The tree and shrub collections of the Polar-Alpine Botanical Garden-Institute

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Abstract

The Polar-Alpine Botanical Garden-Institute (PABGI) is the northernmost botanic garden in Russia and one of the few botanic gardens in the world inside the Arctic Circle. It has a unique collection of live plants and an extensive herbarium. This paper presents a list of the introduced woody plants in the PABGI collection which, in 2018, comprised 25 families, 55 genera and a total of 361 taxa.

For most of the tree species introduced into PABGI the regular occurrence of flowering and fruiting was a major consideration in their selection. The collection contains two species included in the Russian Federation Red List and 232 accessions of 78 taxa of woody plants in Russian Regional Red Lists. According to the IUCN list of rare species the collection contains 298 accessions of 106 taxa of woody plants in at least one international protection category.

This paper contains data on the environmental conditions in PABGI. Plants are monitored for their tolerance of these conditions, and information is provided on species with a high degree of resistance to the adverse circumstances associated with the influence of low temperatures.

Introduction

Botanic gardens ideally should be sites for biodiversity conservation, undertaking many aspects of plant conservation. Kuzevanov *et al*. (2010) note that botanic gardens should be considered as environmentally significant resources that contribute to sustainable community development. Driven by research in the maintenance and development of living collections, botanic gardens can play an important role in the conservation of plants on a global scale. The main task of many such gardens, including the Polar-Alpine Botanical Garden-Institute (PABGI), is to study, display and maintain a wide diversity of plants. Some researchers have noted that, taken together, botanic gardens and their staff possess considerable knowledge about the various properties and characteristics of plants; they play a central role in the conservation and application of plant diversity around the world, and occupy a significant place in climate change research (Cannon & Kua, 2017; Dosmann, 2006; Primack & Miller-Rushing, 2009).

Creating and maintaining living collections is the most common way to conserve plants in an *ex situ* setting,

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especially those of economic interest (Ensslin & Godefroid, 2019; Acosta Ramos *et al.*, 2019). PABGI's living collection contains many rare trees and shrubs and, while there is a pressing need to preserve all endangered species of woody plants in, among other approaches, *ex situ* collections, the preservation of *ex situ* plants is still associated with some difficulties. These difficulties include the size of individual plants, the collection and storage of seed, and the maintenance of accompanying documentation (Oldfield, 2009). Most botanic gardens have seed storage facilities of one type or another, and these help to preserve the genetic diversity of plants (O'Donnell & Sharrock, 2017). Seeds stored in seed banks are useful for horticultural research, phenological observations and exchange with other botanic gardens (Heywood, 2017).

PABGI was founded in 1931 and was inspired by the vision of Professor N.A. Avrorin, its first director. Avrorin had envisaged the creation of a laboratory of economically valuable plants, nurseries for the introduction of valuable plants into cultivation, a soil and geobotanical department, a spore plant department, a biocenology department, a park and a museum. Located on the Kola Peninsula in the north-west of Russia, it is the country's most northerly botanic garden (67°38'N) and one of the few botanic gardens in the world inside the Arctic Circle. PABGI's collection of woody plants is located at its main site in Kirovsk and at its experimental site in Apatity. Both towns are located 120 km north of the Arctic Circle. Climatic factors in this region are very variable and the circumpolar position determines the harsh natural conditions. However, due to the proximity of the warm Gulf Stream (Fig. 1) the climate is more favourable than in other polar regions. The woody plant collection in Kirovsk was first developed at the time of the foundation of PABGI and continued to evolve with the creation of a woody plant nursery in Apatity in 1958.

Fig. 1 PABGI's location. Map drawn by Irina Lipponen.

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The main adverse climatic factors include:

- high probability and high intensity of spring-summer and autumn frosts (possible in any summer month);
- frequent occurrence of strong winds;
- significant fluctuations in precipitation and duration of dry periods in the growing season (creating a moisture deficit);
- insufficient heat supply in the growing season;
- low level of total solar radiation and uneven distribution during the growing season;
- specific daylight status: the region experiences polar days and nights[1] (the polar night in Kirovsk and Apatity lasts from 15 December to 28 December, the polar day from 20 May to 27 July).

Information on meteorological data is shown in Table 1.

Composition of the collection

In 2018, the collection of woody plants included 25 families, 55 genera and a total of 361 taxa (see Appendix). The collection is mostly composed of angiosperms (89.5 per cent) with the remainder, 10.5 per cent, being made up of gymnosperms. Rosaceae is the family represented by the largest number of samples. Furthermore, according to Goncharova (2018), 60.8 per cent of the collection has a bush-like life form while a typical tree shape accounts for only 38.5 per cent, and samples of shrubs, semi-shrubs and vines make up less than 1 per cent.

Most trees and shrubs are relatively old and 32.2 per cent of the collection have been tested for 31 to 40 years. Currently, 69.1 per cent of the total number of samples are of cultivated origin, with material of known wild origin making up 28.6 per cent of the collection. Most of the plants growing in the collection (71.2 per cent) have been grown from seed.

