

A Historical and Ethnozoological Study on Local Zoological Knowledge Recorded in the Book "Mongolia and Amdo and the Dead City of Khara-Khoto"

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Abstract

Background: *Mongolia and Amdo and the Dead City of Khara-Khoto* (MAKK) represents an expedition note by Pyotr Kuz'mich Kozlov (1863-1935), a famous Russian Central Asian explorer, completed after his expedition to northwestern China during 1907 and 1909. Although the record note lacks a professional adequacy on measures of zoology research, some valuable information of local knowledge on animals (MLKA) were recorded. These local knowledge provide valuable reference to the study of ethnozoology and history of science and technology among ethnic minorities in China.

Method: The current study referenced the two Russian editions of MAKK (1923 and 1948) as research materials and collated, textualized, and analyzed the MLKA records through the methods such as textual research, zoological classification, comparison, and interview. Since the MLKA is mainly concentrated in Alxa and its adjacent areas, we conducted field surveys and interviews in two separate visits during 2019 and 2020, following precisely Kozlov's exploration routes in Alxa more than a century ago. The methods including key informants interview, snowball sampling, and rational sampling were used in the interviews. By investigating evidences and analyzing the interview data of 33 key informants, our field work re-verified the MLKA in MAKK and obtained its concurrent situation in the above destinations.

Result: According to textual research, the MLKA records included in MAKK contain a description of 23 species, belonging to 14 families and 21 genera. The local knowledge mainly consists of the naming, utilization, and wildlife preservation by the Mongolian community. Corresponding relations between Mongolian folk name and scientific name are existed in "one-to-one", "multitude-to-one" and "one-to-multitude" forms. There are three types on the structures of animals' Mongolian names: simple primary name, complex primary name, and secondary name. Animals' morphological characteristics, living habits, and Mongolian traditional grazing experience are crucial naming basis. The utilization of animals by the Mongols mainly includes diet, textile, accessory, transportation, instrument, toponym, and weather forecast. Moreover, the Mongols mainly rely on folk beliefs and official decrees for wildlife protection. Field work indicates that much of this knowledge is still preserved among local folks, but some are becoming unattainable due to population aging and lesser frequent use nowadays.

Conclusion: (a) The naming methods of Mongolian for animals are of high scientific and practical value. The Mongols probably have indigenous naming rules and classifying systems for animals. (b) The MLKA possesses a multiform character and interacts with Mongolian culture. (c) Mongolian knowledge of thoughts and measures on preserving animal resources include high value culturally and practically. (d) The 100-year-old historical notes supply reliable information and meaningful historical data for the studies on ethnozoology and the history of science and technology of China's ethnic minorities, along with offering references for Mongolian Plateau's fauna and history of zoology researches.

Background

The Mongols ethnic group is a typical nomadic ethnic population that lives primarily in Central Asia's vast regions, such as the Mongolian Plateau and the Qinghai-Tibet Plateau. Through nomadic living practice, Mongolians have acquired a great abundance of knowledge and experience regarding the naming, utilization, management, and protection of wildlife.[1,2] The Mongolian local knowledge on animals (MLKA) shares a unique part of the traditional Mongolian knowledge at large, which belongs to the research domain of ethnozoology from the perspective of modern science. Despite being passing down the generations verbally and through first-hand acquisition, the knowledge has also been recorded professionally in many classics literature.[3] This conventional knowledge and experience had been considered a significant value in ethnozoology, biodiversity conservation, and the history of science and technology.[1,2,4,5]

In modern times, foreign investigators have frequently visited China, and they started making a significant contribution to the gathering of traditional Mongolian knowledge through investigative writings. However, these publications did not catch the interest of the majority of scholars to date. Along with society's continuing development and transformation, the Mongolian lifestyle had come to a drastic change from nomadic to the sedentary way of living, but behind it is a serious issue. Some zoology-related conventional knowledge starts to vanish at an alarming rate since the conditions and necessity of inheritance gradually diminishes.[6-8] From the point of ethnozoology, it is considered highly indispensable and urgent to sort out and study the literature about the inspection carried out by foreign scholars in the areas inhabited by the Mongolian.

Pyotr Kuz'mich Kozlov (Петр Кузьмич Козлов, 1863~1935, Fig.1) is a well-known Russian explorer, archaeologist, and dedicated investigator of Central Asia.[9-14] And he is renowned for the discovery of Khara-Khoto, also known as the ruins of Heishui City during the Western Xia Dynasty, located in Ejina Banner of Inner Mongolia.[15] Among seven scientific expeditions he made to China in his lifetime, the sixth visit (1907~1909) led to his discovery of Khara-Khoto.[16] In addition to excavating the ancient city, Kozlov adopted field investigation to conduct an in-depth inspection for the natural ecological environment and ethnic, social culture of Mongolia (today's Mongolia and China's Inner Mongolia) and Qinghai region. In this expedition, Kozlov documented a large list of MLKA, and he also noted professional information about zoology, including a description of the animal's living environments, habits, morphological characteristics, and other information. These contents had been primarily contained in his expedition book—Mongolia and Amdo and the Dead City of Khara-Khoto (MAKK). The book (MAKK) was published by State Geographical Literature Publishing House of the Soviet Union in 1923 (Fig.2)[17] and reprinted in 1948 (Fig.3)[18]. The book is currently available in various translated versions, including English, Italian, German, Mongolian, Chinese, and other languages.[19-22]

The Kozlov's expedition zones comprised the central and southern Mongolian plateau, the northeast Qinghai-Tibet Plateau, ranging from the desert to grassland areas in Asia's interior regions. The above locations show a complex geographical and ecological environment. The inspection region covers a large span of landscape, approximately 100°E~107°E, 34.7°N~50.3°N. (Fig.4) The Kozlov's expedition routes can be divided into three sections: (a) The expedition team headed south from Kyakhta to Gulban-saihan mountain of the Gobi Altai Mountains passing through Kulun (Ulaanbaatar now); (b) The team members climbed Gulban-saihan Mountain into Ejina Banner of Inner Mongolia. Furthermore, they followed the

Ejina River upstream from Subonur (East Juyan Lake Basin now) to the remains of the ancient city of Harahot (the Black City Ruins now). Soon after, a journey to the east, passing through Goizso (Wentugaole now), hiked along the northeast edge of Badain Jaran Desert, and ultimately reached Dingyuaning (Bayanhot now), then went on exploring Helan Mountains. After two months, Kozlov's team left Inner Mongolia along the Tengger Desert border to travel south-east; (c) Next, the expedition passed over Pingfan (Yongdeng County now), climbed the Qilian Mountains, gone up the Huangshui River until finally reached Xining. They visited Kumbum Monastery (Ta'er Lamasery now), Qinghai Lake, Guide, and Amdo Tibetan areas throughout the expedition. At last, Kozlov's journey went back over the same routes on the whole.

The Kozlov's expedition passed through the Gobi Desert in the central Mongolian plateau. The team reached the northern Tibetan side of Qinghai-Tibet Plateau, crossing the regions settled by Khalkha-Mongol and Olot Mongolian territory. The territory primarily refers to the Tushiyetu Khan Aimag and Sayinoyan tribe of Khalkha Mongolia, the Ejina Torgut tribe of the Olot Mongolia, [23]Alxa Khoshud Department,[24] along with the Khoshud Mongol regions in Gansu and Qinghai provinces.[25-31] There were many ethnic groups in Kozlov's investigation zones. It is suggested that the traditional Mongolian culture had not been influenced and infiltrated by other ethnic cultures to a significant extent (especially the Han nationality's farming culture) when Kozlov visited. Mongolians who lived in these areas had not been significantly affected by modern civilization in the early 20th century. They cling to traditional nomadic lifestyles for a long time, retaining and inheriting the relatively complete Mongolian indigenous knowledge and culture.

There had been little attention in the academic world regarding the zoological value of Kozlov's travel note. Because the book is widely considered inadequate for academic zoology research, and Kozlov's most significant accomplishment was unknown in zoology research. Also, information regarding Mongolians' understanding and utilization for animals had been quite fragmentary and occasionally mentioned along with his investigation. However, it is necessary to summarise, analyze and investigate MLKA mentioned in MAKK. Nobody has carried out the ethnozoological research in MAKK because a thorough survey was considered tremendously challenging, mainly if a continuing investigation to be conducted. Even so, the 100 years old records of Kozlov possessed a substantial academic value, namely the provision of reliable information, obtaining critical historical materials for the research of ethnozoology, and contributing a historical heritage of science and technology in China's ethnic minorities. The note records enable specific reference to investigating the Mongolian Plateau fauna, zoology history, and relevant research.

