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## An update of the family-Level taxonomy of vascular plants in Mongolia

M. Urgamal & Ch. Sanchir

### Abstract

A new comprehensive checklist of Mongolian vascular plant families includes descriptions of all accepted plant families, each with a basionym, homonym and full list of synonyms. The list is a completely revised update of GUBANOV's conspectus (1996) of the Mongolian flora. The currently list covers a total of 3113 species, subspecies and 683 genera, 112 families of vascular plants, belonging to 39 orders, 14 classis or clades and 5 divisions of the vascular plants in the flora of Mongolia.

**Keywords:** Mongolian flora, family arrangement, phylogenetic classification, LAPG III - APG III system

### Introduction

The first flora of Mongolian vascular plants was compiled by the Russian botanist V.I. GRUBOV in 1982, and recently an English edition was published in 2001. The original checklist included 103 plant families. The update by N. ULZIKHUTAG (1989) contained 122 families; I. A. GUBANOV (1996) listed 128 families and the most recent contribution by DARIIMAA et al. (2010) gave more than 130 families. A comparison of the different accounts is presented in table 1, showing the large differences. Our revision presents an updated classification of families of vascular plants and was based on GUBANOV's conspectus (1996). Many recent studies have provided support for the APG III (2009) system, which was basically also adopted here.

Table 1: Comparison of published family classifications for the Mongolian flora

division	GRUBOV (1982)		ULZIKHUTAG (1989)		GUBANOV (1996)		URGAMAL et al. (2013)	
	families (n)	%	families (n)	%	families (n)	%	families (n)	%
1. Lycopodiophyta	-	-	3	2.5	3	2.3	2	1.7
2. Pteridophyta	5	4.9	12	9.8	11	8.6	11	9.7
3. Pinophyta	3	2.9	3	2.5	3	2.3	2	1.8
4. Gnetophyta	-	-	-	-	-	-	1	0.9
5. Magnoliophyta								
- Nymphaeaceae	1	1.0	1	0.8	1	0.8	1	0.9
- Ceratophyllaceae	1	1.0	1	0.8	1	0.8	1	0.9
- Monocots	16	15.5	19	15.6	24	18.8	21	18.6
- Eudicots	77	74.8	83	68.0	85	66.4	73	65.5
<b>total</b>	<b>103</b>		<b>122</b>		<b>128</b>		<b>112</b>	

### Material and methods

The Herbarium UBA of the Institute of Botany, Mongolian Academy of Sciences (UBA) contains in total more than 123,000 specimens of algae, fungi, lichens, mosses and vascular plants, which represent 2739 species of vascular plants belonging to more than 610 genera and more than 110

families. The database of the Mongolian Flora includes over 3000 species of vascular plants belonging to more than 670 genera in about 130 families (as of the old version in 2008).

For the present study, taxonomy and nomenclatural data for Mongolian plant families were checked against the following sources and websites: APG III system (version 13, last updated by July, 2013), W3 Tropicos of Missouri Botanical Garden (2014); World Checklist Selected Plants, Royal Botanic Gardens, Kew, (WCSP 2014); International Plant Name Index (IPNI, 2014), Global Biodiversity Information Facility (GBIF 2013); The Plant List - Royal Botanic Gardens, Kew (2014); The Linear Angiosperm Phylogeny Group (LAPG III 2009) and a linear sequence of the families in the APG III system - Germplasm Resources Information Network (GRIN) 2011; online database of USDA and International Plant Names Index (IPNI 2005).

Compared to the previous APG classification (APG II 2003) information has much increased, especially on evolutionary relationships of flowering plants (APG II 2003), providing a refined and better-resolved classification. We opted for LAPG III & APG III (2009) as a standard and used the linear family order of HASTON et al. (2009). In general, broader circumscriptions were favoured here. Nomenclature of families is based on GUBANOV (1996) and GRUBOV (2001). Fern classification followed the scheme proposed by SMITH et al. (2006) and CHRISTENHUSZ et al. (2011).

