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Short communication

Plant species composition and vegetation cover of Kherlen Toono Mountain, Mongolia

Dariimaa Shagdar*, Oyunchuluun Yadamsuren

Department of Biology, School of Mathematics and Natural Sciences, Mongolian State University of Education, Ulaanbaatar, Mongolia

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ABSTRACT

The Kherlen Toono Mountain Natural Reserve has a unique natural formation that makes its flora and vegetation cover unique. This study aimed to prepare a species inventory of flora and conduct make visual assessments of the vegetation cover of Kherlen Toono Mountain. A total of 202 species belonging to 115 genera, 46 families, and 4 phyla (Equisetophyta, Polypodiophyta, Pinophyta, and Magnoliophyta) were recorded. During this study, a species [*Vincetoxicum lanceolatum* (Grubov) Grubov] was newly recorded in the vegetation of the Dundad Khalkh district. An endemic species, 7 subendemic species (4.9%), and 10 rare species (3.9%) were recorded in the study area, which comprised 8.9% of the total species. These species recordings indicated the unique flora of the Kherlen Toono Mountain region. Forb–khargana and needle grass–forb communities of 10 different communities were commonly recorded in the study area.

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Introduction

Kherlen Toono Mountain (latitude: 47°01'32.58", longitude 109°16'04.96", elevation 1,578 m) is located 10 km southeast of the Avraga Toson resort in Khentii Province, Mongolia (Figure 1). This area is a natural reserve that belongs to the Great Dornod Steppe (National Atlas 2009) and the dry steppe of Dundad Khalkh district (Grubov 1982).

The vegetation of this area is mainly composed of mountain steppes and steppe vegetation associated with its geomorphology features. The plant species and their habitats recorded are very unique to this area.

Grubov (1955, 1982) and Ulziikhutag (1989) subdivided the region into 16 vegetation-geographic districts based on the geography of Mongolian territories and their vegetation cover characteristics. Based on this subdivision, the Kherlen Toono Mountain region is located in the Dundad Khalkh steppe (Figure 1).

Plant species and vegetation cover of Kherlen Toono Mountain are relatively less studied and there is no plant species inventory for this region. The general features of the vegetation cover of this area are covered by some studies on the vegetation of

Mongolia (Grubov 1955, 1982; Unatov 1950) and by the studies on the vegetation of Khentii, Mongol Daguur, Dundad Khalkh, and Dornod Mongol districts (Dashnyam 1974; Shagdar 2003). The Kherlen Toono Mountain region is included in the vegetation map of Mongolia (scales, 1:1,500,000 and 1:3,000,000; Dorjgotov 2009).

In recent years, there has been an increase in anthropogenic impacts such as livestock grazing and mining in this area. Therefore, it is important to create a species inventory of flora, in order to determine species composition and vegetation cover, so as to provide baseline information about vegetation pattern in this area for future research on changes in biological communities caused by land-use impacts and environmental management.

This study aimed to determine vascular plant species, major plant community and their vegetation cover, and rare species in this area.

Materials and methods

The research was performed on the Kherlen Toono Mountain region in Khentii Aimag, Mongolia, between July 4, 2015 and July 8, 2015 (Figure 1). Six sites and 20 plots in each site were chosen in the study area. Site 1: Southeast upper to lower slope of Kherlen Toono Mountain; Site 2: South upper slope to lower slope of Kherlen Toono Mountain; Site 3: Southwest upper slope to lower slope of Kherlen Toono Mountain; Site 4: Northwest upper slope to

* Corresponding author.

E-mail address: shagdar_dariimaa@yahoo.com (D. Shagdar).

