, the Science Committee of Mongolia and the Mongolian committee at the Russian Academy of Sciences, founded in the 1920's, organized agricultural expeditions in 1947-1951, which played an important role in the study of plant resources of Mongolia [33].

As a result of this expedition, V.I. Grubov (1955) compiled the "*Conspectus of the flora of Mongolia*", where 1877 species of vascular plants belonging to 552 genera and 97 families were included. The number of species in Mongolian flora increased up to 2239 in V.I. Grubov's key to vascular plants in 1982 and to 2823 in I.A. Gubanov's conspectus in 1996 [13-16, 33, 35]. The last conspectus (Urgamal et al. 2014) includes 3127 species and infraspecific taxa, belonging to 683 genera of 112 families, registered in the Flora of Mongolia and includes data on their nomenclature, classification and distribution (Table 1).

Table 1. Development of the number of vascular plant taxa known from Mongolia

Sources and references	Family	Genus	Species and infraspecific taxa
Maximowciz (1859)	-	-	489
Grubov (1955)	97	555	1897
Grubov (1982)	103	599	2239
Ulziykhutag (1989)	122	625	2443
Gubanov (1996)	128	662	2823
Oyuntsetseg & Urgamal (2013)	112*	676	3014
Urgamal et al. (2013)	112*	679	3053
Urgamal et al. (2014)	112*	683	3127
Urgamal (2017, 2018); Urgamal et al. (2018)	108**	684	3160
Urgamal & Oyuntsetseg (2019)	108**	684	3163
In this article	108**	684	3191

** - according to APG III (2009)*
*** - according to APG IV (2016)*

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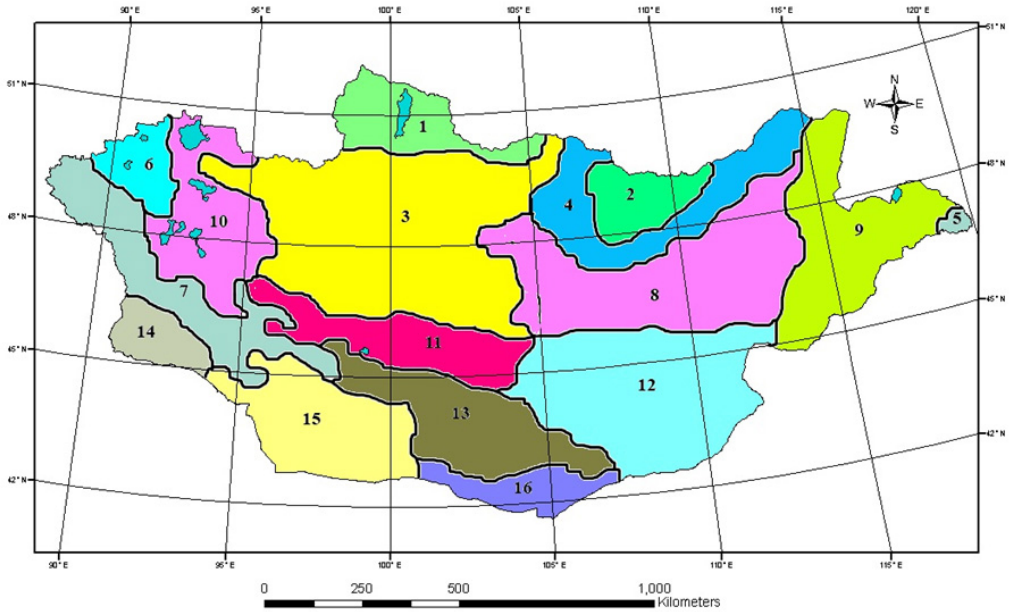
The present article is a continuation of the previous works dedicated to new national, new regional and location records for "*Additions to the vascular plant of Mongolia – I* (Urgamal et al. 2013), II (Urgamal 2014), III (Urgamal et al. 2016)", and this is a revision of the floristic composition of Mongolia, which was based on "Urgamal et al. 2014, *Conspectus of the vascular plants of Mongolia*" [34, 35, 37-39].