The collection includes two species included in the Russian Federation Red List: *Cotoneaster alaunicus* and *C. cinnabarinus*. A total of 78 taxa of woody plants from the PABGI collection are included in the Red Lists of Russia (Plantarium, 2007–2020). According to the IUCN List of Rare Species (IUCN, 2020), 106 taxa of woody plants fall into one or other international protection category.

Materials and methods of monitoring the collections

The high-latitude position of PABGI influences its focus of research. This focus is on the development of the northern and mountainous regions of the world. It shows that the most promising species for the introduction of trees to the Kola Peninsula are those whose altitudinal limit of distribution is at least 1,000 m above sea level for the humid mountains and 2,000 m above sea level for the arid mountains. However, in reality, the development of the woody plant collection is not always limited to these parameters.

The development of the PABGI collection takes place mainly through the *Index Seminum* system, and preference is given to wild origin seeds and those collected in the northern and alpine regions of the world. In addition, in previous years, PABGI staff have conducted several expeditions to collect wild origin material. The collection is in a constant state of change, caused by new taxa and samples entering the collection combined with natural losses. Plants are included in the collection

[1] The polar day is a period when the sun does not set beyond the horizon for more than 24 hours, while the polar night is a period when the sun does not appear over the horizon for more than 24 hours.

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Table 1 Meteorological data for Kirovsk and Apatity in the Murmansk region of Russia, 2015–2019.

Average monthly temperature Kirovsk, °C												
Year	Month											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
2015	–11.1	–7	–	–	5.8	8.9	9.7	10.8	8.1	1.3	–3.5	–7.3
2016	–	–	–4.2	0.8	8	10.4	15.8	14.3	6.4	1.1	–5.1	–6.2
2017	–10	–8.6	–5.1	–3.2	0.8	7.2	13.6	11.3	5.2	–0.2	–4.5	–9.9
2018	–8.9	–10	–9.3	–0.4	7	9.8	17.4	11.7	6.2	–0.4	–2.7	–9.1
2019	–	–	–	1.1	3.6	9.4	10.9	10.3	6.7	–2.9	–6.3	–5.5
Average monthly relative humidity Kirovsk, %												
Year	Month											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
2015	86	82	–	–	72	74	83	83	87	89	89	88
2016	–	–	85	75	70	74	78	88	87	90	89	88
2017	88	85	82	75	74	73	75	86	88	90	92	90
2018	89	85	80	74	69	73	73	83	85	90	90	90
2019	–	–	–	74	74	74	80	87	87	89	90	91
Average monthly temperature Apatity, °C												
Year	Month											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
2015	–12.9	–6.8	–1.9	0.6	7.5	10	11	12.2	9.2	2.2	–3.1	–9.3
2016	–19.1	–5.7	–3.6	1.2	8.9	11.2	17.4	12.9	7.7	2.3	–5.5	–7.4
2017	–10.7	–9.3	–4.6	–1.7	1.8	8.2	15	11.4	6.4	1.8	–4.5	–9.8
2018	–10	–14.2	–9.8	0.3	8.1	10.4	18.9	13.2	8.4	0.6	–1.6	–8.1
2019	–14.3	–10.5	–6.5	1.4	5	10.7	12.2	10.9	7.8	–1	–6.2	–5.8
Average monthly relative humidity Apatity, %												
Year	Month											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
2015	90	85	82	76	73	77	83	84	89	92	93	72
2016	79	89	87	75	70	76	78	88	89	92	91	88
2017	92	91	85	74	73	75	74	89	81	87	94	91
2018	90	86	85	76	66	73	67	84	87	91	92	92
2019	91	91	86	74	72	75	79	89	90	93	95	95

Weather data prepared by Elena Poloskova. When calculating the average monthly air temperature, day and night temperatures were taken into account.

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that have been tested in open ground conditions without special shelters for three years. In most cases, such tests are conducted in the transplant nursery. Plants usually spend three to five years in the transplant nursery, and occasionally up to ten years. During this period both the root system and the crown have a chance to develop from the seedling stage. Plants in the transplant nursery are continuously being replenished as new material enters and older plants move on to the botanic garden. The content of the nursery can therefore change significantly from year to year.

The annual programme of monitoring and recording the woody species in the collection includes a number of activities. At the beginning of the growing season (May) the degree of damage to the plants from low temperatures is assessed, and the winter hardiness score is determined on a 7-point scale (Alexandrova *et al.*, 1975) as follows:

1 point – no damage
2 points – annual shoot frozen up to 50 per cent
3 points – 50–100 per cent of annual shoot frozen
4 points – two-year-old and older shoots frozen
5 points – shoots frozen to the snow cover level
6 points – shoots frozen to the root collar
7 points – the plant is completely frozen

Phenological observations of selected plants are carried out two or three times a week during the growing season (May–September) (Borodina, 1965; Bulygin, 1974, 1976; Alexandrova *et al.*, 1975). Phenological observations are considered when about 50 per cent of the selected plants have started growing and the abundance of flowering, pollination, fruiting and seed production are assessed according to the V.G. Kapper scale (1930).

Results and discussion

The winter hardiness of woody plants in the PABGI collections ranges from 1 to 6 points on the 7-point scale (with 1 being the most hardy and 7 being the least hardy). Sixty-three per cent of the total number of plants attained 1 point of winter hardiness, while 25 per cent and 9 per cent of the samples have a winter hardiness score of 2 and 3, respectively. The number of samples of woody plants with 4 points of winter hardiness is about 2.9 per cent. Less than 1 per cent are characterised by 5 or 6 points of winter hardiness.