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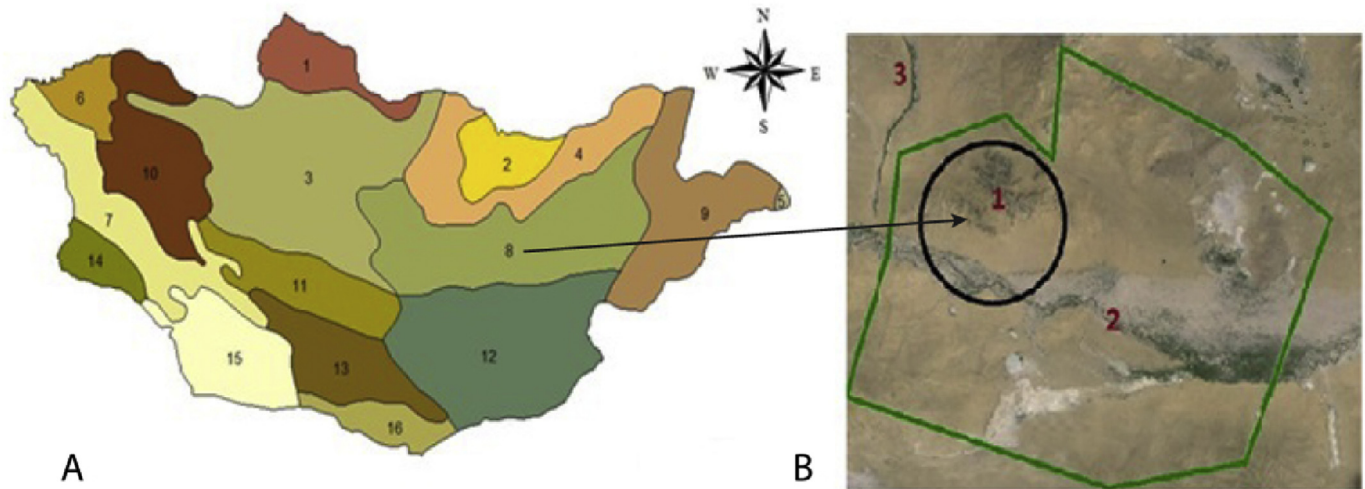


Figure 1. A, Vegetation-geographical districts of Mongolia: 1. Khövsgöl taiga mountain; 2. Khentii taiga mountain; 3. Khangai forest mountain; 4. Mongol Daguur forest steppe; 5. Khyangan meadow steppe; 6. Kovd mountain desert steppe; 7. Mongol-Altai mountain steppe; 8. Dundad Kalkh dry steppe; 9. Dornod Mongol steppe; 10. Great lakes depression desert steppe; 11. Valley of lakes desert steppe; 12. Dornogovi desert steppe; 13. Gobi Altai mountain desert steppe; 14. Dzungaria Gobi Desert; 15. Trans-Altai Gobi Desert; 16. Alasha Gobi Desert. B, Study area: 1. Kherlen Toono Mountain, 2. Kherlen River 3. Avraga stream. Green line is the border of Kherlen Toono Natural Reserve.

lower slope of Kherlen Toono Mountain; Site 5: Riparian zone of Avraga stream; and Site 6: Riparian zone of Kherlen River.

In this work, a general methodology of plant taxonomy and vegetation cover estimation based on ecological–geographical–morphological approaches was adopted (Buyan-Orshikh 2005; Kamelin 1998, 2004; Malyshev and Peshkova 1984; Peshkova 1972; Shennikov 1964; Ulziikhutag 1989). We recorded only the presence of species within the 20 plots using the qualitative sampling method. Geobotanical records were obtained using 1-m² net (100 cm × 100 cm grids) in each plot and 100 herbaria were made. Canopy cover was evaluated by visual assessment (calculated as percentage) within each site.

Results

In this work, a total of 202 species belonging to 115 genera, 46 families, and four phyla (Equisetophyta, Polypodiophyta, Pinales, and Magnoliophyta) were recorded (Table 1). The following six families were more diverse and accounted for 52.5% of the total flora recorded (Table 1): Asteraceae (28 species), Poaceae (21 species), Rosaceae (17 species), Fabaceae (15 species), Ranunculaceae (14 species), and Caryophyllaceae (10 species).

