Traditional utilization and management of wild *Allium* plants in Inner Mongolia

Zhijie Ma, Rainer W. Bussmann, Huajie He, Nan Cui, Qinghui Wang, Ziyan Xu, Bo Liu*

Research

Abstract

Background

In Inner Mongolia, *Allium* plants are rich in variety and widely distributed. Concentrated and distributed in a contiguous manner, they play an important role in the ecology of grasslands and forests. In addition, Inner Mongolia *Allium* species have a high utilization value. The Mongolian people have accumulated rich traditional knowledge of the on the uses of *Allium*, including food, forage, medicine and culture. At present, unreasonable use of *Allium* resources has led to decline in population. Therefore, this study was conceived to understand the local people's traditional utilization methods and management of *Allium* plants.

Methods

This research mainly uses literature research, key person interviews, semi-structured interviews, field surveys, data collection and catalog analysis.

Results

In this paper, 38 species of *Allium* plants distributed in Inner Mongolia were sorted out, and their Chinese names, scientific names, Mongolian names and parts used were catalogued. The Mongolian people in Inner Mongolia are rich in knowledge about the edible, medicinal, forage, and cultural utilization of *Allium* plants.

Conclusion

Mongolian people in Inner Mongolia have a variety of traditional uses for wild *Allium* plants. However, at present, these species gradually decreasing and related traditional knowledge is being lost. The article puts forward three related suggestions: (1) Pay attention to the conservation of wild *Allium* plants. (2) The traditional knowledge related to the use and ecology of *Allium* plants needs to be documented, preserved, and promoted. (3) To promote awareness on the importance of Mongolian culture.

Keywords: Inner Mongolia, *Allium*, Traditional knowledge.

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摘要

背景：内蒙古地区葱属植物的种类丰富、分布广泛，它往往集中连片地分布，所以对草原、森林的生态环境保护有重要意义。另外，葱属植物有很高的利用价值，蒙古族在经营草原游牧经济的历史过程中不断积累了认识和利用葱属植物资源的传统知识，包括传统的食用、饲用、药用、文化用知识。目前，由于人类不合理利用葱属植物资源，导致了其资源与植被的严重破坏。因此，为改变葱属植物资源的利用现状和合理地保护其资源，摸清当地民族对葱属植物的传统利用方法与管理。

方法：本研究主要采用文献研究、关键人物访谈、半结构式访谈、实地调查、数据整理和编目分析的方法。

结果：本文对内蒙古分布的 38 种葱属植物进行了整理，对每个物种的中文名、学名、蒙古名和利用部分进行了编目和整理。结果发现，内蒙古蒙古人民对葱属植物的食用、药用、饲用和文化利用等方面的知识很丰富。

结论：内蒙古蒙古族对野生葱属植物的传统利用方式有多样性特点。但是目前，内蒙古葱属植物资源逐渐减少，相关的传统知识正在丧失。因此本文提出了三个相关的建议：（1）重视野生葱属植物的资源保护。（2）有关野生葱属植物的资源利用和生态相关的传统知识保护需要被记录、保护和传承
（3）加强蒙古族对本民族文化的保护和传承意识。

