Knowledge Co-Production Approaches to Understanding and Documenting the Role of Sound in Nomadic Herders' Life in Mongolia

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INTRODUCTION

Herding livestock is well known to be a livelihood which is nomadic and closely tied to nature (Levin 2010; Fijn 2011; Reid et al., 2014; Post 2017, 2022; Fernández-Giménez et al., 2017). Herders around the world have been the caretakers of natural areas for thousands of years, and are thus local knowledge holders that understand how to care for their livestock and families in highly variable rangeland environments. In Mongolia, the concept of Nutag is strong – it is defined as the connection of the culture of herding to the birthplace and to the place where herding is done. It is one of the important lenses by which one needs to understand herding in Mongolia. Additionally, sound is an important lens as it is the fabric of herder culture in numerous ways. Many sounds of nature are important indicators of environmental change (Post, 2022); for example, the first cuckoo song and the sounds of ice breaking are used to determine the timing of moving a family ger or *khot ails* (union of livestock keeping families (Bold, 1996). In addition to sounds of nature, herders have a variety of expressive sonic forms that are part of their culture. Songs of praise (Post, 2019), another key cultural feature, are made to the spirits of natural world to give thanks to the land (e.g., soil and grass) and sky (e.g., rain) that provide the necessary resources for herders to survive. Long songs of herders (Yoon, 2018) tell stories about the love of nature, country, parents and their birthplace, and thus embed important knowledge about life and of place. Herding livestock also requires a means to communicate to livestock (Hutchins, 2019). Herders do so using hundreds of sonic practices (e.g., calls, whistles, simple words) that have been have been passed on through generations (Fijn, 2011). Sonic practices are recognized as a key multi-species communication aspect of herding culture. In short, herding traditional knowledge can help us to understand how people live sustainably in highly variable environments such as rangelands. Understanding how culture is tied to nature and place through senses, we argue, is vitally important if the practice of herding is to be sustained.

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There are several well-known threats to the sustainability of herding throughout the world (Reid et al., 2014). In Mongolia, the rangeland condition has been decreasing, as measured by western scientific methods and local herder observation. Causes of grassland decline presented in the literature include: overgrazing, climate change (especially decreasing rainfall amount or the increasing variability in timing of rains), supply-chain economics, and local to national agricultural policies. Other threats to the sustainability of herding in Mongolia mentioned in the literature (Sneath, 2003) include migration to cities, transition from a fully nomadic lifestyle to a partially nomadic lifestyle (e.g., winters are spent in cities and herding is practiced in spring and summer), mining (Bumochir, 2019), and transitions to cropping as a means of food production.

A group of scholars from many interdisciplinary areas such as cultural anthropology, rangeland ecology, systems ecology, soundscape ecology, ethnomusicology, and remote sensing, have recently embarked on a project to understand and document the role of sounds in Mongolian herder communities. All scholars have worked within and across two or more disciplines most of their entire careers. Together, the group includes experts that have a long history of working in Mongolia to a few that have worked in other areas of the world and bring their expertise to the team. These scholars are from the United States and Mongolia, as well as herders and community leaders living in four *baghs* of the Arkhangai province of Mongolia. To honor and recognize the role of local knowledge holders, we have officially adopted the term "Nutag Researchers" for those members of our team that are local to Arkhangai. The main aim of the project is to understand the role of sound in coupling people and nature in the herding lifestyle. We endeavor to identify whether any of these couplings are becoming uncoupled and also discover together how local knowledge holders can suggest solutions that aim to recouple important components of pastoralist-rangeland systems in Mongolia. We argue that sound provides a clear means to understand culture and especially cultural linkages to the environment. To accomplish our research objectives, we have adopted the approach of co-production of knowledge, which is also known as co-generation or co-creation, which we summarize below.

OBJECTIVES

The objectives of this paper are to:

1. Explain our ethical stance when doing research on soundscapes and sonic practices in Mongolia with herder communities as a Mongolian-American research team.

2. Describe our research process in concept and practice, which is based on a co-production or co-generation approach to research, highlighting the role of the team's Nutag Researchers.

3. Discuss some cases of our co-production practice and some of the opportunities and challenges our team faces working together.