These aforementioned families were more diverse families of the Mongolian flora and were recorded from the mountain steppe and steppe regions. One to thirteen species were recorded within a genus. The most diverse genera were *Artemisia* (13 species) and *Potentilla* (6 species; Table 1). During the study period, *Vincetoxicum lanceolatum* (Grubov) Grub was newly recorded in the vegetation district of Dundad Khalkh.

An endemic species (*V. lanceolatum*), eight subendemic species (*Stipa klemenzii*, *Cotoneaster mongolicus*, *Astragalus galactites*, *Oxytropis lasiopoda*, *Oxytropis salina*, *Caryopteris mongolica*, *Thymus gobicus*, and *Pedicularis flava*), 10 rare species (*Ephedra sinica*, *Juniperus pseudosabina*, *Allium anisopodium*, *Allium ramosum*, *Iris humilis*, *Chelidonium majus*, *Bistorta alopecoroides*, *Stellaria dichotoma*, *V. lanceolatum*, and *Artemisia rutifolia*), were included in the rare species list of Mongolia. These species indicate the unique flora of Kherlen Toono Mountain.

Distribution by vegetation-geographic district

The Kherlen Toono Mountain is located in the Dundad Khalkh dry steppe (Figure 1). Of note, plants of all 16 vegetation districts were recorded in the Kherlen Toono Mountain, but their percentages were different depending on the district's ecological and geographical differences. Plants of neighboring vegetation district were also commonly recorded in the study area.

Ecological groups

Plant species were divided into 8 ecological groups and the number of species recorded varied between the groups (Figure 2). Xerophytes and xero-lithophytes comprised 40% of total plants, meso-xerophytes and meso-lithophytes 29.7%, mesophytes 16.3%, halophytes 6.5%, hygrophytes 4.5%, and hydrophytes 3% (Figure 2).

Vegetation cover and its characteristics

Mountain steppe, steppe shrubs, and annual grasses were predominant in the vegetation cover of Kherlen Toono Mountain. Forb, khargana, and needle grass–forb communities of 10 different communities were commonly recorded in the study area.

Forb community

This community was relatively diverse, with canopy cover of approximately 45–65% and distributed on the lower slope and lower part of the mountain. The commonly recorded species included *Artemisia dracunculus*, *Galium verum*, *Aconogonon divaricatum*, *Aconogonum angustifolium*, *Thalictrum minus*, *Rheum undulatum*, *Phlomis tuberosa*, and *Sanguisorba officinalis*. Some communities also include *Potentilla fruticosa*, *Spiraea aquilegifolia*, *Cotoneaster melanocarpa*, and *Artemisia gmelinii*.

Shrub community

This community was reported from the mountain side hill, trench, and at river banks. *S. aquilegifolia* and *Amygdalus pedunculata* were predominant and *Ulmus pumila*, *P. fruticosa*, and

Table 1. Species list of vascular plants at Kherlen Toono Mountain, Khentii Aimag, Mongolia.

