Research paper

Folk nomenclature of plants in *Cistanche deserticola*-associated community in South Gobi, Mongolia

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A R T I C L E   I N F O

Article history:
Received 20 April 2020
Received in revised form 20 August 2020
Accepted 26 September 2020
Available online 6 October 2020

Keywords:
*Cistanche deserticola*
Plant community
Ethnobotany
Folk nomenclature
Conservation strategy
South gobi of Mongolia

A B S T R A C T

*Cistanche deserticola* is an important medicinal plant in Mongolia. Despite its significant role in local healing systems, little traditional knowledge had been reported. The present study investigated folk names of *C. deserticola* and other species of the same community in Umnugobi Province, South Gobi region of Mongolia, based on ethnobotanical approaches. The high correspondence between folk names and scientific names of plant species occurring in *Cistanche*-associated community shows the scientific meaning of folk nomenclature and classification in Mongolia. The Mongolian and folk names of plants were formed on the basis of observations and understanding of wild plants including their morphology, phenology and traditional uses as well. Results from this study will support the conservation of *C. deserticola* itself, a rare and endangered plant species listed in the Mongolian Red Data Book. Our documentation of folk nomenclature based on 96 plant species in the *Cistanche* community, as a part of traditional knowledge associated with biodiversity, will be very helpful for making strategy of plant biodiversity conservation in Mongolia.

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1. Introduction

Folk taxonomy and nomenclature are common in the world (Loko et al., 2018; Tokuoka et al., 2019). The local people use their own knowledge to name plants, animals and microorganisms (Phaka et al., 2019; Wang et al., 2020). The traditional knowledge of classification, identification and nomenclature has shown significant values in nature conservation and biodiversity uses (Turpin and Si, 2017; Ulicsni et al., 2016). Traditional knowledge (TK) associated with biodiversity covers the folk nomenclature systems, uses of bioresources available, and management of ecosystems by the local people of a given area (Khasbagan et al., 2000).

Folk nomenclature of plant species are the roots of traditional botanical knowledge (Khasbagan and Soylot, 2008; Li et al., 2013). Thus it will be impossible to hand TK down to future generations. Collection and analysis of plant folk names of the Mongolians are extremely important because of the rapid socio-economic changes and desertification of grasslands in the country. Unfortunately few investigations had been conducted to document the folk names of plants in Mongolia. On the other hand, ethnobotanical investigation in Inner Mongolia have been carried out since 1980s, including useful plants of herders (Village and Khasbagan, 2017), and folk nomenclature (Soyolt et al., 2013).

The genus *Cistanche* Hoffmg. et Link is a group of perennial parasitic herbaceous plants in the family Orobanchaceae. About 20 species had been described in the genus, with distribution in Asia and Europe (Zhang and Tzvelev, 1998). Most of their host plants are sand-binding plants such as some species in *Kalidium* Miq.,...
were included, i.e., C. salsa, C. deserticola, C. salsa, C. ningxiaensis Y. C. Ma, and C. deserticola. A Russian scientist (Zhang and Tzvelev, 1998) had recorded four species of Cistanche in Conspectus of Flora in Outer Mongolia. They are: 1) Cistanche deserticola Y. C. Ma, 2) Cistanche lanzhouensis Z.Y. Zang, 3) C. ningxiaensis D.Z. Ma et J.A. Duan, and 4) C. salsa. The taxa, C. feddenia was divided into two species (Grubov, 1982). Among all Cistanche species, C. deserticola is the most valuable and widely used for medicinal purposes in different countries.

Cistanche deserticola is mainly distributed in China (Xinjiang, Inner Mongolia, Ningxia, Gansu, and Qinghai), Iran, India and Mongolia (Wang et al., 2012). C. deserticola has its own viable green leaf and root system, and its growing organs become green in spring and orange in autumn, its orga

