The vascular flora of the Sutai Khairkhan Mountain Nature Reserve, Mongolia

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ABSTRACT
In this study we examined the floristic diversity of the Sutai Khairkhan Mountain Nature Reserve in western Mongolia’s Altai Mountain range. This nature reserve area was established in 2019 and compared to nearby reserves, its flora is relatively understudied. From field surveys in 2014, 2019, and 2020, we collected about 400 herbarium specimens from various habitats and different altitudes in the reserve. We identified total of 317 taxa including 10 subspecies and three varieties of vascular plants belonging to 157 genera and 45 families. Among these, five species are nationally endemic, 27 species are endemic to Altai Mountains, and 37 species are threatened, including two critically endangered, 11 endangered, 16 vulnerable, and eight near threatened. In addition, we rediscovered Microula tibetica var. pratensis (Maxim.) W.T. Wang after 40 years. This first complete checklist of the SKMNR flora amplifies the value of protecting the diverse and threatened plants in the reserve and creates a baseline to assess future population changes.

Keywords: Microula tibetica, vascular plants, protected area, west Mongolia, Altai endemic.

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The Altai Mountains, also known as the Altai Mountain Country (AMC), are located in the western part of the Altai-Sayan Ecoregion, and lies at the junction of four countries: Russia, Kazakhstan, China, and Mongolia (Kamelin 2005, Vaganov et al. 2019). One of the biggest parts of the AMC is located in western Mongolia which includes the Khovd (Kho), Mongolian Altai (MA), and Dzugarian Gobi (DzG) phytogeographical regions according to Grubov (1982). West Mongolia is a center of high vascular plant diversity comprises approximately 2000 taxa, which contains large number of endemic and threatened plant species compared to other parts of Mongolia (Pyak et al. 2008, Onolova et al. 2010, Oyuntsetseg et al. 2017, Baasanmunkh et al. 2019a, b, 2021a). Several high elevation mountains in the Mongolian part of the Altai Mountain range include Munkhkhairkhan, Jargalan, Bumbat, Baatar, Sutai Khairkhan, and Tsambagarav. The Sutai Khairkhan Mountain Nature Reserve (SKMNR) belongs to the Mongolian Altai (MA) phytogeographical region in western Mongolia (Grubov 1982).
In the past, the flora of western Mongolia was quite well studied by botanists mainly from Mongolia, Russia and Germany. A number of researchers have given much attention to the new species and new records of the vascular plants from western Mongolia (Zhao et al. 2018, Gundegmaa & Munkh-Erdene 2018, Nobis et al. 2019, Pyak & Pyak 2018, Pyak et al. 2020, Ovchinnikova 2020, Baasanmunkh et al. 2020, Shiga et al. 2020). Additionally, in western Mongolia, a few studies on floristic diversity have recently been conducted in the protected areas such as Strictly Protected Areas (SPA), National Parks (NP) as well as Nature Reserves (NR). For example, Oyuntsetseg et al. (2017) contributed a floristic survey on the Munkhkhairkhan NP and Baasanmunkh et al (2021a) provided an annotated checklist of vascular plants in the Dzungarian Gobi region including the Great Gobi B Strictly Protected Area (SPA) and part of Bulgan Ikh Ongog NP. Despite this research, several nature reserve areas, particularly in western Mongolia, such as the SKMNR, are still underexplored, particularly in regards to documenting their floristic diversity, endemism, and threatened vascular plants. The SKMNR covers a 172713.9-hectare area and was established in 2019 under the Ministry of Environment, Green Development and Tourism (https://eic.mn/spa/). Moreover, the Sutai Khairkhan Mountain is one of the sacred mountains in Mongolia, according to UNESCO (https://whc.unesco.org/en/tentativelists/6068/).

To date, approximately 3200 species of vascular plants have been recognized in Mongolia (Urgamal et al. 2014, 2019a, Shiga et al. 2020, Baasanmunkh et al. 2021b, Yano et al. 2021). In addition, several new species and new records were described from western Mongolia (Zhao et al. 2018, Nobis et al. 2019, Pyak et al. 2019, Ovchinnikova 2020). More recently, Saussurea odorata E. Pjak was described as a new species from the Mongolian Altai (MA) region (Pyak et al. 2020) and critically endangered Saussurea bogdaiensis Yu J.Wang & J.Chen was also newly discovered in Mongolia in the Dzungarian Gobi region (Baasanmunkh et al. 2020). Additionally, nine aquatic plants were recently found at the Khar-Urs Lake NP in western Mongolia (Shiga et al. 2020). As shown by these recent publications, a number of new plant species are still being found and many unknown species remain to be discovered in Mongolia.

Based on our three years of field observations, this paper provides the first full checklist of floristic diversity of the Sutai Khairkhan Mountain NR area and reviews the conservation status of rare species.

MATERIAL AND METHODS

The Sutai Khairkhan Mountain Nature Reserve (46°40′–46°34′N 99°26′–93°53′E) is located in the Khovd and Gobi-Altai provinces of Mongolia and belongs to the MA phytogeographical region of Mongolia (Figs 1, 2). The dominant vegetation types here are alpine, high mountain, and mountain steppe. The Sutai Khairkhan, the mountain at the center of the SKMNR, rises 4000 m a.s.l. and is one of the highest mountains in the Altai Mountain system.

The field study was conducted in 2014, 2019 and 2020. During this time, we collected approximately 400 herbarium specimens from different elevations and various vegetation types. Species were identified using the standard guides of Grubov (1982), Flora of Mongolian series, Flora of China (cFlores 2008), and Endemic Plants of the Altai Mountain Country (Pyak et al. 2008). The accepted name of each species follows the Plants of the World Online (POWO 2020, http://www.plantsoftheworldonline.org/). The status of national endemic plants follows Baasanmunkh et al. (2021c), and endemic plants of the AMC follows Erst et al. (2021). Threatened plant species were based on Nyambayar et al. (2011), Oyuntsetseg et al. (2018) and Urgamal et al. (2019b). The regional distribution points for each species were based on Grubov (1982), Guhanov (1996), Urgamal et al (2014), German (2015) and Baasanmunkh et al. (2021a). The voucher specimens were deposited in the herbarium of the National University of Mongolia (UBU). The species data of each protected areas were derived from literature (if available) as well as Mongolian Protected Areas (http://mpa.gov.mn/). The grid distribution map of Miralta tibetica var. pratenis Maxim. W.T. Wang was created in ArcGis, using the same approach as Baasanmunkh et al. (2022).
RESULTS

From three years of field surveys, approximately 400 herbarium collections were gathered; many of these samples have one or several duplicates. From the collections, we identified 317 vascular plant taxa (10 subspecies and 3 varieties) belonging to 157 genera and 45 families in the SKMNR (Fig. 2; Appendix 1). The angiosperms are represented by 308 species belonging to 151 genera. Additionally, four species of fern and fern allies in three genera as well as three species of gymnosperms belonging to three genera, were noted. Among these, the family with the greatest species diversity was Asteraceae with 48 species, followed by Fabaceae (27 species), Rosaceae (27 species), Caryophyllaceae (24 species) and Poaceae (23 species). The largest genus was Potentilla L. with 17 species followed by Oxypogon DC. (13 species), Artemisia L. (11 species) and Salsola DC. (9 species), shown in Table 1.