Family	Species
Equisetaceae Rich. ex DC.	1. <i>Equisetum arvense</i> L.
Woodsiaceae (Deils) Herter.	2. <i>Woodsia ilvensis</i> (L.) R.Br.
Athyriaceae Alston	3. <i>Cystopteris fragilis</i> (L.) Bernh.
Cupressaceae Gray	4. <i>Juniperus pseudosabina</i> Fisch. et Mey.
Ephedraceae Dumort	5. <i>Ephedra monosperma</i> C.A. Mey.
	6. <i>Ephedra sinica</i> Stapf.
Potamogetonaceae Bercht. et J. Presl.	7. <i>Potamogeton filiformis</i> Pers.
	8. <i>Potamogeton perfoliatus</i> L.
Juncaginaceae Rich.	9. <i>Triglochin maritima</i> L. (syn. <i>Triglochin maritimum</i>)
	10. <i>Triglochin palustre</i> L.
Poaceae Barnhart	11. <i>Setaria viridis</i> (L.) Beauv.
	12. <i>Achnatherum splendens</i> (Trin.) Nevski
	13. <i>Stipa capillata</i> L.
	14. <i>Stipa klemenzii</i> Roshev.
	15. <i>Stipa krylovii</i> Roshev.
	16. <i>Stipa sibirica</i> (L.) Lam.
	17. <i>Alopecurus aequalis</i> Sobol.
	18. <i>Beckmannia syzigachne</i> (Steud.) Fern.
	19. <i>Cleistogenes kitagawae</i> Honda
	20. <i>Cleistogenes squarrosa</i> (Trin.) Keng.
	21. <i>Koeleria cristata</i> (L.) Pers.
	22. <i>Poa attenuata</i> Trin.
	23. <i>Poa botryoides</i> Trin. ex Griseb
	24. <i>Poa subfastigiata</i> Trin.
	25. <i>Glyceria triflora</i> (Korsh.) Kom.
	26. <i>Puccinellia macrantha</i> V. Krecz.
	27. <i>Puccinellia tenuiflora</i> (Griseb.) Scribn. et Merr.
	28. <i>Festuca sibirica</i> Hack. ex Boiss.
	29. <i>Agropyron cristatum</i> (L.) Beauv.
	30. <i>Leymus chinensis</i> (Trin.) Tzvel.
	31. <i>Hordeum brevisubulatum</i> (Trin.) Link.
Cyperaceae Juss.	32. <i>Eleocharis acicularis</i> (L.) Roem. et Schult.
	33. <i>E. yokoscensis</i> Franch. et Savat.
	34. <i>Carex duriuscula</i> C.A. Mey.
	35. <i>Carex reptabunda</i> (Trautv.) V. Krecz.
	36. <i>Carex media</i> R. Br.
Juncaceae Juss.	37. <i>Juncus bufonius</i> L.
	38. <i>Juncus salsuginosus</i> Turcz. ex E.Mey.
Alliaceae Borkh.	39. <i>Allium anisopodium</i> Ledeb.
	40. <i>Allium bidentatum</i> Fisch. ex Prokh.
	41. <i>Allium lineare</i> L.
	42. <i>Allium polyrrhizum</i> Turcz. ex Regel.
	43. <i>Allium ramosum</i> L.
	44. <i>Allium senescens</i> L.
	45. <i>Allium tenuissimum</i> L.
Liliaceae Juss.	46. <i>Lilium pumilum</i> Delile
	47. <i>Polygonatum odoratum</i> (Mill.) Druce.
	48. <i>Polygonatum sibiricum</i> Delaroché
Asparagaceae Juss.	49. <i>Asparagus dahuricus</i> Fisch. ex Link.
Iridaceae Juss.	50. <i>Iris humilis</i> Georgi.
	51. <i>Iris lactea</i> Pall.
Salicaceae Mirb.	52. <i>Salix miyabeana</i> Seemen
Ulmaceae Mirb.	53. <i>Ulmus pumila</i> L.
Urticaceae Juss.	54. <i>Urtica cannabina</i> L.
Polygonaceae Juss.	55. <i>Rheum undulatum</i> L.
	56. <i>Rumex acetosa</i> L.
	57. <i>Atrophaxis pungens</i> (M.B.) Jaub. et Spach.
	58. <i>Bistorta alopecuroides</i> (Turczaninow ex Besser)
	59. <i>Aconogonon angustifolium</i> (Pall.) H. Hara
	60. <i>Polygonum aviculare</i> L.
	61. <i>Polygonum patulum</i> Bieb.
Chenopodiaceae Ulbr.	62. <i>Chenopodium album</i> L.
	63. <i>Atriplex fera</i> (L.) Bunge
	64. <i>Kochia prostrata</i> (L.) Schrad.
	65. <i>Salsola pestifera</i> Nels.
Caryophyllaceae Juss.	66. <i>Stellaria dichotoma</i> L.