关键词：内蒙古；葱属植物；传统利用知识

ᠬᠤᠪᠢᠯᠠᠰᠤᠨ ᠤ ᠵᠤᠪᠬᠠᠯ (Mongolian abstract)：

ᠬᠥᠭᠵᠢᠯ ᠲᠡ ᠣᠷᠣᠭᠤᠯᠬᠤ：ᠡᠮᠡᠨᠡ ᠬᠦᠮᠦᠨᠭᠡᠨ ᠤ ᠵᠢᠨᠰᠦ ᠵᠦᠢᠯ ᠪᠤᠶᠤ ᠂ᠮᠣᠩᠭᠣᠯ ᠤᠨ ᠭᠠᠵᠠᠷ ᠤᠨ ᠤᠯᠠᠭᠠᠨ ᠪᠤᠷᠤᠭᠤ ᠵᠦᠢᠯ ᠤᠨ ᠤᠯᠠᠭᠠᠨ ᠪᠤᠷᠤᠭᠤ ᠵᠦᠢᠯ ᠲᠡᠷᠡᠭᠡᠨ ᠤ ᠵᠢᠨᠰᠦ ᠵᠦᠢᠯ ᠪᠤᠶᠤ ᠂ ᠠᠮᠢᠲᠠᠨ ᠤ ᠲᠣᠭᠲᠤᠨ ᠣᠷᠴᠢᠨ ᠤ ᠪᠠᠶᠢᠭᠠᠯᠢ ᠪᠤᠶᠤ ᠂ ᠲᠡᠭᠡᠳᠡ ᠤᠯᠠᠭᠠᠨ ᠤᠰᠤ ᠤᠨ ᠭᠠᠵᠠᠷ ᠤᠨ ᠤᠰᠤ ᠵᠠᠭᠠᠰᠤ ᠪᠤᠶᠤ ᠂ ᠡᠨᠡ ᠲᠡ ᠣᠷᠣᠭᠤᠯᠬᠤ ᠵᠦᠢᠯ ᠲᠡ ᠮᠣᠩᠭᠣᠯ ᠤᠨ ᠠᠷᠠᠳ ᠤᠨ ᠤᠯᠠᠭᠠᠨ ᠪᠤᠷᠤᠭᠤ ᠵᠦᠢᠯ ᠤᠨ ᠤᠯᠠᠭᠠᠨ ᠪᠤᠷᠤᠭᠤ ᠵᠦᠢᠯ ᠲᠡᠷᠡᠭᠡᠨ ᠤ ᠵᠢᠨᠰᠦ ᠵᠦᠢᠯ

utilization of *Allium* plants over the years has led to serious damage to their population. Hence, it is important to document the local people's traditional uses of *Allium* species and their traditional management practices to better understand the mechanism of interactions between ethnic groups occupying and using the grasslands, and grassland plants. It is also of great significance for the sustainable utilization and protection of plant resources (Bao 2000; Bao 2007; Has Bagen & Pei 1999).

All species of the genus *Allium* L. are perennial herbs. The first edition of Flora of Inner Mongolia (Flora of Inner Mongolia Committee 1985), included only 27 species and 3 varieties. In 1997, Zhao studied the ecological and geographical distribution of *Allium* in Inner Mongolia and found that environments of high humidity and temperature were not conducive to the proliferation of *Allium* species, whereas, moderate humidity and temperature promoted increase in population of *Allium* species. Thus, it can be concluded that Inner Mongolia with moderate humidity and temperature would have more *Allium* species than other places in China (Zhao 1994). The Flora of China reports 34 species including both wild species and cultivars. Most species are also distributed outside Inner Mongolia, as the genus has a very wide distribution. Only *A. flavovirens* Regel is endemic to Alex league, Inner Mongolia.

In 1999, Has & Pei investigated scientific connotations of the traditional names, and uses in forage, food, medicinal and culture of *Allium* species in Inner Mongolia and discussed their protection and rational utilization in grasslands. In 2000, Bao analyzed the geographical distribution of this genus in Inner Mongolia; the results showed that the genus *Allium* was mainly distributed in the central, eastern and peripheral mountainous areas of Inner Mongolia plateau. Yang et al. (2006) elucidated the diversity of the morphological characteristics, flower organ morphology, chromosome karyotype and geographical distribution of *Allium* wild vegetables in Inner Mongolia. They also reviewed the utilization status and potential of wild vegetables in Inner Mongolia (Yang et al. 2006). Hu et al. (2007) studied the exploitation and protection of wild *Allium* resources in Inner Mongolia and proposed effective measures to expand the planting area and rational utilization of the genus *Allium* by seed propagation. The method of seed propagation can help in protecting wild *Allium* resources and natural vegetation (Hu et al. 2007).

Materials and Methods

Overview of the study area

The Inner Mongolia Autonomous Region is located in the eastern part of the Asian continent between 37°30′- 53°20′N and 97°10′- 126°02′E. It is an arc of narrow areas, from the northeast oblique to the southwest, with a total length of about 3000 km, 1.18 million km2. Inner Mongolia has characteristics of temperate continental climate. The Great Xingan and its eastern and western foothills have a moist, semi-humid climate, while the rest of the temperate plateau is semi-arid and arid. The humid areas are covered with a forest landscape, the semi-arid areas with grasslands, and the arid areas by deserts (Zhao 2009). There are 2781 plant species known from in Inner Mongolia, of which the genus *Allium* has a wide distribution with abundant species. The genus is widely distributed in mountainous areas, forest margins, undergrowth thickets and various grasslands. Only few species are dominant in their vegetation types. Thirty-eight species of *Allium* in Inner Mongolia have been recorded on the basis of a literature review (Table 1) (Has Bagen & Pei 1999; Has Bagen 2010).

