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RESEARCH PAPER

The vascular plant flora of Hustai National Park, Mongolia: Composition, life forms, ecological groups and geographical elements

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The present study gives an overview of the flora of Hustai National Park, which hosts southern outposts of boreal forests embedded in a matrix of typical steppes. We address floristic composition, life forms, ecological groups and geographical elements, and compare our data against studies from broadly similar regions. A total of 493 vascular plant species belonging to 246 genera and 65 families were recorded. The biggest plant families are Asteraceae (67 species) followed by Poaceae (56 species), Fabaceae (51 species), and Rosaceae (33 species), while 21 families were represented by only one species each. Mesophytes (32.5%) and xerophytes (25.4%) were the most frequent ecological groups, indicating a typical mountain steppe environment. Most species were hemicryptophytes (56.8%), followed by therophytes (18.7%) and cryptophytes (geophytes 10.5%), while the least frequent life form classes were chamaephytes (5.1%) and helophytes (0.2%). Asian chorological elements constituted 52.3% of the total flora, while Eurasian account for 30%, Holarctic for 14.8%, Asian-American for 1.4% and Cosmopolitan for 1.4%. The Hustai mountain range thus represents a key example of the transition zone between the relatively moist Taiga forests and the drier steppe grasslands. These climate transitional zones are very sensitive to changing climate and land use.

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1 Introduction

A total of 3127 vascular plant species has been recorded in Mongolia (Urgamal et al. 2014), distributed across 16 phytogeographical regions that are distinguished for the country. Checklist-level data are available for these relatively large regions, while comprehensive and synoptic treatments were published for selected sites only. Forest steppe habitats, i.e. the

transition zone between mesophytic Taiga forests and more drought tolerant steppes are interesting in this respect. A valuable case study is available from a forest steppe reserve near Ulaanbaatar (Hilbig et al. 2004), and base-line data have been published for Hustai National Park (HNP) southeast of the capital (Wallis de Vries et al. 1996, Manibazar & Bulgan 1999). The latter can perhaps be considered Mongolia's most prominent reserve due to its outmost importance for conservation of flora and fauna, especially larger mammals.

Because of the intermediate geographical position, several vegetation types and their associated species reach their ecological limits here, resulting in a high importance of climatic controls. Mosaics of steppes and

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forest islands, typically located on north-facing mountain slopes, create a large range of habitats, and thus a relatively diverse flora and fauna. These forest steppes represent the southernmost outposts of the Siberian Taiga, and are sensitive to climate change (Dulamsuren et al. 2010a). They are declining in distribution because of the increasing summer temperature which is not compensated for by increases in precipitation (Dulamsuren et al. 2010b, Liu et al. 2013, Vandandorj et al. 2017). Forest steppe vegetation has received considerable attention in the last years, with studies addressing northern, island-like occurrences in southern Siberia (Ermakov 2012, Ermakov et al. 2006), and core forest steppe sites in the Khentei mountain range of northern Mongolia and near Ulaanbaatar (Dulamsuren et al. 2010a, Hilbig 1995). Less well known are the southernmost outposts (Dulamsuren et al. 2005), where forests form very scattered habitat islands in a matrix of typical grass steppes.

The HNP is a key site for biodiversity of these southern forest steppes. It is under strict protection as the main site for re-introduction of Przewalski horses (*Equus przewalski*) that commenced in 1992. A nature reserve was gazetted in the same year, and human activities had to be restricted. Status and importance of the protected area were raised in 1998, when the region was upgraded from nature reserve to national park (MPHNPIBZ 2011). At the same time, research and conservation activities were extended. The mountain ranges around Hustai are cool and relatively humid, while arid and warmer conditions prevail in the depressions (Tsegmid 1969). There are high mountains, hills and valleys; differences in soils and microclimate are reflected in a vegetation zonation with steppe, mountain steppe and forest steppe. About 88% of the park is covered by steppes, grassland and shrubland (Wallis de Vries et al. 1996), and 95% of its territory is suitable for grazing (Tsolmon 1994). In recent years, the forests of HNP started to dry out significantly, and the entire landscape has changed (Bayarsaikhan et al. 2009, Tuvshintogtokh & Bat-Enerel 2013, Enkhsaikhan 2009). According to a recent survey, steppe habitats at a total of 179 km², and mountain steppes at 267 km² are the dominant habitat types that cover about 90% of the park area. The mountain steppe area has decreased by 6.4% between 1999 and 2013, being replaced by dry steppes (Tuvshintogtokh & Bat-Enerel 2013).

The flora of the region is relatively rich compared to other sites in Mongolia. Manibazar (1996), Manibazar et al. (1999), Bulgan (2002) and others studied the vascular plant flora, while detailed accounts of the vegetation cover were given by Wallis de Vries et al. (1996) and van Staaldin (2007). These publications yielded lists of vascular plants as well as a vegetation map of the HNP. Moreover, Kherlenchimeg (2001), Enkhtuya (2001) and Tsegmed (2003) studied the fungi, lichens and mosses of the HNP, respectively. There are 217

species of medicinal plants (Sanjid 1999), 236 species are known as nectar plants relevant for honey production (Ochirbat 1999), and 200 species of forage vascular plants were recorded in HNP.

Here, we provide an updated and comprehensive list of vascular plant species of HNP, and also analyze the flora with respect to composition of life-forms and ecological groups as well as biogeography. Specifically, we assessed

- which taxonomical groups are dominant in the region;
- which biogeographical affinities are apparent; and
- which life forms and ecological types are most common in HNP?

We compared our results to similar studies in the wider region to put data in perspective.

2 Material and methods

Study area

Hustai NP is located at the most southern part of the Siberian taiga in the Mongolian Dauria phytogeographical region of Mongolia. This region borders on the most southwestern parts of the Khentei High Mountain region and the northern parts of Middle Khalkha (Grubov 1982, Gubanov 1996, Manibazar et al. 1999). The NP is located at 105°43'–106°08' E and 47°32'–47°50' N within the Tuv (Central) province of Mongolia (Fig. 1). Its total spatial extent is ca. 506 km² (MPHNPIBZ 2011), equivalent to some 0.03% of the Mongolian territory (1.5 Mio. km²). The region is characterized by steppes in basins and an otherwise mountainous relief, partly covered by forests. The geomorphology is governed by a pronounced relief with partly steep slopes; the total vertical range is some 750 m from the floodplain of the Tuul gol at 1190 m a.s.l. to the summit of Hustai uul at 1843 m (AAGC, MPHNPIBZ 2011).

According to Walter et al. (1975), the study area lies within the dry temperate grassland zone characterized by moderately warm and wet summers and dry and cool winters (Fig. 2). For the years 1999–2017, the average annual precipitation was 222 mm, of which 70% occurs in June, July and August (Table 1). The winter months December to February yield a mere 3% of the mean annual precipitation. Precipitation varies strongly from year to year; the standard deviation of interannual precipitation variability is 64 mm (coefficient of variance 29%). The mean annual temperature is 0.0°C; January is the coldest month at a mean of -21.2°C and a mean minimum of -31.3°C, while July is hottest at a mean of +19.3°C and a mean maximum of +32.9°C (Table 1).

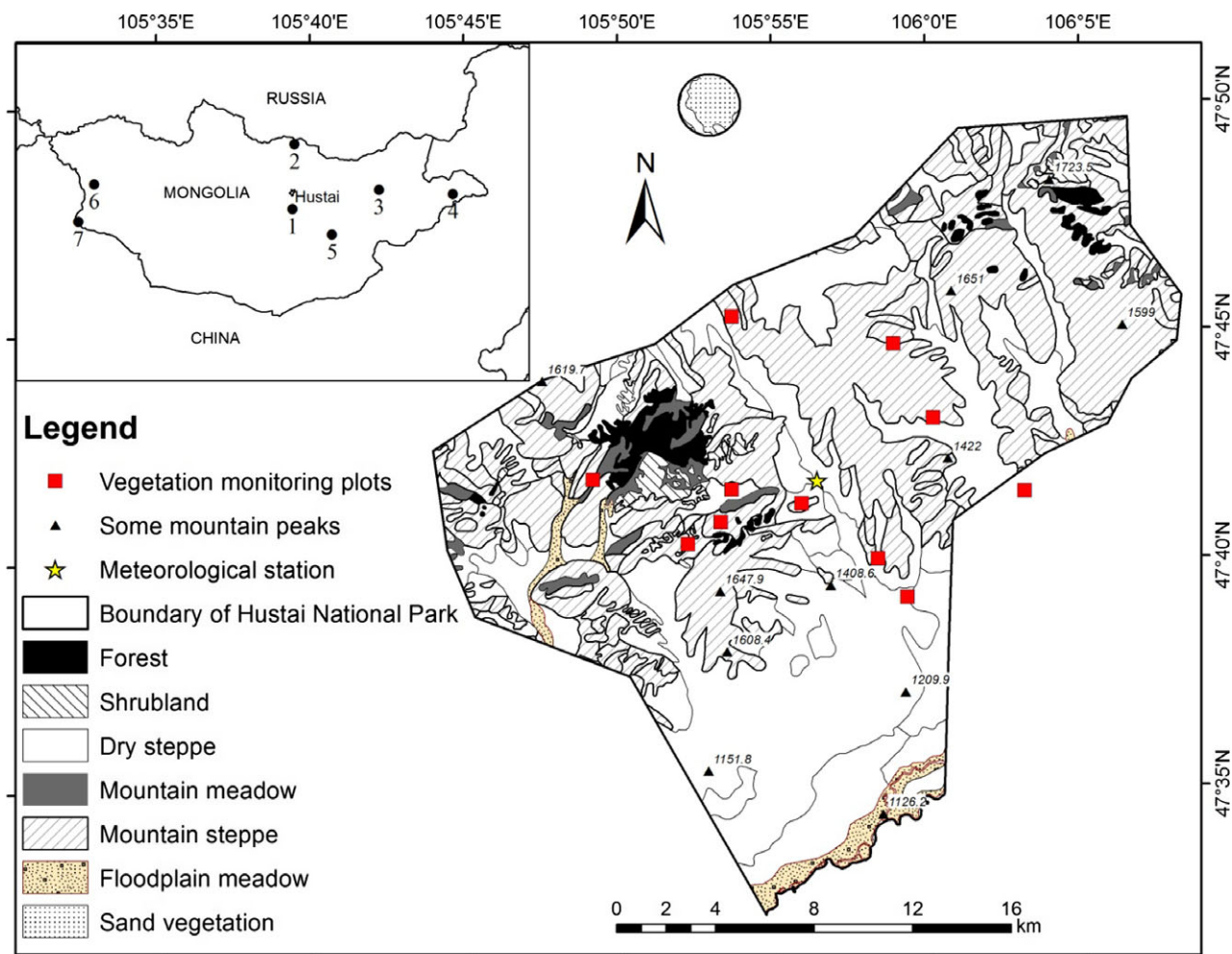


Figure 1. Map of the HNP (data source: administration of the HNP). The study area belongs to the Mongolian Dauria region (Grubov 1982). The small insert gives localities of further studies that were used to compare the data from Hustai: 1-Unjuul soum, 2-Shaamar soum, 3-Timentsogt soum, 4-East Mongolia phytogeographical region, 5-Ikh Nart Nature Reserve, 6-Mongolian Altai Mountain Range, 7-Baitag Bogd Mountain (numbering sequence follows phytogeographic similarity and geographic proximity to HNP; Appendix 1).

There are no climate data from the upper slopes, yet assuming a standard lapse rate of ca. 0.6 K / 100 m would imply that mean temperatures at the upper slopes are -3°C, and discontinuous permafrost indeed occurs. Precipitation should be higher in the mountains than in the basin, but there are no data on this from HNP. There are, however, estimates for Bogd uul, which is ca. 85 km east of HNP and at the same latitude, yet some 400 m higher. Hilbig et al. (2004) estimated 400–450 mm for its upper regions.

Methods

For appendix 2, we compiled a complete list of vascular plant species and their distribution based on published literature (Wallis de Vries et al. 1996, Manibazar &

Wallis de Vries 1999), and also paid special attention to unpublished research reports of ours and other teams (Bulgan 2001, Bayasgalan 1999, Sergelenkhoo 2003–2006, Tserendulam & Oyunbileg 2008–2010 annual research reports). From 1993–2015, additional plant specimens were collected and deposited in the herbarium of HNP, which includes now over 1280 specimens of more than 600 species (ca. 60% of specimens already mounted).