Table 1 (continued)

Family	Species
	67. <i>Stellaria diffusa</i> Willd
	68. <i>Stellaria brachypetala</i> Bunge
	69. <i>Stellaria petraea</i> Bunge
	70. <i>Arenaria capillaris</i> Poir.
	71. <i>Arenaria meyeri</i> Fenzl.
	72. <i>Silene repens</i> Patr.
	73. <i>Melandrium brachypetalum</i> (Hornem.) Fenzl.
	74. <i>Melandrium apricum</i> (Turcz. ex Fisch. et Mey.)
	75. <i>Dianthus versicolor</i> Fisch.
	76. <i>Caltha natans</i> Pall. ex Georgi.
	77. <i>Aquilegia viridiflora</i> Pall.
	78. <i>Pulsatilla bungeana</i> C.A.Mey
	79. <i>Pulsatilla turczaninowii</i> Kryl et Serg.
	80. <i>Halerpestes salsuginosa</i> (Pall. ex Georgi) Greene
	81. <i>Halerpestes sarmentosa</i> (Adams.) Kom.
	82. <i>Batrachium divaricatum</i> (Schrank) Schur
	83. <i>Ranunculus repens</i> L.
	84. <i>Ranunculus reptans</i> L.
	85. <i>Ranunculus sceleratus</i> L.
	86. <i>Thalictrum foetidum</i> L.
	87. <i>Thalictrum minus</i> L.
	88. <i>Thalictrum simplex</i> L.
	89. <i>Thalictrum squarrosum</i> Steph. ex Willd.
Papaveraceae Juss.	90. <i>Papaver croceum</i> Ledeb.
	91. <i>Chelidonium majus</i> L.
Brassicaceae Burnett	92. <i>Lepidium latifolium</i> L.
	93. <i>Isatis costata</i> C.A.Mey.
	94. <i>Rorippa palustris</i> (L.) Bess.
	95. <i>Sisymbrium polymorphum</i> (Murr.) Roth.
Crassulaceae J. St.-Hil.	96. <i>Sedum hybridum</i> L.
	97. <i>Orostachys fimbriata</i> (Turcz.) Berger.
	98. <i>Orostachys spinosa</i> (L.) C.A. Mey.
Grossulariaceae DC.	99. <i>Ribes pulchellum</i> Turcz.
Rosaceae Juss.	100. <i>Spiraea aquilegifolia</i> Pall.
	101. <i>Spiraea hypericifolia</i> L.
	102. <i>Spiraea media</i> Franz. Schmidt.
	103. <i>Cotoneaster mongolicus</i> Pojark.
	104. <i>Potentilla fruticosa</i> (L.) Rydb.
	105. <i>Potentilla acaulis</i> L.
	106. <i>Potentilla anserina</i> L.
	107. <i>Potentilla bifurca</i> L.
	108. <i>Potentilla multifida</i> L.
	109. <i>Potentilla strigosa</i> Pall. ex Pursh
	110. <i>Potentilla supina</i> L.
	111. <i>Potentilla tanacetifolia</i> Willd. ex Schlecht.
	112. <i>Potentilla viscosa</i> G. Don.
	113. <i>Sibbaldia adpressa</i> (Bunge) Juz.
	114. <i>Geum aleppicum</i> Jacq.
	115. <i>Sanguisorba officinalis</i> L.
	116. <i>Rosa acicularis</i> Lindl.
Fabaceae Lindl.	117. <i>Thermopsis lanceolata</i> R.Br.
	118. <i>Medicago falcata</i> L.
	119. <i>Medicago ruthenica</i> (L.) Trautv.
	120. <i>Caragana microphylla</i> Lam.
	121. <i>Caragana pygmaea</i> (L.) DC.
	122. <i>Astragalus adsurgens</i> Pall.
	123. <i>Astragalus galactites</i> Pall.
	124. <i>Oxytropis lasiopoda</i> Bunge
	125. <i>Oxytropis myriophylla</i> (Pall.) DC.
	126. <i>Oxytropis salina</i> Vass.
	127. <i>Lespedeza dahurica</i> (Laxm.) Schindl.
	128. <i>Vicia amoena</i> Fisch.
	129. <i>Vicia megalotropis</i> Ledeb.
	130. <i>Vicia multicaulis</i> Ledeb.
	131. <i>Vicia costata</i> Ledeb.
Geraniaceae Juss.	132. <i>Geranium sibiricum</i> L.