Materials And Methods

Materials

This paper took two Russian editions of MAKK (the first edition of 1923 and the second edition of 1948) as the model and selected MLKA as the research object to collate, textually research, and thorough studying. For example, Kozlov recorded the expedition's whole process and many investigation results according to their itinerary.

Investigation areas

Despite Kozlov's expedition featuring a sizeable geographical span, MLKA recorded in MAKK had mainly concentrated in Alxa and its adjacent areas. Therefore, this paper made Alxa League in the Inner Mongolia Autonomous Region of China as the central region of field investigations employing allowed conditions. We surveyed Kozlov's main roads in Alxa during 2019 and 2020 (Fig.5). We verified and compared the zoology-related contents recorded in MAKK in the form of field investigations and interviews. Additionally, to obtain more relevant investigation materials, telephone interviews were conducted with Mongolians living in Qinghai and other Inner Mongolian areas.

Methods

The first step was to compare the two Russian versions of MAKK, reorganizing the relevant information of MLKA.

On the second, the well-organized animal names and utilization information were cataloged using verification and cross-reference with books[2,24,32-39], such as Fauna Sinica[40-44], Fauna Inner Mongolia[45-49], A Checklist on the Classification and Distribution of the Birds of China (Third Edition) [50], Mongolian Orthography Dictionary (Revised Edition)[51], Russian and Chinese Zoological Vocabulary[52], and other related web sources from Zootaxonomy professional database website (ITIS, Species 2000 and CASD).

Thirdly, During the Kozlov's investigation month, we carried out along the routes of his inspection in Alxa by field investigations in 2019 and 2020, respectively. According to the records in MAKK, the interviews were conducted with the local Mongolians to further verify the accuracy of Kozlov's records and investigate the status quo of those knowledge. A total of 33 key informants participated in the interviews via selection using snowball sampling and rational sampling[53,54]. Since 7 of them are Mongolians living in Ordos, Inner Mongolia, and Qinghai, we conducted the interviews by telephone. The key informants are herders, scholars, civil servants, teachers, vendors and students, and the ages of them ranged from 26 to 76.

Results And Discussion

A total of 20 indigenous names of 18 species of animals were recorded in MAKK, along with 7 applicatory knowledge of 10 species of animals by Mongolian folks and measures regarding prevention and protection of 2 animals. The ethnozoological classification involved 23 species of animals, related to 14 families and 21 genera. The MLKA recorded by Kozlov could be summarized into three sections: Mongolian naming, utilization, and protection.

Mongolian names of animals in MAKK

One of the usual methods of recording a specific animal in MAKK was that Mongolian words were pronounced and spelled in Russian alphabet as transliteration. However, the pronunciation of the Mongolian terms of animals recorded by Kozlov was proved slightly different from the standard Mongolian pronunciation and the formal speaking due to time, dialect accent, and transliteration

deviation. Therefore, we identified, analyzed, and summarized these names and found that the Mongolian terms of animals recorded in MAKK can be summarized into the following two categories: (a) Mongolian name of a particular animal had been registered, for example, a specific Mongolian character correlating an individual animal. Nine species of animals fall into this category (Table 1); (b) The Mongolian name was not specified, but the name was spelled in Russian and annotated with Latin scientific names. Ten species of animals were recorded in this regard (Table 2).

Table 1
Be clearly indicated local Mongolian names of animals in MAKK

| Original record name | Corresponding scientific acceptance name | Corresponding Mongolian folk names | Meaning | Morphological characteristics |
|---|--|------------------------------------|------------------------|--|
| Гюрьбюль-могой | <i>Eremias przewalskii</i> | gurbel mogai | lizard - snake | - |
| (<i>Eremias przewalskii</i>) | | * mogai gurbel | Snake - lizard | - |
| Хонин-могой | <i>Elaphe dione</i> | honin mogai | Sheep - snake | This snake is particularly fond of attacking sheep |
| (<i>Coluber dione</i>) | | * nomhan bor | Docile - gray | It has a gentle disposition and gray stripes on its back |
| Эребень | <i>Cygnus columbianus</i> | urub | Primary Name | - |
| (<i>Cygnus bewicki</i>) | | * hun galuu | Swan | - |
| Хойлык | <i>Tetraogallus altaicus</i> | hoilog | Primary Name | - |
| (<i>Tetraogallus altaicus</i>) | | | | |
| Хара-такя | <i>Crossoptilon auritum</i> | har tahia | Black chicken | Feathers are blue black |
| (<i>Crossoptilon auritum</i>) | | * sarleg tahia | yak - chicken | Its rectrices are very long |
| Цогонда | <i>Felis bieti chutuchta</i> | chohondai | Primary Name | Wild cat |
| (<i>Felis chutuchta</i>) | | | | |
| Боро-цзере | <i>Gazella subgutturosa</i> | bor jeer | Gray antelope | Grayish-white from mouth to eyes |
| (<i>Gazella subgutturosa</i>) | | * suult jeer | Tail - antelope | Long-tail |
| Куку-яман | <i>Pseudois nayaur</i> | huh yamaa | Cyan goat or blue goat | The upper body hair is greyish-brown |
| (<i>Pseudois Burrehel</i>) | | | | |
| Хаёнык (-) | dzo(A hybrid of yaks and cattle) | hainag | Primary Name | - |
| * The Mongolian folk name obtained by interview | | | | |

PN: primary name, no other meaning.

The Mongolian folk names of animals are spelled according to their pronunciation.

Table 2
Unspecified local Mongolian names of animals in MAKK

| Original record name | Corresponding scientific acceptance name | Corresponding Mongolian folk names | Meaning | Morphological characteristics |
|--|--|------------------------------------|----------------|---|
| Болдурук (<i>Syrrhaptēs paradoxus</i>) | <i>Syrrhaptēs paradoxus</i> | buldurga | Primary Name | |
| Беркут (<i>Aquila chrysaētus daphanea</i>) | <i>Aquila chrysaētus daphanea</i> | burged | Primary Name | |
| Хулан (<i>Asinus kiang</i>) | <i>Equus hemionus</i> | hulan | Primary Name | |
| | | * jerleg luoz | Wild mules | |
| | | * chihde | Primary Name | |
| Марал (<i>Cervus asiaticus</i>) | <i>Cervus elaphus</i> | maral | Primary Name | - |
| | | * torog bug | Big - deer | |
| Хара-сульта (<i>Gazella subgutturosa</i>) | <i>Gazella subgutturosa</i> | har suult | Black tail | The outer end of the tail is black and brown |
| Оронго (<i>Pantholops hodgsoni</i>) | <i>Pantholops hodgsoni</i> | orongō | Primary Name | - |
| Аргали (<i>Ovis darwini</i>) | <i>Ovis ammon darwini</i> | argali | Primary Name | |
| | | * gulj | Primary Name | |
| Цзерен (<i>Antilope gutturosa</i>) | <i>Procapra</i> | jeer | Primary Name | - |
| Цаган-цзере (-) | <i>Procapra gutturosa</i> | chagan jeer | White antelope | The hair on the belly, hips and insides of the extremities is white |
| * The Mongolian folk name obtained by interview. | | | | |

| Original record name | Corresponding scientific acceptance name | Corresponding Mongolian folk names | Meaning | Morphological characteristics |
|--|--|------------------------------------|--------------|-------------------------------|
| Ада (<i>Procapra picticauda</i>) | <i>Procapra picticaudata</i> | ad bor | Primary Name | - |
| Тарабаган (<i>Aetomys robustus</i>) | <i>Marmota himalayana robusta</i> | tarbag | Primary Name | - |
| * The Mongolian folk name obtained by interview. | | | | |

PN: primary name, no other meaning.

The Mongolian folk names of animals are spelled according to their pronunciation.

Studies achieved by Gerelt Zhao[2,38,39] and other scholars had set the animal naming's methodological principles in Mongolian. Based on the above literature, our analysis and discussion on the Mongolian names of animals were summarised as follows:

Verification of animals' Mongolian names

In MAKK, the Mongolian name of *Eremias przewalskii* was recorded as Гюрьюль-могой, which stands for the Mongolian expression of gurbel mogai. However, according to our interview at Kozlov's recording location, the local herders mentioned mogai gurbel, but not gurbel mogai. The two words were in reverse order, resulting in a shift in meaning. In specific, mogai gurbel means "a snakelike lizard," which corresponds to the morphological characteristics of *E. przewalskii*. By contrast, gurbel mogai, which refers to "a lizard-like snake," does not match the description in MAKK. Thus, it is concluded as Kozlov mistakenly recorded the Mongolian name of *E. przewalskii* mogai gurbel as gurbel mogai.