Ethnobotanical Methods

This research mainly used literature research and key participant interviews for data collection. Semi-structured interviews were carried out with local people in order to document the *Allium* species, including their edible and medicinal value. A total of 47 participants, including 20 men and 27 women, most of whom were either middle-aged or young were interviewed. All interviews were conducted after obtaining oral prior informed consent of the individual participants. Surveys documented the local name, frequency of use, and other values held by informants.

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Figure1. *Allium senescens*, photo by Yi LIU and Runkuan LIU in Hexigten Banner,

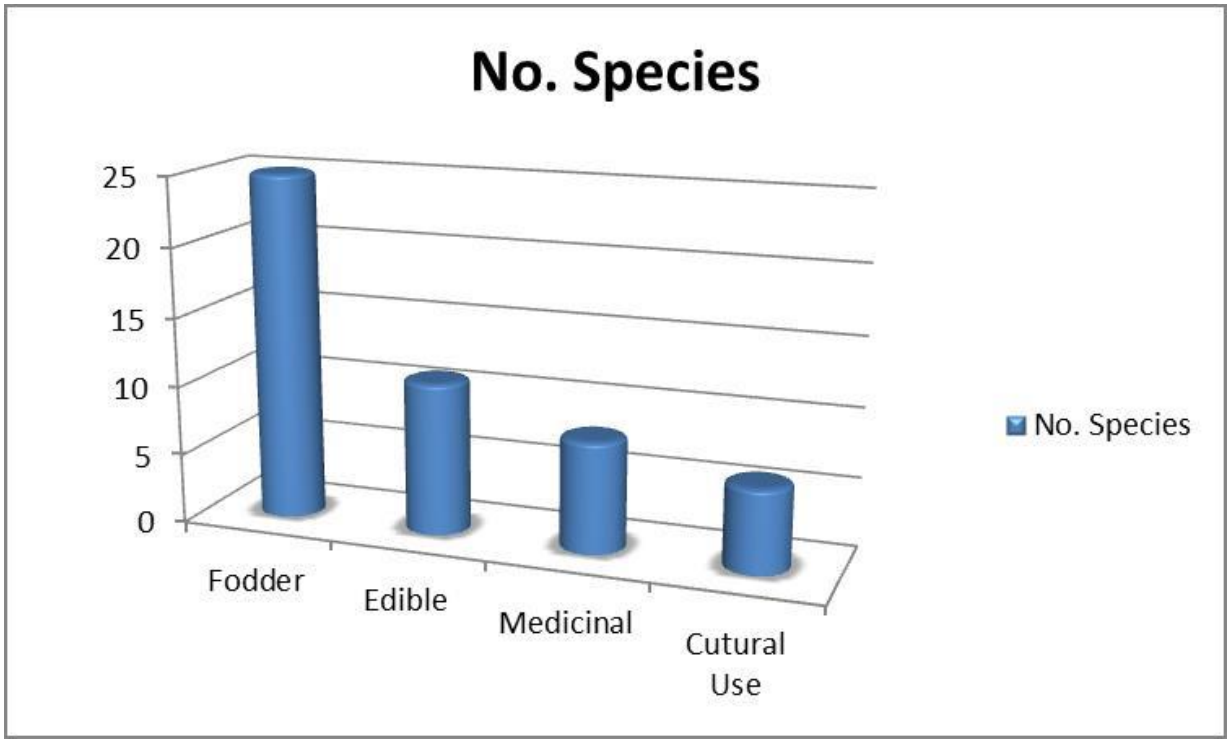

Figure 2. Traditional use categories of *Allium* by Mongolians

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Figure 3. *Allium przewalskianum* Regel （Chinese 青甘韭）

Figure 4. *Allium ramosum* L.（Chinese 野韭）

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Figure 5. *Allium mongolicum* Regel（Chinese 蒙古韭）