A total of 11 permanent sampling plots were established across the HNP representing all main vegetation types (mountain steppe, steppe, meadow steppe and forest steppe). Sites have been re-sampled since 2003 until now, at intervals of every 10 days from 24th of April to 24th of September. Moreover, we have made additional field surveys every summer that yielded further

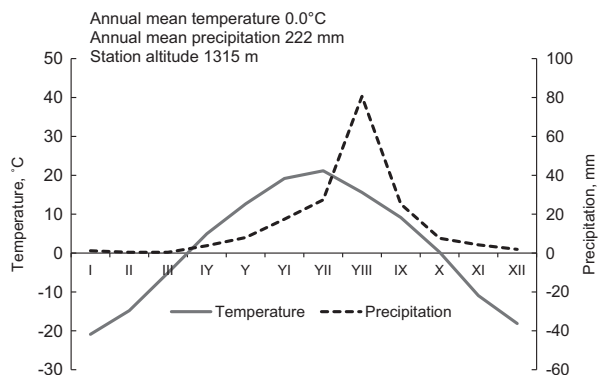


Figure 2. Climate diagram for HNP, Mongolia (data obtained from Hustai meteorological station) based on data from 1999–2017.

collections and complement the data from the regularly visited monitoring plots.

Plant specimens were identified using the standard flora of Mongolia (Grubov 1982), as well as Manibazar (1995), Bolormaa (1995), Bayasgalan (1999), Sergelenkhuu (2006) and Tserendulam & Oyunbileg (2008). While earlier checklists used Engler's phylogenetic system, the present list is based on the APG III system; species taxonomy follows the recent checklist of Mongolia (Urgamal et al. 2014).

In addition, seven other sites were compared with respect to floristic properties. Sites were either on a broadly similar latitude or longitude. Apart from compiling summary figures, we also calculated broad-scale similarity by comparing share of total species numbers for the

ten most important families (pairwise Euclidean distance, made in past 2 software).

Species life-forms were determined according to the location of regenerative buds and the parts shed during the unfavorable season (Raunkiaer 1934). Life-form data were compiled from various sources (Tuvshintogtokh 2014, Ganbold 2010, Jäger 2011, www.efloras.com 2016, www.tropicos.org 2016).

Distribution of species within phytogeographic regions of Mongolia followed Urgamal et al. (2014), based on regions proposed by Grubov (1982). A chorological analysis was made by assigning species to main distribution groups, following Ganbold (2010), Malyshev & Peshkova (1978), Dulamsuren et al. (2005), Jäger (2011), Grubov (1963ff, 1999ff) and Komarov (1934ff). Geographical analysis followed classes suggested by Tolmachev (1974), and all species were classified into 5 main distributional groups. The Asian group as the single largest group was divided in 12 subgroups.

3 Results and Discussions

Flora

A total of 493 vascular plant species belonging to 246 genera and 65 families were recorded in the HNP with dicotyledons being the main group (Table 2, full list as appendix 2). The main plant families in terms of species numbers are Asteraceae (67 species), followed by Poaceae (56 species), Fabaceae (51 species), Rosaceae (33 species), and Ranunculaceae (24 species). These 5

Table 1. Mean and standard deviation of precipitation and temperature from 1999 to 2017 (data obtained from Hustai meteorological station).

Months	Rainfall (mm)	Temperature (C°)		
		Max.	Min.	Mean.
January	2.3 ± 2.8	−8.8 ± 4.9	−31.3 ± 3.6	21.2 ± 2.5
February	2.2 ± 2.1	−3.5 ± 6.1	−28.6 ± 4.5	17.0 ± 3.7
March	4.4 ± 4.9	8.9 ± 4.9	−22.4 ± 5.6	6.9 ± 2.7
April	5.5 ± 4.7	19.3 ± 5.4	−12.2 ± 4.8	2.8 ± 2.2
May	27.2 ± 23.9	26.5 ± 4.4	−3.5 ± 3.6	10.0 ± 1.7
June	42.4 ± 27.2	30.5 ± 4.1	3.4 ± 3.1	16.4 ± 1.6
July	58.7 ± 32.9	32.9 ± 4.1	8.1 ± 1.9	19.3 ± 1.9
August	50.6 ± 28.4	30.5 ± 3.8	3.5 ± 3.5	16.2 ± 1.4
September	15.0 ± 10.9	25.6 ± 3.6	−4.4 ± 4.0	9.7 ± 1.3
October	7.1 ± 8.0	17.2 ± 3.2	−14.0 ± 4.7	0.2 ± 2
November	4.4 ± 3.3	5.5 ± 4.4	−24.2 ± 4.7	11.1 ± 2.6
December	1.9 ± 1.3	−5.0 ± 3.3	−30.5 ± 3.9	18.3 ± 2.3
Annual	222.1 ± 62.6	15.0 ± 4.4	−12.9 ± 4.0	0.1 ± 0.7

Table 2. Floristic richness of HNP.

Plant group	Families	Genera	Species
Pteridophyta	5	5	7
Gymnosperms	3	3	4
Angiosperms	57	239	482
Monocotyledons	9	43	97
Dicotyledons	48	196	385
Total vascular flora	65	247	493

Table 3. Species richness of the main vascular plant families in the HNP.

	Largest vascular plant families of HNP	Number genera	Number species	Percent of flora
1	ASTERACEAE	30	67	13.8
2	POACEAE	27	56	11.4
3	FABACEAE	14	51	10.3
4	ROSACEAE	14	33	6.7
5	RANUNCULACEAE	11	24	4.9

families comprise 47% of the total flora (Table 3). *Artemisia* is the largest genus represented by 19 species (Table 4), followed by *Astragalus* (14 species), *Potentilla* (13), *Carex* (11), *Allium* (10), and *Oxytropis* (10). The 5 largest genera comprise 16% of all species.

Pteridophyta are represented by 7 species in the HNP, all being herbaceous. They are all considered vulnerable, because of their dependence on forest habitats. Currently, these forests cover 13.1 km² (Tuvshintogtokh & Bat-Enerel 2013), dominated by *Betula platyphylla* and *Populus tremula*.

The next biggest families (6–8th) are Brassicaceae (21 species), Amaranthaceae (19), and Polygonaceae (16), while 34 families are represented by only 1 and/or 2 species each, and 10 families are represented by 3–4

species. Thus, 68% of the families are represented by 4 species or less (rare), accounting for a mere 17% of total species richness.

The dominant species in the vegetation are *Stipa krylovii*, *S. klemenzi*, *Artemisia frigida*, *A. dracunculoides*, *Carex duriscula*, *C. korshinskyi*, and *Cymbaria dahurica* in both steppes and mountain steppes, while *Festuca ovina* and *F. lenensis* dominate in the summit regions of the mountains. There is only one species endemic to Mongolia (*Taraxacum bornuurens*, Urgamal & Oyuntsetseg 2017), while 24 species are subendemic and also occur in neighbouring countries Russia and China (Urgamal et al. 2014). Ten species have been assessed as regionally threatened, and 19 species are considered relicts of moister phases in the late Tertiary and Quaternary (Manibazar & Bulgan 1999, Urgamal et al. 2014). Most of Mongolian endemic species (79.2%) are indeed neo-endemics (Manibazar & Bulgan 1999, Urgamal & Oyuntsetseg 2017). Most of the subendemics are Fabaceae (11 species), while 2 species of both Lamiaceae and Poaceae, and 1 species of a further 9 families occur. This reflects the overall importance of Fabaceae in the Mongolian flora (Ulziikhutag 1989a). Compositae is not only the largest family in the flora of HNP and of entire Mongolia (Dashnyam 1974, Grubov 1982, Ulziikhutag 1989b), but also next to orchids the second largest and most widespread family of angiosperms in the world (The Angiosperm Phylogeny Group 2016 and related sources).

Records of Mongolian vascular plants have rapidly increased over the last 3 decades from a country total of 2239 species (Grubov 1982) to 2823 species (Gubanov 1996) and 3127 species (Urgamal et al. 2014). At some 15% of these, HNP hosts a relatively large share of the Mongolian flora, given that it represents a mere 0.03% of the Mongolian territory.

Hustai's 493 plant species belonging to 246 genera and 65 families are equivalent to 38% of the 1289 species that have been registered for the Mongolian Dauria phytogeographical region (Urgamal & Sanchir 2014).

Table 4. The most important genera in terms of number of species.

Rank	Genus	Number of species	Rank	Genus	Number of species
1	<i>Artemisia</i>	19	8-9.	<i>Salix</i>	7
2	<i>Astragalus</i>	14	10-12.	<i>Taraxacum</i>	7
3	<i>Potentilla</i>	13	10-12.	<i>Poa</i>	6
4	<i>Carex</i>	11	10-12.	<i>Polygonum</i> ¹	5
5-6.	<i>Allium</i>	10	13-16.	<i>Iris</i>	5
5-6.	<i>Oxytropis</i>	10	13-16.	<i>Festuca</i>	5
7	<i>Pedicularis</i>	8	13-16.	<i>Stipa</i>	5
8-9.	<i>Chenopodium</i>	7	13-16.	<i>Spiraea</i>	5

¹excluding *Persicaria*

The species composition reflects the range of habitats, soil conditions, climate, and notable human activity over 2 decades in HNP. Key for the diversity, however, is the position of the study region in the transition between the two main phytogeographical regions Khentei taiga and Middle Khalkha steppe, which host the largest share of forest species and of dry steppes species, respectively, in Mongolia.

We compared the flora of HNP with data from 7 different sites distributed across Mongolia (Fig. 1, Table 5). We used sites along the same latitude (Beket 1983, Darikhand 2016, Dashnyam 1975, Sanchir & Mandakh 2008) or in geographic proximity (Dariimaa & Mandakh 1984, Dariimaa & Ulziikhutag 1984, Mandakh et al. 2015). Unjuul (Dariimaa & Ulziikhutag 1984), Shaamar (Dariimaa & Mandakh 1984), and Tumentsoyt (Sanchir & Mandakh 2008) soums are also located in steppes, but in different phytogeographical regions. The Mongolian Altai (Beket 1983), the Ikh Nart Nature Reserve (Mandakh et al. 2015), and the Baitag Bogd Mountain (Darikhand 2016) are mountain ranges located in drier desert steppes. Most of the sites used for comparison are larger than HNP, but only Shaamar and Mongolian Altai have more species than our focus region. At 10 000 km², the Mongolian Altai region is 20 times larger than our study area and thus its larger diversity is not surprising. Shaamar (670 km²) belongs to the Mongolian Dauria region (as does Hustai) but is located in its northern part and closely borders the Khentei taiga region, explaining its relatively large richness. Unjuul is located in Middle Khalkha region, and thus closest to HNP. It is 10 times as large, yet has far lower species numbers (Table 5). The high biodiversity in HNP is mainly explained by characters of the phytogeographical region: Mongolian Dauria region is located between Khentei mountain taiga and Middle Khalkha steppe region, influenced by both locally humid and arid environments.

Judged by the percent share of species richness of the largest 10 families, HNP is, however, most similar (with respect to Euclidean distance, appendix 1) to Mongolian Altai, Baitag Bogd and Ikh Nart. These three places are in the relatively dry Gobi region; while their landscape is even more mountainous than HNP.

With respect to the genus level, the species composition in HNP is quite typical for central Mongolia. Dashnyam (1974) described that the largest genera in the steppe region are *Artemisia*, *Potentilla*, *Carex* and *Astragalus*. The species pool also reflects the mountainous character of HNP, with species like *Artemisia frigida*, *A. dracunculus*, *A. glauca*, and *A. gmelinii* (Ganbold 2010). In addition, the high frequency of ruderal Asteraceae (*Artemisia adamsii*, *A. frigida*, *A. scoparia*, *A. palustris*, *Aster hispidus* and *Neopallasia pectinata*) may be related to an increasing share of degraded areas.

The mean number of species per genus in the present study is 2 (493/246), a small ratio compared to that of the total Mongolia flora (Urgamal et al. 2014) at 4.6 (3127/683). This means that biodiversity in HNP is partitioned at higher taxonomical levels compared to the average across all Mongolian regions.

Since 1998 HNP has been protected by law due to its status being raised from Nature Reserve to National Park, and livestock grazing was removed after that. This at least partly explains the relatively high species richness in this park compared to other protected areas in steppe regions like Ikh Nart and Khar Yamaat Nature Reserves (Manibazar & Bulgan 1999, Tsegmed 2003, Enkhtuya 2001, MPHNPBZ 2011, Batsaikhan et al. 2016).