(continued on next page)

Table 1 (continued)

Family	Species
Rutaceae Juss.	133. <i>Erodium stephanianum</i> Willd. 134. <i>Haplophyllum dahuricum</i> (L.) G. Don.
Polygalaceae Hoffmanns. et Link.	135. <i>Polygala tenuifolia</i> Willd.
Euphorbiaceae Juss.	136. <i>Euphorbia discolor</i> Ledeb.
Haloragaceae R.Br.	137. <i>Myriophyllum verticillatum</i> L.
Hippuridaceae Vest	138. <i>Hippuris vulgaris</i> L.
Apiaceae Lindl.	139. <i>Bupleurum bicaule</i> Helm. 140. <i>Bupleurum scorzonerifolium</i> Willd.
Primulaceae Batsch ex Borkh.	141. <i>Ferulopsis hystrix</i> (Bunge) Pemenov 142. <i>Androsace incana</i> Lam. 143. <i>Androsace septentrionalis</i> L. 144. <i>Glaux maritima</i> L.
Plumbaginaceae Juss.	145. <i>Goniolimon speciosum</i> (L.) Boiss. 146. <i>Limonium bicolor</i> (Bunge) O. Kuntze.
Gentianaceae Juss.	147. <i>Limonium flexuosum</i> (L.) O. Kuntze. 148. <i>Gentiana decumbens</i> L. 149. <i>Gentiana squarrosa</i> Ledeb. 150. <i>Anagallidium dichotomum</i> (L.) Griseb.
Asclepiadaceae Borkh.	151. <i>Vincetoxicum lanceolatum</i> (Grub.) Grub. 152. <i>Vincetoxicum sibiricum</i> (L.) Decne.
Convolvulaceae Juss.	153. <i>Convolvulus ammannii</i> Desr. 154. <i>Convolvulus arvensis</i> L.
Boraginaceae Juss.	155. <i>Myosotis caespitosa</i> C.F. Schultz. 156. <i>Lappula consanguinea</i> (Fisch. et Mey.) Guerke 157. <i>Amblynotus rupestris</i> (Pall. ex Georgi) M. Pop. ex Serg.
Verbenaceae St.-Hil.	158. <i>Caryopteris mongolica</i> Bunge
Lamiaceae Martinov	159. <i>Schizonepeta multifida</i> (L.) Briq. 160. <i>Dracocephalum foetidum</i> Bunge 161. <i>Leonurus sibiricus</i> L. 162. <i>Thymus gobicus</i> Tscherneva 163. <i>Physochlaina physaloides</i> (L.) G. Don. 164. <i>Hyoscyamus niger</i> L.
Scrophulariaceae Benth.	165. <i>Linaria acutiloba</i> Fisch. ex Rchb. 166. <i>Linaria buriatica</i> Turcz 167. <i>Veronica incana</i> L. 168. <i>Pedicularis flava</i> Pall. 169. <i>Cymbaria dahurica</i> L.
Plantaginaceae Juss.	170. <i>Plantago depressa</i> Schlecht. 171. <i>Plantago major</i> L.
Rubiaceae Juss.	172. <i>Rubia cordifolia</i> L. 173. <i>Galium verum</i> L.
Dipsacaceae Juss.	174. <i>Scabiosa comosa</i> Fisch. ex Roem. et Schult.
Asteraceae Dumort. Berch. et J. Presl.	175. <i>Ixeridium gramineum</i> (Fisch.) Tzvel.
Compositae Giseke	176. <i>Taraxacum dissectum</i> (Ledeb.) Ledeb. 177. <i>Taraxacum glaucanthum</i> (Ledeb.) DC 178. <i>Crepis crocea</i> (Lam.) Babç. 179. <i>Scorzonera austriaca</i> Willd. 180. <i>Echinops latifolius</i> Tausch. 181. <i>Saussurea amara</i> (L.) DC. 182. <i>Saussurea pricei</i> Simps. 183. <i>Saussurea salicifolia</i> (L.) DC. 184. <i>Rhaponticum uniflorum</i> (L.) DC. 185. <i>Serratula centauroides</i> L. 186. <i>Gnaphalium baicalense</i> Kirp. 187. <i>Leontopodium leontopodioides</i> (Willd.) Beauv. 188. <i>Aster alpinus</i> L. 189. <i>Arctogeron gramineum</i> (L.) DC. 190. <i>Artemisia adamsii</i> Bess. 191. <i>Artemisia anethifolia</i> Web. ex Stechm. 192. <i>Artemisia annua</i> L. 193. <i>Artemisia dolosa</i> Krasch. 194. <i>Artemisia dracunculus</i> L. 195. <i>Artemisia frigida</i> Willd.

