Conservation implications of ethnoveterinary knowledge:

A Mongolian case study

by

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Declaration

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Abstract

Across the world, pastoralist livelihoods are centred on the health of livestock herds. In Mongolia, where herders rely on the well-being of their livestock and the vast rangelands they inhabit, pastoralism holds important economic and cultural significance. Through centuries of herding, Mongolian pastoralists have developed a rich heritage of traditional ecological knowledge, which includes local knowledge, beliefs and practices relating to animal health. This ethnoveterinary knowledge is the focus of the present study.

Ethnoveterinary data were recorded from 50 semi-structured interviews, conducted with pastoralist families in the central northern region of Mongolia. Interviews included free listing opportunities, the use of photographs of plants in a reference book, and a questionnaire with open- and closed-ended questions. In addition, participant observation schedules, journal keeping and travelling on horseback were used to gain a better understanding of the context in which the ethnoveterinary knowledge is embedded. The methods and approaches used to collect data for this study were critically reviewed by comparing theory and practice, culminating in a better understanding of the data, and the development of constructive recommendations for researchers in similar fields.

This study demonstrates that Mongolian herders possess a wealth of ethnoveterinary knowledge. This includes the sophisticated use of a variety of medicinal plants. The use of 39 botanical species from 20 families, equating to 29 ethnospecies, was recorded in this study. Medicinal plant use and importance was analysed by means of use-values, free-listing salience index and fidelity levels. According to these, *Urtica cannabina*, *Sanguisorba officinalis*, *Plantago* spp., *Rhodiola* spp., *Pulsatilla* spp. and *Cacalia hastata* are particularly important ethnospecies, used in the treatment of various livestock ailments. The ethnoveterinary uses of twenty non-plant remedies and three techniques were also recorded.

This study indicates that ethnoveterinary knowledge is held by both men and women, and is transmitted between generations as lived knowledge, experiential learning and by active teaching. Maintaining this traditional ecological knowledge requires the continuation of herding practices and herding culture as well as a family structure that allows for intergenerational connection across space and time.

The ethnoveterinary knowledge of Mongolian pastoralists is embedded in the context of a social-ecological system with both biological and cultural components. Therefore, to determine the conservation implications of ethnoveterinary knowledge, the concept of biocultural diversity was used. To allow for a better understanding of biological and cultural diversity and the connections between them, a novel framework for biocultural diversity was developed. This framework was populated with examples from the Mongolian pastoralist context to describe the factors that influence conservation in this environment.

Opsomming

Regoor die wêreld is die broodwinning van herders gesentreer rondom die gesondheid van hulle lewendehawe kuddes. In Mongolië, waar herders staat maak op die welstand van hulle lewendehawe en die uitgestrekte weivelde wat hulle bewoon, het pastoralisme belangrike ekonomiese en kulturele betekenis. Deur eeue van herderskap, het Mongoolse herders 'n ryk nalatenskap van tradisionele ekologiese kennis ontwikkel, wat plaaslike kennis, gelowe en gebruike met betrekking tot diere gesondheid insluit. Hierdie etno-veeartsenykundige kennis is die fokus van die huidige studie.

Etno-veeartsenykundige data is ingesamel deur 50 semi-gestruktureerde onderhoude, gevoer met herder families in die sentrale noordelike streek van Mongolië. Onderhoude het vrye lys geleenthede, die gebruik van fotos van plante in 'n verwysingsboek, en 'n vraelys met oop en geslote vrae ingesluit. Daarmee saam is deelnemer waarnemingsskedules, joernaal inskrywing en reis te perd gebruik om beter begrip van die konteks waarin etno-veeartsenykundige kennis geleë is te bekom. Die metodes en benaderings wat gebruik is om data in te samel vir hierdie studie is krities hersien deur teorie en praktyk te vergelyk, wat gekulmineer het in 'n beter begrip van die data en die ontwikkeling van konstruktiewe aanbevelings vir navorsing in soortgelyke velde.

Hierdie studie demonstreer dat die Mongoolse herders 'n rykdom van etno-veeartsenykundige kennis besit. Dit sluit die gesofistikeerde gebruik van 'n verskeidenheid medisinale plante in. Die gebruik van 39 botaniese spesies van 20 families, wat gelyk is aan 29 etnospesies, is in hierdie studie aangeteken. Medisinale plant gebruik en belangrikheid is geanaliseer deur gebruik te maak van gebruikswaardes, vry lys opvallendheidsindeks en getrouheidsvlakke. Volgens hierdie maatstawwe is *Urtica cannabina*, *Sanguisorba officinalis*, *Plantago* spp., *Rhodiola* spp., *Pulsatilla* spp.en *Cacalia hastata* van besondere belang as etnospesies, en word gebruik in die behandeling van verskeie lewendehawe kwale. Die etno-veeartsenykundige gebruik van twintig nie-plant geneesmiddels en drie tegnieke is ook aangeteken

Hierdie studie dui aan dat etno-veeartsenykundige kennis deur beide mans en vrouens gehou word, en tussen generasies oorgedra word as geleefde kennis, ervaringsleer en aktiewe onderrig. Om te verseker dat tradisionele ekologiese kennis behou word, vereis die voortbestaan van herderspraktyke en die herderskultuur, sowel as 'n familie struktuur wat inter-generasie skakeling toelaat deur ruimte en tyd.

Die etno-veeartsenykundige kennis van Mongoolse herders verskyn in die konteks van 'n sosio-ekologiese sisteem met beide biologiese en kulturele komponente. Om die bewaringsimplikasies van etno-veeartsenykundige kennis te bepaal is die konsep van biokulturele diversiteit dus gebruik. Om toe te laat vir 'n beter begrip van biologiese en kulturele diversiteit en die skakels tussen die twee, is 'n nuwe raamwerk vir biokulturele diversiteit ontwikkel. Hierdie raamwerk is ingevul met voorbeelde van die Mongoolse herders konteks om die faktore te beskryf wat bewaring in hierdie konteks beïnvloed.

Тойм

Дэлхий даяар малчдын аж амьдрал мал сүргийн эрүүл мэндээс голчлон хамаарч байдаг. Малчид нь мал сүрэг хийгээд нутаглан буй уудам газар нутгийнхаа сайн сайхантай амь нэгтэй байдаг Монгол орны хувьд мал аж ахуй нь эдийн засаг, соёлын чухал ач холбогдолтой байдаг. Зуун зууны туршид мал маллаж ирсэн Монголын малчид нутаг усныхаа тухай мэдлэг, малын эрүүл мэндтэй холбоотой арга туршлага, итгэл үнэмшил зэрэг экологийн уламжлалт мэдлэгийн арвин их өв үүсгэжээ.

Малын уламжлалт эмчилгээний мэдээллийг 50 удаагийн ярилцлагаар цуглуулсан бөгөөд Монголын төвийн хойд зүгийн бүс нутагт амьдарч буй малчин өрхүүдийг судалгаанд хамруулсан. Ярилцлага авахдаа нээлттэй жагсаалт үүсгэх боломж олгож, лавлах номны ургамлын зураг болон нээлттэй, сонголтот хариулттай асуумжийг ашигласан. Түүнчлэн малын уламжлалт эмчилгээний мэдлэг бүрэлдэн тогтсон орчин нөхцөлийг илүү сайн ойлгохын тулд оролцон ажиглах туршилт явуулах, тэмдэглэл хөтлөх болон морь унах зэрэг аргыг ашигласан. Энэхүү судалгааны мэдээлэл цуглуулахад ашигласан арга, аргачлалуудыг онол, практик хослуулан нарийн нягталж, мэдээллийг сайтар шинжилсэн бөгөөд мөн адил салбарт ажиллаж буй судлаачдад зориулан зөвлөмж боловсруулахад тус болсон юм.

Энэхүү судалгаанаас Монголын малчид малын уламжлалт эмчилгээний арвин их мэдлэг, мэдэгдэхүүнтэй болох нь харагдаж байна. Тэд мөн олон зүйлийн эмийн ургамлын нарийн хэрэглээг сайн мэдэж байсан юм. Хорин овгийн 39 зүйлийн ургамал буюу нийтдээ 29 угсаатны зүйл энэхүү судалгаанд бүртгэгдсэн. Эмийн ургамлын хэрэглээ, ач холбогдлыг хэрэглээний үнэт зүйлс, шинж чанарын үзүүлэлтийн нээлттэй жагсаалт үүсгэн ургамлын хэрэглээ, ач холбогдол болон индексийн аргаар шинжилсэн. Үүнээс үзэхэд *Urticacannabina*, *Sanguisorba officinalis*, *Plantago* төрөл зүйл, *Rhodiola* төрөл зүйл, *Pulsatilla* төрөл зүйл болон *Cacalia hastata* зэрэг ургамал нь чухал угсаатны зүйл байсан бөгөөд малын олон төрлийн эмчилгээнд ашигладаг байна. Ургамлын бус 20 эм, 3 аргачлалыг малын уламжлалт эмчилгээнд мөн ашигладаг болох нь тогтоогдсон юм.

Энэхүү судалгаанаас үзэхэд эрэгтэйчүүд, эмэгтэйчүүд бүгд малын уламжлалт эмчилгээний мэдэгдэхүүнтэй байсан бөгөөд уг мэдлэгээ амьдрал дээр туршин суралцах болон идэвхтэй сургах байдлаар үеэс үед дамжуулдаг байна. Энэхүү экологийн уламжлалт мэдлэгийг хадгалахын тулд мал аж ахуйн арга туршлага, соёл,мөн цаг хугацаа, орон зайгаар холбогдох үе хоорондын холбоог хадгалсан гэр бүлийн бүтцийг цаашид үргэлжлүүлэх шаардлагатай юм.

Монголын малчдын малын уламжлалт эмчилгээний мэдлэг нь биологийн болон соёлын бүрэлдэхүүн хэсгийг агуулсан нийгэм, экологийн тогтолцооны нэгэн хэсэг болжээ. Иймээс малын уламжлалт эмчилгээний мэдлэгийг хамгаалах аргыг тодорхойлохын тулд биосоёлын олон талт үзлийг ашигласан юм. Биологийн болон соёлын олон талт байдлыг сайтар ойлгож, тэдний хоорондын холбоог нарийн тогтоохын тулд биосоёлын олон талт байдлын боловсронгуй бүтцийг тодорхойлсон. Энэхүү бүтцээ Монголын мал аж ахуйтнуудын амьдралын орчин нөхцөлөөс авсан жишээгээр амилуулж, өнөөгийн нөхцөлд малын уламжлалт эмчилгээний мэдлэгийг хамгаалахад нөлөөлөх хүчин зүйлсийг тодорхойлохыг зорьсон юм.

Dedication

To

Tintin

und für Mama, Papa

und Großmutti

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Glossary

Aaruul	(Mongolian) dried curds, with or without sugar added; often dried on the roof of the ger (Fijn, 2011)
Ail	(Mongolian) herding family
Aimag	administrative subdivision in Mongolia (province)
Airag	(Mongolian) fermented mare's milk
Aarts	(Mongolian) curds made from sour milk
Baigal	(Mongolian) term for nature, includes animals, plants, the landscape, weather, and all human existence as well as the ways in which they affect each other (Humphrey et al., 1993)
Biocultural diversity	the sum total of diversity, including biological diversity at all its levels and cultural diversity in all its manifestations and, importantly, the interactions among all of these (Loh and Harmon, 2005)
Collectives	Soviet era, state run administrative units that Mongolian herders had to join; included the intensification of livestock production and the regulation of pasture use (Fernández-Giménez, 2000)
Dzud	(Mongolian) unusually difficult winter conditions that result in the loss of a large number of livestock (Marin, 2010)
Ethnoveterinary knowledge (EVK)	local knowledge, beliefs and practices pertaining to any aspect(s) of animal health among species raised or managed by human beings (Mathias-Mundy and McCorkle, 1989)
Ethnoveterinary medicine (EVM)	local system of livestock health management, rooted in culture, customs and traditions used to keep animals healthy and productive, and to treat and control diseases and livestock related problems (Wanzala et al., 2005)
FAO	Food and Agriculture Organisation of the United Nations
Fidelity level (FL)	used to determine the most preferred treatment/medicinal plant within a particular ailment category (Musa et al., 2011; Trotter and Logan, 1986)
Free listing salience index	used to ascertain the importance of free list items by taking into consideration the position of mention, the length of the free list and the frequency of mention (Smith, 1993)
Ger	(Mongolian) traditional felt home

GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (German agency for international cooperation)
Informant consensus factor (ICF)	used to examine and compare the similarity between medicinal plants used within an ailment category (Trotter and Logan, 1986)
Khar ukhaan	(Mongolian) folk knowledge or common sense, that includes everyday folk instruction in animal husbandry and forms part of the traditional Mongolian herder identity (Marzluf, 2015)
Khot ail	(Mongolian) small groups of households, usually kinship based (Upton, 2010)
Mal	(Mongolian) domestic animal or herd animal
Malchin	(Mongolian) herder
Mal süreg	(Mongolian) to herd
Mongol bilchig	(Mongolian) traditional Mongolian script
Mongol derby	self-supported, 1000km endurance ride in Mongolia
Morin khuur	(Mongolian) horse-head fiddle
Naadam	national festival in Mongolia, centred around horse racing, wrestling and archery
Negdel	(Mongolian) livestock collectives, see ‘Collectives’
Nutag	(Mongolian) birthplace or homeland
Otor	(Mongolian) temporary, mobile camp, set up to allow animals to graze on better (usually distant) pastures
Ovoo	(Mongolian) sacred rock cairn and ceremony, often held on prominent mountain tops (Fijn, 2011)
SDC	Swiss agency for development and cooperation
Tamga	(Mongolian) brand on horse’s hindquarter
Tengger	(Mongolian) the sky, heavens, a god, weather (Fijn, 2011)
Traditional ecological knowledge (TEK)	cumulative body of knowledge, practice, and belief about the relationship of living beings (including humans) with one another and with their environment (Berkes, 1999)
Soum	(Mongolian) administrative centre
UNESCO	United Nations Educational, Scientific and Cultural Organisation

Use report (UR)	defined as a preparation and administration of a specific plant part against a specific disease, mentioned by one informant (Ahmad et al., 2015)
Use value (UV)	demonstrates the relative importance of species known locally, based on the number of different uses for a specific plant as reported by respondents (Sharma and Manhas, 2015).
Zoopharmacognosy	self-medicative behaviour in animals
Zootherapy	the treatment of human or animal ailments using medicines that are derived from animals (Souto et al., 2011)

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Chapter 1

General Introduction

1. Research rationale and significance

Worldwide, raising and taking care of livestock remains a major livelihood strategy, especially for pastoralists in developing countries (Mathias, 2007; Schillhorn Van Veen, 1996). Ensuring the health and well-being of livestock herds is both culturally and economically important and accordingly, livestock diseases and ailments are often a source of concern, especially in rural areas with limited access to veterinary centres and services (Wanzala et al., 2005). Accessibility, together with affordability and cultural appropriateness accounts for the high number of pastoralists who rely on local knowledge pertaining to livestock health, also termed 'ethnoveterinary knowledge' (Mathias et al., 1996; McCorkle, 1986).

Mongolian pastoralists, whose livelihoods depend on the well-being of their herds and the vast rangelands they inhabit, possess and use a variety of products and practices to ensure the health of their herds (Damiran and Darambazar, 1999). The ethnoveterinary knowledge and practice of Mongolian pastoralists, which forms the basis of this study, includes the use of medicinal plants, fungi, remedies of animal and mineral origin, as well as ethnoveterinary techniques for the treatment and prevention of various livestock ailments.

Ethnoveterinary data were collected using a variety of methods and approaches. The importance of applying the most appropriate methods and approaches to this research as well as the problems encountered during the data collection are explored in a critical albeit constructive review of the methods used during my fieldwork in Mongolia. As emphasized by Shackeroff and Campbell (2007), it is important that the choice of research methods is directed by an understanding of the specific research context. Reflecting on fieldwork methods and associated challenges, holds valuable lessons for further research.

As both ethnoveterinary knowledge and associated rangeland knowledge involve the practices and relationships of living beings with one another and with the environment, they can also be classified as traditional ecological knowledge, defined by Berkes (1999) as "*a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment."*

The significance of traditional ecological knowledge for biodiversity conservation and sustainable resource use is increasingly recognised (Berkes, 1999; Drew and Henne, 2006; Fraser et al., 2006; Gadgil et al., 1993; Huntington, 2000). This emphasizes not only the need for cultural dimensions to be integrated into biodiversity conservation strategies (Poe et al., 2013), but also the need to understand traditional or local resource use from an ecological perspective (Berkes et al., 2000). The ethnoveterinary knowledge of

Mongolian herders is embedded in a social-ecological system and has both biological and cultural elements, therefore a biocultural approach was taken for investigating the conservation implications of ethnoveterinary knowledge. Studying the role of pastoralists' ecological knowledge for resource management is essential for understanding the conditions necessary for the success of traditional rangeland management systems (Fernández-Giménez, 2000) and ethnoveterinary practices.

Mongolia's characteristic rangelands and the biodiversity they support, are central to herder livelihoods and livestock health. Although half the Mongolian population depend directly or indirectly on the livestock sector (Johnson et al., 2006), pastoralists are faced with a host of global and local challenges including climate change, urbanisation, economic constraints, land-tenure insecurities, and population increase. Within this context it becomes clear that there is a need to investigate broader approaches to solutions that include an understanding of the complex social, cultural, political, and biological elements within socioecological systems (Berkes et al., 2000; Ostrom, 2009; Poe et al., 2013), and to ensure livestock herding practices, including ethnoveterinary practices, remain resilient to modern realities and challenges (Sternberg, 2008).

Although studies have been done on various aspects of Mongolian pastoralists' traditional knowledge, including the contribution of nomadic herders' observations to analysing climate change (Marin 2010) and the role of ecological knowledge in rangeland management (Fernández-Giménez, 2000), this is, to my knowledge, the first study (in English) that focuses on the ethnoveterinary knowledge and practices of Mongolian herders as well as the conservation implications of this knowledge.

2. The Mongolian context

2.1 Climate

Mongolia is a landlocked country, comprising 1.56 million km^2 and is characterised by extreme geographic and climatic conditions. Known as the 'Land of Blue Sky', Mongolia has a continental climate characterised by a low precipitation regime that ranges from 50mm/year in the dry southernmost part of the country, to 400mm/year in small areas in the north, with about 90% of the rainfall occurring in the summer months from June to August (Natsagdorj, 2000). Mongolia experiences extreme annual temperature variation from 40°C in summer to -50°C in winter (Batima and Dagvadorj, 2000). Winters are characterised by extremely dry and cold conditions, whilst dry, cold and windy conditions are prevalent in spring (Johnson et al., 2006). *Dzud*, a term used to describe extreme winter conditions where livestock are not able to access fodder sources, results in, oftentimes severe, livestock losses (Marin, 2010).

2.2 Ecology and vegetation

Mongolia is characterised by its vast grasslands, also known as the 'Steppe'. These comprise 80% of the country's area and are home to 50 million livestock (FAO, 2016) including cattle and yak, sheep, goats, camels, and horses. The country can be ecologically divided into six ecoregions from north to south: boreal forests/taigas, alpine grasslands, forest steppe, steppe, desert-steppe, and desert (Marin, 2010). Mongolia is home to roughly 3000 vascular plant species, of which more than 150 are endemic, 200 sub-endemic, and 148 are included on the IUCN red data list (Nyambayar et al., 2011). In addition to livestock, Mongolia's grasslands also support important populations of wild herbivores (Fernández-Giménez, 2000), including Mongolian gazelle (*Procapra gutturosa*), argali (*Ovis ammon*) as well as the critically endangered Bactrian camels (*Camelus bactrianus ferus*) and Asian wild ass (*Equus hemionus*) (Mix et al., 2002; Reading et al., 2001). In terms of biodiversity, the Mongolian steppe is one of the largest contiguous areas of common grazing in the world (World Bank, 2003) and two World Wildlife Fund (WWF) Global Ecoregions lie partly within Mongolia's borders. As of 2002, Mongolia's protected areas cover 13 % of the country, or 20.68 million hectares (Reading et al., 2006).

2.3 Historical context of Mongolian pastoralism

During the Mongol empire (1206-1609) and the time of Chinggis Khan, various clans and tribal groups - under direction of clan chiefs - grazed their herds of livestock with wide-ranging seasonal migrations (Fernández-Giménez, 1999). This was followed by the Manchu colonial period (1691-1911), where all herding decisions were controlled by Nobles. A short period of autonomy from the Chinese was followed by a Socialist system in 1921, where Mongolia adopted a communist socialist government with a centrally planned economy (Johnson et al., 2006), and became a so-called Soviet satellite state. The 70-year Soviet-era brought with it many changes as the pastoral herder system was 'developed' into a livestock production system (Sternberg, 2008). Livestock and rangelands were all state-owned and herders had to join collectives. Herding decisions around livestock numbers, breeds (specific breeding programs were put in place and exotic livestock breeds introduced), when to move and where to move to, were all strictly regulated by the collective administration. Although decision-making power was reduced, the Soviet-based system offered support for herders in the form of veterinary technicians, water infrastructure, and transport and encouraged herders to move regularly (Fernández-Giménez, 1999). Even though the total radius of distance moved decreased, highly mobile, low impact grazing patterns were maintained during this era, which limited environmental consequences (Fernández-Giménez, 1999; Sternberg, 2008).

In 1990, with the collapse of the Soviet Union, Mongolia entered a free market economy, and became a democracy. Almost all livestock was privatised and collectives dismantled, but herders now faced a myriad of new challenges that are still relevant today. These include reduced government support in terms of transport and water infrastructure maintenance, land tenure uncertainties, and a lack of formal regulatory governance of pasture use and mobility (Sneath, 2003). The increase in poverty that accompanied the change from a centralised- to a free-market economy resulted in an influx of 'new herders' from the city to the countryside[1] as well as consequent increase in overgrazing and year-round grazing of pastures reserved for winter and spring (Fernández-Giménez, 2000; Sternberg, 2008). The rise in livestock numbers and the decline in traditional pastoral practices of mobility and reserve grazing pastures are increasingly a cause for concern (Ulambayar et al., 2016).

2.4 Mongolian herders and their livestock

Mongolian pastoralists involved in this study fall within the Khalkha ethnic group. Of the more than 20 ethnic groups that inhabit Mongolia, the Khalkha constitute the majority of the population (>75%) and live in central and eastern Mongolia (Machulla et al., 2003). The basis of Mongolian social organisation is a patrilocal stem-family system where residency is grounded on the husband's family. Although herders conduct both Buddhist- and shamanic-based practices, herders do not subscribe solely to one or the other as a religion, but have taken up a complex mix of rituals and practices established over time (Fijn, 2011).

I use the term 'herder' in the same way Mongolians refer to themselves as *malchin* (herders) and their way of life as *mal süreg* 'to herd'. 'Herder' is used interchangeably with pastoralist and is gender neutral. Furthermore, the term includes the herding family (*ail*), which refers to a family group, typically encompassing a husband and wife and their children (including grandparents) who occupy one or two felt tents (*gers*) that form their home (Fijn, 2011).

Mongolian herders are deeply connected to their livestock herds and the landscape they inhabit. Livestock depend almost solely on the nutrition provided by wild grasses, herbs and shrubs (Fernández-Giménez, 1999). Extended family groups, usually comprising three generations often share tasks and combine animals together in one herd. Herders move their livestock herds several times a year, usually seasonally, depending on the availability of pastureland and the needs of the animals. During the summer, livestock are watered everyday (if grazing away from a river or lake) and roam freely far away from the homestead. Autumn sees the collection and storage of medicinal plants and herds are moved closer to their winter quarters. During winter, herds graze pastures that have been specially reserved, to allow vegetation to grow tall enough to not be covered by snow (Marin, 2010). During the winter and spring months, livestock are kept closer to the *ger*. Spring, with its low temperatures and extreme winds, is the most difficult season for herders and their livestock herds, which now include many new-borns. After the long winter, most livestock have lost condition, and it is therefore during this time that medicinal plants (stored in autumn) are used extensively to treat ailments and improve the general health of animals. The treatment of animal illnesses, using a range of techniques and a remarkable knowledge of local medicinal plants, forms a major part of the herders' lives (Fijn, 2011) and is the topic of this thesis.

[1] All rural areas where herders and their livestock live and move in are known in Mongolia as 'the countryside'

3. Study area

The study area is located in the north-central part of Mongolia (Fig. 1.1) and is characterised mainly by forest steppe and steppe grasslands. This area was chosen as it includes a range of ethnoveterinary plant use scenarios in different ecoregions (steppe, forest, alpine meadows) and geographical breadth. In addition, important contacts had been made previously with various key informants through my participation in the Mongol derby 2015[2], and thus, effective snowball sampling could be initiated through these contacts who live in the above described area.

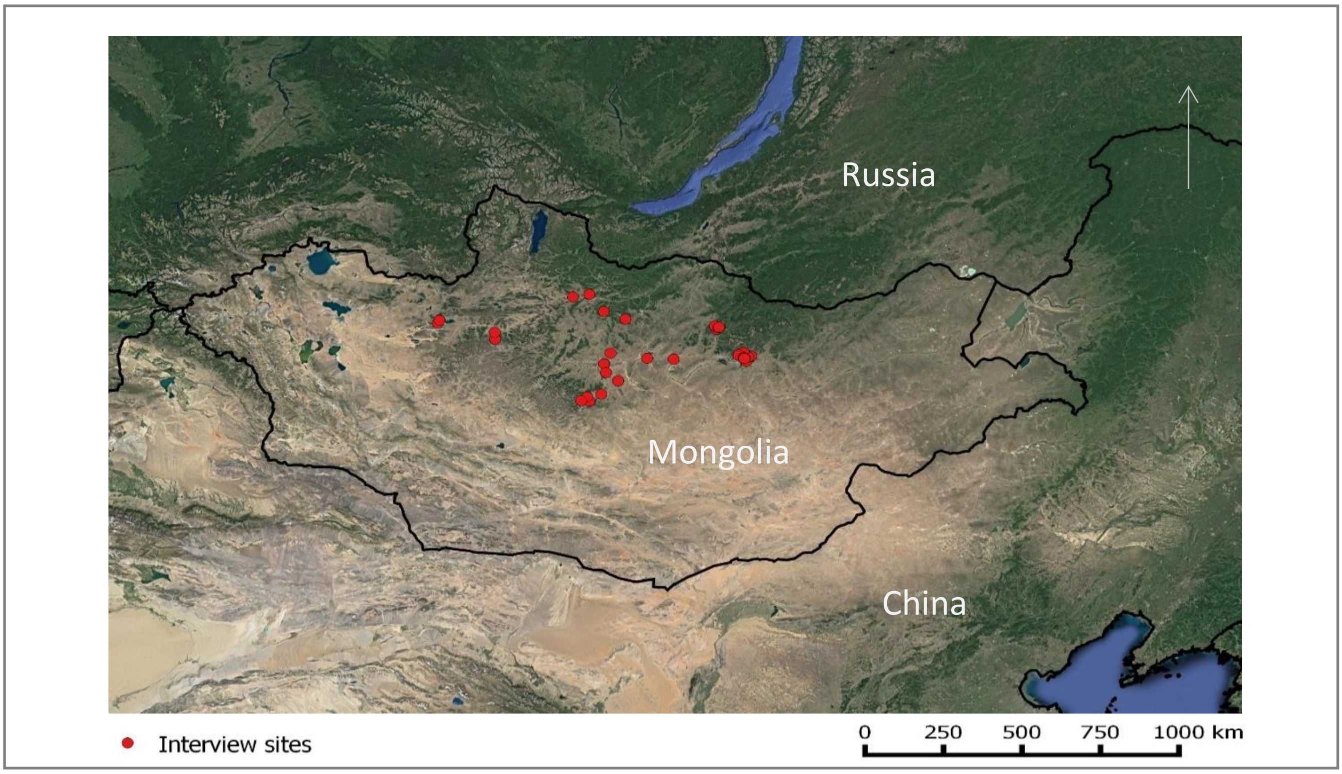

Fig. 1.1 Map of Mongolia, with red markers indicating specific study sites (Google Satellite, 2016).

4. Aims and key questions

The main aim of this study was to gain an understanding of the ethnoveterinary knowledge of Mongolian pastoralist herders and to investigate the implications thereof for biocultural diversity conservation.

This was achieved through the following objectives:

- Understand, document and analyse ethnoveterinary resource use of Mongolian pastoralists
- Critically review the methods and approaches used to collect ethnoveterinary data for the current study, thereby identifying possible implications for similar ethnobotanical studies

[2] The Mongol derby is a 10 day, 1000 km endurance ride where participants are self-supported, ride local Mongolian horses and overnight with herder families along the way.

- Apply ethnoveterinary knowledge to biocultural diversity understanding and assessment
- Gain insight into the transfer and dynamics of ethnoveterinary knowledge in the Mongolian context

The following research questions were addressed to meet the specific objectives of the study:

1. What plants and other resources are used by Mongolian pastoralists for ethnoveterinary purposes, and why? (Chapter 2)
2. Who are the ethnoveterinary knowledge holders and what are the modes of knowledge acquisition and transmission? (Chapters 2 and 4)
3. In terms of theory versus practice, what are the implications of particular research methods and approaches used during the fieldwork stage of data collection? (Chapter 3)
4. Along with ethnoveterinary knowledge and practice, what are the factors that influence biocultural diversity in the Mongolian context? (Chapter 4)
5. How can the biocultural diversity of the Mongolian rangelands be maintained? (Chapter 4)

5. Thesis structure and overview

The thesis is divided into five chapters: two synthesis chapters (introduction and conclusion) and three data chapters. The latter have been written as stand-alone manuscripts for publication and may therefore contain some duplications, particularly in the introductory sections.

Chapter 1 presents a general introduction to the entire thesis and allows the reader to become familiar with the Mongolian context. The chapter further discusses the research rationale and significance as well as the research aims and objectives. In addition, this chapter serves as a road map for the rest of the thesis by giving a brief overview of the thesis structure.

Chapter 2 presents ethnoveterinary findings and results, in a Mongolian context. This includes medicinal plants, fungi, and remedies of animal origin together with a description of ethnoveterinary techniques used by Mongolian herders for the health and well-being of their livestock. Ethnoveterinary medicinal plants are further explored and analysed in this study according to plant use and importance.

Chapter 3 consists of a synthesis and review of the methods and approaches used throughout the study, with a focus on the fieldwork period in Mongolia. This is done by juxtaposing the theory of each method with the practice of applying it in the Mongolian context.

Chapter 4 addresses biocultural diversity in the Mongolian pastoralist context. Mongolian herders' ethnoveterinary knowledge, beliefs and practices, which are embedded in a socio-ecological system, are further explored in this chapter within the context of biocultural diversity conservation. This is done by developing a framework for biocultural diversity and populating it with examples from the Mongolian case study. These are drawn from, among other sources, the ethnoveterinary knowledge of Mongolian herders and the dynamics thereof.

Chapter 5 presents general conclusions drawn from the complete thesis, discusses research challenges and limitations, and includes recommendations for future studies.

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Chapter 2

Horse sense: Ethnoveterinary knowledge of Mongolian herders

1. Introduction

Across the world, groups of people rely on the health and wellbeing of their animals for their livelihoods (Gradé et al., 2009; Wanzala et al., 2005; Yineger et al., 2007). The local knowledge of animal healthcare practises, or ethnoveterinary knowledge, plays an important role in maintaining livestock health, especially in rural areas of developing countries where access to modern veterinary services and centres is limited (Mathias, 2007; Wanzala et al., 2005).

As the field of ethnoveterinary research has grown, so too have both the definition and understanding thereof evolved (Wanzala et al., 2005). The term 'ethnoveterinary research' was first used by McCorkle (1986) to refer to systematic research that focuses on '*folk knowledge and beliefs* (…)*, practices, technology and resources, social organisation and so forth pertaining to any aspect(s) of animal health among species raised or managed by human beings*'. A few years later, Mathias-Mundy and McCorkle (1989) then equated traditional veterinary medicine to 'veterinary anthropology', signifying the complexity thereof (González et al., 2011). A more recent review by Wanzala et al. (2005) addressed the evolution, perception and understanding of ethnoveterinary medicine (EVM) and formulated a more comprehensive definition of EVM as '*a holistic tradition or local/native system of livestock health management rooted in the people's culture, customs, taboos and traditions and adopted by livestock raisers all over the world in their respective environmental conditions to keep their animals healthy and productive and to treat and control diseases and livestock-related problems by use of medicines, management practises, information about diseases, animal production and breeding methods, tools and technologies and magico-religious beliefs embodied in people's traditional and local practises for their own developments and survival*'.

The importance of EVM lies within it being affordable, accessible, and culturally appropriate (Mathias et al., 1996). In addition, by its nature of being local, the knowledge and use of EVM can be used to develop livestock practises that are suited to the local environment and native context (McCorkle and Mathias-Mundy, 1992). Knowledge about EVM can be used to improve livestock healthcare services (Mathias and McCorkle, 2004; Wanzala et al., 2005), and could be an essential veterinary resource in the potential discovery and development of new drugs (González et al., 2011; McGaw and Eloff, 2008). However, in tapping into this potential, it is of critical importance that intellectual property rights are respected and that appropriate measures are taken to conserve endangered plants (Mathias, 2007). Additionally, knowledge about EVM can contribute to biodiversity conservation (González et al., 2011) and the sustainable use of natural resources (Sheikh et al., 2013). Local knowledge, often transmitted through oral folklore from generation to generation is disappearing in many communities, and there is an urgent need for it to be documented and recorded (Masika et al., 2000).

The field of ethnoveterinary research has grown considerably (Mathias, 2007) and includes a number of publications on the ethnoveterinary knowledge and practises of nomadic pastoralists across the world. These include a study on the ethnoveterinary medicinal plants used by nomadic tribes of northern India (Sharma and Singh, 1989), a description of the indigenous veterinary knowledge held by the Koochi Powandah (nomadic pastoralists of southern Afghanistan) (Davis et al., 1995), and a study by Khan (2009) on the ethnoveterinary practices of Roohelay pastoralists in Pakistan. Examples from Africa include publications on the ethnoveterinary practices of the semi-nomadic Fulani herders of Cameroon (Toyang et al., 1995), the Tuareg pastoralists of Nigeria (Antoine-Moussiaux et al., 2007), the Karamojong, pastoralists of Uganda (Gradé et al., 2009), and a recent publication on the ethnoveterinary knowledge of the Sahrawi pastoralists of Western Sahara (Volpato et al., 2015).

In Mongolia, where approximately half the population depends directly or indirectly on the pastoral economy for its livelihood (Fernández-Giménez, 2000), local knowledge about livestock health and rangelands is both economically and culturally important. It is therefore surprising that, to my knowledge, other than brief mentions of medicinal plants being used for livestock (Damiran and Darambazar, 1999; Fijn, 2011; Humphrey et al., 1993; Tungalag, 2012; WHO, 2013), no published studies (in English) exist on the ethnoveterinary knowledge of Mongolian pastoralists. This is rather unexpected, especially considering that traditional knowledge about the Mongolian environment and resource use within the environment is widespread (GIZ, 2013) and well-documented in the literature. For example, Fernández-Giménez (2000) studied the role of Mongolian nomadic pastoralists' ecological knowledge with respect to rangeland management, whilst Marin (2010) reported on the contribution of herders' observation to analysing climate change. Herders' perceptions of other environmental challenges were also investigated by Sternberg (2008). Further examples from the theme of traditional ecological knowledge include a description of Mongolian herders' attitudes to nature (Humphrey et al., 1993) and a discussion of the connections between nature and nomadism (Upton, 2010).

Taking this into account, the aims of this chapter are threefold. Firstly, to document and record ethnoveterinary knowledge among Mongolian herders for future generations. Secondly, to describe and quantitatively analyse the use of ethnoveterinary medicinal plants within the study area, and thirdly, to examine non-plant ethnoveterinary treatments and techniques used by Mongolian herders. After a review of previous research relevant to ethnoveterinary medicine, I provide some background information to the Mongolian context and give a description of the study area where field-work took place. This is followed by an explanation of the various methods used to gather EVM data for this study. Subsequently, detailed EVM plant data from free listings and interviews are presented. EVM plant usage and plant importance is analysed by means of use-value (UV), salience index, informant consensus factor (ICF) and fidelity level (FL). I then briefly present and discuss EVM from non-plant sources as well as other EVM techniques. The chapter concludes by outlining and discussing the importance of the recorded EVM data for further studies in various fields.

2. Background and study area

Mongolia is a land-locked country in central Asia, well-known for its vast steppe grasslands. Of the country's 156 million hectares, eighty percent form the largest remaining contiguous area of common grazing land in the world (Fratkin and Mearns, 2003; Sternberg, 2008). Mongolia is sparsely inhabited, with a population of 3 million people of which about a third are pastoralists and depend on livestock production as their livelihood strategy (Mongolian Statistical Yearbook, 2005). In addition, livestock herding also has cultural significance, with many folk tales, songs, musical instruments and celebrations being centred on the pastoral lifestyle and heritage. Pastoralists follow a nomadic lifestyle with seasonal migrations between pastures. Livestock herds include cattle and yak, sheep, goats, horses, and camels with varying differences in herd composition across regions (Upton, 2010). Camels, for example, are generally herded in the more arid southern parts of the country, while yak are found in the more mountainous northern and western regions.

2.1 Vegetation and climate

Mongolia forms a transitional zone between the Siberian boreal forest to the north and the Gobi Desert to the south, and can be ecologically divided into six regions: high mountains, taiga, forest steppe, steppe, desert-steppe, and desert (Marin, 2010). Mongolia has an extreme continental climate with high annual (-53°C in January to +42°C in July) and diurnal temperature fluctuations (Batima and Dagvadorj, 2000). Rainfall ranges from 50mm/year to 400mm/year (Natsagdorj, 2000), with most rain falling in the summer months (June-August). The long winter and spring seasons, with low temperatures and high winds, present a difficult period for pastoralists and their livestock. Spring is cold and stormy with scarce pastures (Marin 2010). The most prominent climatic hazards faced by Mongolian herders are drought and *dzud* events (severe and unusually difficult winter conditions), which result in the mass loss of livestock (Middleton et al., 2015). In the *dzud* events of 1999-2002 and 2009-10, for example, 30% and 20% of the national herd were lost, respectively (Fernandez-Gimenez et al 2015).