The very thorough surveys over the last two decades are another reason for the unusually large number of records in HNP. The National Park's administration has conducted long-term monitoring research on vegetation and flora (Sergelen 2003–2007, Tserendulam & Oyunbileg 2008–2010, Tserendulam 2011–2012, 2014–2016) as well as other studies (e.g. on forest habitats, Tserendash 2003, Enkhsaikhan 2009). Many species were newly recorded in the course of the monitoring activities, with the overall number of species known increasing from 307 species in 1995 to 450 species in 1999 to finally 493 in the present study. Unfortunately, recently most of the humid habitats rapidly degraded in the HNP because of global climate change and other impacts (such as overgrazing, outbreaks of herbivorous insects etc.).

15 species and 1 variety occur in HNP that had not been recognized for the Mongolian Dauria region before (*Allium altaicum*, *Alyssum desertorum*, *Artemisia transbaicalensis*, *Astragalus mellotoides* var. *tenuis*, *Atrapaxis frutescens*, *Carex cespitosa*, *Centaurea adpressa*, *Dracocephalum moldavicum*, *Leontopodium ochroleucum*, *Potentilla strigosa*, *Ribes nigrum*, *Rumex acetosa*, *Salix reticulata*, *Saxifraga sibirica*, *Senecio dubitabilis*, *Trigonella ruthenica*). This raises the question if HNP may not actually belong to another phytogeographical region. Manibazar et al. (1996) had suggested that the HNP should remain in the Mongolian Dauria region. We agree and suggest that for the listed species Mongolian Dauria simply is added to their distribution information. The reason is that they do not have a common larger scale distribution pattern. Of those 16 taxa, 8 are Eurasian geographical elements, 3 are Asian (Central Asian, East Siberia-Mongolian, Altai-Dzungarian Mongolian), 2 are Holarctic, and 3 are undefined geographical elements. Most of them (9 species) are distributed across six or more phytogeographical regions of Mongolia, and most occur also in the Khentei (12 species) region that borders on the HNP. With respect to ecology, the 16 species represent 9 groups. Nine are considered mesophytes needing substantial moisture, 6

Table 5. Comparison of HNP flora with other sites (Fig. 1).

Authors	1) Hustai National Park	2) Unjuul soum	3) Shaamar soum	4) Tumentsogt soum	5) Eastern Mongolia	6) Ikh Nart Nature Reserve	7) Mongol. Altai range	8) Baitag Bogd Mountain
	Present study	Dariimaa Sh. and Ulziikhutag N. 1984	Dariimaa Sh. and Mandakh B. 1984	Sanchir Ch. and Mandakh B. 2008	Dashnyam B. 1975	Mandakh B. et al. 2015	Beket U., 1983	Darikhand D. 2016
Territory of study area (km ²)	500	4790	672	2500	5704	438	10000	3500
Study years	1992-2016	1973-1974	1976-1980	1982-1987	1975	2000-2015	1976-1982, 1987	2009-2015
Main phytogeographical region (by Grubov 1982)	Mongolian Dauria	Middle Khalkha	Mongol Dauria	East Mongolia	East Mongolia	East Gobi	Mongolian Altai	Dzungarian Gobi
Pteridophyta	1.4	0.9	2.4	0.5	0.9	0.9	0.5	0.7
Gymnosperms	0.8	1.7	1.4	0.9	0.2	1.3	1.1	1.5
Angiosperms	97.8	97.4	96.2	98.6	98.9	97.8	98.4	97.8
Monocotyledons	18.7	22.3	23.4	22.2	29.2	6.9	18.8	15.2
Dicotyledons	78.1	75.1	72.8	76.4	69.7	90.9	79.6	82.6
Total number of vascular plant species	493	346	577	424	455	232	1101	454
Large families and their percentage share in given areas								
ASTERACEAE	13.6	14.8	15.4	13.9	14.3	18.5	13.5	11.7
POACEAE	11.4	11.8	9.5	12.0	16.7	12.1	11.1	6.2
FABACEAE	10.3	8.4	7.1	8.0	7.9	8.2	9.5	8.6
ROSACEAE	6.7	6.9	6.6	8.5	5.2	6.9	4.3	5.7
RANUNCULACEAE	4.9	3.1	4.9	4.2	2.8		4.6	3.5
BRASSICACEAE	4.3	4.3		3.3	2.7	3.0	6.5	6.4
AMARANTHACEAE	3.9	6.1			6.6	9.5	4.6	9.7
LAMIACEAE	3.0	3.1	2.8		4.4	2.6	3.5	3.3
POLYGONACEAE	3.2	(3.1)	3.1	4.0		3.0		4.0
CARYOPHYLLACEAE	2.6		2.8			3.0	4.5	4.0
SCROPHULARIACEAE			(2.8)	3.5			3.8	
AMARYLLIDACEAE						3.9		
CYPERACEAE		4.1	4.9	3.8	5.0			
LILIACEAE		4.1	3.5	3.5	4.2			
Total percent in flora	63.9	66.7	60.5	64.9	69.8	70.7	66.4	63.0

species belong to the xerophyte group and only one species is a petrophyte. Clearly, the novel records do not share a common ecology and distribution pattern.

Life forms

The overall life form spectrum of HNP indicates typical mountain steppe vegetation where shallow soils intermingle with more favorable sites. The most frequent life form group are the hemicryptophytes with the maximum number of species (56.8%), followed by therophytes (18.7%), phanerophytes (8.7%), cryptophytes (geophytes; 10.5%), helophytes (0.2%) and chamaephytes (5.1%). Most of the phanerophytes are nano-phanerophytes (28 species) while two species are lianas; 1 species is a hemi-phanerophyte, and 12 species are trees.

Annuals and biennials (therophytes) which form the second most abundant life form group, are concentrated in the families *Amaranthaceae* (16 species), *Brassicaceae* (15), *Asteraceae* (12), *Poaceae* (9), and *Gentianaceae* (6). These families are known to comprise many annuals in the Mongolian flora. Together, they illustrate that HNP is affected by disturbance, mainly by agriculture (including farming) and livestock grazing. Annuals are, however, also characteristic of dry conditions and eroded soils (Smith 1913). With respect to genus composition, *Chenopodium* (7 species) and *Artemisia* (6) account for most of the short-lived species, and they all occur in degraded or abandoned areas.

Hustai is similar to Baitag Bogd Mountain and Ikh Nart Nature Reserve with respect to the share of hemicryptophytes. They account for 61% of the total species of the HNP, and are well adapted to conditions of the more temperate zone (Raunkiaer 1934). Our results correspond to the life form spectrum found in different parts of Mongolia (Dashnyam 1975, Ulziikhutag 1989b, Darikhand 2016, Mandakh et al. 2015). Again, the dominance of hemicryptophytes is typical for a mountain steppe (Kamelin 1973) region with a dominance of hemicryptophytes. In all studies conducted in the HNP and in other parts of Mongolian Dauria phytogeographical region, hemicryptophytes and epiphytes usually comprise the highest and lowest percentages of life forms, respectively (Fig. 3).

Ecological groups

Ulziikhutag (1989b) distinguished 19 ecological groups in the Mongolian flora. Of those, 17 groups were recorded in the present study. The flora of HNP is dominated by the ecological groups of mesophytes (32.5%) and xerophytes (25.4%; Fig. 4), followed by mesoxerophytes (14.4%), xeropetrophytes (9.1%), hygrophytes (5.7%), halophytes (4.1%), and another twelve ecological groups (2.2–0.2%, respectively).

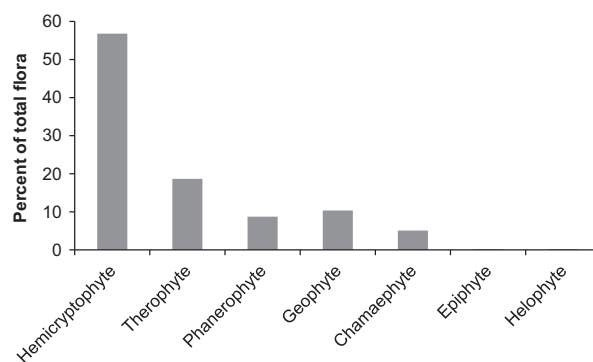


Figure 3. Share of life forms with respect to percent of total species number.

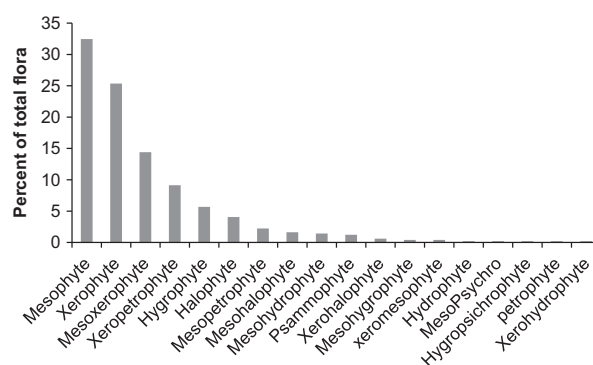


Figure 4. Ecological groups in the flora of HNP.

Mesophytes are so common in HNP because their largest species richness is found in humid habitats such as forests and meadows. Indeed, the majority of the dominant hemicryptophyte species (265 species) are mesophytes (27.9%), followed by xerophytes (27.1%) and mesoxerophytes (17%).

The high share of mesophytes is also typical for Shaamar region (Dariimaa & Mandakh 1984) that was similar to HNP with respect to other aspects as well (Table 5).

Geographical elements

The occurring species differ with respect to distribution in other phytogeographical regions of Mongolia (Fig. 5). Not surprisingly, strongest overlaps are apparent with the Mongolian Dauria region, HNP is considered to be part of. Of all species in HNP, 97% (appendix 2) had been listed for the Mongolian Dauria region (Urgamal et al. 2014), the remaining 3% are simply the 16 species not recorded so far. Also not surprising is the high overlap with the Khangay and Khentei regions, which border Mongolian Dauria in the southwest and northeast. The relatively high number of species shared with

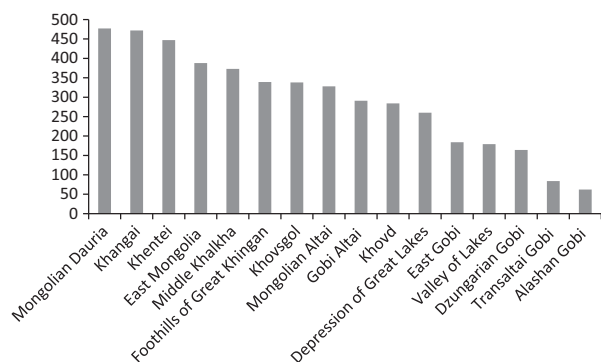


Figure 5. Overlap (number of species) of the flora of HNP with the flora of the main phytogeographical regions of Mongolia.

distant Mongolian Altai and Gobi Altai is explained by the mountainous relief. East Mongolia, Middle Khalkha and foothills of the Great Khingan in far eastern Mongolia all have broadly similar moisture conditions as HNP, while the flora of the arid regions of the Gobi in southern Mongolia is different.

Larger-scale chorological analysis followed concepts established by Tolmachev (1974) and his followers (Ganbold 2010, Malyshev & Peshkova 1978), especially with respect to Asia that was broken down to 12 subgroups. If authors gave contrasting information, we chose that indicating the larger range to avoid overestimating the number of small range species (Malyshev & Peshkova 1978, Ganbold 2010, Dulamsuren et al. 2005, Meusel et al. 1965, 1978, 1992).

With respect to the global distribution, Asian elements were clearly dominant at 258 species (Fig. 6). These are followed by Eurasian elements (148 species) and Holarctic (73) elements, while cosmopolitan (7) as well as Asian-American elements (7) were not important. Among the Asteraceae, 55.2% were of Asian, 26.9% of

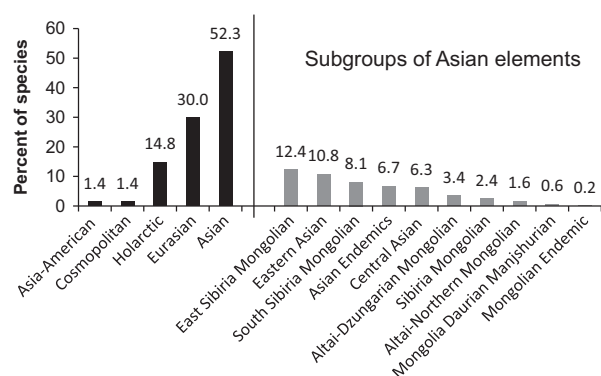


Figure 6. The percent of chorological elements and Asian subgroups to total flora.