Table 1 (continued)

Family	Species
	196. <i>Artemisia gmelinii</i> Web. ex Stechm. 197. <i>Artemisia macrocephala</i> Jacq. ex Bess. 198. <i>Artemisia messerschmidtiana</i> Bess. 199. <i>Artemisia mongolica</i> (Bess.) Fisch. ex Nakai. 200. <i>Artemisia palustris</i> L. 201. <i>Artemisia rutifolia</i> Steph. ex Spreng. 202. <i>Artemisia scoparia</i> Waldst. et Kit.
Total: 46	

A. gmelinii were commonly reported. The common herbaceous plants in the community were *A. angustifolium*, *A. divaricatum*, *Pulsatilla turczaninovii*, *Pulsatilla bungei*, *T. minus*, and *Filifolium sibiricum*.

Khargana community

It was commonly reported in the mountain slope and its canopy cover was 20–40%.

Ephedra–Siberian needle grass–khargana community

This community was reported from mountain slopes and lower steppe. Its canopy cover was ~40%.

Needle grass community

This is the most common community in the area and was found on hill tops and rocky slopes of the mountain. In addition, lithophyte forbs and shrubs were distributed at elevation from 1,100 m to 1,200 m. The vegetation cover consisted of 25–30 species and it was short and scarce, with canopy cover of approximately 30–45%. Grasses (*Stipa krylovii* and *Cleistogenes squarrosa*) and lithophyte forbs (*Arenaria capillaris*, *Bupleurum bicaule*, *S. dichotoma*, *A. angustifolium*, *Saussurea salicifolia*, and *T. gobicus*) were common.

Chinese lyme grass community

This was one of the communities reported from the steppe of Eastern Mongolia at elevations from 950 m to 1,100 m on table lands and lower parts of hills, and contained relatively few species (15–20 species). Its canopy cover is ~25–40%.

Grass community

This community consisted of 25–28 species such as *C. squarrosa*, *S. krylovii*, *Stipa sibirica*, *Agropyron cristatum*, *Leymus chinensis*, *Koeleria cristata*, *Serratula centauroides*, *Artemisia frigida*, *Potentilla acaulis*, *G. verum*, *Allium senescens*, and *A. anisopodium*, and has a canopy cover of 50–65%.

Scabrous hide seed grass (*C. squarrosa*) community

This community was found in table lands of valleys at elevations from 950 m to 1,040 m. The canopy cover was 25–50% (shrubs occupying 1–4% of the cover). This community included 18–30 species such as *A. frigida*, *S. centauroides*, *A. anisopodium*, *Allium bidentatum*, *P. turczaninovii*, *E. sinica*, *S. krylovii*, *S. sibirica*, and *C. squarrosa*.

Onion community

This community was found in the east and northeastern parts of Kherlen Toono Mountain. The *Allium* community included *A. senescens*, *A. anisopodium*, *A. bidentatum*, *Allium odorum*, *Allium tenuissimum*, and *Allium racemosum*. *A. senescens* and *A. racemosum* were common and occupied 50% of canopy covers.

