Ecological Calendars for Climate Adaptation in Savnob and Roshorv, Bartang Valley, Tajikistan

A Thesis

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by

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ABSTRACT

This thesis presents elements of ecological calendars and perspectives of climate change in the villages of Savnob and Roshorv, in the Bartang valley of Tajikistan in the Pamir Mountains. This body of work serves as preliminary research for the Ecological Calendars for Climate Adaptation in the Pamirs project, led by Dr. Karim-Aly Kassam at Cornell University and funded by the National Science Foundation and the Belmont Forum. Fundamentally, this research addresses issues of food security in subsistence communities in the context of climate change, while acknowledging the critical role of ecological knowledge holders in building adaptive capacity for future change. Past scholarship on traditional ecological knowledge, feminist political ecology, decolonial methodologies, indigenous feminisms, and critical ethnography have informed the research methodologies and analysis. I use Kassam's (2009) Human Ecological Lens as a tool in analyzing areas of complexity and nuance in this research: diversity of knowledges, microclimate and biological diversity, contexts of Soviet history, and embodied knowledge. I look towards a Decolonial Feminist Political Ecology framework (Rocheleau and Nirmal 2015) in situating future research.

BIOGRAPHICAL SKETCH

Talia Chorover grew up in California, central Pennsylvania, southern Arizona, and the coast of Maine. Talia's affinity for diverse landscapes led her to study geology and environmental studies at Oberlin College. During college, Talia spent a semester on the Big Island of Hawai'i, where she became interested in traditional ecological knowledge and indigenous land use practices for biodiversity conservation. After graduating with a BA in 2013, Talia worked as a park ranger at Katmai National Park in Alaska, as a biological science technician for the National Park Service in the Sierra Nevada backcountry of California, as an environmental project consultant for Clean Water Action in Boston, and as a Montessori teacher's aide. In 2016, Talia began her Master of Science graduate work in the Department of Natural Resources at Cornell University with a focus on community-based natural resource management. Talia's future plans include working in biocultural diversity conservation, hiking in the mountains, and swimming in the ocean.

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I dedicate this work to the women, men, and children of the Bartang valley. I am endlessly grateful for the help and friendship of our community research partners and translators in Savnob and Roshorv: Tohir Saradbekov, Shahlo Saradbekova, Saradbek Tohirbekov, and Topchibek Bekov. Thank you to Saradbek, Mulkabek, Mamadsho, Anifa, Hamruz, Zubujin, and their families for keeping us nourished, and to everyone we met for making us feel at home in the Bartang. We could not have done this without them.

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PROJECT BACKGROUND

This thesis work is in contribution to a larger project, Ecological Calendars for Climate Adaptation in the Pamirs (ECCAP), funded by the National Science Foundation and the Belmont Forum, led by Dr. Karim-Aly Kassam, Professor of Environmental and Indigenous Studies at Cornell. The overarching project objective is to build anticipatory capacity for climate change among mountain communities in the Pamirs through the revitalization of ecological calendars. The ECCAP project works with communities in the Shugnan valley of Badakhshan, Afghanistan; the Alai valley of Osh Province, Kyrgyztan; the Tashkurgan valley of Xinjiang, China; and the Bartang valley of Gorno-Badakhshan, Tajikistan.

During the summer of 2017, Kayla Scheimreif, another masters student working on the ECCAP project, and I conducted fieldwork as a team at our field sites in Tajikistan and Kyrgyzstan. My thesis focuses specifically on our research in Tajikistan, in the villages of Savnob and Roshorv in the Bartang valley, while Kayla's thesis focuses on research in Sary Mogol in the Alai valley of Kyrgyzstan. In the future of this project, our research will be integrated with our international collaborators' research (Dr. Cyrus Samimi, University of Bayreuth, Germany; Dr. Jianchu Xu, Kunming Institute of Botany, China; and Dr. Antonio Trabucco, Euro-Mediterranean Center on Climate Change, Italy), whose teams are focusing on climatology, plant phenology, and crop modelling, respectively.