## Results

The list covers a total of 112 families of vascular plants from the Mongolian flora belonging to 39 orders, 14 classes or clades and 5 divisions (tab. 2). The list also provides reference for herbarium curators, because a simple linear numbered sequence as recognized in APG III (2009) is provided. The list includes 112 accepted names for scientific families occurring in Mongolia; table 2 gives the full list of families including orders and numbers of genera.

Table 2: Updated list of vascular plant families in the Mongolian flora (based on LAPG III, 2009; by Angiosperm Phylogeny Website. Version 12, July 2012). Symbols: # - including another family (+ sister taxa); \$ - modified with new name; + - new addition to the Mongolian flora

ID	Family - accepted scientific name	Order	genera (n)
# 1	Lycopodiaceae Beauv. ex Mirb. 1802 [incl. Huperziaceae]	Lycopodiales	3
2	Selaginellaceae Willk. 1854	Selaginellales	1
\$ 3	Ophioglossaceae Martinov 1820 [incl. Botrychiaceae]	Ophioglossales	1
4	Equisetaceae Michx. ex DC. 1804	Equisetales	1
\$ 5	Dennstaedtiaceae Lotsy 1909 [incl. Hypolepidaceae]	Polypodiales	1
\$ 6	Pteridaceae E.D.M. Kirchn. 1831 [incl. Cryptogram-maceae, Sinopteridaceae]	Polypodiales	2
\$ 7	Cystopteridaceae Shmakov 2001 [incl. <i>Cystopteris</i> from Athyriaceae]	Polypodiales	1
8	Aspleniaceae Newman 1840	Polypodiales	2
9	Thelypteridaceae Ching ex Pic. Serm. 1970	Polypodiales	1
# 10	Woodsiaceae Herter 1949 [incl. <i>Athyrium</i> , <i>Diplazium</i> , <i>Gymnospermum</i> from Athyriaceae]	Polypodiales	4
+ 11	Onocleaceae Pic. Serm. 1970 [incl. new genus <i>Matteucia</i> ]	Polypodiales	2
\$ 12	Dryopteridaceae Herter 1949 [incl. Aspidiaceae]	Polypodiales	1
13	Polypodiaceae Bercht. et J. Presl 1822	Polypodiales	2
14	Pinaceae Spreng. ex Rudolphi 1830	Pinales	4
15	Cupressaceae Gray 1822	Pinales	1

ID	Family - accepted scientific name	order	genera (n)
16	Ephedraceae Dumort. 1829	Ephedrales	1
17	Nymphaeaceae Salisb. 1805	Nymphaeales	2
\$ 18	Acoraceae Martinov 1820 [incl. <i>Acorus</i> from Araceae]	Acorales	1
# 19	Araceae Juss. 1789 [incl. Lemnaceae]	Alismatales	2
\$ 20	Tofieldiaceae Takht. 1995 [incl. <i>Tofieldia</i> from Melanthiaceae]	Alismatales	1
21	Alismataceae Vent. 1799	Alismatales	2
22	Butomaceae Mirb. 1804	Alismatales	1
\$ 23	Hydrocharitaceae Juss. 1789 [incl. Najadaceae]	Alismatales	1
24	Scheuchzeriaceae F. Rudolphi 1830	Alismatales	1
25	Juncaginaceae Rich. 1808	Alismatales	1
# 26	Potamogetonaceae Bercht. et J. Presl 1823 [incl. Zannichelliaceae]	Alismatales	3
27	Ruppiaceae Horan. 1834	Alismatales	1
# 28	Melanthiaceae Batsch. ex Borkh. 1797 [incl. Trilliaceae]	Liliales	3
29	Liliaceae Juss. 1789	Liliales	6
30	Orchidaceae Juss. 1789	Asparagales	15
31	Iridaceae Juss 1789	Asparagales	1
\$ 32	Xanthorrhoeaceae Dumort. 1829 [incl. Hemerocallidaceae]	Asparagales	1
\$ 33	Amarylloidaceae J. St.-Hil. 1805 [incl. Alliaceae]	Asparagales	1
# 34	Asparagaceae Juss. 1789 [incl. Asphodelaceae, Convallariaceae]	Asparagales	5
# 35	Typhaceae Juss. 1789 [incl. Sparganiaceae]	Poales	2
36	Juncaceae Juss. 1789	Poales	2
37	Cyperaceae Juss. 1789	Poales	13
38	Poaceae Barnhart 1895 (Gramineae Juss. 1789)	Poales	62
39	Ceratophyllaceae Gray 1822	Ceratophyllales	1
# 40	Papaveraceae Juss. 1789 [incl. Fumariaceae, Hypecoaceae]	Ranunculales	7
41	Menispermaceae Juss. 1789	Ranunculales	1
42	Berberidaceae Juss. 1789	Ranunculales	1
43	Ranunculaceae Juss. 1789	Ranunculales	21
44	Paeoniaceae Raf. 1815	Saxifragales	1
45	Grossulariaceae DC. 1805	Saxifragales	1
46	Saxifragaceae Juss. 1789	Saxifragales	5
47	Crassulaceae J. St.-Hil. 1805	Saxifragales	6
48	Haloragaceae R. Br. 1814	Saxifragales	1
49	Cynomoriaceae Endl. ex Lindl. 1833	Saxifragales	1
50	Santalaceae R. Br. 1810	Santalales	1
51	Frankeniaceae Desv. 1817	Caryophyllales	1
52	Tamaricaceae Link 1821	Caryophyllales	3
# 53	Plumbaginaceae Juss. 1789 [incl. Limoniaceae]	Caryophyllales	4
54	Polygonaceae Juss. 1789	Caryophyllales	12
55	Droseraceae Salisb. 1808	Caryophyllales	1