Eurasian, 13.4% of Holarctic, 1.5% of Asian-American distribution.

Of the 16 species newly recorded in Mongolian Dauria, 8 are Eurasian geographical elements, 5 are Asian (Central Asian, Eastern Siberia-Mongolian, South Siberia Mongolian, Altai-Dzungarian Mongolian), and 3 are Holarctic elements.

The 24 Mongolian subendemic species all are Asian elements. Within the Asian elements, the East Asian elements are represented by 11 species, while there are 7 species of Central Asian, 2 species of South Siberia Mongolian, 2 species of Asian endemic elements, and 2 species of Altai Northern Mongolia (subgroups according to Ganbold 2010).

4 Conclusion

We presented an updated floristic inventory of Hustai National Park and demonstrated that the park is important with respect to its high local diversity. This is mainly due to the presence of a range of microhabitats differing with respect to soil types, landscape types, regional features, and agricultural impact and conservation activities. Moreover, HNP is located at the transition zone between forests and steppes.

Although the present study tried to compile all available data on HNP's flora and its composition, there almost certainly remain gaps. That and the need to come up with sound data on long-term trends call for continued monitoring in this hotspot area of steppe biodiversity.

We extend our sincere thanks to administration and colleagues from Hustai National Park, who made this research possible; the same holds true for the international donors of Hustai National Park. We acknowledge the kind support provided in the framework of a high level study project of National University of Mongolia. Part of the work was financed by the German Federal Ministry of Education and Research within the joint research programme BioTip (here: MoreStep project). Special thanks go to E. Jäger and one anonymous referee who put tremendous effort in cross-reading earlier versions of this paper. Their extremely thoughtful suggestions greatly helped to improve our ideas and presentation.

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Appendix 1:

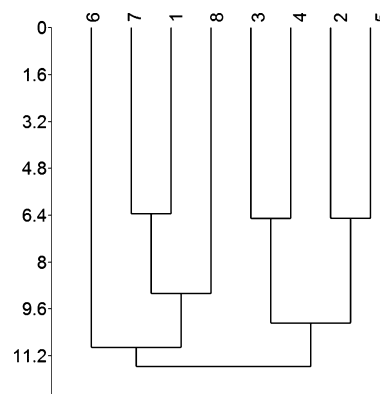


Figure Appendix 1. Cluster analysis based on percentage share of the 10 largest families compared to the total flora of a given reference region. 1) HNP, 2) Unjuul soum, 3) Shaamar soum, 4) Tumentsogt soum, 5) Eastern Mongolia, 6) Ikh Nart Nature Reserve 7) Mongolian Altai range, 8) Baitag Bogd Mountain (UPGMA based on Euclidean distance, calculated in Past 2.0 software, HAMMER, Ø. 2011: PAST - PAleontological STATistics. Oslo: Natural History Museum, University of Oslo)

Appendix 2: Vascular plant species of Hustai National Park

Notes:

Regional distribution in Mongolia: Numbers after the species name refer to phytogeographical regions of Mongolia: 1-Khovsgol, 2-Khentei, 3-Khangai, 4-Mongolian Dauria, 5-Foothills of Great Khingan, 6-Khovd, 7-Mongolian Altai, 8-Middle Khalkha, 9-East Mongolia, 10-Depression of Great Lakes, 11-Valley of Lakes, 12-East Gobi, 13-Gobi Altai, 14-Dzungarian Gobi, 15-Transaltai Gobi, 16-Alashan Gobi.

Chorotypes: Hol, Holarctic; Cosm, Cosmopolitan; Eura, Eurasian; AA - Asian-American.

Life forms: H, hemicyptophyte; P, phanerophytes; C, chamaephytes; G, geophytes; He, helophyte, and Th, therophytes.

Ecological groups: M, mesophyte; Mx, mesoxerophyte; Mh, mesohalophyte; Mhyd, mesohydrophyte; Mhyg, mesohydrophyte; Mpet, mesopetrophyte; Mpsy, mesopsychrophyte; X, xerophyte; Xh, xerohalophyte, Xhyd, xerohydrophyte; Xm, xeromesophyte; Xpet, xeropetrophyte; Ha, halophyte; Hyd, hydrophyte; Hyg, hygrophyte; Hygpsy, hygropsychrophyte; Pet, petrophyte; Ps, psammophyte.

1	OPIOGLOSSACEAE
1	<i>Botrychium dusenii</i> Alston. 1, 2, 3, 4, 5, 7, 9, Hol, G, Mpsy
2	EQUISETACEAE
2	<i>Equisetum arvense</i> L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 14, Cosm, G, M
2	<i>Equisetum palustre</i> L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 14, Hol, G, Hyg
3	<i>Equisetum pratense</i> L. 1, 2, 3, 4, 5, 6, 7, 9, 10, Hol, G, M
3	CYSTOPTERIDACEAE
5	<i>Cystopteris fragilis</i> (L.) Bernh. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, Hol, H, Mx
4	WOODSIACEAE
6	<i>Woodsia ilvensis</i> (L.) R. Br. 1, 2, 3, 4, 5, 6, 7, 8, 9, 13, Hol, H, Mpet
5	POLYPODIACEAE
7	<i>Polypodium virginianum</i> L. 1, 2, 3, 4, 5, 8, Hol, H, M
6	PINACEAE
8	<i>Pinus sylvestris</i> L. 1, 2, 3, 4, 5, 8, 9, Eura, P, M
7	CUPRESSACEAE
9	<i>Juniperus pseudosabina</i> Fisch. et Mey. 1, 2, 3, 4, 7, 8, 13, Eura, P-nano, Mpet
8	EPHEDRACEAE
10	<i>Ephedra monosperma</i> G.G. Gmel. ex C.A. Mey. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, As, C, Xpet
11	<i>Ephedra sinica</i> Stapt. 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, As, C, Xpet
9	JUNCAGINACEAE
12	<i>Triglochin palustris</i> L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, Cosm, H, Hyg
10	LILIACEAE
13	<i>Gagea pauciflora</i> (Turcz. ex Trautv.) Ledeb. 1, 2, 3, 4, 5, 7, 9, 14, As, G, M
14	<i>Lilium pumilum</i> Delile 1, 2, 3, 4, 5, 8, 9, 12, As, G, X
11	ORCHIDACEAE
15	<i>Dactylorhiza salina</i> (Turcz. ex Lindl.) Soo 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 14, As, G, Ha
16	<i>Corallorhiza trifida</i> Chatel. 1, 2, 4, Hol, G, M
17	<i>Gymnadenia conopsea</i> (L.) R. Br. 1, 2, 3, 4, 5, Eura, G, M
18	<i>Spiranthes sinensis</i> (Pers.) Ames. 2, 3, 4, 5, 8, 9, 10, As, G, Mh
12	IRIDACEAE
19	<i>Iris humilis</i> Georgi 1, 2, 3, 4, 5, 8, 9, 12, Eura, H/G, X
20	<i>Iris lactea</i> Pall. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, As, G, Ha
21	<i>Iris ruthenica</i> Ker Gawl. 1, 2, 3, 4, 5, As, G, M

- 22 *Iris sibirica* L. 4, Hol, G, Hyg
 23 *Iris tigridia* Bunge ex Ledeb. 1, 2, 3, 4, 8, As, G, Xm
- 13 **AMARYLLIDACEAE**
 24 *Allium altaicum* Pall. 1, 2, 3, 6, 7, 8, 10, 13, 14, As, G, Xpet
 25 *Allium anisopodium* Ledeb. 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, As, G, X
 26 *Allium bidentatum* Fisch. ex Prokh. & Ikonn.-Gal. 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, As, G, X
 27 *Allium leucocephalum* Turcz. ex Ledeb. 1, 2, 3, 4, 7, 8, 9, 10, 11, 12, 13, 14, As, G, X
 28 *Allium lineare* L. 1, 2, 3, 4, 6, 7, 10, 13, 14, Eura, G, Mx
 29 *Allium ramosum* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, Eura, G, X
 30 *Allium prostratum* Trev. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, As, G, X
 31 *Allium schoenoprasum* L. 1, 2, 3, 4, 5, 6, 7, 10, Hol, G, Hygpsy
 32 *Allium senescens* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, Eura, G, Xm
 33 *Allium tenuissimum* L. 1, 2, 3, 4, 5, 7, 8, 9, 11, 12, 13, 14, 15, As, G, Xpet
- 14 **ASPARAGACEAE**
 34 *Asparagus dahuricus* Fisch. ex Link. 2, 3, 4, 5, 6, 7, 8, 9, 11, 12, As, H, X
 35 *Maianthemum bifolium* (L.) F. Schmidt. 1, 2, 3, 4, 5, Eura, G, M
 36 *Polygonatum odoratum* (Mill.) Druce 1, 2, 3, 4, 5, 8, 9, Eura, G, M
 37 *Polygonatum sibiricum* Delaroché 1, 2, 3, 4, 5, 8, 9, 12, As, G, M
- 15 **JUNCACEAE**
 38 *Juncus bufonius* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, Hol, T, Ha
 39 *Juncus gerardii* Loisel. 2, 3, 4, 6, 7, 8, 9, 10, 13, 14, 15, Eura, G, Ha
 40 *Juncus salsuginosus* Turcz. ex C.A. Mey. 1, 2, 3, 4, 6, 7, 8, 10, 11, 12, 13, 15, As, H/G, Ha
- 16 **CYPERACEAE**
 41 *Blysmus compressus* subsp. *brevifolius* (Decne.) Kukkonen 2, 3, 4, 5, 7, 8, 9, 11, 13, 14, Eura, G, Ha
 42 *Carex cespitosa* L. 1, 2, 3, 5, 6, 7, 8, 9, 10, 15, 16, Eura, H/He, Hyg
 43 *Carex coriophora* Fisch. et Mey. ex Kunth 1, 2, 3, 4, 5, 8, 9, As, H, Hyg
 44 *Carex delicata* Clarke 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, Hol, G, M
 45 *Carex pamirica* subsp. *dichroa* (Freyen) T.V. Egorova 1, 2, 3, 4, 6, 7, 10, As, H, Mhyd
 46 *Carex duriuscula* C.A. Mey. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, AA, G, X
 47 *Carex enervis* C.A. Mey. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, As, G, Hyg
 48 *Carex korshinskyi* Kom. 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, As, G, X
 49 *Carex pediformis* C.A. Mey. 1, 2, 3, 4, 5, 6, 7, 8, 9, 13, 14, Eura, H/G, Mx
 50 *Carex reptabunda* (Trautv.) V. Krecz. 1, 3, 4, 5, 8, 9, 10, 11, 12, 16, As, G, Mh
 51 *Carex sabulosa* Turcz. ex Kunth 1, 2, 3, 4, 7, 8, 10, As, G, Ha
 52 *Carex tomentosa* L. 2, 4, 8, Eura, H/G, Mhyd
 53 *Eleocharis palustris* (L.) Roem. & Schult. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, Hol, G/H/He, Hyg
- 17 **POACEAE**
 54 *Achnatherum splendens* (Trin.) Nevski 2, 3, 4, 7, 8, 9, 10, 11, 13, 14, 15, 16, Eura, H, Xh
 55 *Elymus reflexiaristatus* (Nevski) Melderis 1978 1, 2, 3, 4, 5, 6, 7, 12, 13, 14, As, G/H/He, X
 56 *Agropyron cristatum* (L.) P.B. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, Eura, H, Xpet
 57 *Agropyron michnoi* Roshev. 1, 3, 4, 5, 8, 9, 10, 13, As, H, Psa
 58 *Agrostis clavata* Trin. 1, 2, 3, 4, 5, 9, Eura, H, Mpet
 59 *Agrostis mongholica* Roshev. 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, As, H, M
 60 *Agrostis vinealis* Schreb. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, As, H, M
 61 *Alopecurus aequalis* Sobol. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, As, T, M
 62 *Alopecurus arundinaceus* Poir. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, Eura, H/G, M
 63 *Alopecurus brachystachyus* M. Bieb. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, As, G, M