GUIDING PRINCIPLES AND OUR ETHICAL STANCE

We write this paper as scientists and humanists without a deep background in the theory or discourse in the broad field of ethics. Instead, we offer in this article as an outside view from scholars working closely with Mongolian herders and community leaders, seeking new understanding and feedback. In writing this paper, we explored the literature on the practical aspects of ethics and co-production of knowledge,

since this is the subject of our work. To date, we found that this literature (Caniglia et al., 2021; Guillemin and Gilliam, 2004; Page, 2022) is sparse and mostly conceptual.

Despite these limitations in our field and knowledge of the field of research ethics, we have developed a deep, practical, ethical stance during our long experience working across disciplines with (and for) local herding communities in Asia, Africa, and the United States. This stance has two main strands:

> First, we object to the practice of extractive science/research, where foreign (local or international) scientists or researchers "helicopter" into field sites and extract information from local families, then leave and never return that information. Our stance is that this is unethical. Our approach here attempts to start to correct this long-standing practice in natural sciences and sometimes in social science research.
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> Second, we object to the over-empowerment and dominance of the western science/researcher voice and knowledge in research. Here, we seek to treat herder knowledge as equal to and often superior to our own. Our approach here attempts to also correct this practice.

The conceptualization of knowledge of our team is illustrated in Figure 1. Here we emphasize four main cross-cutting themes of our work: (1) an inter- and multi-disciplinary nature of knowledge integration; (2) the important role of Nutag Researchers as local holders of knowledge which may be similar to or different from Western scientific knowledge; (3) the important process of knowledge co-production that combines, or allows for contrasting, knowledge sources; and (4) the need to form ethical principles that create trust and mutual understanding.