2.2 Land tenure and animal husbandry

During the Soviet Era (1921-1990), almost all livestock in Mongolia was owned by state-run collectives. Herders had to join collectives and were assigned to care for specific livestock types and breeds. This changed after the collapse of the Soviet Union, with almost 90% of livestock now being privately owned.

Pastureland, however, remained constitutionally excluded from private landownership (Fratkin and Mearns, 2003). Even so, as both customary and more official rights of possession evolve, the issue of land tenure has become increasingly complex (Sternberg, 2008). Following the dismantling of livestock collectives, competition for grazing lands reached crucial levels, especially in easily accessible pastures (Fratkin and Mearns, 2003). By 1998, livestock numbers had reached a peak of 32.9 million (Lise et al., 2006); however, shortly thereafter, changes in livestock mobility and rangeland management coupled with extreme *dzud* events and decreased rainfall led to major livestock losses and disastrous results for the recently expanded pastoralist community. By 2002, livestock numbers had dropped down to 24 million (Lise et al., 2006). These numbers have since picked up, passing the 50 million mark for the first time in 2016 (FAO, 2016a).

Throughout the 60 years of Socialist rule in Mongolia, veterinary support for livestock, owned by collectives, was provided by the presence of a veterinarian in every *soum* (administrative centre), together with regular vaccinations and active disease eradication programs (Splisteser, 2009). Although these veterinary practices succeeded in controlling most livestock disease outbreaks (Edström, 1993), it also led to a loss of traditional veterinary knowledge and skills (Fernández-Giménez, 1999). Since 1990, when collectives were disbanded, surveillance of livestock disease outbreaks have only been undertaken to a limited extent (Odontsetseg et al., 2005). Foot-and mouth-disease continues to cause economic losses and brucellosis, rabies, and anthrax are still serious problems (Odontsetseg et al., 2005). Non-infectious diseases occur frequently in young and new-born animals, notably during the spring months after long and hard winters when nutritional reserves and immune defences are low. These include problems such as gastro-intestinal infections, intoxication, nutritional and mineral deficiencies, pneumonia, diarrhoea, and lesions of internal organs (Edström, 1993). Mange is the most important ecto-parasitic disease, and because of the damage caused to the wool and hides of livestock, leads to large production losses. Drugs for the treatment of mange and other parasitic diseases, such as Ivermectin, are very costly as a result of having to be imported (Edström, 1993). Recently, however, a new decentralised veterinary system has been reported to be under development (SDC, 2009).

2.3 Study area

This study was conducted in the north-central region of Mongolia (see Fig. 2.1). The study area stretches from Zakhvan *aimag* (province) in the west to the Khentii mountain range in the east, and from the capital Ulaanbaatar north up to Tunkhel, with interviews and research taking place in the Khangai mountain ecoregion, the Khentii Daguur ecoregion, and the Central Mongolian ecoregion (Dash et al., 2007) and in various ecosystems (see Appendix A1 and A2 for maps of these ecoregions and ecosystems, respectively). The study area was chosen to allow sampling that would cover various vegetation biomes, including steppe, forests, and high mountains, representing a range of EVM plant use scenarios, and for geographical breadth.

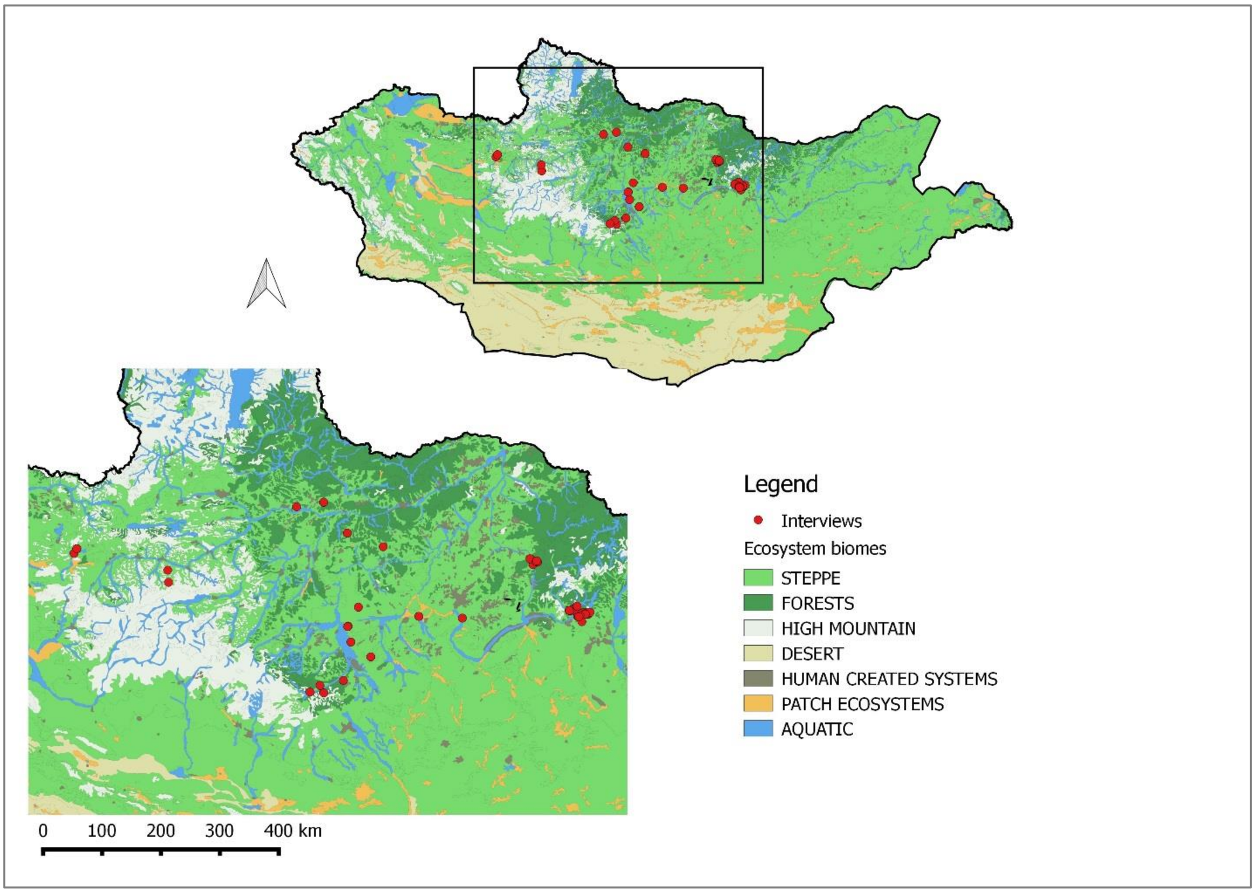

Fig. 2.1 Map of the Mongolian study area and ecosystem biomes, with red markers indicating specific interview sites (source: Chimed-Ochir et al., 2010; Vostokova and Gunin, 2005).

3. Materials and methods

3.1 Data collection

Preliminary field work was done in the autumn of 2014 in order to establish research contacts and to ascertain the feasibility of both the master's research project and of using plant photographs in a book as a reference tool, as described by Thomas et al. (2007). This was followed by an intensive fieldwork session over a three-month period during the summer of 2015. Initial and invaluable contact with herders and key informants was made through the Mongol derby[3], and was further strengthened by links with the Traditional Medical Institute at the National University of Mongolia. Furthermore, members of the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) Biodiversity office in Ulaanbaatar offered valuable fieldwork assistance and advice.

[3] The Mongol derby is a 10 day, 1000 km endurance ride where participants are self-supported, ride local Mongolian horses and overnight with herder families along the way.

Data were collected using a mixed method approach, with both quantitative and qualitative data collection methods (Creswell and Garrett, 2008) and a combination of snowball and purposive sampling (Babbie, 2010). Through the use of semi-structured interviews (see Appendix B1-3) with Mongolian pastoralist families, that included free listing (section 3.1.2), the use of a reference book (Thomas et al., 2007) (section 3.1.3), and a questionnaire (section 3.1.4) detailed information was collected on the ethnoveterinary use of medicinal plants.

Field work was initially conducted using a motor vehicle as the basic form of transport between herding families. This allowed for preliminary preparations to be made and for the research project to get underway in a safe manner. Thereafter, all fieldwork was done using horses (with the assistance of a local guide) as the means of travel between interviews. Although this meant a decrease in the daily distance covered, it soon became clear that this was the preferable mode of transport. Respondents seemed to feel more at ease and the common topic of horses acted as an 'ice-breaker', leading to naturally stimulated conversation around livestock care (personal observation).

Ethical clearance for this research project was obtained from Stellenbosch University (DESC/Seele/Feb2015/1) and from the Traditional Medical Institute at the National University of Mongolia (17132015-17). In addition, ethical guidelines as stipulated by the International Society of Ethnobiology (2006) were strictly followed at all times.

3.1.1 Interviews

Fifty Interviews were conducted in the study area (section 2.3, Fig. 2.1). Upon meeting the family, cultural formalities were observed (Sternberg, 2008), followed by introductions by a local (Mongolian) interpreter and/or horse guide. Background to the research project was given, together with a subject information sheet (written in Mongolian) explaining the aims and objectives of the study, as well as contact details of the primary researcher. A copy of this information sheet was given to respondents as a reference of their consent and to allow them to contact the researcher should they so wish. Interviews only commenced if and after prior informed signed consent was given. It was explained that the interview could be ended at any time by the respondent if they so chose, that questions did not have to be answered, and that all interviewee information would remain confidential. Interviews were held in Mongolian, with assistance from a local interpreter, and hand-written notes were made during the interview. Audio recordings (35) and photographs of the interview were only taken if consented to by the respondents.

Additional data were compiled from personal observations and recorded on detailed observation schedules (Appendix C). Insight was also acquired through informal discussions, journeying on horseback, and staying with herder families. As three different interpreters were used during the fieldwork, audio recordings were transcribed and translated by an official translation company (with a signed confidentiality agreement) in order to account for interpreter bias.

3.1.2 Free listing

Interviews began with a free listing opportunity during which herders were asked to list the medicinal plants that they used for their livestock. This was done verbally and simultaneously translated and written down (Appendix B1). Free listing allowed respondents to become comfortable with the interview situation and encouraged a more balanced positionality of power between researcher and respondents. Recording which plants were mentioned in the beginning of free list (position of mention) and how often certain plants were mentioned (frequency of mention) enabled the researcher to understand the categories and plants that are locally used and important (Quinlan, 2005). This type of emic, or insider approach, incorporates the views of participants (Creswell, 2013) and gives insight into the way people see and classify objects (Martin, 2004). In addition, free listing gave an idea of local nomenclature as well as an awareness of cultural sensitivities around talking about problems and traditional knowledge. Moreover, as mentioned by Martin (2004), free listing can give a fairly complete set of native or local categories as well as information on the most culturally important plants.

Although the focus was on medicinal plants used for ethnoveterinary purposes, other ethnoveterinary information pertaining to the use of minerals, fungi, and items of animal origin as well as plants used for human medicine, was recorded and analysed. In addition, data on non-plant remedies and EVM techniques were also recorded.

3.1.3 Reference book

Free listing was followed by the use of photographs as a reference tool as described by Thomas et al. (2007). Here, herders were asked to page through the reference book '*Flowers of Mongolia*' (Hauck and Solongo, 2010) and asked to point out any EVM plants that are used, known, or recognised (Appendix B2). '*Flowers of Mongolia*' by Hauck & Solongo (2010) contains colour photographs of 435 species of vascular plants belonging to 75 families, reflecting approximately 15% of all vascular plant species in Mongolia. As the book offers a graphic supplement to the existing floras of Mongolia using detailed photographic pictures, it was well-suited to be used as an ethnobotanical reference tool during interviews (Thomas et al., 2007). A 97.8% adult literacy rate in Mongolia (UNESCO, 2006) and the number of years of schooling respondents in this study had received enabled us to make use of the reference book method as respondents were used to seeing two dimensional depictions of real life plants. Photographs of flowering plants are presented with scientific species name according to Gubanov (1996) and the Mongolian species name (written in the Cyrillic alphabet) drawn from Grubov (1982) and Ulziikhutag (1985). In addition, the reference book contains an index of common Mongolian and English scientific names.

Herders were asked to indicate the plants they used for ethnoveterinary purposes and to explain the uses, dosage, collection, storage, preparation, and administration methods, as well as any local names (if different from those in the book). Plants that were recognised and used for other purposes, such as human medicine, were also recorded, and this was used as a proxy for general plant knowledge. Whilst paging through the book, many respondents verified the plants mentioned during the free listing session with photographs of the plants found in the reference book.

3.1.4 Questionnaire

Following on from the reference book session, participants were interviewed using a semi-structured questionnaire with open- and closed-ended questions, and were given an opportunity to ask questions and comment on the study (Appendix B3). Questionnaires were designed to collect respondent demographic data (age, education, livestock numbers, and mobility and migration patterns), and information on livestock illnesses and diseases together with their respective ethnoveterinary remedies. In addition, open ended questions were chosen to gain an understanding of ethnoveterinary knowledge transfer, and to examine herders' perceptions of medicinal plant use threats and conservation (for these results see Chapter 4). Where possible, herder reports were verified by personal observations of nearest water sources, medicinal plant storage methods, and livestock numbers.

3.1.5 Voucher specimens

Plant voucher specimens were collected where possible, either in the field together with respondents (ideally), together with the knowledgeable horse-guide, or from dried specimens that respondents had stored for later use. These were collected, pressed, and transported using a mobile plant press, and were identified by Dr Tserentsoo Byambaa (Traditional Medical Institute, National University of Mongolia). In addition, voucher specimens were compared to digital scans of herbarium specimens and/or images of plants from *The Virtual Guide to the Flora of Mongolia* (University of Greifswald, 2010) to confirm correct identification. Plant voucher specimens were left at the herbarium of the Traditional Medical Institute, National University of Mongolia. Scans of the voucher specimens can be obtained from the primary researcher.

3.1.6 Non-plant items

Although the focus of data collection was on ethnoveterinary medicinal plants, other non-plant products (mostly fungi, mineral and soil products and remedies of animal origin) as well as ethnoveterinary techniques were recorded and analysed.

3.2 Data analysis

3.2.1 Data organisation (species accumulation curve, ethnospecies and use reports)

Data were firstly categorised as EVM plants, EVM remedies of non-plant origin, and EVM techniques and organised accordingly in Excel worksheets. Secondly, a species accumulation curve was constructed for the EVM plant data recorded, using S(est) values computed by the public-domain software EstimateS (Colwell, 2013). This was done in order to assess survey completeness and sampling effort (Begossi, 1996; Hanazaki et al., 2000; Williams et al., 2007). Thirdly, all statistical analyses were performed on EVM plant data using Microsoft Excel (2016).

For these analyses, ethnospecies were used as a proxy for scientific species. Categorising plants by ethnospecies takes folk nomenclature into consideration as explained by Hanazaki and Tamashiro (2000) and is widely used in ethnobotanical studies (De Almeida et al., 2012; Silva et al., 2014; Williams et al., 2005). Many common Mongolian names refer to more than one botanical species within the same family. For example, 'tavan salaa' is used for *Plantago media*, *Plantago major*, and *Plantago depressa* (Plantaginaceae). Ethnospecies were therefore used across all analyses, to account for folk names used for more than one scientific species and to ensure that certain species were not repeated and over-represented (Williams et al., 2005).

3.2.2 Analysis of EVM plant importance: use value (UV) and free listing

Where applicable, EVM plant use statistics were based on use reports (UR). A use report is defined as a preparation and administration of a specific plant part against a specific disease, mentioned by one informant, as described in Ahmad et al. (2015). With this as the unit of analysis, plant importance, plant use and ailment categories were described and analysed.

In order to ascertain species importance, the free-list-item salience index can be calculated for every species free listed by respondents (Smith, 1993). This takes into consideration the order or position of mention, the length of the free list and the number of times a species was mentioned (frequency of mention), thereby indicating which species are important to the respondents (Martin, 2004; Quinlan, 2005). The salience index of each ethnospecies reported from free lists was calculated according to Smith and Borgatti (1997), as:

$$S = \left(\frac{\Sigma\left(\mathrm{L} - \mathrm{R}_j + 1\right)}{\mathrm{L}}\right)/\mathrm{N}$$

Where S is the free-list salience index, L the length of list (number of items), R_j the rank of item *j* in the list (first=1) and N is the number of lists in the sample.

To further understand plant importance in terms of plant use, the use-value (UV) is calculated. The UV estimate demonstrates the relative importance of species known to the respondents, based the number of different uses for a specific plant as reported by respondents (Sharma and Manhas, 2015). The UV of each EVM ethnospecies was calculated using the following two-step formula (Phillips and Gentry, 1993), where the UV attributed to a particular species (s) by one informant (i) is calculated as:

$$UV_{is} = \Sigma \mathrm{U}_{is}/n_{is}$$

where U_{is} is the number of use reports mentioned by the informant for the species and n_{is} the number of interviews held with the informant (in this case each respondent was only interviewed once, therefore, $\mathrm{n}_{is} = 1$). The overall use value of a species can then be calculated as follows:

$$UV_s = \Sigma \mathrm{UV}_{is}/n_s$$

where the sum of use values contributed by each informant is divided by the total number of informants who mentioned the species (n_s).

3.2.3 Ailment categories, informant consensus factor (ICF) and fidelity level (FL%)

Livestock illnesses and ailments, as mentioned and described by the respondents, were classified into 16 groups using an emic or 'bottom up' approach. Ethnoveterinary knowledge is closely linked to cultural practices and therefore, ailment categories should reflect the cultural context and local classification (Staub et al., 2015). For this reason, a natural classification of ailments, guided by respondents' answers, was used.

In order to examine and compare the similarity between plants used within an ailment category, the Informant Consensus Factor (ICF) of each ailment category was calculated. This gives an indication of the level of agreement on selection criteria between informants (Gazzaneo et al., 2005). Values pertaining to the ICF range between 0 and 1, with values closer to 1 indicating a well-defined selection criteria in the community and a high degree of sharing of EVM knowledge between respondents (Sharma et al., 2012).
ICF values for ailment categories were calculated according to Trotter and Logan (1986):

$$ICF = \frac{(n_{UR} - n_{spp.used})}{n_{UR} - 1}$$

where n_{UR} is the number of use reports per category of use, and $n_{spp.used}$ is the number of species used per category of use.

To ascertain the most preferred ethnospecies used for a particular ailment category, the fidelity level (%) of each ethnospecies within that category was determined (Musa et al., 2011). This was calculated according to Friedman et al. (1986):

$$FL\ (\%) = \left(\frac{n_P}{N}\right) \times 100$$

where n_P is the number of informants mentioning a particular plant species for a specific disease and N is the total number of respondents mentioning this plant species.

3.2.4 Non-plant data and ethnoveterinary techniques

Non-plant items were grouped into the following categories: fungi, mineral, geological, animal-derived, and other and were recorded together with their corresponding number of citations. Fungi were tentatively identified using photographs of respondent specimens and respondents' descriptions of growth habitat and local names. Of all animal-derived products, only the marmot's second stomach (*Marmota sibirica*) and a shed snake skin were shown to the research team.

4. Results

4.1 Descriptive statistics

A total of 50 interviews were conducted during this study. These included a total of 40 free listings and 40 reference book sessions, with 48 at least partially completed, questionnaire surveys. Forty-eight percent of interviews were led by men (n=24) and 52% by women (n=26); however, it must be noted that although interviews (including free listing and use of the reference book method) were conducted mainly with one respondent (usually the man or woman at the head of the household) they were not conducted in an isolated setting. Interviews were usually held in the family home in a fluid manner, with tea being served and a general interest, curiosity, and coming and going. The sample size of 50 interviews therefore represents 50 family units' opinions and knowledge rather than that of 50 individuals. The age of main respondents ranged from 27 to 79 years with an average age of 52 years.

In terms of plant knowledge with respect to gender, the majority of respondents (70%, n=29) indicated that there is no difference in the medicinal plant knowledge held by men versus women. Here comments included "*there is a good exchange between men and women*" and "*there is no difference, it depends on the person's interest*". Fifteen percent of respondents (n=6) perceived men to be more knowledgeable about ethnoveterinary medicinal plants, and equally, 15% perceived women to be more knowledgeable. Here one respondent mentioned that men know more about choosing plants and women know more about the preparation thereof. Reasons for men knowing more about medicinal plants included "*men know more because they go with the animals*", "*it's easier for men to travel to the mountains where medicinal plants grow*" and "*men know more because they are closer to the animals*". Reasons for women being more knowledgeable about medicinal plants for livestock use included women being more sensitive and the comment "*women know better than men, men just fly on their horses without seeing what plants are under them*".

During the data gathering months (June-July 2015), most herders were located in the summer pastures of their migratory cycle (15% of those interviewed do not migrate anymore), with a few being in special pre-*Naadam*[4] grazing areas. The drought of the summer 2015 (FAO, 2016b) affected fieldwork with many herders having to move closer to water sources or in some cases even having to bring in water from other areas. With regards to seasonal migration patterns, 64% of all respondents together with their families (n=47 families) moved three times or more per year (Fig. 2.2), with annual moves ranging from 2 to 200 km and an average distance of 38 km per move (Fig. 2.3). Fourteen percent (n=7) of family units have stopped seasonal migrations and now follow a sedentary pastoralist lifestyle.

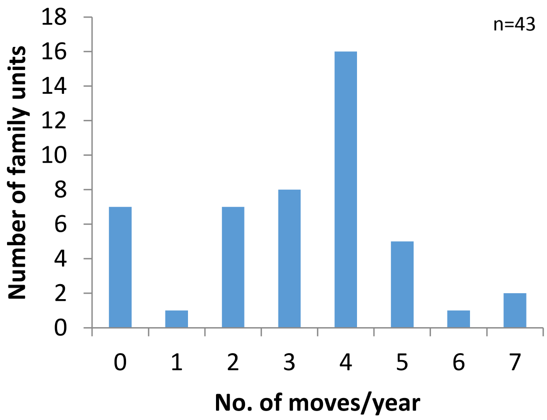

Fig. 2.2 Number of nomadic moves per family unit (n= 47 family units) with 0 representing pastoralists that do not move anymore.

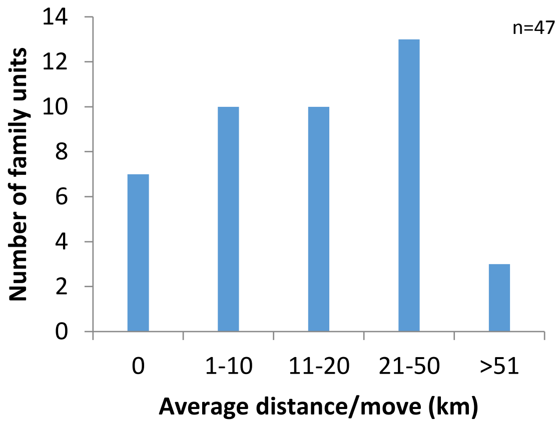

Fig. 2.3 Average distance travelled by family units (n=43 family units) with 0 representing pastoralists that do not move anymore.

Herder experience (years of herding) ranged from three to 62 years with an average number of 33 years of herding experience per respondent. Eighty-four percent of respondents had completed at least four years of schooling with only one respondent having received no formal education (Fig. 2.4). Respondents, together with their families, kept mixed herds of livestock (cattle/yak, sheep, goats and horses) in varying ratios, with total herd sizes ranging from three head of cattle to more than 1500 head of livestock and an average of 405 head of livestock per family unit. Data on livestock numbers should be viewed conservatively as for some respondents this was a sensitive question regarding personal finances and possibly felt the need to underestimate herd sizes. Of the 50 herders interviewed, 42 mentioned herding as their main source of income (84%). Other sources of income were tourism and pension funds.

[4] *Naadam* is a traditional festival in Mongolia centred around horse racing, wrestling and archery.

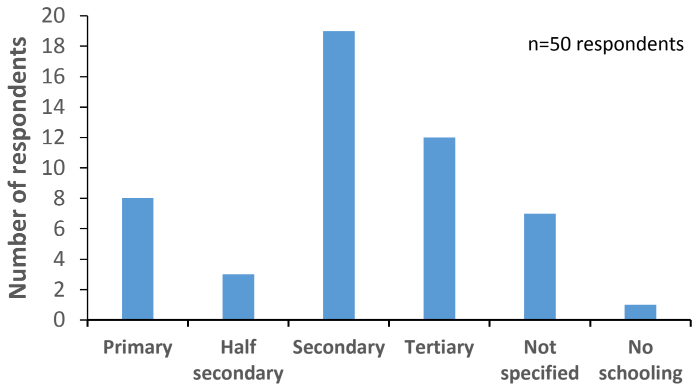

Fig. 2.4 Level of schooling held by respondents that were interviewed about ethnoveterinary knowledge and practices (n=50).

4.2 Ethnoveterinary medicinal plants

A total of 39 botanical species from 28 genera and 20 families, with a total of 309 use reports, were recorded as being used for ethnoveterinary medicinal purposes. Botanical species, together with family, vernacular name and meaning thereof, voucher/photo specimen identification code, ailment category, plant parts used, notes on collection, preparation, mode of administration and use report values are arranged alphabetically according to genera in Table 2.1. From these plant species, the most represented families are Ranunculaceae and Asteraceae (six species each), followed by Rosaceae (four species) and Gentianaceae (three species) (Fig. 2.5).

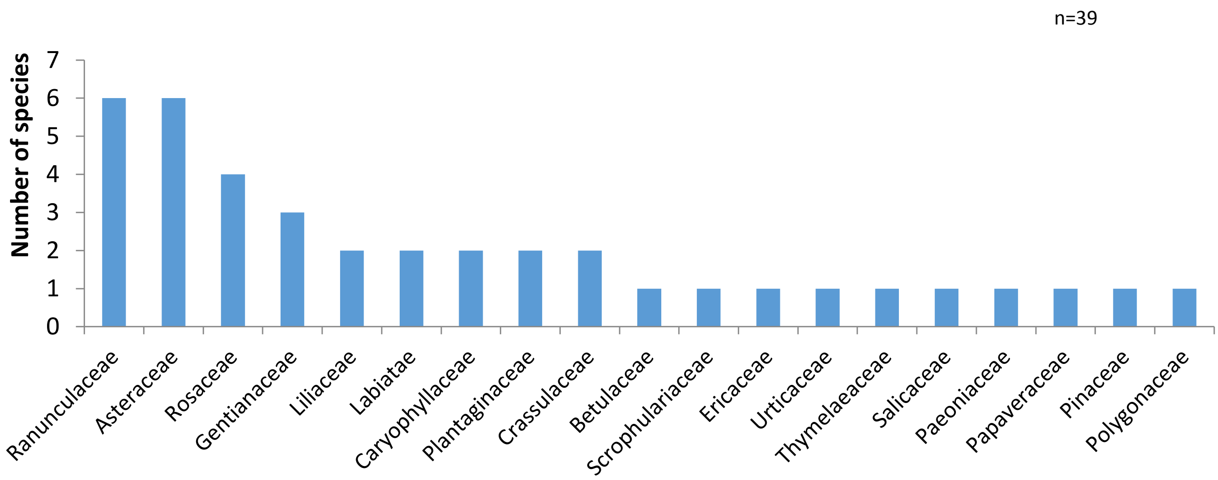

Fig. 2.5 Number of species used for ethnoveterinary purposes, arranged according to botanical family (n=39).

It should be noted that all species are wild harvested, and the majority of treatments are prepared from a single species, with only two citations of species being used in combination: *Dianthus* spp. together with white mushroom (tentatively identified as *Agaricus bisporus*) and *Rheum undulatum* together with red ants' nest. Medicinal plants were used on all four livestock types (cattle/yak, sheep, goats and horses), unless otherwise specified, and 59% of plants are reported as also being used for human medicine (Table 2.1).

Ethnoveterinary plant species in Table 2.1 are classified according to ailment categories. A brief description and explanation of each ailment category, as developed from participants' responses, is given below.

1. **Medicinal food**: includes salutiferous (health-giving) plants used as extra feed during winter and spring, and plants with humoral properties that are 'heating'.
2. **Gastrointestinal ailments:** includes diarrhoea, bloat, indigestion, stomach problems, abdominal problems, body swelling, and stomach ulcers.
3. **Post-partum ailments:** mainly retained placenta and resulting fevers.
4. **External wounds**: skin or surface wounds (often as a result of wolf attacks) and burns.
5. **Internal wounds**: including organ injuries.
6. **Respiratory ailments**: any lung- or chest-related problems.
7. **Skeletomuscular ailments**: broken bones, muscle damage, bruising/swelling.
8. **Fever**: often described as internal heat, or the need to reduce body heat. Fevers resulting from post-partum complications fall under post-partum ailments.
9. **Hepatological ailments**: liver- and gall bladder-related problems.
10. **Ritual**: includes plants used for ritual purposes such as clearing bad energy.
11. **Dermatological ailments and ectoparasites**: includes plants that are specified as being good for the skin, used to treat hair loss, bumpiness of skin, and mange. Reports of unspecified parasites where treatment was applied topically are included.
12. **Endoparasites**: internal parasites, mainly worms.
13. **Urological ailments**: includes urinary retention and kidney problems.
14. **Circulatory aliments**: relates to blood, heart and spleen ailments, especially ***deluurekh***, (enlarged spleen).
15. **Poisoning**: refers to the treatment of poisoned livestock
16. **Other**: Thirst (one use report), unspecified swelling, tumours and ulcers (seven use reports), castration-related problems (two use reports), fly repellent (one use report), lactation (one use report), and reproductive stimulants (one use reports).

For the region where this study took place, the majority (79%) of ethnoveterinary medicinal plants (Table 2.1) were described to be collected in summer or autumn, and dried for storage and later use during winter and spring. Correct drying was described as hanging the plants in a dry, dark place, with emphasis on the importance of correct drying procedures. Storage containers shown to the research team included Pringle chips cardboard boxes, cotton cloth bags, plastic bags, and disused medicine bottles.

In general, voucher specimens were difficult to collect for all mentioned plant species (both from free listing opportunities and the reference book). This was due to the ongoing drought at the time (FAO, 2016b), herders being very busy in the sheep shearing season and cultural objections to the collection of plant samples. In addition, many medicinal plants were cited as growing far away from the homestead in sacred mountains and forests.

In the case of some species where no voucher specimen could be collected, either a digital photography number, as used by González et al. (2011), or a reference book page number is included (Table 2.1). Plants mentioned during free listing were verified where possible with the reference book during the interview. Plant species that were only identified from the reference book and without a voucher or photographic specimen were carefully and conservatively considered and were only included in the table if two or more respondents identified the same plant in the book with the same common name. These species are marked with an asterisk in Table 2.1. The species with less than two reference book identifications, and those species mentioned during the free listing but not verified with the reference book or voucher specimen amount to 34 (Appendix D). These, together with the species that respondents mentioned as being secret, were excluded from all analyses.

Table 2.1

Ethnoveterinary medicinal plants used by Mongolian pastoralists. All numbers in brackets indicate the use reports (UR). 'Same' in the last column indicates that the plant has the same use in human medicine. Plant species without voucher or photo specimen, but identified from the reference book by two or more respondents are indicated by an asterisk.

Species, family, collection #	**Local name (meaning)**	**Growth form**	**Ailment category (UR)**	**Parts used (UR)**	**Route of administration (UR)**	**Collection, if mentioned (UR)**	**Use (UR)**	**Total URs**	**Used for human medicine**
Achillea asiatica* Serg., **Asteraceae, Hauck and Solongo (2010:53)	Yazkhuu (no meaning), neg myanga navchit urgamal (one thousand leafed plant)	Herb	Wounds (3)	Flower and leaves (3)	Topical (1). Topical and oral (2)	Harvest before 20 August, dry in shade (1)	A decoction is made after which the liquid is put on the wound and the plant is used to make a bandage for wounds, wolf bites and scratches (1). Dried in shade, boiled in water, given orally and applied topically on external wounds (2)	3	Y same (2). N (1)
Allium schoenoprasum L., **Liliaceae**, BS_250715_003	Khunkheel (no meaning)	Herb	Medicinal food (5)	Leaves (1), Aerial parts (1), Whole plant (1), Not specified (2)	Feed (5)		Given to animals to eat in autumn for weight gain before winter (1). Pickled with salt and added to wheat grain for winter feed (1). Used as extra feed (1). Mixed with bran and salt to heat animals from the inside during winter (1). Dried and mixed with curds and bran to treat tiredness (1)	5	Y (1) to season food. N (4)
Artemisia frigida Willd., **Asteraceae**, BS_030815_027	Agi (no meaning)	Shrub	Medicinal food (7)	Above ground parts (7)	Grazing (1). Feed (6)	Harvest in summer and dry for winter (1). Collect in August and dry in the shade (2)	Weak animals are herded to areas where it grows (1). Mixed with arts (*Juniperus* spp.) and dairy products and fed to weak animals (1), sometimes mixed with bran (1). Harvested in summer, dried and used as extra feed in winter for tired livestock (3). Dried, powdered and mixed with bran, *khujir* salt, milk and burned, powdered bone and fed to livestock (1)	7	N (7)
Artemisia gmelinii Web. ex Stechm., **Asteraceae**, BS_080815_029	Tsarvan (no meaning), sharilj (no meaning)	Shrub	Respiratory (2). Medicinal food (2)	Flower (2). Above ground parts (1). Not specified (1)	Oral (2). Feed (2)	Pick in summer and dry for winter (1). Pick in autumn (1)	Flower is boiled in water and given orally as cough treatment and is good for the chest and throat (2). Dried to use as extra feed in winter (2)	4	Y same (2). N (2)
Betula spp. **Betulaceae** Hauck and Solongo (2010:30-31)	Khusnii bor ungur (brown furred layer of birch tree bark)	Tree	Gastrointestinal (3)	Bark (3)	Oral (3)	Collected from fallen trees that have dried (1)	Boil, strain and give orally for stomach pain and diarrhoea, especially to young livestock (2), and during the hot season (1)	3	Y same (2). N (1)

Cacalia hastata L. **Asteraceae**, BS_120815_036	Iguu shen (no meaning)	Herb	Wounds (9). Gastrointestinal (2). Skeletomuscular (3). Urological (1). Post-partum (1). Medicinal food (1). Respiratory (1)	Leaves (13). Above ground parts (5)	Topical (3). Oral (9). Topical & oral (3). Not specified (3)	Collect in August (1). Grows from end of August to September (1). Good time to collect medicinal plants is from the 15th June (1). Dried in the shade or dark place (3)	A decoction is made for wound treatment, both the resulting liquid (3) and the leaves (1) are placed on the wound. Dried powdered leaves are also put on external wounds (1). Dried leaves are used as a bandage for wolf or dog bite wounds (1) or infused and the wound washed put (1). A decoction of dried leaves is given orally to treat kidney problems (1), post-partum problems (1) and general weakness (1), for stomach ulcers (2), internal wounds (1), as treatment for a serious cold and pain in the lungs (1), and as treatment for sore muscles and muscle injuries (1). Leaves are used for broken bones (1), muscle damage (1) and external wounds (1)	18	Y (18)
Dianthus superbus L. subsp. *superbus*, **Caryophyllaceae**, IMG_LD_290914	Yumduujin (no meaning), bashir (no meaning)	Herb	Other (1). Fever (4). Post-partum (5). Circulatory (1)	Flower (5). Flower and leaves (6)	Oral (10). Not specified (1)	Grows in the mountains. Best time to collect is in July (after July the colour is not so bright anymore). Dry in cool, shady space. If kept in sunlight it will lose its quality, don't dry on the roof (1)	Flowers are put in boiling water or boiled in water and given orally post-partum to treat dehydration (1), fever (1) and aid with the delivery of retained placenta (3) especially for cattle (1). Flower, stem and leaves are boiled in water and given orally for fever (3) and blood problems (1). Used for post-partum placenta related infections (1)	11	Y same and for the heart (8). N (3)
Dianthus versicolor Fisch. Ex Link, **Caryophyllaceae**, BS_020815_020	Yumduujin (no meaning), bashir (no meaning)	Herb	Post-partum (9). Fever (2). Circulatory (1)	Flower (5). Flower and leaves (5). Not specified (2)	Oral (10). Not specified (2)	Dried by hanging from top of *ger* (felt tent)	Flower is put in boiled water and given orally for delivery of retained placenta (1). A decoction of the flower is made and given orally for delivery of retained placenta (4), especially for yak and cattle (2). A decoction is made from the flower and leaves and given orally to treat fevers (2) and blood problems (1). Used for post-partum placenta related infections (1). Flower and leaves are boiled and mixed with *tsagaan muug* (white mushroom) to treat fever that develops from retained placenta (1)	12	Y same (8), N (4)
Gentiana algida* Pall., **Gentianaceae, Hauck and Solongo (2010:90)	Vanjingarab (no meaning), tsagaan degd (white degd)	Herb	Respiratory (7)	Flower (5). Flower and leaves (2)	Oral (7)	Flowers in July and August (1). Can be dried and stored (1)	A decoction is made and given orally as treatment for a cold (4) and cough (1), pneumonia (1), and is good for the lungs (1)	7	Y same (7)