- 64 *Avena fatua* L. 3, 4, 7, 8, 10, 11, 13, 14, Hol, T, Mx
- 65 *Avena sativa* L. 2, 3, 4, 9, 11, 12, Hol, T, M
- 66 *Beckmannia syzigachne* (Steud.) Fern. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, Eura, H, Mhyd
- 67 *Bromus inermis* Leyss. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, Hol, H, M
- 68 *Bromus korotkiji* Drobow 3, 4, 8, 9, 10, 11, 13, As, H, M
- 69 *Calamagrostis epigeios* (L.) Roth 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, Eura, H, Xh
- 70 *Calamagrostis macilenta* (Griseb.) Litv. 1, 2, 3, 4, 6, 7, 8, 10, 13, 14, 15, As, H, Hyg
- 71 *Calamagrostis pseudophragmitis* (Haller f.) Koeler 1, 2, 3, 4, 7, 8, 10, 11, Eura, H, M
- 72 *Catabrosa aquatica* (L.) P. Beauv. 1, 2, 3, 4, 7, 8, 9, 10, 13, Hol, H, Mhyd
- 73 *Cleistogenes kitagawae* Honda 2, 3, 4, 5, 8, 9, As, H, X
- 74 *Cleistogenes squarrosa* (Trin.) Keng 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, As, H, X
- 75 *Echinochloa crus-galli* (L.) P. Beauv. 7, 9, 12, 13, Hol, T, M
- 76 *Elymus dahuricus* Turcz. ex Griseb. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, As, G/H, M
- 77 *Elymus gmelinii* (Ledeb.) Tzvelev 1, 2, 3, 4, 5, 6, 7, 8, 9, 13, As, G/H, M
- 78 *Elymus sibiricus* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, Eura, G/H, M
- 79 *Elytrigia repens* (L.) Nevski 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, Eura, G/H, Mx
- 80 *Eragrostis minor* Host 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, Hol, T, Xpet
- 81 *Festuca dahurica* (St.-Yves) Krecz. & Bobrov 2, 4, 5, 9, As, H, Xpet
- 82 *Festuca lenensis* Drobow 1, 2, 3, 4, 5, 6, 7, 8, 9, 13, 15, As, H, X
- 83 *Festuca ovina* L. 1, 2, 3, 4, 5, 6, 7, 9, 13, Eura, H, Mpet
- 84 *Festuca rubra* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 13, Hol, H, M
- 85 *Festuca sibirica* Hackel. ex Boiss 1, 2, 3, 4, 5, 8, 9, 10, 13, As, H, M
- 86 *Helictotrichon hookeri* (Scribn.) Henrard 1, 2, 3, 4, 5, 6, 7, 8, 9, 13, Eura, H, M
- 87 *Hierochloa glabra* Trin. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, As, H, M
- 88 *Hordeum brevisubulatum* (Trin.) Link 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 16, As, H, Ha
- 89 *Hordeum vulgare* L. 1, 2, 3, 4, 7, 10, 11, 12, 13, Cosm, T, M
- 90 *Koeleria macrantha* (Ledeb.) Schult. 1, 2, 3, 4, 5, 8, 9, 10, 11, 12, 13, Hol, H, X
- 91 *Leymus chinensis* (Trin.) Tzvelev 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, As, H, X
- 92 *Melica turczaninowiana* Ohwi. 2, 3, 4, 5, 9, As, H, Mpet
- 93 *Melica virgata* Turcz. ex Trin. 1, 2, 3, 4, 5, 8, 9, 10, 12, 13, As, H, Xpet
- 94 *Panicum miliaceum* L. 2, 3, 4, 9, 10, 12, 13, Eura, T, M
- 95 *Poa attenuata* Trin. 1, 2, 3, 4, 6, 7, 8, 9, 10, 12, 13, 14, As, H, X
- 96 *Poa attenuata* var. *botryoides* (Trin. ex Griseb.) 1, 2, 3, 4, 6, 7, 8, 9, 10, 12, 13, 14, As, H, X
- 97 *Poa nemoralis* L. 1, 2, 3, 4, 5, 8, 9, Eura, H, M
- 98 *Poa pratensis* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, Eura, H, M
- 99 *Poa sibirica* Roshev. 1, 2, 3, 4, 5, 6, 7, 10, 13, Eura, H, M
- 100 *Poa subfastigiata* Trin. 1, 2, 3, 4, 5, 6, 8, 9, 10, 13, As, H, M
- 101 *Puccinellia tenuiflora* (Griseb.) Scribn. et Merr. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, As, H, Ha
- 102 *Setaria viridis* (L.) P. Beauv. 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, Eura, T, Xpet
- 103 *Stipa baicalensis* Roshev. 1, 2, 3, 4, 5, 7, 8, 9, 12, As, H, X
- 104 *Stipa grandis* P.A. Smirn. 3, 4, 5, 8, 9, As, H, X
- 105 *Stipa krylovii* Roshev. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, As, H, X
- 106 *Stipa sibirica* (L.) Lam. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, As, H, X
- 107 *Stipa tianschanica* var. *klemenzi* (Roshev.) Norl. 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, As, H, X
- 108 *Trisetum sibiricum* Rupr. 1, 2, 3, 4, 5, 7, 8, 9, 10, 13, Hol, H, Mx
- 109 *Triticum aestivum* L. 2, 4, 10, 11, 13, 14,, As, T, M

18 **PAPAVERACEAE**

- 110 *Chelidonium majus* L. 2, 3, 4, 5, 7, 8, 9, Eura, H, Xpet
 111 *Hypecoum erectum* L. 2, 3, 4, 5, 8, 9, 13, As, T, Xpet
 112 *Papaver nudicaule* L. 1, 2, 3, 4, 5, 6, 7, 9, 13, As, H, M
 113 *Papaver rubro-aurantiacum* Lundstr. 1, 2, 3, 4, 5, 7, 8, 9, 10, 13, As, H, X

19 **RANUNCULACEAE**

- 114 *Aconitum barbatum* Pers. 1, 2, 3, 4, 6, 7, 8, 10, 11, 13, Eura, H/G, M
 115 *Anemone silvestris* L. 1, 2, 3, 4, 5, 6, 7, 9, Eura, H/G, Mx
 116 *Anemone narcissiflora* subsp. *crinita* (Juz.) Kitag. 1, 2, 3, 4, 6, 7, Eura, H, M
 117 *Aquilegia viridiflora* Pall. 2, 3, 4, 5, 7, 8, 9, 10, 12, 13, As, H, Xpet
 118 *Caltha natans* Pall. 1, 2, 3, 4, 5, 8, 10, 11, Hol, H, Hyd
 119 *Clematis alpina* var. *sibirica* (L.) Kuntze 1, 2, 3, 4, 6, 7, 8, 10, 13, Eura, P-Lian, M
 120 *Clematis tangutica* (Maxim.) Korsh. 2, 3, 4, 7, 8, 10, 13, 14, 15, As, P-Lian, X
 121 *Delphinium cheilanthum* Fisch. ex DC. 2, 3, 4, 6, 7, 8, 13, As, H, M
 122 *Delphinium grandiflorum* L. 1, 2, 3, 4, 5, 9, 13, As, H, Mx
 123 *Delphinium triste* Fisch. 1, 2, 3, 4, 8, 13, As, H, Mx
 124 *Halerpestes salsuginosa* (Pall. ex Georgi) Greene 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, As, H, Ha
 125 *Leptopyrum fumarioides* (L.) Rchb. 1, 2, 3, 4, 6, 7, 8, 9, 13, AA, T, M
 126 *Pulsatilla ambigua* (Turcz. ex Hayek) Juz. 1, 2, 3, 4, 6, 7, 13, As, H, Mx
 127 *Pulsatilla bungeana* C.A. Mey. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, As, H, X
 128 *Pulsatilla patens* subsp. *flavescens* (Zucc.) Zamelis 1, 2, 3, 4, 5, 7, Eura, H, M
 129 *Pulsatilla turczaninowii* Kryl. & Serg. 1, 2, 3, 4, 5, 6, 8, 9, As, H, X
 130 *Ranunculus grandis* Honda 4, 5, 9, As, H, M
 131 *Ranunculus natans* C.A. Mey. 1, 2, 3, 4, 6, 7, 8, 9, 10, 13, 15, As, H, Hyg
 132 *Ranunculus pedatifidus* Smith. 1, 2, 3, 4, 5, 6, 7, 9, 13, As, H, M
 133 *Ranunculus sceleratus* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, Hol, T, Hyg
 134 *Thalictrum foetidum* L. 1, 2, 3, 4, 6, 7, 8, 9, 10, 13, 14, Hol, H, X
 135 *Thalictrum petaloideum* L. 1, 2, 3, 4, 5, 9, As, H, X
 136 *Thalictrum simplex* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, Eura, G, M
 137 *Thalictrum squarrosum* Steph. ex Willd. 2, 3, 4, 5, 8, 9, 13, As, H, X

20 **Grossulariaceae**

- 138 *Ribes diacanthum* Pall. 2, 3, 4, 5, 8, As, P-nano, Xpet
 139 *Ribes nigrum* L. 1, 2, 3, 5, 6, 7, 10, 13, Eura, P-nano, Mhyg
 140 *Ribes pulchellum* Turcz. 1, 2, 3, 4, 5, 8, 9, 12, 14, As, P-nano, Xpet
 141 *Ribes rubrum* L. 1, 2, 3, 4, 5, 6, 7, 9, 13, Eura, P-nano, M

21 **SAXIFRAGACEAE**

- 142 *Saxifraga bronchialis* L. 1, 2, 3, 4, 8, As, H, Xpet
 143 *Saxifraga sibirica* L. 1, 3, 6, 7, 10, 13, 14, Eura, H, Mpet

22 **CRASSULACEAE**

- 144 *Orostachys fimbriata* (Turcz.) Berger 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, Eura, H, Xpet
 145 *Orostachys malacophylla* (Pall.) Fisch. 1, 2, 3, 4, 5, 8, 9, As, H, Xpet
 146 *Orostachys spinosa* (L.) C.A. Meyer 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, Eura, H, Xpet
 147 *Orostachys thyrsiflora* Fisch. 1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, Eura, H, Xpet
 148 *Sedum aizoon* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 13, 14, As, C, Mx
 149 *Sedum telephium* L. 1, 2, 3, 4, 5, 6, 7, 9, 10, Eura, G, M

- 23 **SANTALACEAE**
 150 *Thesium refractum* C.A. Mey. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, As, G, Mx
- 24 **Plumbaginaceae**
 151 *Goniolimon speciosum* (L.) Boiss. 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 13, 14, 15, Eura, H, X
 152 *Limonium aureum* (L.) Hill. 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, As, H, Xh
 153 *Limonium flexuosum* (L.) Kuntze 1, 2, 3, 4, 6, 7, 8, 9, 12, 13, As, H, X
- 25 **POLYGONACEAE**
 154 *Atraphaxis frutescens* (L.) C. Koch. 3, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16, Eura, P-nano, X
 155 *Atraphaxis pungens* (M. Bieb.) Jaub. & Spach. 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, As, P-nano, Xpet
 156 *Fagopyrum tataricum* (L.) Gaertner 3, 4, 6, 9, 10, 12, Eura, T, Xhyd
 157 *Persicaria lapathifolia* (L.) Delabre 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, Hol, T, Hyg
 158 *Persicaria vivipara* (L.) Ronse Decr. 1, 2, 3, 4, 6, 7, 8, 10, 13, 14, Hol, H, M
 159 *Polygonum alopecuroides* Turcz. ex Besser 1, 2, 3, 4, 5, 6, 8, As, H, Mx
 160 *Polygonum angustifolium* Pall. 1, 2, 3, 4, 5, 7, 8, 9, 11, 13, As, H, X
 161 *Polygonum aviculare* L. 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 16, Cosm, T, M
 162 *Fallopia convolvulus* (L.) A. Love 2, 3, 4, 5, 8, 9, 10, 12, 15, Hol, T, M
 163 *Polygonum divaricatum* L. 1, 2, 3, 4, 5, 8, 9, As, H, X
 164 *Polygonum sericeum* Pall. ex Georgi 2, 3, 4, 8, 9, As, H, Psa
 165 *Rheum rhabarbarum* L. 1, 2, 3, 4, 5, 7, 8, 9, 12, 13, 14, As, H, Mx
 166 *Rumex acetosa* L. 1, 2, 3, 6, 7, Hol, H, M
 167 *Rumex acetosella* L. 1, 2, 3, 4, 5, 8, 9, Eura, H/G, M
 168 *Rumex gmelinii* Turcz. 2, 3, 4, 5, 8, 9, As, H, M
 169 *Rumex thyrsiflorus* Fingerh. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, Hol, H, M
- 26 **CARYOPHYLLACEAE**
 170 *Cerastium arvense* L. 1, 2, 3, 4, 5, 6, 7, 9, 10, 13, 14, Hol, C, M
 171 *Dianthus chinensis* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, Eura, H, Mx
 172 *Dianthus superbus* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, Eura, H/G, M
 173 *Eremogone capillaris* (Poir.) Fenzl 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, As, H, X
 174 *Eremogone meyeri* (Fenzl) Ikonn. 2, 3, 4, 6, 7, 9, 10, 12, As, H, Xpet
 175 *Silene samojedorum* (Sambuk) Oxelman 1, 2, 3, 4, 5, 9, As, H, Mx
 176 *Moehringia lateriflora* (L.) Fenzl 1, 2, 3, 4, 5, 7, 9, 13, Hol, H, Mhyg
 177 *Silene aprica* Turcz. 1, 2, 3, 4, 5, 7, 8, 9, 10, 12, 13, As, T, Xpet
 178 *Silene jensseensis* Willd. 1, 2, 3, 4, 5, 6, 8, 9, As, H, Xpet
 179 *Silene repens* Patr. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, Eura, H, M
 180 *Stellaria brachypetala* Bunge 3, 4, 5, 6, 7, 9, 11, 13, 14, Eura, H, Hyg
 181 *Stellaria crassifolia* Ehrh. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 14, Hol, H, Hyg
 182 *Stellaria dichotoma* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, As, H, X
- 27 **AMARANTHACEAE**
 183 *Axyris amaranthoides* L. 2, 3, 4, 5, 8, 9, 13, Hol, T, X
 184 *Axyris prostrata* L. 1, 2, 3, 4, 6, 7, 8, 9, 10, 13, 14, As, T, Mx
 185 *Bassia dasyphylla* (Fisch. & Meyer) O. Kuntze 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, As, T, X
 186 *Bassia prostrata* (L.) Beck 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, Eura, C, X
 187 *Bassia scoparia* (L.) A.J. Scott 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, As, T, X
 188 *Chenopodium acuminatum* Willd. 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, As, T, Mx
 189 *Chenopodium album* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, Cosm, T, M
 190 *Chenopodium foliosum* Ascherson 3, 4, 6, 7, 12, 13, 14, 15, Eura, T, Mpet