In addition, 11 species were newly found in the MA region (Table 2) which were previously only recorded in several other phytogeographical regions of the country. For example, Microsia tibetica var. pratensis (Maxim.) W.T. Wang was found again in the MA region, after 40 years; we provided more information about this rediscovery below (see Taxonomic treatment).

We also found 37 threatened plants including critically endangered (two species), endangered (11 species), vulnerable (16 species) and near threatened (8 species) from the Sutai Khairkhan Mountain NR (Table 3). Examples of some rare and threatened plants were also photographed for documentation, namely Leontopodium exscapa (C.A. Mey.) F. Dvorsk (Fig. 3A), Corydalis inconspicua Bunge ex Ledeb. (Fig. 3B), Saussurea gladiolus Herder (Fig. 3C), Drosera altaica (C.A. Mey.) Bunge (Fig. 3D), and Waldheimia tridentifolia Kar. & Kir. (Fig. 3E) in this area. For example, S. gladiolus was frequently distributed in Mongolia but there are no wild photographs to date.

DISCUSSION

The Mongolian Altai region has one of the highest diversities of vascular plants compared to other regions of Mongolia (Neuffer et al. 2003, Urgamal et al. 2014, Gundegmaa et al. 2018, Baasanmunkh et al. 2019, 2021). Approximately 1700 species of vascular plants have been recognized in this region which accounts for 53% of Mongolia’s vascular plants (Gubanov 1996, Neuffer et al. 2003, Urgamal et al. 2014, Bekket et al. 2015, Oyuntsetseg et al. 2017, Baasanmunkh et al. 2021). In addition, we found 11 species which had not been recorded before in the MA region, according to Urgamal et al. (2014). Furthermore, we re-discovered the wild population of Microsia tibetica var. pratensis (Maxim.) W.T. Wang after 40 years.

The Altai Mountain parts of Mongolia has a large number of endemic plants and threatened plant species compared to other parts of Mongolia (Pyak et al. 2008, Oyuntsetseg et al. 2018, Baasanmunkh et al. 2019, Erst et al. 2021). Recently, Erst et al. (in press) updated and revised the checklist of endemic plants of the AMC which contains 302 species with representative herbarium barcodes. Among these, we documented 27 species in the SKMNR which shares about 9% of the species in the AMC. Furthermore, Erst et al. (in press) determined that the species richness is 312 species based on botanical-geographical subdivisions of the AMC. According to Erst et al. (2021), there are two subdivisions, namely Khobdo-Tonkhiil (ZM3) and South-Mongolia (UM), that have relatively few species with 10 and 4 species, respectively. However, our results show a much higher species richness of about 27 endemic plants that occur in the SKMNR ZM3 subdivision because of our more comprehensive field surveys.

Since 2011, over 600 species’ regional conservation status in Mongolia has been assessed (Nyambayar et al. 2011, Oyuntsetseg et al. 2018, Baasanmunkh et al. 2019, Urgamal et al. 2019, Baasanmunkh et al. 2021c). We documented about 30 of these threatened species in the SKMNR.

The Sutai Khairkhan Mountain NR is a small area compared to the whole Altai Mountain range; however, it contains a high diversity of vascular plants including endemic and threatened plant species (Fig. 2). Additionally, because it is one of the largest mountain ranges in western Mongolia, it’s flora must not be overlooked as it is significant to our understanding of the conservation of these species.

Table 1. The most represented families (≥14 taxa) and genera (≥8 taxa) in the Sutai Khairkhan Mountain Nature Reserve.

| Family              | Number of taxa | Genus             | Number of taxa |
|---------------------|----------------|-------------------|----------------|
| Asteraceae          | 48             | Potentilla        | 17             |
| Fabaceae            | 27             | Oxypogon         | 13             |
| Rosaceae            | 27             | Artemisia        | 11             |
| Caryophyllaceae     | 24             | Saussurea        | 9              |
| Poaceae             | 23             | Astragalus       | 8              |
| Ranunculaceae       | 14             | Pedicularia      | 8              |

Table 2. List of newly recorded species in the Mongolian Altai region.

| Taxon                                | Family          |
|--------------------------------------|-----------------|
| Astragalus brevifolius Ledeb.         | Fabaceae        |
| Carex caurinaeflora Fisch. & C.A. Mey. ex Kunth | Cyperaceae |
| Dasiphora parviflora (Fisch. ex Lehm.) Juz. | Rosaceae       |
| Eritrichium alpinum Ovezinikova       | Boraginaceae    |
| Koeleria maritima (Ledeb.) Schult.    | Poaceae         |
| Leymus chinensis (Trin.) Tzvelev      | Poaceae         |
| Microsia tibetica var. pratensis (Maxim.) W.T. Wang | Boraginaceae |
| Minuartia stricta (Sw.) Hiern         | Caryophyllaceae |
| Potentilla minor (Huds.) Opiz         | Polygonaeceae   |
| Potentilla argentea Soják             | Poaceae         |
| Stellaria longifolia Muhl. ex Willd.  | Caryophyllaceae |

Table 3. Status of taxa, endemic, and threatened plants in the Sutai Khairkhan Mountain Nature Reserve.

| IUCN status | Family | Genus | Species | Endemic & Altai Endemic species | Threatened species |
|-------------|--------|-------|---------|-------------------------------|-------------------|
| Total       | 45     | 157   | 317     | 32                            | 37                |
| Critically Endangered (CR) | 2     | 2     | 2       | 2                             | 2                 |
| Endangered (EN) | 6     | 8     | 11      | 5                             | 11                |
| Vulnerable (VU) | 11    | 15    | 16      | 4                             | 16                |
| Near threatened (NT) | 7     | 8     | 8       | 3                             | 8                 |
rare alpine plants. This complete checklist improves the current floristic knowledge of the SKMNR area, increases its conservation value, and provides a baseline for future research. This checklist is only foundational; additional studies should include vegetation surveys, hotspot richness surveys, and detailed distribution map of rare species in the SKMNR to further inform management and conservation strategies. Because alpine vegetation can move higher in elevation due to climate changes, and Mongolian’s mountain taiga is predicted to be replaced by steppe species (Sainnemekh et al. 2022), monitoring the changes in plant community and rare species distribution, is needed. New distribution records of rare or endemic species can greatly affect our understanding of their abundance, threats, and genetics. Therefore, close studies of these species are needed to update the Mongolian Red List and inform the reserve’s management to protect plant hotspots from overgrazing or other human disturbances.

**Taxonomic treatment**

*Microula tibetica var. pratensis* (Maxim.) W.T. Wang (Boraginaceae) = *Tretocarya pratensis* Maxim.

In the literature, *Tretocarya pratensis* Maxim. was first recorded in the Khangai region of central Mongolia (Grubov 1982, Biazrov et al. 1989). In addition, we examined the herbarium specimens from all available herbaria which we found four herbarium specimens only from Mongolian Academy of Science (UBA), Mongolia. These four specimens were collected from the Khangai region of Mongolia between 1971 and 1976. Since 1976, there have been no record of wild populations and herbarium specimens in the country. Almost 40 years later, we found it on the Sutai Khairkhan Mountain, where there were less than 50 individuals within 1 km² (Fig. 4D). In general, *Tretocarya pratensis* Maxim. was treated synonym of *Microula tibetica var. pratensis* (Maxim.) W.T. Wang by Zhu et al. (1995). According to Zhu et al. (1995), this varieties occurs only in the Qinghai, Xinjiang, and S. Xizang of China, but it is already distributed in Mongolia (Grubov 1982, Biazrov et al. 1989). In addition, Yu et al. (2012) confirmed two varieties *Microula tibetica* var. *pratensis* and *M. tibetica* var. *tibetica* are distinguished by nutlets and corolla limbs based on nutlet micro-morphology. Based on our collections, *Microula tibetica* var. *pratensis* is similar to *M. tibetica* var. *tibetica* but could easily be distinguished by the corolla limbs (1.2–1.8 mm wide; Fig. 4B) and nutlets with abaxial aperture (Fig. 4C) according to Zhu et al. (1995) and Yu et al. (2012).