The local names, frequency of uses, and other values of Cistanche were gathered from the literatures. Fieldworks were conducted from April 25 to August 12, 2019. Ethnobotanical data were collected from the field investigations in five selected sites (Table 1). Fieldworks were carried out in five villages, and 38 local herders as key informants were interviewed. The informants’ age varied from 18 to 75 years old (comprising 25 males and 33 females). Key informants own rich traditional knowledge about the Cistanche including habitat of old Cistanche in saxaul forest area. They guided us to visit the saxaul forest area as well. Particular attention was paid to collect information about folk names of Cistanche (Table 1) and other species in the plant community. While noting the information, all relevant taxonomic characteristics were documented. The identification was done by consulting with an expert: botanist Battseren Munkhjargal, Department of Botany, Mongolian Academy of Sciences, and through several literature sources. The determined species were further compared with the “Key to the Vascular Plants of Mongolia” for justification of correct scientific names and author citations (Urgamal et al., 2019). All voucher specimens were deposited in the Herbarium, Mongolian Academy of Sciences.

The methods of semi-structured interviews were used in field surveys. Ethnobotanical interviews were organized in two ways: local plant specimens were collected beforehand and then interviews were organized; and local herders were invited to the field and were interviewed. Mongolian was used as the working language, and findings were recorded in Mongolian. Folk names of plants were confirmed through collection and identification of voucher specimens.

2. Material and methods

2.1. The study area

The study area is in Umnugobi of Southern Gobi Desert area. Umnugobi Province of Southern Gobi Desert area (between 24°12′–26°86′ N and 98°13′–102°42′ E) (Fig. 1).

2.2. Data collection and methods

All literature related to Umnugobi Province were collected. The local names, frequency of uses, and other values of Cistanche were gathered from the literatures. Fieldworks were conducted from April 25 to August 12, 2019. Ethnobotanical data were collected from the field investigations in five selected sites (Table 1). Fieldworks were carried out in five villages, and 58 local herders as key informants were interviewed. The informants’ age varied from 18 to 75 years old (comprising 25 males and 33 females). Key informants own rich traditional knowledge about the Cistanche including habitat of old Cistanche in saxaul forest area. They guided us to visit the saxaul forest area as well. Particular attention was paid to collect information about folk names of Cistanche (Table 1) and other species in the plant community. While noting the information, all relevant taxonomic characteristics were documented. The identification was done by consulting with an expert: botanist Battseren Munkhjargal, Department of Botany, Mongolian Academy of Sciences, and through several literature sources. The determined species were further compared with the “Key to the Vascular Plants of Mongolia” for justification of correct scientific names and author citations (Urgamal et al., 2019). All voucher specimens were deposited in the Herbarium, Mongolian Academy of Sciences.

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3. Results

3.1. The Cistanche-associated community

Based on the identification results of specimens collected from the Cistanche-associated community, the folk names of all plants corresponded with 96 species which belong to 26 families and 71 genera. Most species were confirmed as recorded by Ulziykhutag (1985) and Urgamal (2018). Some literatures did not report extensive research on species components of Mongolian saxaul forest, such as Gal (1972) who had given an overview of their work (Gal, 1972). The saxaul forest range is considered to be an independent region of the Asian desert. Its components are mostly from Asteraceae, Amaranthaceae, Zygophyllaceae, Poaceae, and other xerophytes, halophytes, gypsophiles and psamophytes.

The most dominant species in the Cistanche-associated community are Peganum nigelastrium, Salsoila collina, Aristida heymannii, and Agriophyllum pungens, and co-dominants are Salsola passerine, Anabasis saba, Calligonum mongolicum, Nitraria sibirica, and Stipa gobica in the saxaul forest (Fig. 2) (Table 2). Some photos of additional plants in the Cistanche-associated community may be available in the supplementary material (Fig. S1).

The scientific names, Mongolian names and folk names were presented, alphabetically listed by family, genus, and species name spellings. The confirmation of some species was mainly based on publications of Grubov (2001), Gubanov (1996), Urgamal et al. (2017).
Fig. 1. Study areas in Umnugobi Province shown sample sites.