- 191 *Chenopodium hybridum* L. 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, Hol, T, M
 192 *Chenopodium karoii* (Murr.) Aellen 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15,, As, T, Mx
 193 *Chenopodium strictum* Roth 2, 4, 9, 14, Hol, T, M
 194 *Chenopodium glaucum* L. 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, Hol, T, Ha
 195 *Corispermum chinganicum* Iljin 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, As, T, Psa
 196 *Corispermum mongolicum* Iljin 3, 4, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, As, T, X
 197 *Dysphania aristata* (L.) Mosyakin & Clemants 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, Hol, T, X
 198 *Kraschennikovia ceratoides* (L.) Gueldenst. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, Eura, C, X
 199 *Kalidium gracile* Fenzl 3, 4, 8, 9, 10, 11, 12, 13, 14, 15, 16, As, C, Mh
 200 *Salsola collina* Pall. 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, Eura, T, Psa
 201 *Salsola tragus* L. 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, AA, T, X
- 28 **Celastraceae**
 202 *Parnassia palustris* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 14, Hol, H, Hyg
- 29 **EUPHORBIACEAE**
 203 *Euphorbia esula* L. 1, 2, 3, 4, 5, 8, 9, 12, As, H, M
- 30 **SALICACEAE**
 204 *Populus tremula* L. 1, 2, 3, 4, 5, 7, 8, 9, 11, Eura, P, M
 205 *Salix kochiana* Trautv. 1, 2, 3, 4, 5, 7, 10, As, P, Hyg
 206 *Salix ledebouriana* Trautv. 1, 2, 3, 4, 6, 7, 9, 10, 11, 12, 13, 14, 15, Eura, P, X
 207 *Salix miyabeana* Seemen 1, 2, 3, 4, 5, 8, 9, As, P, M
 208 *Salix reticulata* L. 1, 3, 6, 7, Hol, P-nano, Pet
 209 *Salix rhamnifolia* Pall. 1, 2, 3, 4, 5, 6, 9, Hol, P, M
 210 *Salix schwerinii* E. Wolf 2, 3, 4, 5, 9, As, P, M
 211 *Salix taraikensis* Kimura 1, 2, 3, 4, 5, 7, 13, As, P, M
- 31 **Violaceae**
 212 *Viola dissecta* Ledeb. 1, 2, 3, 4, 5, 7, 9, 13, As, H, Mpet
- 32 **LINACEAE**
 213 *Linum sibiricum* DC. 2, 3, 4, 7, 8, 9, 10, 13, 14, Eura, H, Mx
- 33 **HYPERICACEAE**
 214 *Hypericum attenuatum* Choisy 2, 3, 4, 5, 9, As, H, Mx
- 34 **FABACEAE**
 215 *Astragalus brevifolius* Ledeb. 1, 2, 3, 4, 6, 8, 11, 12, 13, As, H, Xpet
 216 *Astragalus chorinensis* Bunge 2, 3, 4, As, H, X
 217 *Astragalus dahuricus* (Pall.) DC. 3, 4, 5, 8, 9, 10, 12, As, T, M
 218 *Astragalus fruticosus* Pall. 2, 3, 4, 9, 13, As, C, X
 219 *Astragalus galactites* Pall. 1, 2, 3, 4, 5, 8, 9, As, H, X
 220 *Astragalus inopinatus* Boriss. 1, 2, 3, 4, 5, 7, 8, 9, 13, As, C, M
 221 *Astragalus laguroides* Pall. 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, As, H, X
 222 *Astragalus melilotoides* Pall. 2, 3, 4, 5, 8, 9, 10, 11, 12, 13, 16, As, H, X
 223 *Astragalus melilotoides* var. *tenuis* Ledeb. 2, 3, 5, 8, 9, As, H, X
 224 *Astragalus membranaceus* (Fisch.) Bunge 2, 4, Eura, H, M
 225 *Astragalus mongholicus* Bunge 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 13, As, H, M
 226 *Astragalus scaberrimus* Bunge 2, 3, 4, 8, 9, 12, As, H, X
 227 *Astragalus adsurgens* Pall. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, As, H, Mx
 228 *Astragalus versicolor* Pall. 1, 2, 3, 4, 6, As, H, X
 229 *Caragana leucophloea* Pojark. 3, 4, 6, 7, 8, 10, 11, 12, 13, 14, 15, 16, As, P-nano, X

- 230 *Caragana microphylla* Lam. 2, 3, 4, 5, 8, 9, As, P-nano, X
 231 *Caragana pygmaea* (L.) DC. 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 14, As, P-nano, X
 232 *Caragana stenophylla* Pojark. 1, 2, 3, 4, 5, 8, 9, 12, 13, As, P-nano, X
 233 *Glycyrrhiza uralensis* Fisch. 2, 3, 4, 5, 8, 9, 10, 11, 12, 13, 14, 15, 16, Eura, H, X
 234 *Gueldenstaedtia verna* (Georgi) Boriss. 1, 2, 4, 9, As, H, X
 235 *Hedysarum alpinum* L. 1, 2, 3, 4, 5, 6, 7, 9, Eura, H, M
 236 *Hedysarum chalchorum* N. Ulzj. 3, 4, 8, As?, H, X
 237 *Hedysarum dahuricum* Turcz. ex B. Fedtsch. 1, 3, 4, 5, 6, 7, 8, 9, 10, 13, As, H, X
 238 *Hedysarum fruticosum* Pall. 3, 4, 5, 8, 9, 10, 11, 12, 13, 16, As, C, Psa
 239 *Lathyrus humilis* (Ser.) Spreng. 1, 2, 3, 4, 5, 8, 9, Eura, T, M
 240 *Lathyrus pratensis* L. 2, 3, 4, 10, Eura, H, Hyg
 241 *Lespedeza davurica* (Laxm.) Schindl. 2, 3, 4, 5, 8, 9, 11, 12, 13, 16, As, C, X
 242 *Lespedeza juncea* (L.F.) Pers. 2, 3, 4, 5, 8, 9, As, C, Mx
 243 *Medicago falcata* L. 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, Eura, H, Mx
 244 *Medicago lupulina* L. 2, 3, 4, 5, 7, 8, 9, 10, 11, 13, 14, Eura, H, X
 245 *Medicago ruthenica* (L.) Ledeb. 1, 2, 3, 4, 5, 8, 9, 10, 11, 13, 14, As, H, Xpet
 246 *Melilotus dentatus* (Waldst. & Kit.) Pers. 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 14, Eura, T, Ha
 247 *Melilotus suaveolens* Ledeb. 1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, As, T, Mx
 248 *Onobrychis arenaria* subsp. *sibirica* (Turcz. ex Besser) P.W. Ball 2, 3, 4, 13, Eura, H, M
 249 *Oxytropis caespitosa* (Pall.) Pers. 1, 2, 3, 4, 5, 8, As, H, X
 250 *Oxytropis coerulea* (Pall.) DC. 1, 2, 4, 5, 9, As, H, Mx
 251 *Oxytropis filiformis* DC. 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 13, As, H, Xpet
 252 *Oxytropis lanata* (Pall.) DC. 1, 3, 4, 8, 9, As, H, Psa
 253 *Oxytropis myriophylla* (Pall.) DC. 1, 2, 3, 4, 5, 8, 9, 12, As, H, Mx
 254 *Oxytropis oxyphylla* (Pall.) DC. 1, 2, 3, 4, 5, 8, 9, 12, As, H, Mx
 255 *Oxytropis pseudoglandulosa* Gontsch. ex Grubov 1, 2, 3, 4, 8, 9, 12, 13, As, H, Mx
 256 *Oxytropis reverdattoi* Jurtzev 2, 3, 4, As, H, X
 257 *Oxytropis glabra* (Lam.) DC. 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, As, H, Ha
 258 *Oxytropis selengensis* Bunge 2, 3, 4, 8, 9, As, H, X
 259 *Thermopsis dahurica* Czefr. 2, 4, 5, 9, 12, As, H, Mx
 260 *Thermopsis lanceolata* R. Br. 1, 2, 3, 4, 5, 8, 9, 11, 13, Eura, H, X
 261 *Trifolium lupinaster* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, Eura, H, Mx
 262 *Vicia amoena* Fisch. 1, 2, 3, 4, 5, 7, 8, 9, As, H, M
 263 *Vicia cracca* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 14, Eura, H, M
 264 *Vicia multicaulis* Ledeb. 1, 2, 3, 4, 5, 6, 8, 13, As, H, Mx
 265 *Vicia unijuga* A. Br. 1, 2, 3, 4, 5, 6, 7, 8, As, H, M
- 35 **POLYGALACEAE**
- 266 *Polygala comosa* Schkuhr. 1, 2, 3, 4, 6, 7, Eura, H, Mx
 267 *Polygala tenuifolia* Willd. 1, 2, 3, 4, 5, 8, 9, 12, 13, As, H, Xpet
- 36 **BETULACEAE**
- 268 *Betula fruticosa* Pall. 1, 2, 3, 4, 5, 6, As, P-nano, M
 269 *Betula ovalifolia* Rupr. 1, 2, 3, 4, 5, 7, 8, 13, As, P-nano, M
 270 *Betula pendula* Roth 2, 3, 4, Eura, P, M
 271 *Betula platyphylla* Sukacz. 1, 2, 3, 4, 5, 8, 13, As, P, M
- 37 **ROSACEAE**
- 272 *Agrimonia pilosa* Ledeb. 1, 2, 3, 4, 5, 6, 9, As, H, M
 273 *Amygdalus pedunculata* Pall. 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 16, As, P-nano, X