ID	Family - accepted scientific name	order	genera (n)
56	Caryophyllaceae Juss. 1789	Caryophyllales	22
# 57	Amaranthaceae Juss. 1789 [incl. Chenopodiaceae]	Caryophyllales	28
58	Molluginaceae Bartl. 1825	Caryophyllales	1
\$ 59	Montiaceae Raf. 1820 [incl. genus <i>Claytonia</i> from Portulacaceae]	Caryophyllales	1
60	Portulacaceae Juss. 1789	Caryophyllales	1
61	Zygophyllaceae R. Br. 1814	Zygophyllales	3
# 62	Celastraceae R. Br. 1814 [incl. Parnassiaceae]	Celastrales	2
63	Oxalidaceae R. Br. 1818	Oxalidales	1
64	Euphorbiaceae Juss. 1789	Malpighiales	1
+ 65	Phyllanthaceae Martinov 1820 [incl. new genus <i>Flueggea</i> to replace <i>Securinega</i> ]	Malpighiales	1
66	Salicaceae Mirb. 1815	Malpighiales	2
67	Violaceae Batsch. 1802	Malpighiales	1
68	Linaceae DC. ex Perleb 1818	Malpighiales	1
69	Hypericaceae Juss. 1789	Malpighiales	1
70	Fabaceae Lindl. 1836 (Leguminosae Juss. 1789)	Fabales	26
71	Polygalaceae Hoffmanns. et Link 1809	Fabales	1
72	Betulaceae Gray. 1822	Fagales	2
73	Rosaceae Juss. 1789	Rosales	28
74	Elaeagnaceae Juss. 1789	Rosales	2
75	Rhamnaceae Juss. 1789	Rosales	1
76	Ulmaceae Mirb. 1815	Rosales	1
77	Cannabaceae Martinov 1820	Rosales	1
78	Urticaceae Juss. 1789	Rosales	2
79	Geraniaceae Juss. 1789	Geraniales	2
80	Lythraceae J. St.-Hil. 1805	Myrtales	2
81	Onagraceae Juss. 1789	Myrtales	2
\$ 82	Cleomaceae Bercht. et J. Presl 1825 [incl. genus <i>Cleoma</i> and Capparaceae absent]	Brassicales	1
83	Brassicaceae Burnett 1835 (Cruciferae Juss. 1789)	Brassicales	61
84	Malvaceae Juss. 1789	Malvales	3
85	Thymelaeaceae Juss. 1789	Malvales	2
86	Biebersteiniaceae Schnizlein 1856	Sapindales	1
# 87	Nitrariaceae Lindl. 1830 [incl. Peganaceae]	Sapindales	2
88	Rutaceae Juss. 1789	Sapindales	2
89	Cornaceae Bercht. et J. Presl 1825	Cornales	1
90	Balsaminaceae A. Rich. 1822	Ericales	1
91	Polemoniaceae Juss. 1789	Ericales	2
92	Primulaceae Batsch ex Borkh. 1797	Ericales	5
# 93	Ericaceae Juss. 1789 [incl. Vacciniaceae, Empetraceae, Pyrolaceae, Monotropaceae]	Ericales	12
94	Boraginaceae Juss. 1789	Boraginales	22
95	Rubiaceae Juss. 1789	Gentianales	3
96	Gentianaceae Juss. 1789	Gentianales	8

