



Mongolian herders' plant knowledge: intergenerational transfer and change

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Abstract

Traditional Ecological Knowledge (TEK) is increasingly recognized as an important component of biocultural diversity and a potentially valuable resource for adaptation to future changes. TEK is a vibrant knowledge system held by geographically and socially defined communities in relation to their day-to-day interactions and relationships with their environment and is transmitted between generations. With the socioeconomic changes in the last 30 years in Mongolia, many young herders have moved to cities for jobs and education and many elder herders have followed them, to help care for grandchildren and to avoid the increasing harshness of livestock herding caused by climate change and rangeland degradation. With these demographic and social changes, some fear that TEK is being lost. Therefore, we sought to document herders' current plant knowledge, and to compare the knowledge of younger and older herders, and those living in remote rural and settled areas. We asked 30 herders in four subdistricts in Arkhangai province, Mongolia to list all the plants they know that grow in their community and to discuss their uses. Knowledge of plants and their uses did not vary between rural and settled areas, likely because many older participants had moved to the province center, taking a lifetime of herding knowledge with them. Plant knowledge did vary with age. Younger herders didn't mention certain species that have declined in the local environment, likely due to environmental changes. To support conservation and intergenerational transfer of plant TEK, we are working with rural herders, schoolteachers and the district cultural center to develop school curricula and museum exhibits featuring local plant TEK.

Introduction

Traditional ecological knowledge (TEK) is increasingly recognized as an important component of biocultural diversity and a potentially valuable resource for adaptation to future changes. TEK is a vibrant knowledge system held by local place-based communities in relation to their day-to-day observations, interactions and relationships with their environment (Berkes 1999, Fernandez-Gimenez and Fillat 2012). TEK is accumulated, practiced and transferred from generation-to-generation and it holds place-based values and belief systems (Berkes et al. 2000). The connection between cultural and biological diversity as known as biocultural diversity emphasizes the coupling of environment/nature and culture (Loh and Harmon 2005; Seele et al. 2019). Plant biodiversity indicates the richness of the rangeland resources and their health, on which herders' dependent on plant resources for livestock forage, food, medicines, firewood, construction of dwellings as well as ritual and cultural practices. Cultural diversity is manifested from individual ideas to entire community and culture (Loh and Harmon 2005).

Many TEK studies warn about potential loss of these knowledge systems due to social-ecological and political changes (Fernandez-Gimenez et al., 2017) and some recent studies also emphasize the importance of TEK application for adaptation to future changes considering of dynamic nature of the TEK (Peter et al. 2024). Therefore, providing means for younger generations to access TEK is critical contribution to preserve, practice and use TEK for adaptive management in a changing world. Mongolia is one of the few countries practicing mobile herding on its vast open native rangelands (Fernandez-Gimenez 2000, Honey church 2010). However, overgrazing and climate change are degrading Mongolia's rangelands (Liu et al. 2013, Zhao et al. 2015), and at same time herding culture is fading due to socio-economic changes (Fernandez-Gimenez et al., 2017). In Mongolia, TEK is transmitted between generations, elders sharing knowledge with children and grandchildren within families during day-to-day activities, and with young herders of communities when they meet and exchange information on the pasture (Peter et al. 2024). Current, ecological and socio-economic changes are thought to weaken and alter access to, transfer and, practice of TEK in Mongolia in two main ways. First, many young herders have moved to cities for jobs and education and many elder herders have followed them, to help care for grandchildren and to avoid the increasing harshness of livestock herding caused by climate change and rangeland degradation. Second, introduced techniques (herding via car and motorbike) and technologies (mobile phone, satellite collar) reduce workloads and save time for herders, but also limit the practice of TEK and weaken herders' close interactions with and observations of their environment (Seele et al. 2019). In light of these changes, we sought to document herders' current plant knowledge, and to compare plant knowledge across herders of different genders, ages and living in remote rural areas versus settlements. We expected women and men both to know many plants, but we expected that the types of plants they emphasized might differ. For example, we thought that women might mention more plants used for food and human medicine and that men might mention more forage plants. We expected older herders to hold more knowledge about specific plants and their uses. We expected herders in more remote rural areas to maintain more traditional practices and therefore to hold more knowledge of plants, in terms of number of plants and their uses.

Methods

We conducted our study in four different subdistricts (baghs) of two districts (soums), Ikh Tamir and Undur Ulaan, of the Arkhangai province. Arkhangai lies 500 km to the northwest of Ulaanbaatar, the capital city of Mongolia. These four baghs include Azarga bagh of the Undur Ulaan soum which is distant from the soum and aimag centers, Bayangol bagh of the Undur Ulaan soum which is very close to the soum center, Khan Undur bagh of the Ikh Tamir soum is close to the soum and aimag centers, and lastly, Tsetserleg VII bagh which is very close to the aimag center. Arkhangai aimag is in the mountain and forest region, where forests, rivers and lush vegetation support four types of livestock, horse, cattle, yak, sheep, and goat.