Figure 6. *Allium tuberosum* Rottl. ex Spreng.（Chinese 山韭）

Figure 7. *Allium tuberosum* Rottl. ex Spreng.（Chinese 山韭）

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Figure 8. *Allium schoenoprasum* L.（Chinese 北葱）

Figure 9. *Allium* schoenoprasum L.（Chinese 北葱）

Figure 10. *Allium thunbergii* G. Don（Chinese 球序韭）

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Figure 11. *Allium polyrhizum* Turcz (Chinese 碱韭)

Figure 12. *Allium moly* Turcz (Chinese 黄花葱)

Figure 13. *Allium polyrhizum* Turcz (Chinese 碱韭)

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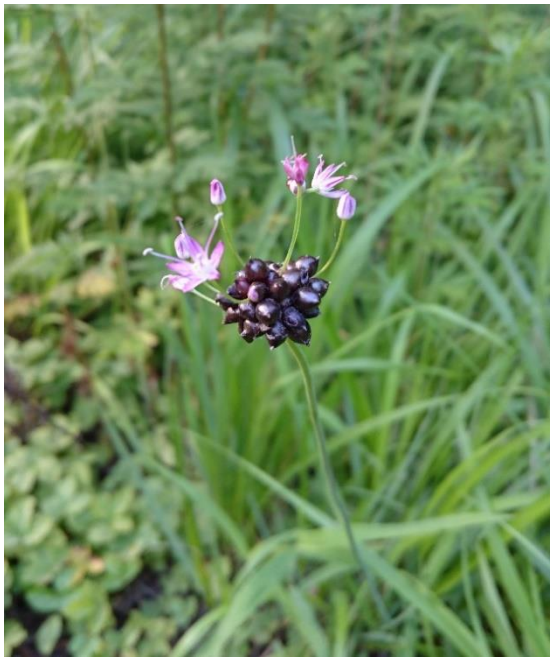

Figure 14. *Allium macrostemon* Bunge（Chinese 薤白）

Figure 15. *Allium mongolicum* Regel (Chinese 蒙古韭)

Results and Discussion

Ethnobotanical Inventory of *Allium* in Inner Mongolia

The literature research and interviews yielded 38 species of *Allium* in Inner Mongolia. Table 1 lists the Chinese names, scientific names, Mongolian names, and utilization sites of *Allium* plants involved in this study (Ma 1997). Figures 3-15 show some of the *Allium* plants collected during the field survey, sorted in order of *A. przewalskianum* Regel, *A. ramosum* L., *A. mongolicum* Regel, *A. tuberosum* Rottl. ex Spreng., *A. thunbergii* G. Don, *A. schoenoprasum* L., *A. polyrhizum* Turcz, *A. moly* Turcz., *A. macrostemon* Bunge.

Traditional utilization and management of *Allium*

Allium is a group of wild plant species that Mongolians have known, named and used for centuries. Inner Mongolia Mongolian people have a variety of ways to use wild *Allium* plants. Literature mainly cites uses for food, medicinal, forage, and cultural utilization. As shown in Fig. 2, 25 species of *Allium* in Inner Mongolia are used as fodder, 11 species for food, eight for medicine, and six for cultural purposes.

Use of forage

The genus is also a forage plant used for grazing by nomadic ethnic groups since ancient times. In Inner Mongolia, the genus serves as an excellent fodder plant. The genus has high crude protein and coarse fat which makes it a high quality forage feed. In the study of forage resources, most species of the genus *Allium* are considered as fat forage. In Mongolian folk classification of grassland, the growth of *Allium* species is very important to judge the quality of grassland. In autumn, herders choose to move their herds to grazing grounds with *Allium* species to fatten the sheep, which is one of the traditional methods of Mongolian use of grassland. Herdsmen believe that sheep fed with *Allium* gain weight quickly, and the meat is delicious with desirable flavor. This traditional knowledge has an important role in promoting the development of Mongolian animal husbandry; their knowledge and experience of grazing value of *Allium* species are consistent with the grassland evaluation of modern science.