For the overwhelming majority of tree species introduced into PABGI, the flowering, pollination, fruiting and seed production phases of growth can vary significantly from year to year. Irregular flowering, pollination, fruiting and seed bearing are characteristic for 37.2 per cent of the woody plant collection. In the dendrological collection of PABGI 31.3 per cent of the plants bloom, are fertilised and bear fruit or seed every year. In general, 81.8 per cent of samples of introduced trees exhibit flowering, pollination, fruiting and seed production phases. Those plants that only exhibit vegetative growth make up 18.2 per cent of the collection. These include plants in the older age bracket, young samples of plants that have not yet reached sexual maturity and cold-sensitive samples.

Newton *et al*. (2015) noted that woody plants have significant ecological value. In recent decades, an increasing number of species have been threatened with extinction as a result of human activities, climate change and the spread of pests and diseases. As a

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result, a comprehensive assessment of the conservation status of trees and shrubs is now needed.

Kirovsk

The area in Kirovsk where the tree and shrub collections are located is on the shore of Lake Bol'shoy Vudyavr. This area hosts the oldest collection of PABGI woody plants (Figs 2 & 3).

Apatity and planned developments

In Apatity (the experimental site), the tree collection is located in a broad area with a buffer zone (Fig. 4). Large collections of woody plants are created and maintained here in addition to the mass reproduction and propagation of trees and shrubs.

Currently, an excursion route for visitors through the grounds of the PABGI experimental site is being created, and the intention is to update the information stands there with details of the work undertaken on site and other useful information.

The first part of the route, which is about 250 m long, passes through a natural pine stand formed after the site was clear-cut in the 1940s. The forest area covers 5.9 ha and consists mainly of pure pine stands which are 60–80 years old. In addition to the *Pinus*, other tree species on the route include *Picea obovata* Ledeb., *Populus tremula* L., *Betula pendula* Roth and *B. pubescens* Ehrh., as well as most of the accompanying and understorey trees growing in the Murmansk region. On this part of the trail, visitors can acquaint themselves with the region's woody vegetation.

The next part of the excursion route is within the part of the arboretum displaying northern and alpine species. It includes an information stand located on the observation platform; this shows not only the route plan but also information about the places where the most interesting specimens come

Fig. 2 The tree and shrub collection area in Kirovsk, on the shore of Lake Bol'shoy Vudyavr. Photo: Irina Lipponen.

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Fig. 3 Planting scheme of the trees and shrubs in the collection, Kirovsk. Scheme drawn by Irina Lipponen.

Fig. 4 Planting scheme of PABGI experimental site, Apatity. The inset shows the scheme of the arboretum. Schemes drawn by Irina Lipponen.

from. This area of the arboretum, together with the natural stand and forest park, has a total area of 10 ha, with cultivated plants covering 2.8 ha. The collection of species in the Northern and Alpine Arboretum displays plants on a geographical basis. Here, information is provided about the biological diversity of the different geographical regions

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Fig. 5 The *Sorbus* collection. Main photo: Irina Lipponen. Inset photo: Olesya Zotova.

Fig. 6 The *Rhododendron* collection. Main photo: Irina Lipponen. Inset photo: Oxana Goncharova.

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Fig. 7 The *Syringa* collection. Main photo: Irina Lipponen. Inset photo: Oxana Goncharova.