**Specimens examined.** MONGOLIA. Khangai Region: Bayankhongor Province, Gurvanbulag sum, Shar Usnii Gol, 1971, D. Tsagaanmaam et al. s.n. (UBA); Bayankhongor Province, Erdenetsogt sum, Ovgor Khvren Mt, Namiin Gol, 22 July 1977, E. Ganbold et al. s.n. (UBA); Zavkhan province, Ongon sum, Ongontenger Mt, Chuluutiin gol, 3100 m a.s.l., 1974 (UBA); Khuvsgul province, Arbulag sum, Sumber brigad, Dund gilaadiin am, 1976, D. Tsagaanmaam et al. s.n. (UBA). Mongolian Altai Region: Gobi-Altai Province, Tonkhil sum, Sutai Mt, 46°34′59.59″N 93°37′55.32″E, 3281 m a.s.L., 16 July 2019, V. Gundegmaa et al. (UBU) (Fig. 5).
Flora of the Sutai Mountain in Mongolia

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**Figure 4** *Microula tibetica* var. *pratensis* (Maxim.) W.T. Wang. A – general habitat; B – flowers; C – abaxial part of nutlet with aperture; D – distribution map (new wild locations in blue and herbarium collections in green). Photo: A, B – V. Gundegmaa, D – L. Jargal
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Appendix 1. A checklist of vascular plants in the SKM NR, with the growth form, status, elevation, phytogeographical regions, and herbarium code for each species. (Growth form: H – herb, T – tree, S – shrub, SS – subshrub; Status: E – Endemic, AE – Altai Endemic, CR – Critically Endangered, EN – Endangered, VU – Vulnerable, NT – Near Threatened. Distribution of phytogeographical regions based on Urgamal et al. (2014) and new distribution records marked by +): 1 – Khuvsgul, 2 – Khentei, 3 – Khangai, 4 – Mongolian Dauria, 5 – Foothills of Great Khingan, 6 – Khovd, 7 – Mongolian Altai, 8 – Middle Khalkh, 9 – East Mongolia, 10 – Depression of Great Lakes, 11 – Valley of Lakes, 12 – East Gobi, 13 – Gobi Altai, 14 – Dzungarian Gobi, 15 – Transaltai Gobi, and 16 – Alashan Gobi.

| Taxon                     | Growth form | IUCN status | Elevation, m a.s.l (low to high) | Region                  | Herbarium code |
|---------------------------|-------------|--------------|----------------------------------|-------------------------|----------------|
| **FERNS AND FERN ALLIES** |             |              |                                  |                         |                |
| Asplenium                  |             |              |                                  |                         |                |
| *Asplenium altajense* (Kom.) Grubov | H           | 2100–2500    | 1,3,4,7,10,13                  | SU20190306              |
| Cystopteris                |             |              |                                  |                         |                |
| *Cystopteris fragilis* (L.) Bernh. | H           | 2600–3300    | 1–10,13,14,15                  | SU20190310              |
| Ophioglossum               |             |              |                                  |                         |                |
| *Botrychium lunaria* (L.) Sw. | H           | 2800–3000    | 1,2,3,4,5,7                     | SU20200507              |
| Woodsia                    |             |              |                                  |                         |                |
| *Woodsia ilvensis* (L.) R. Br. | H           | 2600–3000    | 1,2,3,4,7,8,9                  | SU20190307              |
| *Woodsia glabella* R. Br.  | H           | 2600–3100    | 1,7,10                          | SU20190311              |
| **GYMNOSPERMS**            |             |              |                                  |                         |                |
| Pinaceae                   |             |              |                                  |                         |                |
| *Larix sibirica* Ledeb.    | T           | 2000–2500    | 1,2,3,4,6,7,8,10,14            | SU20200220              |
| Cupressaceae               |             |              |                                  |                         |                |
| *Juniperus pseudoabiesina* Fisch. & C.A.Mey. | S           | EN           | 2600–3000                      | SU20140601              |
| Ephedraceae                |             |              |                                  |                         |                |
| *Ephedra monosperma* J.G.Gmel. ex C.A.Mey. | SS          | 2000–2500    | 1–8,10,12,13                   | SU20190204              |
| **ANGIOSPERMS**            |             |              |                                  |                         |                |
| Amaranthaceae              |             |              |                                  |                         |                |
| *Blitum virgatum* L.       | H           | 1600–2000    | 3,4,6,7,12–15                  | SU20200908              |
| *Chenopodium album* L.     | H           | 1500–2100    | 1–16 (all regions)             | SU20190212              |
| *C. frutescens* C.A.Mey.   | SS          | AE           | 1500–2000                      | SU20140310              |
| *Genusia dasyphylla* (Fisch. & C.A. Mey.) Freitag & G. Kadereit | H | 1500–2200 | 3–16 | SU20200903 |
| *Krascheniinikia ceratoidea* (L.) Gueldenst. | SS | 1500 | 1,3,4,6,7,8,10–16 | SU20190101, SU20200906 |
| *Salsola collina* Pall.    | H           | 1700–2300    | 2–15                            | SU20200907              |
| *Suaeda tschujensis* Pall. | H           | 1500–2000    | 6,7                             | SU20140206              |
| Amaryllidaceae             |             |              |                                  |                         |                |
| *Allium altaicum* Pall.    | H           | 2800–3050    | 1,2,3,4,6,7,8,10,13,14         | SU20140504              |
| *Allium mongolicum* Regel  | H           | 1500–2100    | 3,4–6                           | SU20200802              |
| *A. polybrotzey* Turcz. ex Regel | H           | 1600–2000    | 1,2,3,4,7–13,15,16             | SU20200803              |
| *Allium protratum* Trevir. | H           | 1800–2300    | 1–13                            | SU20190106              |
| *Allium pumilum* Vved.     | H           | 2000–2600    | 6,7                             | SU20190105              |
| Apiaceae                   |             |              |                                  |                         |                |
| *Bupleurum bicaule* Helm   | H           | 1500–2300    | 1,2,3,4,6–13                   | SU20200602, SU20200709 |
| *Bupleurum mongolicum* V.M. Vinogr. | H | 3000–3550 | 7,13,14 | SU20201510 |
| *Carum carvi* L.           | H           | 1800–3000    | 1–5,7,8,9,10,14                | SU20200215              |
| *Fenouilopsis hystrix* (Bunge) Pimenov | H | 1900–2700 | 2,3,4,6–11,13,15 | SU20190108, SU20200101, SU2020026 |
| *Neogaya simplex* (L.) Meisn. | H | 2100–3000 | 1,2,3,4,6,7,13,14 | SU20190504 |
| *Ostericum tenax* (Pall. ex Schult.) Y.C. Chu | H | 2200–3000 | 1,2,3,4,6–10,13 | SU20190508, SU20200503 |
| *Seseli buchtormense* (Fisch. ex Hornem.) W.D.J. Koch | H | 2100–3000 | 7,14 | SU2021405 |
| *Seseli condensatum* (L.) Rehb. f. | H | 2100–3000 | 1,2,3,6,7,8,10,14 | SU2021340 |
| Asteraceae                 |             |              |                                  |                         |                |
| *Ajania grubovii* Maldashev | SS          | E            | 1500                            | SU20140102              |
| *Artemisia argyrophylla* Ledeb. | SS         | AE           | 1800–2100                      | SU20200410              |
| *Artemisia campestris* subsp. borealis (Pall.) H.M.Hall & Clem | H | 2000–2600 | 1,2,3,4,6,7,10,13 | SU20190203, SU20200910, SU2021002 |
| *Artemisia draconculus* L. | H           | 1500–2500    | 1–15                            | SU20140202, SU20140304, SU20190102, SU20190201, SU20190302, SU20190101, SU20201001 |
| *Artemisia draconculus var. pamirica* (C.Winkl.) Y.R.Ling & Humphries | H | 1800–2500 | 3,6,7,10,11,12,13 | SU20200204, SU20200302, SU20200404 |
### Appendix 1. Continued