On the eastern edge of the Tengger Desert, Kozlov caught a kind of ferocious venomous snake. Because of frequent incidences of bitten sheep by such snake, the local Mongolian herdsmen called it as honin mogai, which means "sheep snake." Its scientific name mentioned in MAKK is *Coluber dione* (1948 edition was annotated as *Elaphe dione*). However, *Elaphe dione* is a kind of snake without nonvenomous and docile, which does not fit the description in MAKK. It had been unfortunate that information about the snake was not acquired during our field researches and interviews. According to the literature[40,41,55,56], only *Psammophis lineolatus* and *Gloydus intermedius* were documented to be poisonous snakes in the Tengger Desert vicinity. The former refers to an "arrow snake" on many occasions in MAKK, so "sheep snake" could probably be *Gloydus intermedius*. Given this, there were possible errors in the species correspondence in Kozlov's record. The cause of this phenomenon might be the result of the specimen he captured was *Elaphe dione*. Still, he mistakingly referred to species correspondence when compiling notes or asking local herdsmen incorrectly regarding *E. dione* as "sheep snake".

Similarly, the Mongolian folk name of *Cygnus columbianus* documented in MAKK is shown as Зребень. However, in literature review and interviews, the Mongolian name of *C. columbianus* is usually known as hun galuu, which is inconsistent with that mentioned in MAKK. Nevertheless, the Mongolian name urub (*Ciconia* spp.) was found to be pronounced very close to Kozlov's notes, and both *C. nigra* and *Cygnus columbianus* are found in their recorded locations. Since MAKK explicitly records the bird's scientific name as *C. bewicki* (variant name of *C. columbianus*), *C. columbianus* should be a species seen by Kozlov. Because *C. columbianus* and *Ciconia nigra* are disparate in morphology and easily distinguished, and Kozlov had obtained high attainments in zoological research. We speculate that he could have improperly recorded the Mongolian name of *Ciconia* spp. as the swan's Mongolian name.

Kozlov hunted a new species of feral cat *Felis chutucha* (1948 edition was annotated as *Felis ocreata*) [18,57] around Goizso in Ejina Banner. The creature is usually regarded as chohondai by local Mongolians. The classification of wild cats has always been controversial in academic circles. Haltenorth[58] and He[59] et al. believe that *F. chutuchta* is a subspecies of *F. silvestris*. However, based on *Fauna Sinica* (Mammalia vol.8), *F. bieti chutuchta* was first mentioned by Birula in 1917. Its habitat distributes in the northwestern region of Ningxia at about 103°E,41°N (Goizso).[44] "Goizso" is Wentugol of Ejina Banner at present, and Ejina was administered by Ningxia at that time. The information mentioned above showed to be consistent with the records in MAKK. Considering the prevailing opinion[49,60-64], we believe that the wild cat hunted by Kozlov could be *F. bieti chutuchta*.

MAKK documented the Mongolian name of *Pseudois nayaur* as Куку-яман. The standard Mongolian name for *P. nayaur* is huh yamaa, a word whose pronunciation is inconsistent with Kozlov's records. We find that this differentiation may be due to the Mongolian dialect in Alxa, which differs from Mongolian's standard pronunciation. For instance, the classic Mongolian sound of Cyan is huh, while the Mongols living in Alxa pronounce it as kuku.

The definition of hulan is *Equus hemionus* in the traditional Mongolian language. MAKK (1923 edition) recorded it as Хулан (*Asinus kiang* ?). Also, *A. kiang* is known as a synonym of *Equus Kiang*. However, *E. Kiang* has not been distributed on the Mongolian plateau. While the symbol of "?" might stand for questionable identification of the species that remains to be confirmed. In contrast, Kozlov's note annotated *Asinus kiang* ? as *Equus hemionus* in the revised edition of 1948. Hence, in conjunction with our survey, hulan corresponds to the scientific name as *E. hemionus* in Table 1. *E. hemionus* belongs to a first-grade state protection animal in China[65] and IUCN near critical (NT) species. According to Kozlov's records, it once was vastly distributed in the vicinity of the Juyan Lake Basin and the northern desert area. Based on recent research, it is shown that the population of *E. hemionus* in Inner Mongolia has reduced drastically.[66,67] Interviews with herders revealed that *E. hemionus* has virtually gone extinct in Alxa, with only a few occasional sightings along the border between China and Mongolia.

In MAKK, Цзепен, which stands for the Mongolian expression of jeer, is defined as the Mongolian name of *Procapra gutturosa* by Kozlov. The word, jeer, in the Mongolian folk is the general name of the antelope. Nevertheless, Mongolians lived in the place like Alxa and its northern Gobi region in Mongolia often call *P. gutturosa* as jeer, and *Gazella subgutturosa* as suult jeer.

Procapra picticaudata was marked as Ада in MAKK, but we did not acknowledge such naming it in Inner Mongolia, Qinghai, and Xinjiang. By contrast, it has been clear that the Mongolians usually regard *P.*

picticaudata as Ада in Nikolay Mikhaylovich Przhevalsky's writings[68-70]. Searching for Mongolian dictionaries, only the Mongolian Orthography Dictionary (Revised Edition) documented a brief explanation (ada is short for ad bor, which is a kind of jeer)[51]. It can be seen that after more than one hundred years of history, the name has practically disappeared in the Mongolian folk. Besides, the Mongolian names har tahia and maral for *Crossoptilon auritum* and *Cervus elaphus* noted in MAKK are no longer frequently used among Mongolians. Instead, namings have been replaced by sarleg tahia and torog bug. In conclusion, some animals' Mongolian folk names are vanishing gradually, or even becoming extinct with the change of living style.

Apart from the few species mentioned above, the Mongolian names of other species have been verified through field investigation in Table 1 and Table 2. Kozlov's century-old records are shown to correspond to modern Mongolian names of these animals.

Structures and types of animals' Mongolian names

Much published literature[71-75] is interested in plant naming with the Mongolian language, but very little research focused on animal naming. Structurally speaking, the Mongolian naming for animals and plants could be indistinguishable.

Mongolian folk names of animals are classified as Simple Primary Name, Complex Primary Name and Secondary Name in Table 1 and Table 2. hoilog, chohondai, hainag, buldurga, maral, orongo, argali and jeer belong to Simple Primary Names, specifically referring to the relevant animals, and having no other meaning. Mongolian phrasal names play a crucial role in animals' naming. For example, gurbel mogai, mogai gurbel and har suult are Complex Primary Name, comprised of "common word + common word" or "Simple Primary Name + Simple Primary Name". Secondary Name is consisted of "modifier + Simple Primary Name", containing har tahia, huh yamaa and chagan jeer. Modifiers are used to describe a certain feature of an animal further. Among them, har, bor, huh as well as chagan are modifiers, simultaneously, tahia, jeer, yamaa, bug, and suult are Simple Primary Name. There is a very close resemblance between the Mongolian naming system and Linnaean binomial nomenclature, where the modifier is equivalent to a specific epithet but existing in a different position.

The correspondence between animals' Mongolian names and scientific names

As shown in Table 1 and Table 2, some animals possess two or more Mongolian names. For instance, *Gazella subgutturosa* has two Mongolian names, bor jeer and har suult. Similarly, *Cervus elaphus* has two Mongolian names, maral and torog bug. The Mongolian folk name of *Crossoptilon auritum* in MAKK are texted as har tahia. Through interviews with local herdsman in Alxa, older adults referred to the subject as sarleg tahia. There are two other Mongolian names of *C. auritum* enrolled in the literature: huh hadan haraa and huh gurguul. A phenomenon like this where two or more different Mongolian names refer to the same species is synonymy; thus, the indigene noted two or more Mongolian names for the identical creature. It is evident that a "multitude-to-one" relationship between the Mongolian names of animals and scientific names. From the taxonomic point of view, such terminology may be at the species level.

Table 1 and Table 2 have shown eight kinds of animals with only one Mongolian name in total, and the

Mongolian name also specifically refers to the animal. Therefore, there could be a “one-to-one” relationship between these animals’ Mongolian and scientific names. For example, huh yamaa is the special name of *Pseudois nayaur*, buldurga refers to the dedicated description of *Syrrhaptes paradoxus*, orongo is treated as the specialized designation of *Pantholops hodgsoni*, moreover, hainag the specified word of dzo (offspring of a hybrid of yaks and cattle). Conversely, each of these animals has only one Mongolian name. From the taxonomic perspective, both the “one-to-one” and “multitude-to-one” relationships are the corresponding species level. It indicates that Mongolian folk classification of some animals reached the level of species.