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Table 1. Ethnographic inventory of *Allium* species Used by Mongolians

Chinese names	Scientific names	Mongolian names	Part used
鄂尔多斯韭	*A. alabasicum* Y. Z. Zhao	ᠬᠣᠷᠢᠨ ᠰᠤᠮᠤᠨ᠋	young leaves
阿尔泰葱	*A. altaicum* Pall.	ᠠᠯᠲᠠᠢ ᠰᠤᠮᠤᠨ᠋	leaves
糙萼韭	*A. anisopodium* var. *zimmermannianum* (Gilg) F. T. Wang et Tang	ᠬᠡᠭᠡᠷ ᠭᠠᠵᠠᠷ	young leaves
矮韭	*A. anisopodium* Ledeb.	ᠨᠠᠷᠢᠨ ᠬᠡᠭᠡᠷ ᠭᠠᠵᠠᠷ	leaves
砂韭	*A. bidentatum* Fisch. ex Prokh. & Ikonn.-Gal.	ᠬᠠᠯᠢᠭᠤᠨ ᠥᠩᠭᠡ᠋	young leaves
镰叶韭*	*A. carolinianum* DC.*	ᠬᠤᠭᠤᠷ ᠨᠤᠭᠠᠲᠤ ᠨᠢᠭᠤᠯᠠᠭᠠ	young leaves
洋葱*	*A. cepa L.*	ᠲᠣᠭᠣᠰ ᠰᠤᠮᠤᠨ᠋	leaves
黄花葱	*A. condensatum* Turcz.	ᠬᠢᠯᠠᠭᠠ ᠰᠤᠮᠤᠨ᠋	leaves, inflorescence
贺兰韭	*A. eduardii* Stearn	ᠪᠤᠭᠤᠰ	young leaves
阿拉善葱	*A. flavovirens* Regel	ᠠᠯᠠᠱᠠ ᠰᠤᠮᠤᠨ᠋	leaves
葱*	*A. fistulosum* L.	ᠰᠤᠮᠤᠨ᠋	leaves
硬皮葱	*A. ledebourianum* Roem.et Schult	ᠬᠠᠭᠠᠨ ᠲᠠ ᠰᠤᠮᠤᠨ᠋	leaves
白头韭	*A. leucocephalum* Turcz.	ᠴᠠᠭᠠᠨ ᠦᠨᠳᠦᠰ	young leaves
北韭	*A. lineare* L.	ᠮᠣᠩᠭᠣᠯ ᠦᠨᠳᠦᠰ	young leaves
长柱韭	*A. longistylum* Baker	ᠤᠷᠲᠤ ᠦᠨᠳᠦᠰ	bulbs, young leaves
薤白	*A. macrostemon* Bunge	ᠰᠤᠮᠤᠰᠤᠭ ، ᠮᠣᠭᠠᠢ	bulbs, young leaves
蒙古韭	*A. mongolicum* Regel	ᠪᠤᠭᠤᠰ	leaves, flower
白花蒙古韭	*A. mongolicum* Regel f. *albi* Y.Bao	ᠴᠠᠭᠠᠨ ᠪᠤᠭᠤᠰ	young leaves, inflorescences
白花长梗韭	*A. neriniflorum* (Herb.) Baker f. *albiflorum* Kitag. ex Tolgor	ᠴᠠᠭᠠᠨ ᠰᠤᠮᠤᠰᠤᠨ	bulbs, young leaves
长梗韭	*A. neriniflorum* (Herb.) Baker	ᠰᠤᠮᠤᠰᠤᠨ	bulbs, young leaves
天蒜	*A. paepalanthoides* Airy-Shaw	ᠲᠡᠩᠷᠢ ᠰᠤᠭᠤᠮ	leaves
雾灵韭	*A. plurifoliatum* var. *stenodon* (Nakai et Kitag.) J. M. Xu	ᠪᠤᠭᠤ ᠭᠠᠵᠠᠷ	young leaves
碱韭	*A. polyrhizum* Turcz.	ᠥᠩᠭᠡ᠋	leaves, inflorescences
蒙古野韭	*A. prostratum* Trevir.	ᠥᠷᠢᠨ ᠰᠤᠮᠤᠨ᠋	bulbs, young leaves
青甘韭	*A. przewalskianum* Regel	ᠰᠤᠶᠢᠯ ᠦᠨᠳᠦᠰ	young leaves, inflorescences
野韭	*A. ramosum* L.	ᠲᠠᠷᠢᠯ ᠦᠨᠳᠦᠰ	inflorescences, young leaves
蒜*	*A. sativum* L.	ᠰᠤᠭᠤᠮ	leaves
山韭	*A. senecens* L.	ᠤᠷᠭᠠ	leaves, flowers
白花山韭	*A. senescens* L. f. *albiflora* Q. S. Sun	ᠴᠠᠭᠠᠨ ᠤᠷᠭᠠ	young leaves
辉韭	*A. strictum* Schrad.	ᠰᠡᠭᠦᠷ ᠰᠤᠮᠤᠨ᠋	young leaves
纳林韭	*A. tenuissimum* L.var. *nalinicum* Sh. Chen	ᠨᠠᠷᠢᠨ ᠲᠡᠮᠳᠡᠭ	young leaves
细叶韭	*A. tenuissimum* L.	ᠲᠡᠮᠳᠡᠭ	leaves, inflorescences
球序韭	*A. thunbergii* G. Don	ᠪᠤᠮᠪᠤᠭᠤᠷ ᠰᠤᠮᠤᠨ᠋	young shoots, inflorescences
韭	*A. tuberosum* Rottb. ex Spreng.	ᠦᠨᠳᠦᠰ	young leaves, bulbs
茖葱	*A. victorialis* L.	ᠤᠯᠠᠭᠠᠨ	young leaves
白花葱	*A. yanchiense* J.M. Xu	ᠴᠠᠭᠠᠨ ᠰᠤᠮᠤᠨ᠋	young leaves, inflorescences
朝鲜薤	*Allium sacculiferum* Maxim.(Syn.:*A. yuchuanii* Y.Z. Zhao et J.Y. Chao)	ᠶᠡᠭ ᠴᠠᠭᠠᠨ ᠰᠤᠮᠤᠨ᠋	leaves