In addition, this article reports new records of 10 species for the first time, and also 18 species mentioned in the following reports by researchers (Doronkin et al. 2015; Kechaykin & Maxim 2015; Erst et al. 2016, 2017; Urgamal et al. 2016, 2018; Kechaykin 2017; Urgamal & Oyuntsetseg 2017; Alexeeva 2018; Gundegmaa & Munkh-Erdene 2018; Korolyuk et al. 2018; Troshkina 2018; Urgamal 2018; Baasanmunkh et al. 2019ab; Li-Qing Zhao et al. 2019; Nobis et al. 2019; Seregin 2016, 2019; Darikhand 2017; Urgamal & yuntsetseg 2019), and has been added to the vascular flora of Mongolia [1-5, 8-12, 17-23, 25-29, 31, 34-42].

MATERIALS AND METHODS

The former herbariums of the Institute of General and Experimental Biology of the Mongolian Academy of Sciences (UBA) and the National University of Mongolia (UBU) were checked for new findings and the material was partly critically revised (Thiers 2017) [32]. The voucher specimens are deposited in the herbarium of the Institute of General and Experimental Biology of the Mongolian Academy of Sciences (UBA), and the National University of Mongolia (UBU).



1 – Khuvsgul (Khu), 2 – Khentii (Khe), 3 – Khangai (Kha), 4 – Mongolian Dauria (MD), 5 – Foothills of Great Khingan (FGKh), 6 – Khovd (Kho), 7 – Mongolian Altai (MA), 8 – Middle Khalkh (MKh), 9 – East Mongolia (EM), 10 – Depression of Great Lakes (DGL), 11 – Valley of Lakes (VL), 12 – East Gobi (EG), 13 – Gobi Altai (GA), 14 – Dzungarian Gobi (DG), 15 – Transaltai Gobi (TG), 16 – Alashan Gobi (AG)

Figure 1. Map of phyto-geographical regions of Mongolia (Grubov 1982)

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For species' determination and comparison, we checked herbarium (UBA, UBU), and electronic data of species information and herbarium materials from the following: "*Database of the Mongolian Flora*" (http://www.eic.mn/flora/, Urgamal 2014), "*Moscow University Herbarium* (MW)" (https://plant.depo.msu.ru; Seregin 2019), "*A virtual approach to the flora of Mongolia* (FloraGREIF)" (https://floragreif.uni-greifswald.de/floragreif/; Rilke et al. 2013), Tropicos.org. Missouri Botanical Garden. (http://www.tropicos.org), and "*Plants of the World Online. Kew Sciences Data Online*". (http://plantsoftheworldonline.org/) [12, 26, 27, 29].

The name of the plant families is based on APG IV (2016) system which is also implemented in the *Conspectus of the Vascular Plants of Mongolia* (Urgamal et al. 2014). Plant names are cited with author names following Brummitt, Powell (1992) and the International Plant Name Index (IPNI; http://www.ipni.org) along with the citation of the reference where the relevant plant name was published [3, 6].

We follow the division of Mongolia into 16 phytogeographical regions (Fig.1), which was introduced by Grubov (1982) and phytogeographical regions were defined [13, 14].

All revised localities of materials mentioned in the article are shown on a map (Fig. 2) made using SimpleMappr (http://www.simplemappr.net).

RESULTS AND DISCUSSION

A new record of 10 species including Cerastium alpinum, Dianthus repens, Draba alpina, Eritrichium tianschanicum, Gastrolychnis violascens, Iris oxypetala, Papaver chakassicum, Papaver lapponicum, Potentilla turczaninowiana, Stellaria depressa were reported in this article on Mongolian vascular flora for the first time (Table 2).