Gentiana decumbens L. fil., **Gentianaceae**, BS_030815_021	Degd (no meaning), khukh degd (blue degd)	Herb	Respiratory (4). Fever (1). Hepatological (1). Other (1)	Flower (5). Above ground parts (1). Whole plant (1)	Oral (7)	Flowers in July and August (1). Can be dried and stored (1)	Whole plant (200g) is boiled in water and given orally for 3 days to treat fever (1), cough (1) and dehydration (1). A decoction is made with the flower and given orally as treatment for common cold (1), cough (1) and is good for the liver (1). A decoction of above ground parts is used as a cure for cough (1)	7	Y same (6). N (1)
Gentiana macrophylla* Pall., **Gentianaceae, Hauck and Solongo (2010:91)	Khukh degd (blue degd)	Herb	Respiratory (3)	Flower (2). Above ground parts (1)	Oral (3)	Starts to grow in late September and flowers in late autumn. Dried in the shade (1)	A decoction of the flower is used to treat common cold (2). A decoction of the above ground parts is given orally for long lasting airway diseases (1)	3	Y same (3)
Leontopodium leontopodioides (Willd.) Beauv., **Asteraceae**, BS_030815_026	Tsagaan turuu (white turuu), tsagaan uul (white mountain)	Herb	Urological (1)	Whole plant (1)	Oral (1)	Dried and stored in *ger* (1)	A decoction is given to livestock orally to treat urinary retention (*shees bagasah*) (1)	1	N (1)
Leontopodium ochroleucum* agg. , **Asteraceae, Hauck and Solongo (2010:69)	Tsagaan turuu (white turuu)	Herb	Circulatory (2). Urological (1)	Flower (2). Whole plant (1)	Oral (3)	Dried and stored in *ger* (3)	A decoction of the whole plant is given to livestock orally to treat urinary retention (*shees bagasah*) (1). Circa 10 flowers are boiled in water and the liquid given orally to treat blood loss (1). A decoction with flowers is given orally to treat high blood pressure (1)	3	Y (high blood pressure). N (2)
Lilium pumilum* Delile, **Liliaceae, Hauck and Solongo (2010:244)	Tumsnii tsetseg (potatoe flower). Tumsnii ulaan tsetseg (red potatoe flower). Saraana (no meaning)	Herb	Circulatory (1). Fever (1). Other (1). Endoparasites (1)	Root (bulb) (1). Bulb in winter, flower in summer (2). Flower (1)	Oral (2). Topical & oral (2)	Flower can be dried (1)	Root (bulb) is boiled in milk and the milk is given orally, good for the heart (1). In winter the bulb is given to eat, in summer the flower is boiled in water and given orally for fever (1) or made into a paste and put on body for swelling (1). The flower is dried, boiled in water and given orally to animals to treat white worm in faeces (1)	4	Y same (3). N (1)
Orostachys spinosa (L.) C. A. Mey., **Crassulaceae**, IMG_JW_260715	Uld uvs (uld grass)	Herb	Other (1). Dermatological (1)	Leaves (1). Leaf sap (1)	Oral (1). Topical (1)		Leaves are given orally for dehydration and thirst (1). Leaf sap is squeezed on to white patch of dry skin (1)	2	N (2)
Paeonia anomala L., **Paeoniaceae**, BS_300615_036	Tseene (no meaning), yagaan tseene (pink tseene)	Herb	Gastrointestinal (2). Medicinal food (1)	Root (2). Flower (1)	Oral (3)	Pick root in August (flower goes into root) (1). Dry root (2), by hanging from the roof (1)	A decoction is made with the dried root and given orally for body swelling (1). Dried root is powdered and mixed with food for weak animals (1). A decoction is made with the flower and given orally, good for the intestines (1)	3	Y same (1). N (1). Not specified (1)

Papaver nudicaule L., **Papaveraceae**, BS_110815_031	Sharkhnii shar tsetseg (yellow flower of wound)	Herb	Wounds (1). Skeletomuscular (1)	Flower and leaves (2)	Oral (2)	Flowers for 20 days after it rains. Can be dried	An infusion is made and given orally for wound healing (1) and broken bones (1)	2	Y (ulcers) (2)
Pinus sibirica* Du Tour. **Pinaceae, Hauck and Solongo (2010:26)	Nars, Borgotsoi (no meaning)	Tree	Other (2)	Wood and leaves (2)	Inhalation. Topical		Horses inhale smoke from burned wood and leaves for recovery after castration (1). Infected wound from castration is covered with smoke from burning wood and leaves (1)	2	N (2)
Plantago depressa Schlecht., **Plantaginaceae,** BS_010815_013	Tavan salaa (five branched)	Herb	Wounds (12). Gastrointestinal (5). Other (1)	Leaves (18)	Topical (8). Oral (7). Not specified (3)	Harvest in August (1). Collect from mid-July to mid-August before it gets dry and leaves turn yellow (1)	A decoction is made with leaves, the liquid is poured over wounds, puncture wounds and burns (1) and the leaf is placed on the wound (2). Fresh leaf is put on wounds (4). A decoction is made with leaves and given orally for organ injuries (1), stomach ulcers (1), inner stomach lining (1), stomach wounds (1), diarrhoea (1) and wounds (2). Fresh leaves are chewed and put on burns and wounds (1). Leaves are used for the stomach (1) and for wounds (2)	18	Y same (9). N (9)
Plantago major L., **Plantaginaceae,** BS_110815_032	Tavan salaa (five branched)	Herb	Wounds (18). Gastrointestinal (5). Urological (1)	Leaves (24)	Topical (10). Oral (11). Topical & oral (2). Not specified (1)	Harvested in August (1)	Fresh leaves are placed on wound (6), dampened and put on wound (1). A decoction is taken orally for internal wounds (4), infected wounds (1), stomach ulcers (1), inner stomach lining (1), injuries (1), stomach problems (1), indigestion (1) and urinary retention (1). A decoction is made with leaves, the liquid is poured over wounds, puncture wounds and burns (1) and the leaf is placed on the wound (2). Fresh leaves are chewed and put on burns or wounds (1). Leaves are given to animals to eat, good for the stomach (1). Leaves are used to treat wounds (1)	24	Y same (16). N (8)

Potentilla fruticosa L., **Rosaceae**, BS_300715_009	Borolzgono (no meaning), Borolzgon shar tsegtseg (borolzgon yellow flower), shar tsetseg (yellow flower), togoonii ugaaltuur (sink cleaner)	Shrub	Skeletomuscular (1). Gastrointestinal (1)	Flower (2)	Oral (2)	Collected end of August, dried in the shade and stored in cotton bag (1)	A decoction is made from dried flowers and given orally for diarrhoea (1), mixed with charcoal and given orally for broken bones (1)	2	Y (heart disease) (1). N (1)
Prunus padus L., **Rosaceae** IMG_BS_100815	Monos (no meaning, name of the fruit), moil (no meaning, name of the tree)	Tree	Gastrointestinal (4)	Fruit and leaves (1). Wood (1). Fruit (2)	Oral (4)	Fruit is dried in the shade and stored (3). If there is no fruit, wood is used (1)	Dried fruit or leaves are infused in hot water (2), or a decoction is made with a small branch (1) and given orally to treat short-term diarrhoea. Dried fruit is mixed with bran and given to animals to treat diarrhoea (1)	4	Y same (3) N (1)
Pulsatilla ambigua* (Turcz.) Juz., **Ranunculaceae, Hauck and Solongo (2010:147)	Yargui (no meaning)	Herb	Medicinal food (7). Skeletomuscular (1). Wounds (1)	Flower (8). Whole plant (1)	Grazing (7). Topical (2)	First flower in spring (1). Most potent during first week of flowering (1)	Livestock are herded to areas where it is in flower and allowed to graze, good for general health and energy (2), weight gain in spring (3), especially for goats (1) and disease protection (1). Flower is dampened and applied topically for swelling (1) and bleeding (1)	9	Y same and for throat, can be a bit harsh (5). N (4)
Pulsatilla bungeana* C. A. Mey. var. *bungeana*, **Ranunculaceae, Hauck and Solongo (2010:147)	Yargui (no meaning)	Herb	Medicinal food (6). Parasite-related (1). Skeletomuscular (1). Wounds (1)	Flower (7). Whole plant (1). Not specified (1)	Grazing (7). Topical (2)		Livestock are herded to areas where it is in flower and allowed to graze, good for energy (1), weight gain (3), for weak animals (1), treatment against worms (1) and disease protection (1). Flower is dampened and applied topically for swelling (1) and bleeding (1)	9	Y same and for internal organs, can be a bit harsh (5). N (4)
Pulsatilla flavescens* (Zucc.) Juz., **Ranunculaceae, Hauck and Solongo (2010:148)	Yargui (no meaning), shar yargui (yellow yargui), tsagaan tuulga (white antihelmintic)	Herb	Parasite-related (2). Skeletomuscular (1). Wounds (1). Medicinal food (4). Lactation (1)	Flower (6). Above ground parts (1). Flower and leaves (1). Not specified (1)	Grazing (7). Topical (2)	First flower in spring (1). Only flowers in June (1)	Livestock are herded to areas where it grows and graze on the flower and leaves, cleans the stomach of worms (2). Flower is dampened and applied topically for swelling (1) and bleeding (1). Livestock graze where it is in flower, good for weight gain (2) and disease protection (1), increases lactation (1) and gives energy in spring (1)	9	Y same and for internal organs, can be a bit harsh (3). N (6)

Pulsatilla tenuiloba (Turcz.) Juz., **Ranunculaceae**, BS_020815_018	Yargui (no meaning)	Herb	Skeletomuscular (1). Wounds (1). Medicinal food (5). Parasite related (1)	Flower (7). Above ground parts (1)	Topical (3). Grazing (1)		Flower is dampened and applied topically for swelling (1) and bleeding (1). Herd animals to where it is in flower, good for weight gain (1), disease protection (1), weak animals (1), helps with recovery (1), gives strength to sheep and goats (1). An infusion is made and put on the skin to treat mange (*khamuu*) (1).	8	Y same (3). N (5)
Pulsatilla turczaninovii* Kryl. & Serg., **Ranunculaceae, Hauck and Solongo (2010:149)	Yargui (no meaning)	Herb	Medicinal food (7). Skeletomuscular (1). Wounds (1). Parasite-related (1)	Flower (9). Above ground parts (1)	Grazing (7). Topical (3)		Eaten by animals, especially goats, good for the immune system (1) and weight gain (1). Flower is dampened and applied topically for swelling (1) and bleeding (1). Herd animals to where it is in flower, good for weight gain (1), disease protection (1), weak animals (1). Sheep and goats gain strength from eating it (1) and helps with recovery (1). An infusion is made and put on the skin to treat mange (*khamuu*) (1).	10	Y same (4). N (5). Not specified (1)
Rheum undulatum L., **Polygonaceae**, BS_030815_022	Gishuugene (no meaning)	Herb	Wounds (7). Post-partum (2). Fever (1). Gastrointestinal (1). Skeletomuscular (1)	Root (8). Leaves (2). Stem (1). Stem and root (1)	Topical (6). Oral (4). Topical & oral (2).	Harvest at the end of summer (1). Root and leaves can be dried (6). Stem can be stored with salt (1)	Dried root is powdered and put on wounds (2) and mixed with ants' nest, boiled in water and applied topically to wolf attack wounds (1). Fresh root is crushed and put on wound together with bark of root (1). A decoction is made with fresh root and poured over wound (1), and given orally for retained placenta and fever (1). A decoction with dried leaves is given orally for internal wounds (1) or topically for external wounds (1). A decoction with small amount of dried root is used to aid in delivery of placenta (1) and for the digestive system (1), given orally for fever, applied with bandages to treat broken bones, bruise and limp (1). Stored and salted stem can be applied to wound (1)	12	Y same and for ulcers (9). N (3)
Rhodiola quadrifida (Pall.) Fisch. et Mey., **Crassulaceae**, WHO (2013:166)	Altan gagnuur (golden solder)	Herb	Skeletomuscular (3). Wounds (1)	Flower (summer) and root (winter) (4)	Oral (4)	Root can be dried and keeps for many years	A decoction is made from either fresh flowers (if present) or dried root and given orally to animals for broken bones (2), muscle injury (1), open wound (1)	4	Y same (4)
Rosa acicularis Lindl., **Rosaceae**, BS_080815_030	Nokhoin khoshuu (dog's nose)	Shrub	Other (3). Medicinal food (1)	Fruit (4)	Oral (3). Feed (1)	Can be dried and stored (1) and preserved in water with sugar(1)	Fruit is boiled in water or milk and the liquid is given orally for treatment of swelling and tumours (1), bumps and growths (1) and inflammation (1). Dried fruit is crushed, mixed with feed and given to emaciated animals (1)	4	Y same (3). N (1)

Salix pseudopentandra* (B. Flod.) B. Flod., **Saliceae, Hauck and Solongo (2010:175)	Burgas (no meaning)	Tree	Post-partum (1). Medicinal food (1)	Bark (1). Leaves (1)	Oral (1). Feed (1).	Leaves collected in autumn (1).	A decoction of the bark is given orally to aid in delivery of retained placenta (1). Leaves are fed to livestock as extra feed in winter (1)	2	N (2)
Sanguisorba officinalis L., **Rosaceae**, BS_250715_002	Sud (feather), sud uvs (feather grass)	Herb	Gastrointestinal (30). Post-partum (3). Fever (3). Other (1). Wounds (1). Circulatory (1)	Inflorescence (34). Seed (1). Inflorescence & seed (1). Not specified (3)	Oral (39)	Harvest in autumn (1). Collected in August (4), when the quality is in the flower, before it goes to the root. Harvested from 15 July-15Aug (1). Collected Aug-Sep and dried (1). Collected between 15 and 20 June and dried in shade (1). Can be harvested until 20 Aug (1).	A decoction is made with the dried inflorescence and given orally to treat: diarrhoea (14) especially for young livestock (7) three times a day (1), stop bleeding (1) treat blood loss (1), treat spring diarrhoea (1), fever (2), retained placenta (2), for stomach stress (1), to keep intestinal flora (1), mixed with *Plantago* spp. for diarrhoea (1), poured into nostril (for horses) or mouth (other livestock) to treat stomach problems (1), treatment for stomach disease (1), stomach ulcer (1). One handful per animal of dried inflorescence is boiled and given orally for fever (1), heat dehydration (1), delivery of placenta (1). Seed is given orally to treat diarrhoea (1).	39	Y same (16). N (22). Not specified (1)
Stellera chamaejasme* L., **Thymelaeaceae, Hauck and Solongo (2010:192)	Dalan turuu (seventy pappus)	Herb	Skeletomuscular (5)	Flower (3). Leaves (2)	Topical (2). Oral (1). Topical & oral (2).		A decoction is made with the flower and the flower is applied topically to bruises and swelling (2) and liquid given orally for treatment of tumours (1). A decoction is made with fresh or dried leaves and given orally (1) to treat broken bones and damaged muscle and leaves used as compress (1).	5	Y same (2). N (3)
Thalictrum minus* L., **Ranunculaceae, Hauck and Solongo (2010:154)	Burzgar (no meaning)	Herb	Hepatological (2). Respiratory (1). Fever (1).	Leaves (4)	Oral (4)		A decoction is given orally and good for the liver (2), used as treatment for cold (1) and fever (1).	4	Y same (4)
Thymus dahuricus Serg., **Labiatae**, BS_030815_025	Ganga (no meaning)	Shrub	Fever (1)	Leaves (1)	Oral (1)	Collected when needed (1)	A decoction is made and given orally to treat fever (1).	1	Y same (1)
Thymus gobicus* Tscherneva, **Labiatae, Hauck and Solongo (2010:105)	Ganga (no meaning)	Shrub	Respiratory (1). Skeletomuscular (1). Ritual (1). Other (1)	Whole plant (1). Leaves (2). Above ground parts (1)	Inhalation (3). Topical (1)		Smoke from burning the whole plant is used to treat cough (1). Stem and leaves are placed on dry dung, lit and smoke is used to clear negative energy from animal shelter (1) and to stimulate mating (1). Above ground parts are boiled and made into a paste to put around joints for joint problems (1).	4	Y for backache & swollen feet (2). N (2)

Urtica cannabina* L., **Urticaceae, Hauck and Solongo (2010:199)	Khalgai (no meaning)	Herb	Medicinal food (26). Skeletomuscular (2). Respiratory (2). Gastrointestinal (2). Other (1). Wounds (1). Circulatory (1)	Leaves (21). Above ground parts (3). Not specified (9). Stem (1). Whole plant (1)	Feed (23). Topical (2). Oral (10)	Collected between 15 July and 15 August, dried, crushed and stored in cotton bag (1). Collected from 15 August to end of August, dry and use for winter and spring (2). Harvest after August (1). Dry in shade (1). Leaves can be stored with salt.	Leaves are dried and given as winter feed (2) mixed with hay (1) wheat (1), bran (3) speeds up recovery (1), for extra feed in spring (2), and to increase heat in winter (3), warms intestines (1). A decoction is made from dried leaves, given orally as immune booster (2), to treat diarrhoea (1), for exhaustion (3), extra food in spring (1) and leaves are placed topically on wounds (1) and swelling (1). A decoction of fresh leaves is given orally to weak animals (2). Leaves are stored in salt to use during winter for weak animals (5) and to increase amount of blood (1). A decoction of fresh or dried young leaves used to treat lung and chest problems (1), helps horses with short breathing to relax (1), used to strengthen and heal bones (1). Dried leaves are mixed with water, bran and curds to treat tiredness (1).	35	Y same & for seasoning (14). N (21)
Vaccinium vitis-idaea L., **Ericaceae**, IMG_BS_300914	Anis (no meaning)	Shrub	Respiratory (5). Wounds (1). Fever (1)	Leaves (4). Leaves and fruit (2). Fruit and flowers (1)	Oral (7)	Collected from mountain in September, autumn and dried	A decoction of leaves, fruit and flowers is given orally to treat lung disease, cold, cough, chest problems (3), breathing problems and runny nose (1). A decoction of leaves is given orally for treatment of internal wounds (1), internal fever (1), phlegm in calves (1).	7	Y same (4).N (3)
Veronica incana L., **Scrophulariaceae**, BS_300615_001	Dagsh (no meaning)	Herb	Wounds (2)	Leaves (2)	Topical (2)		Dampen leaves and put on wound (1). Dry, powder and put on wound (1).	2	N (2)

Additional notes on Table 2.1:
Scientific name of the family is given according to the Flora Europaea (Tutin et al., 1993, 1980, 1976, 1972, 1968), Mongolian name according to Grubov (1982), scientific species name according to Gubanov (1996), and Mongolian species name according to Grubov, (1982) used from '*Flowers of Mongolia*' (Hauck and Solongo, 2010). The translation of Mongolian words is written in accordance with the grammar of '*Colloquial Mongolian'* (Sanders and Bat-Ireedüi, 1999) such as the use of 'kh' instead of 'h', and elongated vowels instead of the shortened form. The translation of names was proofed by two independent sources. Many of the common Mongolian plant names mentioned by herders and recorded in this study are of Tibetan origin *e.g. Dianthus* spp.: ***Yumduujin*** is the Tibetan name, whereas the Mongolian name is ***Bashir*** (Hauck and Solongo, 2010; World Health Organization, 2013).

4.3 Ethnospecies and species accumulation curve

The 39 botanical species mentioned in Table 2.1 equate to 29 ethnospecies, following the definition of Hanazaki et al. (2000). Ethnospecies, are shown in Table 2.2 together with their common name(s) and the estimated number of botanical species represented by each ethnospecies. These estimates were derived from the number of botanical species in the reference book that were identified by participants as belonging to the same ethnospecies. Where more than one common name is present, all names were used across all included botanical species. The use of birch (*Betula*) bark was reported with only bark specimens, so it was not possible to infer the number of different species used.

Table 2.2
Ethnoveterinary medicinal plants used by Mongolian pastoralists, arranged according to ethnospecies.

Ethnospecies	**Mongolian name (meaning)**	**Comprised of more than 1 botanical species**	**Estimated number of botanical species**
Achillea spp.	Yazkhuu (no meaning)	Yes	2
Allium spp.	Zerleg songino (wild onion), khumkheel (no meaning),	Yes	4
Artemisia frigida	Agi (no meaning)	No	1
Artemisia gmelinii	Tsarvan (no meaning), sharilj (no meaning)	No	1
Betula spp.	Khus (no meaning)	Yes	Unsure
Cacalia hastata	Iguu shen (no meaning)	No	1
Dianthus spp.	Yumduujin (no meaning)	Yes	2
Gentiana spp.	Degd (no meaning)	Yes	5
Leontopodium spp.	Tsagaan uul (white mountain), tsagaan turuu (white turuu)	Yes	2
Lilium pumilum	Tumsnii ulaan tsetseg (red potatoe flower)	No	1
Orostachys spinosa	Uld uvs (uld grass)	No	1
Paeonia anomala	Yagaan tseene (pink tseene)	No	1
Papaver nudicaule	Sharkhnii shar tsetseg (yellow flower of wound)	No	1
Pinus sibirica	Nars, Borgotsoi (no meaning)	No	1
Plantago spp.	Tavan salaa (five branched)	Yes	3
Potentilla spp.	Borolzgono (no meaning)	Yes	2
Prunus pardus	Monos (no meaning), moil (no meaning)	No	1
Pulsatilla spp.	Yargui (no meaning)	Yes	5
Rheum undulatum	Gishuugene (no meaning)	No	1
Rhodiola spp.	Altan gagnuur (golden solder)	Yes	2
Rosa acicularis	Nokhoin khoshuu (dog's nose)	No	1
Salix pseudopentandra	Burgas (no meaning)	No	1
Sanguisorba officinalis	Sud uvs (feather grass)	No	1
Stellera chamaejasme	Dalan turuu (seventy pappus)	No	1
Thalictrum minus	Burzgar (no meaning)	No	1
Thymus spp.	Ganga (no meaning)	Yes	2
Urtica cannabina	Khalgai (no meaning)	No	1
Vaccinium vitis-idaea	Anis (no meaning)	No	1
Veronica incana	Dagsh (no meaning)	No	1

A species accumulation curve for all EVM ethnospecies recorded from interviews with herding families is presented in Fig. 2.6. The flattening of the curve, or decline in the upward trend, indicates that the sample size reflects an adequate size for this study and that the sampling effort was sufficient (Begossi, 1996; Williams et al., 2007). This is also emphasized by the extrapolation of the curve (dashed line) indicating that less than one new species would have been gained with a further five interviews.

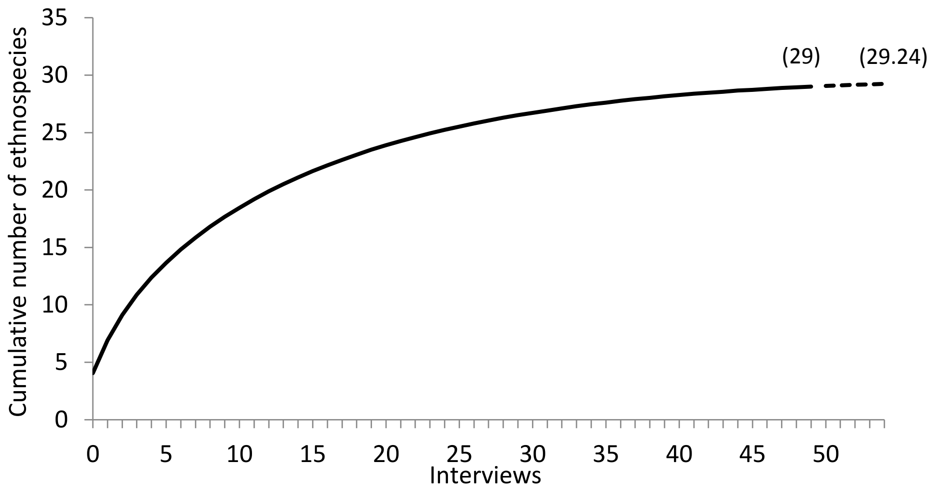

Fig. 2.6 Species accumulation curve for ethnoveterinary medicinal plant use recorded over the summer of 2015 (solid line) and extrapolated to include five further interviews (dashed line). Number of ethnospecies are indicated in brackets.

4.4 Plant parts used, preparation method and route of administration

Ethnospecies used for ethnoveterinary purposes are presented according to plant parts used together with respective use reports and species numbers in Fig. 2.7. The use of leaves and flowers corresponds to both the highest use report percentages (leaves: 36%, flowers 28%) and species percentages (17% for both).

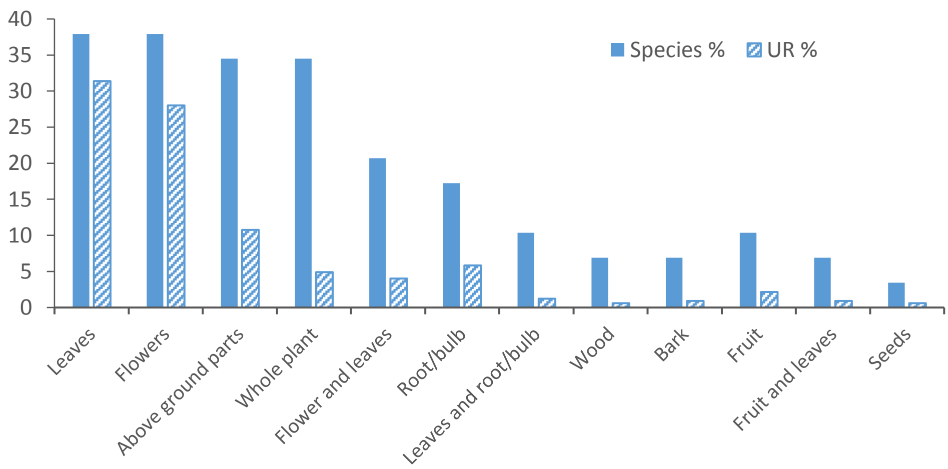

Fig. 2.7 A summary of use report (UR) percentage and species percentage, per medicinal plant part used for ethnoveterinary purposes in Mongolia.

The ways in which medicinal plants were administered were grouped as topical, oral, feed (animals given extra feed in winter), grazing (animals herded to specific areas to graze on particular plants), and through inhalation. Oral administration of EVM plant preparations had the highest use report and species percentage: 57% and 43%, respectively (Fig. 2.8). It must be noted that administration is reportedly not done by one route exclusively. Often topical and oral administration of a certain plant species are done in coordination.

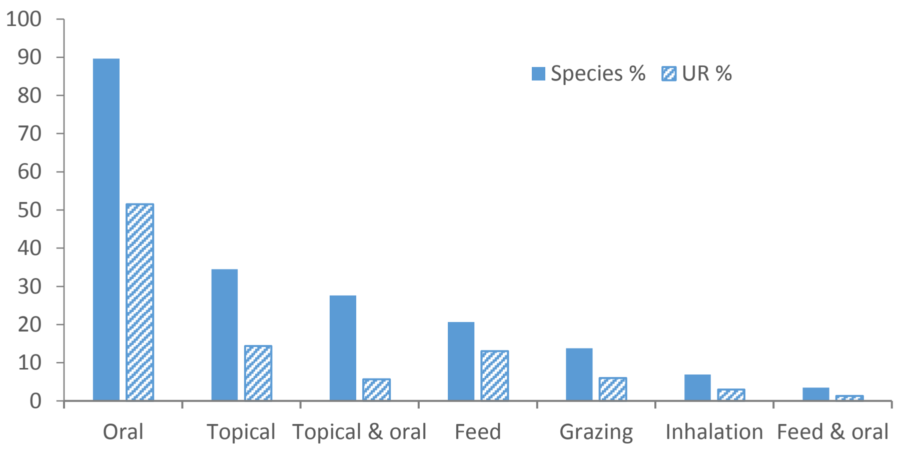

Fig. 2.8 Administration routes of Mongolian ethnoveterinary medicinal plants, together with respective use report (UR) and species percentages.

4.5 Species use and importance

Species use was analysed with the use of use value (UV) ratings, calculated for medicinal plants recorded from free listings and the reference book (Fig. 2.9). The highest use values were recorded for *Cacalia hastata, Rosa acicularis* and *Thalictrum minus* (UV=2 for all). The use values of species can be used together with species importance ratings from free listing, in order to understand both plant use and plant importance.

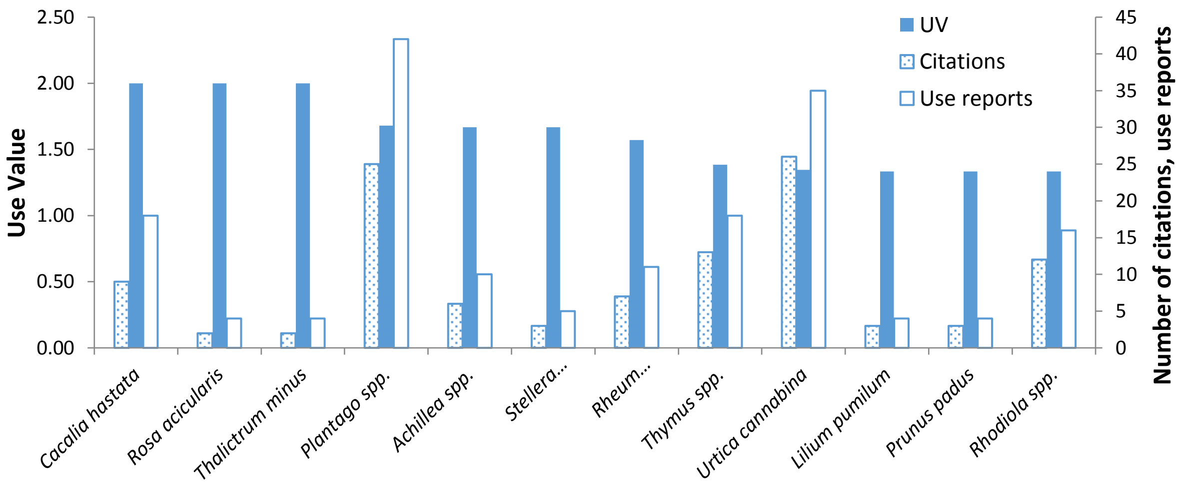

Fig. 2.9 Ethnoveterinary medicinal plant species with the highest use values together with respective citations and use reports. The twelve ethnospecies with the highest use values are displayed (n=29 ethnospecies).

Free lists ranged from one to 22 species, with an average of seven species mentioned per respondent and a total of 27 ethnospecies mentioned across all lists. In order to ascertain species importance, the free-list-item salience index (S) was calculated for species recorded during free listings (Smith, 1993). This takes into account the rank or position of an item across all lists in the sample, weighted by the lengths of the lists in which the item was mentioned (Smith and Borgatti, 1997). The more important a species, the more likely it is to be listed in the beginning of free listings and by many respondents (Martin, 2004) and the higher its salience value. According to free listings recorded during this study *Sanguisorba officinalis* and *Urtica cannabina* are the most important ethnoveterinary plants (Fig. 2.10). These are followed by *Plantago* spp., *Dianthus* spp. and *Rhodiola* spp.

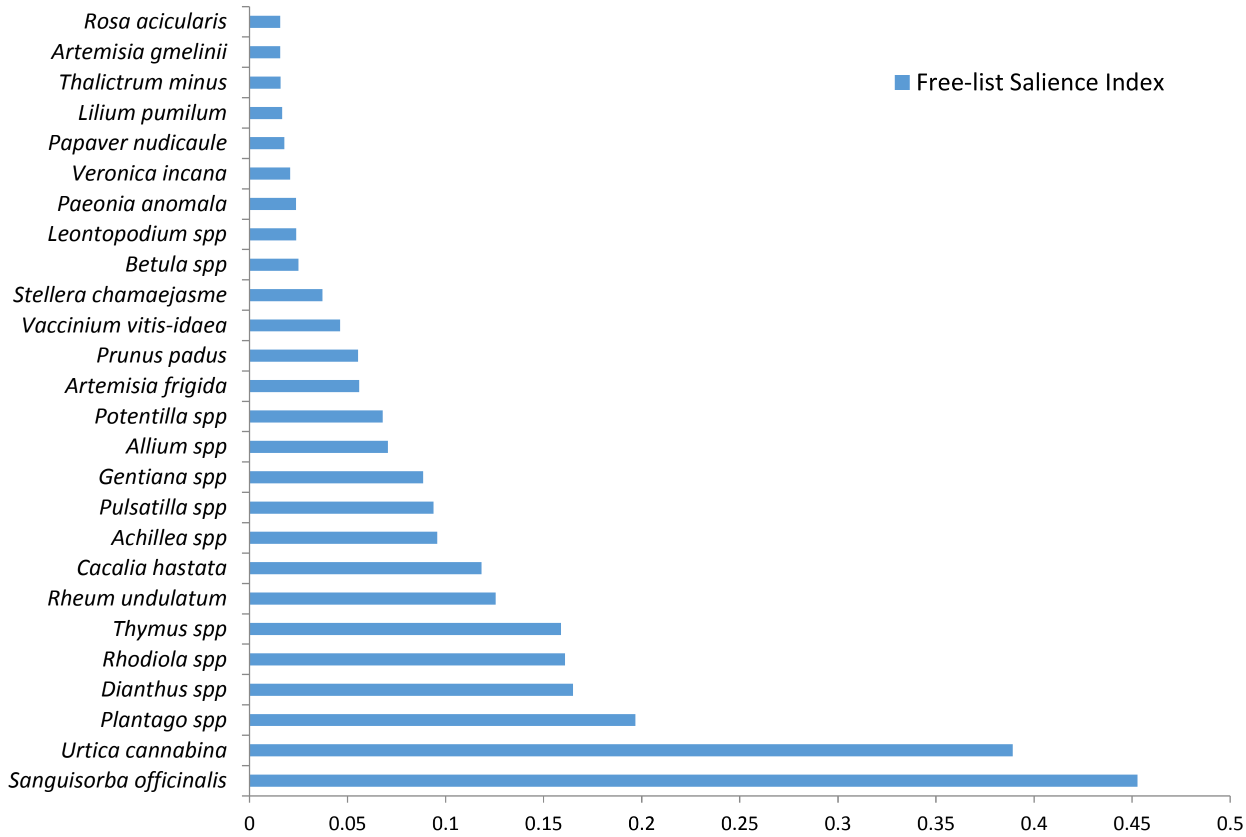

Fig. 2.10 Plant importance according to free-list salience index of ethnospecies mentioned during free listing (n=40 free listings).

4.6 Ailment categories, informant consensus factor and fidelity level (%)

Ailment categories were selected using an emic approach, taking both the frequency and positionality of ailments/diseases mentioned during free listing sessions into account. From these it became clear that some of the most common livestock ailments can be classified as gastrointestinal (most often diarrhoea, especially in young livestock), post-partum complications (retained placenta) and external wounds (from wolf bites). The ritual clearing of bad energy from animal shelters also plays a big role in the life of the herders (participant observation) and should not be overlooked.

Ailment categories together with number of reported species, use reports, and informant consensus factor (ICF) are presented in Table 2.3 according to ICF value. ICF values range from 0 to 1, where a higher ICF value indicates that respondents use more similar species within ailment categories (Gazzaneo et al., 2005). The highest ICF value is recorded for the treatment of poisoned animals and ritual purposes (1), followed by medicinal food (0.87) and post-partum and gastrointestinal ailments (both 0.81). However, it must be noted that the categories 'ritual' and 'treatment for poisoning' each only have two use reports. By contrast, 'medicinal food' and 'gastrointestinal' correspond to 63 and 58 use reports, respectively. The ailment category 'other' includes unspecified tumours, swelling and ulcers, thirst, fly repellents, lactation related problems, ailments associated with castration, and reproductive stimulants.

Table 2.3
Ailment categories arranged according to informant consensus factor values (ICF) from highest to lowest, together with the number of ethnospecies and use reports per ailment category. 'Other' includes unspecified tumours and ulcers, thirst, castration-related problems, fly-repellents, stimulants and lactation-related problems.

Ailment category	Use reports	No. of ethnospecies	Informant consensus factor (ICF)
Treatment for poisoning	2	1	1.00
Ritual	2	1	1.00
Medicinal food	63	9	0.87
Post-partum	27	6	0.81
Gastrointestinal	58	12	0.81
External wounds	53	13	0.77
Respiratory	28	8	0.74
Skeletomuscular	30	10	0.69
Hepatological	4	2	0.67
Dermatological and ectoparasites	7	3	0.67
Fever	18	8	0.59
Endoparasites	3	2	0.50
Internal wounds	7	4	0.50
Other	13	8	0.42
Circulatory	7	6	0.17
Urological	3	3	0.00

In order to understand plant importance within ailment categories, the fidelity level (FL [%]) is used. The FL of a given species quantifies the percentage of informants that suggest the same medicinal use for that species compared with the total number of informants that mentioned the species (Friedman et al., 1986), and is used to identify the most preferred species used in the treatment of a particular ailment (Sharma and Manhas, 2015). The values of FL in this study range from 3% to 100%, with nine species having a 100% FL. Species with high FL values and high citation frequencies within specific ailment categories are shown in Table 2.4 to indicate species popularity per ailment use. The importance and frequent use of *Rhodiola* spp., *Urtica cannabina* and *Sanguisorba officinalis* are evident from these data.

Table 2.4
The most frequently used medicinal plants for different ailments with their citations, fidelity level and uses.