ID	Family - accepted scientific name	order	genera (n)
# 97	Apocynaceae Juss. 1789 [incl. Asclepiadaceae]	Gentianales	2
# 98	Plantaginaceae Juss. 1789 [incl. Callitrichaceae, Hippuridaceae]	Lamiales	8
99	Scrophulariaceae Juss. 1789	Lamiales	3
\$ 100	Phrymaceae Schauer 1847 [incl. two genera <i>Dodartia</i> , <i>Lancea</i> from Scrophulariaceae]	Lamiales	3
# 101	Lamiaceae Martinov 1820 (Labiatae Juss. 1789) [incl. <i>Caryopteris</i> from Verbenaceae]	Lamiales	24
102	Orobanchaceae Vent. 1799	Lamiales	9
103	Lentibulariaceae Rich 1808	Lamiales	2
104	Bignoniaceae Juss. 1789	Lamiales	1
# 105	Convolvulaceae Juss. 1789 [incl. Cuscutaceae]	Solanales	4
106	Solanaceae Juss. 1789	Solanales	4
107	Campanulaceae Juss. 1789	Asterales	4
108	Menyanthaceae Dumort. 1829	Asterales	2
109	Asteraceae Bercht. et J. Presl 1820 [Compositae Giseke 1792]	Asterales	87
110	Apiaceae Lindl. 1836 (Umbelliferae Juss. 1789)	Apiales	37
111	Adoxaceae E. Mey. 1839 [incl. <i>Sambucus</i> , <i>Viburnum</i> from Caprifoliaceae]	Dipsacales	3
# 112	Caprifoliaceae Juss. 1789 [incl. Valerianaceae, Dipsaceae]	Dipsacales	5
<b>total</b>		<b>39 orders</b>	<b>683</b>

In summary, 18 families were included in other families ('#, +' sister taxa); 13 families received new names ('\$') and two were newly added ('+') to the flora of Mongolia compared to Gubanov's conspectus (1996). The 2 newly added families are Onocleaceae and Phyllanthaceae, their circumscriptions are described in the table 2.

The following is a list of 33 taxa that occur in the Mongolian flora but are no longer accepted as families: Alliaceae, Asclepiadaceae, Asphodelaceae, Aspidiaceae, Athyriaceae, Botrychiaceae, Callitrichaceae, Chenopodiaceae, Convallariaceae, Cryptogrammeaceae, Cuscutaceae, Dipsacaceae, Empetraceae, Fumariaceae, Hemerocallidaceae, Hippuridaceae, Huperziaceae, Hypocoaceae, Hypolepidaceae, Lemnaceae, Limoniaceae, Monotropaceae, Najadaceae, Parnassiaceae, Peganaceae, Pyrolaceae, Sinopteridaceae, Sparganiaceae, Trilliaceae, Vacciniaceae, Valerianaceae, Verbenaceae, Zannichelliaceae.