INTRODUCTION

Ecological calendars are systems of telling time in relation to indicators in the environment. These indicators, such as the thawing of a particular body of ice or the emergence of a flower, are sometimes used as cues to inform local livelihood activities, such as moving livestock to higher pastures or planting a crop. Ecological calendars consider time in respect to local ecology, rather than as a fixed commodity separate from the oscillations of the seasons. Therefore, ecological indicators are dynamic: they are phenomena that are influenced by environmental change and are therefore markers of change in and of themselves. Because ecological calendars are relational, highly adapted to local conditions, and have a dynamic relationship with seasonal and microclimatic variation, they can be used to inform agriculture and livelihood activities at the scale of village or valley. Ecological calendars are ever-changing systems of knowledge and therefore retain an inherent adaptive capacity (Kassam et al. 2018).

Ecological calendars can take many forms, have a variety of applications, and are found in communities across the world. The Tukano people of the northwestern Brazilian Amazon, for example, use an ecological calendar to sustain fisheries based on river levels, plant phenology, and astronomical events (Cochran et al. 2015). On Torres Island in Vanuatu, people use the combination of prevailing winds and the emergence of a sea worm to indicate times of ritual and celebration (Mondragón 2004). In another case, Aboriginal communities in Western Australia use seasonal indicators to plan for land management activities, such as prescribed burns to promote ecosystem health (Prober et al. 2011).

My project aims to better understand current use of ecological calendars in the Pamir Mountains of Tajikistan, specifically in the communities of Savnob and Roshorv in the Bartang valley. Both oral and archival evidence show that Pamiri ecological calendars have been used in the

Bartang valley for over 600 years, and have taken the form of a "Calendar of the Human Body" (Kassam et al. 2011). However, as a result of Soviet occupation, collectivization of agriculture, and the subsequent civil war in Tajikistan, knowledge about ecological calendars in the Pamirs has been lost (Kassam et al. 2011). According to archival sources, "Calendars of the Human Body" conceived of time as situated literally within the body, where the body was used as a calendar to count time. A community leader and keeper of time, called a *Hisobdon*, would define the phase changes of the calendar for his community, based in the context of the local ecology. When the sun was felt in the intestines, for example, this would represent the coming of spring, avalanches, and hunger, and when sun was felt in the heart it would indicate the presence of the vernal equinox, depending on what the local *Hisobdon* would determine (Kassam et al. 2011). These calendars were highly adapted to unique ecological habitats and were therefore not standardized across the Pamirs (Kassam et al. 2011).

As climate change continues to accelerate, cultures, ecosystems and food systems are losing their capacity to adapt to environmentally- and anthropogenically-driven changes. As we move into the 21st century, we are faced with a climate crisis driven by systems of multi-scale complexity that requires holistic models of climate change adaptation (Ogden et al. 2013; Steffen et al. 2011; Walker et al. 2009). Communities that rely on subsistence livelihoods, such as the communities in the Pamir Mountains of Central Asia, are being negatively impacted by anthropogenic climate change, while nations that are contributing the most to climate change remain the least affected (Figuera 2011; O'Brien and Leichenko 2000; Ogden et al. 2013; Steffen et al. 2011). Contemporary climate science has focused primarily on global-scale climate models and broad adaptation strategies, but climate change is having dramatic effects at the local scale (Kassam 2009; Pierotti 2011). Communities in the Bartang valley of Tajikistan are witnessing rapid glacial melting and subsequent loss of agricultural land, increased intensity of rainfall, loss of cold days necessary for fruit vernalization, less abundance

of fodder, and variable seasons that cause fluctuations in the timing of ploughing, planting and harvesting (Kassam et al. 2011). Thus, there is an increasing need for localized approaches to climate change adaptation for food security in the Pamirs.