- 274 *Chamaerhodos altaica* (Laxm.) Bunge 1, 2, 3, 4, 6, 7, 8, 10, 11, 13, As, C, Xpet
 275 *Chamaerhodos erecta* (L.) Bunge 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, As, T, X
 276 *Cotoneaster melanocarpus* Lodd., G. Lodd. & W. Lodd. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, Eura, P-nano, Mx
 277 *Cotoneaster mongolicus* Pojark. 2, 3, 4, 5, 7, 8, 9, 12, 13, As, P-nano, Mx
 278 *Crataegus dahurica* Koehne ex Schneider 2, 4, 5, 9, As, P-nano, M
 279 *Crataegus sanguinea* Pall. 2, 3, 4, 5, 9, Eura, P-nano, M
 280 *Fragaria orientalis* Losinsk. 2, 3, 4, 5, Eura, H, M
 281 *Geum aleppicum* Jacq. 2, 3, 4, 5, 9, Hol, H, M
 282 *Padus avium* var. *asiatica* (Kom.) T.C. Ku & B.M. Barthol. 1, 2, 3, 4, 5, 9, As, P, M
 283 *Potentilla acaulis* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, As, H, X
 284 *Potentilla anserina* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, Hol, H, Ha
 285 *Potentilla betonicifolia* Poir. 2, 3, 4, 5, 8, 9, As, H, X
 286 *Potentilla bifurca* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, Eura, H, M
 287 *Potentilla conferta* Bunge 1, 2, 3, 4, 5, 6, 7, 8, 9, 12, 13, 14, Eura, H, X
 288 *Potentilla fruticosa* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 13, Hol, P-hemi, M
 289 *Potentilla multifida* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, Hol, H, Mx
 290 *Potentilla sericea* L. 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 15, Eura, H, X
 291 *Potentilla strigosa* Pall. ex Pursh. 12, Eura, H, Mx
 292 *Potentilla supina* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 16, Hol, T/H, M
 293 *Potentilla tanacetifolia* Willd. ex Schlecht. 2, 3, 4, 5, 6, 7, 8, 9, 12, 13, As, H, Mx
 294 *Potentilla verticillaris* Stephan ex Willd. 2, 3, 4, 5, 8, 9, As, H, Mx
 295 *Potentilla longifolia* Willd. ex Schlecht. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, Eura, H, Mx
 296 *Rosa acicularis* Lindl. 1, 2, 3, 4, 5, 6, 7, 8, 9, 13, Hol, P-nano, Mx
 297 *Rubus saxatilis* L. 1, 2, 3, 4, 5, 9, Hol, H, M
 298 *Sanguisorba officinalis* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, Hol, H, M
 299 *Sibbaldia adpressa* Bunge 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, As, H, Xpet
 300 *Spiraea aquilegifolia* Pall. 1, 2, 3, 4, 5, 8, 9, 12, 13, As, P-nano, Xpet
 301 *Spiraea flexuosa* Fisch. ex Cambess 1, 2, 3, 4, 5, 6, 8, 9, 13, As, P-nano, M
 302 *Spiraea hypericifolia* L. 2, 3, 4, 6, 7, 9, 10, 12, 14, Eura, P-nano, X
 303 *Spiraea media* Schmidt. 1, 2, 3, 4, 5, 6, 7, 8, 13, Eura, P-nano, M
 304 *Spiraea salicifolia* L. 2, 3, 4, 5, 9, Hol, P-nano, M
- 38 **ELAEAGNACEAE**
- 305 *Hippophae rhamnoides* subsp. *mongolica* Rousi 3, 4, 6, 7, 10, 11, 13, Eura, P-nano, M
- 39 **RHAMNACEAE**
- 306 *Rhamnus erythroxylon* Pall. 2, 3, 4, 8, 9, 12, 13, As, P-nano, Xpet
- 40 **ULMACEAE**
- 307 *Ulmus pumila* L. 2, 3, 4, 5, 7, 8, 9, 11, 13, 16, As, P, X
- 41 **URTICACEAE**
- 308 *Urtica angustifolia* Fisch. ex Hornem. 1, 2, 3, 4, 5, 7, 9, 10, Eura, H, M
 309 *Urtica cannabina* L. 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, As, H, Mx
- 42 **GERANIACEAE**
- 310 *Erodium stephanianum* Willd. 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, As, T, Xpet
 311 *Geranium pratense* L. 1, 2, 3, 4, 6, 7, 8, 9, 12, 13, Eura, H, M
 312 *Geranium pseudosibiricum* J. Mayer 1, 2, 3, 4, 5, 6, 7, 8, 10, Eura, H, Mx
 313 *Geranium sibiricum* L. 1, 2, 3, 4, 5, 7, 8, 9, 10, 12, 13, 14, 16, Eura, H, M

- 43 **ONAGRACEAE**
 314 *Epilobium angustifolium* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 14, Hol, H/G, M
 315 *Epilobium palustre* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, Hol, H, Hyg
- 44 **BRASSICACEAE**
 316 *Alyssum desertorum* Stapf 3, 6, 7, Eura, T, X
 317 *Alyssum lenense* Adams 1, 2, 3, 4, 5, 7, 8, 9, Eura, H, Xpet
 318 *Alyssum obovatum* (C.A. Mey.) Turcz. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, As, H, X
 319 *Barbarea vulgaris* W.T. Aiton 2, 3, 4, 5, 7, Eura, T/H, Mhyd
 320 *Brassica rapa* L. 2, 3, 4, 6, 7, 8, Hol, T, Mx
 321 *Catolobus pendulus* (L.) Al-Shehbaz 1, 2, 3, 4, 5, 6, 8, 9, 12, 13, Hol, T, M
 322 *Clausia aprica* (Steph.) Korn.-Trotzky. 1, 2, 3, 4, 6, 7, 9, Eura, H, X
 323 *Descurainia sophia* (L.) Webb ex Prantl 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, Hol, T, M
 324 *Dontostemon integrifolius* (L.) C.A. Mey. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 16, Eura, T, Mpet
 325 *Draba nemorosa* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, Hol, T, M
 326 *Erysimum cheiranthoides* L. 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 13, 14, Eura, T, M
 327 *Erysimum hieraciifolium* L.f. 2, 3, 4, 6, 7, 10, 13, 14, As, T/H, X
 328 *Hesperis flava* Georgi 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, As, T, Xpet
 329 *Isatis oblongata* DC. 1, 3, 4, 6, 7, 8, 9, 13, As, T, Mx
 330 *Lepidium densiflorum* Schrad. 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, As, T, Ha
 331 *Lepidium ruderales* L. 1, 2, 3, 4, 5, 7, 8, 11, 13, Eura, T, Mx
 332 *Ptilotrichum canescens* (DC.) C.A. Mey. 1, 2, 3, 4, 6, 7, 8, 9, 11, 12, 13, 15, 16, As, H, X
 333 *Rorippa palustris* (L.) Bess. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, Eura, T, Hyg
 334 *Sisymbrium polymorphum* (Murr.) Roth 3, 4, 6, 7, 8, 9, 10, 14, Eura, H, Mpet
 335 *Thlaspi arvense* L. 1, 2, 3, 4, 6, 7, 13, Eura, T, M
 336 *Thlaspi cochleariforme* DC. 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 13, Eura, H, Mx
- 45 **MALVACEAE**
 337 *Malva verticillata* L. 1, 2, 3, 4, 7, 8, 10, Hol, T, Mx
- 46 **THYMELACEAE**
 338 *Stellera chamaejasme* L. 2, 3, 4, 5, 9, As, H, Mx
- 47 **RUTACEAE**
 339 *Haplophyllum dauricum* (L.) G. Don. 2, 3, 4, 5, 6, 8, 9, 11, 12, 13, 16, As, H, X
- 48 **POLEMONIACEAE**
 340 *Polemonium chinense* (Brand) Brand 1, 2, 3, 4, 5, 6, 7, 9,, As, H, Mhyd
- 49 **PRIMULACEAE**
 341 *Androsace amurensis* Prob. 1, 2, 3, 4, 6, 7, 9, 14, As?, T, Mx
 342 *Androsace maxima* L. 2, 3, 4, 6, 7, 8, 9, 10, 13, 14, 15, Eura, T, X
 343 *Androsace septentrionalis* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 12, 13, Hol, T, M
 344 *Androsace villosa* var. *incana* (Lam.) Duby 1, 2, 3, 4, 5, 6, 7, 8, 9, 13, As, H, Xpet
 345 *Lysimachia maritima* (L.) Galasso, Banfi & Soldano 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, Hol, H, Ha
 346 *Primula farinosa* L. 1, 2, 3, 4, 6, 7, 10, 13, Eura, H, Hyg
- 50 **ERICACEAE**
 347 *Pyrola incarnata* (DC.) Freyn. 1, 2, 3, 4, 5, 6, 7, 9, Eura, H, M
 348 *Pyrola rotundifolia* (DC.) Freyn. 1, 2, 3, 4, 7, Hol, C/H, M
- 51 **BORAGINACEAE**
 349 *Amblynotus rupestris* (Pall. ex Georgi) M. Popov ex Serg. 1, 2, 3, 4, 5, 6, 7, 8, 9, 13, As, H/G, Xpet
 350 *Cynoglossum divaricatum* Stepan ex Lehm. 3, 4, 8, 9, 13, 14, As, T, X

- 351 *Lappula myosotis* V. Wolf 2, 3, 4, 5, 8, 9, 13, Eura, T, X
 352 *Myosotis caespitosa* Schultz 2, 3, 4, 5, 9, 10, 14, Hol, H, M
 353 *Myosotis alpestris* F.W. Schmidt 1, 2, 3, 4, 5, 6, 7, 9, 14, Eura, H, M
 354 *Nonnea pulla* (L.) DC. 2, 4, 8, 9, 14, Eura, H, X
 355 *Pulmonaria mollissima* A. Kern. 2, 4, Eura, H, M
- 52 **RUBIACEAE**
 356 *Galium boreale* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, Eura, G, M
 357 *Galium verum* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, Hol, H, Mx
- 53 **GENTIANACEAE**
 358 *Gentiana decumbens* L.f. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, Eura, H, M
 359 *Gentiana macrophylla* Pall. 1, 2, 3, 4, 5, 6, 7, 9, 13, 14, As, H, M
 360 *Gentiana squarrosa* Ledeb. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, As, T, X
 361 *Gentianopsis barbata* (Froel.) Ma 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, Eura, T, M
 362 *Halenia corniculata* (L.) Cornaz 1, 2, 3, 4, 5, 8, 13, As, T, M
 363 *Lomatogonium carinthiacum* (Wulfen) Rchb. 1, 2, 3, 4, 6, 7, 8, 11, 13, As, T, Hyg
 364 *Lomatogonium rotatum* (L.) Fr. ex Nyman 1, 2, 3, 4, 5, 6, 7, 8, 10, 13, 14, Hol, T, M
 365 *Swertia dichotoma* L. 1, 2, 3, 4, 8, 9, As, T, Mx
- 54 **APOCYNACEAE**
 366 *Cynanchum purpureum* (Bunge) Kitag. 1, 2, 4, 5, 8, 9, 12, As, H, X
 376 *Cynanchum thesioides* (Freyen) K. Schum. 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, As, H, X
- 55 **PLANTAGINACEAE**
 368 *Linaria vulgaris* subsp. *acutiloba* (Fisch. ex Rchb.) D.Y. Hong 1, 2, 3, 4, 6, 7, 8, 13, 14, As, H, M
 369 *Plantago depressa* Willd. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, As, H, M
 370 *Plantago major* L. 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, Eura, H, M
 371 *Pseudolysimachion linariifolium* (Pall. ex Link) Holub 1, 2, 3, 4, 5, 8, 9, As, H, M
 372 *Pseudolysimachion longifolium* (L.) Opiz 1, 2, 3, 4, 6, 7, 9, 10, Eura, H, M
 373 *Veronica anagallis-aquatica* L. 1, 2, 3, 4, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, Eura, He, Hyg
 374 *Veronica incana* L. 1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 13, Eura, H, X
- 56 **SCROPHULARIACEAE**
 375 *Scrophularia incisa* Weinm. 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, As, H, Mpet
- 57 **LAMIACEAE**
 376 *Amethystea coerulea* L. 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, As, T, X
 377 *Caryopteris mongholica* Bunge 2, 3, 4, 7, 8, 9, 11, 12, 13, 14, 15, 16, As, C, Xpet
 378 *Dracocephalum foetidum* Bunge 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, As, T, X
 379 *Dracocephalum moldavicum* L. 12, 13, 15, Eura, T, Mx
 380 *Dracocephalum ruyschianum* L. 1, 2, 3, 4, 5, 6, 8, Eura, H, M
 381 *Lamium album* L. 1, 2, 4, 5, 7, 9, Hol, H, M
 382 *Leonurus deminutus* V.I. Krecz. ex Kuprian. 1, 2, 3, 4, 7, 8, 9, 13, As, H, X
 383 *Leonurus sibiricus* L. 1, 2, 3, 4, 5, 8, 9, 12, Eura, H, X
 384 *Lophanthus chinensis* (Rafin.) Benth. 1, 2, 3, 4, 6, 7, 8, 9, 10, 12, 13, As, T, X
 385 *Nepeta multifida* L. 1, 2, 3, 4, 5, 7, 8, 9, 13, As, T, X
 386 *Panzeria lanata* (L.) Sojak 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, As, H, X
 387 *Phlomis tuberosa* L. 2, 3, 4, 5, 6, 7, 8, 9, Eura, G, M
 388 *Scutellaria galericulata* L. 1, 2, 3, 4, 5, 6, 9, 10, 14, Eura, H, Hyg
 389 *Scutellaria scordifolia* Fisch. ex Schrank 1, 2, 3, 4, 5, 8, 9, As, H, Mx
 390 *Thymus gobicus* Czern. 2, 3, 4, 7, 8, 9, 10, 11, 12, 13, As, C, X