| Taxon | Growth form | IUCN status | Elevation, m a.s.l. (low to high) | Region | Herbarium code |
|-------|-------------|-------------|----------------------------------|--------|----------------|
| Artemisia frigida Wild. | SS | | 1500–2100 | 1–16 (all regions) | SU20190203, SU20190202, SU20200402 |
| Artemisia laciniata Wild. | H | | 1600–2500 | 1–5,7,8,9,10,12,14 | SU20190202, SU20190204 |
| Artemisia macrocephala Jacquem. ex Besser | H | | 1500–2600 | 1–16 (all regions) | SU20190205, SU20200203 |
| Artemisia mongolica (Fisch. ex Besser) Nakai | H | | 1600–2000 | 1–15 | SU20190301 |
| Artemisia pycnostigma Ledeb. | H | | 1500–2500 | 1–4,6,7,8,10,11,13,14 | SU20190103, SU20190303, SU20190305 |
| Artemisia steleomanniana Besser | SS | | 1500–2500 | 2,3,6–15 | SU20200601 |
| Artemisia strenuicifolia Krasch. | S | | 2000–3000 | 6,7,8,10–16 | SU20191014 |
| Askellia pygmaea (Ledeb.) Sennikov | H | | 2900–3250 | 1,3,6,7 | SU20190305, SU20190102 |
| Aist alpinus L. | H | | 1600–2700 | 1–10,13 | SU20190702 |
| Aist alpinus Willd. | H | | 1500–2100 | 1,2,3,4,6,7,8,10,12–16 | SU20140306 |
| Aist flaviculus subsp. flaviculus | H | | 2100–2500 | 1,2,3,4,6,7 | SU20200202 |
| Aistrotalassum central-asiaticum Novopokr. | SS | LC | 1800–2000 | 7,8,9,11–16 | SU20140406 |
| Aistrotalassum heteroptiapalid Novopokr. | SS | AE, NT | 1500–1800 | 6,7,10,14 | SU20140502 |
| Carthamus occultum (Stev.) C.A.Mey. | H | | 2000–2800 | 1,2,3,4,6–11,14 | SU20201302 |
| Cephalanthera tenuifolia (Willd.) Sennikov | H | | 1800–2300 | 1–11,13,14 | SU20190603 |
| Cerastium chrysanthe (Ledeb.) Turez. | H | | 3000–3300 | 1,2,3,6,7,10 | SU20190403 |
| Dromicium turkestanicum Cavill. | H | | 3050–3200 | 3,7,14 | SU20190311 |
| Eritrichium pauciflorum DC. | H | | AE | 2100–2600 | 7,14 | SU20190308, SU20190301 |
| Eryngium eriocalyx | H | | 2100–2500 | 1,2,3,6,7,13 | SU20190303 |
| Eryngium petoletarius Vierh. | H | | 2200–2500 | 3,7 | SU20190306 |
| Loentopodium nanum (Hook.f. & Thomson ex C.B.Clarke) Hand.-Mazz. | H | | 2100–3200 | 7,16 | SU20140103, SU20190403 |
| Loentopodium ochroleucum Beauverd | H | | 2100–3300 | 1,2,3,6,7,13 | SU20140402, SU20190808 |
| Saussurea glacialis Herder | H | | EN | <3500 | 3,6,7,13 | SU20190501, SU20190305 |
| Saussurea latifolia Ledeb. | H | | VU | 1600–2500 | 3,7 | SU20190107 |
| Saussurea leucophylla Schrenk | H | | VU | 2000–2200 | 1,3,6,7,13 | SU20190109 |
| Saussurea erysii Khann. & Krasnob. | H | | AE, EN | 3000–3300 | 7 | SU20140505, SU20140203 |
| Saussurea pruica N.D.Simpson | H | | 2000–3000 | 3,6,7,8,10,11,13,14 | SU20140305 |
| Saussurea pseudoalpina N.D.Simpson | H | | 2600–3000 | 1,2,3,6,7,13,14 | SU20170105 |
| Saussurea rachromanensis Kom. ex Lipsch. | H | | E | 2000–3000 | 1,2,3,6,7,13,14 | SU20140501 |
| Saussurea schizaniana (Wydler) Fisch. ex Herder | H | | 3000–3300 | 1,2,3,6,7,13 | SU20140405 |
| Saussurea subsacculata (Ledeb.) Serg. | H | | VU | 3000–3300 | 1,3,6,7,13 | SU20140302 |
| Scorzoner a ikonnikovii Lipsch. & Krasch. | H | | 1800–2300 | 3,6–15 | SU20090703 |
| Senecio dubitabilisii C.Jeffrey & Y.L.Chen | H | | 1800–2200 | 2,3,7,8,10–15 | SU20090608 |
| Tanacetum changtangicum (Krasch. ex Grubov) K.Bremer & Humphries | H | | E, EN | 2900–3300 | 3,7,10 | SU20190312, SU20190210 |
| Tanacetum lanuginosum Sch.Bip. & Herder | H | | 3000–3300 | 1,6,7,13 | SU20190113 |
| Tanacetum pulchrum (Ledeb.) Sch.Bip. | H | | 3000–3300 | 3,7,13 | SU20140409 |
| Taraxacum ceratophorum (Ledeb.) DC. | H | | VU | 2300–3000 | 3,67 | SU20140406 |
| Taraxacum discodendron (Ledeb.) Ledeb. | H | | VU | 2000–3000 | 1,2,3,4,6–10,12,13 | SU20200110 |
| Taraxacum junatorii Tevzev | H | | E | 2600–3000 | 3,7,13,14 | SU20140306 |
| Taraxacum lyratum (Ledeb.) DC. | H | | AE | 2600–3000 | 1,3,6,7,13 | SU20130403 |
| Tephrosia integrifolia (L.) Holub | H | | 3000–3300 | 1,2,3,4,6,7,8,9,13 | SU20190314 |
| Tephrosia pruica (N.D.Simpson) Holub | H | | 1800–2000 | 1,3,6,7,13,14 | SU20190315 |
| Waldheimia tristadetifolia Kar. & Kir. | H | | <3500 | 1,3,6,7,13 | SU20190403, SU20140404 |