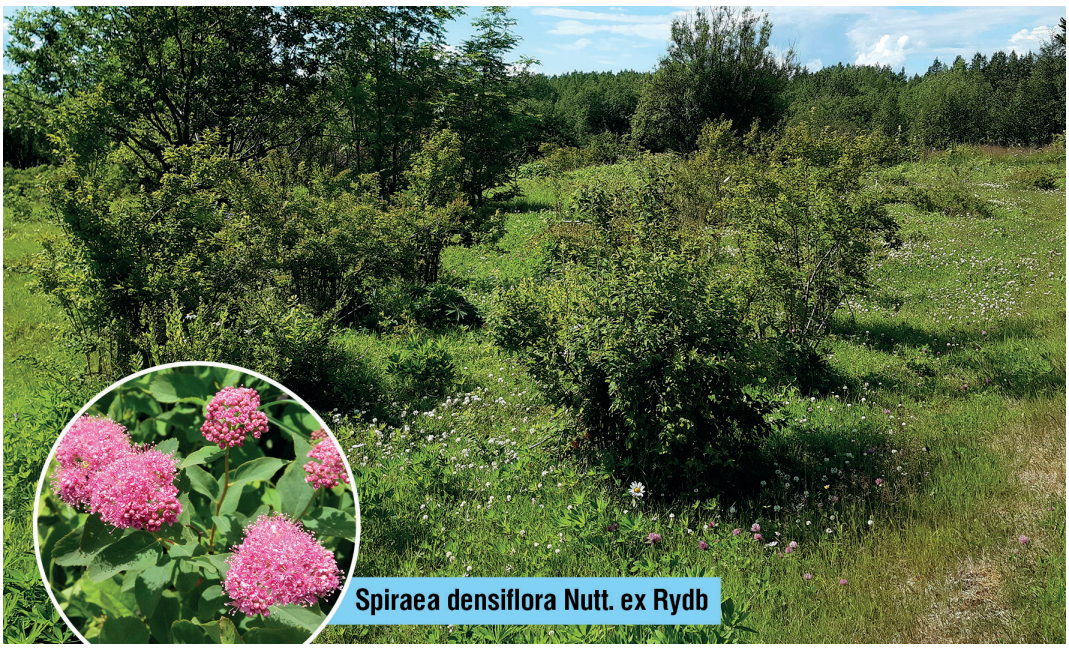

Fig. 8 The *Spiraea* collection. Main photo: Irina Lipponen. Inset photo: Olesya Zotova.

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Fig. 9 The *Crataegus* collection. Main photo: Irina Lipponen. Inset photo: Olesya Zotova.

Fig. 10 The *Lonicera* collection. Main photo: Irina Lipponen. Inset photo: Oxana Goncharova.

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of the boreal zone. The arboretum is divided into six sections: Siberia (Yakutia, Western and Eastern Siberia, Mountains of Siberia), Northern Europe (North of Fennoscandia, Mountains of Europe), Kamchatka, Rare and Endemic Species, Mountains of Asia (Mountains of Central and Southeast Asia) and North America (Boreal Region and Rocky Mountains).

The starting point of the next part of the route, which takes visitors through the introduced woody plants collection, is marked by an information stand placed by the introduced conifers in the southern part. The cultivated area of this part of the collection is 6.1 ha in area and is laid out to represent tree species on a generic basis. It includes collections of *Sorbus*, *Rhododendron*, *Syringa*, *Spiraea*, *Crataegus* and *Lonicera* (Figs 5–10).

Species within the genera *Larix, Picea* and *Pinus* are presented in the coniferous area with specimens of *Larix* making up the largest part of the collection. Other plant groups are also presented, including specimens of *Tilia*, *Betula*, *Thuja* and *Juniperus*.

The excursion route also passes through parts of the transplant nursery and here the collection contains a section of plants which are considered to have lower resistance to the prevailing conditions. This group includes plants that lack complete lignification of shoots, flowering and the formation of mature seeds. Such plants may not retain their usual habit under such conditions. The section is surrounded on three sides by dense plantings of *Abies* and *Picea* which provide a favourable microclimate for less hardy species in genera such as *Acer, Quercus* and *Hydrangea*. In recent years, old specimens have gradually been replaced by new specimens of the same species but of a more northerly origin, which consequently may have greater genetic adaptation to the conditions.

After completing the excursion route through the collection visitors can visit Lake Shchuchye where many bird species nest in the wetland habitat. The forest is also inhabited by squirrels and hares, and the presence of such large numbers of these and other animal species in a small area near the large industrial city of Apatity is, the authors believe, a unique phenomenon.

The diversity of the plant collections and the fauna supported by the collections are both attractive to visitors. The plants and fauna also provide a rich resource for research into plant behaviour and cultivation in line with Avrorin's vision.

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Appendix

Taxonomic composition of the collection of woody plants in open ground conditions in the Polar-Alpine Botanical Garden-Institute. Plant names are listed according to The Plant List (2013), Plantarium (2007–2020) and GRIN Taxonomy for Plants (U.S. National Plant Germplasm System, 2020).

No.	Taxa
	Adoxaceae
1.	*Sambucus racemosa* L. ssp. *kamtschatica* (EL Wolf) Hultén
2.	*Sambucus racemosa* L.
3.	*Viburnum glomeratum* Maxim.
4.	*Viburnum lantana* L.
5.	*Viburnum opulus* L.
6.	*Viburnum opulus* L. f. *roseum* (L.) Hegi
	Araliaceae
7.	*Eleutherococcus sessiliflorus* (Rupr. & Maxim.) S.Y. Hu
	Berberidaceae
8.	*Berberis aggregata* C.K. Scheid.
9.	*Berberis amurensis* Rupr.

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No.	Taxa
10.	*Berberis aquifolium* Pursh
11.	*Berberis canadensis* Mill.
12.	*Berberis chinensis* Poir.
13.	*Berberis francisci-ferdinandii* C.K. Schneid.
14.	*Berberis heteropoda* Schrenk
15.	*Berberis integerrima* Bunge
16.	*Berberis koreana* Palib.
17.	*Berberis lycium* Royle
18.	*Berberis thunbergii* DC.
19.	*Berberis vulgaris* L.
20.	*Berberis vulgaris* L. f. *atropurpurea* Regel
	Betulaceae
21.	*Alnus alnobetula* (Ehrh.) K. Koch
22.	*Alnus alnobetula* ssp. *fruticosa* (Rupr.) Raus
23.	*Alnus alnobetula* ssp. *sinuata* (Regel) Raus
24.	*Alnus hirsuta* (Spach) Rupr.
25.	*Alnus incana* (L.) Moench
26.	*Alnus incana* ssp. *rugosa* (Du Roi) R.T. Clausen
27.	*Alnus incana* ssp. *tenuifolia* (Nutt.) Breitung
28.	*Betula ermanii* Cham.
29.	*Betula kenaica* W.H. Evans
30.	*Betula nana* L.
31.	*Betula neoalaskana* Sarg.
32.	*Betula papyrifera* Marshall
33.	*Betula pendula* Roth
34.	*Betula pendula* var. *carelica* (Merckl.) Hämet-Ahti
35.	*Betula pendula* f. *dalecarlica* (L.f.) C.K. Schneid.
36.	*Betula pubescens* Ehrh.