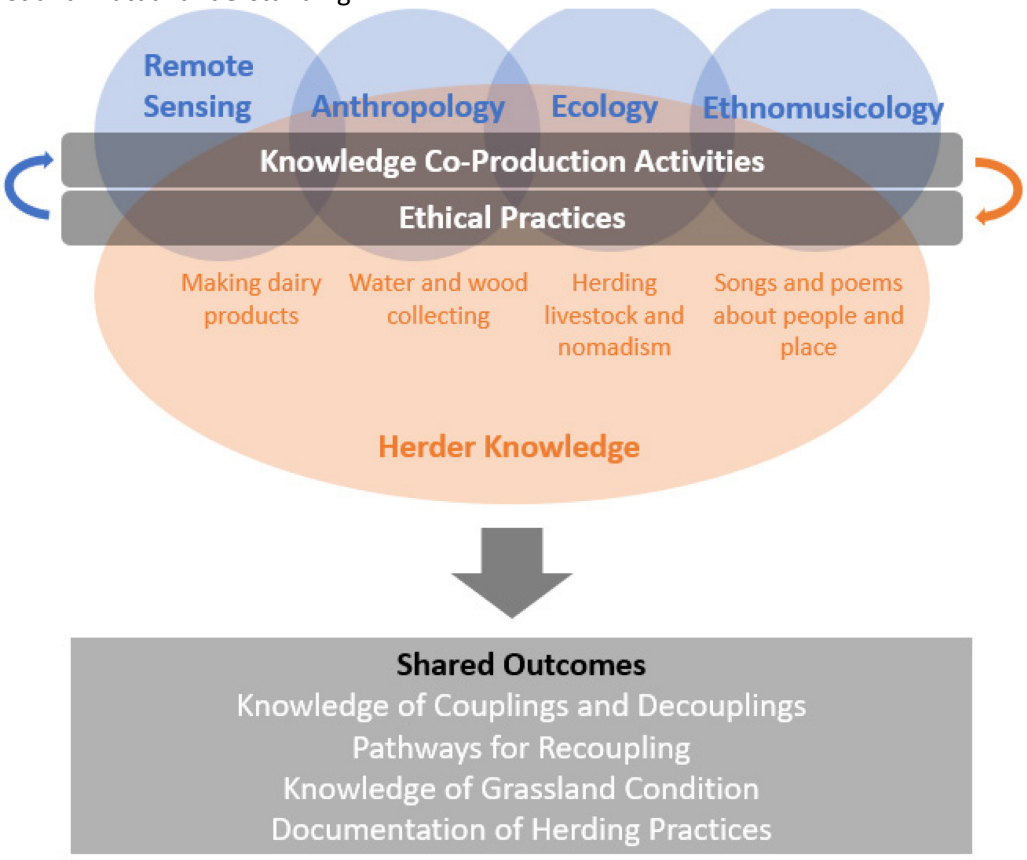

Figure 1. Knowledge spaces (blue and orange) and processes (gray) for knowledge co-generation. Knowledge of herders is likely to be greater that those from academic backgrounds and so it is larger. Example knowledge spaces shown here for herders represents a small list of potentially many areas of important knowledge.

Below, we describe our approach to conducting research in a way that aligns our work to these two main ethical strands.

METHODS

1. Coproduction/Cogeneration of Knowledge: Background

Like much of the current wide-ranging literature, we call our practical process co-production or co-generation of knowledge (Kassam et al., 2018; Wyborn et al., 2019; and Nordstrom et al., 2020). This process is defined as the creation and negotiation of existing and new knowledge by a broad range of actors in society, both inside and outside of academia and research (Nordstrom 2018). Coproduction is usually inter-disciplinary and problem-focused, and often linked directly with action by societal actors at the local, national, and/or international levels.

Coproduction is a new way of describing an old process. This process grew from a long history in anthropology, development studies, and medicine, and a more recent history in natural science (Knapp et al., 2019). Today, the reasons that teams engage in this process are diverse (Chambers et al., 2021). Some teams are researching solutions to problems in response to policy issues or community needs. Others aim to empower local voices so that they are heard by those in power. Other groups work through this process to broker or reframe power. And yet others are navigating differences among different actors or reframing agency and who makes decisions.

Around the world, pastoral communities, government officials, and researchers are building partnerships to pursue coproduction of knowledge in rangelands (Reid et al., 2021). An analysis of six cases in Asia, Africa, and the US showed some common processes in which these partnerships engage. The foundation of these partnerships is building collaborative relationships and defining issues to work on that pastoral communities and researchers co-identify. During the whole process of coproduction, these partnerships engage in a deep process of negotiating and sometimes integrating their different knowledges. At the heart of the process is social learning, about knowledges, issues, power, and politics. Often these partnerships build a great deal of capacity among all their members, they build strong networks, and sometimes they implement an action they identify.

2. Study Sites

We decided to conduct our research in the province of Arkhangai, one of the locations that a member of our team (Fernández-Giménez) has studied for over 30 years. Arkhangai is one of 21 Mongolian provinces (also known as an aimag) and is located in the center of Mongolia. Tseterleg is the capital of Arkhangai aimag. The region is well known for its production of dairy products, including milk tea, yogurt, butter cream, and airag (fermented mare's milk).

We hypothesized that herders that are closest to urban centers are more likely to transition from nomadic herding practices to ones that are either hybrid (e.g., some forms of sedentary practices) to leaving herding all together and that herders that are far from a soum center are likely to maintain more traditional herding practices. As such, we selected a gradient of four baghs – Tseterleg, Khan Undar, Bayangol and Azarga -- to consider as separate communities that we would compare to understand key cultural-environmental couplings, decouplings, and potential recouplings.

3. Building Our Co-Production Team (May 2022)

In May 2022, our "Team Building Group", composed of one researcher from the US (MFG) and two from Mongolia (CJ and BI), conducted meetings with two soum governors in Arkhangai to present an overview of the project, including its objectives and general approach of knowledge co-production. Both soum governors suggested that working groups be formed that would include current and past bagh governors, cultural center directors located in each of two soum centers, and regional scientific institutes located in the aimag center of Tseterleg. In total, over 30 herders and community leaders were identified by working group leaders as potential participants. Our Team Building Group then met with each of the potential local members to describe our project and gage interest. Nearly all herders and community leaders expressed interest. To follow up and build a cohesive team, we scheduled a workshop for the first week of June 2022 to design our study using potential approaches and tools (e.g., passive acoustic sensors).

As all members of the US team were not able to travel, four of them were updated on a semi-regular basis (about every five days) using Zoom. These meetings allowed the US team members to learn about advances, provide input on what we were learning, and also suggest new ideas to consider for research and shared outcomes.