Furthermore, there is a “one-to-multitude” relationship between the Mongolian names and scientific names of animals. Based on our investigation, the Mongolian folk refers to *Tetraogallus* as hoilog. While chohondai refers to the general name of wild cats, such as *Felis bieti*, *F. silvestris*, *F. chaus*, and *Prionailurus bengalensis*. The white swan of the genus *Cygnus* is regarded hun galuu. Based on geographical distribution, the swan can be specified as *C. cygnus*, *C. columbianus*, and *C. olor*, while they are generally regarded to/despite species difference. There is a homonyms phenomenon in Mongolian folk; for example, a Mongolian name refers to various animals or animals that share the same Mongolian name. Therefore, the folk classification of these animals is the family or genus of modern animal taxonomy.

Meaning and naming basis of animals’ Mongolian names

Traditional Mongolian grazing experience plays a significant role in the naming of animals in Mongolian. From the Mongolian name analysis of *Gloydus intermedius*, xonin is “sheep,” and mogay refers to “snake.” According to a description in MAKK, sheep and other domestic animals often suffer from snake bites. As a result, Mongolian herdsman refer to snakes as “sheep snake.” It subsequently proved that Mongolian folk’s naming of animals could be closely related to the traditional grazing experience. The living habits of animals are also one of the bases for Mongolian naming of animals. The Mongolian name of *Elaphe dione* is nomhan bor, and nomhan stands for the characteristic meaning of meek and honest. This Mongolian name accurately describes the temperament and habit of the mentioned snake species.

The morphological characteristics of animals are the essential foundation for the Mongolian naming of animals. The naming is the essence of a Secondary Name, which comprises a modifier indicating the morphological characteristics or habits of an animal and a Simple Primary Name. For instance, because of the blue-black features of *Crossoptilon auritum*, its Mongolian name is har tahia. Har means black and tahia is a pheasant. Similarly, the corresponding color of the dorsal seta of *Pseudois nayaur* is cyan; hence its Mongolian name is huh yamaa, among which huh means cyan and yamaa refers to a goat. A large number of Secondary Name is constructed from a comparison of similar names, and they are based on Simple Primary Name, using modifiers to identify features and distinguish similar species. The Mongolian names of *Gazella subgutturosa* and *Procapra gutturosa* are bor jeer and chagan jeer individually. Among them, bor is grey, chagan means white, and jeer refers to an antelope. Color modifiers distinguish the two animals because of their different fur.

From the Mongolian name of *Crossoptilon auritum*, *Pseudois nayaur*, *Gazella subgutturosa*, and *Procapra*

gutturosa, we can conclude that tahia, jeer and yamaa are equivalent in terms of the generic name. Moreover, har, chagan and huh are equal indicates of the specific epithet, which reveals the concept of genus and species. Therefore, the Mongolian folk naming methods and basis for animals are of extreme significance and practical value to drafting Mongolian names of animals in modern zoology.

Animal utilization of the Mongols in MAKK

Animal husbandry has always been the pillar industry of Mongolian herdsman, which involves all aspects of Mongolian life. Hence, the Mongolian style of domesticated animals (domestic animals) has been more abundant and frequent than wild animals. The contents about animal utilization mentioned in MAKK are also closely related to Mongolian life, featuring domestic and wild animals.

Table 3
Usage information of Animals among Mongolian folk recorded in MAKK

| Usage | Animals' names | Parts | Methods |
|--|--|----------------|---|
| Diet | <i>Rhombomys opimus, Gazella subgutturosa, Procapra gutturosa, Pseudois nayaur</i> | flesh | Hunt for meat, process into food |
| | sheep, goat | flesh | Process into jerky or hand-served mutton |
| | bactrian camel, horse | milk | Brew kumiss or Boil milk tea |
| Textile | bactrian camel, horse, sheep, goat | villi hairs | Weave into cloth or blanket, sew into sacks |
| Accessory | <i>Crossoptilon auritum</i> | rectrices | Insert into hats for decorations |
| Transport | bactrian camel, horse | whole | Riding and carry goods |
| Instrument | sheep-goat | derm | Make instruments drum head |
| Toponym | <i>Pseudois nayaur, Lutra lutra,</i> horse | - | Name toponym |
| Weather forecast | <i>Tetraogallus altaicus</i> | - | Indicate the weather by sound |
| Domestic animals are given their English names, and wild animals are given their scientific (Latin) names. | | | |

According to the use of animals in Table 3, the Mongolians' utilization in MAKK was analyzed.

Diet

The purpose of diet mainly includes consumption of meat and milk. Domestic animals comprise the primary source of protein intake for Mongolians. It is recorded in MAKK that several steps involve air-dried

mutton preparation, namely the slaughtering, flaying, bone removal, thinly slicing of mutton, boiling and salting for 10~15 minutes, and hanging with a string for air drying in a well ventilated shady area. After that, the air-drying of mutton usually takes three or five days before reaching readiness.[17,18] The purpose of making dried mutton is to preserve animal protein for a prolonged period when a provision of a “dry food” during a crossing of the uninhabited Gobi and desert is required. According to MAKK, Kozlov’s team mastered the nomadic Mongolian folk’s skills to cope with the practical food demand during their expedition. Based on our survey, the production method of preparing air-dried beef and mutton in Mongolian folk is still quite common. Although the Mongolians in the eastern part of Inner Mongolia used to make dried meats out of raw beef and mutton, drying of beef and mutton’s currently increasingly relied on other methods, such as roasting or frying.

Preying on wild animals provides crucial meat supplementations for the Mongolians. Kalkha Mongolians consume rodents since ancient times, and it is still practiced as usual nowadays. According to writings of MAKK, it was relatively common practice for Mongolian folk to preying on *Rhombomys opimus*, an animal distributing in the Bukert region (now Bogdor County, Former Khangai Province, Mongolia) in the northern part of the Altai Mountains. They believe that the meat of tastes more tender than mutton. A simple wooden trap in a skilled hand can catch about thirty *R. opimus* per day.[17,18] Besides, it is documented that Alxa Mongolians hunt *Pseudois nayaur* in MAKK. During Kozlov’s visit to Helan Mountains, a large number of *P. nayaur* were reportedly witnessed. The Mongolians living near Dingyuanying were well aware of their living habits. They often went hunting in the mountains, especially in autumn when *P. nayaur* was fattened. However, due to the destruction of the natural environment and people’s wanton hunting, the number of *P. nayaur* had remarkably declined by the end of the 20th century. [76-78] The population of *P. nayaur* in Helan Mountains has recovered in recent years, thanks to the establishment of Helan Mountains Nature Reservation Zone and listing of *P. nayaur*’s as China’s second-grade national protected wildlife[79] and IUCN[80] (World Union for Conservation of Nature) low-risk species.[81-83]

Tea drinking is a common hobby of the Mongolian people. A saying goes, “It is better to have no meal than a cup of tea.” It can be seen that milk tea is an indispensable drink in Mongolian life. Nevertheless, the milk source of brewed milk tea in different regions remain varied. For example, Kozlov recorded that Mongolian people living in desert areas used camel milk to make milk tea. However, according to the survey, Mongolians distributing in grassland areas are more likely to use milk to prepare milk tea. This is because the Mongolians living in different regions have different kinds of animals as their primary sources of milk. Therefore, MLKA in various areas shares some common but differences in some cases. Some customs of Mongolian brewing and drinking horse milk wine were also documented in MAKK. For example, in the lower reaches of the Ejina River, the expedition made daily trips to nearby pastures to drink home-brewed Mongolian horse milk spirit. Once, they visited a widow’s yurt, where they were not allowed to take the horse milk spirit out of the yurt. Since the husband was just deceased, the widow was in an obligated mourning period of 40 days or more. Therefore, the team had to drink the spirit onsite before leaving.

Textile

Mongolian textile's primary raw materials are the wool and cashmere of camel, horse, sheep, and other livestock. Wool and cashmere were yarn into thread, cloth, and felt to make clothes, blankets, or other daily necessities by Mongolians. MAKK notes: "There is a fine well next to our station, carefully covered with felt by the Mongols. The felt cloth, which was named as taglaa by Mongols, was made of coarse animal hair or horse mane and was used by the Mongols to sew sacks." However, our investigation at the Kozlov's expedition's site revealed that it was not the felt that was called taglaa, but the wellhead covers made of such material. Due to the scarcity of water, local herdsman cherish water resources very much. The purpose of making such wellhead covers is to protect the opening from being destroyed by animals and buried by sand and reduce the evaporation of water to a certain extent.

The investigation revealed that this kind of cover was no longer found in present-day Alxa. As a result of social development and material abundance, they were replaced by canvas or other products purchased from the market. Fortunately, we found not only the sack made of animal's mane as described by Kozlov in Alxa (Fig.6) but also saw another sack made of wool (Fig.7). The local herders said that they used to cover the wellheads with these worn-out sacks.