No.	Taxa
37.	*Betula pubescens* Ehrh. f. *rubra* T. Ulvinen
38.	*Betula tianschanica* Rupr.
39.	*Betula utilis* D. Don
40.	*Carpinus betulus* L.
41.	*Corylus avellana* L.
	Caprifoliaceae
42.	*Lonicera altaica* ssp. *subarctica* (Pojark.) Vorosch.
43.	*Lonicera caerulea* L.
44.	*Lonicera caerulea* ssp. *altaica* (Pall.) Gladkova
45.	*Lonicera caerulea* ssp. *pallasii* (Ledeb.) Browicz
46.	*Lonicera chamissoi* Bunge ex P. Kir.
47.	*Lonicera chrysantha* Turcz. ex Ledeb.
48.	*Lonicera chrysantha* var. *koehneana* (Rehder) Q. E. Yang, Landrein, Borosova & J. Osborne
49.	*Lonicera dioica* L.
50.	*Lonicera edulis* Turcz. ex Freyn
51.	*Lonicera edulis* Turcz. ex Freyn 'Solovei'
52.	*Lonicera ferdinandii* Franch.
53.	*Lonicera glehnii* F. Schmidt.
54.	*Lonicera hispida* Pall. ex Schult.
55.	*Lonicera involucrata* (Richardson) Banks ex Spreng.
56.	*Lonicera involucrata* (Richardson) Banks ex Spreng. f. *flavescens* Rehd.
57.	*Lonicera involucrata* (Richardson) Banks ex Spreng. 'Kesa'
58.	*Lonicera korolkowii* Stapf var. *zabelii* (Rehder) Rehder
59.	*Lonicera maximowiczii* (Rupr.) Regel
60.	*Lonicera* × *muscaviensis* Rehder
61.	*Lonicera nigra* L.

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No.	Taxa
62.	*Lonicera* × *pseudochrysantha* A. Barun
63.	*Lonicera tatarica* L.
64.	*Lonicera tatarica* L. f. *bicolor* Carr
65.	*Lonicera tatarica* var. *morrowii* (A. Gray) Q. E. Yang, Landrein, Borosova & J. Osborne
66.	*Lonicera utahensis* S. Watson
67.	*Lonicera xylosteum* L.
68.	*Symphoricarpos albus* (L.) S.F. Blake
69.	*Symphoricarpos orbiculatus* Moench
70.	*Symphoricarpos vacciniodes* Rydb.
	Celastraceae
71.	*Euonymus europaeus* L.
72.	*Euonymus macropterus* Rupr.
	Cornaceae
73.	*Cornus alba* L.
74.	*Cornus sanguinea* ssp. *australis* (C.A. Mey.) Jáv.
	Cupressaceae
75.	*Juniperus communis* L.
76.	*Juniperus communis* var. *saxatilis* Pall.
77.	*Juniperus horizontalis* Moench
78.	*Thuja occidentalis* L.
79.	*Thuja plicata* Donn ex D. Don.
	Elaeagnaceae
80.	*Hippophaë rhamnoides* L.
81.	*Shepherdia canadensis* (L.) Nutt.
	Ericaceae
82.	*Rhododendron aureum* Georgi
83.	*Rhododendron caucasicum* Pall.
84.	*Rhododendron fauriei* Franch.
85.	*Rhododendron ferrugineum* L.
86.	*Rhododendron hirsutum* L.
87.	*Rhododendron* × *intermedium* Tausch
88.	*Rhododendron myrtifolium* Schott & Kotschy
	Fagaceae
89.	*Fagus sylvatica* L.
90.	*Quercus robur* L.
	Grossulariaceae
91.	*Ribes alpinum* L.
92.	*Ribes americanum* Mill.
93.	*Ribes aureum* Pursh
94.	*Ribes burejense* F. Schmidt
95.	*Ribes carpaticum* Schult.
96.	*Ribes cynosbati* L.
97.	*Ribes glandulosum* Grauer
98.	*Ribes hudsonianum* Richardson
99.	*Ribes irriguum* Douglas
100.	*Ribes komarovii* Pojark.
101.	*Ribes latifolium* Jancz.
102.	*Ribes laxiflorum* Pursh
103.	*Ribes montigenum* McClatchie
104.	*Ribes nigrum* L. f. *aconitifolium* Kirchn.
105.	*Ribes nigrum* L. 'Barnaulka'
106.	*Ribes nigrum* L. 'Chuchur-Muran'
107.	*Ribes nigrum* L. 'Igarka'
108.	*Ribes nigrum* L. 'Krasnojarskaja'
109.	*Ribes nigrum* L. 'Marmita'
110.	*Ribes nigrum* L. 'Nariadnaia'
111.	*Ribes nigrum* L. 'Neapolitanskaia'
112.	*Ribes nigrum* L. 'Pechorskaia'
113.	*Ribes nigrum* L. 'Seianecz Igarki'
114.	*Ribes nigrum* L. var. *sibiricum* W. Wolf.
115.	*Ribes nigrum* L. 'Taiozjnaia'
116.	*Ribes nigrum* L. f. *viridis*
117.	*Ribes niveum* Lindl.