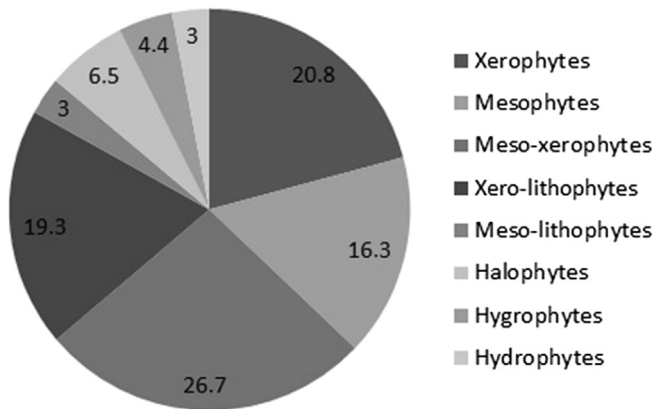


Figure 2. Vascular plant species of Kherlen Toono Mountain by their ecological groups.

Bindweed–khargana community

These steppe communities were degraded, and their species richness and vegetation cover declined. There was an increase in the dominance of *A. frigida* and *Artemisia adamsii* due to overgrazing. The Bindweed–khargana community commonly overcomes due to livestock overgrazing. The vegetation cover of this community, in general, was short.

Pasture sagebrush community

Needle grass–sagebrush community's canopy cover was 60%, with needle grass accounting for 3–5% and sagebrush 8–10%.

Adams sagebrush community

Because of overgrazing, this community was unstable, and was colonized by plants such as Adams sagebrush, annual herbaceous plants, and sedge grass.

This community was distributed over a wide range of area, and its canopy cover was 45%. Adams sagebrush covered 10% of the canopy and annual herbaceous plants covered 30%. There were ~10–15 common species such as *Carex duriuscula*, *L. chinensis*, *C. squarrosa*, and *P. acaulis*. Overgrazed pasture community consisted of annual herbaceous plants (80%) and less edible or inedible plants.

The classification of flora of the Kherlen Toono Mountain region was made according to Grubov (1982) and Gubanov (1996).

Discussion

The flora of the study area was relatively diverse because of its high elevation and habitat diversity, which included high mountain forests, taiga, steppe, desert, and meadow. The different flora in a vegetation district reflects the adjacent vegetation district's flora. Kherlen Toono Mountain is located in the steppe zone and borders with mountain steppe in north and desert steppe in south and west. Thus, a majority of flora consisted of mountain steppe, steppe, forest steppe, and desert steppe vegetation. For ecological groups, the most commonly recorded group (~40%) was meso-xerophytes and xerophytes, and the next commonly recorded group was xero-lithophytes and mesophytes, thus indicating the characteristics of the study area (Figure 2). Community structure is associated with habitat location and its biotic and abiotic factors. Forb, khargana, and needle grass–forb communities were commonly reported in the study area, indicating dry steppe characteristics (Tuvshintogtokh 2014). Vegetation cover was mainly shrub, undershrub, annual, and biennial herbaceous plant species of mountain steppe and steppe.

Forb community (canopy cover: 45–65%) mainly occurred on mountain slope, trench, ditch, riparian zone; khargana community (canopy cover: 20–55%, with 20–40% being khargana) occurred on sandy mountain slope; needle-grass community (canopy cover: 30–45%, with 25–30 species) occurred on hill tops, rocky slopes of the mountain; and shrub community occurred on slopes and trenches of Kherlen Toono Mountain. The commonly recorded species were *S. aquilegifolia*, *A. pedunculata*, *U. pumila*, *P. fruticosa*, and *A. gmelinii*. The commonly recorded herbaceous plants were *A. angustifolium*, *A. divaricatum*, *P. turczaninonii*, *P. bungei*, *T. minus*, and *F. sibiricum*.

Scabrous hide seed grass community (canopy cover 25–50%) was common in open plain steppe and table lands between mountains. *A. frigida*, *S. centauroides*, *A. anisopodium*, *A. bidentatum*, *P. turczaninonii*, *E. sinica*, *S. krylovii*, and *S. sibirica* were commonly reported in the community.

This study period was short, but we were able to document many plant species and perform visual assessment of vegetation cover in the study area. The study provides baseline information about the vegetation pattern of this area for future studies and management. In the future, additional sampling is required to create a vegetation map of this area.

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