Ethnospecies	Citations	Fidelity level (%)	Ailment category	Use
Rhodiola spp.	12	100	Skeletomuscular	Used to treat broken bones
Artemisia frigida	7	100	Medicinal food	Good for weak, tired livestock
Urtica cannabina	23	100	Medicinal food	Immune booster, used in winter and spring
Pinus sibirica	2	100	Other	Used in post-castration recovery
Thalictrum minus	2	100	Hepatological	Good for the liver
Prunus pardus	3	100	Gastrointestinal	Used to treat diarrhoea
Betula spp.	2	100	Gastrointestinal	Used to treat diarrhoea and stomach problems
Sanguisorba officinalis	27	87	Gastrointestinal	Used to treat diarrhoea especially in young animals
Dianthus spp.	16	84	Post-partum	Delivery of retained placenta
Vaccinium vitis-idaea	5	83	Respiratory	Cough and cold treatment, good for lungs
Achillea spp.	5	83	External wounds	Used to treat external wounds
Gentiana spp.	13	81	Respiratory	Cough and cold treatment, good for lungs
Cacalia hastata	7	78	External wounds	Used to treat external wounds
Plantago spp.	19	76	External wounds	Used to treat external wounds
Leontopodium spp.	2	67	Circulatory	Treatment for blood related problems
Pulsatilla spp.	4	19	Ectoparasite	Treatment for mange
Thyme spp.	2	15	Ritual	Clear bad energy
Thymus spp.	2	15	Poisoning	Smoke is used to treat poisoned animals

4.7 Non-plant products and other techniques

In addition to medicinal plants, a total of 19 non-plant substances or items were recorded as being used for ethnoveterinary purposes. These are recorded, together with the Mongolian name, meaning thereof, tentative species name (if applicable), collection notes and number of citations in Table 2.5. Remedies of non-plant origin are categorised as fungi, mineral or soil products, animal-derived remedies, and 'other' compounds, including the use of animal dung for the treatment of diarrhoea (fresh cow and horse dung) and the treatment of wounds (dry cow dung and mouse droppings), as well as single citations of the use of child's urine, whey, butter from oil candles and charcoal. Of these, the use of fungi was cited the most frequently (15), followed by products of animal origin (10). Photographs of various ethnoveterinary non-plant remedies and medicinal plants are shown in Fig. 2.11.

Three ethnoveterinary techniques were mentioned during free listings and are presented in Table 2.6 together with their Mongolian name, use and number of citations. Techniques include blood-letting, cauterisation, and 'stinging' or acupuncture.

Fig. 2.11 Ethnoveterinary medicines used by Mongolian pastoralists. A. shed snake skin, B. dried inflorescence of *Sanguisorba officinalis*, C. *Plantago* spp., D. a decoction made from *Vaccinium vitis-idaea* berries, E. Fresh *Vaccinium vitis-idaea* berries, F. dried *Dianthus versicolor* flowers, and G. '*Sender*', a red mineral used to treat ophthalmological ailments. Photo A-D, F-G: H. Wiese. E: B.Seele

Table 2.5
Ethnoveterinary remedies of non-plant origin, including fungi, minerals and soils, remedies of animal origin and other recorded to be used by Mongolian pastoralists in the study area.

Fungi

Species (tentative)	Mongolian name (meaning)	Collection (number of citations)	Use (number of citations)	Citation frequency
Agaricus bisporus	Tsagaan muug (white mushroom)	Only grows for 15 days in August, pick and dry in *ger* (1). Collect in autumn (1). Harvest beginning of August. Grows on sunny side of mountain where there are no trees (1). Grows after mushroom fog or many days of light rain, can also use the soil from the area where the mushroom grows (1).	A decoction is made with dried mushroom and given orally to assist with delivery of retained placenta (3), used to treat fever (2), fever and bloat (1) and fever related to retained placenta (2) and to reduce the size of the uterus after birth (1). Dried mushroom is powdered and put on wounds (1). A decoction is made together with Dianthus spp. to assist in delivery of placenta (1).	11
Fomitopsis officinalis	Khar modnii muug (black tree's mushroom)	Grows on *Larix* spp. (*khar*) (1).	Cut quickly (poisonous), can be used externally or taken with boiled water (dry or fresh), 1/2l given to animal to treat internal and external wounds, swelling and tumours	1
Not identified	Khur modnii ur (seed of rain tree)	Mushroom that grows on *Betula* spp. (1).	Dry, powder, mix with water and give orally, good for all inner organs. Do not use raw.	1
Not identified	Khusnii muug (birch mushroom)	Mushroom that grows on *Betula* spp. (1).	Mushroom is boiled with black tea, water and mixed with charcoal, given orally to treat diarrhoea.	1
Calvatia gigantean	Tengeriin dulii (sky deaf)	Has to dry before harvesting it (1).	Mushroom is opened and powder (spores) put on wounds, especially saddle sores.	1
				15

Minerals and soils

Name	Mongolian name (meaning)	Collection	Use reports	Citation frequency
Salt from saline lake	Khujir (no meaning)	Harvested with a spade (1). Lake water that contains *khujir* is collected (1).	Given to animals to lick, good for the immune system (1). Mixed and heated with sugar and 2nd grade flour, sometimes bran, formed into balls, flattened and fed to livestock to increase inner heat when they are cold, also dried and fed to young animals in spring (1). Given to thin livestock, very good as it is natural (1). Lake water with *khujir* is given to animals to lick up as treatment for worms in the nose of livestock (1).	4
Red soil harvested from a lakeshore in Uvs	Sender	Harvested from a lakeshore in Uvs (1)	A cut is made in the veins around the eye and sender is put in the eye to treat eye disease (voucher photo)	1
Red ant nest, ant nest	Ulaan shorgooljnii uur (red ant nest), Shorgooljnii uur (ant nest)		A decoction is made and given orally for bloat, broken bones, wounds and fever (1). Mixed with *Rheum undulatum*, boiled in water and applied topically to wounds such as those from wolf attacks (1), given orally and topically for serious wounds from wolves and dogs (2).	4
				9

Remedies of animal origin

Name	Mongolian name (meaning)	Collection	Use reports	Citation frequency
Wolf meat	Choniin makh (wolf meat)		Wolf (or dog) meat is boiled in water and horses are forced to drink it, good for the lungs.	1
Second stomach (marmot)	Tarvaganii hoyor dakhi khodood (marmot's second stomach)	Marmots are hunted in August (after August they prepare to hibernate). Stomach is dried with stomach contents, or separately.	Dried stomach contents are given to emaciated animals during winter, very nutritious (1), used to relieve tiredness (*yadargaa*) (1). Plants inside the second stomach are dried in a cold place over winter and given to tired livestock in spring (1)	3
Fat (horse, marmot)	Aduunii ookh (horse fat) Modnii nuurstei tarvaganii tos (marmot fat with charcoal)		Horse fat is smeared on external wounds (1). Marmot fat is mixed with charcoal and used as treatment for *tsahlaitah* (hair falls out and skin is left white, Capripox virus) (1)	2
Bone (cow)	Butsalgasan yasnii shul (boiled bone soup) Uneenii yasnii shul (cow bone marrow)		Boiled horse bone soup is given orally to tired animals (1) and to thin animals, in spring (1). Cow bone marrow is boiled and given orally to very young livestock that are at a high risk of dying (1).	3
Snake skin	Urt ut (long worm's skin). Mokhoin khalis (snake skin)	Found near winter camp and dung heaps. Any type of snake skin can be used. Can be venomous or non-venomous snake. Poisonous snake has darker skin.	Shed snake skin is boiled in water and given orally to animals to clean the placenta. Shed snake skin can be stored for later use.	1
Blood (deer)	Yamaan guruus (tentative id: Siberian ibex blood) Bor guruusnii tsus (tentative id: Roe deer blood)		Blood is dried, powdered, put in water and given orally for bone injury, e.g. broken leg.	1
				11

Other

Name	Mongolian name (meaning)	Collection	Use reports	Citation frequency
Dung	Ukhriin shine baas (fresh cow dung). Ukhriin argal (dry cow dung). Khomool (horse dung). Baragshun (mouse droppings)		Fresh cow dung is mixed with water and given to horses orally to treat diarrhoea (1). Dry cow dung is applied topically to wounds with worms (1). Fresh horse dung is mixed with water and given orally to sheep and goats to treat diarrhoea (1) and *deluurekh* (swollen spleen) (1). Mouse droppings are mixed with water and given orally for wound and inflammation treatment (1).	5
Urine	Khuukhdiin shees (child's urine)		Urine is mixed with charcoal, applied topically on wounds and orally for fever (1).	1
Whey	Uurag (whey)		Whey is used topically to clean the hooves when livestock go out to field wet with dew and hoof becomes sore, wet, bumpy. Contagious, *dogol* disease - foot and mouth (1).	1
Butter from oil candle	Shar tos (shar butter)		Heated up in a big pot and given to horses to lick up for treatment of diarrhoea (1).	1
Charcoal, grime from the cooking pot	Togoonii khoo		The pot is 'scratched', charcoal and water are added and given to animals to drink for the treatment of weak or broken bones (1).	1
				9

Table 2.6
Ethnoveterinary medical techniques used by Mongolian pastoralists.

Technique	Mongolian name	Use	Citation frequency
Blood-letting	Tsus khanah	A small cut is made just above the eye to treat *erguutekh* (rabies). A small cut is made just above the hoof of racehorses.	2
Blood-letting with cauterisation	Tsus khanah & tuunukh	As treatment for a wound (horse), a very hot stone is put on the wound and blood-letting is done to get rid of bad blood (1). A small incision is made on the main blood vessel of the udder and covered with glowing dung to increase lactation.	2
Blood-letting with sender (red soil harvested from a lakeshore in Uvs)	Tsus khanah	A cut is made in the veins around the eye and sender is put in the eye to treat eye disease (Fig. 2.11, photo G)	1
'Stinging' with cauterization	Zuugeer khatgakh & tuunukh	Used to treat *deluurekh* (enlarged spleen) as a result of eating poisonous grass or eating too much (1). Treated by sticking knife in at the right place and letting blood out (1).	2
			7

5. Discussion

This study aimed to record and understand the ethnoveterinary knowledge and practices of Mongolian herders. In addressing these aims significant insight into Mongolian pastoralists' ethnoveterinary knowledge were obtained with a notable focus on livestock ailments, ethnoveterinary plant-use and species importance, and non-plant products used across the region.

5.1 Livestock ailments

The diseases and ailments in the study area are largely seasonal. Most livestock health problems arise at the end of winter or in spring as a result of drought, *dzud* (extreme weather), and livestock being weak, with low immune defences as mentioned by Edström (1993). Wound treatment (often due to wolf attacks), birthing problems (retained placenta), gastrointestinal problems (new-born livestock suffering from diarrhoea), and general weakness and tiredness (*yadargaa*) reflect the ailment categories of wounds, post-partum, gastrointestinal, and medicinal food, respectively. These are all common problems and, in this study, are reported as often being treated with EVM plants. Herders also mentioned livestock diseases such as rabies and foot-and-mouth disease, against which livestock are routinely vaccinated. Medicinal plants are not used exclusively, and a tendency towards polypharmacy (the use of multiple medications to treat a single ailment) exists. For example, herders mentioned the use of commercially available Ivermectin together with medicinal plants in the treatment of mange, and the use of *Moil* (*Prunus padus*) was referred to as being "*like a natural Phtalazol*", from Phthalazolum, a Russian medication used to treat diarrhoea.

Medicinal food was chosen as a category, because often the first plants mentioned by herders were those given to livestock as additional feed during winter and spring for weight gain and immune defence. As suggested by Etkin and Ross (1982), including medicinal plants that are used as both food and medicine results in a broader understanding of the importance of the plants. The category of 'medicinal food' was allocated to plants that were fed to livestock in spring and winter as general immune boosters, as well as plants that herders mentioned livestock would seek out when needed. One suggested evolutionary pathway of ethnoveterinary practise is the observation of self-medication in animals (also known as zoopharmacognosy) by livestock herders (Benítez et al., 2012; Huffman, 2003; Pieroni et al., 2006). Medicinal food plants were often the first plants mentioned during free listing opportunities, and are clearly of importance and use to herders. As also reported by Carrió et al. (2012), many respondents also attributed medicinal properties to feed plants. The perception of food plants as medicine and the rather diffuse border between food and medicine is described in an ethnoveterinary context by Pearson (2004). In the Mongolian context, where winter and spring present the biggest challenges to livestock health, it becomes clear that extra feed plants given to improve the general health, resilience and immune system, can indeed be viewed as medicinal plants.

5.2 Ethnoveterinary medicinal plants

Mongolian herders use a variety of medicinal plants for their livestock. As most EVM plants are needed and used during winter and spring, and because these grow in summer and autumn, the drying and correct storage preparation of medicinal plants becomes very important. Collection of medicinal plants is often done while herding. According to Fijn (2011), the appropriate time for collecting is before the stamens of the flowers collapse at the end of summer (around August), otherwise the potency of the herbs can decline. This collection time is supported by reports from this study where the most common time to collect was mentioned as being the end of summer and autumn.

Medicinal plants are prepared by drying the plants in a cool, dry and dark area (often inside the *ger*) and, once dry, are stored in various containers for later use. The frequency of using dried medicinal plants (rather than fresh) is in contrast to results from Gakuubi and Wanzala (2012) where there is a belief among the Ameru of central Kenya, that most plants lose their efficacy and potency if stored for a long time. As shown by Stafford et al., 2005, the effect of drying and storage on the biological activity of a plant is species specific, with some species showing an increase in biological activity after storage.

5.2.1 Species importance using use-value, free listing and fidelity level

The significance of applying use value (UV) to determine plant importance is that it is guided by informants and not biased by the opinion of the researcher (Sharma et al., 2012). On the one hand, as mentioned by Martin (2004), not all uses are equally important, and the use value could provide a distorted view of how people assess the importance of plants, but on the other hand culturally significant plants typically have multiple uses (Martin, 2004). Another critique of the UV method is the question of whether informants felt comfortable enough and had enough time to mention all the uses of a specific plant. As stated by Martin (2004), it is important to conduct each interview in a similar way to achieve a consistency of sorts. Whether this is always possible remains the challenging question. One of the shortcomings of the use-value index is that it does not take into account the number of times that plant was cited. For example, *Veronica incana* with one use report and one citation receives a UV of one, whilst *Artemisia frigida*, with seven use reports and seven citations, receives the same UV of one (see Appendix E for the use-values, citation frequencies and use reports of all 29 ethnospecies).

From the results of this study, it can be seen that plants indicated as being culturally important in terms of high use values differed significantly from those shown important from the salience index of free-listed species. It can also be seen that the importance of a species such as *Sanguisorba officinalis* (with the highest free-listing salience index) is not reflected in the use value ratings. The question here remains: how can the importance of a specific species that is used for a number of different uses be compared to another species used by many respondents for the same use? I suggest that both are calculated. The free-list salience index, by taking into account the position- and frequency-of- plant mention, gives insight into plant importance in a region; the use-value describes plant use. In addition, use values should be reported together with total use reports and citation frequencies to allow for a clearer understanding of plant use.

In order to calculate the importance of plant species for a specific ailment type the fidelity level (%) can be used (Tariq et al., 2014), with highly preferred plants having greater values than less preferred plants. A high FL indicates a favoured species that is used for a specific ailment. The FL (%) should be analysed together with citation frequency as, for example, a low FL with a high number of citations indicates that a species is used for many different purposes. In this study, 16 species stand out when looking at their fidelity level percentage and citation frequency within ailment categories. These can be compared to species with high use values and those with free listing importance, in order to gain an understanding of overall species importance to respondents in this study. A few of these important species are highlighted below.

Urtica cannabina L. (***khalgai***) is an important plant for Mongolian herders. Leaves and above ground parts are harvested in summer and autumn, dried and/or pickled and stored for use during winter and spring when it is fed to livestock in a variety of forms, mostly as medicinal food for weak animals. Interestingly, Asseldonk (2013) recorded the ethnoveterinary use of two *Urtica* species in the Netherlands (*U. dioica* L. and *U. urens* L.), which are wild harvested as a strength-improving tonic and to aid in recovery. In addition to livestock uses, *Urtica cannabina* is also used for human medicinal purposes (WHO, 2013) and the new growth shoots are used to season food.

Sanguisorba officinalis L. (***sud uvs*** – feather grass) was mentioned by 38 respondents, and is mainly used as a cure for diarrhoea, especially in young and new-born livestock. Inflorescences are harvested in autumn and are dried and stored for use in spring. According to Mabberley (2008) the genus *Sanguisorba* also has styptic properties that can halt bleeding.

Tavan salaa (five branched), the common name given to *Plantago* species, was mentioned as an EVM plant by almost all respondents (42) and is used mainly for wound healing and gastro-intestinal problems. *Plantago depressa* Schlecht. has also been recorded as an important ethnoveterinary plant species used by Nu people in NW Yunnan of China for the treatment of gaseous stomach, poison, and constipation (Shen et al., 2010). It is used as a medicinal plant by humans to treat gastrointestinal and urinary problems (WHO, 2013).

Altan gagnuur, the descriptive common name of *Rhodiola quadrifida* (Pall.) Fisch. et Mey. and *Rhodiola rosea* L. can be directly translated as 'golden solder' or 'golden welding' and describes its use in the treatment of skeletomuscular problems, including broken bones and muscle injuries. Interestingly, in this study, it was recorded that the yellow flowers (or the root of that plant) were used for bone injuries, while the red flowers (or root) are used for muscle injuries. Khaidav (1978) describes *Rhodiola rosea* as a multipurpose medicinal plant and an excellent medicine to treat bone fractures.

Yumduujin, the common name for *Dianthus superbus* L. subsp. *superbus* and *Dianthus versicolor* Fisch. Ex Link, was cited by 19 respondents and is used mainly for problems associated with retained placenta. This is a common livestock problem and has a direct impact on fertility. As reported by Kletter et al. (2008), *Dianthus versicolor* is also used in Mongolian medicine to treat liver and gastrointestinal disorders.

5.3 Non-plant remedies and ethnoveterinary techniques

5.3.1 Non-plant remedies

Although ethnoveterinary studies in the literature mainly focus on plant and plant-derived products, a few studies have recorded ethnoveterinary remedies of animal or mineral origin: Piluzza et al. (2015) reported on the ethnoveterinary knowledge of Sardinian shepherds and Benítez (2011) and Benítez et al. (2012) on the knowledge of plant and animal use in ethnoveterinary practices in the Province of Granada, Spain. More specifically, González et al. (2016) reviewed the use of wild vertebrates in contemporary Spanish ethnoveterinary medicine, and Barboza et al. (2007) and Confessor et al. (2009) discuss animals used in veterinary medicine mainly in Brazil.

In addition to medicinal plants, Mongolian herders use a variety of other substances, products and techniques for ethnoveterinary purposes. EVM remedies of non-plant origin include the use of mushrooms; animal-derived remedies; mineral and soil substances; as well as a variety of other compounds such as dung, urine, whey, butter oil, and charcoal.

Three species of fungi were tentatively identified, and an additional two recorded by common name. ***Tsagaan muug*** (meaning white mushroom), cautiously identified as *Agaricus bisporus*, had the most citations and is used mainly for treatment of retained placenta and associated problems. The use of fungi for medicine and wild-food in China is well-recorded, and similar traditions are expected in Mongolia (Boa, 2004). For example, in the Tibetan community of Zhagana (Gansu, China), Kang et al. (2016) recently recorded the use of 22 mushroom taxa as wild food plants. Although the use of fungi within ethnoveterinary systems is mentioned in a few publications (Benítez, 2011; Katunguka-Rwakishaya et al., 2004; Khan et al., 2015), the detailed use and classification of fungi within EVM is poorly recorded and remains an exciting new field for further study.

Three mineral and soil substances were mentioned by herders to be used for EVM purposes. Four separate citations confirmed the use of ***khujir***, a type of salt that is collected either as water from saline lakes or in solid form from lake deposits. *Khujir* was recorded as being used to strengthen the immune system, mixed with extra feed in spring for thin livestock, and used as treatment for worms that are found in the nose of cattle. Inland salt lakes (with no connection to the marine environment) are mostly confined to dry regions of the world; however, despite the global extent of dry regions and the number of salt lakes within them, they have largely been ignored by limnologists, due to an underestimation of their value (Williams, 2002). The problem is compounded by the lack of recognition of the importance of salt lakes as integral elements of inland aquatic ecosystems, and there is an urgent need to address this issue and conserve salt lakes. The use of *khujir a*s recorded in this study adds to the value of the saline lakes of Mongolia. ***Sender***, a red type of soil, was mentioned and shown to us by one respondent. The red powder is harvested from a lakeshore in Uvs aimag, and is used topically to treat diseases of the eye in cattle. The use of red ant's nest material was recorded four times during this study, as a treatment for bloat, broken bones, fever and wounds (often from wolf attacks). Interestingly, Aston Philander et al. (2014) mention the use of ant hill by Rasta bush doctors of the Western Cape, South Africa, for the topical treatment of sores and wounds.

Mongolian herders cited six products derived from animals: wolf meat, the second stomach of marmots, horse and marmot fat, bone and bone marrow, shed snake skin, and antelope blood. Interestingly, it is the plants contained within the marmot's second stomach that are used, and not the stomach itself. Both are dried together or separately, and given to livestock in winter and spring to relieve tiredness (*yadargaa*). A large number of folk veterinary medicines are produced from animal fats and are usually applied to wounds or thorns (Barboza et al., 2007). Herders indicated that horse fat and marmot oil are used for external wounds and skin conditions, respectively. Piluzza et al. (2015) also mention the use of fat from lard to treat mange as well as scabies, skin disease, and swelling. Ram fat is reportedly used for burns, bone fractures, and thorns (Confessor et al., 2009); however, no mention was made of the ethnoveterinary use of horse or marmot fat. Shed snake skin was presented, stored in a medicine bottle, by one respondent, who explained that the skin is boiled and given to livestock orally to "*clean the placenta"*. The shed skins are obtained without the animal having to be killed. In the Province of Grenada, snake skin is the most important animal-use within EVM and involves the skins of several snake species used mainly as a treatment for colds and to heal wounds (Benítez et al., 2012). Interestingly, in the review of the use of wild vertebrates in Spanish ethnoveterinary medicine, González *et al.* (2016) cite the use of the Montpellier snake's skin, boiled in water to treat equine colic (González et al., 2015), as well as records of the ladder snake (entire snake) being used for retained placenta in cows (Bonet, 2012), and snake meat (of the same snake) used for retained placenta (among others) in ewes and sows (Agelet, 1999). Blood from two types of deer (tentatively translated as Siberian Ibex and Roe deer), was cited as being used for bone injuries. The use of animal products such as these have important conservation implications, which are further discussed in Chapter 4.

5.3.2 Ethnoveterinary techniques

In addition to pasture land management, mobility and selective herding techniques (Damiran and Darambazar, 1999), all of which play an important role in the health of livestock (but are beyond the scope of this paper), Mongolian herders spoke of three local veterinary techniques that are used for livestock health: blood-letting, cauterisation, and acupuncture or 'stinging'. Both blood-letting and cauterisation are common ethnoveterinary techniques among pastoralists (McCorkle, 1986). Cauterisation is an ancient pastoralist practise and is well-established for the treatment of camel ailments in Saudi Arabia (Field & Simpkin, 1999; Abbas et al. 2002), but was only mentioned by one respondent in this study, recorded as a red hot stone being put on the wound (of a horse) together with a small incision being made to get rid of bad blood. This low citation frequency could be due to the fact that conversation was generally steered towards the use of EVM plants. Blood-letting is a common technique for a large number of livestock and human ailments (McCorkle & Martin, 1998). In this study, the use of blood-letting by Mongolian herders for various treatments including rabies, hoof injuries of race horses, to increase lactation and for treating eye diseases was recorded. In the Mongolian context, Damiran and Darambazar (1999) report blood-letting to be widely used by herders on poisoned animals, with horses having more than 30 points for blood-letting, and Fijn (2011) reports the use of blood-letting as a treatment for horses that have become lame or developed a cold. Blood-letting is also used by traditional healers in the Qassim region of Saudi Arabia (Abbas et al., 2002) and is a much used technique in African veterinary practise. This includes reports of blood-letting by traditional Dinka healers in South Sudan (Schwabe and Kuojok, 1981) and among Kenyan pastoralists including the Turkanas (Ohta, 1984) and the Maasai (Schwabe, 1978).

6. Conclusion

Mongolian (semi-) nomadic pastoralists have a wealth of traditional ecological knowledge (Fernandez-Gimenez 2000; Marin 2010; Sternberg 2008; Lise et al. 2006; Upton 2010; Humphrey et al., 1993) which, as this study shows, includes detailed knowledge about ethnoveterinary remedies and practices. This encompasses the use of medicinal plants, fungi, substances of animal origin, mineral and soil products as well as various techniques, all used to improve the health of livestock herds.

Within the study area, EVM knowledge is used in combination with vaccination programmes and veterinary medicines. Whilst for more serious or life-threatening ailments, a veterinarian and pharmaceuticals (often unknown) are used, EVM is used in the treatment of common, day-to-day ailments and to improve the general health and resistance of livestock. As indicated by the study findings, both men and women are holders, and users, of ethnoveterinary knowledge. This knowledge is learned from spending time with livestock (herding) and is passed on to younger generations by parents and elders in the community, as described by a respondent: "*We learn from the daily life"*.

In order to prevent the loss of this valuable resource of EVM knowledge, there is an urgent need to record and conserve this knowledge. Climate change (Marin 2010), increasingly complex tenure issues (Sternberg, 2008), and reduced mobility (Fernández-Giménez, 2002) threaten the pasture lands and the Mongolian herder way of life, highlighting the need to conserve both the environment that livelihoods depend on and the knowledge associated with these environments. As mentioned by a herder, "*The people of modern times are getting very lazy. Instead of harvesting and drying herbs, they go to pharmacy. If they learn a lot about medicinal plants from a young age, like this girl* (points to his granddaughter), *that would be great*".

In conclusion, our aims of documenting and recording ethnoveterinary knowledge of Mongolian pastoral nomads, quantitatively analysing ethnoveterinary medicinal plant usage among herders and exploring other non-plant EVM substances and techniques are underpinned by the wish to honour and record the vast knowledge that Mongolian herders have of ethnoveterinary ailments and treatments, for future generations.

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Chapter 3

The loneliness of the long distance ethnobotanist: a constructive critique of methods used in an ethnoveterinary study in Mongolia

1. Introduction

The use of traditional, or indigenous, knowledge in scientific research has received growing interest over the past few decades (Huntington, 2011). Although the importance of local knowledge, for example in solving environmental problems, is increasingly recognised (Alexiades, 2003), there are concerns that some of the more complex issues within social-scientific research are being overlooked (Shackeroff and Campbell, 2007). Among others, these include the cultural context in which the knowledge is situated (Haraway, 1988), insensitivity to local concerns (Huntington, 2011) and the quantitative analysis and reporting of data that have been collected through social interactions. As argued by Shackeroff and Campbell (2007) it is the *human context* and the '*ability to adequately understand this context, that will largely determine the success or failure of the research*'.

Local, or traditional, knowledge about livestock health is termed ethnoveterinary knowledge (McCorkle, 1986). Because ethnoveterinary knowledge comprises of the practices, beliefs and relationships of living beings (herders and livestock) with one another and with the environment, it can be described as a specific type of traditional ecological knowledge (Berkes, 1999). In addition, because ethnoveterinary knowledge and practices focus largely on the use of medicinal plants, ethnoveterinary research can be more broadly categorised as ethnobotanical research, which is, simply defined, the study of interactions between people and plants (Martin, 2004).

Several books, manuals and journal articles have been published on ethnobotanical research methods (Alexiades, 1996; Cotton, 1996; Cunningham, 2001; Martin, 1995; Thomas et al., 2007) including ethnoveterinary research techniques (McCorkle et al., 1996). Although these are important for explaining proposed methods and approaches, the cultural and political context within which they are applied can differ significantly. This includes where and with whom the research is done, and whether the research is being carried out by local or foreign researchers. Applying the most suitable method to a specific research context can be challenging and many unexpected problems can arise. These are the 'skeletons in the methods cupboard' that are rarely examined, despite the fact that some of the most significant lessons for ethnobotanical research arise from a better understanding of why challenges occur in field research. The real challenges facing ethnobotanical research often differ according to the context, but are rarely written about. Droughts happen, children are born, sheep need shearing, policies change and other life complexities, often unrelated to research, can play a large role in shaping research outcomes. These factors, however, often remain concealed in the discussions around fieldwork methods, approaches and techniques.

Since the development of the 1992 Convention on Biological Diversity (CBD) and the revisions provided in the adopted Nagoya Protocol (2010), the common research approach is to develop collaborative partnerships, include local research partners in the research process and ensure the '*fair and equitable sharing of benefits derived from the utilization of genetic resources*' (Article 1, Nagoya protocol). This requires '*prior informed consent'* before gaining access to traditional knowledge and that the sharing of traditional knowledge is based on the consent of both parties to '*mutually agreed terms'* (Article 7, Nagoya Protocol). Although fieldwork for the current research project was done in accordance with these agreements, and prior experience of the research area had been gained, unexpected and often difficult challenges arose during the research period. The understanding gained from these experiences could have wide applicability.

Although the best lessons come from failed experiments and problematic fieldwork, scientists rarely write about the difficulties experienced during data collection, and if at all, then they are only mentioned briefly (Davis et al., 1995; Grandin and Young, 1996; Sternberg, 2008). Reflections on methodology and associated problems, although still uncommon are slowly receiving some recognition, for example a dedicated 'setbacks and surprises' section in *Restoration Ecology* and occasional editorials offered by the *Journal of Ethnobiology and Ethnomedicine* (Nolan and Pieroni, 2013). One example is a discussion by Shackeroff and Campbell (2007) of the complexities involved in the use of traditional ecological knowledge for conservation research, with a specific emphasis on the issues of power and politicisation, ethics and situated knowledge. In terms of ethnographic accounts, where the focus is on a complete description of a culture-sharing group (Creswell, 2013), not only is very little written about reflections on fieldwork problems and possible reasons thereof, but even less is written on gender roles, bias and associated vulnerabilities (Howard, 2003). These are important topics and worthy of reflection and discussion.

Instead of focusing solely on the success stories of my research project, I would like to highlight some of the challenges faced as they are valuable lessons for further research. Within a project that had the research aim of identifying conservation implications of Mongolian herders' ethnoveterinary knowledge, the objective of this chapter is to critically review the methods used, by taking a theory versus practice approach. This is done by situating and critiquing the methods and approaches used to collect and understand ethnoveterinary knowledge of nomadic Mongolian herding families, as a foreign researcher. Because the project focused mainly on the medicinal plants used for livestock, ethnoveterinary data in this context is regarded as a form of ethnobotanical data.

A critical review of this kind, where the experience and use of various methods, techniques and approaches is openly shared and evaluated, is a contribution to fine-tuning the methods best suited to a particular research context.

2. Methods

2.1 Critical review of methods

The methods used to collect ethnoveterinary data in Mongolia are critically reviewed by comparing the theory and practice of each method or approach that was used. This is done by means of an ethnographic account of my experiences. An ethnography is both a research methodology and a written product of the research, in which the researcher describes and interprets behaviours of a culture sharing group mainly through participant observation (Creswell, 2013). According to Babbie (2004) an ethnography can also be described as a report on social life that focuses on detailed and accurate descriptions. As participant observation is central to this method, ethnographic accounts are both highly reflective and reflexive (Scott Jones, 2010). Key themes, drawn from my experiences and from the process of juxtaposing theory and practice, are then discussed in more detail.

The impetus for the described research project came from two sources. The first impetus was through my competing in the Mongol derby in 2013. This is a 1 000 km self-navigated and self-sufficient endurance horse ride, where competitors ride on Mongolian horses and stay with local herder families, following the Chinggis Khaan postal system. It is through this experience that I first gained insight into the livestock-directed context of Mongolian herders. Second, was an impetus created through my coming from a farming background, where I had spent most of my life on a working farm, and where care for livestock and the landscapes in which they grazed is important to my family. Upon identification of a feasible project and following an initial pilot visit and fieldwork trip in autumn 2014, an arrangement was made between Stellenbosch University and a local Mongolian University. This included ethical clearance for the project obtained separately from both institutions. Ethical guidelines as stipulated by the International Society of Ethnobiology (2006) were strictly followed at all times.

Ethnoveterinary data for the research project were collected over an intensive three-month period during the summer of 2015. A mixed method approach was used for the collection of these data, and included snowball sampling, free listing, the use of images in a reference book and interview sessions with herders. These are described in more detail in the following section. Observation schedules and a daily fieldwork journal were also used to record and later reflect on fieldwork experiences.

A range of methods was used to collect ethnoveterinary data, and these are reviewed chronologically in the order in which they were used. The associated theory behind each approach is described, together with the practical reality of what happened when I attempted to use the method or approach during fieldwork.

Related comments, questions and critiques are briefly reported, and expanded on within the broader themes that emerge from the review.

In addition, following an approach from the social sciences, natural, free-flowing reflections on my experiences of using the above-mentioned methods were written, and include reflexive comments, questions and suggestions.

Findings from the review were used to develop recommendations for ethnobotanical research in a similar context, especially for young female researchers. It is hoped that these findings stimulate thought and discussion on research methods and approaches.

2.2 Interviews, free listing and reference book

Fifty interviews were conducted in the described study area. Upon meeting each family, cultural formalities were observed (Sternberg, 2008), followed by introductions by the translator and/or horse guide. Background to the research project was given, together with a subject information sheet (written in Mongolian) explaining the aims and objectives of the study, as well as contact details of the primary researcher. A copy of this information sheet was given to respondents as a reference of their consent and to allow them to contact the researcher should they so wish. Interviews only commenced if and after prior informed signed consent was given. It was explained that the interview could be ended at any time by the respondent, that questions did not have to be answered and that all interviewee information would remain confidential. Interviews were held in Mongolian, through an interpreter, and hand written notes were made during the interview. Audio recordings (35) and photographs of the interview were only done if respondent consent was given. Because three different interpreters were used during the fieldwork, audio recordings were transcribed and translated by an official translation company (with a signed confidentiality agreement) in order to account for interpreter bias as much as possible.

Interviews began with a free listing opportunity during which herders were asked to list the medicinal plants that they used for their livestock. This was done verbally and simultaneously translated and written down (Appendix B1). Using position of mention and frequency of mention (Martin, 2004; Quinlan, 2005) enabled the researcher to ascertain, through an emic, or insider, approach, the categories and plants that are important and useful.

Free listing was followed by the use of photographs as a reference tool as described by Thomas et al. (2007). Here herders were asked to page through the reference book '*Flowers of Mongolia*' (Hauck and Solongo, 2010) that contains photographs of flowering plants together with scientific species name according to Gubanov (1996) and the Mongolian species name (written in the Cyrillic alphabet) drawn from Grubov (1982) and Ulziikhutag (1985). Herders were asked to indicate plants used for ethnoveterinary purposes, and explain the uses, dosage, collection, storage, preparation and administration methods, as well as local names (if different from those in the book) (Appendix B2). Plants that were recognised and used for other purposes (human medicinal and other) were also recorded, and used as a proxy for general plant knowledge. Whilst paging through the book, many respondents verified the plants mentioned during the free listing session with photographs of the plant found in the reference book.

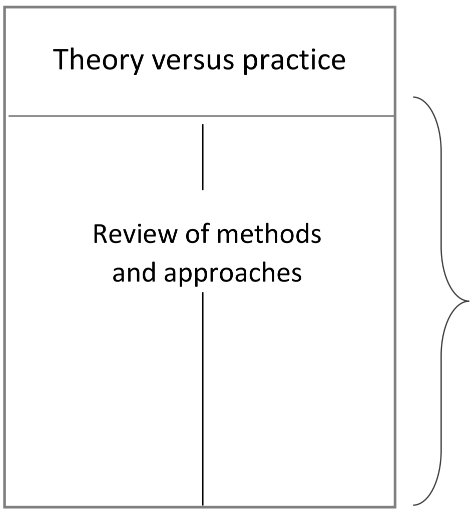
Thereafter, participants were interviewed using a semi-structured questionnaire with open- and closed-ended questions (Appendix B3), and were given an opportunity to ask questions about and comment on the study. Interviews were designed to gather descriptive data and respondent demographic information (age, education, livestock numbers, and migration patterns), livestock illnesses and disease, knowledge transfer and threats, and to examine herders' perceptions of medicinal plant use, knowledge and conservation. Where possible herder reports were verified by personal observations of nearest water sources, medicinal plant storage and livestock numbers. Ethnographic notes and journal entries were made at the end of the day for every interview.

Voucher specimens were collected where possible, either in the field together with respondents (ideally), together with the knowledgeable horse-guide or from dried specimens that respondents had stored for the winter. These were collected, pressed and transported using a mobile plant press, for later identification and storage.

Fieldwork was initially conducted using a motor vehicle as the basic form of transport between herding families, allowing for preliminary preparations to be made and for the research project to get underway in a safe manner. Thereafter all fieldwork was done on horseback, together with a local guide, as the means of travel between families and ecoregions, camping out, or staying with families that welcomed us in.

3. Results and discussion

The methods used to collect ethnoveterinary data are critically reviewed by comparing the theory and practice of each method and approach. Key themes that emerged from my experiences and from the process of contrasting theory and practice are then discussed in more detail, including corresponding recommendations (Fig. 3.1). Photographic descriptions of fieldwork methods and experiences are presented in Fig. 3.2 and Fig. 3.3.



<u>Themes</u>

1. Importance of understanding the context
2. Data collection
3. Assumptions around involving local people
4. Concerns around biopiracy
5. Gender related issues
6. Researcher well-being
7. Recommendations

Fig. 3.1 Key themes drawn out from a critical review of the theory and practice of methods used for an ethnoveterinary research project in Mongolia.

A total of 19 methods and approaches were used for gathering ethnoveterinary data in Mongolia, and are summarised in Table 3.1. Here, the theory behind each method is described together with an account of how the method was used (practical reality) and comments on the outcomes of using the method.

Examples and suggestions from ‘*Reflections on Research – The Realities of Doing Research in the Social Sciences*’ (Hallowell et al., 2005) were used to stimulate natural, free-flowing reflections on my experience of the methods that I used and problems encountered (Appendix F1). In addition, further reflections, aided by fieldwork journal entries and ethnographic notes, on questionnaire improvement and biopiracy, can be viewed under Appendix F2 and F3.