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No.	Taxa
118.	*Ribes oxyacantoides* L.
119.	*Ribes petraeum* Wulfen
120.	*Ribes procumbens* Pall.
121.	*Ribes rubrum* L.
122.	*Ribes rubrum* L. 'Varzuga'
123.	*Ribes spicatum* ssp. *hispidulum* (Janch.) L. Hämet-Ahti
124.	*Ribes triste* Pall.
Hydrangeaceae	
125.	*Hydrangea bretschneideri* Dippel
126.	*Hydrangea paniculata* Siebold
127.	*Philadelphus coronarius* L.
128.	*Philadelphus tenuifolius* Rupr.
Leguminosae	
129.	*Caragana arborescens* Lam.
130.	*Caragana arborescens* Lam. f. *pendula* Dipp.
131.	*Caragana aurantiaca* Koehne
132.	*Caragana boisii* C.K. Schneid.
133.	*Caragana frutex* (L.) K. Koch
134.	*Caragana grandiflora* (M.Bieb.) DC.
135.	*Caragana* × *sophoraefolia* Bess.
136.	*Chamaecytisus ruthenicus* (Fischer ex Woloszczak) Klásk.
137.	*Genista tinctoria* L.
Malvaceae	
138.	*Tilia cordata* Mill.
139.	*Tilia* × *europaea* L.
Myricaceae	
140.	*Myrica tomentosa* (DC.) Asch. & Graebn.
Oleaceae	
141.	*Fraxinus americana* L.
142.	*Fraxinus excelsior* L.

No.	Taxa
143.	*Fraxinus mandshurica* Rupr.
144.	*Syringa emodi* Wall. ex Royle
145.	*Syringa* × *henryi* C.K. Schneid.
146.	*Syringa josikaea* J.Jacq. ex Rchb.f.
147.	*Syringa komarowii* C.K. Schneid.
148.	*Syringa* × *nanceiana* McKelvey
149.	*Syringa oblata* Lindl.
150.	*Syringa persica* L.
151.	*Syringa pinetorum* W.W.Sm.
152.	*Syringa* × *prestoniae* McKelvey
153.	*Syringa pubescens* Turcz.
154.	*Syringa pubescens* ssp. *patula* (Palib.) M.C. Chang & X.L. Chen
155.	*Syringa reticulata* (Blume) H. Hara
156.	*Syringa tomentella* ssp. *sweginzowii* (Koehne & Lingelsh.) Jin Y. Chen & D.Y. Hon
157.	*Syringa villosa* Vahl
158.	*Syringa villosa* ssp. *wolfii* (C.K. Schneid.) Jin Y.Chen & D.Y.Hong
159.	*Syringa vulgaris* L.
Pinaceae	
160.	*Abies balsamea* (L.) Mill.
161.	*Abies fraseri* (Pursh) Poir.
162.	*Abies lasiocarpa* Lindl.
163.	*Abies nephrolepis* (Trautv.) Maxim.
164.	*Abies sachalinensis* Fr. Schmidt
165.	*Abies sachalinensis* var. *gracilis* (Kom.) Farjon
166.	*Abies sibirica* Ledeb.
167.	*Abies sibirica* ssp. *semenovii* (B.Fedtsch.) Farjon
168.	*Larix decidua* Mill.
169.	*Larix gmelinii* (Rupr.) Kuzen.
170.	*Larix kaempferi* (Lamb.) Carrière