Climate change is predicted to continue to greatly affect the high Pamir Mountains of Central Asia. Overall temperature is expected to increase, causing anomalous heavy precipitation and heat (Zahid and Rasul 2011), rapid glacial melting and an increase in variable weather events (Khromova et al. 2006). This climatic variability puts agriculture, livestock, and other livelihood activities at risk (Lioubimtseva and Henebry 2009). Smallholder farmers and pastoralists in the Pamir region have acknowledged this increased variability in weather and climate patterns, which has led to general anxiety over the inability to plan effectively for livelihood activities. Due to increased climate variability in the region, Pamiri villagers have expressed a desire to revitalize their ecological calendars to build anticipatory capacity to climate change (Kassam et al. 2011).

While the greater ECCAP project conducts research that bridges contemporary climate science and traditional ecological knowledge to conceptualize a holistic, place-based approach to climate change adaptation in multiple sites throughout Central Asia, this thesis seeks to examine ecological calendars for climate change adaptation specific to Savnob and Roshorv, in the Bartang valley of Tajikistan.

In this thesis, I aim to answer the following questions:

1. What are the elements of ecological calendars in Savnob and Roshorv? That is, what are the linkages of biophysical indicators and human-ecological activities?
2. How is climate change perceived in Savnob and Roshorv?

As I was conducting my field research, it became clear that in order to answer the above research questions, I had to delve more deeply into exploring the multi-scalar factors that influence

ecological calendars. I realized that microclimatic and biological diversity within and among village ecosystems greatly influences the cues that people use to plan their livelihood activities. I also came to understand how complex social systems, such as sharing networks of crops and seeds, within and among villages, are inherently woven into ecological calendars and must be accounted for. I learned about the complexities of Soviet history and the remnants of collectivization on ecological knowledge systems. Additionally, my field research inspired a curiosity about the performative practice of ecological knowledge that is embodied and/or intuitive, rather than delineated and quantifiable.

Thus, I deepened my original research questions with the following inquiries:

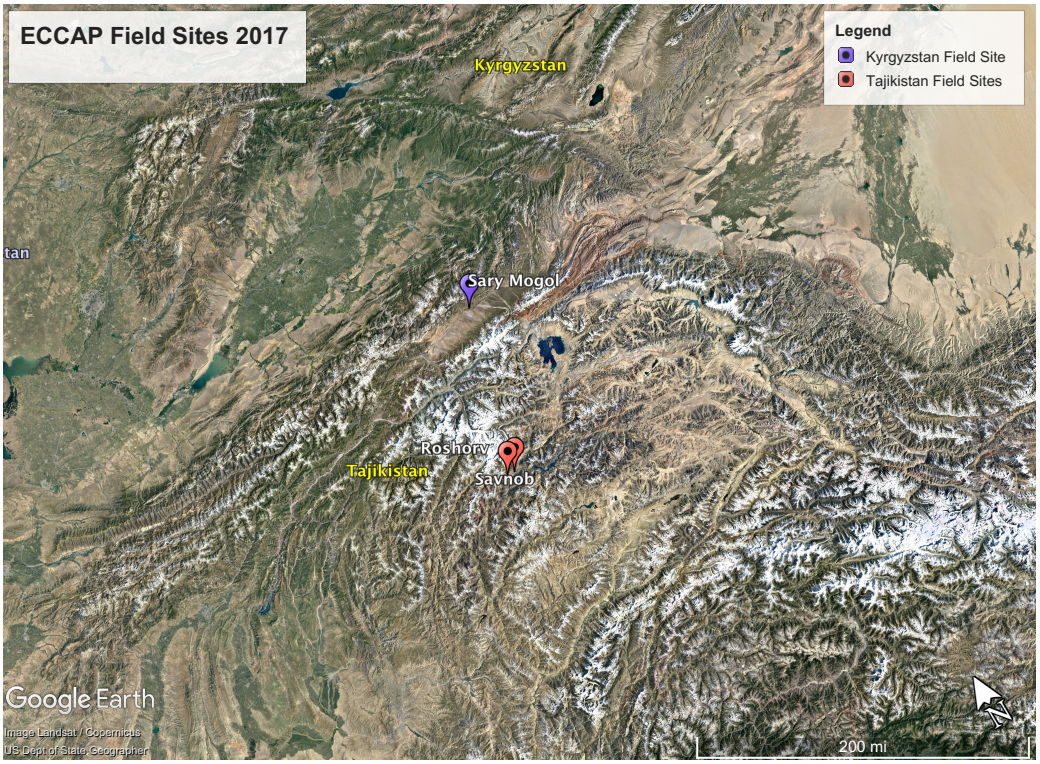
1. How does microclimatic and biological diversity influence ecological calendars?
2. How do social dynamics, like gender roles, community structures, and sharing networks, inform ecological calendars?
3. What is the role of embodied/intuitive knowledge in ecological calendars?