Fig. 3.2 Interviews held with Mongolian herders. A. *Paeonia anomala*, an example of an ethnoveterinary medicinal plant, and D. respective reference book entry and dried root stored for use in winter. B & C. Interviews with men using the reference book *Flowers of Mongolia* with men were usually held outside, and E. with women, usually inside the *ger* (felt tent home). Photo A, C-E: B.Seele, B: L. Dreyer

Fig. 3.3 Fieldwork approaches used for an ethnoveterinary research project in Mongolia. A. Fieldwork was conducted using horses as the main form of transport. B. Introductions between researchers and respondents were made by the horse guide and respected community member. C. Interviews were conducted in a manner that allowed female respondents to complete their daily chores such as the making of *aaruul* (dried curds). Photo A: B.Seele, B-C: H. Wiese

Table 3.1

Theory versus practise: a review of the methods and approaches used for ethnoveterinary research conducted in Mongolia.

Methods used (chronologically ordered)	Theoretical Approach	Practical Reality	Comments on outcomes
Participation in the Mongol derby (1000 km self-supported endurance horse ride)	Establish rapport with local knowledge holders (Martin, 2004). Understanding the 'human context' in which the traditional knowledge is embedded (Shackeroff and Campbell, 2007).	Riding Mongolian horses and staying with local herder families allowed me to gain insight into Mongolian herder way of life, especially in terms of livestock.	Highly beneficial: increased my understanding of the context in which ethnoveterinary knowledge is embedded. Enabled the establishment of important relationships with knowledge holders, interpreters and local guides.
Collaboration with local university	Establish local research partners (CBD, 1992; International Society of Ethnobiology, 2006).	Administrative benefits (research visa and local university affiliation, ethical clearance), but little fieldwork and data collection support. Use of university herbarium was very helpful.	Although more about administrative steps, this was a crucial part of the research process, and it is hoped it will play a role in the dissemination of findings in Mongolia.
Ethical clearance and prior informed consent	Prior informed consent (International Society of Ethnobiology, 2006; Nagoya Protocol, 2010).	Obtained from two universities. This was instrumental in explaining intention and motivation of the research project. Proof of ethical clearance offered protection from a false accusation of biopiracy.	It proved invaluable to receive ethical clearance from a local institution, as it offers protection to both respondents and researchers.
Employing a local vehicle driver and local interpreters	Local involvement in research team and research logistics (International Society of Ethnobiology, 2006).	There was a dependence on the driver, and cultural sensitivity was misused by him. The driver became aggressive. Good interpreters are in high demand and easily find other jobs. The interpreter also brought her personal agenda into interviews. There was some interpreter bias towards research and respondents.	The importance of a driver is often underrated, especially where a language barrier exists. The driver used in this study made the experience more difficult. 'The mere fact that interviewers, enumerators or extension agents are from the local area does not mean they have that requisite local knowledge, language skills and cultural sensitivities for studying local knowledge systems' (Grandin and Young, 1996).
Recording	Use of recorder during interviews (Martin, 2004), only if consent was given .	Seventy percent (n=35) of interviews were recorded. In retrospect, the manner in which the interpreter explained the recording influenced respondents' reaction towards recording.	Transcription and translation of recordings gave insight into interpreter bias.
Snowball sampling	A nonprobability sampling method, often employed in field research, whereby each person interviewed may be asked to suggest additional people for interviewing (Babbie, 2004).	Mongolian pastoralists have an extensive social network, which was key to locating knowledge holders and to establishing trust. Both contacts from the Mongol derby and from the horse guide assisted with snowball sampling.	Suggestion from respondent translated incorrectly due to personal agenda of driver and interpreter (n=1).
Free listing	Free listing can provide insight into culturally important plants and ailment categories (Martin, 2004). Because free lists are not exhaustive (Quinlan, 2005), where possible, inventories from free listing were supplemented and cross-checked using a plant reference book (see following row).	Free listing allowed respondents to become comfortable with the interview situation and encouraged a more balanced positionality of power between researcher and respondents.	Using position of mention and frequency of mention also enabled the researcher to ascertain, through an emic approach, what categories and plants are seen as important and useful.

The use of photographs in a reference book *Flowers of Mongolia* (Hauck and Solongo, 2010) for ethnoveterinary medicinal plant inventories	Interviews held *ex situ* with plant photographs as a reference tool (Thomas et al., 2007).	A high adult literacy rate of 97.8% in Mongolia (UNESCO, 2006) substantiated the use of the reference book method. In general herders reacted positively and with much interest to the book. However, four respondents mentioned having poor eyesight and chose not to use the reference book.	In the reference book, two species of the same genus are frequently shown on one page. Respondents often indicated (by vaguely pointing at all photographs on the page) that both species (sharing the same common name) were used, although not both voucher specimens could be collected.
Voucher specimens	Good quality herbarium specimens are crucial to ethnobotanical (and ethnoveterinary) studies (Alexiades, 1996; Cunningham, 2001; Martin, 2004). Researchers must take into account sensitivity to conservation and local cultural concerns (Cunningham, 2001).	In general, voucher specimens were difficult to collect for all mentioned plant species due to an ongoing drought (FAO 2016), herders being too busy, distance between interview location and medicinal plant location and cultural objections.	Concerns were raised about the use of a GPS to mark voucher specimen coordinates, possibly due to suspicions related to similar technology used by geologists prior to mining, and possible fears around bioprospecting.
Use of GPS	Used to determine geographical distance and to record interview and voucher specimen location.	Not everyone uses the 'western' approach to map reading and direction. Locally, time and distance measures were done taking horseback travel and jeep tracks into consideration. Compass directions can be interpreted in different ways. Concerns were raised around the use of a GPS to record voucher specimens, based on fears of bioprospecting.	One needs to be flexible in terms of when and how to get to a specific area, and prepare for cultural differences in map reading. Cultural sensitivity around voucher specimen location needs to be considered. The horse guide was fascinated with the GPS after time was taken to explain to him how it works.
Interviews	Semi-structured interview with open- and closed-ended questions (Martin, 2004).	Conducting interviews of good ethical, social and scientific quality is challenging, especially when dealing with non-interview related issues that come up during the interview. Questions around herd size and demographic information made some respondents feel uncomfortable (also briefly reported by Heffernan et al., (1996)) and, in this case, were left out.	Researchers should receive specific training, from the social sciences, in conducting interviews.
Travelling on horse back	Establish rapport with local knowledge holders and participant observation (Alexiades, 1996; Martin, 2004). Reduce imbalance in position of power (Shackeroff and Campbell, 2007).	Although this meant a decrease in the daily distance covered, it soon became clear that this was the appropriate mode of transport, with respondents feeling more at ease. This led to naturally stimulated conversation around livestock care. It enabled the research team to establish good report with herders and allowed for valuable insight into life on the steppes.	This had a very positive effect on the success of the project. It allowed me to place ethnoveterinary knowledge in the context of Mongolian herders (Shackeroff and Campbell, 2007).
Local horse guide as part of research team	Place ethnoveterinary knowledge in context (Shackeroff and Campbell, 2007). Local involvement in research team and research logistics (International Society of Ethnobiology, 2006); Establish rapport with local knowledge holders (Martin, 2004).	The horse guide was a well-known and respected community member. He suggested which families to visit, and introduced the research team and project to these families. He also assisted with voucher specimen collection.	The assistance of the horse guide with horse-care, logistics and introductions to knowledge holders was invaluable during field work.

Support of having my partner as field assistant.	Ensuring researcher health and well-being (Kara, 2015; Moncur, 2013). Partner was introduced as my husband.	Help and support from my partner during the often strenuous fieldwork provided crucial support, motivation and understanding. The presence of my 'husband' prevented any untoward responses, increased my status in a patrilineal society and reduced vulnerability associated with doing fieldwork as a foreigner.	Gender issues (Howard, 2003) and vulnerability are important to consider before and during fieldwork. Especially the vulnerabilities associated with alcohol, untoward advances and general safety of a young female foreign researcher should be considered.
Keeping a journal and observation schedules	Daily entries into a fieldwork journal, and observation schedules (Appendix C) for interviews and other noteworthy experiences (Martin, 2004).	This allowed me to record and keep track of finer, often crucial, details. In addition, time spent on this offered an opportunity to de-brief and reflect on fieldwork.	This proved to be instrumental for later analysis. However, it was challenging to add qualitative data to a largely quantitative research project in a meaningful way.
Market surveys	Interviews were conducted with market sellers at two major markets following guideline described by Martin (2004) and Cunningham (2001).	Market sellers reacted with suspicion to questions relating in any way to plant sales and popularity. The *ca*. 60 years of being a Soviet satellite state could be a factor in suspicions related to interviews and questions. A relationship was established with only one market seller.	Performing market-related research can be difficult due to the informal, varied and somewhat hidden nature of the medicinal plant trade (Etkin et al., 2011). I needed more time to establish relationships prior to conducting market research.
Assistance from boundary organisations	Boundary organisations bridge the gap between research and practise (Cook et al., 2013; Guston, 2001) and are familiar and experienced with the local context.	Staff from the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Biodiversity and Adaptation of Key Forest Ecosystems to Climate Change Programme, offered valuable support in terms of interpreters, horses and fieldwork logistics.	It is important to identify and receive support from the correct and genuinely supportive boundary organisations. This takes time and should be factored into research planning.
Support	There is a need for researchers, especially young and novice researchers, to have support systems in place that offer support before fieldwork commences and to allow for debriefing after the fieldwork period (Hallowell et al., 2005; Kara, 2015).	Academic and motivational support was received from my supervisors before, during and after fieldwork. Professional psychological support was sought after fieldwork had been completed. The help from a psychologist in dealing with post-traumatic stress (main sources of stress: problems with driver, politicization of the intellectual property rights issue) played a critical role in finishing the research project.	From my experience, I recommend that researchers performing ethnobotanical studies in a foreign country for the first time, receive psychological support (of some form) pre- and post-fieldwork.

3.1 Importance of understanding the context

Gaining insight into the Mongolian context in which ethnoveterinary knowledge is developed and used today, is key to understanding, analysing, and correctly and ethically reporting on this knowledge. The ethnoveterinary findings (discussed in Chapter 2) reflect the knowledge held and used by a relatively small number of Mongolian herders. Care should be taken to view and interpret the findings within the local context, and not to extrapolate these to all Mongolian herders.

Competing in the Mongol derby endurance riding event, a completely non-academic endeavour, allowed me to gain crucial insight into the daily lives of Mongolian herders, especially around horses. These are one of the Mongolian's most important cultural symbols. Competing in this ride gave rise to both the idea of the current research project, and led to a strong interest and passion for Mongolia, Mongolian horses and medicinal plants. This type of passion and purpose are essential for a project of this nature, where both geographical and cultural loneliness are very real challenges. Passionate interest is an important resource and should be valued as such along with time and financial support. Equally important was a mental toughness to persist and complete the fieldwork despite many challenges, a mental discipline honed through my dedication to trail running and long distance horse riding.

Central to traditional ecological knowledge research, including ethnoveterinary research (as experienced through this study), is that a researcher must understand the context in which the traditional knowledge is located (Agrawal, 1995; Nadasdy, 1999). Furthermore, the choice of research methods needs to be directed by an understanding of the context (Shackeroff and Campbell, 2007). Otherwise, how can a researcher know that, for example, discussing fish out of season is believed to upset the natural order of the universe (Berkes, 1999) or, in the case of this study, that there is a tendency in the Mongolian culture to not speak openly about problems, including livestock health problems? As pointed out by Etkin et al. (2011), there is a need for researchers to recognize and acknowledge that local knowledge, and, more specifically the use of ethnomedicines, are embedded in a much larger system and influenced by many factors, including political, economic, local disease experience and explanations.

Travelling on horseback, with a local guide, despite contrary advice and concerns, was one of the most important and successful approaches used, as it allowed for a more participatory research mode. Although choosing to use horses as a means of transport came with some challenges, such as where to source suitable horses, tack and safety gear and meant a decrease in the daily distance covered, it soon became clear that this was the better mode of transport. Respondents felt more at ease, the common topic of horses acted as an 'ice-breaker' and led to naturally stimulated conversation around livestock care. In addition, it gave the research team significant insight into life on the steppes. Both competing in the Mongol derby and doing fieldwork on horseback enabled me to gain an understanding of the herder way of life in which the ethnoveterinary knowledge is embedded and used.

According to Shackeroff and Campbell (2007), 'the human context, and the researcher's ability to adequately understand and account for it, will largely determine the success and/or failure of traditional ecological knowledge research'. This, in my opinion, also holds true for ethnoveterinary research. The human context in which traditional knowledge is embedded is complex and dynamic. In the Mongolian context this complexity is deepened by 70 years of being a Soviet satellite state prior to the (current) influx of western non-governmental organisations (NGO's) and conservation related organisations and researchers. Although some respondents were suspicious of the research intentions and of the interpreter (this was only understood in retrospect), most were welcoming, hospitable and thanked me for coming to their country and doing research there.

Cultural immersion, participant observation and journal keeping played a critical role in placing indigenous knowledge in context. In addition, it allowed for insight to be gained into the local context, if not at the time, then certainly in retrospect upon reflection. Important insights for the interpretation of results can be gained in this way. In addition, photographs of my own background and country went a long way in explaining the rationale behind the research and in establishing rapport with respondents.

Together with understanding the local context, a researcher must be aware of the influence and dynamics of position of power. It is important to have an understanding of who holds what power during fieldwork, whether it is during interviews, informal discussions or the planning of logistics. Researchers are powerful in a number of ways, especially when research is undertaken by a foreigner researching non-Western knowledge systems and where the entire research process and related benefits lies more with the researchers than the 'researched' (Shackeroff and Campbell, 2007). A number of methods were used to balance the position of power between researcher and respondents. For example, by arriving at interviews on horseback rather than in an expensive four-wheel drive vehicle, participating in culturally important activities such as eating meat (even though I had been a vegetarian for 20 years), and by beginning discussions about ethnoveterinary medicine with a free listing opportunity. This allowed respondents to feel more at ease with a more balanced position of power. Despite these methods and approaches, it must be acknowledged that as a westerner doing western research on indigenous knowledge, certain imbalances of power were inevitably present. If nothing else, it is hoped, that through our interactions, local Mongolian herders became aware, if not so already, of their wealth of knowledge and the importance and power thereof.

3.2 Data collection

3.2.1 Free listing, reference book and interviews

Beginning interviews with a free listing opportunity allowed respondents to become comfortable with the interview situation and encouraged a more balanced positionality of power between researcher and respondents. Recording which plants were mentioned in the beginning of the free list (position of mention) and how often certain plants were mentioned (frequency of mention) enabled the researcher to understand local plant use and importance (Quinlan, 2005). In addition, free listing gave the research team an idea of local nomenclature, and awareness of cultural sensitivities around talking about problems and traditional knowledge. Subsequently using the reference book as described by Thomas et al. (2007) after the free listing then enabled herders to verify free listed plants with photographs from the reference book.

A 97.8% adult literacy rate in Mongolia (UNESCO, 2006) and the fact that 49 of the 50 respondents had received formal schooling, and are therefore used to seeing two dimensional depictions of real life plants, enabled me to make use of the reference book method. In general, the reference book was met with much interest from the herders and enabled them to share their knowledge on plants (not only ethnoveterinary) with those around them. Although the reference book only represents about 15% of vascular plants that exist in Mongolia, it offers a graphic supplement to the existing floras of Mongolia by using detailed colour photographs. This made it well-suited to be used as an ethnobotanical reference tool during interviews (Thomas et al., 2007). In addition, free-listing gave respondents an opportunity to mention plants that were not necessarily represented in the book.

However, reflecting upon the experience of using a reference book during interviews, a few criticisms of this method arise. Firstly, doing both free listing and paging through the reference book had the potential of becoming a lengthy procedure. A few herders seemed tired after the free listing and were not interested in looking at the reference book, or paged through very quickly. Herders and their families are busy and occupied with seasonal chores, and in future, emphasis should be placed on avoiding unnecessarily lengthy research interviews. Secondly, four respondents mentioned having poor eyesight and could not see the plant photos in the book clearly. This must be kept in mind when making use of a reference book, especially where knowledge is held mostly by older people. Thirdly, because the format of the reference book shows numerous photographs of two species of the same genus per page, respondents often indicated (by vaguely pointing at all photographs on the page) that both species, sharing the same common name, were used, but both voucher specimens could not be collected. Therefore, analyses on species use and importance were done using ethnospecies (Hanazaki et al., 2000) as a unit of analyses rather than botanical species (Chapter 2). More research needs to be done on the local nomenclature and differentiation of species.

Due to this being my first research project on ethnoveterinary knowledge in this geographical region, snowball sampling was used to locate and interact with respondents. At a later stage in similar research projects, where a relationship with respondents has already been established and where medicinal plant use is well-documented, other techniques could be used, such as the matrix method described by De Beer and Van Wyk (2011).

Of the 50 respondents interviewed, only 30 (60%) completed all three sections of the interview. Possible reasons for this include time constraints, poor eyesight, tiredness, length of interview, and, in certain instances, local knowledge not being shared easily due to linguistic difficulties and translator bias. The reluctance to share local knowledge has also been recorded in other ethnobiological studies (Luseba and Tshisikhawe, 2013; Sternberg, 2008) and emphasizes the need to establish good rapport with respondents, as well as local interpreters, drivers and research team members, and to form relationships based on trust and understanding.

In cases where informants felt uncomfortable with answering a question, it was left out, for example, questions on livestock numbers, due to discomfort around the sharing of personal financial information. As described and discussed in Hallowell et al. (2005), one cannot predict how an interview will go, and what reactions or emotions it will elicit in others. During my experience, reactions of respondents towards the questions were sometimes difficult to understand and interpret. The transcription and translation of audio recordings assisted in, retrospectively, understanding the influence of the interpreter's personal agenda on interviews and respondents.

Although pilot surveys assist in predicting which questions could be more problematic, there is no such thing as a 'safe' question, and all interviews should be conducted with sensitivity, diplomacy, intuition and skill and may involve some very hard, 'on-the-spot' decisions (Hallowell et al., 2005). From my experience, I recommend that novice ethnobotanists receive anthropological training in the science and art of conducting interviews and how to deal and cope with non-interview related issues that arise during an interview. Anthropologists place emphasis on research objectives being explained and understood locally and that 'residents find in their participation a value that transcends whatever immediate remuneration we offer' (Etkin, 1993). Consequently, ethnobotanical and ethnoveterinary research would benefit from being guided by anthropological methods that emphasize the importance of the larger context in the research of medicinal plants and people-plant interactions (Etkin, 1993).

Recordings and the taking of photographs was only done if prior consent was given. That not all interviews were recorded stands testament to the fact that participants felt free to make a decision around these options. Although I did not experience this, difficulties and misunderstandings around the use of audio recorders can arise in interview situations (examples described in Hallowell et al. (2005)), and researchers should be aware of the possible cultural and personal sensitivities around recording information.

3.2.2 Voucher specimens

Voucher specimens were collected where possible, either in the field together with respondents (ideally), together with the knowledgeable horse-guide or from dried specimens that respondents had stored for the winter. In general, voucher specimens were difficult to collect for all mentioned plant species (both from free listing opportunities and looking at the reference book) for various reasons. Voucher specimen collection was hampered by the ongoing drought at the time (FAO, 2016), and as a consequence many medicinal plants were difficult to find in the field. With concerns about finding water sources and it being shearing season, many herders were too busy to show the research team examples of medicinal plants in the field, especially in cases where plants grew further away or in difficult to access regions. Many medicinal plants were described as growing in sacred mountain or forest areas, far away from the *ger* (felt tent home) and were only visited when out herding. The research team also experienced cultural objections to the collection of voucher specimens, with one respondent asking the researchers to please not pick any plants as this would result in a thunderstorm. In addition, it became clear that respondents (and interpreters) had fears around the use of a GPS and knowledge of the location of certain plants being misused, and therefore, accordingly, the research team decided to tread lightly in terms of voucher specimen collection.

Cunningham (2001) mentions sensitivity to cultural concerns as one of five important reminders for collecting plant specimens. However, the way to satisfy the academic requirement of voucher specimens, whilst taking cultural fears and sensitivities into consideration, was challenging. From my experience, explaining what a voucher specimen is, why it is needed (perhaps in future taking an example along) and explaining that they will remain in a local herbarium helped to reduce suspicion. Perhaps making labelled herbarium specimens together with respondents and encouraging local voucher specimen collections is a possible idea for further related research. This could also be used as a tool for imparting and sharing ethnoveterinary knowledge with others.

3.3 Assumptions around involving local people

Although the inclusion of local research partners and community participation is strongly encouraged (CBD, 1992; Martin, 2004), researchers cannot assume that local partners and local research team members understand the research project and have the necessary skills, experience and sensitivities required for the research. In their ethnoveterinary interview guide, Grandin and Young (1996) highlight the need for cultural sensitivity, but caution against assuming that local interviewers or extension agents automatically have the required knowledge, language skills and cultural sensitivities for researching local knowledge systems. This holds true in my experience where local members of the research team did not always have the necessary cultural understanding and objectivity during interviews. Difficult problems arose when an interpreter began misusing the interview settings for personal intentions and when this agenda became the priority of interviews. The reason that very few magic-religious practises were spoken about during the interviews, could well be due to the personal religious agenda of the interpreter that seeped through into the interview session. Only in retrospect, through audio recordings, did this become clear. In addition, on two occasions, my intention to be culturally sensitive, aware and respectful was somewhat exploited by a driver and an interpreter on the team. The importance of commitments made to the research project (time or employment) do not necessarily hold the same worth for local interpreters, drivers and team members as for the researcher. This especially when arranged in advance, across countries. Good interpreters are in demand and do not necessarily feel loyalty to a specific research project. Being aware, in advance, of the difficult tightrope that sometimes needs to be walked during this type of research, allows the researcher to anticipate these challenges and to be prepared and educated in how to deal with them.

Similarly, although essential and beneficial, establishing relationships with local research partners, for example, at a local university, does not automatically ensure that research partners will be active and provide support for the research. Again, prior knowledge of possible challenges enables the researcher to remain flexible and somewhat prepared. Although academic research institutions can play a major role in fieldwork related to a research project, the importance of connecting with local boundary organisations is often overlooked. Boundary organisations are those that bridge the gap between research and practise, or science and management, and facilitate the working together and building of relationships between scientists and non-scientists (Cook et al., 2013; Guston, 2001). Although researchers should, ideally, immerse themselves in the culture and live or engage with the community for a long-term period, the practical reality is that grant holders, funders and university schedules do not, and cannot always, take this into consideration. In these cases, boundary organisations, that form a bridge between scientific research and community engagement, and that are experienced in the local customs and culture, provide important support (among others logistic and technical) for fieldwork. The genuine understanding and support received from the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) Biodiversity office in Ulaanbaatar helped immensely, especially in terms of interpreter support, finding suitable horses and other fieldwork logistics.

3.4 Concerns around biopiracy

As so well-described by Etkin et al. (2011), it is important, especially as a researcher, to enter into a community slowly, and even more so now since '*concerns about biopiracy cast us in shadow throughout much of the world*'. 'Biopiracy', first coined by Mooney (2000), and now a frequently used term, is defined by Dutfield (2005) as '(i) *the theft, misappropriation of, or unfair free-riding on, genetic resources and/or traditional knowledge through the patent system; and* (ii) *the unauthorised and uncompensated collection for commercial ends of genetic resources and/or traditional knowledge*'. With reference to the current study, I also experienced the 'shadow of biopiracy' (Etkin et al., 2011), although ethical clearance for the research was obtained from the university of registration and a local partner university and prior informed consent was a prerequisite for the commencement of all interviews together with the ethical guidelines of the International Society of Ethnobotany (2006) being followed at all times. Even though considerable effort was made to explain the intention of the research project, the motivation behind it, and that there was no financial incentive in conducting the research (sometimes met with disbelief), questions and concerns around biopiracy fears were raised by some respondents. Misunderstandings and fears around the misuse of local medicinal plant knowledge were shared by respondents through anecdotes about individuals entering communities and asking questions about medicinal plants, only to return at a later stage and pillage entire populations of the specific medicinal plant.

In general, however, once the development and rationale of the research project had been explained and rapport had been established, most respondents felt comfortable with discussing and sharing their ethnoveterinary knowledge. Although I tried to make it clear that there was no need to share secret information, the eagerness of the interpreter sometimes caused misunderstandings. In the analysis of transcribed and translated audio tapes of interviews, any information described as secret or not to be shared further (two cases), was not recorded nor included in any part of the thesis writing and consequent publications. Audio tapes will be destroyed when the project is complete, and a confidentiality agreement has been signed with the audio translation company.

In addition, although effort was made to ensure that all local team members understood the research rationale and methods (by explaining for example about my participation in the Mongol derby, being on horseback) and the meaning of ethical clearance and local collaboration, a family member of one of the research team members, when hearing of the research, accused me of stealing information that belongs to Mongolia. Although the matter was clarified when copies of ethical clearance, information sheets, signed prior informed consent, and proof of local university support, was given, it was a disconcerting experience, and brought to light the importance of having local research support, both for research participants and for the safety of the researcher.

As an ethnobotanical researcher, it is imperative to obtain ethical clearance from a local institution in the country of study, to have the legal support of a local collaborator, to carry proof of both of these with you in the field, and to ensure, as far as possible that all research team members understand and are comfortable with the ethics around the research project. In addition, it is important to acquaint oneself with the literature, treaties and protocols surrounding research into indigenous knowledge and to study bioprospecting regulations. Cultural misunderstandings are bound to occur, and it is the responsibility of the researcher to ensure that these are cleared up in a manner that is constructive to both researcher and researched.

In the discussion around bioprospecting, intellectual property rights and traditional knowledge, it is important to be guided by the Convention of Biological Diversity (CBD, 1992) and the regulations of the adopted Nagoya Protocol (2010) and to adhere to the prescribed rules and regulations. However, within the quagmire of debates surrounding benefit sharing agreements and the ownership of indigenous knowledge (Prathapan and Rajan, 2011), it is worth keeping track of the bigger picture. This is described in the question posed by Dutfield (2015) '*How can traditional medicinal knowledge stay in use if the lands where the plants grew have been ploughed over*? and further expressed as the need to provide '*political space to allow indigenous peoples themselves to establish the rules of engagement*'. As concluded by Huntington, (2011), '*at its heart, the greater engagement of scientists with traditional knowledge is really about the greater engagement of people, sharing information about what matters most to them*'.

3.5 Gender related issues

Gender context, influence and related issues are often overlooked or not taken into consideration in ethnobotanical research (Pfeiffer and Butz, 2005). Results are often misinterpreted as a result of not being viewed firstly, within the context of gender roles in terms of medicinal plants in the specific community being studied and secondly, within the specific context of the gender situation between researcher and respondents (Howard, 2006). In the present study both men (n=24) and women (n=26) were interviewed and the research team comprised of both men and women, with the principal researcher and two of the three interpreters used during the entire study being female, and the driver (only on the initial fieldtrip), horse guide, research assistant and interpreter (one) being male. The experience of using first female, then male interpreters, allowed me to gain insight into and understanding of gender related knowledge and gender differences in the particular Mongolian context. In designing and implementing more inclusive, gender-neutral research, Pfeiffer and Butz (2005) suggest using a mixed-gender team as this lessens the likelihood of experiencing cultural restrictions in data gathering. However, as noted by Logan and Huntley (2001), the potential impact of gender power dynamics within the research team itself must be taken into consideration, and includes possible gender-based translation issues that can arise if culturally induced power relations influence the interview (Pfeiffer and Butz, 2005).

As in many pastoralist societies, the Mongolian women of herder families have many roles and duties to fulfil, from preparing food and medicinal plants for the colder months and looking after children, to preparing daily meals, milking the animals and seeing to sick livestock. In order to take the full and busy lives of women into consideration, and the situation in a patriarchal society where women are sometimes shy of speaking out especially to foreign researchers, interviews held mainly with women were always held in the *ger*, whilst cooking and preparing food, whereas interviews held with men, where often conducted outside the *ger*.

During interviews, the question "*are there differences in medicinal plant knowledge held by men and women?*" was asked. The majority of respondents (70%, n=29) indicated that there was no difference, and further comments included: "*What is important is the individual's interest in medicinal plants"*, "*there is a good exchange between men and women"* and "*there is no difference, it depends on the person's interest*". Men were perceived to be more knowledgeable about medicinal plants by 15% (n=6) of respondents, and equally, 15% (n=6) of respondents perceived women to be more knowledgeable, with one respondent mentioning that men know more about choosing plants and women know more about the preparation thereof. Howard (2003) remarks that across the world post-harvest processing and preservation are roles often assigned to women and girls. Reasons for men knowing more about medicinal plants included "*men know more because they go with the animals*", "*it's easier for men to travel to the mountains where medicinal plants grow*" and "*men know more because they are closer to the animals*". Explanations for women being more knowledgeable about medicinal plants included "*women know better than men, men just fly on their horses without seeing what plants are under them*", and women being more sensitive than men. From my experience, in interviews where both husband and wife were present, sometimes the wife took the lead and sometimes the husband, depending on the question. In two interviews, however, the wife seemed to be more knowledgeable but would only share information when directly asked by her husband. What did become apparent is that herding of livestock is done mainly by men and young children. Therefore, in general, men have wider access to grazing lands, forests, hard to access mountainous areas and other sacred sites where medicinal plants grow and are harvested, than women whose daily roles mainly play out in and around the home. However, women are directly involved with the use of medicinal plants, because they are responsible for sick animals. These are often treated close to the home, especially in winter where herds are kept close to the homestead. In addition, because most medicinal plants are dried and stored for later use, women are directly involved with the preparation and storage of ethnoveterinary medicinal plants.

It must be emphasised that these findings reflect the respondents involved with this study, and cannot be extrapolated to the entire Mongolian nomadic pastoralist society and culture. It should also be remembered that gender roles, expectations and taboos, as with any cultural realm, are dynamic and constantly changing due to internal and external influences.

In terms of gender roles, position of power and cultural context, the methodological difficulties of researching women for ethnobotanical studies are only rarely mentioned or written about (Howard, 2006). Here, although being a woman, and using mostly female interpreters, I fully acknowledge the limitations of my findings. The 26 women interviewed, together with participant observations and informal discussions gave me valuable insight into gender roles, and ethnoveterinary medicinal knowledge held by women. However, due to very few (n=2) interviews being held with only women present (respondent and research team), it is possible that sensitive topics or ailments were not mentioned, and that the full wealth of knowledge held by Mongolian herder women was not recorded. In addition, it is possible that, as a foreign researcher, I was not aware of all cultural sensitivities around gender, for example, did all women feel comfortable enough to discuss castration or fertility-related livestock problems with me? Although it can be assumed that there are fewer sensitive areas around livestock health than human health, and many female-related livestock ailments were openly shared by men and women, it is for the reasons and uncertainties mentioned above that I refrained from analysing the ethnoveterinary data gathered in terms of gender. As noted by Shackeroff and Campbell (2007), it is more important to understand why people will or will not share information, than determining the most knowledgeable person to talk to.

Gender complexities between a young female researcher and older male respondents from a mostly patriarchal society are complex, and can put female researchers in vulnerable situations. Examples from my experience include having to override decisions made by a male driver, working through the consequent conflict, and dealing with alcohol related problems and the uneasiness and misperceptions around these. As a female researcher working in a male-dominant society, how does one handle a situation where an interview is sabotaged by intoxicated family members, or when the horses organised for a research trip are not available because the owner is drunk? Acknowledging and addressing these vulnerabilities, and learning the necessary skills and tools to deal with these, is vital, especially for young women scientists doing research in foreign, patriarchal societies with a history of alcohol abuse.

Having my partner with me as research assistant, and introducing him as my husband, was of great help in dealing with and reducing gender related vulnerabilities. The presence of a husband gave me and my research more credibility, prevented any untoward advances or remarks, and gave me the much-needed support in dealing with gender related tensions.

3.6 Researcher well-being

Although research ethics and manuals focus on the well-being of research participants (and correctly so), not much is written about the well-being of the researcher (Malacrida, 2015). However, it is important that researchers are aware of the potential impacts that doing research can have on their mental and emotional well-being, and protect themselves accordingly (creative research). Ensuring the health and well-being of the researcher is essential, not only for the sake of the researcher, but also for the validity of the research and interpretation of research findings (Moncur, 2013).

The loneliness and isolation that comes with doing research in a foreign place, far away from home, can be challenging. In addition, participant observation, as part of the research process, requires a willingness and commitment to engage in the social worlds of the research that can be physically and emotionally draining (Scott Jones, 2010). From my experience, having someone in the field with you that understands your background and is truly supportive of you and of your research (in my case my partner), is essential.

Self-care and support mechanisms are crucial for the well-being of a researcher (Kara, 2015). Further strategies, suggested by Moncur (2013), include advanced-preparedness, peer-support, opportunities for reflection and access to counselling. From my personal experience, the help from a psychologist in dealing with fieldwork related post-traumatic stress played a critical role in my motivation levels and approach towards writing up my research.

3.7 Recommendations for ethnobotanical fieldwork

Further recommendations of a more general nature developed out of my personal experience of gathering ethnoveterinary data in Mongolia are described below. Although these arose out of a specific researcher and respondent context, they could have broad applicability to other ethnobotanical, including ethnoveterinary, research.

The ethnoveterinary findings from the current research project (recorded in Chapter 2) could further be elaborated on and strengthened by more in-depth studies with selected key respondents and with longer time periods spent with selected key informants. In addition, using only one interpreter, experienced with this type of research, and having the necessary cultural sensitivity and objectivity, for the duration of the study would strengthen the validity and range of the research.

The formation of a multidisciplinary research team (Martin, 2004) where an anthropologist, a botanist, an ecologist, and a veterinarian (for ethnoveterinary studies) would offer valuable support and input from many different fields. This would allow for a pooling of knowledge and resources. It is important that grant holders, funders and academic institutions are aware that this type of social-scientific requires enough time and funding, and offer the necessary support and understanding. Sufficient time should be factored in for preparing for fieldwork challenges in advance, including the necessary training and support, as well as for building relationships in the field. Understanding the context in which traditional ecological knowledge is embedded, requires time, preparation and consideration (Shackeroff and Campbell, 2007). This is often overlooked in research projects that focus on quantitative rather than qualitative outputs.

Researchers of indigenous knowledge should receive social and more specifically anthropological training in the skills and approach required for establishing genuine report, conducting interviews, dealing with non-research related human issues and in ensuring one's own health and well-being during the research period (Kara, 2015). Scientific researchers, especially, need to receive the proper training and support in dealing with people. The loneliness and challenges of doing fieldwork in a foreign country should not be underrated, and, from my experience, researchers should have access to a support person or network prior to the start of fieldwork and upon completion of fieldwork.

There is a tendency to not talk or write about fieldwork stress, and the emotional consequences of long-term fieldwork, as reflected by Julie Scott Jones, in Watt (2010), to the detriment of young researchers. In the same way that living and working in a foreign country can be hard, returning to one's home country may also hold challenges and is often an emotional process (Watt, 2010). Therefore, support in the form of both formal and informal opportunities for debriefing should be in place, where personal responses to fieldwork can be discussed (Moncur, 2013). In addition, literature on problems encountered by other researchers during fieldwork, such as by Hallowell et al. (2005), can provide vital support and should be freely available and the reading thereof encouraged.

Cultural immersion, participant observation and journal keeping play a critical role in placing indigenous knowledge in context and allows for insight to be gained into the local context, if not at the time, then certainly in retrospect upon reflection. Important insights for the interpretation of results can be gained in this way. In addition, photographs of your own background and your country go a long way in explaining the rationale behind the research and in establishing rapport with respondents.

4. Conclusion

Although the description and acknowledgement of personal experiences, anecdotes and reflections are not often emphasized in ethnobiological literature (Nolan and Pieroni, 2013), increasing attention is being turned to the importance of sharing these recollections and experiences. Here the memoir essays of ethnobiologists describing their first experiences in the field (Albuquerque, 2014; Ertuğ, 2013) and a recollection of failed fieldwork (Svanberg, 2014) are particularly noteworthy. The importance of these writings, among others, is found in the valuable lessons and insights into ethnobotanical fieldwork and associated methods. The reflective questions of what worked, what failed and why things happened, hold a wealth of knowledge for students and researchers new to the field.

Even though the study and use of ethnobotanical manuals and understanding the theory behind the discussed methods is of critical importance, it should also be acknowledged that the prescribed and suggested methods need to be adapted to the specific context in which the research is to take place, and should be adjusted and calibrated according to the human context and the related dynamic shifts of politics and culture within the research area.

While the aim of ethnobotanical, and in this study ethnoveterinary, research is to collect detailed and quantifiable data, there is a need to recognise and emphasize that the collection of these data is done mainly using qualitative methods (Shackeroff and Campbell, 2007). These include social interactions such as interviews, participant observation and intensive engagement with knowledge holders. It is these crucial social interactions, and the required ethical conduct, sensitivity, experience and skill that researchers should prioritise. In addition, it is important that ample time is set aside for the building of meaningful relationships with local team members and with respondents.

According to Albuquerque and Hanazaki (2009), ethnobotanists should continually ask themselves whether the methods and approaches used are the most adequate for evaluating the questions being asked. As the scientific, often linear, method of asking questions and collecting data does not always fit with the circular tradition of oral history (on which most ethnobotanical research is based), researchers should be guided by methods that allow both researcher and researched to '*traverse a landscape rather than follow a linear path*' (Rhoda Malgas *pers. comm.*). In addition, from my experience, the need to be flexible, especially during fieldwork and to expect the unexpected, remaining sensitive, yet resilient, should not be overlooked.

Although certain things are not foreseeable and cannot be pre-emptively managed, having prior knowledge of the possible problems that could arise allows one to anticipate them and prepare for them. It is hoped, that through this review, certain methods, complications and associated recommendations will aid (especially, young female) long-distance ethnobotanists.