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No.	Taxa
171.	*Larix* × *marschlinsi* Coaz
172.	*Larix sibirica* Ledeb.
173.	*Picea abies* (L.) H. Karst.
174.	*Picea asperata* Mast.
175.	*Picea engelmannii* Parry ex Engelm.
176.	*Picea* × *fennica* (Regel) Kom.
177.	*Picea glauca* (Moench) Voss
178.	*Picea jezoensis* (Siebold & Zucc.) Carrière
179.	*Picea koraiensis* Nakai
180.	*Picea mariana* (Mill.) Britton, Sterns & Poggenb.
181.	*Picea obovata* Ledeb.
182.	*Picea omorika* (Pancic) Purk.
183.	*Picea pungens* Engelm.
184.	*Picea pungens* Engelm. f. *glauca* Beissn.
185.	*Picea pungens* Engelm. 'Taina'
186.	*Picea sitchensis* (Bong.) Carrière
187.	*Pinus cembra* L.
188.	*Pinus mugo* Turra
189.	*Pinus pumila* (Pall.) Regel
190.	*Pinus sibirica* Du Tour
191.	*Pinus sylvestris* L.
192.	*Tsuga canadensis* (L.) Carrière
Ranunculaceae	
193.	*Clematis alpina* ssp. *ochotensis* (Pall.) Kuntze
194.	*Clematis alpina* ssp. *sibirica* (L.) Kuntze
Rosaceae	
195.	*Amelanchier alnifolia* (Nutt.) Nutt. ex M. Roem.
196.	*Amelanchier alnifolia* var. *semi-integrifolia* (Hook.) C.L.Hitchc.
197.	*Amelanchier bartramiana* (Tausch) M. Roem.
198.	*Amelanchier canadensis* (L.) Medik.
199.	*Amelanchier spicata* (Lam.) K. Koch
200.	*Aronia melanocarpa* (Michx.) Elliott
201.	*Cotoneaster alaunicus* Golitsin
202.	*Cotoneaster cinnabarinus* Juz.
203.	*Cotoneaster integerrimus* Medik.
204.	*Cotoneaster uniflorus* Bunge
205.	*Crataegus arnoldiana* Sarg.
206.	*Crataegus canadensis* Sarg.
207.	*Crataegus chlorosarca* Maxim.
208.	*Crataegus chlorosarca* Maxim. f. *pyramidalica*
209.	*Crataegus cuneata* Siebold & Zucc.
210.	*Crataegus dahurica* Koehne ex Schneid.
211.	*Crataegus douglasii* Lindl.
212.	*Crataegus flabellata* (Bosc ex Spach) K. Koch
213.	*Crataegus foetida* Ashe
214.	*Crataegus intricata* Lange
215.	*Crataegus korolkowii* L. Henry
216.	*Crataegus laevigata* (Poir.) DC.
217.	*Crataegus maximoviczii* C.K. Schneid.
218.	*Crataegus nigra* Waldst. & Kit.
219.	*Crataegus pentagyna* Waldst. et Kit. ex Willd.
220.	*Crataegus pinnatifida* Bunge
221.	*Crataegus russanovii* Cinovskis
222.	*Crataegus sanguinea* Pall.
223.	*Crataegus* × *schroederi* (Regel) Koehne
224.	*Crataegus submollis* Sarg.
225.	*Malus baccata* (L.) Borkh.

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No.	Taxa
226.	*Malus mandshurica* (Maxim.) Kom. ex Juz.
227.	*Malus niedzwetzkyana* Dieck ex Koehne
228.	*Malus sylvestris* (L.) Mill.
229.	*Malus toringo* (Siebold) Siebold ex de Vriese
230.	*Prunus maackii* Rupr.
231.	*Prunus padus* L.
232.	*Prunus padus* L. f. *colorata* Almquist
233.	*Prunus padus* L. f. *commutata* Dippel
234.	*Prunus pensylvanica* L. f.
235.	*Prunus ulmifolia* Franch.
236.	*Prunus virginiana* L.
237.	*Pentaphylloides davurica* Ikonn.
238.	*Pentaphylloides* × *friederichsenii* hort.
239.	*Pentaphylloides fruticosa* (L.) O.Schwarz
240.	*Physocarpus amurensis* (Maxim.) Maxim.
241.	*Physocarpus malvaceus* (Greene) Kuntze
242.	*Physocarpus opulifolius* (L.) Maxim.
243.	*Physocarpus opulifolius* var. *intermedius* (Rydb.) B.L.Rob.
244.	*Rosa acicularis* Lindl.
245.	*Rosa amblyotis* C.A. Mey.
246.	*Rosa amblyotis* C.A. Mey × *R. rugosa* Thunb.
247.	*Rosa amblyotis* C.A. Mey. × *R. spinosissima* L.
248.	*Rosa corymbifera* Borkh.
249.	*Rosa davidii* Crep.
250.	*Rosa davurica* Pall.
251.	*Rosa glauca* Pourr.
252.	*Rosa laxa* Retz.

No.	Taxa
253.	*Rosa majalis* Herrm.
254.	*Rosa majalis* Herrm. 'Tornedalica'
255.	*Rosa* 'Minisa'
256.	*Rosa nitida* Willd.
257.	*Rosa spinosissima* L.
258.	*Rosa spinosissima* L. f. *plena*
259.	*Rosa rugosa* Thunb.
260.	*Rosa rugosa* Thunb. 'Frau Dagmar'
261.	*Rosa rugosa* Thunb. 'Hansa'
262.	*Rosa sherardii* Davies
263.	*Rosa sicula* Tratt.
264.	*Rosa villosa* L.
265.	*Rosa virginiana* Mill.
266.	*Rubus arcticus* L.
267.	*Sibiraea laevigata* (L.) Maxim.
268.	*Sorbaria kirilowii* (Regel & Tiling) Maxim.
269.	*Sorbaria pallasii* (G. Don.) Pojark.
270.	*Sorbaria sorbifolia* (L.) A. Braun
271.	*Sorbaria sorbifolia* var. *stellipila* Maxim.
272.	*Sorbaria tomentosa* (Lindl.) Rehder
273.	*Sorbus albovii* Zinserl.
274.	*Sorbus americana* Marshall
275.	*Sorbus aria* (L.) Crantz
276.	*Sorbus aucuparia* L.
277.	*Sorbus aucuparia* ssp. *sibirica* (Hedl.) Krylov
278.	*Sorbus buschiana* Zinserl.
279.	*Sorbus commixta* Hedl.
280.	*Sorbus fedorovii* Zaik.
281.	*Sorbus gorodkovii* Pojark.
282.	*Sorbus hybrida* L.
283.	*Sorbus intermedia* (Ehrh.) Pers.