**Boraginaceae**

| Taxon | Growth form | IUCN status | Elevation, m a.s.l. | Region | Herbarium code |
|-------|-------------|-------------|-------------------|--------|----------------|
| Amblyosorus rupestris (Georgii) Popov | H | | 2200–3000 | 1–9,13 | SU20200309 |
| Ceratocephalum caesius DC. | H | | AE, VU | 2000–2500 | 3,7,13,14 | SU20140204 |
| Erinrichium alpinum Ovczirkova | H | | AE, VU | 2100–2800 | 6,7+ | SU20200310 |
| Erinrichium paniculatum DC. | H | | 2100–2600 | 1–8,13 | SU20200312 |
| Microsila tibetica var. pratensis (Maxim.) W.T.Wang | H | | 3000–3300 | 3,7+ | SU20190401 |
| Mynotis alpestris F.W.Schmidt | H | | 2500–3300 | 1,2,3,4,6,7,9,14 | SU20200313 |
| Mynotis asiatica (Vesterg.) Schischk. & Serg | H | | 2100–2800 | 1,2,3,4,6,7,9,14 | SU20200505 |
| Mynotis anupshirica O.D.Nikif. | H | | 2100–2800 | 7,13 | SU20190309 |
### Appendix 1. Continued

| Taxon | Growth form | IUCN status | Elevation, m (low to high) | Region | Herbarium code |
|-------|-------------|--------------|-----------------------------|--------|----------------|
| **Brassicaceae** | | | | | |
| Draba aizanoi Maxim. | H | | 1500–2100 | 6,7,8,10–16 | SU20200607 |
| Draba altaica (C.A.Mey.) Bge | H | VU | 3000–3300 | 6,7,10 | SU20201407 |
| Draba sarothroides | H | | 2100–2500 | 1,2,3,4,6,7,13 | SU20200313 |
| Drosophila angustifolia | H | | 2600–3300 | 1,2,3,4,6,7,13 | SU20190316 |
| Drosophila nemorosa | H | | 2600–3300 | 1–10,13 | SU20190502 |
| Drosophila oreades Schrenk | H | <3500 | 1,3,6,7,13 | | SU20190503, SU20201506 |
| Leptota excisa (C.A.Mey.) E.Dvorak | H | AE | <3500 | 1,6,7 | SU20190402 |
| *Pachyseris grandiflora* (C.A.Mey.) Bunge | H | AE | 3000–3300 | 1,3,6,7,13 | SU20190408 |
| Pulsatilla camtschatica (DC.) C.A.Mey. | H | | 1500–2100 | 1–4,6,9,11,13,15,16 | SU20140103 |
| Smelowskia altaica (Pall.) Regel | H | | 3000–3350 | 1,3,4,6,7,10,13 | SU20190307 |
| Smelowskia altaica (Poljak.) Botsch | H | AE, VU | 3000–3300 | 6,7 | SU20190303 |
| Smelowskia calyculata (Stephan ex Willd.) C.A.Mey. | H | <3500 | 1,3,6,7,13,14 | | SU20190401 |
| **Caprifoliaceae** | | | | | |
| *Eremogone meyeri* (Fenzl) Ikonn. | H | | 2100–2500 | 1–11,13 | SU20140105 |
| Heterochroa desertorum | H | | 2500–3000 | 1–10,13 | SU20200504 |
| Draba nemoralis (L.) Bunge | H | | 2500–3000 | 1–7,10,14 | SU20200508 |
| Eremogenes andru志a (Grubov) Ilonnn. | H | EN | 2200–3000 | 13,7 | SU20140411 |
| Eremogenes meyeri (Fenzl) Ilonnn. | H | | 2300–3000 | 2,3,4,6,7,9,10,12,13 | SU20140105 |
| Eremogenes mongolicus (Schischk.) Ilonnn. | H | AE, EN | 2500–3000 | 7 | SU20200413 |
| Heterocentron desertorum Bunge | H | | 1500–2300 | 1,2,3,4,6–13,16 | SU20190113 |
| Mimula striga (Sw.) Hiern | H | NT | 2500–3200 | 1,2,3,7+ | SU20190303, SU202016 |
| Salvia viridis (L.) Schreber | H | | 2300–3500 | 1,2,3,6,7,14 | SU20190418 |
| Silene amara (L.) Schrenk | H | | 2100–3300 | 6,7,10,14 | SU20190315 |
| Silene chamaemorpha Turcz. | H | | 2100–3300 | 1,2,3,6,7,9,10,12,13 | SU20190114 |
| Silene sanguinea (Fisch., C.A.Mey. & Avé-Lall.) Bocquart | H | | 2600–3000 | 1–7,9,12,13 | SU20190317, SU20190315 |
| Silene uralesis subsp. apetala (L.) Bocquart | H | | 2000–3000 | 1,2,3,6,7,10,13,14 | SU20140303 |
| Stellaria brachypetala Bunge | H | | 2000–2600 | 3–7,9,11,13,14 | SU20200501 |
| Stellaria dichotoma L. | H | LC | 1800–2500 | 1–14 | SU20200902 |
| Stellaria imbricata Bunge | H | | 2000–2500 | 6,7,14 | SU20190318 |
| Stellaria longifolia Mühl. ex Willd. | H | | 2100–2800 | 1,2,3,4,5,7+,9 | SU20190509 |
| Stellaria palustris Elhrh. ex Hoffm. | H | | 2100–2500 | 2,3,7,9 | SU20200319 |
| Stellaria poikilophylla Grubov | H | AE, VU | 2000–2800 | 6,7 | SU20190207 |
| **Crassulaceae** | | | | | |
| Crassula gemmata (Low) Sweet | H | | 1500–2200 | 1,2,3,4,6–15 | SU20200102 |
| Rhodobalanus squarrosula (Fisch. & C.A.Mey.) Fisch. | H | | 2900–3300 | 1,2,3,4,6,7,13 | SU20190410, SU20210107 |
| Rhodobalanus rupestris L. | H | VU | 2500–3300 | 1–8,13,14 | SU20140412 |
| Rhodobalanus stephani (Cham.) Traur. & C.A.Mey. | H | AE | 3000–3300 | 7 | SU20190321, SU20140604 |
| **Cyperaceae** | | | | | |
| Carex atrata Schkuhr | H | | 2600–3000 | 1,3,7 | SU20190316 |
| Carex ericetorum Fisch. & C.A.Mey. ex Kunth | H | | 2600–3000 | 1,2,3,4,5,7+,8,9 | SU20200408 |
| Carex duriuscula (C.A.Mey.) Fisch. | H | | 1500–3300 | 1–14,16 | SU20200414 |
| Carex melanocarpa Turcz. | H | | 2600–3000 | 1,3,7 | SU20210107, SU20210206 |
| Carex myurosoides (L.) Vill. | H | | 2600–3300 | 1,2,3,4,6,7,10,13,14 | SU20210110, SU20210211 |
| Carex pediformis (C.A.Mey.) Fisch. | H | | 2100–3000 | 1–9,13,14 | SU20190322, SU20200412 |
| Eriophorum angustifolium Honck. | H | | 2900–3300 | 1–7,9,10,11 | SU20140413 |
| Eriophorum brunniei Turcz. | H | | 3000–3300 | 1,3,5,6,7 | SU20140414 |
### Flora of the Sutai Mountain in Mongolia