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Chapter 4

Maintaining biocultural diversity: A Mongolian case study

1. Introduction

Throughout history, communities of people have relied on careful observations of the natural world around them and their ability to successfully adapt to any related changes (Berkes, 1999). This inter-relationship between humans and nature, and the inextricable links between both cultural and biological diversity are reflected in the term 'biocultural diversity' (Maffi and Woodley, 2010), defined by Loh and Harmon (2005) as '*the sum total of the world's differences, no matter what their origin. It includes biological diversity at all its levels, from genes to populations to species to ecosystems; cultural diversity in all its manifestations (…), ranging from individual ideas to entire cultures; and, importantly, the interactions among all of these'*.

Biodiversity is crucial to ecosystem health, as it can increase ecological resilience to disturbance and may help buffer environmental shocks and stresses (Folke et al., 2004; Gadgil et al., 1993; Peterson et al., 1998; Stolton et al., 2008). Similarly, cultural diversity, the 'raw material for evolutionary adaptive responses' (Berkes, 1999) has the capacity to increase the resilience and adaptability of the social system (Berkes and Turner, 2006; Dudgeon, 2008; Gunderson et al., 2002). Therefore, together, biological and cultural diversity contribute to the resilience of social-ecological systems (UNESCO, 2008). The connection of biological diversity and cultural diversity into a single concept reflects the development of socio-ecological sciences, and the worldview of many cultures, where people and nature are viewed not as separate entities, but as an interconnected whole (Berkes, 1999).

Mongolian pastoralists share a worldview that includes themselves, their livestock, and the landscape they live in as a strongly interrelated unit (Humphrey et al., 1993). Pastoralists' traditional ecological knowledge (TEK) about the rangelands they inhabit and the health of their animals (ethnoveterinary knowledge) is embedded in a complex social-ecological system and includes both cultural and biological elements (Wanzala et al., 2005). Therefore, in order to investigate the conservation implications of traditional knowledge, both cultural factors and biological factors need to be considered. The concept of biocultural diversity allows for this.

The relationship between biological and cultural diversity is increasingly recognised (Agnoletti and Rotherham, 2015; Loh and Harmon, 2005; Maffi and Woodley, 2010; Sutherland, 2003) and in 2010 the Convention on Biological Diversity (CBD) office, representing biological diversity, and the United Nations Educational, Scientific and Cultural Organisation (UNESCO), representing cultural diversity, together launched the *Joint Programme on the Links between Biological and Cultural Diversity* (Agnoletti and Rotherham, 2015). Important issues concerning biocultural research activities were addressed in the consequently developed *Florence Declaration* (UNESCO and SCBD, 2014) and include, among others, indications that, landscapes rich in biocultural diversity are often those managed by traditional pastoralists, peasant farmers, and small-scale fishermen. Although the Florence Declaration was made with a particular reference to Europe, it also points towards the suitability of using Mongolian pastoralist knowledge and landscape use as a case study for the importance of maintaining biocultural diversity.

The practice of indigenous knowledge is, in particular, the '*story of how social or cultural systems adapt to specific ecosystems*' (Berkes, 1999). In this study, as in Berkes (1999), TEK is used in the same way that aboriginal people from the Canadian North refer to their '*knowledge of the land*' (Berkes, 1999). This dynamic body of knowledge, practices and beliefs about the relationship of living beings (including humans) with one another and with their environment, is a characteristic of societies that have for generations been dependant on resource use on specific lands (Berkes, 1999). Mongolian nomadic herders are one such group, who for centuries have lived and herded livestock, with a worldview closely connecting the sky (*Tengger*), landscape and its component parts, including totemic species such as wolves. Although TEK of Mongolian herders has been the focal point of various studies, including pastoralists' ecological knowledge in rangeland management (Fernández-Giménez, 2000), and perceptions on climate change (Marin, 2010), to date no studies have focused on the ethnoveterinary knowledge of Mongolian herders as a form of TEK. Ethnoveterinary knowledge and practices of Mongolian herders includes the use of medicinal plants, fungi and remedies of mineral and animal origin (Chapter 2), as well as specific herding techniques that are closely linked to ecological markers (Fernández-Giménez, 2000). Furthermore, ethnoveterinary knowledge is built upon specific cultural beliefs, customs and traditions and based on the relationship of herders to the land and to their animals (Wanzala et al., 2005).

The extent to which the Mongolian pastoralist example can be used as a case study in which to frame the concept of biocultural diversity is explored in this chapter. In order to gain an understanding of biocultural diversity, there is need for tools that assist in the understanding of the links between people and nature, and their implications for conservation (Ommer et al., 2012; Poe et al., 2013). This need is addressed in this chapter by the development of a novel framework for biocultural diversity, which takes into account both the biological and the socio-cultural dimensions of biocultural diversity, along various levels of organisation. The framework is then populated with examples from the Mongolian pastoralist case study, leading to a better understanding of biological and cultural diversity, and the links between them. The need for this is emphasised by Reading et al. (2006) who state that 'adequately conserving Mongolia's rangelands requires a sound understanding of the ecological, social, and cultural context and values of these rangelands'.

2. Materials and methods

2.1 The Mongolian context

Mongolia's vast grasslands (126 million ha) represent one of the largest contiguous rangelands in the world (World Bank, 2003). Roughly one third of Mongolia's three million inhabitants are pastoralists, caring for a total of 50 million head of livestock (Fernández-Giménez, 2000; FAO, 2016). Two World Wildlife Fund (WWF) Global Ecoregions lie partly within Mongolia's borders (Reading et al., 2006), and as of 2002, Mongolia's protected areas cover 13 % of the country, or 20.68 million hectares.

The characteristic Steppe rangelands, and the biodiversity they support, are central to herder livelihoods and livestock health. While, it is from its long history of pastoralism, low human population density and strong cultural ties to the land that Mongolia has largely maintained its natural biodiversity (Reading et al., 2006). Most Mongolian herders still follow a nomadic or semi-nomadic lifestyle, largely influenced by pastureland quality and availability, water sources and family ties. Mongolian herders have a wealth of traditional ecological knowledge on rangeland management (Fernández-Giménez, 2000) and ethnoveterinary practices and beliefs (Chapter 2). In general, ethnoveterinary medicinal (EVM) plants are harvested in the wild by herders and their families, mostly during the autumn months, dried in the felt home (*ger*) and stored for use during the harsh winter and spring months.

As indicated by (Berkes, 1999), traditional ecological knowledge should not be separated from its cultural and historic context. *Baigal*, the Mongolian term for nature, is closely related to *baidal*, 'the way things are' or a 'state of being' and includes animals, plants, the landscape, weather, and all human existence as well as the ways in which they affect each other (Humphrey et al., 1993; Humphrey and Sneath, 1999). Reciprocity applies to human-animal and human-landscape relationships (Humphrey et al., 1993) and herders believe that if they treat other beings and the landscape around them with respect, their extended family will remain strong and healthy (Fijn, 2011), however, if harmed, nature could retaliate (Humphrey et al., 1993).

Traditions and spiritual norms around interactions with nature were supressed during the Soviet era (Bawden, 1986) and, in contrast to indigenous and spiritual methods of conservation, a more scientific state-led conservation practise was implemented based on species identification and enumeration (Reading et al., 2006). Since the end of the Soviet era, conservation programmes and practises have been largely influenced by donor agencies (*e.g.* WWF, UNDP and GIZ) together with the adoption of key global conventions such as the Convention of Biological Diversity and the passing of a host of new environmental legislation (Mearns, 2004; Upton, 2010). Recently, however, western conservation structures and programmes have become more community-orientated, often driven by sustainable livelihood or community based conservation (*e.g.* the formation of herder groups) although the success of these has been variable (Fernández-Giménez et al., 2015; Ulambayar et al., 2016). In addition, there has been a re-emergence of spiritual beliefs as the foundation for interactions with nature (Upton, 2010).

2.2 Methods

To gain a better understanding of biocultural diversity, a two-part conceptual framework was developed that represents both biological and cultural diversity. Biological diversity is represented using the biodiversity structure developed by (Noss, 1990). This reflects structural, functional and compositional components and follows a nested hierarchical approach (Franklin et al., 1981; Noss, 1990). As there was no parallel and convenient way to investigate cultural diversity, Noss' (1990) conceptual figure for biodiversity was used as a departure point from which to develop a framework for cultural diversity. This represents three components of cultural diversity, which have an influence on biocultural diversity. These include political approaches, folk-taxonomic approaches and cognitive processes, and following Noss' (1990) hierarchical structure, are presented along four levels of organisation. Together the two figures provide a conceptual framework for biocultural diversity and a new approach to investigating biocultural diversity.

To explain the framework, I have populated both parts (representing biodiversity and cultural diversity) with examples from the Mongolian pastoralist case study. These were sourced from ethnoveterinary data, mainly regarding the use of medicinal plants (Chapter 2), data from specific open-ended questions in interviews held with Mongolian herder families, participant observation and data collected from the literature pertaining to traditional ecological knowledge and practices of Mongolian herders, notably *Wolf Totem* (Rong, 2009). Ethnoveterinary medicinal plant data was analysed using Microsoft Excel.

Interviews were conducted with 22 men and 26 women, representing 48 herder family units. The average age of respondents was 52 years (range: 27 to 78 years), with an average of 33 years of herding experience. Interviews were conducted in Mongolian, through a translator, after prior informed consent was received (see Chapter 3 for a detailed description of interview methods). Interview questions 17 and 18 (Appendix B3) were specifically developed to gain an understanding of herders' perceptions of the threats to medicinal plant and conservation of medicinal plants, whilst questions 15, 19 and 20 were developed in view of understanding the dynamics of ethnoveterinary knowledge: who the knowledge holders are, how this knowledge is acquired and transmitted, perceived threats to the continuation of this knowledge, and how this knowledge can be conserved. These data were coded and used to further populate the biocultural diversity framework.

Qualitative data from open-ended interview questions focused on medicinal plant use and knowledge were analysed using the qualitative data analysis software package Atlas.ti (v. 7.5.15). Interviews were transcribed and imported into the package and quotations from answers were iteratively coded using an inductive or open-coding approach based in grounded theory (Glaser and Strauss, 1968). This allowed for a better understanding of herders' perceptions of medicinal plant abundance and gave insight into the transmission and dynamics of medicinal plant knowledge (Appendix H). These in turn were arranged into broader family codes and analysed further according to the concepts or themes that emerged. Co-occurrence of codes within a quotation was then investigated in order to gain an understanding of the connections and associations between codes (Hopping et al., 2016). Furthermore, the co-occurrence of codes across themes were explored to investigate linkages between biological and cultural diversity that contribute to the unified concept of biocultural diversity.

3. Results

3.1 Biocultural diversity framework

In order to understand biocultural diversity a two-part, interrelated conceptual framework of biocultural diversity was developed (Fig. 4.1) This consists of the biodiversity framework developed by Noss (1990) (Fig. 4.1 left-hand side) and a cultural diversity framework (Fig. 4.1, right-hand side). Whilst the biodiversity framework represents the **compositional**, **structural** and **functional** components of biodiversity along a scale of organisation levels (Noss, 1990), the equivalent cultural diversity framework represents the **political**, **social** (folk taxonomical) and **cultural** (cognitive) components of cultural diversity. **Folk taxonomic** (FT) approaches are represented by ethnobiological classification systems (Berlin, 1992), and refer to the classification of landscapes, ecosystems (for example, ethnopedology), species (for example ethnospecies) and linguistic-meme. **Cognitive processes** include moral and religious belief systems and are further explored as religious, ritual or mythical perspectives of landscape, and the connections to particular places and species of mythical potency (Upton, 2010). Cognitive processes, or learning systems, involved in the continual shaping and adapting to the environment can influence and describe the relationship between humans and nature (Pretty, 2002). **Political approaches** take into consideration the effect that political institutions and political decisions have on communities and their interactions with nature, for example through land tenure decisions and rights (Cunningham, 2001; Upton, 2010). The political element of biocultural diversity describes and includes the political (mis)perceptions of landscape value, ecosystem value and species value (Freemuth and McGreggor Cawley, 1998; Nie, 2002). In addition, political decisions can have a direct influence on a community’s sense of place and possible dislocation of sense of place (Williams and Stewart, 1998). The three components of cultural diversity represented in the developed framework not only influence cultural diversity, but also influence biocultural diversity as a whole. The two parts of the framework are strongly interlinked and together form a unified concept for understanding bio-cultural diversity along various levels of organisation.

The genetic level of organisation (Noss, 1990) has been adapted to incorporate meme theory (Dawkins, 1976). Using the analogy between cultural and genetic evolution, Dawkins (1976) defines a meme as the ‘unit of cultural transmission, or a unit of imitation’ and offers the examples of ideas, tunes, catch-phrases and ways of doing things. Drout (2006) further suggests that traditions, in memetic terms, are a combination of several smaller memes and adds that 'memes are the atoms and their combinations are the molecules of culture'. Using language and customs as examples of cultural evolution, Dawkins (1976) suggests that co-adapted meme-complexes evolve in a similar way as co-adapted gene-complexes. Successful cultures therefore, suggests Harari (2015), are those that excel at reproducing their memes, regardless of whether these are good or bad for their human hosts.

The two-part interlinked framework is further explained by populating it with examples from the Mongolian pastoralist case study. Examples of factors that affect terrestrial biodiversity in the Mongolian context are presented at four levels of organization, from regional landscape and ecosystem-community to population-species and genetic levels (Noss, 1990) (Table 4.1). This includes, among other sources, ethnoveterinary medicinal plant data, with a specific focus on the plant parts used (Appendix G). Furthermore, in order to gain a better understanding of the influence of cultural elements on biocultural diversity, Mongolian examples of folk taxonomic, cognitive and political factors that influence biocultural diversity are presented along similar levels of organisation: regional landscape, ecosystem, species, and meme-levels (Noss, 1990) (Table 4.2).

3.2 Links between biodiversity and cultural diversity

Pastoralists' responses to open-ended interview questions on ethnoveterinary medicinal plant use and ethnoveterinary knowledge were iteratively coded using inductive codes that emerged from the data. This produced 27 codes in two general themes: factors that influence the conservation of medicinal plants, and factors that influence the conservation of medicinal plant knowledge. These were broadly viewed as representing biodiversity and cultural diversity. The co-occurrence of codes within quotations (Appendix I) gives an indication of the relationship between codes (Hopping et al., 2016; O'Halloran, 2011). For example, the overlap of the codes 'mobility', 'overgrazing' and 'incorrect pasture-land use' indicates herders' perceptions of the links between livestock and rangeland use. The co-occurrence of codes across themes points to the links and interrelatedness of the themes (Foster et al., 2007). Four codes occurred across both themes of medicinal plant conservation and ethnoveterinary knowledge: nature connection/balance with nature, modern day-life and -activities, education (of children and herders) and government support (Table 4.3) (see Appendix I for a detailed table of all codes). This co-occurrence of codes across the two themes representing biological and cultural diversity, gives an indication of the relatedness and integration of these two concepts within biocultural diversity (Hopping et al., 2016; Pretty et al., 2009). The co-occurrence of codes is further discussed using the bridges that link biodiversity and cultural diversity suggested by Pretty et al. (2009).

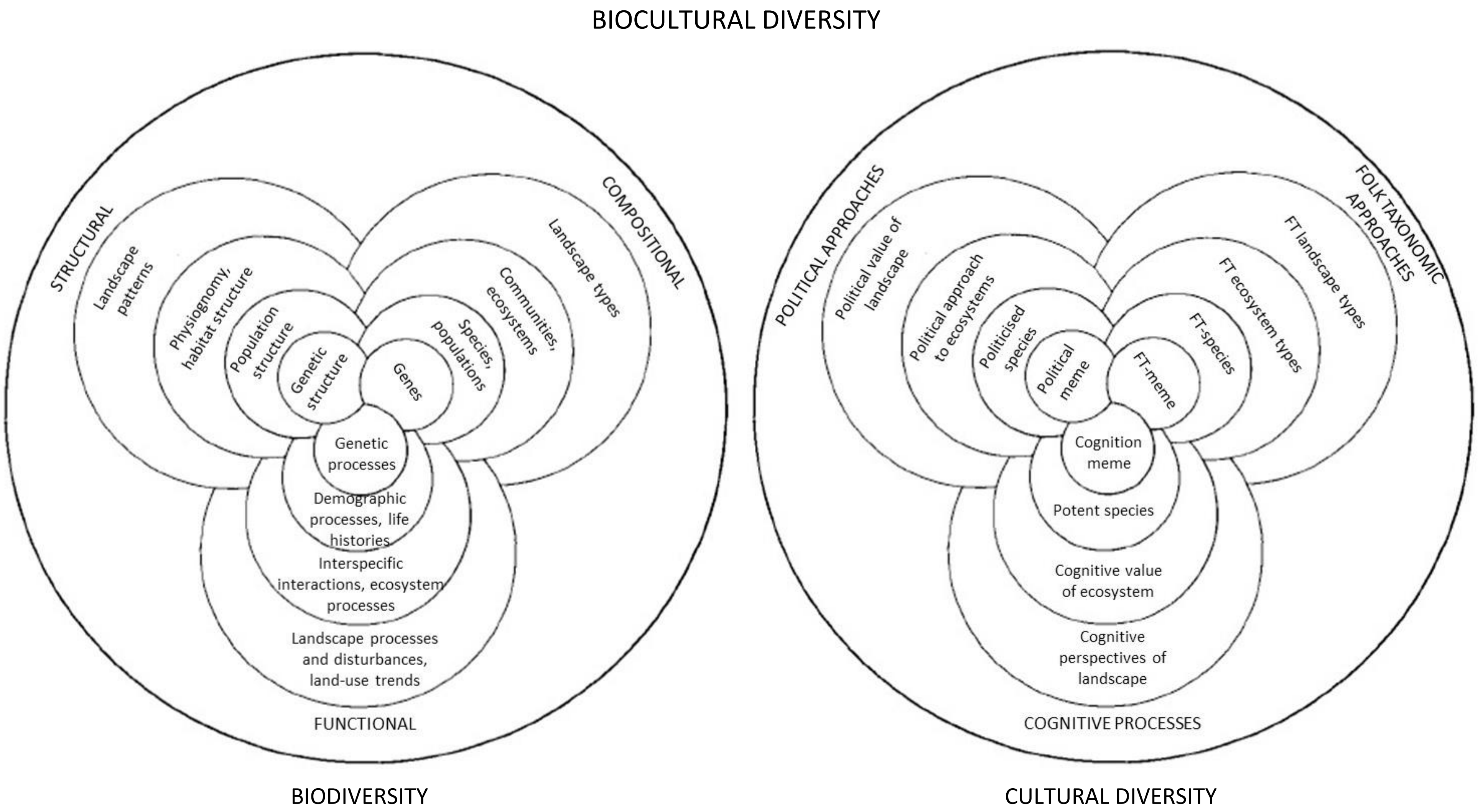

Fig. 4.1 Two-part conceptual framework for biocultural diversity, consisting of a framework representing biodiversity (Noss 1990) (left-hand side figure), and a conceptual framework representing cultural diversity (right-hand side figure), indicating political approaches, folk-taxonomic approaches and cognitive processes which influence biocultural diversity as interrelated spheres along four levels of organisation. Together, the two figures and the links between them provide a framework for biocultural diversity.

Table 4.1

Examples of factors that influence biodiversity in the Mongolian pastoralist context, using compositional, structural and functional elements of biodiversity along four levels of organisation. Based on the conceptual framework for biodiversity developed by Noss (1990).

	Composition	Structure	Function	Inventory and monitoring tools
Regional landscape	Grasslands cover 80% of Mongolia (Reading et al., 2006). Ecoregions: high mountains, taiga, forest steppe, steppe, desert-steppe and desert (Marin, 2010). *Ca.* 3000 vascular plant species (Nyambayar et al., 2011).	Mongolian steppe: one of largest contiguous grasslands in the world (World Bank, 2003). Fragmentation of habitat types (caused by mining), settling in urban areas, water sources. Seasonal and *otor* (short) rotation of livestock and herder families determined by water sources and grazing quality.	Precipitation and grazing influence productivity and composition of vegetation (Fernández-Giménez, 1999). 50 million livestock graze these rangelands. Seasonal rotation, with reserve pastures set aside for the spring and winter. Human land use trends: grazing, increase in agriculture, erosion, desertification, mining. Climate change: less rain, higher temperatures, more frequent *dzud* (harsh winter conditions/storms, animals cannot forage).	Occurrence of drought and *dzud.* Ease of mobility. Distance and frequency of seasonal moves. Aerial photographs. Climate charts. Remote sensing. GIS. Map of water sources. Orthographic images. Time-series analysis.
Ecosystem/community	Important ethnoveterinary ecoregions: inland salt lakes, forests, mountains. EVM plants often collected in forests and mountain areas, but also occur in grasslands. >150 endemic vascular plant species in Mongolia, 200 sub-endemics; 148 of *ca*. 3000 vascular plants are on the IUCN red data list (Nyambayar et al., 2011).	Threat of better soils being used for agriculture. Increase in fencing of winter pastures and haymaking. Water and resource availability: Soviet era water wells, many in need of repair. Snow cover extensive over winter months.	Livestock grazing and trampling is a major biological disturbance. Overgrazing around water sources in dry years. Seasonal migration and in-between migration. Rate of human intrusion. Livestock numbers increasing.	Aerial photographs, remote sensing, vegetation mapping, GIS, orthographic images, livestock data.
Population/species	Medicinal plants and remedies of animal origin used for EVM, and use value (Chapter 2). Abundance. Status and perceived decline of certain species (Appendix H).	EVM plant parts used, (Appendix G). Possible effect of EVM harvest on dispersion. Seasonal harvest mainly in autumn.	Possible effect of EVM harvest on fertility, growth rate? Life history of EVM plants.	Remote sensing, observations, counts, market data.
Genetic	Allelic diversity, presence of rare alleles.	Census and effective population size, heterozygosity.	Rate of genetic drift, gene flow.	Population genetic analysis required.

Note: EVM is used for ethnoveterinary medicinal plants

Table 4.2

Examples of cultural factors that influence biocultural diversity in the Mongolian pastoralist context, using social (folk-taxonomic), cultural (cognitive) and political elements along four levels of organisation. Adapted from Noss (1990).

	Folk taxonomic (FT) approaches	Cognitive Processes	Political Processes	Inventory and monitoring tools
Regional landscape	FT landscape types. ***Baigal***: nature (to be) ***Khaan***: mountain (king) ***Gobi***: desert ***Tengger***: sky Differentiation of rain ***Shiruun boroo:*** hard rain ***Shivree boroo***: soft rain ***Torgnii hee boroo:*** silk embroidery rain (rain that occurs over small patches of land, more frequent, could be indicative of climate change) (Marin, 2010).	Cognitive landscapes. Ancestral connections to the landscape (Humphrey, 1995): -landscape represented by shamanic gown - mountains and rivers described metaphorically using the human body, e.g. ***gol*** (river) means aorta/blood vessel of life (Humphrey, 1995) - ***Tengger*** (sky) is the most important natural power - all entities in nature having their own powers.	Political value of landscapes: Han Chinese: opportunity for 'development' (Rong, 2009) Soviet system: collectives Present democratic government: resource mining. Will Mongolian land tenure policies take herders' perspectives and needs into consideration? Herders are against privatisation of rangelands (Fernández-Giménez, 2000).	Aerial and landscape photographs. Maps: hand drawn, labelled. Methods for documenting indigenous land use: map biographies, oral history, sketch maps and GIS. Resource use area mapping, ethnocartography (Berkes, 1999).
Ecosystem	FT ecosystem types Ethnopedology Mongolian names for specific ecosystems: ***Nuur*: lake** ***Gol***: river (blood vessel) ***Khujir***: saline lake/soil deposits Classification of grazing territories: ***Seruun nutag***: "cool" pastures ***Khaluun nutag***: "hot" pastures (Fernández-Giménez, 2000; Fijn, 2011).	Ecosystems/places of mythical potency Sacred areas: forests and valleys ***Ovoo***: Rock cairn and ceremony on mountain top Women are not allowed on some mountains. Shamanism more powerful in forested mountain areas (*pers. comm.*; Humphrey, 1995). Protection of grasslands: balance between wolves and antelope (Rong, 2009).	Political value of ecosystems: Protected areas, *e.g. Khaan uul* reserve Political influence (pre-socialism, collective, post-collective) on mobility grazing regime, stocking intensity and herd composition of Mongolian pastoralists (Fernández-Giménez, 2000; Sternberg, 2008).	Songs, poems, proverbs, teachings paintings about particular ecosystems. Vitality index of traditional environmental knowledge (VITEK) (Zent and Maffi, 2009). Place identity (visual qualities) (Fry et al., 2009). Levels of land use intensity (Bürgi et al., 2015).
Species	FT species Mongolian names for specific populations or species. Ethnospecies: ***Yumduujin*** (*Dianthus* spp.), also classified according to humoral properties. Camel and goats classified as ***seruun khamar*** ("cold muzzle", browsers), whilst horses and cattle/yak are ***khaluun khamar*** ("hot muzzle", grazers) (Fernández-Giménez, 2000).	Species of mythical potency. All entities in nature have their own 'majesty' (Humphrey, 1995). Rocks should not be moved carelessly or taken away (*pers. comm.*). Wolf: "spirit" animal (Fijn, 2011), connection to ***Tengger***, grassland steward (Rong, 2009) , strength of a wrestler linked to that of a wolf (Fijn, 2011). ***Morin khuur***: horse head fiddle.	Politicisation of particular species. Descriptions of Mongolians as wolves (Mongolians) and Han Chinese as sheep (Rong, 2009).	Songs, poems, proverbs, paintings about specific species. Species used politically. Cultural keystone species. Story-telling (Poe et al., 2013).
Meme	FT/linguistic meme	Cognitive meme. Basic idea/thought/value that is imitated across individuals and generations. Example: family lineage is interpreted through the branding marks on horses (Waddington, 1974).	Political meme. Ideology at different scales. Beliefs, approaches at smallest level.	Words, tunes, habits, thoughts, ideas, actions that are imitated by others and spread.

Table 4.3
Co-occurrence of four codes (framed) across the themes of 'medicinal plants' and 'medicinal plant knowledge'. Groundedness values indicate the number of times each code was used throughout all interview.

Code	Groundedness
MEDICINAL PLANTS	
Climate	19
Harvesting	15
Education	2
Fire	2
Government	6
Incorrect use of pasture-land	3
Livestock numbers	5
Overgrazing	5
Mobility	6
Modern day life	11
Nature connection	6
Protection of nature	12
Research	4
Way of nature	3
Wild mice	1

Code	Groundedness
MEDICINAL PLANT KNOWLEDGE	
Books	2
Decrease in knowledge of medicinal plants	6
Education	6
Government	3
Loss of traditions	2
Modern day life	2
Modern medicine	3
Nature connection	4
Teach children	15
Urbanisation	2

4. Discussion

4.1 Links between biodiversity and cultural diversity

In a study of the cultural dimensions of ecosystems, Poe et al. (2013) highlight the need for tools to 'conceptualise the cultural dimensions of human wellbeing in socioecological systems'. It is within this context that I developed a conceptual framework that facilitates the understanding of biocultural diversity at various scales. The two parts of the conceptual framework are interrelated and connected by a number of links. How the three factors in the framework that influence cultural diversity also relate to and influence biodiversity is investigated using the bridges between biological and cultural diversity suggested by Pretty et al. (2009): Beliefs and worldviews, knowledge bases and languages, norms and institutions and livelihoods and practices. In addition, I have added the concept of cultural keystone species as a fifth bridge.

4.1.1 Beliefs and worldviews (cognitive processes)

In order to understand people's connection to the land, and behaviours that are linked to resource conservation, it is important to understand the 'worldviews' and associated beliefs and rituals that people have (Berkes, 1999; Cunningham, 2001). It is through beliefs and worldviews that cognitive processes such as cultural and spiritual norms, taboos and rituals, by being the basis for interactions with nature, can influence local resource use, for example the grazing of seasonal pastures (Upton, 2010).

Mongolian pastoralists, like many other traditional societies, have a 'community-of-beings' worldview; a cosmology whereby they see themselves, and their actions, as an inherent and interconnected part of nature (Berkes, 1999; Humphrey et al., 1993). This is reflected in the ancestral connections to the landscape (Humphrey, 1995), and in the belief of all entities in nature having their own powers, with *Tengger*, the sky, being the most important natural power (Humphrey et al., 1993).

In terms of Mongolian culture, it is important to acknowledge the central role of particular spiritual concepts of nature and the environment (Upton, 2010). These concepts are described by Humphrey et al. (1993) as the 'personified spirits of natural objects'. Rules around these spiritual concepts are often enacted through resource and habitat rules and taboos (Colding and Folke, 2001), such as replacing any upturned rocks and not taking anything from the landscape (participant observation).

Mongolian pastoralists have a strong connection to the land, from the landscape level and particular places within the landscape, through to individual relationships with specific mountains, trees or cliffs (Humphrey, 1995). Forests and high mountains are often revered as places of mythical potency and sacredness, and the sites of ceremonial practices. Medicinal plants are often collected from these forests and high mountains, known for their mythical potency, which extends through to the plants, that are not just viewed as a resource, but as a gift from powerful spirits (Fijn, 2011).

As stated by Humphrey (1995), cognitive approaches to the landscape are closely linked to behaviours and landscape use, which in turn can influence biodiversity. This is also reflected in herders' perception that the 'connection with nature' is important for both medicinal plant- and knowledge-conservation. Fundamental to the discussion of maintaining biocultural diversity, therefore, is the acknowledgment and understanding of cognitive connections to the landscape through time and space.

4.1.2 Knowledge bases and languages (folk taxonomic systems)

Knowledge bases and language are one of the bridges connecting humans and nature (Pretty et al., 2009), and are directly linked to folk taxonomic approaches. These approaches incorporate ethnobiological classification systems as described by Berlin (1992) along all levels of organisation, which offer valuable insight into the historic relationship and understanding of the environment (Berlin, 1973). As explained by Hunn (1993), folk taxonomic systems can shed light on resource use and value, as different cultures have developed detailed classifications of those elements of the environment that are important to them.

At a landscape level, folk taxonomies offer information that allows for a better understanding and description of landscape structure (*e.g.* heterogeneity), function (*e.g.* water and nutrient flows) and change (*e.g.* disturbance regimes), as they tell us something about the land, its value and management (Krasilnikov and Tabor, 2003). At a community level, ethnopedology, the study of folk or indigenous soil knowledge and names, can provide much insight into how the soils are valued and managed (Krasilnikov and Tabor, 2003). Local names often reflect local characteristics and value. For example, in contrast to the soil names used in the west of Russia, strongly influenced by agriculture (Shoba, 2002), the names used by Yakutians, Evenks, and other Siberian communities describe fens and natural sources of salt, which affect livestock management and hunting (Krasilnikov and Tabor, 2003). Similarly, *khujir*, the Mongolian name for saline deposits of inland salt lakes (and soils) plays an important role in maintaining livestock (and human) health. As described by Krasilnikov and Tabor (2003), local systems of land classification are important for understanding land value as well as land tenure relationships. Understanding local taxonomic systems can be critical in maintaining sustainable resource management, especially in ecologically fragile areas of the world (WinklerPrins and Barrera-Bassols, 2004).

At a species level, the local and cultural importance of a particular species is often reflected in over-differentiation of the species in local terms, compared to the Linnaean classification (Hunn, 1993; Martin, 2004). Furthermore, livestock are also classified according to whether they are 'hot muzzle' *khalun khamar* (horse and cattle) or 'cold muzzle' *seruun khamar* (camel and goats), which can be compared to the separation of grazers and browsers, respectively (Fernández-Giménez, 2000). Pastures too are classified as 'warm' *khaluun nutag*, such as desert steppes, waterless pastures and south-facing slopes; whereas 'cool' grazing lands *seruun nutag*, include mountain-steppe pastures and pastures near rivers, on mountaintops and south-facing slopes. This classification system is incorporated in herder's ecological knowledge of plant-animal-environment interactions and consequent grazing practices, where cool muzzled animals are best suited to 'warm' grazing lands, whilst hot muzzled animals fare better on 'cool pastures' (Fernández-Giménez, 2000). In the Mongolian context, it is important to acknowledge and maintain the unique folk taxonomic classification systems and the rich vocabulary that reflects a sense of identity and a strong connection to the landscape.

4.1.3 Norms and institutions (political approaches)

The influence of political approaches on biocultural diversity are investigated through the bridge of norms and institutions (Pretty et al., 2009) using the example of Mongolian pastoralist' mobility.

Since the transition from Socialism to a market economy (1990), there has been a decrease in herders' ability to migrate according to seasonal or ecological conditions (Sternberg, 2008). This includes a decrease in both the frequency and the range of herder mobility, which has important ecological implications (Fernández-Giménez, 2000; FAO, 2016; Sternberg, 2008). Correctly interpreting these trends in mobility requires an understanding of the historical and political context thereof (Fernández-Giménez, 1999).

Long before the Soviet era (1924-1990), Mongolian herders developed sophisticated animal husbandry and herding systems, based on the accumulated knowledge of climate, animal behaviour, plant ecology and from a lifelong association with livestock (Fernández-Giménez, 1999; Fijn, 2011). By developing a flexible and nomadic way of herding, pastoralists have been able to use the rangelands both efficiently and sustainably (Fernández-Giménez, 1999). However, during the Soviet era, traditional social organisation was disrupted and a system enforced whereby all herders had to become members of collectives (*negdel*) and almost all livestock became state-owned. Herder's freedom to decide where and when to move, now depended largely on the collectives, and, with the introduction of specific breeding strategies, herders became responsible for herding only a particular kind and number of livestock (Fernández-Giménez, 1999). The disruption of traditional social organisation and mobility, together with the 'modernisation' of livestock herding and healthcare, led to a loss of important traditional knowledge and skills (Fernández-Giménez, 1999; Sokolewicz, 1982). In ecological terms, although the basic nomadic strategy of rotating amongst pastures was preserved under the 70 years of the Soviet era, the overall distance of movements decreased, which confined herders to smaller areas and limited access to a broad range of ecological zones (Fernández-Giménez, 1999). In addition, the specialization of livestock to large single-species herds led to the overuse of pastures (Mearns, 1993).

Although herders' decision-making power was largely reduced during the Socialist era, the end of the collective era brought with it many new challenges for herders that directly influenced herders' use of the steppe rangelands. After the collapse of the Soviet era, and subsequent dismantling of collectives, almost all livestock herds were privatised, and the infrastructure and support provided by collectives was not replaced (Fernández-Giménez, 1999). Following privatisation, a rise in poverty (and reduced social services) led to an increase in the number of herding households and livestock numbers. This influx of "new" herders in addition to a lack of formal regulatory institutions responsible for herding decisions, and reduced government support regarding transport and water sources, led to a change from coordinated seasonal movements to an increase in year-round grazing of seasonal pastures (Fernández-Giménez, 2000, 1999; Sternberg, 2008). In addition, changes in herders' economic well-being and pasture land tenure in turn caused an increase in the grazing of reserve pastures set aside for use in winter and spring, and led to further declines in the distances and frequency of seasonal moves (Fernández-Giménez, 1999). This decline in mobility intensified grazing pressure and has had a 'detrimental effect on rangeland that, when paired with reduced water sources, serves to create a positive feedback loop as human action exacerbates natural forces in affecting the environment' (Sternberg, 2008). Along with the many impacts on biodiversity, the reduction in mobility among herders, influences herders' connection to the land and landscape entities, indicating how essential mobility is for rangeland use to be sustainable (Fratkin and Mearns, 2003; Ykhanbai et al., 2004). The extensive influence of political approaches and decisions on biocultural diversity is highlighted by the examples of Mongolian herder mobility. This is also reflected in herders' perceptions of the government being responsible for the conservation of both medicinal plants and associated knowledge.

Further political effects are reflected by land tenure concerns. As mentioned by Poe et al. (2013), governance and land access are often entangled with political issues of power and inequalities. Although studies have found herders to be against the privatisation of rangelands, and have articulated the need to keep access to pastureland unrestricted by one person (Fernández-Giménez, 2000; Sternberg, 2008), and also expressed by a respondent in the current study, land privatisation is still being discussed (by local and global advisors) as a remedy for land degradation (Sternberg, 2008). However, land tenure reform that includes privatization threatens two important norms of pasture use, formed from herder's perceptions and observations of resource use. The first is that all herders must refrain from out-of-season grazing of the pastures reserved for winter and spring, and the second, based on reciprocity, that no herding group may deny another group access to their grazing in times of need (Fernández-Giménez, 2000). This highlights the need for local and international policy advisors and decision makers to see tenure and property rights in a cultural context (Cunningham, 2001), as privatisation not only threatens the land, but also threatens pastoral identity and resource management that is based on land as a common resource (Marzluf, 2012).

4.1.4 Cultural keystone species

Developed by Garibaldi and Turner (2004) 'cultural keystone species' as a concept describes species that play a specific role in shaping the identity of the people who rely on them and feature prominently in language, ceremonies, and narratives. Cultural keystone species are therefore an example and culmination of the interrelatedness between biological and cultural diversity, and highlight the connections between folk taxonomic, political and cognitive processes with biological diversity.

An example of a cultural keystone species, from the Mongolian context, is the Mongolian grey wolf (*Canis lupus*). The importance of the wolf for Mongolian identity, culture and grassland ecology clearly comes to the fore in the semi-autobiographical novel *Wolf Totem* by political scientist and former activist Lu Jiamin, under the pseudonym Jiang Rong (2009). *Wolf Totem* is based in the Inner Mongolia Autonomous Region of China, which borders directly with Mongolia, and is set mostly during the Chinese Cultural Revolution (1966-1976). Through the story of four Beijing students during their self-exile in Inner Mongolia, Rong (2009) describes how the Han Chinese introduce sedentary agriculture and industrial animal and land management practises to the nomadic pastoral grasslands of Inner Mongolia with devastating consequences (Bürgi et al., 2015). Amongst others, they destroy the wolf population, thereby causing an increase in grass-eating marmots, gazelle and mice. The Han Chinese disregard of nomadic Mongolian pastoralism and rangeland stewardship ultimately leads to the desertification and degradation of the once magnificent grasslands and the cultural patterns interwoven with this (Varsava, 2011). In contrast to the

Han Chinese ideas of agricultural ‘development’, Rong (2009) describes the traditional Mongolian pastoralist view of ecology and the symbiotic relationship of wolves and herders as:

> *“…wolves are sent by Tengger to safeguard the grassland. Without them, the grassland would vanish. And without wolves, we Mongols will never be able to enter heaven.”* (p. 123)

Wolves maintain the ecological balance by controlling gazelle numbers (and livestock numbers) and maintain the ‘cultural-spiritual balance’ as the Mongolian primary totem (Varsava, 2011). Wolf populations in turn are controlled by the herders and therefore, both Mongolian and wolves can be seen as stewards of the grassland. The health of the grassland is key to survival, and the Chinese scholars realise that the so-called backward, primitive nomadic way of life, in retrospect, is actually ‘practical wisdom’ (Varsava, 2011).