Table 1
Information of case sites for ethnomedicinal investigation of Cistanche deserticola and associated plant community in South Gobi, Mongolia.

| No. | City           | Site                                      | Longitude   | Latitude    |
|-----|----------------|-------------------------------------------|-------------|-------------|
| 1   | Bayandalai Soum| Zuun Bukht, Zuramta Mountain, saxaul forest| 103°17'15.7" | 42°56'13"  |
| 2   | Bayandalai Soum| Zuun Bukht, Zuramta Mountain, Ephedra steppe| 103°16'39.9" | 42°57'15"  |
| 3   | Bayandalai Soum| Naran Bag                                  | 103°14'12.5" | 42°57'03"  |
| 4   | Gurvantes Soum | North part of Jaran Sand, saxaul forest    | 101°55'36.6" | 43°22'37"  |
| 5   | Bulgan Soum    | Tevsh Mountain, saxaul forest              | 103°28'57.5" | 44°14'50"  |

Fig. 2. Cistanche deserticola—associated communities.

Table 2
Life form of dominant and subdominant species in the Cistanche community.

| Life form                  | Habit                  | Species                                                                 |
|----------------------------|------------------------|-------------------------------------------------------------------------|
| Eucerophytes, halophytes, gypsites | Shrub                  | Calligonum mongolicum, Atriplex pungens, Zygophyllum xanthoxylon, Tamarix ramosissima, Nitraria sibirica, Nitraria roborovskii, Anabasis aphylla, Anabasis eriopoda, Eurotia ceratooides, Eurotia ewersmanniana, Artemisia xerophytica, Convolvulus gortschokovii, Ephedra przewalskii, Salsola ikonnikovii, Salsola passerine, Sympegma regelii, Kalidium cuspidatum, Kalidium flatum, Kalidium gracile, Caragana microphylla. |
|                           | Subshrubs              |                                                                           |
| Mesoxero-galophyte        | Biennial and annual herbaceous plants | Chensneya mongolica, Artemisia gobica, Lastagrostis splendens, Chloris virgata, Pappophorum boreale, Aristida ascensionis, Setaria viridis, Cleistogenes muticus, Eragrostis, Elymus ginganteus, Asparagus gobicum, Rheum nanum, Chenopodium acuminatum, Echinopsilum divaricatum, Corispermum mongolicum, Agropyrrhum gobicum, Sueda corniculata, Salsola ikonnikovii, Halogoton glomeratus, Halogoton arachnoideus |
3.2. Folk names of plants in Cistanche-associated community

The vascular plants of Cistanche-associated community were listed in Table 3 according to the most recent Angiosperm Phylogeny Group (APG IV, 2016) and other research results. We compared Mongolian names with folk names about all species in Cistanche community, and showed different naming systems by morphology, original places and traditional uses of the recorded plants (Table 3).

As shown in Table 3, the plants recorded from the Cistanche-associated community are mostly perennial herbaceous with 72 species, accounting for 75% of the total number of plants. Annual herbaceous plants of 24 species occupy 25%. There are 11 species of shrubs in the community, occupying 11.5%.

Mongolians have rich and unique traditional knowledge because of their long-term survival in the pasturelands and desert areas. The local people in South Gobi named wild plants based on their traditional knowledge (Fig. 3).

The plant names mostly presented the information of plants. A comparison of meanings of plant names in the Cistanche community was shown in Fig. 3. The plant names in Cistanche community could be divided into five categories including morphology, original place, author name, color, and sensory character. In the scientific names of plants, the category of morphological characteristics constituted the highest proportion represented by 36 species (37.5%), while there were 15 species (15.6%) named in memory of authors and authority botanists or other people, 13 (13.5%) for color, 27 (28.1%) for original place, and 5 (5.2%) for sensory character. In Mongolian names, species named by morphological characteristics reached 38 species (39.6%), original place was 26 (27.1%), author name was 14 (14.6%), color was 13 (13.5%), and sensory character was 5 (5.2%). According to these data, the scientific and Mongolian names are not significantly different in five categories. That means the Mongolian names and scientific names are very similar by using all of categories as translated into Mongolian language.