This exploratory and reflexive research process was influenced by Kassam's human ecological lens, as well as critical ethnography methodologies (Kassam 2009; Madison 2012; Marcus 1995; Sorge & Padwe 2015). These methodologies led me to adapt my interview questions throughout the fieldwork based on threads that emerged from workshops, semi-structured interviews, guided walks, and participant observation. New iterations of interview guides were crafted to include additional questions about microclimatic and biological diversity within and among villages in the Bartang and how these factors inform ecological calendars, how sharing occurs within and among communities (seeds, crops, work, knowledge), and how local history, including the transition to and from collective farming during the Soviet occupation, has affected food systems and communities in the Bartang.

CONTEXT

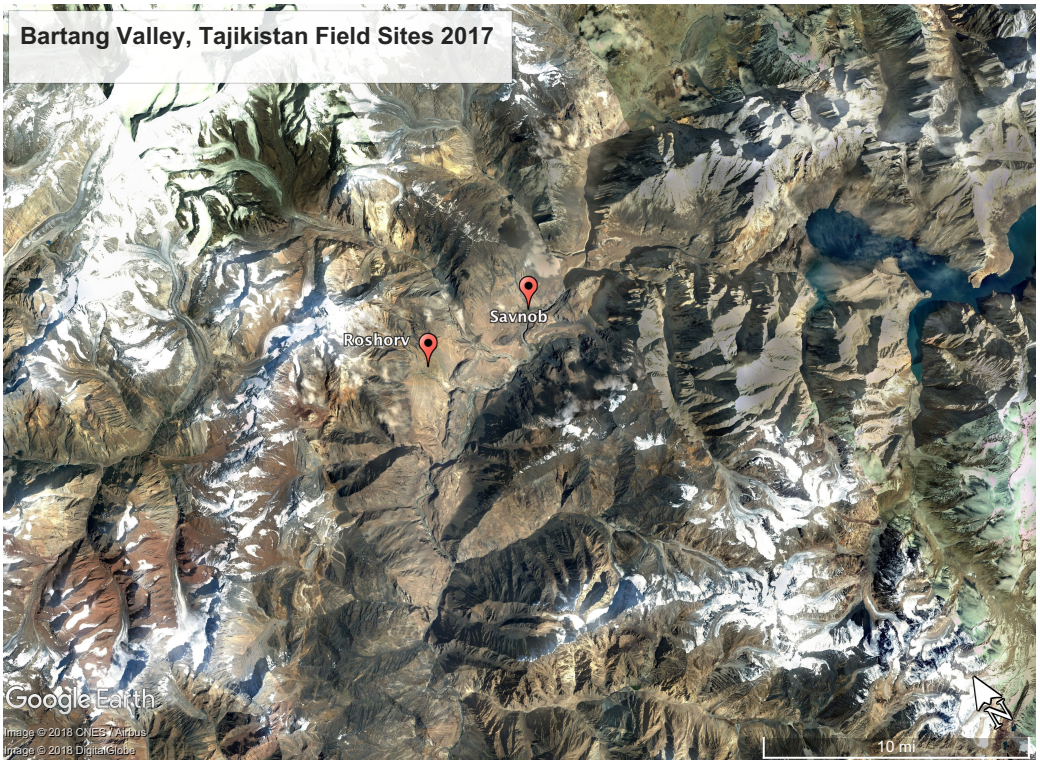
The Pamirs are a high mountainous region with peaks rising above 7000 meters. Five mountain ranges converge here to form the "Pamir Knot," or the "Roof of the World" (Middleton and Thomas 2008). Continued uplift of these mountain ranges at around 2 cm/year provides for dramatic terrain, extreme climate patterns, and relative geographic isolation (Hergarten 2004). Despite the extreme topography, the high valleys of the eastern Pamir and deep-cut valleys of the western Pamir have supported Indo-European mountain communities for at least 3000 years (Bliss 2006). For our fieldwork, fellow graduate student, Kayla Scheimreif and I worked as a team in Savnob and Roshorv in the western Pamir in Tajikistan and in Sary Mogol in the Pamir-Alai mountain range in Kyrgyzstan during the summer of 2017.