**Appendix 1. Continued**

| Taxon | Growth form | IUCN status | Elevation, m a.s.l (low to high) | Region | Herbarium code |
|-------|-------------|-------------|---------------------------------|--------|---------------|
| **Euphorbiaceae** | | | | | |
| Euphorbia mongolica (Prokh.) Prokh. | H | | 3,6,10,11,12,13 | SU20190114 |
| Euphorbia potentii Prokh. | H | | 3,6,10,13 | SU20140313 |
| **Fabaceae** | | | | | |
| Astragalus brevifolius Ledeb. | H | | 1,2,3,4,6,7,8,11,12,13 | SU20200211 |
| Astragalus chinensis Bunge | H | | 3,6,10,12,13,14 | SU20190115 |
| Astragalus denticulatus Ledeb. | H | | 7,15 | SU20190217 |
| Astragalus eliptoides Ledeb. | H | | 7,10 | SU20140111 |
| Astragalus gubanovii N.Ulz. | H | | 3,6,7,8,13 | SU20201106 |
| Astragalus laevis Jaccq. | H | | 3,6,13 | SU20140104 |
| Astragalus leptostachy Pal. | H | | 3,6,13 | SU20140104 |
| Astragalus tsoyajensis Bunge | H | AE | 7 | SU200904 |
| Astragalus vallesiensis Kamelin | H | | 3,7,10-14 | SU20200707 |
| Carex tenuifolia Ledeb. | S | | 3,6,10,11,13,14,15 | SU20140104 |
| Chondrilla arundinacea monophylla Fisch. | H | VU | 6,7,10,12,13,16 | SU20200705 |
| Hedysarum alpinum L. | H | | 7-9 | SU20140104 |
| Hedysarum inordinatum Turcz. | H | | 1,2,3,6,7,10,13 | SU20140214 |
| Oxytropis acanthace Jurtzev | H | | 6,7 | SU20160160 |
| Oxytropis aczephalia Ledeb. | SS | LC | 3,6,7,10-16 | SU20080805 |
| Oxytropis alzizica (Pall.) Pers. | H | | 6,7 | SU20040142 |
| Oxytropis ampullata (Pall.) Pers. | H | | 2,3,7,8,9,12,13 | SU20200708 |
| Oxytropis bungei Krom. | H | | 3,6,7,8,10-14 | SU20190216 |
| Oxytropis intermedius Bunge | H | AE | 3,6,7 | SU20060113 |
| Oxytropis oligantha Bunge | H | | 3,6,7,10,13 | SU20140104 |
| Oxytropis paniculata Bunge | H | | 1,6,7,13 | SU20140151 |
| Oxytropis pumila Tisch. DC. | H | | 3,6,7,8,10,11,13 | SU20200706 |
| Oxytropis saposhnikovii Krylov | H | AE, EN | 7,10 | SU20140303 |
| Oxytropis satureiica N.Ulz. | H | EN | 3,6,7,10,11,13,14 | SU20190117 |
| Oxytropis tchajaej Bunge | H | AE | 1,7 | SU20190216 |
| Trifolum eximium Stephan ex Ser. | H | | 1,2,3,4,6-11,13 | SU20140103 |
| Vicia saturea Ledeb. | H | | 2,3,4,6-14,16 | SU20140124 |
| **Gentianaceae** | | | | | |
| Comastoma falcatum (Turcz.) Toyok. | H | | 1,2,3,6,7,13 | SU20190335 |
| Comastoma tenuillum (Rottl.) Toyok. | H | | 1,2,3,6,7,13 | SU20050153 |
| Gentiana alpigena Pall. | H | EN | 1,2,3,6,7,13 | SU20140703 |
| Gentiana aquatica var. pseudoaquatica (Kusn.) S.Agrawal | H | | 1,2,3,4,6,7,8,9,13 | SU20110105 |
| Gentiana decumbens Lf. | H | | 1-11,13,14 | SU20140104 |
| Gentiana riparia Kar. & Kir. | H | CR | 7,14 | SU20110104 |
| Gentianella amarella subsp. acuta (Michx.) J.M.Gillett | H | | 1,2,3,4,6,7,8,9,13 | SU20140103 |
| Gentianella azepica (Bunge) Holub | H | | 2,3,6,7,13 | SU20100112 |
| Gentianopsis barbata (Froel.) Ma | H | LC | 1-11,13,14 | SU20140207 |
| Lamatorionum carinthiacum (Wulfen) A.Braun | H | | 1,2,3,4,6,7,8,11,13 | SU20140417 |
| **Geraniaceae** | | | | | |
| Erinium tibetanum Edgew. & Hook.f. | H | | 4,6,7,8,10-16 | SU20140208 |
| Geranium pratense L. | H | | 1,2,3,4,6,7,8,9,12,13 | SU20001100 |
| Geranium pseudocularis J.Mayer | H | | 1-8,10 | SU200111 |
| **Grossulariaceae** | | | | | |
| Ribes aciculare Sm. | S | NT | 2,3,4,6,7,8,10,13,14 | SU20140315, SU20140316 |
| Ribes petraeum Wulfen | S | | 2,3,4,7,14 | SU20140416 |
| **Iridaceae** | | | | | |
| Iris potaninii Maxim. | H | LC | 1,2,3,4,6-13 | SU20190115 |
| **Juncaceae** | | | | | |
| Luzula multiflora subsp. silvica V.I.Kreez. | H | | 1,2,3,4,6,7 | SU20140306 |
| **Lamiaceae** | | | | | |
| Dracaecophalum fruticosum Stephan ex Wildl. | SS | | 3,4,6,7,8,10-13,14 | SU20190118 |
| Dracaecophalum imberbe Bunge | H | | 1,6,7 | SU20190120 |
| Dracaecophalum orgioides Stephan ex Wild. | H | | 1,3,4,6,7,8,9,13,14 | SU20190334 |
| Dracaecophalum subsph. bungeanum (Schischk. & Serg.) A.I.Budantsev | H | | 1,3,4,6,7,8,9,13,14 | SU20190416 |
| Lagochilus ilicifolius Bunge ex Benth. | H | | 3,7,8,10-16 | SU20190113 |
| Lagotis marcelliastrom (Stephan) Ikonn.-Gal. | H | | 3,6,7,13,14 | SU20190115 |