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Food use

Among the wild edible plant resources in Inner Mongolia, *Allium* species are used frequently. The whole plant contains allicin, and *Allium* is not only a delicacy, but also helps to treat bacterial disorders of the digestive tract, as it has bactericidal effects. Stem and leaf cellulose content is low in *Allium*. The plants have a soft texture, are rich in vitamins, and are especially suitable as cooking vegetables. Historic records list *Allium* as food as early as 13th century (Has Bagen 1996; Ma 1997; Zheng 2016).

Nowadays several species are commonly consumed. Our investigations found that the Mongolians in modern pastoral areas continue to use *Allium* as wild vegetables, side food or condiments. As a vegetable, it is mainly consumed as bulbs and young leaves. There are many ways to eat *Allium*, including fried, in soup, as stuffing or raw food. When frying and making soup, it is usually cooked with high-protein foods such as beef, lamb, and eggs. For stuffing, it is usually mixed with onions or scallions, along with beef and mutton. The mixture is also used for making buns, dumplings, pies and other foods. Among them, one distinctive national character is to use potatoes stuffed with *Allium* and beef jerky or fresh meat, with added *Ximidan* (cream), or add fresh milk *tofu*. Herdsmen call the final product "white buns". To eat them fresh, *Allium* plants are boiled in water and then mixed with various seasonings to form a cold dish, directly dipped in sauce, or simply eaten with some salt. Non-staple foods or condiments are the most common method to consume edible *Allium* wild plants in Inner Mongolia. They are eaten as a seasoning; the bulbs sun-dried and chopped; young leaves, inflorescences, are chopped and kneaded it into a small cake to be dried and stored to be finally used for seasoning stew, barbecue or noodle.