Figure 1:



The villages of Savnob and Roshorv are located in the Bartang valley in the Rushan district of the Gorno-Badakhshan Autonomous Oblast (GBAO) of Tajikistan. The Bartang valley takes its name from the river that carved it, whose swift waters create the largest tributary of the Amu-Darya in Tajikistan, which is reputed to be "the wildest of all of Western Pamir and remained the least accessible well into the twentieth century" (Bliss 2006). This narrow river valley is characterized by vertical cliffs on both sides, and most settlements occur in protected areas of river valleys, sitting on small cones of alluvial sediment above the Bartang river. The rugged river valleys and massive glaciers of the Bartang create conditions for rockslides and road washouts in the summer. Road access is sporadic and precarious during the summer season, and roads are often not open for the rest of the year due to snowpack.

Figure 2:



Alluvial deposits are the basis for farming in the Bartang valley. Despite the extreme topography, which constrains viable agricultural land, Bartangi communities subsist primarily on

growing food and fodder crops and herding livestock. Staple crops in Savnob and Roshorv consist of wheat and potatoes for food, and barley, peas and *gharj* (*Onobrychis* sp.) for fodder. Goats, sheep, cattle, donkeys, and yaks are the primary livestock animals.

Extreme weather and temperature swings are customary in the Bartang valley. This weather produces a cold, dry climate with sparse vegetation and thus limited resources for herding and pastoralism. Though the elevation of the Bartang valley makes for a short growing season, extreme weather is crucial for agriculture; maximum exposure to sunlight in the summers is integral for the short growing season, while the cold winters are necessary to preserve food.

The Pamir region of Tajikistan has a long history of being a crossroads for the passage of many ethnic groups (Scythians, Persian dynasties, Macedonian/Greek armies under Alexander the Great, Parthians, Kushans, Chinese, Huns, Hephthalites, Mongols, Arabs, Russians, Nestorian Christians, Jews and British) (Middleton and Thomas 2008). The mountain passes and valleys of the Pamirs are of historic significance: as passageways along the Silk Road, they played an important role in the cultural exchange and diversity of the region. Bliss (2006) notes that although the western Pamirs were along this route, the region likely acted as a transit area rather than a junction, so local communities in the region hardly profited from the position of the Silk Road.

Pamiri people represent a faction the Tajik ethnic group. While the term "Tajik" is used for all Persian-speaking peoples in the region of Iranian origin, Pamiris are an ethnic group specific to the Gorno-Badakhshan region of Tajikistan who were able to preserve their Persian culture and language due to their mountainous homeland terrain despite the westward movements of nomadic Turkic peoples led by Genghis Khan, Tamerlane and Babur (Middleton 2008).