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Appendix 1. Continued

| Taxon | Growth form | IUCN status | Elevation, m a.s.l. (low to high) | Region | Herbarium code |
|-------|-------------|--------------|---------------------------------|--------|----------------|
| Nepeta sibirica L. | H | 1800–2250 | 2,3,6,7,10,13,14 | SU20190122, SU20200806 |
| Panzerina canescens (Bunge) Sojak | H | NT | 1600–2200 | 6,7,10,13 | SU20140213 |
| Panzerina lanata (L.) Sojak | H | 1500–2150 | 2,3,4,6–14,16 | SU20200807 |
| Ziziphora pamiricausia Juz. | H | 2150–2500 | 7,14 | SU20200121 |
| Liliaceae | | | | | |
| Gagea serotina (L.) Ker Gawl. | H | 2600–3100 | 1,2,3,6,7,13 | SU20140515 |
| Tulipa uniflora (L.) Besser ex Baker | H | VU | 2000–2800 | 3,5,7,8,9,10,14 | SU20190114 |
| Orchidaceae | | | | | |
| Neottia camtschatea (L.) Rchb.f. | H | CR | 2100–3100 | 1,2,3,7 | SU20200512 |
| Orobanchaceae | | | | | |
| Corydalis inconspicua Bunge ex Ledeb. | H | VU | 3000–3350 | 1,2,7 | SU20190413 |
| Hypecoum lactiflorum (Kar. & Kir.) Pazij | H | 1600–2100 | 3,4,6–16 | SU20140111 |
| Papaver chakassicum Peschkova | H | 2980–3250 | 6,7 | SU20140314 |
| Papaver lapponicum (Tolm.) Nordh. | H | 3000–3300 | 7 | SU20190326 |
| Papaver pseudocanescens Popov | H | 2500–3250 | 1–7,13 | SU20190325, SU20201409 |
| Plantaginaceae | | | | | |
| Lagotis integrifolia (Wild.) Schischk. | H | 2900–3150 | 1,2,3,7,13 | SU20201407 |
| Linaria altaica Fisch. | H | 2050–2500 | 3,6,7,10,14 | SU20140107 |
| Linaria hepatica Bunge | H | NT | 2100–2550 | 6,7,11,13,14 | SU20190110 |
| Plantago depressa Willd. | H | 2000–2500 | 1–10,12,13 | SU20190109 |
| Plantago kamarovii Pavlov | H | NT | 2000–2500 | 1,3,6,7,13 | SU20190325 |
| Plantago major L. | H | 1800–2100 | 2–14 | SU20190109 |
| Veronica ciliata Fisch. | H | 3100–3200 | 1,2,3,6,7 | SU20190328 |
| Veronica densiflora Ldb. | H | 2000–2500 | 2,7 | SU20140107 |
| Veronica spicata L. | H | 2100–2550 | 7,14 | SU20190411 |
| Plumbaginaceae | | | | | |
| Limonium congestum (Ledeb.) Kuntze | H | AE | 2900–3150 | 1,2,3,7,13 | SU20140607 |
| Poaceae | | | | | |
| Agropyron cristatum (L.) Gaertn. | H | 1500–2800 | 1–16 (all regions) | SU20190211, SU20200612 |
| Alopecurus megallanicus Lam. | H | 2600–3250 | 1,2,3,4,6,7,8,13 | SU20140107 |
| Anthoxanthum glabrum (Trin.) Veldkamp | H | 2100–2500 | 1–10 | SU20190110 |
| Anthoxanthum monticola (Bigelow) Veldkamp | H | 2600–3200 | 1,2,3,6,7,10 | SU20200512 |
| Anthoxanthum nipponicum Honda | H | 2050–3000 | 2–7 | SU20201212 |
| Cleistogenes songorica (Roshev.) Ohwi | H | 1500–2450 | 4,7–16 | SU20200805 |
| Elymus glaucus L. | H | 1600–2000 | 1–10,13–16 | SU20140208 |
| Festuca alpina L. | H | 1900–2550 | 1,3,4,6,7 | SU20190214 |
| Festuca leniennis Drobow | H | 1500–2200 | 1–9,13,15 | SU20200804 |
| Hordeum brevisubulatum (Trin.) Link | H | 1500–2000 | 1–14,16 | SU20190213, SU20200209 |
| Koeleria alpina (Domin) Krylov | H | 2000–3000 | 1–10,13 | SU20190324 |
| Koeleria macrantha (Ledeb.) Schult. | H | 1600–2500 | 1,2,3,4,5,7,8–13 | SU20201103 |
| Leymus chionensis (Trin.) Tzvelev | H | 1500–2100 | 1–6,7,8–14 | SU20130106 |
| Leymus salsulus (Georgii) Tzvelev | H | 1500–2000 | 1,2,3,4,6–16 | SU20200605 |
| Neotritia splendens (Trin.) M.Nobis, P.D.Gudkova & A.Nowak | H | 1500–2100 | 2,3,4,7–16 | SU20200704 |
| Pileum alpinum L. | H | VU | 2000–3000 | 7 | SU20140607 |
| Poa alpina L. | H | 2000–3000 | 1,3,6,7,15 | SU20200208 |
| Poa attenuata Trin. | H | 1500–2500 | 1,2,3,4,6–10,12–15 | SU20190323, SU20201201 |
| Poa glauca subsp. alpina (Trin.) Olonova & G.H.Zhu | H | 1500–3000 | 1,2,3,6,7,10,13 | SU20140414, SU20201003 |
### Appendix 1. Continued

| Taxon | Growth, IUCN status | Elevation, m a.s.l (low to high) | Region | Herbarium code |
|-------|---------------------|---------------------------------|--------|----------------|
| **Polygonaceae** |                      |                                 |        |                |
| Atriplex panguen  (M.Biech.) Jauh. & Spach | S | 1800–2100 | 2–16 | SU20090611 |
| *Bistorta elliptica* (Wildl. ex Spreng.) V.V.Petrovsky, D.F.Murray & Elven | H | 2600–3300 | 1,2,3,6,7 | SU20140309 |
| *Bistorta vivipara* (L.) Delarbre | H | 2500–3250 | 1–4,6,7,8,10,13,14 | SU20190320, SU20201101 |
| *Koennigia alpina* (All.) T.M.Schust. & Reveal | H | 2600–3300 | 1,2,3,4,6,7,8,14 | SU20190114 |
| *Oxyria digyna* (L.) Hill | H | 3000–3300 | 1,2,3,6,7,13 | SU20190317, SU20201205 |
| *Persicaria minor* (Huds.) Opitz | H | 2500–2800 | 7,10,14 | SU20140207 |
| *Rheum compactum* L. | H | 2600–3150 | 1,2,3,4,6,7,12,13,14 | SU20190318 |
| *Rheum nutans* Sieveck. Pall. | H | 1500–2000 | 7,8,10–16 | SU200701 |
| *Ranunculus thyrsiflorus* F. Fingerh. | H | 2850–3200 | 1–14 | SU20190319 |
| **Primulaceae** |                      |                                 |        |                |
| *Androsace bungeana* Schischk. & Bobrov | H | 2000–2600 | 1,2,3,6,7,9 | SU20190319 |
| *Androsace dasyphylla* Bunge | H | 2600–3280 | 1,2,3,6,7,13 | SU20140207 |
| *Androsace lactoflora* Fisch. ex Willd. | H | 2300–3000 | 1,2,3,4,6,7,9,14 | SU20190316, SU20200808 |
| *Androsace lemanniana* Spreng. | H | 2800–3300 | 1,2,3,6,7,9 | SU20190306 |
| *Androsace macrantha* L. | H | 2500–3200 | 2,3,4,6–10,13,14,15 | SU20140308 |
| *Androsace septentrionalis* L. | H | 2300–3000 | 1–9,12,13 | SU20190605 |
| *Primula algida* Adams | H | 2900–3250 | 3,6,7 | SU20140513 |
| *Primula bukukunica* Kvet. | H | 3000–3280 | 7,11,13 | SU20190410 |
| *Primula longispata* Ledeb. | H | 2100–2800 | 3,6,7,10,13,14 | SU2000319 |
| *Primula nivalis* Pall. | H | 3050–3220 | 1,2,3,6,7,10 | SU20140512 |
| **Ranunculaceae** |                      |                                 |        |                |
| *Aquilegia glandulosa* Rapaces | H | 2600–3000 | 1,2,3,4,6,7,13,14 | SU20140508 |
| *Clematis alpina* subsp. silvica (L.) Kunze | SS | 2100–2500 | 1,2,3,4,6,7,8,10,13 | SU20140301 |
| *Delphinium crisphalum* Schrad. ex Spreng. | H | 2800–3200 | 1,2,3,5,6,7 | SU20140407 |
| *Delphinium instruction* Ser. | H AE | 2800–3100 | 3,6,7,14 | SU20140408 |
| *Hallerpestes sarmentosa* (Adams) Kom. | H | 2600–3280 | 3,4,6–16 | SU20190305 |
| *Laportetrium fumarioides* (L.) Rehb. | H | 1600–2200 | 1,2,3,4,6,7,8,9,13 | SU20190901 |
| *Pulsatilla bungiana* C.A.Mey. | H | 1800–2100 | 4,6 | SU20140205 |
| *Ramunculus longisulcatus* Ledeb. ex A.Spreng. | H | 2300–2800 | 1,2,3,4,6,7,11,14 | SU20140509 |
| *Ramunculus pedatifidus* Sm. | H | 2400–2900 | 1–7,9,13 | SU20140207 |
| *Ramunculus pseudoborcheri* Schrenk. | H | 3100–3300 | 1,2,3,6,7,13,14 | SU20140411 |
| *Ramunculus sapozhnikovii* Sebegol. | H AE | 3080–3250 | 7 | SU20140409 |
| *Trichocodon albium* L. | H | 2500–2800 | 1,2,3,4,6,7,13 | SU20120707 |
| *Trichocodon foetidum* L. | H | 2100–2800 | 1,2,3,4,6–10,13,14 | SU20190912 |
| *Trillosia alpina* C.A.Mey. | H | 2600–3000 | 6,7,14 | SU20140506 |
| **Rosaceae** |                      |                                 |        |                |
| *Argentina anserina* (L.) Rydb. | H | 1600–3000 | 1–11,13,14,15 | SU20201303 |
| *Chamaelebdis erecta* (L.) Bunge. | H | 2100–2500 | 1–13 | SU20140046 |
| *Coluteaster uniflorus* Bunge | S | 2250–2900 | 1,2,3,7,8,13 | SU20140510 |
| *Diaspilora parviflora* (Fisch. ex Lehms.) Juz. | S | 2100–2800 | 3,4,6,7,8+ | SU20140409, SU20190410 |
| *Dryas oregona* Juz. | SS | 3100–3280 | 1,2,3,4,6,7 | SU20120280 |
| *Frunotopsis saksowiana* (Stephan) Chrtek & Sojak | SS | 2600–3200 | 6,7,10,13,14 | SU20140401 |
| *Potentilla agrimonioides* M.Biech. | H | 2500–3000 | 6,7,14 | SU20190111 |
| *Potentilla altaica* Bunge | H | 2000–2600 | 1,6,7 | SU20190110 |
| *Potentilla aphanes* Sojak | H | 2100–3000 | 3,6,7,10,13,14 | SU20140408 |
| *Potentilla asterolophia* Bunge | H | 1800–2200 | 3,6,7,10,11 | SU20190604 |
| *Potentilla conferta* Bunge | H | 2000–3100 | 1–9,12,13,14 | SU20190911 |
| *Potentilla crebriodora* Juz. | H | 2150–2900 | 1,2,3,6,7 | SU20190210, SU20190502 |
| *Potentilla gelida* C.A.Meyer. | H | 2100–2950 | 1,2,3,6,7,9,13,14 | SU20140312, SU20120299 |
| *Potentilla kryloviana* Th.Wolf | H | 2000–3050 | 3,7,14 | SU20140202 |
| *Potentilla nivea* L. | H | 1900–3100 | 1,2,3,4,6,7,13,14 | SU20190206, SU20190210 |
### Appendix 1. Continued