Accessory

Crossoptilon auritum, one of the precious birds in northwest China, is the national second-grade protected animal,[84] and the bird is listed as vulnerable species in China Species Red List[85]. The two pairs of long tail feathers are valuable decorative feathers in the center of its tail, and the outer rectrices can also be used as decorations (Fig.8).[43] In the Qing Dynasty, the tail feathers of *C. auritum* were inserted into low-level officials' official hats as accessories called "Lán líng" in Chinese (Fig.9). "Local hunters were brutally killing these gorgeous and strange birds due to the beautiful feathers of its long tail, which were used for adornments in Chinese official hats," MAKK says. Literature records show that *C. auritum* was widely distributed in Helan Mountains.[68,86] According to recent research data, *C. auritum* has been greatly reduced due to environmental destruction and overhunting.[46,87] Their distribution area in the Helan Mountains is less than 20% of the total area, and the number of *C. auritum* is only more than 600. [83]

Transportation

As Kozlov described, the Mongols' primary transportation method was horses, while camel caravans were used to transport their supplies. That was the historical reason behind this since the areas were underdeveloped at that time. However, with modern technology development and mechanization, Mongolian herdsman are no longer a common practice to take horses for transportation. The condition of relying on camel caravans for cargo transportation has long been replaced by modern transportation options such as trains or automobiles.

By using animals for an extended period, Mongolians invented and manufactured many accessories related to them, such as Lele cart, saddles, reins (Fig.10-a), camel nasal stick (Fig.10 b), camel cushions, and stirrups (Fig.10-c), carry rack (Fig.10-4) and many others. These accessories are the carrier of the

Mongolian traditional culture, and their production skills and use methods compose part of the Mongolian traditional culture. However, these tools are gradually being replaced along with the change and advancement of technology, and fewer and fewer people would be proficient in these skills. Hence, the inheritance of this cultural heritage is facing a severe challenge.

Instrument

It was also mentioned in MAKK that some Mongolian musical instruments were made out of animal leather. For example, a kind of percussion instrument in Mongolian Buddhist temples, called hengereg, have sidewalls of the drum tightened with sheep belts without hoops. The drumhead is made of sheepskin and is usually tanned to be as thin as paper.

Toponym

The Mongolian names of animals profoundly influenced the local human geography, and many places were named after the local animals directly or indirectly. Such customs are still in use at present. According to MAKK, there was a place called "Horse Drinking Valley" in Alxa Left Banner, whose Mongolian name was aduun hudug-in am, Its translation meaning is understood as "the gorge where horse hooves dig out water" or "the gorge where horses drink." Interestingly, Kozlov happened to see some horses grazing and drinking at the spring while he was passing through the area. Again for instance, yamaat-in gool means "A valley with goats" in Mongolian. It was one of the key destinations of Kozlov's expedition to Helan Mountains. Our investigation confirmed that this place is located in the Zhenmuguan area of Helan Mountains today (Fig.11). It is named yamaat-in gool because Pseudois nayaur often appeared here. So far, the toponym's Mongolian name remains unchanged, and P. nayaur was often seen on the nearby hillside. For another example, the Mongolian name of East Juyan Lake Basin was written as "Соҗо-нор" in MAKK, namely Mongolian sub nuur, meaning "the Lutra lutra lake." It possibly used to be a habitat of L. lutra, and locals named the lake after it.[39] The name stuck till this day though L. lutra have long since disappeared there (Fig.12).

From the above evidence, we concluded that animals' distribution represents a key element to the naming of toponyms or a location. The toponyms related to animals also reflect the historical conditions of the ecological environment and animal distribution of those areas.

Weather forecast

The Mongolians summarized some impressive phenological knowledge from their prolonged interactions with animals. Tetraogallus altaicus is a common avian species in the Gobi Altai Mountains. According to Kozlov's records, their chirp was loud and reverberated in the mountains. The local Mongolian herdsmen used to predict weather changes relied on the chirp's timing during the day. For example, if the tweeting happens in the morning, it would possibly rain that day. However, this ancient forecasting method has been replaced almost by modern forecast technologies.

To sum up, the utilization of animals by Mongols is closely related to life and production, involving clothing, food, housing, transportation, and other aspects. Coexistence with animals through the ages, the Mongols have accumulated a mass of zoology knowledge and abundant experience and technology and formed a traditional culture with local characteristics. All these indicate that the folk culture influenced

the use of animals by the Mongolians and enriched Mongolian culture. Therefore, the knowledge on animal utilization of Mongols has an absolute scientific and cultural value.

Like many nomadic people, the Mongolian populations in different areas share a high degree of consistency in lifestyle and cultural customs. Since MLKA is a form of Mongolian culture, they possess a broad unity despite being in geologically separate regions.[88] Nevertheless, due to the wide distribution of the Mongolian ethnics, their customs are slightly diverse in different areas, and animals in other geographical locations also vary, so their understanding and utilization of animals may also not be the same.[75] From the usages of animals mentioned above, MLKA is uniform while exhibiting some differences and diversity.

The Mongols' protection and precaution for animals

The Mongols have accumulated a mass of experience in livestock protection and risk prevention during generations of grazing life. MAKK recorded that a poisonous snake, *Glydium intermedium*, was captured in a meadow on the southeastern edge of the Tengger Desert. Kozlov described the snake as: "The snake is known for its ferocity and often bites livestock, especially sheep. Once the animal gets bitten, the wound swells and aches for about 1.5 to 2 weeks." Therefore, local herdsman will try their best to avoid this kind of snake when grazing, not to suffer losses.

MAKK contained some Mongolian thoughts and measures of animal protection. For example, there were many *Cervus elaphus* in the Helan Mountains, which the Mongols considered sacred and did not hunt them. Furthermore, the Prince of Alxa strictly prohibited his subjects from hunting divine animals such as *C. elaphus*. The three specimens of *C. elaphus* collected by Kozlov's expedition were hunted in Helan Mountains with special permission from the Prince of Alxa. There are many *C. elaphus* still living in Helan Mountains with folk beliefs and official protection measures.

Mongolian traditional thoughts and efforts on animal protection and prevention are one of the critical factors for their long-term harmonious coexistence with nature, and they are still of crucial practical significance and reference value for ecological restoration and biodiversity protection today.[53,89,90]

Conclusion

Firstly, in the long-term interaction between the Mongolians and animals, they have accumulated countless animal naming knowledge and utilization experience and formed a traditional culture with local characteristics. The local expertise of 23 species of animals recorded in MAKK confirmed traditionality and diversity regarding local knowledge and enriches ethnozoology contents in research.

Secondly, by analyzing the structure, meaning, and name basis of the Mongolian names of local wildlife, the Mongols probably possess an indigenous set of naming rules and classification system for animals. And this is very similar to the naming and classification of plants in Mongolian folk, though the issue needs further systematic study. Scientifically speaking, the Mongolian folk naming methods and basis

for animals are of extreme significance and practical value to drafting Mongolian names of animals in modern zoology.

Thirdly, through summarizing and comparing the utilization of animals by Mongols, it can be seen that MLKA and Mongolian culture have mutual influence and interdependent relationships. Meanwhile, the MLKA in different regions has both extensive unity and specific differences.

Fourthly, according to the survey, some of the MLKA recorded by Kozlov is still in use. The historical notes are reliable supply information and momentous historical data for the studies on ethnozoology and history of science and technology of Chinese minorities. Besides, the thoughts and measures of the Mongols on the protection of animal resources more than 100 years ago provides high cultural value and a specific practical value. All these mentioned above offer absolute reference values for the Mongolian Plateau's fauna and history of zoology research.

Finally, with social development, lifestyle changes, and the interference of various human factors, some MLKA is disappearing at an alarming rate. Some Mongolian folk culture associated with animals is also becoming unattainable simultaneously. Therefore, the excavation and research of ethnozoological knowledge in modern scientific investigation documents should be paid enough attention, but the related protection and inheritance work is essential and urgent. Given this, we suggest that MLKA in literature should be reasonably protected and inherited in various forms, such as collation, reporting, promotion and re-studies.

Abbreviations

MAKK: Mongolia and Amdo and the Dead City of Khara-Khoto

MLKA: Mongolian Local Knowledge on Animals

Declarations

Ethics approval and consent to participate

All participants in this study provided permissions. The authors have all copyrights.

Consent for publication

Not applicable.

Availability of data and materials

All data generated or analyzed during this study comply with this published article and its supplementary information files.

Competing interest

The authors declare that they have no competing interests.