4. Design Workshop: Using Knowledge Co-Production for Study Design and Shared Outcomes (June 2022)

Our project design workshop was held over a 1.5-day period where each herder, herder couple, or community leader was either picked up and driven to a ger camp in Ikhtamir or drove themselves. The first day of the design workshop was initiated by the local soum governor who officially recognized the project as a local project. The US-Mongolian research team made several presentations about the expertise and equipment we had available to do research, provided a summary of the scope of the work (e.g., original research hypotheses that we presented to our funders), and facilitated discussions about how Nutag Researchers would like to conduct studies and what shared outcomes were desirable.

During the workshop, we described how we use passive acoustic recorders to record sounds of a place, how we use drones to create maps of habitats (grasslands, forests, wetlands), the forms of interviews that we could use (e.g., soundwalks, sound mapping), plant survey equipment and methods for assessing rangeland condition, the use of audio recording equipment (e.g., parabolic microphones) to record specific sounds, and how we use DSLRs and 4K video cameras to document people and place.

In short, the Design and Shared Outcomes Workshop led to the following study design which was co-produced:

Passive acoustic recorders (PARs). We used 24 high-end Wildlife Acoustics Song Meters (SM4s) that we set to record for 10 mins per hour in CD quality audio (in .wav format). The US-Mongolian Team members had set a priority of placing one sensor each in a forest, a grassland area, and a riparian area (in some cases these were forest galleries and in other cases these were grassland sites along rivers). Nutag Researchers suggested our site selection expand our grassland category to record in degraded grasslands and grasslands which represented the best grazing area in the bagh ("representative"). They also asked for recorders to be deployed near gers and in energy giving sites. For the latter, these sites were locations where herders go to listen to nature, get a sense of calmness and clarity of mind, which all are represented in the feeling Mongolians they call *khiimori* (translated literally as "air" "horse").

Nutag Researchers volunteered to help deploy sensors. Table 1 summarizes the types of sensor locations. Soon after the Design Workshop, two teams went out to deploy sensors. During site selection, interviews were conducted with the herders to fully understand the rationale for site selection. US and Mongolian team members also worked together to build fences around many of the acoustic sensors to protect them from livestock.

Table 1. Sensor location types

Name	Rationale	Source
Representative Grassland	Understand the types of sounds that occur at sites that are "less grazed" using acoustic indices that reflect biological diversity	US-Mongolian Team Members/Nutag Researchers
Degraded Grassland	Understand if the sounds of a degraded ("more grazed") grassland can be used as an indicator of health comparing these to representative grasslands	US-Mongolian Team Members/Nutag Researchers
Representative Forest	Understand how forest biodiversity differs from grassland biodiversity and how forest structural complexity gives rise to animal diversity. Livestock graze these areas, most often during winter	US-Mongolian Team Members
Riparian Area	To understand if riparian areas differ from grasslands and forests and if acoustic information can be used to assess the condition of these habitats	US-Mongolian Team Members
Near Ger Camp	To record the sounds of livestock leaving in the morning and returning in the evening but also record the other sounds of herding life that might include motorcycles, cars, etc.	Nutag Researchers
Energy-giving Sites	To record areas that are rarely grazed and/or have trees harvested that are important culturally and for herder health	Nutag Researchers

Rangeland Condition Assessments. Herders and community leaders were very interested in knowing what the condition was of their grasslands and so a group of plant ecologists, including a local, Mongolian expert botanist, conducted plant surveys at nearly all of the 24 sites (two were excluded as these were at the tops of mountains). A drone used in agriculture and forestry research and monitoring, was flown over all of the sites as well creating maps of surface height and color reflectance, at 1cm x cm

pixel sizes. Herders had also expressed a heightened interest in the plant survey group in identifying a plant species that was poisonous to livestock and knowing the cause of its recent increase across the region.