> *“Out here, the grass and the grassland are the life, the big life. All else is little life that depends on the big life for survival. (…). If the grassland dies, so will the cows and sheep and horses, as well as the wolves and the people, all the little lives”* (Rong, 2009: 45,234).

The present day relationship between herders and wolves is complex and interchangeable. Used for medicinal purposes the Mongolian grey wolf (*Canis lupus*), *chono*, is thought to be a ‘high’ or ‘spirit’ animal, but also called the ‘sheep’s assassin’ (Fijn, 2011). Herders recognise that wolves sometimes display good and sometimes bad characteristics. In folk legend, for example, Mongolians as a people originally came from a wolf (Fijn, 2011), but wolf attacks on livestock are one of the biggest concerns for herders. Although the status of the Grey Wolf is ‘Near Threatened’ in Mongolia (Clark et al., 2006), the Mongolian government allows the hunting of wolves, with many urban Mongolians going on wolf hunting trips for sport (Fijn, 2011), and wolf pelts can be bought in most markets. In the countryside, however, herders do not usually kill wolves for sport, but kill them to protect their livestock. As recollected by Fijn (2011), on a number of occasions herders informed her that if the wolf disappeared, the balance would become upset and many plants and animals would disappear with them. As commented by a respondent from the present study, “*During the birthing season, after winter (we) need a lot of people. Wolves come during this time, they are part of nature, sent from God, we don’t mind (them) coming*.”

Cultural keystone species, such as the wolf for Mongolian herders, are a direct link between cultural diversity, in all its aspects, and biologic diversity, and as suggested by Poe et al. (2013), offers important ways to evaluate the connections between ecological integrity and cultural wellbeing.

4.1.5 Livelihoods and practices: ethnoveterinary knowledge and practice

Livelihoods and practices, the final link between biological and cultural diversity is investigated using the example of ethnoveterinary knowledge of Mongolian pastoralists, highlighting the importance of maintaining traditional ecological knowledge.

The wealth of botanical and plant use knowledge held by Mongolian pastoralists (Chapter 2) in terms of plant growth form, fodder and medicinal use as well as palatability is indicative of the close connection between herders, their livestock and the environment (Fernández-Giménez, 2000). Ethnoveterinary practices of Mongolian herders include, among others, the harvesting of wild (uncultivated) medicinal plants, mainly in autumn, and the subsequent storage for use during the challenging winter and spring months. In terms of medicinal plants, of the 39 scientific species recorded as being used for livestock, four are listed in the Mongolian red list of plants (Nyambayar et al., 2011), namely: *Gentiana algida* Pall. as 'Endangered' and *Allium altaicum* Pall.*, Paeonia anomala* L. and *Rhodiola rosea* L. as 'Vulnerable'. During interviews, herders mentioned that *Cacalia hastata* L., *Artemisia frigida* Willd., *Paeonia anomala, Rhodiola* spp., and *Achillea* spp. had become more difficult to find. Most ethnoveterinary medicinal plant species are used for their leaves, with only 7% being used only for their roots or bulbs. In order to ascertain the sustainability of current medicinal plant harvesting, information on actual harvest and management practises, in addition to quantitative market data across formal and informal spheres, is needed (Etkin et al., 2011). This will require insight, understanding and the necessary time needed to build trusting relationships with collectors and market sellers (see Appendix J for a report on market data that was collected during this study).

In terms of ethnoveterinary remedies of animal origin, undomesticated species used include wolves (meat), marmots (stomach, skin), deer (blood) and snakes (shed skin), of which snake skin is the only one collected in a non-lethal manner. In order to be able to properly assess these impacts there is a need to firstly understand and quantify the use, and secondly, to increase our knowledge about the biology and ecology of the species used (Alves et al., 2007). Importantly, medicinal species that are already threatened, should receive urgent attention, and any conservation objectives should emphasize their current and future medicinal uses (Oliveira et al., 2010). The use of deer blood for ethnoveterinary purposes, as mentioned by one respondent, should be further investigated in order to ascertain correct data on the specific species used. Although zootherapeutic practises are less common in ethnoveterinary medicine than in human complementary medicine, there are still conservation related implications, as it represents a possible pressure on wild animal populations (Souto et al., 2013). If properly managed, the use of animals in EVM can be compatible with environmental conservation programmes where the natural resources are used in a way that both human needs and biodiversity protection is guaranteed (Alves and Rosa, 2006).

Roughly half of the herders interviewed, were under the impression that medicinal plants (including medicinal fodder plants) are becoming more difficult to find or get hold of (Appendix H). As explained by one respondent "*They are becoming fewer, especially in a year like this when the rain is late, it means the flowers cannot blow seeds, then next year there is no plant. If the balance is lost, then in the next year there will be fewer or no plants*," and, in addition, "*We don't have a choice now, we have to use western medicines because the plants don't grow here anymore*." Some herders (29%), however, did not agree, mentioning that plants will always grow and that nature knows how to recover. Similar findings were recorded by Fernández-Giménez (2000), who found that many herders do not perceive an imminent threat to the resources they use. This does not mean that herders' perceptions are 'wrong', rather as Fernández-Giménez (2000) suggests, 'herders' relative lack of experience with high densities of livestock grazing year-round in concentrated areas may limit their ability to foresee potentially irreversible degradation'.

When further prompted for possible reasons why medicinal plants have become more difficult to find, climate (drought and less rain), increased livestock numbers and overgrazing, reduced mobility, incorrect harvesting methods, the effects of 'the modern way of life', mining, agriculture and a loss of balance and communication with nature were mentioned: "*We don't use the world as it is supposed to be used*", "*Herders are not migrating* (moving) *anymore, that is why* (the) *pasture is becoming damaged*".

Herders' perceptions and ideas around what can be done to ensure medicinal plant supplies in the future indicate the importance of 'correct' harvesting (with a focus on not harvesting the root and seeds), herder and livestock mobility, livestock numbers, political support, and the connection and communication with nature: "*In my opinion, first we need to adjust the number of livestock, and secondly we need to pay attention to getting winter and spring quarter places freed from illegal ownership as soon as possible* (…). *If herders can move as early as possible and do not fight with each other, the soil will not get barren".*

Merely possessing traditional ecological knowledge does not mean that a group will live in harmony with nature, and there are many cases of environmental mismanagement by traditional societies (Berkes, 1999). Instead this knowledge must be used, adapted and passed on between generations. Therefore, understanding the dynamics of knowledge, is crucial in maintaining the knowledge and cultural beliefs and values associated with it (UNESCO, 2008).

As discussed by Berkes (1999), because many traditional groups rely on a spectrum of resources for their livelihoods, traditional resource use practices often tend to conserve biodiversity, for example by maintaining sacred areas and other ecological refugia. This can be seen in Mongolia, where forests and mountains that harbour medicinal plants are seen as sacred. Through interaction with herders, it became clear that medicinal plants are protected through certain taboos and through the protection of critical life history stages. Therefore, I suggest that the knowledge and practices associated with ethnoveterinary medicinal plants, if used sustainably, could play a role in maintaining herders' relationship and connection to the landscape. In addition, the collection of medicinal plants (and grazing of medicinal food plants) could increase the mobility of pastoralists and their herds as they search for specific medicinal plants and pastures.

Local knowledge about medicinal plants (used for livestock) among Mongolian herders is largely transferred from generation to generation, as lived knowledge (from herding and life experience), through active teaching (show and tell) and experiential learning (by collecting medicinal plants together). In addition, knowledge is gained through following the 'herding way of life'. This everyday folk instruction in animal husbandry also forms part of *khar ukhaan*, folk knowledge or common sense (literally: black knowledge) that builds the 'traditional' Mongolian herder identity (Marzluf, 2015). Maintaining this traditional ecological knowledge therefore requires the continuation of herding practices and culture, and a family structure that allows for the intergenerational connection through space and time.

Both parents and grandparents are the main role players in sharing knowledge with children and younger relatives. The herding family structure, where three generations share a 'homestead' space is essential in allowing the intergenerational transmission of knowledge. This was also identified by respondents: "*We should teach our younger generation and save this knowledge. City children should come to the countryside for summer and they will interact with nature and learn to love*".

The majority of herders (70%, n=44) indicated that traditional ethnoveterinary knowledge is in danger of disappearing. Associated threats and concerns include a decrease in medicinal plants and in medicinal plant knowledge, the development of 'modern' medicine and the perceived convenience thereof, urbanisation and resulting education, and a loss of connection to livestock and to nature. The following quotes illustrate the interrelatedness of (ethnoveterinary) medicinal plant knowledge, ecological changes and socio-political developments: "*The problem is that many young people are moving to (Ulaanbaatar), destroying the culture and knowledge; if they are here then the knowledge will stay alive and the culture will continue", "People…prefer medicines to plants. Modern young children are not living close with nature, they don't communicate with nature, mostly they use TV, phones, these things separate them from nature. (…) Also plants are becoming hard to find and only growing in the mountains. People are not going further to collect them*". The perception that the 'modern' education system results in children learning less about the environment, was also recorded by Hopping et al. (2016) in a study on the local knowledge of Tibetan herders. As the culturally inappropriate modernisation of healthcare systems and education can be a threat to biocultural diversity (Pretty et al., 2009), we suggest that veterinary programmes begin to take into consideration traditional ethnoveterinary practises, which incorporate medicinal plants, rangeland management, seasonal migrations and livestock wellbeing in all its forms.

Ethnoveterinary knowledge and practice, an example of the traditional ecological knowledge of Mongolian pastoralists, offers valuable insight into the maintenance of biocultural diversity. Essential to the continued existence and use of this knowledge and practice is an understanding of the historic, political and cultural context, the influence of political approaches, and the interrelatedness to ecological systems and processes. My investigation of biocultural diversity, in a Mongolian pastoralist context, strongly suggests that maintaining a mobile 'herding way of life', and the associated balance and communication with nature, is vital for both the continued transmission of knowledge and the ecological resources relied upon.

In view of understanding ethnoveterinary resource use by pastoralists, Chapman (1987) points out that in order for a society to conserve a habitat or resource, three conditions must be met: firstly, the resource (area or species) must be valued and important to the society, secondly, the resource needs to be recognized as being limited and 'vulnerable to impacts by humans'; and thirdly, institutions that manage and monitor the resource must be in place. With reference to these three conditions it is clear that Mongolian herders value the rangelands that support them and their livestock. However, the lack of recognition by all herders that the rangeland ecosystem is under threat by human influence could stand in the way of successful conservation of the landscape and the herding way of life. It is hoped that, as indicated by this study, the majority of herders that are aware of the threats to their rangelands and livelihoods, will encourage other herders to realise the severity of current threats. The third condition mentioned by Chapman (1987) highlights the important role held by regulatory institutions in the conservation of a resource. This in reinforced in the Mongolian case study, where a gap has been created by not replacing Soviet-collectives with any other form or regulatory institution. This has led to the year-round grazing of conveniently located pastures and the out-of-season grazing of reserve pastures.

5. Conclusions

In the last decades there has been a growing recognition of the value of traditional knowledge in both biological and cultural diversity discourses (UNESCO, 2008), and it has become clear that the biocultural heritage needs to be at the centre of conservation strategies, as a link between people and biodiversity, as "much biodiversity relates to long-term, predictable sustainable traditional uses" (Agnoletti and Rotherham, 2015). In this study we set out to conceptualise the interrelationships between humans and nature by developing a framework for biocultural diversity that together with indicators for monitoring biodiversity, takes into account the cultural (cognitive), social (folk taxonomic) and political factors that influence diversity. Within the context of biocultural diversity, the case study of Mongolia showcases the need for national policies that acknowledge, value, support and maintain the important and complex processes underlying the Mongolian landscape and the associated worldviews, knowledge and practices.

Currently the use of herders' traditional ecological knowledge is constrained by various factors, which in turn are connected to larger socio-economic causes. As suggested by Fernández-Giménez (2000), a lack of access to transport and key pasture areas together with a lack of regulatory pasture use systems are limiting herders' ability to use traditional ecological knowledge. This in turn leads to behaviours that transgress widely held rules of pasture use, and calls for a re-establishment of strong local institutions to regulate the way grasslands are used. Furthermore, herders' concerns around the privatisation of land need to be incorporated in policy discussions and decisions concerning land tenure.

As mentioned by Cunningham (2001) there is no specific formula that ensures a community or society will successfully conserve a resource, especially common property resources, made all the more complex by ever-changing ecological, social, political and economic variables. However, the development of a framework for biocultural diversity, that takes these factors into account, from the genetic to the landscape scale, allows for a clearer understanding of the variables at play, and the use of indicators to monitor and assess biological and cultural diversity at various scales.

In order to maintain biocultural diversity, the Mongolian herder way of life and the traditional herder-livestock and herder-landscape connection should be maintained, together with continued and increased mobility, both in range and in frequency. Furthermore, in order to maintain traditional ecological knowledge, and the cultural practises relevant to the safeguarding of biological diversity, the continued transmission of this knowledge between generations is required (UNESCO, 2008). As stated by Agnoletti and Rotherham (2015), "*Without stopping the clock, we need to record local cultural knowledge and insight and to re-build and celebrate local connectivity with nature, to value local traditions and uses and to apply the knowledge in a meaningful way*".

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Chapter 5

General Conclusions

1. Introduction

Mongolian pastoralists possess a wealth of ethnoveterinary knowledge and associated practices. This includes the sophisticated use of a variety of medicinal plants as well as the use of non-plant remedies and ethnoveterinary techniques.

Through the journey of this study a number of steps were taken. In Chapter 1 a description of the research rational and significance is given. The research study and specific study area is then described within the Mongolian pastoralist context, including a brief historic account together with a description of the geographic, climatic and ecological context.

Chapter 2 focuses on the ethnoveterinary knowledge of Mongolian herders. This includes the knowledge and practices of using medicinal plants to treat livestock ailments. Medicinal plants are also given to livestock as ‘immune boosters’ and for maintaining general health, often through the use of medicinal food (Etkin and Ross, 1982). These findings are then further analysed according to plant use and plant importance. In addition to medicinal plants, remedies of non-plant origin are also recorded. These include the use of fungi, minerals, and animal-derived remedies as treatments for livestock illnesses. Ethnoveterinary techniques such as blood-letting and cauterisation, used by herders for their livestock, are also recorded.

In Chapter 3 the various methods and approaches used to collect ethnoveterinary data in Mongolia are critically reviewed. This is done by contrasting theory and practice of each method. The outcomes and experiences of applying the chosen methods to the Mongolian context are described in order to make recommendations that could be of benefit to other researchers in similar research fields. Furthermore, it is hoped, that the review will assist other researchers to be more prepared, to ‘expect the unexpected’, and to openly acknowledge fieldwork problems and failures in a constructive way.

Having gained insight into the wealth of ethnoveterinary knowledge held by Mongolian pastoralists, the journey continues to Chapter 4, where ethnoveterinary data from the previous chapters together with data from other sources is applied to the challenge of maintaining biocultural diversity. This is done by developing a two-part framework for biocultural diversity. This is then populated with examples from the Mongolian case study. In addition to indicators of biodiversity, the biocultural framework takes into account the social (folk-taxonomic), cultural (cognitive) and political factors that directly, and indirectly, have an influence on biocultural diversity at various scales. The framework, therefore allows for a better understanding and assessment of biocultural diversity.

This brings us to the current chapter, a synthesis of the findings from the previous chapter, a summary of the research journey, and a conclusion of the main findings as well as recommendations for further research.

2. Conclusions and key messages

2.1 Ethnoveterinary knowledge of Mongolian herders

Mongolian pastoralists in the study area use a range of ethnoveterinary practices to ensure the health and well-being of their livestock, and there is an urgent need to document and conserve this rich knowledge for future generations.

Herder ethnoveterinary knowledge and practice consists of medicinal plant use, both for treating illnesses and diseases, and as medicinal food. Other ethnoveterinary remedies include the use of fungi, mineral substances, remedies of animal origin and other products (*e.g*. use of urine). Ethnoveterinary practices performed by herders include the use of blood-letting and cauterisation in the treatment of livestock ailments.

The ethnoveterinary use of 39 scientific plant species equating to 29 ethnospecies is recorded, of which leaves and flowers are the most used plant parts. The majority of medicinal plants are collected in summer and autumn and stored for later use in winter and spring. Particularly important species, according to use value, frequency- and position-of-mention, and fidelity level, include *Urtica cannabina*, *Sanguisorba officinalis*, *Plantago* spp., *Rhodiola* spp., *Pulsatilla* spp. and *Cacalia hastata.* The highest number of plant species are used for wound treatments (often from wolf attacks during spring), while medicinal plants were used most often as medicinal food in order to improve the health of their animals during winter and spring. My findings indicate that Mongolian herders tend to use ethnoveterinary medicines for common, day-to-day livestock ailments, especially in winter and spring, but make use of veterinarians and pharmaceuticals for more serious livestock diseases and conditions.

As indicated by this study, ethnoveterinary knowledge and practices still play a large role in the lives of Mongolian herders. This knowledge is held by both men and women, and is transferred across generations by various modes of acquisition and transmission, mainly through the sharing of life-experiences centred around herding. In order to prevent the loss of ethnoveterinary knowledge and associated practices, knowledge transfer systems and intergenerational links need to be maintained and encouraged. In addition, local knowledge about animal health, medicinal plants and the treatment of ailments, held and used by herders, should be included in the development of veterinary programmes and associated support structures.

2.2 Methodological lessons

Important lessons from fieldwork problems are shared by constructively reviewing the methods and approaches used to collect ethnoveterinary data for this study. Difficulties around the collection of voucher specimens, linguistic and cultural misunderstandings, interpreter bias, gender roles and influences, and associated vulnerabilities were some of the challenges encountered during the fieldwork period.

By being aware of possible vulnerabilities and challenges, researchers and fieldwork assistants can prepare accordingly. This includes gaining a thorough understanding of the research area, and having backup plans in the eventuality that things 'go wrong'. Here, the book *Reflections on research* (Hallowell et al., 2005) offers examples of possible challenges that can arise during interviews, and how to best deal with them. Although certain things are not foreseeable and cannot be pre-emptively managed, having prior knowledge of the possible problems that could arise allows one to anticipate them and prepare for them.

It became clear that it is important to have a strong support base especially during fieldwork periods. As a female researcher working in a patriarchal society, having a 'husband' figure can assist in preventing uncomfortable advances and situations. Furthermore, in order to conduct interviews in a sensitive, intuitive, yet confident manner, it is suggested that researchers undergo anthropological and interview skills training.

As a researcher interacting and working in a foreign environment and culture, a pre-fieldwork session with a psychologist (or similar professional) is encouraged, together with a post-fieldwork debriefing session, in order to work through any challenges that were experienced.

2.3 Maintaining biocultural diversity

The need for traditional resource use and associated cultural dimensions to be understood and integrated into biodiversity strategies, is increasingly recognised (Berkes et al., 2000; Poe et al., 2013). The interrelatedness and complexity of cultural diversity and biological diversity is summarised by the term biocultural diversity (Maffi and Woodley, 2010). In order to better understand biocultural diversity in the study area, a conceptual framework for biocultural diversity was developed and populated with examples from the Mongolian pastoralist case study. The framework includes a sub-framework for biological diversity (Noss, 1990) and an original, innovative sub-framework for cultural diversity. Together the two sub-frameworks form an overarching biocultural diversity framework.

Applied to the Mongolian pastoralist context, the conceptual framework of cultural diversity, indicates the social (folk taxonomic), cultural (cognitive) and political factors that influence, and can be used to assess, biocultural diversity. From this the following can be concluded:

- The mobility of herders is essential for both biological and cultural diversity to be maintained. With the current decline in both range and frequency of mobility, there is an urgent need for regulatory institutions, leaders and policy makers to encourage and support the mobility of herders.
- In order for herders to be more mobile, water infrastructure (developed in the Soviet era) needs to be maintained and transport costs subsidized.
- To ensure the continuation of traditional ecological knowledge (including ethnoveterinary knowledge) that encourages the sustainable use of natural resources, modes of knowledge transmission need to be conserved. In the Mongolian context this highlights the importance of children (especially those that are educated in the city) spending time in the countryside with their parents and grandparents, or relatives, that are livestock herders.
- Currently the use of herders' traditional ecological knowledge is constrained by various factors, which in turn are connected to larger socio-economic causes. As suggested by Fernández-Giménez (2000), a lack of access to transport and key pasture areas, together with a lack of regulatory pasture use systems are limiting herders' ability to use traditional ecological knowledge linked to mobility. This in turn leads to behaviours that transgress widely held rules of pasture use, such as rotation grazing and reserving winter pastures. This calls for a re-establishment of strong local institutions to regulate the way rangelands are used.

In conclusion, in order to maintain biocultural diversity, the Mongolian herder way of life and the traditional herder-livestock and herder-landscape connection must be maintained, together with continued and increased mobility, both in range and in frequency. Furthermore, in order to maintain traditional ecological knowledge, and the cultural practises relevant to the safeguarding of biological diversity, the continued transmission of this knowledge between generations is required

3. Reflections on research challenges and limitations

3.1 Challenges

A number of challenges were experienced during the course of this research project. Logistical challenges related to doing research in a foreign country, with a foreign language, although expected, took up a lot of valuable time. This together with the relatively short summer season meant that efficient time management was crucial.

One of the biggest challenges was working with interpreters, where much time and energy was spent on solving 'lost in translation' problems. The religious fervour and personal agenda of one interpreter created interview situations that were sometimes uncomfortable for both respondents and researcher. This could also be the reason that herders did not mention any shamanic ethnoveterinary practices. I only properly understood the situation, and what had happened, in retrospect, through the transcription of recordings. The challenge of interpreter-influence and bias is a common problem, also recorded in various other studies (Cornelius, 2016; Pfeiffer and Butz, 2005). Although I found the interpreter-situation very challenging, it must be mentioned that I also had the honour of working with another very capable interpreter who created a calm, safe space for both researcher and respondents.

The interpretations of maps, distances and direction brought another interesting challenge. It soon became clear that these can be interpreted in different ways, and that there is a need to regularly cross-check that everyone is on the same page. An example is the question of "how far is A from B?" Where I would often take out a map and use the scale to judge how far (km) the two places are apart, the horse-guide would judge the distance by how long it took to ride (on horseback) from place A to place B, taking into consideration landmarks such as mountains and rivers.

A further challenge, that kept me company throughout the thesis, was the interdisciplinary nature of the research. A vast array of skills was needed (and learned) for the research, including ecological, botanical, social and anthropological skills and tools. In addition, although quantitative data were required for further analysis, and scientific rigour, these were mostly collected using qualitative methods. Understanding both quantitative and qualitative data, and acquiring necessary skills and knowledge for both, was an ultimately strengthening, challenge.

In conclusion, a challenge experienced during fieldwork, and reflected on throughout the analysis of fieldwork data, is the statement by Shackeroff and Campbell (2007) "*Ultimately, while we agree with the general sentiment that true benefits can come to all participants, we suggest that there is nothing about conducting traditional ecological knowledge research that makes it inherently respectful and culturally sensitive. In fact, traditional ecological knowledge research may require extra vigilance to ensure respectful and culturally sensitive methods, the most powerful of which may very well be staying out of indigenous communities entirely!*"

3.2 Limitations

As previously mentioned, the ethnoveterinary data gathered and analysed in this research reflect knowledge derived from respondent interviews. It cannot be assumed that this knowledge is representative of the entire Mongolian pastoralist population (Howard, 2003). In addition, the study sites encompass a relatively small area of Mongolia, and further ethnoveterinary research should be done in other areas of the country, especially the drier desert steppe and desert rangeland areas, in order to gain a more comprehensive understanding.

A further limitation of this study is the fact that data were collected by a foreigner and through an interpreter. Ideally, in the future, this type of project should be conducted by a Mongolian student, fluent in the language and well-versed and comfortable in both the academic and pastoral arenas. This is summarised by A. Barrera, one of the first promoters of ethnobotany in Mexico, and recorded by (Martin, 2004): *"The best ethnobotanist would be a member of an ethnic minority who, trained in both botany and anthropology, would study…the traditional knowledge, cultural significance, and the management and uses of the flora. And it would be even better – for him and his people – if his study could result in economic and cultural benefits for his community".*

4. Recommendations and further research

Recommendations derived from the results of this study include the following:

- Ethnoveterinary knowledge of Mongolian herders still plays an important role in the lives and livelihoods of pastoralists, and should be recorded and maintained.
- The wealth of ethnoveterinary knowledge held and used by Mongolian herders should be acknowledged and could potentially be included in the development of veterinary programmes and associated support structures.
- The well-being of researchers is important, and formal support structures should be in place to assist with this.
- It is important that the necessary time is set aside for both fieldwork preparations, and for building meaningful relationships in the field.
- In an ethnobotanical study such as this, the choice of logistic support team is as important as respondents, and it is recommended that the necessary time and effort be put into developing a multi-disciplinary support team.
- In order to maintain biocultural diversity, the Mongolian herder way of life and the traditional herder-livestock and herder-landscape connection should be maintained, together with continued and increased mobility, both in range and in frequency.
- In order to encourage and maintain mobility of herders, political structures and policies need to offer support in terms of transport and maintain water infrastructure.
- Rangeland use should be monitored and protected by local institutions to prevent out-of-season grazing of reserve pastures, and herders should be involved in the development and running of this.
- National policies and decisions with regards to land tenure need to incorporate herders' concerns around the privatisation of land.

- Children that are growing up in urban areas should be encouraged to spend holidays in the countryside with older family members in order to allow for the transmission of local ecological knowledge, such as ethnoveterinary knowledge.

Future research

Further, more in depth studies with selected key respondents and with longer time periods spent with selected key informants that are interested and positive about the study, is recommended. In addition, using only one interpreter for the duration of the study would strengthen the validity and range of further research.

Further studies should focus on ensuring the sustainable use of medicinal plants. This requires the collection of detailed harvest and market data, on both the ethnoveterinary and human medicinal use of medicinal plants. This would require the necessary time and funds to build up a relationship with collectors and market sellers, based on trust. Although it was planned to gather medicinal plant market data, the specific context of possibly Soviet-era mistrust and scepticism, meant that only limited data could be gathered. Although good rapport was established with one market seller, more time would be needed for further and more in-depth market data collection.

In order to fully assess the conservation implications of using ethnoveterinary remedies of animal origin, there is a need to firstly understand and quantify the use, and secondly, to increase our knowledge about the biology and ecology of the species used (Alves et al., 2007). Importantly, medicinal species that are already threatened, should receive urgent attention, and any conservation objectives should emphasize their current and future medicinal uses (Oliveira et al., 2010).

Further possibilities for future research include broadening the study area to include ethnoveterinary knowledge of Mongolian herders in other regions of Mongolia. Here the more southern, arid rangelands where different vegetation, different livestock (camels) and possibly different rangeland management techniques could lead to interesting, and comparable, data. In addition, the western Altai mountains, and the north eastern regions, home to large reindeer herds, also represent important research areas.

5. Dissemination of findings

The findings, key messages and recommendations of this research project will be disseminated through a number of avenues. In South Africa, an English copy of the entire thesis, containing a copy of the abstract in Afrikaans and in Mongolian, will be available through Stellenbosch University. In addition, a number of journal publications, developed from the data chapters, are planned for early 2017.

How the results of the data will be shared and used in Mongolia, both in academic and pastoralist circles, is very important, and should be done using the appropriate format (Gilmore and Eshbaugh, 2011). Unfortunately, returning research results to local communities in alternative formats is, often, not encouraged or rewarded by academic advancement and promotion systems (Shanley and Laird, 2002). This although the International Society of Ethnobiology Code of Ethics (2006:7) clearly states that "…*research and related activities should not be initiated unless there is reasonable assurance that all stages can be completed from (a) preparation and evaluation, to (b) full implementation, to (c)* ***evaluation, dissemination and return of results to the communities in comprehensible and locally appropriate forms****, to (d) training and education as an integral part of the project, including practical application of results*." [emphasis added]

In terms of academic institutions, a copy of the entire thesis will be sent to the Traditional Medical Institute at the National University of Mongolia, and it is planned that the entire thesis will be translated into Mongolian, when the necessary funds are found. Furthermore, the Traditional Medical Institute has shown an interest in future research collaborations with Stellenbosch University.

All effort will be made to distribute the findings of this research among the herders who so generously shared their knowledge with me. The knowledge and practices recorded in this study are theirs. In order to share my research findings with respondents, and other herders, a summary of the research project will be translated into Mongolian, and will be emailed as far as possible to respondents who provided me with their email addresses, or those of their relatives. In addition, it will be requested that hard copies of this summary be distributed among pastoralists by researchers at the Traditional Medicinal Institute, and by a travel company that works in some of the areas where research was conducted. Furthermore, with the help of Mongolian colleagues and friends, I plan to develop and design an illustrated ethnoveterinary medicinal plant booklet, that records and explains medicinal plant usage in a simple and user-friendly manner. It is worth mentioning, that the idea to write a children's book about ethnoveterinary medicine, that arose at the start of this project, but due to time constraints has not been done, will hopefully still be realised.

6. Closing synthesis

Mongolian herders possess a wealth of ethnoveterinary knowledge, still used today. This includes the sophisticated use of a range of medicinal plants, together with various non-plant remedies. These are comprised of fungi, remedies of mineral origin and animal-based preparations. In addition, blood-letting and cauterization are techniques frequently used for ethnoveterinary purposes.

Mongolian pastoralists rely on the health of their livestock, and the rangelands they inhabit, for their livelihoods. It is important that their ethnoveterinary knowledge and associated beliefs and practices be recognised, acknowledged and the transmission thereof maintained. In light of the regional and global developments that threaten the continued use and sharing of traditional ethnoveterinary knowledge, the need to document and conserve this local knowledge, before it is lost, is crucial.

Ethnoveterinary knowledge that encourages the sustainable use of rangelands is invaluable for the conservation of rangelands. Just as important as it is to conserve biodiversity for sustainability, is the need to conserve the diversity of local cultures and the indigenous knowledge that they hold (Gadgil et al., 1993). By maintaining biocultural diversity, thereby increasing the resilience of social-economic systems, it is hoped that a sustainable future can be ensured (Rapport, 2007).

This study serves as an initial baseline study on ethnoveterinary knowledge of Mongolia. Although a relatively small area, and a small number of herding families, were sampled, it is hoped that the study becomes a catalyst for further ethnobotanical, ethnoveterinary and conservation-related studies, and encourages further research towards increasing the resilience of the human-animal-environmental system in Mongolia. In addition, it is hoped, that this study has contributed to the recognition of the wealth of ethnoveterinary knowledge held and used by Mongolian herders.

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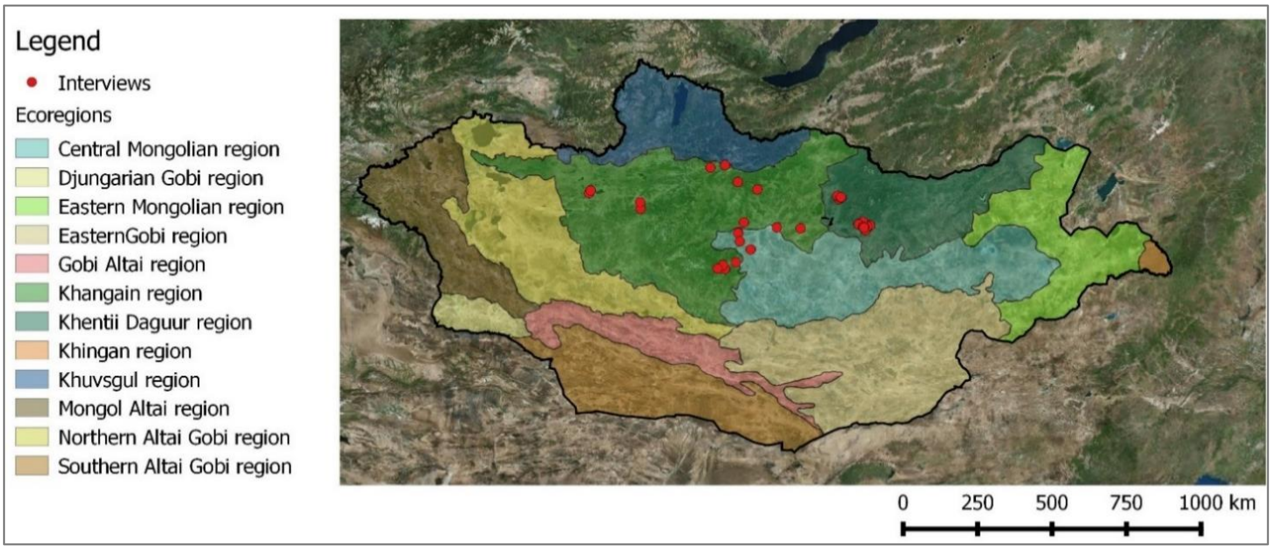
Appendices

Appendix A: Maps of the study sites in Mongolia

QGIS version 2.12 (QGIS Development Team, 2015) was used for the development of all maps.



A1. Map of ecoregions

Fig. A1. Map of Mongolia showing ecoregions (Dash et al., 2007) and interview study sites (basemap: World Imagery).

A2. Map of ecosystems

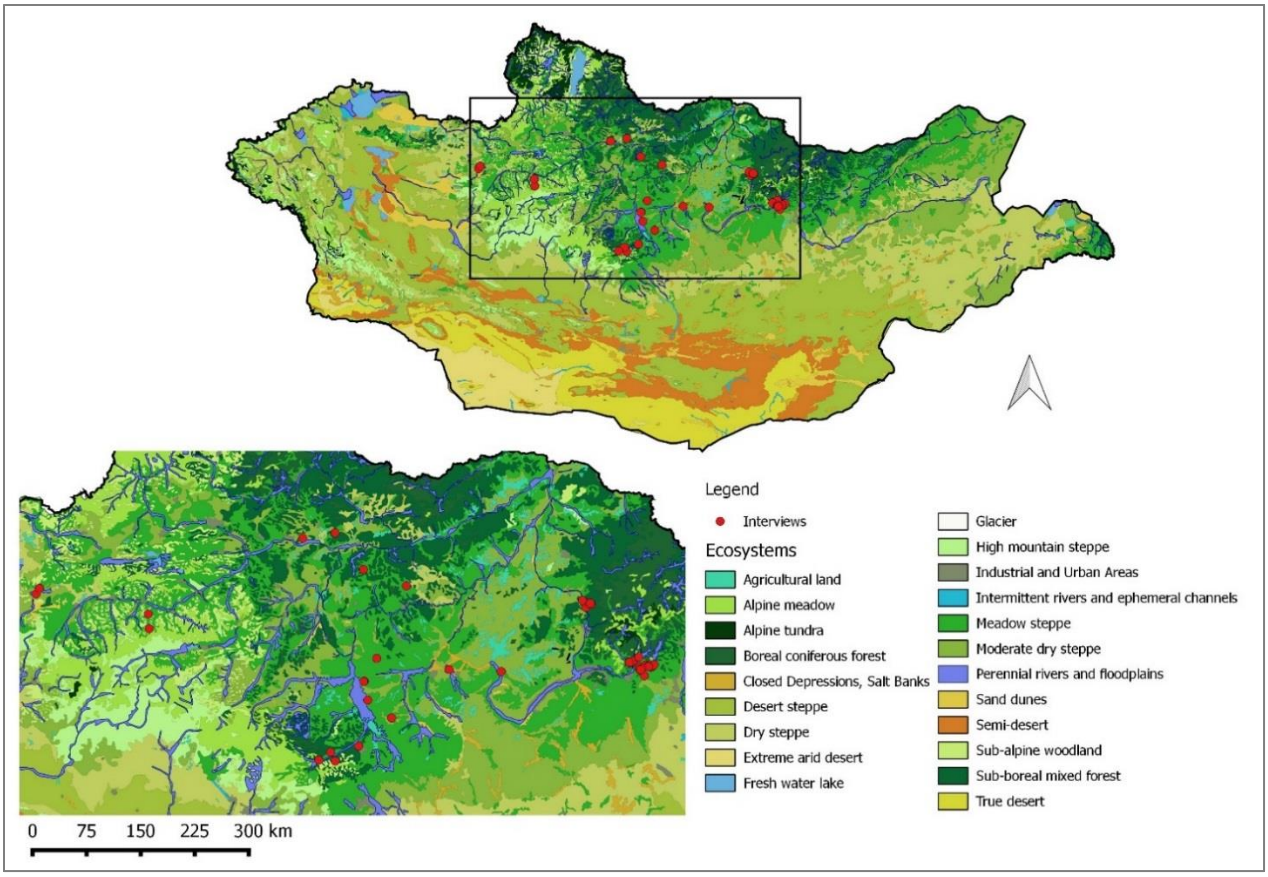


Fig A2. Map of Mongolia showing ecosystems (Chimed-Ochir et al., 2010; Vostokova and Gunin, 2005) and interview study sites (red markers).