The folk names indicated that meanings of plants were ranked by morphological characteristics (42.7%), color (22.9%), and sensory character (11.5%). The author names was 14 (14.6%), the same as that of scientific and Mongolian names. But the original place (27.1%) was quite different from other categories in folk names. In scientific nomenclature, the morphological characteristics of a plant is usually used to name the species. The original place names revealed the origins of plants, the first sites to collect specimens or their growing environment, such as Mongolia, Zungar Gobi, Sibiri, Tataar, Soutern Gobi, borderland, dryland and marsh, and others. Some plants were named in memory of the botanists’ names who firstly discovered the plants. This category is almost equal in scientific, Mongolian and folk names. For example, Amman, Bunge, Gmelin, Grubov, Potanin, Regel, Rozov, Yunatov and other botanists or authors had been used to name the plants. Scientifically the Latin names are used as classifying or identifying specific plants. The name of a plant is also given by the color of flowers, or stem, or leaves which have golden, brown, grey, green, pearl grey, yellow, white, stain or other colors. The meanings of names related to sensory characters have been identified as edible, salty, poisonous, tasteless, stinky or oily, which reflected the local people’s traditional knowledge about these plants.

3.3. Folk nomenclature of Cistanche deserticola

Six folk names of Cistanche deserticola were recorded (Table 4). The plant grows in two forms: red and white. The white one is called “Tsoliin Argamjin tsetseg” and plays a key role in maintaining the local Gobi ecosystem.

Tsoilli Argamjin tsetseg is the Mongolian name for Cistanche deserticola. Because it mainly grows on the roots of Haloxylon ammodendron, and the name comes from the Mongolian which means tethering animals in the desert. Another possibility is because it grows on sand dunes like a rope made of animal’s hair. Under the species level of Tsoilli Argamjin tsetseg, six folk names were used. This species in South Gobi has been called “goyo” for a long history (Ligaa et al., 2006; Khurelchuluun et al., 2007). Therefore, “goyo” appeared in five names.

The only exception is Tatigshamo (Ts. "Tsöö tshin gšmo") (No. 5) which is a Tibetan name. The Gobi region was rich in Cistanche deserticola. Since ancient times it has been used as Tibetan medicine to treat many diseases. In South Gobi, the Tibetan medicine is still commonly adopted by the indigenous people, and the local healers and herdsmen call medicinal C. deserticola as Tatigshamo.

Goyohoi (No. 6) is a folk name for a type of Cistanche deserticola. It refers to the C. deserticola with small size but beautiful flower. Goyohoi is very rarely occurred. Other four folk names (No. 1–4: Tsagaan goyo, Zerleg goyo, and Suman goyo) are related to the principal growth stage and development of C. deserticola. The explanations are shown in Fig. 4.

Suman goyo (Bullet goyo): It is probably because it protrudes from the ground, like a shotgun’s bullet. At the bud flower and spike inflorescences stage (Zhang and Tzvelev, 1998) of Cistanche deserticola, it is 50–150 (sometimes 250) cm high, with stem rounded, diameter 8 (~20) cm, opposite scales, with wide scaly apex, dense surface yellowish or pale yellow, bluish-brown after flowering it becomes colored. The lower part of the stem, which is located at the base of the stem, is coarse, with a cylindrical shape. The scales are often blunt. It resembles like shotgun’s bullet form.

Tsagaan goyo (White goyo): The flowering stage starts in early or mid-May (Fig. 3), with year to year variations. During the flowering stage, some small fleshy buds may also form at the top of each side axis of the inflorescence and at the base of each fleshy group. Inflorescences with drooping flowers begin to bloom from about May 1, and full bloom occurs on May 15–20, and from then on.

Zerleg goyo (Wild goyo): In Mongolia, this type is rarely found. Some plants that do not bloom in the spring will bloom in the fall (September–October) when the moisture content is higher. But they will often fail to produce fruits.

Toson goyo (Oil goyo): Stage of end blooming and fructuation of Cistanche deserticola is more useful. When the flowering phase is over and the plants are mowing, the resinous liquid is released from the plant. Apart from the fact that the people called resinous liquid as oil, it was also named after the name of the land because of the widespread distribution of the place Tos and Toson Bumba in Umnugobi Province.

We found six developmental stages of Cistanche deserticola: bud flower, inflorescence emergence, full flowering, end blooming, senescence and beginning of dormancy. The local people named four flowering stages with different names. It is useful that the growth cycle of C. deserticola was differed by folk names in southern Mongolia.