From the 15th to 19th centuries, Tajikistan was under competing control by Uzbek dynasties until undermined by Russian conquest of Central Asia in the late 1800's. In the late 19th century, the Pamirs of Tajikistan were considered to have strategic importance because of their proximity to

China and British India, while residing in the confines of the Russian Empire. Hence, the "Great Game" began, wherein Russian and British diplomats, soldiers, and spies fought for control over the region. Tajikistan fell under Soviet rule in 1921 and remained a part of the Soviet Union until its independence in 1991 (Middleton 2008).

Tajikistan's independence resulted in the Tajikistani Civil War, which lasted from 1992-1997. During this time there were major changes in the political economy, development policies, and infrastructure that led mountain communities to have to adapt to challenging socio-economic conditions (Kreuzmann and Watanabe 2016). The control of the Soviet central government led Pamiri mountain villagers to embrace industrial improvements, such as the building of roads, the development of irrigation and hydropower, the introduction of new crop species, and the development of a subsidized system of food deliveries to mountain communities. During this time, most Pamiri villages were forced into collectivized farming, and had the majority of their food and other goods provided to them by the Soviet central government. By 1993, Pamiris were only producing 10-20 percent of their food locally (Bliss 2006; Middleton 2016).

Although Pamiri people did not have many civil freedoms during times of Soviet control, they had modernity. Soviet "improvements" gave Pamiri people relative wealth: the standard of living was high, many families owned cars and TVs, most larger towns had high schools and hospitals, there was a high rate of education, and agriculture had become mechanized (Bliss 2006).

Shortly after the collapse of the Soviet Union and the outbreak of the civil war in Tajikistan, the few travel and trade routes into the Gorno-Badakhshan Autonomous Oblast were bombed and Bartangi communities were effectively cut off from the rest of the country and from the global market economy. The civil war forced Bartangi communities to return to subsistence livelihoods, but Soviet rule had created a rift in knowledge about subsistence agriculture. Soviet influence had led to the occupation of knowledge systems and the suppression of indigenous languages and ideas. In

turn, Bartangi people were not relying on ecological knowledge for subsistence agriculture and pastoralism, so ecological calendars fell out of use (Kassam et al. 2011). After independence and as a result of the subsequent civil war, those who had been scholars, teachers, public leaders or agricultural engineers once again took up occupations as farmers and herders, many of whom had to relearn these skills (Bliss 2006).

LITERATURE REVIEW

This research is built on the conceptual tenants of the study of human ecology, which recognizes that human ecosystems are not separate from their environments, as both human and non-human agents influence and respond to the environments around them. Human ecology builds linkages between the biological and social sciences, promoting an understanding of the connections between biological and cultural diversity, often using what are considered to be traditional ecological concepts to describe human-influenced systems (Kassam 2009). The study of human ecology is anthropocentric by definition, as it is an attempt to epistemologically sew back together the nature/culture binary, which has always been interwoven but has been severed by the institutionalization and classification of knowledge (Kassam 2009; Rocheleau & Nirmal, 2015). In situating my research in the broader frame of human ecology, I engage in this act of "stitching up" the theoretical divide.

Research of traditional ecological knowledge rests on the pillars of human ecology scholarship. Here, I explore the linkages and dissonances of traditional ecological knowledge (TEK) and feminist political ecology (FPE) scholarship, and look at how resituating TEK within a decolonial feminist political ecology (DFPE) framework benefits research on ecological calendars in the Bartang valley. While the greater Ecological Calendars for Climate Adaptation in the Pamirs (ECCAP) project is focused on revitalizing ecological calendars by incorporating TEK and climate science for climate change adaptation, my thesis is focused on understanding current use of ecological calendars, perceptions of climate change, and the multi-scalar influences on ecological knowledge in the villages of Savnob and Roshorv, Tajikistan.

The contribution of this work is to bring together TEK and DFPE perspectives for a holistic study of the ecological knowledge situated in the Bartang valley. While TEK research sheds

light on how local ecological knowledge can be used for climate change adaptation, a DFPE framework can add depth by illuminating *why* and *among whom* certain knowledge persists. In this synthesis, I aim to explore not only the ecological, but also the social, political, and cultural structures that have impacted and continue to shape the use and transmission of traditional ecological knowledge in the Bartang valley.