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Authors' contributions

K and L proposed the idea and designed the plan of the study. L was responsible for the collection and collation of literature data. L, Z and K completed the textual research of biological species recorded in literature. The fieldwork for data collection were conducted by L, Z and W. Voucher specimen (photos) identification, data analysis, and manuscript preparation were by L, Z, K, S, Y, and G. Mongolian language input and proofreading work was undertaken by L, S and W. All authors read and approved the final manuscript.

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Figures



Figure 1

P. K. Kozlov(1863-1935) (Source: <https://www.rgo.ru/sites/default/files/media/2020-07-08/kozlov.jpg>)

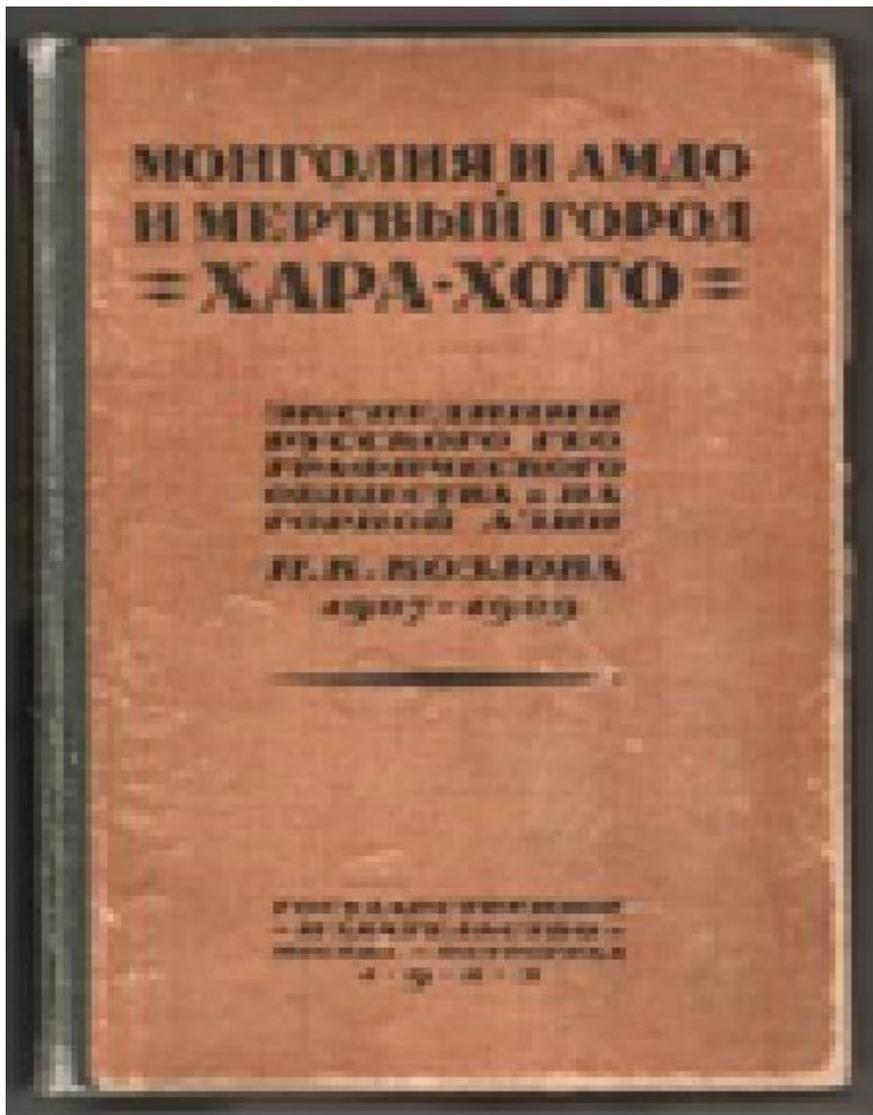


Figure 2

Original edition of MAKK (1923) (Source: <http://kozlov-museum.ru/wp-content/uploads/2016/07/3-218x300.jpg>)

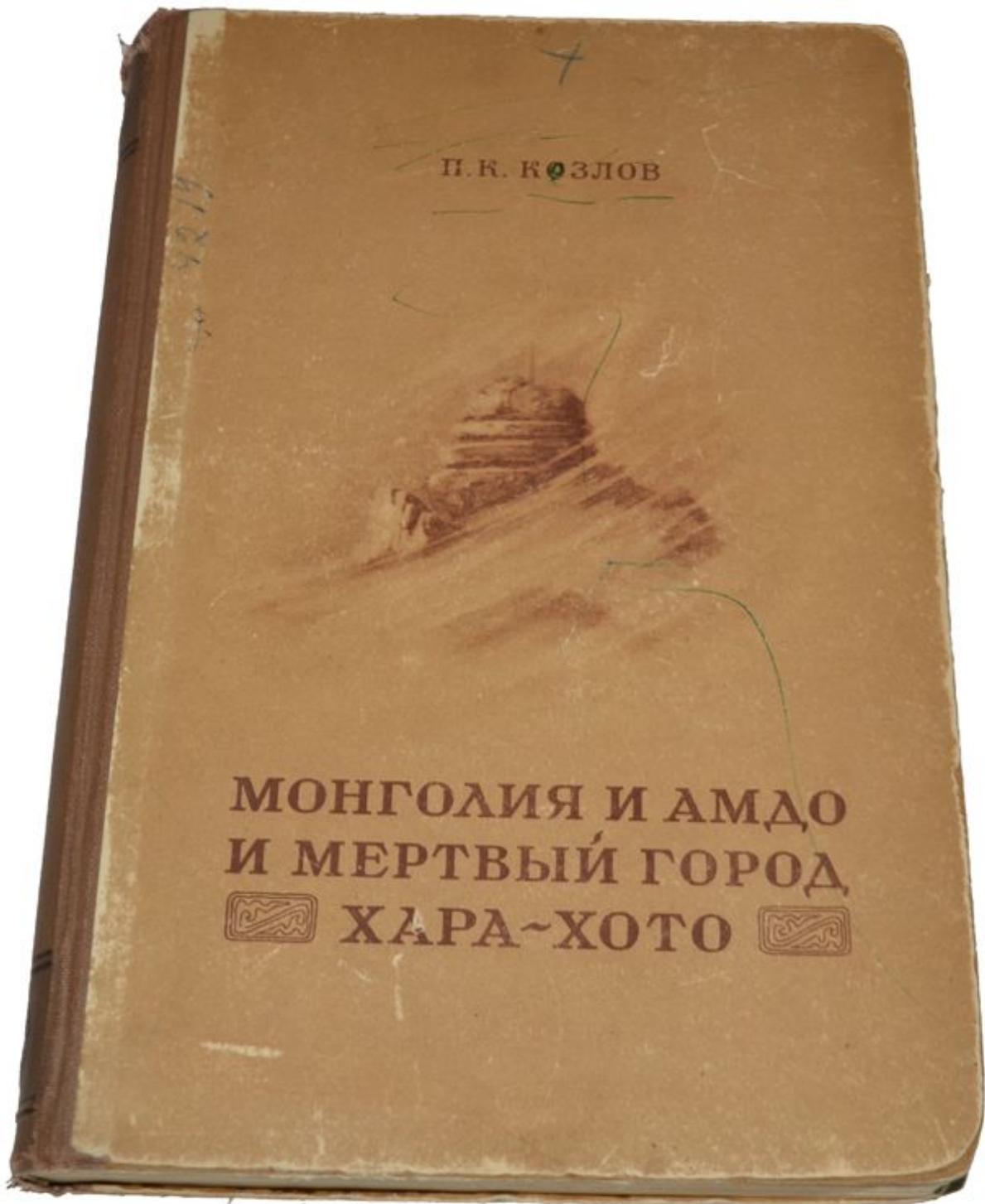


Figure 3

Second edition of MAKK (1948) (Source:https://www.wolmar.ru/images/auctions/1080/1976659_1.jpg)