Documenting the Herder Work Activity Sounds. One member of the US-Mongolian Team (BI) led a portion of the workshop on day two that focused on Nutag Researchers providing examples of activities of their daily lives that were important part of being a herder and what sounds were produced and how these sounds were changing. A list of 15 daily work activities were identified and these were then organized into 7 groups. Three were selected for high priority: (1) milking and making milk tea; (2) making other dairy products such as yogurt and cheese; and (3) harvesting wood. After the Design Workshop, several US-Mongolian team members visited herders who volunteered to contribute to video and audio documenting of specific work tasks. In all, over 120 short videos were made inside gers and also within the ger camp. Interviews were also conducted that documented specific practices and also what these practices meant to the herder. Several other b-rolls were made to enhance the story (drone flights over ger camps, forests and livestock, local rivers flowing, etc.). One member of the team (MFG) developed a storyboard for the first video montage and this was used by a US film maker to create a pilot mini-documentary.

5. Feedback-Dialogue Workshops: July 2022, May 2023, June 2023.
We also conducted feedback-dialogue workshops where several members of the field team visited each of the four communities separately in July of 2022. Here, we presented some of the preliminary results from the plant surveys in each of our study plots, provided sample videos that were collected for the mini-documentaries, showed sample drone imagery (videos and habitat maps) and also shared photos of US-Mongolian and Nutag Researchers working together in the field. In May of 2023, CJ gave a presentation at a large community gathering of women herders in Undur-Ulaan, where she shared more detailed results of the plant surveys with summaries of conditions of each site. In June of 2023, at the same Design and Shared Outcomes workshop venue in 2022, the US-Mongolian team presented results from the analysis of the passive acoustics data and showed the first mini-documentary to the Nutag Researchers. We presented all of them with a thumb drive that contained: (1) photos of wildlife and habitats in their communities; (2) videos from drone flights; (3) photos of people working together in the field (4) the mini-documentary. All items are playable on standard TVs that have a USB-A port.

KNOWLEDGE CO-PRODUCTION CASES: ILLUSTRATIONS AND CHALLENGES

A. Degraded Grassland Case

When we approached the herding communities in Arkhangai in 2022, we initially spoke about measuring sound and sonic practices. We also had the ability on our team to look at rangeland health. Herders were initially very interested in all these topics, so these were some of the foci of our initial research together.

More broadly in the academic literature, there is a global conversation about whether or not rangelands are degraded by pastoralists, which has been a subject of discussion for decades. Our team has participated in this discussion over many years, collecting information about this from herder observations, plant measurements, and remote sensing data (e.g., Fernández-Giménez et al., 1999; Fernández-Giménez et al., 2017; Jamsranjav et al., 2018; Jamsranjav et al 2019). In general, we try to avoid the word ‘degradation’ because of its value laden nature, preferring to talk about either rangeland

health or areas that are more or less grazed. And then we let the herders and the plants speak for themselves.

Our conclusions from this work so far have been that the idea that rangelands are highly degraded worldwide is not accurate (Reid 2012; Reid et al., 2014). However, we have seen cases of heavily grazed and hard to restore rangeland areas. And with intensifying climate change, like our Nutag Researchers, we are observing this more and more.

After measuring sound, plants and soils together in these more and less grazed grasslands, our lead Mongolian ecologist (and coproduction leader) brought the information back to the communities right away. In discussing those results, she presented the scientific numbers, which showed that most of the sampled grassland was moderately "degraded", with a few places more 'degraded'.

But more importantly in these discussions, she described the results in a way that has more meaning to herding communities. She did this to not only communicate, but was aware that our Nutag Researchers would then be discussing the results more widely and wanted them to have some examples that would make sense from a herding perspective. For example, she told a story about how the loss of rangeland health affects livestock. She described how livestock used bite once, then chew before swallowing the grass, but today they are biting 3 to 4 times before chewing because the grass is shorter from previous grazing and changes in plant species. Thus, they were taking in less grass and growing less quickly.

Another way she described the results was about how grazing affects plants. She talked about how livestock have offspring in the spring and then the herds grow. She then said it is the same with plants, they have offspring, or seeds, in July or August. If the plants are grazed too heavily at the time, they won't have enough offspring and will not be able to grow in a robust way.