Traditional Ecological Knowledge

According to Berkes, traditional ecological knowledge (TEK) research is a relatively new field of interdisciplinary study, predominantly emerging in the 1980s from the fields of human ecology and ethnoscience (Berkes 2012). Arguably the most commonly used and agreed upon definition of TEK was first conceived in Gadgil et al.'s (1993) seminal paper. That definition has been reworked and appears in its present form in the third edition of Fikret Berkes' book (2012), *Sacred Ecology*. For the purposes of this paper, I will turn to Berkes, a widely-cited scholar in the field. He defines TEK 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" (Berkes 2012). Berkes considers the word "traditional" in "traditional ecological knowledge" not to mean "static" or of the past, but rather a body of knowledge that is dynamic, with a focus on "knowledge as [a transmission] process" as well as knowledge as content. Given its dynamism, TEK is a system of knowing that is adaptive to changes and thus has an embedded mechanism for future adaptation. Although TEK often refers to indigenous ecological knowledge, it can also be used to describe local knowledge that has remained *in situ* for multiple generations (Berkes 2012).

Interest in TEK by policy makers, scholars, and the public surfaced largely in response to the tendency of Eurocentric scientific discourses to create artificial distinctions between science and

nature (Bateson 1972), and the propensity of economics, natural resource management, and ecology to be materialistic and utilitarian in nature, rather than holistic. TEK became a way of framing human-environment relationships as resource stewardship. Until recently, the integration of TEK with Eurocentric science was mainly used in areas of biological conservation and resource management (Ellis 2004; Gadgil et al. 1993; Huntington 2000). In the last decade, however, TEK research has begun to focus more specifically on integrative climate change adaptation strategies (Alexander et al. 2011; Berkes 2012; Joshi et al. 2013; Nakashima 2012). These publications often refer to the Intergovernmental Panel on Climate Change (IPCC)'s inclusion of the role of indigenous knowledge in their fourth assessment report (AR4), which states that "indigenous knowledge is an invaluable basis for developing adaptation and natural resource management strategies in response to environmental and other forms of change" (Parry et al. 2007). Other recent public policy documents that emphasize the inclusion of indigenous knowledge in policy decisions include the Kyoto Protocol, the ACIA, and the UNFCCC (Nakashima 2012; Smith & Sharp 2012).

An important factor in TEK research, and a nearly unanimous opinion in the world of TEK scholarship, is that TEK research must be collaborative and participatory, with local communities and outside researchers co-producing relevant knowledge for on-the-ground adaptation to environmental problems outlined by the community members themselves (Berkes 2012; Nakashima 2012). Berkes (2012) outlines three guiding methodological principles of TEK (which most scholars in this area agree on):

- TEK research must be participatory, and will fail if indigenous peoples are not treated as equals in collaboration;
- Indigenous knowledge as written accounts will always be incomplete, because "the written page will never be an adequate format for the teaching of indigenous knowledge;" and
- Both the researcher and reader of TEK "have to be prepared to question her or his own values, to be reflexive, and to be prepared to "unpack" one's own values before unpacking

those of the indigenous culture in question. As such, cross-cultural sensitivity is at the heart of all research and understanding of traditional knowledge."