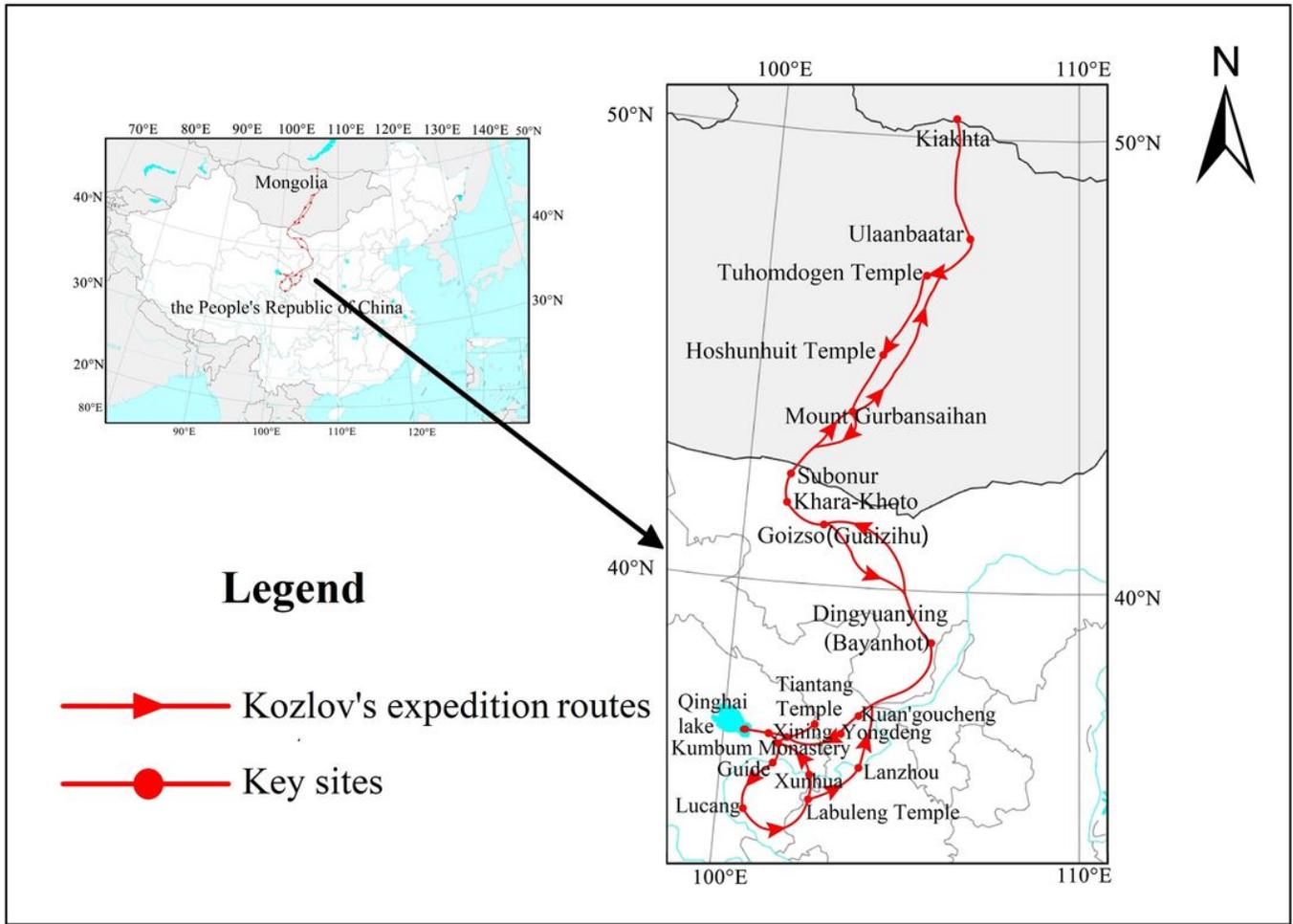


Figure 4

Kozlov's expedition routes—Drawn by Hui Zhang and Guixi Liu— Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.

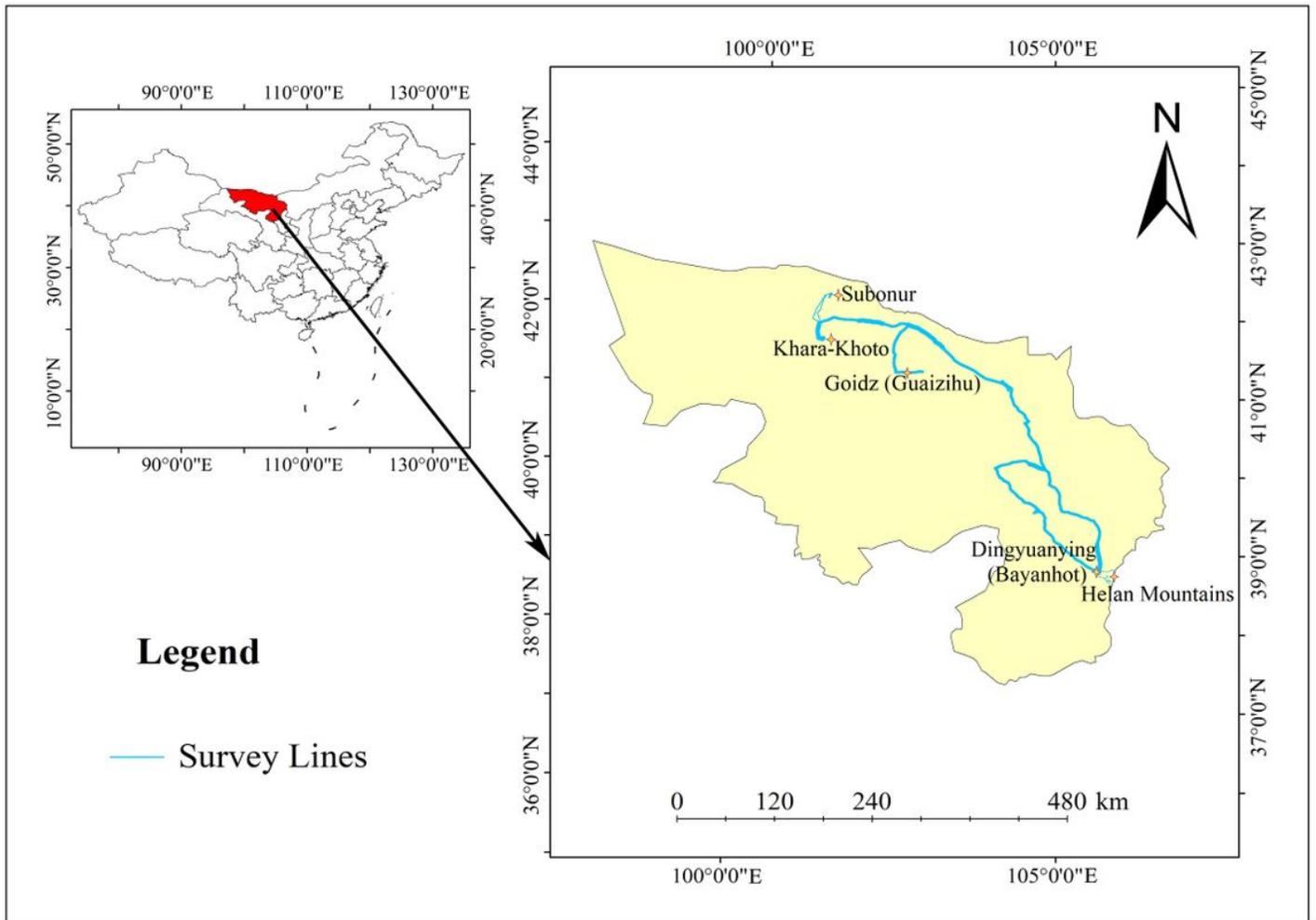


Figure 5

Field survey lines recorded by GPS (Drawn by Hui Zhang and Guixi Liu) Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.



Figure 6

A sack made of camel's mane (taken by Wuriheng)