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World Imagery. Sources: Esri, DigitalGlobe, GeoEye, i-cubed, USDA FDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS user community

Appendix B: Interview schedule (including free listing and the use of a reference book)

B1. Free listing schedule

Plant name	Meaning of name	Livestock use or human use	Plant part used	Collection & Preparation	Comments
e.g. Sud uvs	Feather grass	Prevents diarrhoea	Inflorescence	Flower is boiled in water & given to young livestock	Not used for humans

B2. Reference book schedule

Table to be completed using Flowers of Mongolia (Hauck and Solongo, 2010) as reference book

Plant # (pg, image)	Species	Does the plant have a name (vernacular) & meaning	Livestock use or human use	Plant part used	Collection & Preparation	Comments (plant recognized or any other info)
42, 1-3	*Dianthus superbus* subsp. *superbus*		Aids in delivery of placenta (horses)	Flower	Flower is boiled in water & tea is given to females to drink after birth	Not used for humans

B3. Interview protocol (nomadic pastoralist family individuals/groups)

General Information

Date:

Interview Number:

Place (GPS):

Interviewer:

Interviewee (and code):

Participant information:

Gender		**Age**	
Marital status		Education	
Harvester		Market seller	
Size of family		Number of children	

Plant use:

1. I use medicinal plants for my animals

0	1	2	3	4
Never	Yearly	Monthly	Weekly	Daily

2. I harvest medicinal plants for my animals

0	1	2	3	4
Never	Yearly	Monthly	Weekly	Daily

3. If you do not harvest plants yourself, where/ from who do you get the plants?

4. For how many years have you been a herder?

5. Is herding your main source of income? If not, what are alternative sources of income (who)?

6. How often and how far do you move?

7. How many animals do you have?

Horses	Cows	Sheep	Goats	Yaks	Dogs	Other (please specify)

8. Ethnoveterinary information:
What are the most common livestock ailments/health problems and how to you treat these?

Livestock ailment/health problem	Treatment

9.
   a. Who (age, gender) harvests the medicinal plants and are there any reasons why?

   b. Who prepares and administers them?

10. Are there differences in the medicinal plant knowledge held by men versus women?

11. Are there any traditional beliefs regarding the best time to harvest medicinal plants and which species do these beliefs apply to? (e.g. months of the year/seasons)

12. Who do you go to for advice on medicinal plants and how far (km) would you travel for this?

13. Would you move somewhere because medicinal plants for your animals grow there? Please elaborate.

First aid kit in homesteads:

14.
   a. Which medicinal plants can only be used fresh?

   b. Which medicinal plants can be stored?

   c. Which medicinal plants do you store and how do you store them (powdered, dry, ethanol etc.)?

15.
   a. How is this knowledge passed on to younger generations?

   b. How did you obtain this knowledge? Who did you learn from?

Name	Relation	Location	Your age when you obtained this knowledge	Manner in which knowledge was obtained

c. Are you teaching someone about this knowledge?

Name	Relation	Location	Age of student	Teaching method

16.
   a. Do you use any other medicines for your livestock?

   b. Where and who do you get these medicines from?

   c. How often do you use these other medicines?

17. Are there any medicinal plants that are becoming more difficult to get hold of/ to find? Which ones?

18. How do you think medicinal plant supplies can be ensured in the future?

19. Is this indigenous plant knowledge in danger of disappearing? Please explain any threats/ future concerns regarding this knowledge.

20. How should we conserve this knowledge?

21. Can you suggest anyone else I should visit to learn more about ethnoveterinary plant use?

22. Do you have any questions for me?

Thank you very much for your time.

Appendix C: Observation schedule

Observation schedule # _

Descriptive notes	Reflective Notes
Demographic Information	Speculations
Time:	Problems
Date:	Ideas
Place:	Questions
Description of physical setting	Impressions
Portraits of participants	
Reconstruction of dialogue	
Account of particular event/activity	

Appendix D: unverified ethnoveterinary medicinal plants

Table D1
Ethnoveterinary medicinal plant species identified in the reference book by only one respondent and not verified with voucher/photo specimens, therefore excluded from all analyses.

Family	Species	Use (UR)
Leguminosae	*Astragalus membranaceus* (Fisch.) Bunge	Gives animals energy in spring, contains good minerals
Asteraceae	*Echinops latifolius* Tausch	Used for kidneys
Grossulariaceae	*Ribes altissimum* Turcz. ex Pojark	Good for general health
Cruciferae	*Thlaspi arvense* L.	Gives animals heat
Labiatae	*Phlomoides tuberosa* (L.) Moench	Wound treatment
Polygonaceae	*Polygonum hydropiper* L.	Diarrhoea and weak stomach
Umbelliferae	*Peucedanum hystrix* Bunge	Inner organs
Asteraceae	*Dendranthema zawadskii* (Herbich) Tzvel.	Used to treat diarrhoea and stomach problems
Gentianaceae	*Lomatogonium rotatum* (L.) Fries	Cough
Scrophulariaceae	*Pedicularis resupinata* L.	Diarrhoea and good for colon
Asteraceae	*Inula Britannica* L.	Use for swelling, bruises
Berberidaceae	*Berberis sibirica* Pall.	Chest, lung
Liliaceae	*Hemerocallis minor* Mill.	Used for broken bones
Gramineae	*Beckmannia syzigachne* (Steud.) Fern.	Used for joints, especially for old animals, especially for goats
Campanulaceae	*Campanula glomerata* L.	Aids In delivery of placenta
Asteraceae	*Aster alpinus* L.	Good for lactating mothers, increases milk
Pinaceae	*Larix sibirica* Ledeb.	Weak animals
Rosaceae	*Fragaria orientalis* Losinsk.	Used for the stomach
Graminaea	*Hordeum brevisubulatum* (Trin.) Link subsp. *brevisubulatum*	Horses like eating it, extra feed for horses
Cruciferae	*Alyssum obovatum* (C. A. Mey.) Turcz.	Use for young livestock if they have diarrhoea
Papaveraceae	*Papaver croceum* Ledeb.	Stimulates mating in cattle
Asteraceae	*Serratula centauroides* L., *Serratula marginata* Tausch	Horses eat it to prevent getting sick
Cupressaceae	*Juniperus sabina* L.	Good for lung and liver
Cuppresaceae	*Juniperus sibirica* Burgsd.	Used in sanitizing or purifying rituals
Polygonaceae	*Bistorta alopecuroides* (Turcz. ex Meissn.) Kom., *Bistorta vivipara* (L.) S. F. Gray	Diarrhoea in young animals
Ranunculaceae	*Thalictrum foetidum* L.	Bloated animals, inner lining of oesophagus
Pinaceae	*Pinus sylvestris* agg.	Treatment for wounds or painful limbs
Chenopodiceae	*Chenopodium hybridum* L., *Chenopodium prostratum* Bunge	Used for external and internal wounds
Gentianaceae	*Gentiana pseudoaquatica* Kusn.	Treatment for common cold, chest pain, lungs
Gentianaceae	*Gentianella acuta* (Michx.) Hultén	For the stomach
Gentianaceae	*Gentianopsis barbata* (Froel.) Ma	Good for stomach and *tsus* (gallbladder)
Asteraceae	*Artemisia macrocephala* Jacq. ex Bess.	Good for animals
Asteraceae	*Artemisia glauca* Pall. ex Willd.	Good for throat
Rosaceae	*Potentilla anserina* L.	Good for kidneys

Appendix E: Use-values of all 29 ethnospecies

Table E1

Use values, use reports and citations of 29 medicinal plant ethnospecies reported to be used for ethnoveterinary purposes by Mongolian pastoralists in the study area.

Ethnospecies	Use reports	Citations	UV
Cacalia hastata	18	9	2.00
Rosa acicularis	4	2	2.00
Thalictrum minus	4	2	2.00
Plantago spp.	42	25	1.68
Achillea spp.	10	6	1.67
Stellera chamaejasme	5	3	1.67
Rheum undulatum	11	7	1.57
Thymus spp.	18	13	1.38
Urtica cannabina	35	26	1.35
Lilium pumilum	4	3	1.33
Prunus padus	4	3	1.33
Rhodiola spp.	16	12	1.33
Pulsatilla spp.	27	21	1.29
Dianthus spp.	23	19	1.21
Gentiana spp.	19	16	1.19
Vaccinium vitis-idaea	7	6	1.17
Sanguisorba officinalis	36	31	1.16
Allium spp.	10	10	1.00
Artemisia frigida	7	7	1.00
Artemisia gmelinii	**4**	**4**	**1.00**
Betula spp.	2	2	1.00
Leontopodium spp.	3	3	1.00
Orostachys spinosa	2	2	1.00
Paeonia anomala	3	3	1.00
Papaver nudicaule	1	1	1.00
Pinus sibirica	2	2	1.00
Potentilla spp.	3	3	1.00
Salix pseudopentandra	2	2	1.00
Veronica incana	**1**	**1**	**1.00**

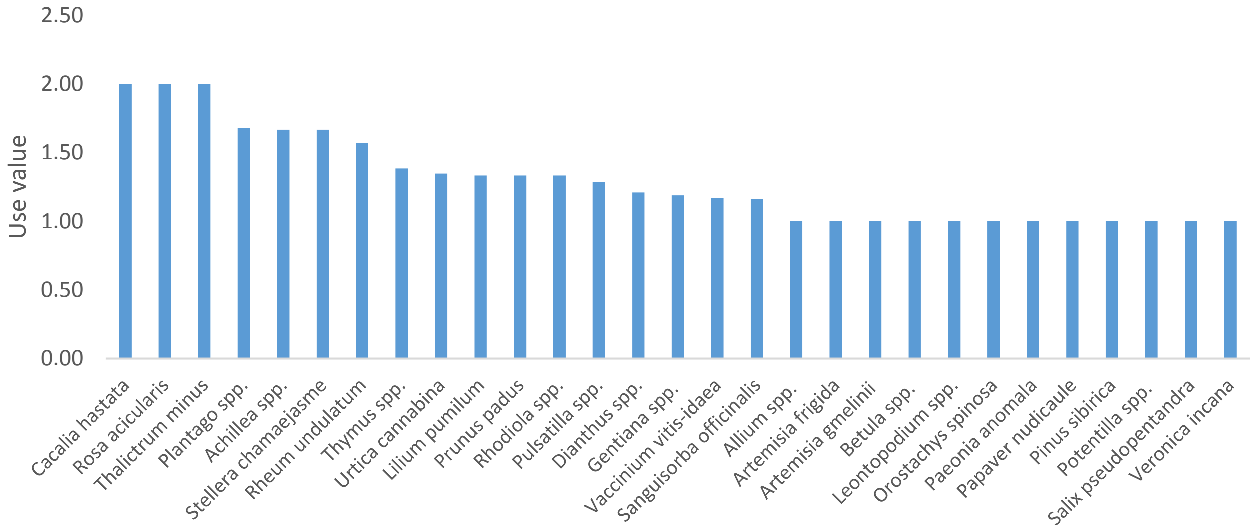


Fig. E1. Use values of 29 ethnospecies, recorded to be used for ethnoveterinary medicinal purposes by Mongolian pastoralists.

Appendix F: Reflections

F1. Reflections on my research experiences and challenges of collecting ethnoveterinary data in Mongolia, written whilst reading *Reflections on Research* (Hallowell et al., 2005)

"…the practical and ethical complexities…" (pg.1)

And so many complexities there are, on so many different levels. This, together with the pressure of collecting enough data to be able to get a masters, was often overwhelming.

Qualitative research, is a "…complex, often chaotic, sometimes messy, even conflictual…" (pg. 2, Byrne-Armstrong *et al.* 2001: vii)

So true…and I think this is something we should be prepared for, told about, encouraged about, motivated. How to deal with conflict was very hard for me…especially being in a foreign country. Not only qualitative research can be messy, but also quantitative research, anything involving living beings…

From these stories/recollections, it becomes clear that there is a need for researchers, especially young or novice researchers to have support systems in place for them to speak to someone about the interviews after the process and during the writing up and analysis process…grant holders and academic supervisors need to think carefully about how they can offer this support (pg. 25)

my own experience could come in here, struggling with post-traumatic stress and then having four sessions with a psychologist and paid for from the university…but people don't speak about these things…Sensitivities, support, vulnerability, this should be spoken about more openly in academia

How do we know when to stop an interview? And how far can we go with pursuing the answer to a question that is being avoided or misunderstood, or causes distress in either ourselves or the research participant? What do we do if we realise that we have already pushed things too far? (pg. 31)

Failing to pick up on verbal and non-verbal cues during an interview. (pg. 31)

Especially if you are working through an interpreter…this leads me to think that the type of research I did, or at least the type of interviews that I did, should be conducted by someone that understands the local language and the local culture…and then I think what if there is no one like that…? I'm not sure whether I *was overstepping the boundary that sometimes naturally falls between cultures, especially on opposite sides of the globe…did I have a right to be working, questioning and seeking data in Mongolia? Was it arrogant, almost proud of me to think that I could do it, that I could help, I could shed light on things, that I could and can make a valid contribution to meaningful science and to the conservation of these beautiful spaces but also the way of life, and the knowledge of plants an ethnoveterinary activities? Who am I to do this, I often thought and think, and it's a strong thought that I need to grapple with. This I am aware of, as somehow, even if only in a tiny way, and only for one person, this research, my being in Mongolia must have made a positive difference…I learned so much, which I want to share. The whole experience, as painful as it often, mostly was, quietened this restless searching and anxiety that was in me before. I know I am much more at peace, no longer searching so deeply for a calling, a purpose to my work, that sense of urgency around doing something meaningful in my work…it sounds strange, but only those that have experienced will know…searching so deeply for something to do in terms of work and career that is meaningful, a calling, the one answer to this big question. Now I just see it as many small questions, with answers that flow and change and are beautiful all the same*…

Helps to remember this advice from Cox: if we are in any doubt about what to ask during an interview, or how hard to push things, then we should hold back, for, as she notes, 'people will tell you what you need to know', *but only if we let them.*

'Hindsight can be a wonderful thing, particularly if we are willing to learn from our mistakes' (pg. 31)

I kept thinking that I want to leave a good impression of what scientists and researchers are like and that they respect the culture…I wanted to pave an easier path for the next researcher that comes after me…

Context, communication and paradox: on learning not to ask 'overly sensitive' questions. (pg. 32)
'People's silence should perhaps speak as loudly as their words' (pg. 34)
'All true morality is felt morality' (pg. 37)
…feeling bad about an interview is a sign that something is probably wrong (pg. 37)

What do I think of this? There are no hard and fast rules…No matter how many books we may read about how to do research, if we want to do the right thing, ultimately our own emotions and intuitions may be our best, and perhaps only, guide.

As researchers, we have to balance our desires and emotions with those of our research participants, which requires more than a little empathy, a not inconsiderable amount of intuition and skill, and may involve some very hard choices. (pg. 40)

This is the crux of the matter – having enormous empathy with your research participants yet still taking care of yourself; trusting your intuition, and yet letting yourself be guided by academic requirements; skills-which need to be developed and honed; and hard choices…very hard choices, for me these included decisions about where to go for interviews, which horses to use, which guide to trust, and how I should handle interpreter bias. And even if, in hindsight, I could have done things differently, it was all a learning curve, a journey of growth.

Hallowell, N., Lawton, J., Gregory, S., 2005. Reflections on Research, The Realities of Doing Research in the Social Sciences. Open University Press, Berkshire, England.

F2. Reflections on questionnaire improvement and reference book

Questionnaire improvement:

The entire process sometimes took a bit long. Would it be possible to leave out the 'formal' questionnaire and only do the free listing and reference book, and informally speak about the rest? But then I would lose a lot of data…

How many times do you use and harvest medicinal plants? Should have rather had number of times in a year, e.g. 1-10 times/year, more than 50 times/year

Question 11 on the traditional beliefs was not always understood by herders, and towards the end of the fieldwork season I often left this question out.

Question 14 in some cases just took too long and herders did not always want to repeat information for all the plants (especially if they had listed many)

Reference book:

Having more than one photo per plant, and more than one plant per page sometimes led to confusion, herders thought each photo might be different plant…I realised that there was a need to explain this at the beginning of the reference book session.

Quite a few herders mentioned that they had never seen this book before, and that they were very interested in getting a copy. It was wonderful to watch parents and grandparents showing the younger children the photographs in the book. One little girl even ran outside to collect the flowers that shown on the front cover of the book.

'Flowers of Mongolia' was not available in Mongolia at the time of research. I should write to the authors and enquire about the possibility of distribution in Mongolia and perhaps even to the herders?

After one interview, the interpreter explained to me that at the beginning the respondents (husband and wife) were struggling to remember medicinal plants that are or can be used for livestock but once they saw the reference book then it all started coming back to them, and helped them remember. Is ethnoveterinary knowledge fading? Seems like it in this case,

For some older respondents with poor eyesight, the reference book didn't work…however then the respondent would free list and the interpreter looked up the plants in the reference book index.

F3. Reflections on biopiracy

This was a very difficult situation for me. During one interview I noticed that the interpreter was misinterpreting some things that respondents were saying, for example, one family mentioned that I could record the interview, but the interpreter said they had said "no, they don't want it recorded". That evening she told me that her brother, a lawyer, had said that she needs to protect herself, that I cannot use any of the notes she had made during interviews and that I was stealing sacred/secret Mongolian information. Strangely, the driver on this trip was very angry with her for doing that, and he seemed to want to look after me.

I made an effort (again) to re-explain what I was doing with the data, the purpose of the research and that I had ethical clearance from both the National University of Mongolia and from Stellenbosch University, South Africa. I re-explained that I was not recording or looking for any 'secret' information, the purpose of the consent form, and that interviews must not be held if respondents feel in any way uncomfortable. The interpreter was very emotional, and the situation was difficult to handle. I stopped all planned interviews (even though this meant a loss of academic data) as she did not feel comfortable with the situation. I then gave her copies of all consent forms and allowed her to keep her original interview notes.

Upon reflection, the following are noteworthy:

- In Mongolia, in some areas, there seems to be a fear of 'biopiracy'. Even a well-known researcher was reported to have problems in obtaining research permits. Could also be due to the perceived fear of the Chinese 'stealing' resources from Mongolia.

- The other two interpreters that assisted me had no fear about biopiracy, and interviews did not become emotionally loaded. Perhaps the interpreter that I had the biopiracy issue with, encouraged respondents to share more personal information than the other interpreters did, even though I had been clear that this is not what I wanted?

- Having ethical clearance from the local university was very important and offered me protection when I really needed it. Good idea to carry it along when doing fieldwork.

- It is good to have legal backing and support when working in a foreign country

- It is important to use interpreters that are emotionally stable, do not have ulterior motives, and have experience with collecting scientific data

I end off wondering about the question of whether the CBD, and the associated Nagoya protocol has possibly led to a misconception of and an overregulating of biological resources leading to an increase in fears around biopiracy, some justified and some not?

When doing ethnobotanical or ethnoveterinary research, the possible or potential fears around biopiracy are something to definitely be aware of, be prepared for and to approach with the necessary skills, tact and sensitivity.

Appendix G: Ethnoveterinary medicinal plants – plant parts used

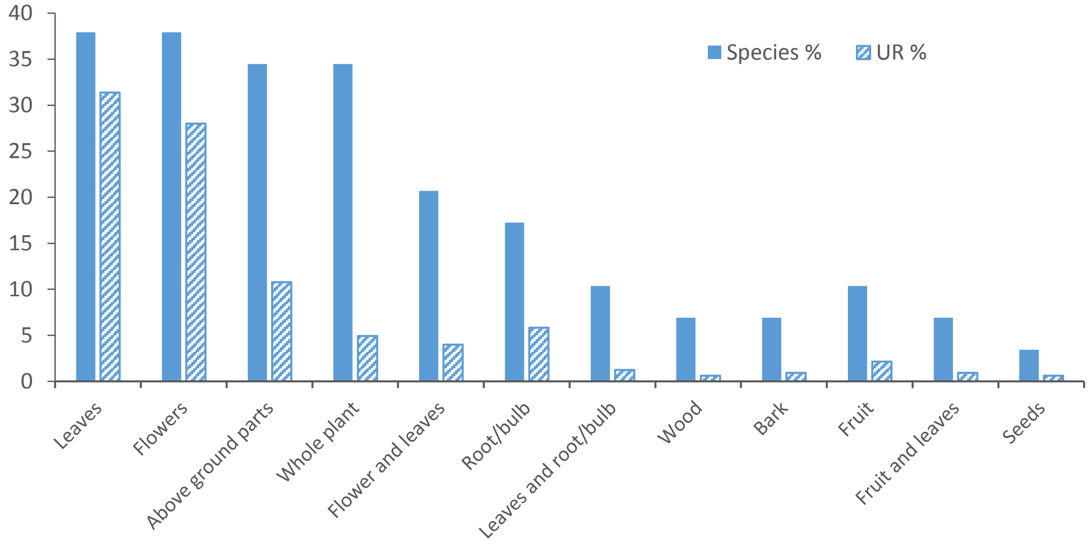


Fig. G1. Ethnoveterinary medicinal plants parts used according to species percentage and use report (UR) percentage. Referred to in Table 4.1, Chapter 4.

Appendix H: Coding of herders' responses to interview questions 15 and 17-20

Table H1

Mongolian herders' perceptions on ethnoveterinary medicinal plants conservation and associated ethnoveterinary medicinal plant knowledge conservation, using Atlas ti for coding and development of themes. Groundedness indicates the number of quotes associated with a quote.

Question	Themes (groundedness)	Total quotations
17. Are there any medicinal plants that are becoming more difficult to get hold of/to find?	Yes (24) No (13) Don't know (3) Other (5)	45
17. Why have they become more difficult to get hold of?	Weather/climate related (12) Increased livestock and decreased mobility (5) Balance and communication with nature (5) Human caused problems (5) Incorrect harvesting of medicinal plants (3) Agriculture (2) Way of nature (2) Other (5)	39
18. How do you think medicinal plant supplies can be ensured in the future?	Correct harvesting (15) Protection and government support (12) Nature knows how to recover (9) Livestock numbers and land degradation (5) Mobility (4) Connection with nature (4) Cultivation and agriculture (4) Human activity and mining (3) Should be looked after by users (2) Research (2) Other (6)	66
15a.How is this (ethnoveterinary) knowledge passed on to younger generations?	From everyday herding and life (14) Show and tell (14) Instructions and advice (10) Through conversations (6) By collecting medicinal plants together (5) Children learn by watching and experience (5) Books (2) From the environment and livestock (2) Boys learn when hunting (1) Other (4)	63
15b. How did you obtain this knowledge? Who did you learn from?	Family (40) Elders (15) Herding way of life (10) Neighbours (5) Knowledgeable people (2) Teachers (3) Books (3)	78

19. Is this indigenous plant knowledge in danger of disappearing? Please explain any threats/future concerns regarding this knowledge?	Yes (31) threats: - Decrease in medicinal plants and knowledge (7) - Modern medicine (6) - Loss of connection to livestock (3) - Loss of traditions (3) - Urbanisation (2) - Loss of communication with nature and incorrect use (2) - Modern education (2) - Dismantling of cooperatives (1) - Other (5) No (9) Other (4)	44
20. How should we conserve this knowledge?	Teach children (12) Written material and research (7) Teaching children in school (5) Children should spend time in countryside (4) Teach herders (4) Connection with nature (3) Record information from elders (2) Follow herding lifestyle (1) Other (9)	47

Appendix I: Co-occurrence between codes and across themes

Table I1
Codes used for the qualitative analysis of medicinal plant abundance and medicinal plant knowledge within the themes of 'medicinal plants' and 'knowledge'. Groundedness values indicate the number of times each code was used throughout all interviews; density indicates the frequency with which they co-occur with other codes.

Code	Description	Groundedness	Co-occurring codes (density)
MEDICINAL PLANTS THEME Q17 and 18	Why are medicinal plants becoming more difficult to find? How can medicinal plant supplies be ensured for the future?		
Climate	Drought, less rain	19	Correct harvest (4), modern day life (3), way of nature (2), nature connection (2), overgrazing (1), research (1), teach children (1), fire (1), incorrect pastureland use (1), livestock numbers (1), mobility (1), wild mice (1)
Harvesting	Correct/incorrect harvesting, not harvesting the root	15	Protection of nature (6), climate (4), education (1), research (2), government (1), mobility (1), modern day life (1), nature connection (1), way of nature (1)
Education		2	Protection of nature (2), correct harvesting (1), government (1), nature connection (1)
Fire		2	Climate (1), protect nature (1),wild mice (1)
Government	Government support. Laws	6	Protection of nature (4), research (2), correct harvest (1), education (1), modern day life (1)
Incorrect use of pasture-land	Trespassing of reserve pastures	3	Mobility (2), overgrazing (2), livestock numbers (1), protection of nature (1), climate (1)
Livestock numbers	Livestock numbers, overgrazing	5	Overgrazing (3), mobility (2),incorrect pasture-land use (1), climate (1)
Overgrazing		5	Livestock numbers (3), mobility (3), incorrect pasture-land use (2), climate (1)
Mobility	Fences	6	Overgrazing (3), incorrect pasture-land use (2), livestock numbers (2), modern day life (1), correct harvest (1), climate (1)
Modern day life	Human activities, agriculture, mining	11	Climate (3), nature connection (2), way of nature (2), correct harvest (1), mobility (1), government (1), protection of nature (1), research (1)
Nature connection	Connection, balance and communication with nature	6	Modern day life (2), climate (2), correct harvest (1)
Protection of nature	Looking after, taking care of nature. Formal and informal protection.	12	Correct harvest (6), government (4), education (2), research (2), fire (1), incorrect pasture-land use (1), modern day life (1), nature connection (1)
Research	Research on medicinal plants, efficacy	4	Protect nature (2), correct harvest (2), government (2), modern day life (1), climate (1)
Way of nature	Plants will just grow back by themselves	3	Climate (2), modern day life (2), correct harvest (1)
Wild mice	Wild mice increase	1	Climate (1), fire (1)

KNOWLEDGE THEME Q19 and 20	What is threatening the continuation of medicinal plant knowledge? How should we conserve this knowledge?		
Books		2	Teach children (1)
Decrease in knowledge of medicinal plants		6	Modern day life (3), education (2), modern medicine (2), nature connection (1), teach children (1), urbanisation (1)
Education	Children are educated in the city. Educate new and young herders	6	Decrease in knowledge of medicinal plants (2), educate herders (1), government (2), nature connection (2), loss of traditions (2)
Government	Government support	3	Education (2), loss of traditions (1)
Loss of traditions	Loss of traditions associated with herding	2	Education (2), government (1), urbanisation (1)
Modern day life		2	Decrease in knowledge of medicinal plants (3), modern medicine (1), urbanisation (1)
Modern medicine	Western/Russian medicine, not medicinal plants	3	Decrease in knowledge of medicinal plants (2), modern day life (2), teach children (1)
Nature connection	Connection to nature, including livestock	4	Education (2), teach children (1), protect nature (1), decrease in knowledge of medicinal plants (1), correct harvest (1)
Teach children	Share knowledge with children, show and teach	15	Books (2), climate (1), decrease in knowledge of medicinal plants (1), modern medicine (1),nature connection (1)
Urbanisation	People are moving to the city	2	Decrease in knowledge of medicinal plants (1), loss of traditions (1), modern day life (1)

Appendix J: Medicinal plant market data

J1. Medicinal plant trade

In order to gain insight into the medicinal plant trade, interview schedules were developed for market sellers and included questions about the medicinal plants sold for livestock use and for human use (see below).

Although it soon became clear that more time would be needed to establish relationships with the market sellers, due to most being very wary and suspicious of a questioning foreigner (possibly due to the past Soviet era's centralised control, and the prohibition of Buddhist-related practices), four interviews were held with medicinal plant market sellers at two of the biggest markets in Mongolia. Three interviews (Appendix J2) were conducted at the Naran Tuul market in Ulaanbaatar, and one at the Erdnenet city market. Although the focus of this study was on interactions with herders and only limited time was available for collecting market data, the four interviews with market sellers gave important insight into the medicinal plant trade. Medicinal plants are mostly sold for human use, as herders usually pick their own in the countryside. One seller mentioned that only herders who keep their livestock very close to the city sometimes buy medicinal plants at the market. Market sellers sell only medicinal plants, not plant preparations, as these are usually made by traditional doctors and Buddhist llamas.

In addition to interviews, aerial maps of both markets were hand-drawn to indicate what proportion of the market is allocated to the medicinal plant trade (Fig. J1 and J2). Less than 1% of the Naran Tuul market space is used for medicinal plants, and ca. 5-10% of Erdenet market space is used for medicinal plant sales. Whilst attempts were made to draw these maps to scale, the space percentages serve only as broad indications, and need to be validated with more exact measurements. Although very little space is used for the medicinal plant sector, it is important to note that in both markets the medicinal plant stalls are located at the main entrances to the market, possibly indicating their importance.

In order to ascertain the sustainability of current medicinal plant harvesting, information on actual harvest and management practises, in addition to quantitative market data across formal and informal spheres, is needed (Etkin et al., 2011). This will require insight, understanding and the necessary time needed to build trusting relationships with collectors and market sellers

Etkin, N.L., Ticktin, T., McMillen, H.L., 2011. Ethnoecological Approaches to Integrating Theory and Method in Ethnomedical Research, in: Anderson, E.N., Pearsall, D.M., Hunn, E.S., Turner, N.J. (Eds.), Ethnobiology. Hoboken, New Jersey, pp. 231–248.

Fig J1. Hand-drawn map of Naran Tuul market, Ulaanbaatar, indicating that less than 1% of market space is used by medicinal plant market stalls, indicated by red circles.

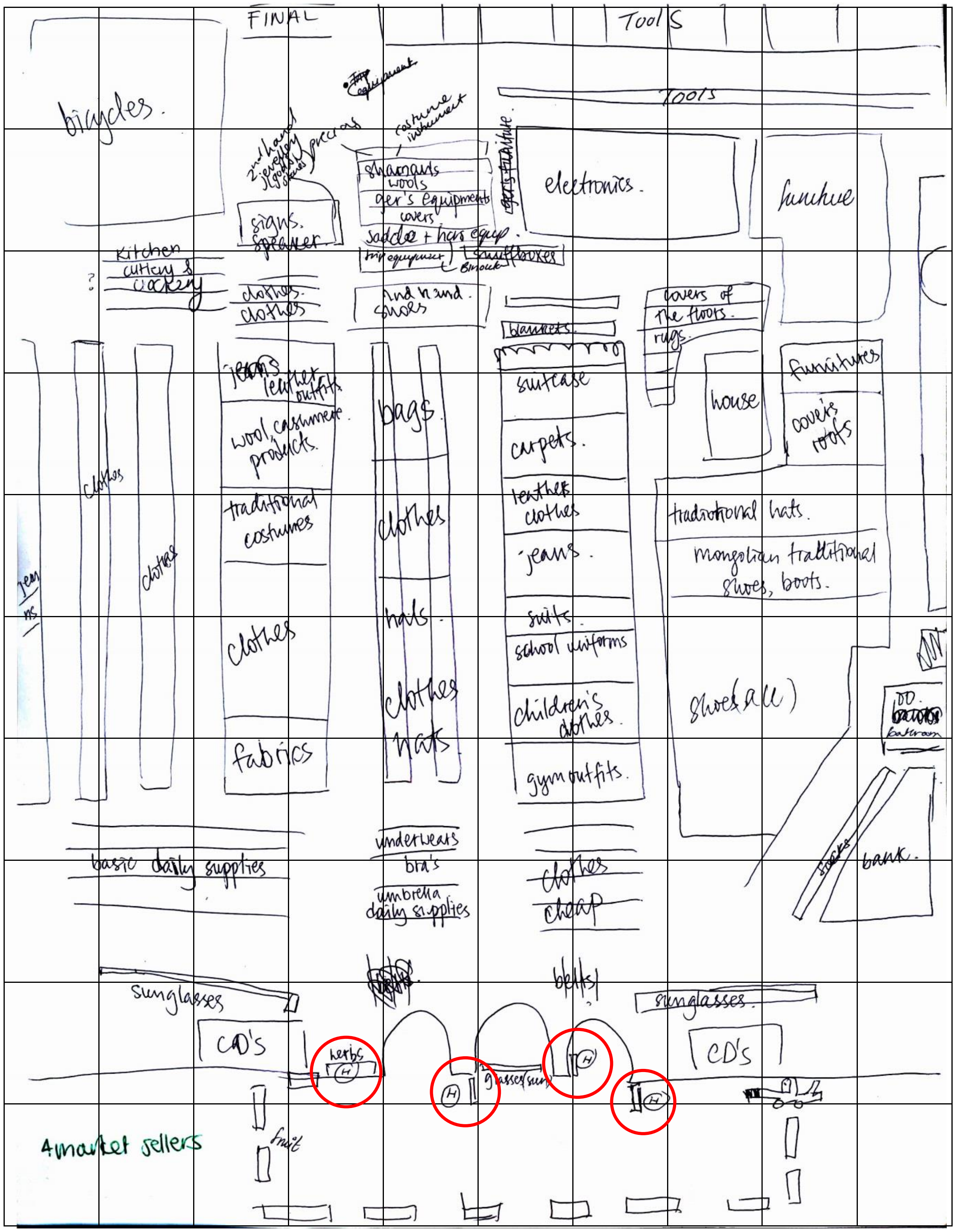
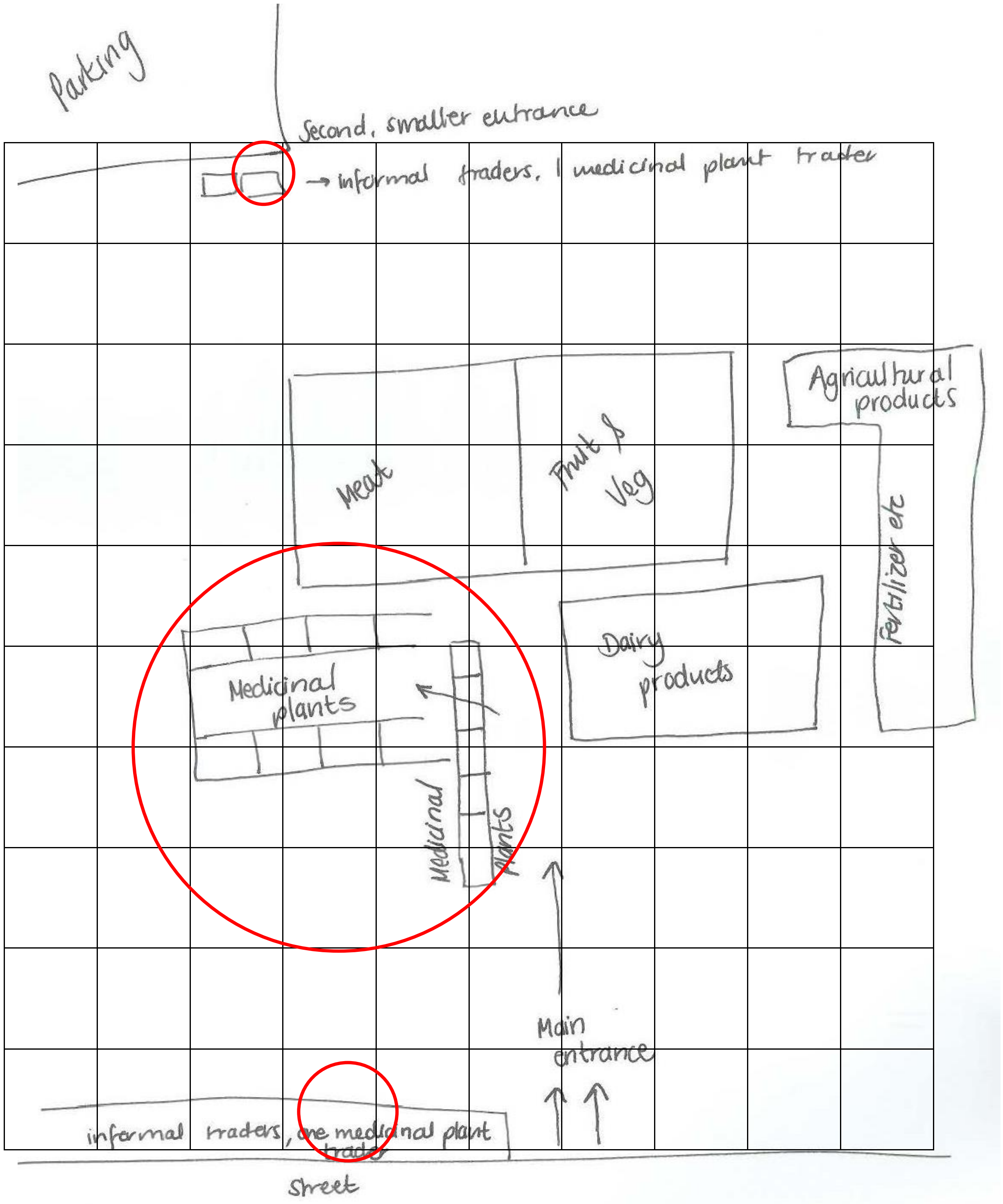


Fig. J2. Hand-drawn map of Erdenet market (Erdenet city), indicating that ca. 5-10 % of market space is used by medicinal plant market stalls, indicated by red circles.



J2. Interview protocol (market sellers)

General Information

Date:

Interview Number:

Place/location of market and size:

Interviewer:

Interviewee (and code):

Participant information:

Gender		Age	
Marital status		Education	
Harvester		Market seller	

1. Which of your medicinal plants are used for both humans and animals?

2. Which of your medicinal plants are used for animals?

3. Who harvests these plants?

4. Do you sell a lot of these plants?

5. What is your best-selling plant (used for animals)?

6. Which of these plants are difficult to find/get hold of?

7. Is there anything people have stopped buying? Do you know why this may be?

8. Are there any plants that you used to be able to get and now cannot find anymore?

9. How did you learn about these plants? Was this knowledge passed down from generation to generation?

10. Are people still interested in using medicinal plants?

11. What do you think needs to be researched about these plants?

12. Who should I visit with to learn more about my questions?

Thank you very much for your time.