Table 2. Information of newly recorded species included in the vascular flora of Mongolia

Scientific name taxa	Region number	Reported and contributors
1. *Aquilegia grubovii* A. Erst, Luferov, Wang et Xiang 2016	2,3,4	Erst et al. (2016)
2. *Aquilegia xinjiangensis* Erst 2017	7,14	Erst et al. (2017); Nobis et al. (2019)
3. *Cancrinia krasnoborovii* Khanm. 1983	10	Korolyuk et al. (2018)
4. *Cerastium alpinum* L. 1753	6	In this article
5. *Dianthus repens* Willd. 1799	6,7	Gundegmaa & Munkh-Erdene (2018)
6. *Draba alpina* L. 1753	6	Gundegmaa & Munkh-Erdene (2018)
7. *Eritrichium tianschanicum* Iljin ex Ovczinnikova 2003	6	Gundegmaa & Munkh-Erdene (2018)
8. Gastrolychnis violascens Tolm. 1971	7	Gundegmaa & Munkh-Erdene (2018)
9. *Geranium amurense* Tzyren. 2006	3,4,9	Troshkina (2018)
10. *Geranium saxatile* Kar. et Kir. 1842	7,14	Baasanmunkh et al. (2019b); Nobis et al. (2019)
11. *Geranium transbaicalicum* subsp. *turczaninovii* (Serg.) Peschkova 1996	3,4	Troshkina (2018)
12. *Iris biglumis* Vahl 1806	1-4	Grubov (1955)

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13. *Iris oxypetala* Bunge 1832	16	Seregin (2019)
14. *Iris schmakovii* Alexeeva 2018	1	Alexeeva (2018)
15. *Myriophyllum sibiricum* Kom. 1914	5	Baasanmunkh et al. (2019a)
16. *Papaver chakassicum* Peschkova 1994	6,7	Gundegmaa & Munkh-Erdene (2018)
17. *Papaver lapponicum* (Tolm.) Nordh. 1931	7	Gundegmaa & Munkh-Erdene (2018)
18. *Potentilla ekaterinae* Kamelin ex Kechaykin 2017	13	Kechaykin (2017)
19. *Potentilla schmakovii* Kechaykin 2015	7	Kechaykin & Maxim (2015); Gundegmaa & Munkh-Erdene (2018)
20. *Potentilla turczaninowiana* Stschegl. 1854	6,7	In this article
21. *Potentilla x vanzhilii* V. Gundegmaa et Kechaykin 2018	3	Gundegmaa & Kechaykin (2018) Urgamal (2018)
22. *Ranunculus songaricus* Schrenk 1842	14	Nobis et al. (2019)
23. *Silene alexandrae* B. Keller 1912	14	Baasanmunkh et al. (2019b)
24. *Stellaria depressa* Em. Schmid 1932	7	Gundegmaa & Munkh-Erdene (2018)
25. *Stipa khovdensis* L.Q. Zhao 2019	3,6	Li-Qing Zhao et al. (2019)
26. *Tripleurospermum limosum* (Maxim.) Pobed. 1961	5	Wu, Z. Y., Raven, P. H. & Hong, D. Y., eds., Flora of China (2011); Flann, C. (ed). (2009)
27. *Trollius dschungaricus* Regel 1880	14	Darikhand (2017)
28. *Typha latifolia* L. 1753	5	Baasanmunkh et al. (2019a)

The newly added species of the following families and genera include (Table 3): Caryophyllaceae (5 species), Ranunculaceae (4 species), Rosaceae (4 species), families and *Potentilla* (4 species), *Geranium* (3 species), and *Iris* (3 species). The most made additions to the following phyto-geographical regions of Mongolia are: Mongolian Altai (9 species), Khovd (7 species), and Khangai (6 species) regions (Table 4).

Currently, 3191 taxa (including 134 subspecies and 34 varieties) of vascular plants, representing over 684 genera from 108 families, 39 orders, 12 classes, includes 5 divisions, and 3 superclades (Ferns, Gymnospermae and Angiospermae) and they are all registered in Mongolia, respectively.