Allium can also be eaten with milk *tofu*. When it is eaten as a non-staple food, the bulbs, young leaves, and inflorescences are marinated in pickles (in Mongolian language called '*soris*', and '*humeli in huwar'*.) The method of pickling is to put *A. ramosum* L. in the rumen of the sheep and bury them in the ground. This is exhumed before the soil freezes in the late autumn and early winter. According to the herdsmen, the color of the wild *Allium* stored in this way is bright and green, still maintaining a strong smell of onion and garlic. The inflorescences of *A. ramosum* L. are also used to modulate the flavor of *soris*. The main method of making *soris* is to chop the collected *Allium* plants and add some salt. The herdsmen will also add the right amount of yogurt or "*Shariwusu*" according to their preferences. "*Shariwusu*" is the remaining yoghurt juice after brewing milk wine. It is eaten after one week of pickling. The herdsmen believe that the pickles are both fragrant and delicious and have the sweet and sour taste of yoghurt. They are the best dishes for guests and do not easily deteriorate and can thus be stored extensive times. '*Humeli in huwar'* is a cake made by adding yogurt to the inflorescence of dried minced *Allium* and glutinous rice or alkaline glutinous rice, which can be used as a stuffing. A widely used species is *Zama* (*A. tenuissimum* L.), whose inflorescence and seeds are used as condiments. It is also an excellent forage plant. *Zama* is widely distributed, but most popular in Central Inner Mongolia, in the Loess Plateau area. This species has very fine and narrow leaves and is extremely drought-tolerant.

Zama grows in extreme water shortage areas along cliff edges in the central and Western Inner Mongolia, northern Shanxi and Northern Shaanxi, accompanied by shrubs like *Ziziphus jujuba* var. *spinosa* (Bunge) Hu ex H. F. Chow (Bunge) Hu ex H. F. Chow, *Xanthoceras sorbifolium* Bunge, *Elaeagnus angustifolia* Linn. and *Caragana korshinskii* Kom. Associated herbs are *Medicago ruthenica* (L.) Trautv., *Achnatherum splendens* (Trin.) Nevski, *Stipa grandis* P. Smirn., *Geranium wilfordii* Maxim., *A. mongolicum* Regel, *Leymus chinensis* (Trin.) Tzvel., *Polygala tenuifolia* Willd., *Melilotus albus* Medic. ex Desr*., Glycyrrhiza uralensis* Fisch., *Artemisia frigida* Willd. *Artemisia annua* Linn., *Artemisia scoparia* Waldst. et Kit. and *Salsola collina* Pall. The flowering period of *Zama* is from May to August. Many people grow *Zama* on their courtyard walls so that they can eat fresh *Zama* flowers. Others plant it near their homes with *Achnatherum splendens* (Trin.) Nevski. *A. mongolicum* Regel is often sold as adulterant of *A. splendens.* Its onion or leek flavor is not pure, slightly stinky, and cattle and sheep do not eat it at all. Another adulterant species is *A. macrostemon* Bunge, with slightly fleshy, cylindrical leaves. People consume its bulb, but the flavour of flowers is weak.

Medicinal use

The use of wild *Allium* species by Mongolian folk in Inner Mongolia has a long tradition. Literature lists eight species of *Allium* used as medicine in Inner Mongolia (Zhu 1989). In addition to being used as medicines most species are also edible. The aboveground part of *A. mongolicum* Regel and the bulbs of *A. altaicum* Pall. are used for their appetizing, digestive and insecticidal function (Gegen Tana 2008); *A. macrostemon* Bunge bulbs can be used to treat insects, stomach cold and

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constipation. Inner Mongolia herdsmen eat *A. condensatum* Turcz. for the treatment of scurvy, caused by a lack of vitamin C, after the flowering period ends. The roots and leaves of *Allium ramosum* L. are washed, crushed and applied to trauma or swellings, and have also an haemostatic effect. If a person hiccups, a small doze of *A. ramosum* L. seeds is cooked with warm water and drunk 1-2 times a day to make it stop. When a person suffers from psoriasis, Mongols use the crushed bulbs of *A. anisopodium* Ledeb. To apply at the affected area. Mongolian farmers collect the bulbs of *A. senescens* L. in summer to eat them cooked or pickled, in order improve the blood conditions. Xilin Gol League Mongolian herdsmen use wild *Allium* to cure dysentery in livestock. Ar Horqin Qi Mongolian herdsmen let horses, sheep, and camels graze in grasslands with *A. mongolicum* Regel, *A. polyrhizum* Turcz., and *A. senescens* L. to reduce the infection of livestock with nasopharyngeal parasites (Has Bagen & Pei 2000). Inner Mongolian herders feed their sheep *A. senescens* L. to prevent digestive tract parasitic diseases. In spring when horses and sheep are extremely thin, they are fed with bulbs of *A. condensatum* Turcz. to restore their strength. When cattle seem to be poisoned, they are detoxified by grazing on meadows with *A. mongolicum* Regel or *A. polyrhizum* Turcz. (Chen & Jia 2002).