We interviewed herders during the spring, early summer, and fall of 2022. We recruited interview participants using a snowball method and sought to include herders of all ages and herding experiences across these four baghs. All interviews were conducted in Mongolian and participants were asked to list all the plants they know and that grow in their homeland (*nutag*). After a participant named all the plants they knew, we asked about each plant's use either as medicine, food, and/or livestock forage. Finally, we asked them to share their observations about increasing or decreasing trends in abundance of each plant. Data collection was conducted with participants' free, prior and informed consent and conducted under the Purdue University Institutional Review Board (IRB) protocol (# 2021-1083). All interviewees read and signed the consent form before we started our interview. In total, we interviewed 30 herders, of which 24 were men, and 6 were women. Seven of the interviewees are from Azarga bagh, six are from Bayangol, eight are from Khan Undur bagh and nine are from Tsetserleg. Seven of the 30 interviewees are people aged above 61 years old, 15 are aged between 41 and 60 years old and 8 are people under 40 years old. The average age of the participants was 50, and the oldest and youngest participants were 81 and 25 years old. Interviews were audio recorded and transcribed for analysis. We entered free lists of plants in the local and scientific names into Excel, calculated descriptive statistics and a cognitive salience index (Sutrop 2001) from free list data. Only plants appearing on two or more lists are included in this calculation. We used one-way ANOVA to test if lists generated by four baghs and three age groups differ from each other and t-test to assess gender differences.

Results

By gender: Men listed more plants than women ($t=2.236$, $df=26.16$, $p=0.034$). Women generated 56 plants' list. Ten of the listed by women are good livestock forage plants, 15 are medicinal plants, 18 are for human food use such as for making tea, jam and juice, other uses such as firewood, hair washing, carpentry. Of the women listed plants, 11 plants are decreasing, and two plants are increasing. Plants with greater CSI listed by women are *Pulsatila ambigua* (khukh yargui), *Urtica* species, and *Artemisia frigida* (agi), *Pulsatila flavescens* (shar yargui), *Gentiana azura* (khukh degd) and *Thymus gobicus* (ganga).

Men listed a total of 125 plants, including 47 livestock forage species, 42 medicinal plants, and 32 plants used for human food and other purposes, such as firewood and carpentry. Of the total listed, 33 plants are decreasing, and 10 are increasing. Plants with higher CSI listed by men include livestock forage species such as *Elumus chinensis* (khiag), *Stipa species* (nariin uvs), *Pulsatila ambigua* (khukh yargui), *Artemisia frigida* (agi), *Gentiana azura* (khukh degd), and *Allium scheonoprasum* (khumkheel), all of which are decreasing.

By age: There was no significant difference in the average number of plants listed by three different age groups ($p=0.13$). However, younger herders listed fewer plants, while older herders listed more.

Young herders (below 40) identified 24 forage, 20 medicinal, and 12 human-use plants out of a total of 69 plants listed. They observed the growth trends of 11 plants, with seven decreasing (2-livestock forage, 2-medicinal, 3-human use), three increasing, and one plant showing differing growth trends according to two herders. Plants with greater CSI are *Stipa species* (nariin uvs), *Elumus chinensis* (khiag), *Pulsatila ambigua* (khukh yargui), *Gentiana azura* (khukh degd), *Artemisia macrocephala* (Tsarvan) and *Gentiana algida* (Vanjingarav), *Allium scheonoprasum* (khumkheel), *Artemisia frigida* (agi).

Middle-aged herders (41-60 years) listed 46 forage, 27 medicinal, and 28 human-use plants out of a total of 94 plants. They observed the growth trends of 34 plants, all of which 26 plants (15-livestock forage, 9-medicinal, 2-human use) are decreasing, six are (3-are livestock use, 2-medicinal, 1-human use) increasing and two plants showing differing growth trends according to four herders. Plants with greater CSI listed by this age group are *Pulsatila ambigua* (khukh yargui), *Pulsatila flavescens* (shar yargui), *Gentiana azura* (khukh degd), *Allium scheonoprasum* (khumkheel), *Sanguisorba officinalis* (Sud uvs), *Oxytropis myriophylla* (tagsh), *Elumus chinensis* (khiag) and *stipa species* (nariin uvs).

Older herders (61+ years) listed a total of 97 plants, including 21 forage species, 31 medicinal plants, and 15 human-use plants. They observed the growth trends of 24 plants, with 21 decreasing and 3 increasing. Plants with higher CSI listed by this age group include *Artemisia frigida* (agi), *Festuca lenensis* (Botuuli), *Elumus chinensis* (khiag), *Allium scheonoprasum* (khumkheel), *Stipa species* (nariin uvs), *Urtica species* (Khalgai), *Gentiana azura* (khukh degd), and *Rheum species* (Gishuune/Tsoorgono).