In early June 2023, we held a feedback workshop with herders to discuss our joint results. At the end, we asked our Nutag Researchers what they had learned from the project. Many commented that they learned that their grassland was less healthy than they had thought. Our lead Mongolian ecologist continues to discuss our joint results in various meetings including a major Arkhangai Women's Conference and smaller community meetings. We are also providing our Nutag Researchers with all of the information from the project so that they can present that information to other community members and to local and regional government officials. Our Nutag Researchers said they are delighted to have such information because it allows them to have stronger conversations with others within and outside their communities and to discuss the need for action more clearly. The actions they are discussing are taxing livestock more fairly at the individual level and working to get better prices for livestock which would allow them to reduce their herd sizes.

B. Sounds of Herding Activities

During our second knowledge co-production workshop, we asked for feedback on how our work recording and co-discovering the role of sounds (natural and expressive forms) was valuable to the community. Herders commented that although sound was always an important part of their daily lives and connection to nature, this project increased that awareness and also the importance of sound, in general, to their livelihoods. Our partners who are cultural center directors were especially appreciative of our work on recording local songs as these are ancient traditions that they worry may be lost. In addition, they also commented that by recording formal and informal (i.e., camp fire songs after dinner) local songs, if integrated into multimedia stories, they could showcase to the world the excitement that

many have about what they consider to be a noble profession. Several members of the co-production team worked to develop short video clips that would tell each story. A draft montage has now been produced by a professional film producer and shown back to the herders for comments on how to improve the montage. The Nutag Researchers had several comments on the mini-documentary and we are in the process of working to make those changes. Nutag Researchers have commented that they would like to have more frequent interaction and they have suggested that we create a Facebook page and use chat and other features to continue the dialogue. At present, we are exploring other technologies that would facilitate knowledge-production while the US team is back home and with 12-to-15-hour time differences.

C. Sounds of Nature and Khiimori

In June 2023, we conducted 13 interviews with herders exploring how the experiences of listening to natural sounds affects their lives. A set of interview questions focused on (1) describing sonic features of a natural place in their Nutag, (2) types of sounds of that place and what they mean, (3) personal reactions to the sounds of the place, (4) how often and why these places are visited, and (5) how these places have changed since they first visited and what the future might be of these places. Our preliminary assessment is that they often experience raised *khiimori* (a feeling of relaxation, calmness, and personal confidence); that many of the places have changed mostly due to climate change which has resulted in reduced water flow and thus less sounds of relaxing water; and that they believe that because these are important places in the community, herders will do what they can to protect them in the future. When asked if these natural sounds make them a better herder, they answered yes almost all of the time. The US-Mongolian and Nutag Researchers are now working on a typology of these natural places and they have many common elements but there are clearly some that are only visited by family, some are visited by groups of families, and others visited by most members of the bagh. When asked what they would like to know about us, most are interested in whether we have the same experiences with nature, what/where are Nutag is and what it is like, and what kinds of spirits we believe in.

D. Challenges

We have identified several challenges that we must overcome in order to co-discover ways to understand decouplings in this pastoralist-rangeland system and to suggest robust ways for recoupling in this system. The first is that this kind of work, that involves many individuals from distance places and from different areas of expertise, needs large funding resources. Second, to maintain trust building, work needs to be long-term. Third, social media and other technologies need to be leveraged to create a potential co-production integration platform that brings people together in different parts of the world working in very different time zones. Fourth, team members from the US have limited Mongolian speaking skills. As such, we have relied on one key individual (a US trained, Mongolian scientist) to work through complex logistics with our Nutag Researchers. We have also resorted to having translators with us and we know that some of the more technical terms from both US and Mongolian speakers reduce our ability to work very effectively. Finally, this conference has brought to the surface some very real and important ethical considerations that we must, as a group, explore more deeply in the future.

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We would like to first acknowledge the time and thoughtful input of the Nutag Researchers of our team. They now number over 40 in four different communities. We have been inspired by their engagement and honor their commitment to the noble profession of herding. The four co-authors wrote this paper during a very brief break from field research in June 2023. Regrettably, we were not able to include all of the US-Mongolian team members on this paper nor any of the Nutag Researchers. A future version of this paper will be fully inclusive and we hope the list of co-authors on this future paper will be numerous. More specifically, we wish thank Maria Fernandez-Giménez (MFG), Laura Zanotti, Jennifer Post, Tim Keitt, Byambabaatar Ichinkhorloo (BI), and Francisco Rivas.

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