Since the last conspectus (Urgamal et al. 2014) was published [38-40], 1 genera, 64 species and subspecies have been newly added to the flora of Mongolia. They include new records for 5 species (*Aquilegia grubovii, Potentilla ekaterinae, P. schmakovii, P. vanzhilii, Stipa khovdensis*) as "endemic", and 9 species (*Aquilegia xinjiangensis, Geranium transbaicalicum subsp. turczaninovii, Iris biglumis, I. schmakovii, Papaver chakassicum, Potentilla turczaninowiana, Silene alexandrae, Stellaria depressa, Trollius dschungaricus*) as "sub-endemic" to Mongolia [1, 2, 5, 9-10, 17-19, 22, 31, 36]. Therefore, currently, a total of 125 species (3.91%) are "endemic", and 532 species (16.65%) are "sub-endemic" to the vascular flora of Mongolia.

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Newly recorded species from Mongolia:

1. *Cerastium alpinum* L. (Caryophyllaceae)
Contributors – Gundegmaa & Munkh-Erdene (2018)

Taxonomic notes: Currently nine species of *Cerastium* L. are reported in Mongolia (Urgamal et al. 2014). *Cerastium alpinum* is a new native species to Mongolia. It occurs in species-rich dwarf-herb communities in the alpine meadows.

General distribution: Europe, Russia (N. European part, W. Siberia), and N. America (Canada and Greenland).

Species examined (*new record*): MONGOLIA. Khovd region (6), Uvs aimag (province), Khovd soum, Tsast mountain, N49°34'17.0, E91°13'18.0, 3700 m. 17 July 2017, *V.Gundegmaa*, 17-09 (UBA).

2. *Dianthus repens* Willd. (Caryophyllaceae)
Contributors – Gundegmaa & Munkh-Erdene (2018)

Taxonomic notes: The genus Dianthus L. includes five species reported in Mongolia (Urgamal et al. 2014). Dianthus repens is a new native species to Mongolia. It occurs in stony slopes and rocks in mountain steppe and mountain tundra (Gundegmaa & Munkh-Erdene 2018).

General distribution: China (Inner Mongolia), Korea, Russia (N. European and Northern part, Siberia, and Far East), N. America (Alaska and Yukon Territory).

Species examined (new record): Mongolia. Mongolian Altai region (7): Bayan-Olgii aimag, Deluun soum, Khar Yamaat mountain, N46°27'38.4, E91°54'14.8, 2462 m. 03 July 2015, *V.Gundegmaa*, 201507021 (UBA). Bayan-Olgii aimag, Altai soum, Chigertein Lake, N47°52'17.7, E90°24'27.7, 2321 m, 05.July.2015, *V.Gundegmaa*, 2015070589 (UBA).

3. *Draba alpina* L. (Brassicaceae)
Contributors – Gundegmaa & Munkh-Erdene (2018)

Taxonomic notes: Currently nine species of *Draba* L. are reported in Mongolia (Urgamal et al. 2014).

Draba alpina is a new native species to Mongolia. It occurs in snowbeds, in moist tundra and gravelly river banks, and on cliff and rocky slopes in the alpine meadows (Gundegmaa & Munkh-Erdene 2018).

General distribution: N. Europe, Russia (N. European part, Siberia, and Far East), and N. America (Alaska and Greenland).

Species examined (new record): MONGOLIA. Khovd region (6): Uvs aimag, Khovd soum. Turgen-Kharkhiraa mountains, N49°35'02.55, E91°12'04.61, 3207 m. 27 June 2014, *V.Gundegmaa*, 14-28, (UBA).

4. *Eritrichium tianschanicum* Iljin ex Ovczinnikova (Boraginaceae)
Contributors – Gundegmaa & Munkh-Erdene (2018)

Taxonomic notes: Seven species of *Eritrichium* Schrad. ex Gaudin are noted in Mongolia (Urgamal et al. 2014). *Eritrichium tianschanicum* is a new native species to Mongolia. It occurs in snowbeds, in moist tundra and gravelly river banks, and on cliff and rocky slopes in the alpine meadows (Gundegmaa & Munkh-Erdene 2018).