| Taxon                          | Growth form | IUCN status | Elevation, m a.s.l (low to high) | Region | Herbarium code |
|-------------------------------|-------------|-------------|----------------------------------|--------|----------------|
| Potentilla ozjorensis Peschkova | H           |             | 2000–2950                        | 1,3,4,7| SU20200205     |
| Potentilla pamirica Th.Wolf    | H           |             | 2500–3180                        | 6,7,10,14| SU20201403    |
| Potentilla pamirudica Juz.     | H           |             | 2950–3200                        | 7,14   | SU20201301     |
| Potentilla rhodophylla Sojak   | E           |             | 2000–2600                        | 7      | SU20190304     |
| Potentilla sovirensis L.       | H           |             | 2100–3000                        | 1,2,3,4,6–13,15 | SU20200405 |
| Potentilla turgidina Sojak     | H           |             | 2600–3100                        | 2,3,4,5,7+,9 | SU20190303    |
| Potentilla terichilica Sobolevsk. | H         |             | 2100–2800                        | 6,7    | SU20200207     |
| Potentilla turgistana Sojak    | H           |             | 2950–3200                        | 7,14   | SU20200211     |
| Rosa laxa Retz.               | S           | NT          | 2500–2800                        | 6,7,13,14,15 | SU20140705    |
| Sibbaldia adpressa (Bge.) Juz. | H           |             | 1800–2600                        | 1–13,15,16 | SU20200606    |
| Sibbaldianthes bifurca (L.) Kurtto & T.Erikk. | SS       |             | 1700–2500                        | 1–14   | SU20190209     |
| Spiraea alpina Pall.          | S           |             | 2200–3000                        | 1,2,3,6,7 | SU20140511    |
| Rubiaceae                     |             |             |                                  |        |                |
| Galium verum L.               | H           |             | 1800–2500                        | 1–10,13,14 | SU20200108    |
| Salicaceae                    |             |             |                                  |        |                |
| Populus lasiocarpa Ledeb.      | T           |             | 1700–2600                        | 2,3,6,7,10,13,14 | SU20140410   |
| Salix arctica subsp. torulosa (Ledeb.) Hultén | S   |             | 3000–3250                        | 1,3,6,7 | SU20140507     |
| Salix berberifolia Pall.       | S           |             | 3000–3100                        | 1,2,3,6,7,13 | SU20140603    |
| Salix terebratifolia Laksch.   | S           |             | 2900–3100                        | 1,2,6,7 | SU20140404     |
| Saxifragaceae                 |             |             |                                  |        |                |
| Saxifraga cernua L.           | H           |             | 2500–3000                        | 1,2,3,6,7,8,9,13 | SU20190316, |
| Saxifraga hirsula L.           | H           | EN          | 2800–3100                        | 1–7,13 | SU20190401     |
| Saxifraga maroccana Tolm.      | H           |             | 2900–3150                        | 1,6,7,13,14 | SU20190314    |
| Saxifraga sibrica L.           | H           |             | 3000–3200                        | 1,3,6,7,10,13,14 | SU20190302, |
| Solanaceae                    |             |             |                                  |        |                |
| Physoclauma physioides (L.) G.Don | H         |             | 1800–2200                        | 1,3–9,11,12,13 | SU20140201    |
| Ulmaceae                      |             |             |                                  |        |                |
| Ulmus pumila L.               | T           |             | 1600–2500                        | 2–5,7,8,9,11,13,16 | SU20140606   |
| Urticaceae                    |             |             |                                  |        |                |
| Urtica cannabina L.           | H           |             | 1800–2600                        | 2–10,12,13,14 | SU20200104    |
| Viburnaceae                   |             |             |                                  |        |                |
| Adoxa moschatellina L.        | H           |             | 2200–2500                        | 1,2,3,5,6,7,13 | SU20200506   |
| Violaceae                     |             |             |                                  |        |                |
| Violas dissecta Ledeb.         | H           |             | 2800–3100                        | 1–5,7,9,13 | SU20140602     |
| Zygophyllaceae                |             |             |                                  |        |                |
| Zygophyllum melongena Bunge    | H           |             | 1500–2100                        | 3,6,7,10,11,13,14 | SU20140106   |