3.4. Folk usage and conservation of Cistanche deserticola

The informants reported that the Gobi bear eats a little of Cistanche deserticola during the flowering period, and after flowering. The local people has used it to strengthen valetudinarian animals. C. deserticola has been used in traditional Mongolian medicine to heal wounds and stomach aches of children. C. deserticola has been used in combination with fluoride for headaches, jaundice, and stomach cramps due to its ability to suppress jaundice and digestion.
| Family                  | Scientific name                                                                 | Mongolian name            | Folk name          |
|------------------------|---------------------------------------------------------------------------------|----------------------------|--------------------|
| Amaranthaceae          | Agriophyllum pungens (Vahl.) Link                                                | Shuvuurt tulshir           | Derveen tulshir    |
| Amaranthaceae          | Anabasis brevifolia C. A. Mey.                                                   |                           |                    |
| Amaranthaceae          | Anxiplex sibirica L.                                                             | Sibiri shornoi             | Gagadai, Luuli     |
| Amaranthaceae          | Bussia dasypalla (Fisch. et Mey.)                                                | Usleg manan-hamhang        | Ust hamhang        |
| Amaranthaceae          | Chenopodium acuminatum Wild.                                                     | Shorgor luuli              | Sharlan luuli      |
| Amaranthaceae          | Corispermum mongolicum Iljin                                                    | Mongol hamhuul             | Horon hamhub       |
| Amaranthaceae          | Eruota ceroides (L.) C. A. Mey.                                                  | Orog teseg                 | Tsomsntsoi teseg   |
| Amaranthaceae          | Haloxylon ammodendron (C. A. Mey.) Bunge                                         | Zag                        | Tsagayn zag        |
| Amaranthaceae          | Halorectum glomeratus (Bieb.)                                                    | Bag hush-hamhang           | Hush-hamhang       |
| Amaranthaceae          | Kalidium foliulion (Pall.) Moq.                                                   | Nurchivghash sadargana     | Udar shar, Shar budgana |
| Amaranthaceae          | K. gracie Fenzl                                                                  | Goolig badargana           | Shar mod           |
| Amaranthaceae          | Salosa passerina Bunge                                                           | Bor budgana                | Tson budgana       |
| Amaranthaceae          | S. pestfera Hels.                                                                | Urgust budgana             | Urgus hamhuul      |
| Amaranthaceae          | Sympegma Regelii Bunge                                                           | Regelin shar mod           | Shar mod           |
| Amaryllidaceae         | Allium mongolicum Regel                                                         | Total                   |                    |
| Amaryllidaceae         | A. anisopodium Ldb.                                                             | Morin sharili              | Morin sharjil      |
| Amaryllidaceae         | A. polyrhizum Turcz. ex Regel                                                    | Taana                      | Taana              |
| Apioaceae              | Ferula bungeania Kitag.                                                          | Bungin havrag              | Havrag             |
| Asclepiadaceae         | Vinsetoecic sibericum (L.) Decne                                                  | Sibiri erundgun            | Temeen hulh       |
| Asparagus              | Asparagus gobicus Ivanova ex Grub.                                               | Govin bereen nud           | Hereen nud         |
| Asteraceae             | Ajania frutculosa (Ldb.) Poljak.                                                 | Sugsun borozol             | Bortaari           |
| Asteraceae             | Artemisia pectinata Pall.                                                        | Shulhii sharili            | Uher shulhii       |
| Asteraceae             | A. intricata Franch.                                                             | Orolodoo sharili           | Bor tulug          |
| Asteraceae             | A. anethifolia Web. et Stechm.                                                   | Bojnoq sharili             | Bojnoq sharjil     |
| Asteraceae             | A. scopuloid Waldst. et.Kit.                                                     | Yamaan sharjil             | Yamaan sharjil     |
| Asteraceae             | A. xerophylica Krasch.                                                           | Huuraisag sharili          | Bor shavag         |
| Asteraceae             | A. annul L.                                                                      | Morin sharili              | Morin sharjil      |
| Asteraceae             | A. xanthochroa Krasch.                                                           | Shar sharjil               | Shar shavag        |
| Asteraceae             | Asterhostachmus centralis-asiaticus Novopokr.                                    | Tov azin lavai             | Bor lavai          |
| Bignoniaceae           | Incarvillea potania Batal.                                                       | Govin tsoi                  | Umbii tulee        |
| Bromeliaceae           | Cnarrinia disoidae (Ldb.) Poljak.                                                | Zeerentsseg altan tovch    | Altan tovch        |
| Cactaceae              | Echinopsis gmelinii Turcz.                                                        | Gmeliniin taijin jins      | Aduun urul         |
| Cactaceae              | Heteropappus altaicus (Wildil.) Novopokr.                                        | Altain sogzos              | Altain sogsooj     |