General distribution: China (Tian Shan), Kyrgyzstan, Tajikistan.

Species examined (new record): MONGOLIA. Khovd region (6): Uvs aimag, Khovd soum. N49°38', E91°12.8, 3200 m. 27 June 2017, *V.Gundegmaa,* 14-24 (UBA).

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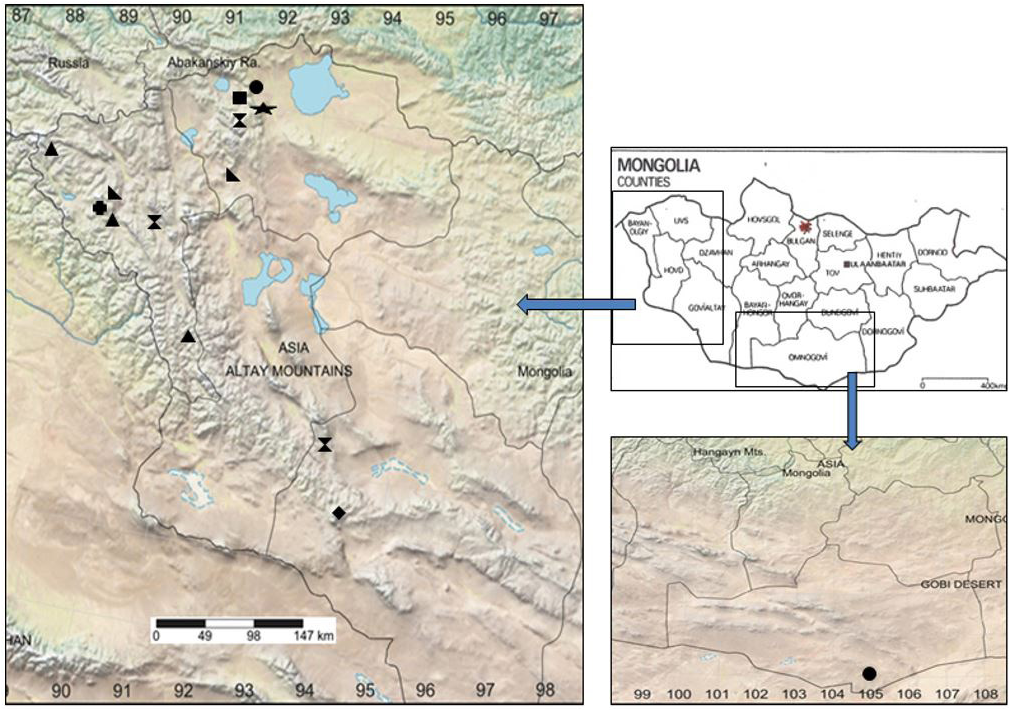

Figure 2. Distribution of newly records species from Mongolia

● - *Cerastium alpinum* ■ - *Eritrichium tianschanicum* ⧗ - *Papaver chakassicum* ◣ - *Potentilla turczaninowiana*
▲ - *Dianthus repens* ⬟ - *Gastrolychnis violascens* ◆ - *Papaver lapponicum* ▲ - *Stellaria depressa*
★ - *Draba alpina* ● - *Iris oxypetala*

5. *Gastrolychnis violascens* Tolm. (Caryophyllaceae)

Contributors – Gundegmaa & Munkh-Erdene (2018)

Taxonomic notes: The genus *Gastrolychnis* Schrad. ex Gaudin includes one species recognized in Mongolia (Urgamal et al. 2014). *Gastrolychnis violascens* is a new native species to Mongolia. It occurs in moss-sedge marshes, sedge-mixed grass meadows, along the river banks in the alpine belts (Gundegmaa & Munkh-Erdene 2018).

General distribution: Russia (Siberia, and Far East).