58 **OROBANCHACEAE**

- 391 *Cymbaria dahurica* L. 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, As, H, Mx
 392 *Euphrasia pectinata* Ten. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, Eura, T, M
 393 *Odontites vulgaris* Moench 2, 3, 4, 7, 8, 9, 10, 11, 14, Eura, T, M
 394 *Orobanche coerulescens* Stephan 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, Eura, G-Parasite, X
 395 *Pedicularis flava* Pall. 2, 3, 4, 6, 7, 8, 9, 10, 11, 13, 15, As, H, X
 396 *Pedicularis myriophylla* Pall. 1, 2, 3, 4, 6, 7, 8, 13, As, T, X
 397 *Pedicularis palustris* subsp. *karo*i (Freyn) Tsoong 1, 2, 3, 4, 5, 6, 8, 9, 10, 14, Eura, H, Hyg
 398 *Pedicularis resupinata* L. 1, 2, 3, 4, 5, 6, 8, 9, 10, 13, Eura, H, M
 399 *Pedicularis rubens* Steph. ex Willd. 1, 2, 3, 4, 5, As, H, M
 400 *Pedicularis striata* Pall. 1, 2, 3, 4, 5, 8, 9, 14, As, H, X
 401 *Pedicularis uliginosa* Bunge 1, 2, 3, 4, 6, 7, 13, As, H, Hyg
 402 *Pedicularis venusta* Schangin ex Bunge 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, As, H, Mh
 403 *Rhinanthus glaber* Lam. 2, 3, 4, Eura, T, M

59 **CONVOLVULACEAE**

- 404 *Convolvulus ammannii* Desr. 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, As, H, X
 405 *Convolvulus arvensis* L. 2, 3, 4, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, Cosm, G, M

60 **SOLANACEAE**

- 406 *Hyoscyamus niger* L. 2, 3, 4, 5, 7, 8, 9, 10, 12, 13, Hol, T, M
 407 *Physochlaina physaloides* (L.) G. Don 1, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13, As, H, Mx
 408 *Solanum septemlobum* Bunge 1, 4, 8, 9, 12, AA, G, M

61 **CAMPANULACEAE**

- 409 *Adenophora stenanthina* (Ledeb.) Kitag. 1, 2, 3, 4, 5, 8, 9, 13, As, G, X
 410 *Campanula glomerata* L. 1, 2, 3, 4, 5, 6, 7, 9, Eura, H, Mx

62 **ASTERACEAE**

- 411 *Achillea alpina* L. 1, 2, 3, 4, 5, 9, 10, AA, H, Mhyd
 412 *Achillea asiatica* Serg. 1, 2, 3, 4, 5, 6, 7, 10, 14, Eura, H, M
 413 *Achillea impatiens* L. 2, 3, 4, As, H, M
 414 *Achillea millefolium* L. 1, 2, 3, 4, 7, Hol, H, M
 415 *Arctogeron gramineum* (L.) DC. 1, 2, 3, 4, 5, 7, 8, 9, As, H, X
 416 *Artemisia adamsii* Besser. 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, As, C, Mx
 417 *Artemisia anethifolia* Weber ex Stechm. 2, 3, 4, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, As, T, Mh
 418 *Artemisia annua* L. 2, 3, 4, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, Eura, T, Mx
 419 *Artemisia commutata* Besser 1, 2, 3, 4, 5, 6, 7, 8, 9, 12, Eura, C, Mx
 420 *Artemisia dolosa* Krasch. 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 13, As, C, X
 421 *Artemisia dracuncululus* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, Hol, H/G, X
 422 *Artemisia frigida* Willd. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, Hol, C, X
 423 *Artemisia glauca* Pall. ex Willd. 1, 2, 3, 4, 5, 6, 7, 8, 10, 14, Hol, H, X
 424 *Artemisia gmelinii* Weber ex Stechm. 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, Eura, C, Mx
 425 *Artemisia laciniata* Willd. 1, 2, 3, 4, 5, 7, 8, 9, 10, 12, 14, Eura, H, Mx
 426 *Artemisia macrocephala* Jacq. ex Besser 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, As, T, X
 427 *Artemisia mongolica* (Fisch. ex Besser) Fisch. ex Nakai 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, As, C, Ha
 428 *Artemisia palustris* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, As, T, X
 429 *Artemisia pubescens* Ledeb. 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 13, 14, As, C, X
 430 *Artemisia rutifolia* Steph. ex Spreng. 1, 2, 3, 4, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, As, C, Xpet
 431 *Artemisia scoparia* Waldst. & Kitam. 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, As, T/H, M

- 432 *Artemisia sericea* Weber ex Stechm. 1, 2, 3, 4, 5, 8, Eura, C, M
 433 *Artemisia sieversiana* Willd. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, Eura, T/H, M
 434 *Artemisia transbaicalensis* Leonova 1, 3, As, G, M
 435 *Aster alpinus* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, Eura, H, Mx
 436 *Aster hispidus* Thunb. 2, 3, 4, 5, 6, 8, 9, 10, 11, 13, 15, As, T, X
 437 *Bidens tripartita* L. 2, 3, 4, 7, 8, 9, 10, 14, Hol, T, Hyg
 438 *Centaurea adpressa* Ledeb. 6, As, H, Xpet
 439 *Chrysanthemum zawadskii* Herbach 1, 2, 3, 4, 5, 8, 9, Eura, H, M
 440 *Cirsium esculentum* (Siev.) C.A. Mey. 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 14, Eura, H, Hyg
 441 *Crepis bungei* Ledeb. 1, 2, 3, 4, 6, 7, 8, 9, 11, As, H, Ha
 442 *Crepis crocea* (Lam.) Bab. 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, As, H, Mx
 443 *Echinops latifolius* Tausch 1, 2, 3, 4, 5, 8, 9, 11, As, H, Mx
 444 *Erigeron acris* L. 1, 2, 3, 4, 5, 7, 9, 10, Hol, H, M
 445 *Erigeron lonchophyllus* Hook. 1, 2, 3, 4, 5, 6, 7, 9, 10, 13, AA, H, M
 446 *Filifolium sibiricum* (L.) Kitam. 1, 2, 3, 4, 5, 8, 9, As, H, Mx
 447 *Galatella dahurica* DC. 1, 2, 3, 4, 5, 6, 7, 9, 10, As, H, M
 448 *Heteropappus altaicus* (Willd.) Novopokr. 2, 3, 4, 6, 7, 8, 10, 12, 13, 14, 15, 16, As, H, Mx
 449 *Heteropappus biennis* (Ledeb.) Tamamsch. ex Grubov 1, 2, 3, 4, 5, 8, 9, As, T, M
 450 *Hieracium umbellatum* L. 1, 2, 3, 4, 5, 7, 9, 10, Hol, H, M
 451 *Inula britannica* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, Eura, H/G, Hyg
 452 *Ixeridium gramineum* (Fisch.) Tzvelev 2, 3, 4, 5, 8, 9, 12, As, H, X
 453 *Lactuca sibirica* (L.) Benth. ex Maxim. 2, 3, 4, 5, 6, 8, 9, 10, 11, Eura, T, M
 454 *Leontopodium leontopodioides* (Willd.) Beauverd 1, 2, 3, 4, 5, 8, 9, 16, As, H, X
 455 *Leontopodium ochroleucum* Beauverd 1, 2, 3, 6, 7, 13, As, H, X
 456 *Rhaponticum uniflorum* (L.) DC. 1, 2, 3, 4, 5, 8, 9, As, H, X
 457 *Neopallasia pectinata* (Pall.) Poljakov 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, As, T, X
 458 *Parasenecio hastatus* (L.) H. Koyama 1, 2, 3, 4, 5, 9, Eura, H, M
 459 *Saussurea amara* DC. 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 14, Eura, H, Ha
 460 *Saussurea laciniata* Ledeb. 3, 4, 6, 7, 8, 10, 11, 13, 14, 15, 16, As, H, Mh
 461 *Saussurea salicifolia* (L.) DC. 2, 3, 4, 5, 6, 7, 8, 9, As, H, Xpet
 462 *Scorzonera austriaca* Willd. 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, Eura, H, X
 463 *Scorzonera radiata* Fisch. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, As, H, M
 464 *Senecio erucifolius* L. 2, 3, 4, 6, 7, 9, 10, Eura, H, M
 465 *Tephrosieris integrifolia* (L.) Holub 1, 2, 3, 4, 6, 7, 8, 9, 13, Eura, H, Mx
 466 *Senecio dubitabilis* C. Jeffrey & Y.L. Chen 2, 3, 7, 8, 10, 11, 12, 13, 14, 15, Eura, T, Mh
 467 *Serratula centauroides* L. 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, As, H, X
 468 *Sonchus arvensis* L. 2, 3, 4, 5, 7, 8, 9, 10, 11, 13, 14, Cosm, H/G, M
 469 *Taraxacum bornuurensense* R. Doll 3, 4, 6, 7, As, H, X
 470 *Taraxacum ceratophorum* (Ledeb.) DC. 1, 2, 3, 4, 5, 7, 9, 13, 14, Hol, H, Mx
 471 *Taraxacum collinum* DC. 3, 4, 6, 7, 8, 9, 14, 15, As, H, X
 472 *Taraxacum dissectum* (Ledeb.) Ledeb. 1, 2, 3, 4, 6, 7, 8, 9, 10, 12, 13, As, H, Mh
 473 *Taraxacum leucanthum* (Ledeb.) Ledeb. 1, 2, 3, 4, 6, 7, 8, 10, 11, 12, 13, 14, 15, As, H, Ha
 474 *Taraxacum mongolicum* Hand-Mazz. 1, 2, 3, 4, 6, 7, 10, 11, 13, As, H, M
 475 *Taraxacum officinale* F.H. Wigg. 1, 2, 3, 4, Hol, H, M
 476 *Tragopogon trachycarpus* S.A. Nikitin 2, 3, 4, 5, 7, 8, 13, As, T, M
 477 *Crepidifolium tenuifolium* (Willd.) Sennikov 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, As, H, Xpet

63 **APIACEAE**

- 478 *Bupleurum bicaule* Helm 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, As, H, X
 479 *Bupleurum scorzonrifolium* Willd. 1, 2, 3, 4, 5, 6, 8, 9, 12, 13, Eura, H, Xpet
 480 *Carum buriaticum* Turcz. 2, 3, 4, 5, 6, 8, 9, As, H, Mx
 481 *Carum carvi* L. 1, 2, 3, 4, 5, 7, 8, 9, 10, 14, Eura, H, M
 482 *Cicuta virosa* L. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15,, Eura, H, Hyg
 483 *Ferulopsis hystrix* (Bunge ex Ledeb.) Pimenov. 2, 3, 4, 6, 7, 8, 9, 10, 11, 13, 15, As, H, Xpet
 484 *Libanotis seseloides* (Fisch. & C.A. Mey. ex Turcz.) Turcz. 1, 2, 3, 4, 5, 6, 7, 9, As, H, M
 485 *Peucedanum vaginatum* Ledeb. 1, 2, 3, 4, 6, 7, 8, 11, 13, As, H, Mx
 486 *Pleurospermum uralense* Hoffm. 1, 2, 3, 4, 5, 6, 8, 9, Eura, H, M
 487 *Saposhnikovia divaricata* (Turcz.) Schischkin. 2, 3, 4, 5, 6, 8, 9, As, H, X
 488 *Sphallerocarpus gracilis* (Bess. ex Trev.) Koso-Pol. 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, As, T, M

64 **ADOXACEAE**

- 489 *Sambucus manshurica* Kitag. 1, 2, 3, 4, 5, 9, As, P-nano, M

65 **CAPRIFOLIACEAE**

- 490 *Patrinia rupestris* (Pall.) Juss. 1, 2, 3, 4, 5, 8, 9, As, H, Xpet
 491 *Patrinia sibirica* (L.) Juss. 1, 2, 3, 4, 5, 6, 7, Eura, H, Xpet
 492 *Scabiosa comosa* Fisch. ex Roem. & Schult. 1, 2, 3, 4, 5, 8, 9, As, H, X
 493 *Valeriana officinalis* L. 1, 2, 3, 4,, 8, 9, AA, H, M
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