| Cactaceae              | Lactuca tatrica (L.) C.A. Mey.                                                   | Tatar ziraa                | Ziraa              |
| Cactaceae              | Saususul salu (Pall.) Spreng.                                                    | Martsni bandzoo            | Banzoo             |
| Cactaceae              | S. amara DC.                                                                    | Gashuu bandzoo             | Gaziin huu         |
| Cactaceae              | Scorzonera divaricata Turcz.                                                     | Dereyer havishana          | Sutu uvs           |
| Cactaceae              | S. capiti. Maximo.                                                               | Danhar havishana           | Hurgan chib        |
| Cactaceae              | Taraxacum lanuginatum (Ldb.) Ldb.                                                 | Tsagayn tseetseg bagvahai  | Bagvaahat          |
| Convolvulaceae         | Convolvulus ammian Desr.                                                         | Toblot bereemmeg           | Bor elgene         |
| Cynomoraceae           | C. gortschakovi Schrenk                                                          | Gorchakoviin sderengene    | Shar sderengene    |
| Cynomoraceae           | Cynomorium songaricum Rupr.                                                      | Zuungaririn goyo           | Ulan goyo          |
| Ephedraceae            | Ephedra sinica Stapf                                                             | Nagdii zergene             | Zeergene           |
| Ephedraceae            | E. monopera S. G. Gonel. ex C. A. Mey.                                           | Yamaa zergene              | Yamaa zegeren      |
| Ephedraceae            | Euphorbia humifusa Schlecht                                                      | Naheelg suut uvs           | Sutu uvs           |
| Ephedraceae            | Euphorbia pungens Bunge                                                          | Huvisanghie hunchir        | Horon hunchir      |
| Fabaceae               | Astragalus variabilis Bunge ex Maxim.                                            | Potaninii ulan tuulam      | Tsagaan balgay     |
| Fabaceae               | A. junolivi Sancz.                                                               | Tolbot bereemeg             | Bor elgene         |
| Fabaceae               | A. grubovi Sancz.                                                                | Yunitsiin tuvch             | Yunitsiin urovch   |
| Fabaceae               | A. monophyllus Bge.                                                              | Gants navchit hunchir      | Gantsnavchitsu hunchir |
| Fabaceae               | A. laguirodes. Paller.                                                           | Tsuulain hunchir           | Bujin hunchir      |
| Fabaceae               | Chesneya monglica Maxim.                                                         | Mongol buurtaga             | Buurtsgana         |
| Fabaceae               | Caragea leucophoile Pojark.                                                      | Altan hargara              | Ulan hargana Altargana |
| Fabaceae               | Oxytropis aciphyllus Ledeb.                                                      | Urgut ortuuz               | Ortunaa            |
| Fabaceae               | Erodium stephanium Wild.                                                         | Stepanii zaan tavg         | Zaan tavg          |
| Geraniaceae            | E. tibetanum Edgew.                                                              | Tuvd zaan tavg              | Hereen hooshu      |
| Geraniaceae            | Iris tenusulit Pall.                                                             | Nairi tsalghid             | Tsulbuer uvs       |
| Geraniaceae            | L. lacte Pall.                                                                   | Tsagailin tuvch             | Hos hartsh tsalghad |
| Lamiaceae              | Lagochilus illicifolius Bunge                                                    | Yamaan angalzur             | Tsarsnechat angalzur |
| Lamiaceae              | Panzhera latonot (L.) Bun ge                                                    | Ushii noholin             | Temene angalzur    |
| Orobanchaceae          | Cistanche deserticola Y. C. Ma                                                   | Argamjin tileeg            | Tsagaan gyooy      |
| Plantaginaceae         | Plantago minuta Pall.                                                            | Baga tuvan salaa           | Ulan tuvala       |
| Plumbaginaceae         | Limonium aureum (L.) Hill et Ktze.                                                | Altan bereemeg             | Shar bermeeg        |
| Plumbaginaceae         | L. tenuilium (Turcz.) Ktze.                                                      | Tuyajan bereemeg            | Tuyajan bermeeg     |
| Poaceae                | Aristida hynnaminii Regal                                                        | Gimmanuii budiui           | Nogelh shinee       |
| Poaceae                | Artemisia sorgoorgica (Roshev.) Ohliwi                                           | Zuungaririn hazer uvs      | Sorgii hazer uvs   |
| Poaceae                | Enneapagon desvavasii P.Beauv.                                                   | Umlairdi oggotiin suul      | Hurgaj, Buddnur     |
| Poaceae                | Eryngos minor Host.                                                              | Baga hurtajl                | Budnneen ur        |
| Poaceae                | Leymus pabious (Claus) Pilg.                                                     | Paboini Tsagaan suli        | Suli               |
In traditional Mongolian medicine, the healing properties of white goyo and red goyo are considered to be similar, and they are also called "oil goyo". It has been a leading fitness medicine for many years and used in traditional medicine. In particular, *C. deserticola* is regarded as one of the best herbal medicines to treat some diseases such as male premature ejaculation and ejaculation, infertility in women, cold back pain, and anemia.