By location/lifeway. There was no significant difference (p value=0.39) in the number of plant listing among herders in the four baghs. Herders in Tsetserleg (aimag center) listed more plants (99 plants) than those in the other three baghs followed by Khan Undur (81 plants) and Azarga (75 plants) baghs. Herders in Bayangol bagh listed fewer plants (62 plants) than those in the other three baghs. Common livestock forage plants listed by herders in all four locations include *Stipa species*, *Elumus chinensis* (khiag), *Gentiana azura* (khukh degd), *Pulsatila ambigua*, and *Artemisia frigida* (agi). Plants with greater CSI listed by herders of the four baghs are shown in the table 2.

Herders in the Tsetserleg emphasized that 9 of the totals listed of 97 plants are livestock forage plants, 33 are medicinal, 12 are for human use. Participants in this bagh observed the growth trend of the only 25 plants and 16 (4 plants-livestock forage, 6 plants-medicinal, 10 plants-human used) of these plants are decreasing and 9 are increasing. Herders in Khan Undur listed as 39 livestock forage plants, 25 medicinal, 22 plants for human use out of 81 plants. They also observed the growth trend of the 19 plants, of which 13 (5 plants-livestock forage, 7 plants-medicinal, 1 plant-human use) are decreasing, 6 are increasing. Herders in Azarga bagh listed

27 plants as livestock forage, 19 medicinal, 16 plants for human use out of 75 plants. They also observed the growth trend of the 17 plants (8 plants-livestock forage, 5-medicinal, 2-human used), of which 15 are decreasing, 2 are increasing. Herders in Bayangol bagh listed 18 plants as livestock forage, 8 medicinal, 10 plants for human use out of 62 plants. They also observed the growth trend of the 10 plants, of which 9 (5 plants-livestock forage, 3plants-medicinal, 1 plant-humanuse) are decreasing, one is increasing.

Discussion [Conclusions/Implications]

Overall, plant knowledge did not vary by age or location but differed by gender. Women have more knowledge of plants used for human purposes, reporting that 32% of the listed plants are for food or other uses, 27% for medicine, and 18% for livestock forage. In contrast, men reported that 38% are livestock forage, 34% are medicinal, and 26% are for human use. Men noted a decline in forage plants like *Festuca lenensis* (Botuuli) and *Allium scheonoprasum* (khumkheel), while women observed plants used for human purposes, such as *Thymus gobicus* (ganga), used for washing hair and burning as incense. Both men and women noted an increase in *Artemisia dracunculus*, along with other weedy species such as *Artemisia macrocephala*, *Chenopodium album*, *Urtica species*, and drought-tolerant *Stipa krylovii* (shivee) which observed by men. Our findings suggest that women are more likely to mention food and medicinal plants, while men focus more on forage plants. Men typically manage livestock grazing, while women handle domestic chores like child and elder care, food preparation, and dairy processing, reflected in their responses. Due to an unbalanced sample (men = 24, women = 6), our conclusions are preliminary.

There was no significant difference in the number of plants listed by the three age groups ($p = 0.13$). However, younger herders listed fewer plants than older groups. Younger herders did not mention plants like *Festuca* (botuuli), *Oxytropis myriophylla* (tagsh), and *Rheum species* (gishuune/tsoorgono), which older herders listed. These plants, important for livestock forage, are declining due to climate change and overgrazing (Khishigbayar et al., 2014; Gantuya et al. 2021). Young herders, traveling by car or motorbike, have less opportunity to gather plant knowledge and observe the environment. They noted growth trends for only 16% of the listed plants, while middle-aged herders (41-60 years) observed 36%, especially more forage plants. Older herders listed more plants but observed fewer growth trends, likely due to moving to soum and aimag centers, limiting their ability to track environmental changes.

Common livestock forage plants listed by herders in all four locations include *Stipa species*, *Elumus chinensis* (khiag), *Gentiana azura* (khukh degd), *Pulsatila ambigua*, and *Artemisia frigida* (agi). We expected herders in remote areas to have more detailed plant knowledge. While Tsetserleg (urban) herders listed more plants overall, they mentioned fewer forage plants and more medicinal plants than other baghs. Herders in Tsetserleg observed a greater decline in plants used for human purposes (e.g., pine nuts, willows, wild berries) compared to forage and medicinal plants. Many older participants had moved to the aimag center (Tsetserleg), taking their herding knowledge with them. Contrary to expectations, living in the aimag center didn't equate to a lack of experience, but this knowledge isn't being applied or passed on to younger generations (Peter et al., 2024). In contrast, herders in Azarga and Khan Undur listed more forage plants, with herders in Azarga and Bayangol observing a decline in forage plants, where livestock population increased 3 times over the last twenty years. while those in Khan Undur noted a decline in medicinal plants.

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