Species examined (new record): Mongolia. Mongolian Altai region (7): Bayan-Olgii aimag, Altai soum, Chigertein Lake, N47°52'17.7, E90°24'27.7, 2320 m. 05 July 2015, *V.Gundegmaa*, 2015.07.05, 2015070588 (UBA).

6. *Iris oxypetala* Bunge (Iridaceae)

Contributors – Seregin (2019)

Taxonomic notes: The genus Iris L. includes 20-22 species (Urgamal et al. 2014; Doronkin et al. 2015) in Mongolia. Iris *oxypetala* is a new native species to Mongolia. It occurs in sandy and sandy-pebble desert steppes, debris-stony hill slopes and bottom of sayrs

General distribution: Afghanistan, China, Japan, Kazakhstan, Kyrgyzstan, Korea, Pakistan, Russia, Tajikistan, Uzbekistan.

Species examined (new record): Mongolia. Alashan Gobi region (16): Mongolia, South Gobi aimag, Nomgon soum. 100 km south of Nomgon soum. Galbiin Gobi. N41038', E105012.8, h=900 m. Coll.: *A.I.Gubanov*, 1981.07.05, No. 5458, (MW). Det.: *A.I.Gubanov*, 1981.

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7. *Papaver chakassicum* Peschkova (Papaveraceae)

Contributors – Gundegmaa & Munkh-Erdene (2018)

Taxonomic notes: Currently ten species of *Papaver* L. are reported in Mongolia (Urgamal et al. 2014). *Papaver chakassicum* is a new native species to Mongolia. It occurs in rocky, pebbled and stony slope in alpine and forest belts (Gundegmaa & Munkh-Erdene 2018).

General distribution: Russia (Altay, Krasnoyarsk, Tuva). (Sub-endemic).

Species examined (new record): MONGOLIA. Khovd region (6): Uvs aimag, Turgen soum, Turgen mountain, Burgastain river. 01 August 1964, *Mongolisch-Deutsche Expedition* 1407, 1472 (GAT). Uvs aimag, Ulaangom soum, Kharkhiraa mountain. E91°806, N49°925, 1750 m. 18 June 1978, *H.Ansorge*, 44594 (HAL). Uvs aimag, Ulaangom soum, Kharkhiraa mountain. Ovot tal. 10 August 1962, *Mongolisch-Deutsche Expedition 1592* (GAT). Mongolian Altai region (7): Bayan-Olgii aimag, Tolbo soum, nearest 4 km from Tolbo Nuur lake. 2300 m, 26 July 1964, *S.Danert, C.Davazamc, P.Hanelt et Sancir,*. 3883 (GAT). Gobi-Altai aimag, Tonkhil soum, Sutai Khairkhan mountain, N44°37'14.3 E93°31'54.8, 3223 m, 9 August 2014, *V.Gundegmaa*, 14-03 (UBA).

8. *Papaver lapponicum* (Tolm.) Nordh. (Papaveraceae)

Contributors – Gundegmaa & Munkh-Erdene (2018)

Taxonomic notes: *Papaver lapponicum* is a new native species to Mongolia. It occurs in dry scree slopes and gravelly ridges in the alpine belt (Gundegmaa & Munkh-Erdene 2018).

General distribution: N. Europe (Norway, Finland), Russia (European part, Siberia, Far East), N. America (Alaska and Canada).

Species examined (new record): Mongolia. Mongolian Altai region (7): Gobi Altai aimag, Bugat soum, Alag Khairkhan mountain, N45°37'416, E94°07'530, 3305 m, 5 July 2015, *V.Gundegmaa*, 2015070565 (UBA).

9. *Potentilla turczaninowiana* Stschegl. (Rosaceae)

Contributors – Gundegmaa

Taxonomic notes: *Potentilla* L. includes 73 species in Mongolia (Urgamal et al. 2014). *Potentilla turczaninowiana* is a new native species to Mongolia. It occurs in stony placers, stony slopes, rocks in alpine.