The families that were placed under a new name include Acoraceae, Amaryllidaceae, Cleomaceae, Cystopteridaceae, Dennstaedtiaceae, Dryopteridaceae, Hydrocharitaceae, Montiaceae, Ophioglossaceae, Phrymaceae, Pteridaceae, Tofieldiaceae, Xanthorrhoeaceae. In some cases, only one or few genera were replaced to other families: Acoraceae [incl. genus *Acorus* from Araceae], Cystopteridaceae [incl. genus *Cystopteris* from Athyriaceae], Lamiaceae [incl. *Caryopteris* from Verbenaceae], Montiaceae [incl. *Claytonia* from Portulacaceae], Phrymaceae [incl. *Dodartia*, *Lancea* from Scrophulariaceae], Tofieldiaceae [incl. *Tofieldia* from Melanthiaceae] (table 2).

Two genera were left in the Scrophulariaceae (*Limosella*, *Scrophularia*), while the vast majority is now included with the Orobanchaceae [incl. *Castilleja*, *Cymbaria*, *Euphrasia*, *Odontites*, *Pedicularis*, *Rhinanthus*), the Plantaginaceae [incl. genus *Lagotis*, *Linaria*, *Veronica*, *Veronicastrum*], and the Phrymaceae [incl. genus *Dodartia*, *Lancea*].

The current Mongolian flora contains 13 families of Ferns; 3 families of Gymnosperms, and 96 families of Angiosperms [incl. the family Nymphaeaceae Salisb.]: 17 families of Monocots; 4 families of Commelinids; the Ceratophyllaceae as likely sister eudicots; 4 families of Eudicots; 17 families of Core eudicots; 28 families of Rosids and 24 families of Asterids).

Table 3: Details of the phylogenetic classification of all families in the Mongolian flora (according to the APG III system, by Angiosperm Phylogeny Website, version 12; July 2012)

superclades	divisions	classes or clades	order	families (n)		
Fern	1. Lycopodiophyta	1. Lycopodiopsida	1. Lycopodiales	1		
		2. Isoetopsida	2. Selaginellales	1		
	2. Pteridophyta	3. Psilotopsida	3. Ophioglossales	1		
		4. Equisetopsida	4. Equisetales	1		
		5. Polypodiopsida	5. Polypodiales	9		
Gymnosperms	3. Pinophyta	6. Pinopsida	6. Pinales	2		
	4. Gnetophyta	7. Gnetopsida	7. Ephedrales	1		
Angiosperms	5. Magnoliophyta	-	8. Nymphaeales	1		
		8. Monocots	9. Acorales	1		
			10. Alismatales	9		
			11. Liliales	2		
			12. Asparagales	5		
		9. Commelinids	13. Poales	4		
		10. Probably sister eudicots	14. Ceratophyllales	1		
		11. Eudicots	15. Ranunculales	4		
		12. Core eudicots	16. Saxifragales	6		
			17. Santalales	1		
			18. Caryophyllales	10		
		13. Rosids	Eurosids I (Fabids)	19. Zygothyllales	1	
				20. Celastrales	1	
				21. Oxalidales	1	
				22. Malpighiales	6	
				23. Fabales	2	
				24. Fagales	1	
				25. Rosales	6	
				Eurosids II (Malvids)	26. Geraniales	1
					27. Myrtales	2
		28. Brassicales	2			
		29. Malvales	2			
		14. Asterids		30. Sapindales	3	
				31. Cornales	1	
			Euasterids I (Lamiids)	32. Ericales	4	
33. Boraginales	1					
Euasterids II (Campanuliids)	34. Gentianales		3			
	35. Lamiales		7			
	36. Solanales		2			
	37. Asterales		3			
	38. Apiales	1				
	39. Dipsacales	2				

The largest 10 families in the Mongolian flora are: Asteraceae [incl. 87 genera), Poaceae [incl. 62 genera), Brassicaceae [incl. 61 genera), Apiaceae [incl. 37 genera), Fabaceae [incl. 26 genera), Amaranthaceae [incl. 28 genera), Rosaceae [incl. 28 genera), Lamiaceae [incl. 24 genera), Caryophyllaceae [incl. 22 genera), Boraginaceae [incl. 22 genera). 49 families (almost 43.5% of all families) are represented by 1 genus only.

Currently, we are working to revise and produce a checklist of all genera and all species given in GUBANOV's conspectus (1996). We hope to be soon able to provide a full list as another update of the Mongolia flora.

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