Cultural use

The genus *Allium* often appears in Mongolian poetry, that laud the richness of grasslands. *A. polyrhizum* Turcz., *A. mongolicum* Regel, and *A. senescens* L. are mentioned particularly often. *Allium* is a symbol for lush pasture. In Mongolian folk songs, the names of four kinds of *Allium* species (*A. polyrhizum* Turcz., *A. ramosum* L., *A. mongolicum* Regel and *A. senescens* L.) occur commonly. In the "Keerqin Folk song" *A. polyrhizum* Turcz., *A. ramosum* L., and *A. mongolicum* Regel are named; in the "Ordos Folk song," *A. ramosum* L. is named, in the "Mongoue Folk song," *A. ramosum* L. and *A. mongolicum* Regel, and in the "Alashan Folk song" *A. mongolicum* Regel are cited frequently. This phenomenon illustrates the correlation between regional plant culture and the local flora. Mongolian people have many taboos related to the genus *Allium*. In Inner Mongolia, there is a taboo about burning *Allium* and garlic plant bulbs, to eat food containing milk together with wild *Allium* or garlic, or eating *Allium* during pregnancy, because it is bad for children's eyes. Likewise, eating stinky garlic during pregnancy will result in body odour in the newborn (armpit odor). There is also a taboo to directly pass garlic with the hand to others close to the ground or table, because this might lead to vengeance. Women cannot eat garlic until 30 days after partum, to avoid skin diseases. A folk taboo refers to not eating *Allium* within 18 days after a vaccine shot. According to folklore, *Allium* is a plant planted by God, so one may only harvest enough to eat, which is a traditional conservation method. *A. macrostemon* Bunge with its white bulbs is called "*Tengerin Betehi*" (meaning the tumor of God), and people believe that before spring thunder they cannot eat *A. macrostemon* Bunge bulbs. Violation of this taboo will lead to the bulbs turning toxic.

Recommendations on the protection and management of *Allium* resources and associated traditional knowledge

At present, the population of *Allium* plants in Inner Mongolia are reported to be facing a sharp decline. This is directly related to grassland degradation, and the factors of grassland degradation include natural factors and human factors (Li et al. 2004). The natural climate of the Inner Mongolia region is characterized by annual droughts and strong winds, which can lead to a decline of grassland vegetation, its productivity and ecological functions. The human factors that aggravate the degradation of grassland mainly include excessive grazing, deforestation, and land reclamation. The traditional knowledge associated with the use of Mongolian *Allium* plants is getting lost along with the population. The development market economy has impacted the value of traditional knowledge, and the influence of foreign culture has led Mongolian people to gradually forget their traditional knowledge.

We propose the following suggestions to conserve and manage *Allium* resources and related traditional knowledge:

(1) Protection of wild *Allium* plants. *Allium* growing conditions in Inner Mongolia are poor, the resources are scattered, and the yield is low. Seeds should be harvested and planted in the spring, to gradually expand the area of wild resources. In addition, cultivation techniques need to be promoted in vegetable growing areas, and the economic benefits of *Allium* need to be promoted.

(2) The traditional knowledge related to the use and ecology of *Allium* plants needs to be documented, preserved, and promoted. It is necessary to establish a joint resource management approach between the government and local communities to prevent the loss of biological resources and associated traditional knowledge (Tian 2005). Through research and demonstration, the best combination of

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traditional knowledge and modern science is achieved.

(3) To strengthen the Mongolian people's awareness of the importance of their own culture. The conservation of *Allium* resources is closely related to cultural diversity, and the protection of traditional knowledge associated with *Allium* plants can directly promote the protection of *Allium* resources. On the contrary, the loss of traditional culture will also lead to the loss of plant resources (Xue 2014). Therefore, in the Mongolian region, it is necessary to promote awareness about traditional culture. This can be achieved by improving the self-confidence and pride of the Mongolian people.

Declarations

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Authors' contributions
ZJM, BL, NC, QHW were responsible for writing articles. BL translated the article into English. RWB and HJH revised the manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate
All participants were asked for their free and prior informed consent before interviews were conducted.

Competing interests
The authors declare that they have no competing interests.

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