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No.	Taxa
284.	*Sorbus koehneana* C.K. Schneid.
285.	*Sorbus margittaiana* (Jáv.) Kárpáti
286.	*Sorbus matsumurana* (Makino) Koehne
287.	*Sorbus mougeotii* Soy.-Will. & Godr.
288.	*Sorbus reflexipetala* Koehne
289.	*Sorbus sambucifolia* (Cham. & Schltdl.) M.Roem.
290.	*Sorbus scopulina* Greene
291.	*Sorbus semipinnata* Borbás
292.	*Sorbus sitchensis* M. Roem.
293.	*Sorbus subfusca* (Ledeb. ex Nordm.) Boiss.
294.	*Sorbus takhtajanii* Gabrieljan
295.	*Sorbus tianschanica* Rupr.
296.	*Sorbus turkestanica* (Franch.) Hedl.
297.	*Spiraea alba* Du Roi
298.	*Spiraea betulifolia* Pall.
299.	*Spiraea betulifolia* Pall. 'Tor'
300.	*Spiraea betulifolia* var. *aemiliana* (C.K.Schneid.) Koidz.
301.	*Spiraea betulifolia* var. *corymbosa* (Raf.) Maxim.
302.	*Spiraea betulifolia* var. *lucida* (Douglas ex Hook.) C.L. Hitchc.
303.	*Spiraea* × *bumalda* Burv.
304.	*Spiraea* × *bumalda* Burv. 'Shraederii'
305.	*Spiraea cana* Waldst. & Kit.
306.	*Spiraea chamaedryfolia* L.
307.	*Spiraea* × *cinerea* Zabel 'Grefsheim'
308.	*Spiraea densiflora* Nutt. ex Rydb.
309.	*Spiraea douglasii* Hook.
310.	*Spiraea douglasii* ssp. *menziesii* (Hook.) Calder & R.L. Taylor
311.	*Spiraea hypericifolia* L.
312.	*Spiraea japonica* L.f.
313.	*Spiraea japonica* L. 'Norroboth'
314.	*Spiraea lasiocarpa* Kar. & Kir.
315.	*Spiraea media* Schmidt
316.	*Spiraea nipponica* Maxim.
317.	*Spiraea* × *rosalba* Dippel
318.	*Spiraea salicifolia* L.
	Salicaceae
319.	*Populus balsamifera* L.
320.	*Populus balsamifera* L. × *P. berolinensis* K. Koch
321.	*Populus laurifolia* Ledeb. × *P. balsamifera* L.
322.	*Populus* × *petrowskiana* R.I. Schrod.
323.	*Populus suaveolens* Fisch. ex Loudon
324.	*Populus suaveolens* Fisch. ex Loudon f. *piramidalis* Rgl.
325.	*Populus suaveolens* Fisch. ex Loudon × *P. laurifolia* Ledeb.
326.	*Populus suaveolens* Fisch. ex Loudon × *P. tristis* Fisch.
327.	*Populus tremula* L.
328.	*Populus tristis* Fisch.
329.	*Salix alaxensis* (Andersson) Coville 'Kenai'
330.	*Salix arctica* Pall.
331.	*Salix arctica* ssp. *crassijulis* (Trautv.) A.K.Skvortsov
332.	*Salix bebbiana* Sarg.
333.	*Salix caprea* L.
334.	*Salix glauca* L.
335.	*Salix gmelinii* Pall.
336.	*Salix kochiana* Trautv.
337.	*Salix krylovii* E. Wolf
338.	*Salix lanata* L.

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339.	*Salix lanata* ssp. *richardsonii* (Hook.) A.K. Skvortsov
340.	*Salix lapponum* L.
341.	*Salix phylicifolia* L.
342.	*Salix phylicifolia* L. 'Brekkavier'
343.	*Salix pyrolifolia* Ledeb.
344.	*Salix rhaetica* Andersson
345.	*Salix rhamnifolia* Pall.
346.	*Salix rorida* Laksch.
347.	*Salix rosmarinifolia* var. *brachypoda* (Trautv. & C.A. Mey.) Y.L. Chou
348.	*Salix sajanensis* Nasarow
349.	*Salix saposhnikovii* A.K. Skvortsov
350.	*Salix schwerinii* E.L. Wolf
351.	*Salix udensis* Trautv. & C.A. Mey.
352.	*Salix viminalis* L.

No.	Taxa
Sapindaceae	
353.	*Acer glabrum* Torr.
354.	*Acer hyrcanum* ssp. *stevenii* (Pojark.) E. Murray
355.	*Acer platanoides* L.
356.	*Acer saccharinum* L. 'Laciniatum Wieri'
357.	*Acer tataricum* L.
358.	*Acer tataricum* ssp. *semenovii* (Regel & Herder) A.E. Murray
Solanaceae	
359.	*Solanum dulcamara* L.
Thymelaeaceae	
360.	*Daphne mezereum* L.
Ulmaceae	
361.	*Ulmus glabra* Huds.

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