It is common to sink the fleshy stems of *Cistanche deserticola* in alcohol at about 40% in local societies. The dried *C. deserticola* plants are also used for medicinal purposes. Other uses had not been reported.

*Cistanche deserticola* has, unfortunately, become endangered due to various reasons. The major factors to threat *C. deserticola* are destruction of saxaul forest, overharvest because of increasing market demand, and drought resulted from global environmental change. It has been included in the Mongolian Law on Plants as a rare plant. In the 2nd edition of the "Mongolian Red Book" (1997), it was registered as a very rare and endangered plant. As the only rare...
and endangered parasitic plant species, it has been included in the 3rd edition of the “Mongolian Red Book” (2013) as an endangered species, and listed in the Mongolian Plant Red List and Conservation Plan (2012).

4. Discussion

Researches about folk nomenclature of Cistanche deserticola and other plants in the community were very rare in Mongolia and other countries. Mongolian botanists studied plant systemsatics (Ulziikhutag, 1984; Manibazar, 2000; Sanchir, 1999; Urgamal et al., 2019), especially the identification with scientific nomenclature (Banzragch and Luvsanjav, 1965). But none had studied the folk nomenclature. We documented the folk names and Mongolian names of plants in the Cistanche-associated community. In particular, folk names of C. deserticola related to plant morphology and phenology were described. The folk nomenclature for C. deserticola is very useful for people to understand this important medicinal plant, especially its different developmental stages (No. 1–4), its special form (No. 5), and its medicinal property (No. 6).

Based on our field surveys in the Gobi region, local people have a lot of traditional knowledge to recognize plant species and plant phenology by giving them different names based on morphological and ecological characteristics. Similarities exist in folk and scientific taxonomy. Some folk names for plants in our study areas are similar to those of binomial nomenclature (e.g. names for species in Artemisia).

Meanings of names with morphological characteristics showed that physical form and external structure of plants (height, inflorescence, handle, roof, pony, in the shower, or thorns). Additionally, the meanings of folk names contained morphological, color and sensory characters of plants, but only a few original places were recorded because the herders live usually in an area smaller than the plant distribution range. The meaning of name with color is dominant in folk names compared with the other two-name categories (scientific and Mongolian names). The local people mostly named plants by colors of plant parts (leaves, stems, flowers and others). To compare with scientific and Mongolian names, the folk names with sensory characters are used very often for the plants in Cistanche-associated community. As the locals do not know the scientific or even Mongolian names, they named plants by sensory characters based on their traditional uses. Therefore, they prefer to give names to plants followed sensory characteristics. There are many cases when the names of different species of plants overlap, and due to this, it is often the case that non-medicinal plants of the same name are wrongly used. For example, two names, red goyo and white goyo, are called “Goyo” under the same folk name, but the scientific names are different. That is, red goyo is for Cynomorium songaricum Rupr., while white goyo is for Cistanche deserticola.