General distribution: Kazakhstan, Kyrgyzstan, Russia (Altay and Sayan), Tajikistan. (Sub-endemic).

Species examined (new record): MONGOLIA. Khovd region (6): Uvs aimag, Khovd soum, Mountain range of Tsast Bogd Uul mountain, stony fields in mountain tundra, N49º35'02.55", E91º12'04.61", 3207 m, *V.Gundegmaa*, 17 July 2017, 1707171 (UBA). Mongolian Altai region (7): Bayan-Olgii aimag, Deluun soum, Chigertein Nuur lake. N47º48'31.86", E90º07'33.05", 2725 m, 24 July 2017, *V.Gundegmaa*, 170724 (UBA).

Table 3. Additions and number of species of following families and genera for the flora of Mongolia

Family name	Species number	Genus name	Species number
Caryophyllaceae	5	*Potentilla*	4
Ranunculaceae	4	*Geranum*	3
Rosaceae	4	*Iris*	3
Geraniaceae	3	*Papaver*	2
Iridaceae	3	*Aquilegia*	2
Papaveraceae	2	*Gastrolychnis*	1
Asteraceae	2	*Cancrinia*	1

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Boraginaceae	1	*Draba*	1
Brassicaceae	1	*Eritrichium*	1
Haloragaceae	1	*Myriophyllum*	1
Poaceae	1	*Cerastium*	1
Typhaceae	1	*Dianthus*	1
		Ranunculus	1
		Silene	1
		Stipa	1
		Tripleurospermum	1
		Trollius	1
		Typha	1
		Stellaria	1
12 families	28 species	19 genera	28 species

***10. Stellaria depressa* Em. Schmid (Caryophyllaceae)**

Contributors – Gundegmaa & Munkh-Erdene (2018)

Taxonomic notes: *Stellaria* L. includes 21 species in Mongolia (Urgamal et al. 2014). *Stellaria depressa* is a new native species to Mongolia. It occurs in pebble belts and gravelly soils in high mountain belt (Gundegmaa & Munkh-Erdene 2018).

General distribution: China (Tibet, West Himalaya). (Sub-endemic).

Species examined (new record): Mongolia. Mongolian Altai region (7): Bayan-Olgii aimag, Tsengel soum, Tavan Bogd mountain, 3225 m, 24 July 2017, *V.Gundegmaa*, 24.7.2017, 170724 (UBA).

Table 4. New records for phyto-geographical regions of Mongolia

Phyto-geographical region name and numbers	Numbers of new records
1. Khuvsgul mountain taiga	2
2. Khentii mountain taiga	2
3. Khangai forest steppe	6
4. Mongolian Dauria forest steppe	4
5. Foothills of Great Khingan mountain meadow steppe	3
6. Khovd mountain semi-desert steppe	7
7. Mongolian Altai mountain steppe	9
8. Middle Khalkh dry steppe	-
9. East Mongolia steppe	1
10. Depression of Great Lakes semi-desert steppe	1
11. Valley of Lakes semidesert steppe	-
12. East Gobi semi-desert steppe	-
13. Gobi Altai mountain semi-desert steppe	1
14. Dzungarian Gobi desert	5
15. Transaltai Gobi desert	-
16. Alashan Gobi desert	1
	Total point: 42

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Figure 3. Photograph a newly recorded species for the Mongolian flora (Photos by V.Gundegmaa):
1 – Dianthus repens, 2 – Papaver lapponicum, 3 – Eritrichum tianshianicum,
4 - Papaver chakassicum,5 – Gastrolychnis violascens, 6 – Potentilla schmakovii,
7 – Cerastium alpinum, 8 – Draba alpina, 9 – Potentilla turczaninowiana

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CONCLUSIONS

This article contains 28 species of plants newly recorded in Mongolia, and most of them are dominated by the geographical elements of South Siberia, Altai-Sayan Mountain, Central Asia, and Dzungarian Gobi regions.

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