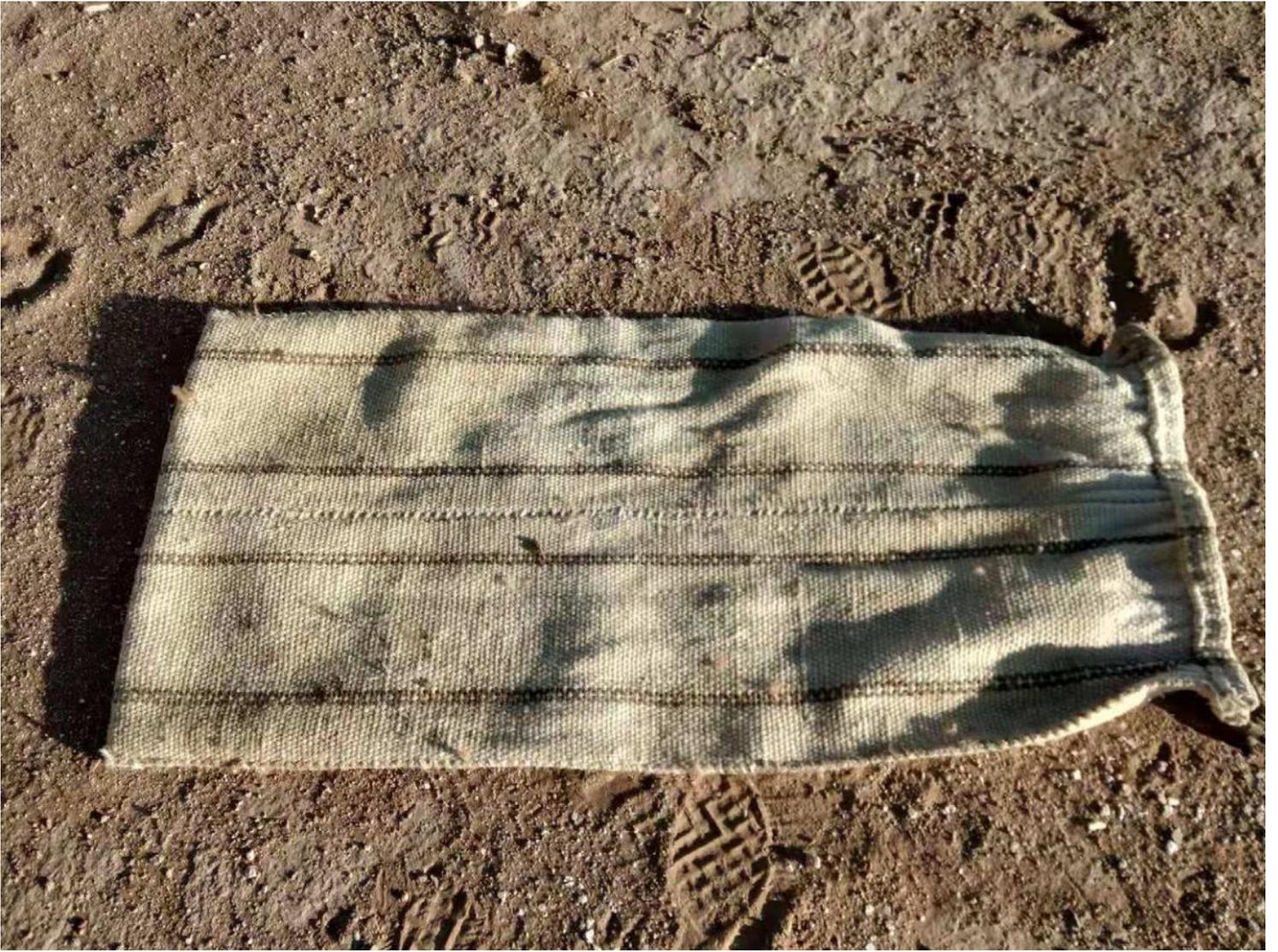


Figure 7

A sack made of coarse wool (taken by Wuriheng)



Figure 8

Crossoptilon auritum (<httpwww.birdnet.cnthread-1122431-1-170.html>)



Figure 9

The Qing Dynasty official hat of “Lán líng” (<http://www.quancang.com/UploadFile/2014-3/20143241421884460.jpg>)

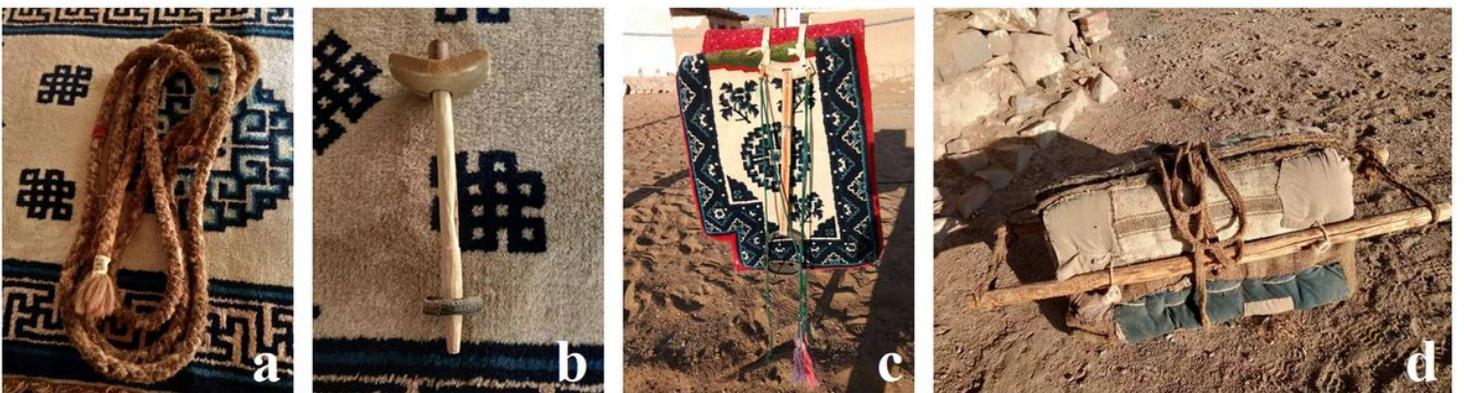


Figure 10

Camel caravans transport accessories (taken by Wuriheng)

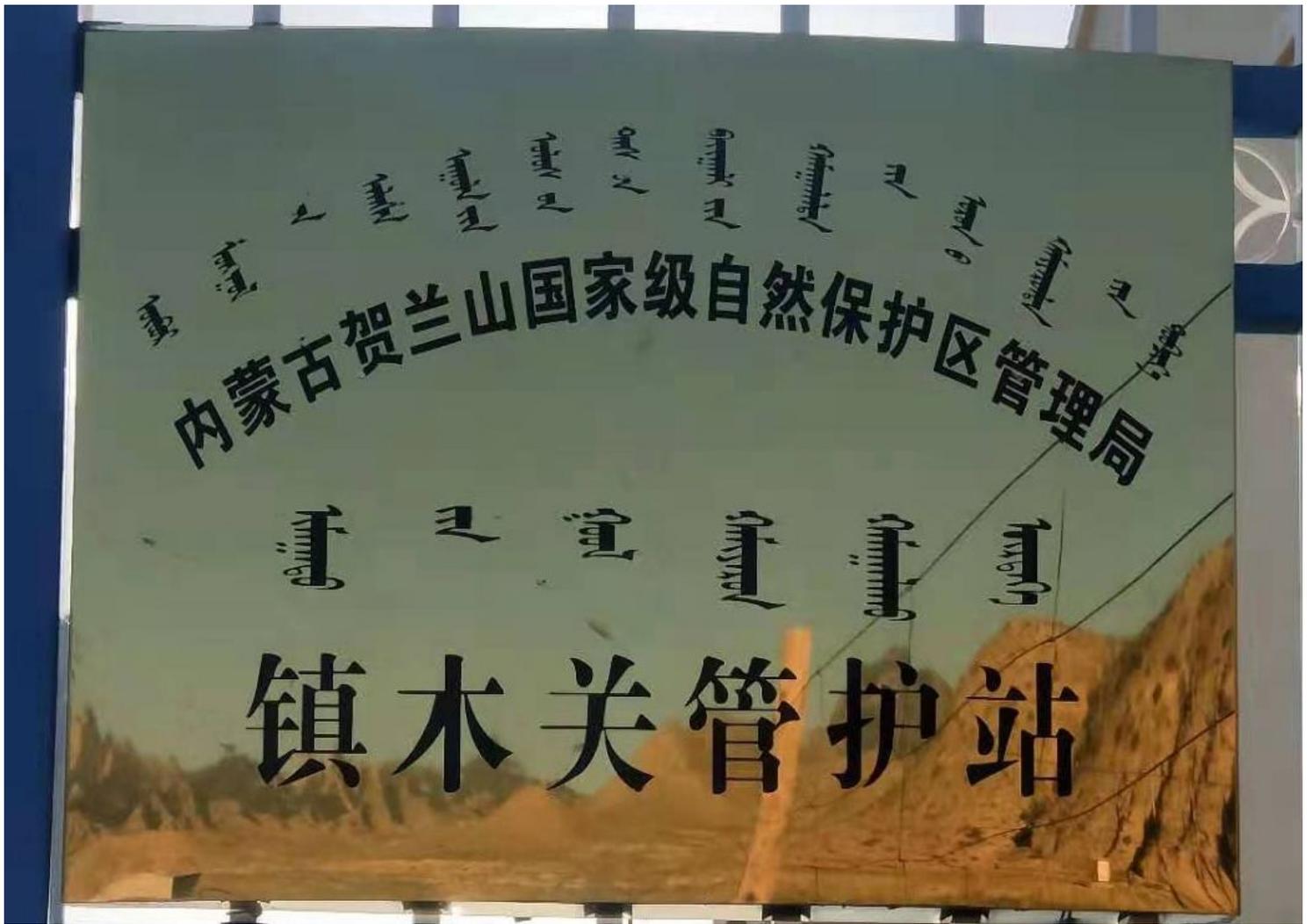


Figure 11

Zhenmuguan (yamaat-in gool) (taken by Yun Su)



Figure 12

East Juyan Lake Basin (sub nuur) (taken by Aimin Wang)