In some cases, there are several different species of plants under the same name (Ligaa et al., 2005). That is, an ethnospecies is much bigger than a natural species. Researchers in Inner Mongolia have noted that the folk names of plants are based on observations and understanding of the wild plants that grow in their desert environment (Khasbagan et al., 2000; Khasbagan and Soyolt, 2008), and that the high correlation between folk names and scientific names reflects the scientific meaning of folk botanical names and classifications (Ligaa et al., 2005). Complex primary names consist of two Mongol words. Some complex primary names include a word which indicates the life form. Caragana spinosa grows taller for camels, Caragana pygmaea is short for goats, and Caragana leucophloea is known for its golden stems. In Umnugobi Province, we also found similar names used by the local herders.

Our paper provided a comprehensive list of plants associated with Cistanche deserticola in South Gobi of Mongolia. Information presented in this study, especially the host plants of C. deserticola, would be valuable to understand this important plant community. Then conservation strategies may be made to effectively protect the rare and endangered species, C. deserticola, and the plant community as a whole.

The folk nomenclature of plants was formed gradually based on the local people’s knowledge about plants and their ecological environments. It not only reflects how people describe a plant “species” and its natural ecosystem, but also relates it to its traditional uses. A recent study revealed that local people understood the habitat difference of different ethn-taxa of Acorus (Cheng et al., 2020). In the present study, there is also rich ethnoecological information in the Cistanche deserticola-associated community. The morphological and ecological features of plants are the most frequently used terms in the folk nomenclature. The
ethnobotanical implication of folk nomenclature is valuable for understanding the plant community and conserving plant diversity in Umnugobi Province, and other parts of Mongolia.

As a part of traditional botanical knowledge, the folk names of plants in the *Cistanche* community implied local people’s wisdoms. The nomenclature was mostly originated from their morphological, color and sensory characters, or uses. The local people understand the relationships between *C. deserticola* and its associated species. It is essential to document such traditional knowledge associated with plant biodiversity. Thus, biodiversity conservation, taking its associated traditional knowledge as a whole, will be well-implemented according to the Convention on Biological Diversity.

5. Conclusion

In this study, we recorded six folk names for *C. deserticola* in Umnugobi Province, South Gobi of Mongolia. Six developmental stages of *C. deserticola* (bud flower, inflorescence emergence, flowering, end blooming, senescence and beginning of dormancy) were found. The local herdsmen in southern Mongolia named four flowering stages with different folk names.

We recorded 96 species in 26 families and 71 genera from the *Cistanche* community in Umnugobi Province. These plants have been named by morphological characteristics, original place, name in memory of botanist or author, color of plant part, and traditional uses in southern Mongolia. There are some similarities between folk and binominal nomenclature, according to our case study. Many folk names in Umnugobi Province are from the colors of plant parts, i.e. leaves, stems, flowers, fruits, and others. The sensory character has commonly used to name plants in the *Cistanche* community.

Our study provided essential information for biodiversity conservation through documentation of traditional knowledge including folk nomenclature. Conservation strategy will be proposed to protect *C. deserticola* and other species in the plant community in South Gobi of Mongolia.

Author contributions

Conceptualization, C.L., and A.B.; methodology, C.L. and U.M.; investigation, U.M., D.G., T.A., Z.A.; data analysis, U.M., Z.A., T.A., D.G. and M.B.; writing—original draft preparation, U.M. and T.A.; writing—review and editing, C.L.; supervision, C.L.; project administration, A.B., C.L. and U.M.; funding acquisition, C.L., and A.B. All authors have read and agreed to the published version of the manuscript.

Declaration of competing interest

The authors declare that there is no conflict of interest.

Acknowledgements

This research was supported by the National Natural Science Foundation of China (31761143001, 31870316), the Ministry of Ecology and Environment of China (2019YFC0510006), the Ministry of Education and Environment of China (2019ZD03001006), the Ministry of Education and Environment of China (308044), the Ministry of Education and Environment of China (308044). Colleagues and Dr. Bayartungalag from the institute of Geography and Geocology, Mongolian Academy of Sciences provided assistances in the field surveys. Yingjie Song at Minzu University of China provided useful comments. We are grateful to all of them.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pld.2020.09.008.

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