There is a critical need for climate change adaptation research to be place-based, flexible and adaptable to future change. A number of contemporary scholars have shown that merging TEK with climate science poses possibilities for local, fine-grained solutions to climate change adaptation and food security (Agrawal 1995; Alexander et al. 2011; Berkes 2012; Gadgil et al. 1993; Kassam 2009; Nakashima 2012; Pierotti 2011). TEK is based on local and intergenerational transmission of knowledge, so it adapts and evolves over time in response to changing environmental contexts. Many indigenous communities hold a wealth of ecological knowledge that is situated in the local landscape and has accumulated over the course of many generations (Alexander et al. 2011; Nakashima 2012). Therefore, TEK provides a substantive base of understanding about changing ecosystems that coarse scientific data struggle to achieve, while also retaining adaptive capacity for challenges such as climate change (Gadgil et al. 1993; Kassam 2009). Since local and indigenous observations of natural phenomena have guided the activities of communities for generations, solutions to environmental problems incorporating TEK are often uniquely suited to that place and time (Pierotti 2011). TEK can inform climate science by offering finer-scale spatial and temporal observations that may not otherwise arise through contemporary climate science methodologies (Nakashima 2012). Although there have been a number of investigations that focus on the role of TEK in understanding ecology and physical environments, there has been little work examining indigenous knowledge of weather and climatic change until recently (Nakashima 2012). Indigenous Athabaskan scholar, Clarence Alexander, advocates for the use of TEK to inform climate science, as it can be complementary and informative for determining patterns with limited instrumental data, especially in remote areas. Alexander et al. (2011) compared peer-reviewed climate change research with indigenous perspectives of climate change and found that TEK of climate change correlates

almost directly with findings in contemporary science, giving it validity among scientific communities (Alexander et al. 2011). Additionally, narratives of local peoples' experiences with climate change can give a more relatable description of the impacts of climate change on human livelihoods than quantitative data can, which has the capacity to build empathy among communities of researchers and policy makers.

Ecological Calendars

The exploration of climate knowledge in TEK research often refers to indigenous calendars, natural calendars, or in our case, ecological calendars, as ways of conceptualizing the timing of livelihood activities in relation to environmental phenomena. Since the new millennium, there have been a number of studies of ecological calendars that have led to significant advances in the scientific community.

In one instance, Orlove et al. (2002) aimed to understand the scientific basis for rain forecasting by indigenous farmers in Peru. These Andean farmers use the quality of the appearance of the Pleiades constellation just after the winter solstice to predict the timing and quantity of precipitation in the wet season later that year, and the quality of the harvest. Orlove et al. describe how this phenomenon can be explained scientifically by changing atmospheric conditions, and discuss how this finding would not have come to light had they not initially worked with locals to understand their ecological calendars. These farmers also show comprehensive knowledge of the timing and regularity of El Niño events, which the scientific community only pinned down in the early 1900s.

In another example, Kanani and Pastakia (1999) established the Ancient Rain Prediction Network (ARPN) from their studies of indigenous meteorological knowledge in Saurashtra, Northern India. The ARPN creates weather forecasts based on a combination of local expertise and

meteorological science, which are used to make climate-related decisions about cropping cycles. For instance, the blooming of the golden shower tree and the direction of the winds provides predictions for the timing of the oncoming monsoon season, which helps to dictate when planting and harvesting should take place.

Lefale (2010), in his research on Samoan seasonal calendars, found that TEK was acutely attuned to the onset of extreme weather events, such as tropical cyclones. Local knowledge of cloud formations had led Samoan islanders to anticipate and adapt to climatic variability for many generations. Lefale suggests that climate science benefits from integrating varied epistemologies, such as TEK, with conventional scientific methodologies.

King et al. (2008) explore Māori weather and climate knowledge to understand how Māori have adapted to climatic variability in the past, and to enhance understanding of climatic change by both Māori and non-native communities. Detailed language used for naming and classifying weather and climate phenomena, oral histories passed through stories, songs, and narrative, and predictions of changing weather using climatic indicators are all mechanisms of Māori adaptation to climate change illustrated in this paper. King et al., too, show that Māori ecological knowledge reflects acute awareness of climatic variability which has led to adaptive capacity in the past and that, if this knowledge is maintained, adaptive capacity will be carried into the future.

Further, in their study of Inuit knowledge of wind changes at Clyde River, Nunavut, Canada in comparison to local meteorological data, Gearheard et al. (2010) discovered that while the local meteorological stations found relatively little change in wind patterns in the past 40 years, Inuits noted key changes in wind variability, wind speed, and wind direction, that affected their livelihood activities, such as hunting. Gearheard et al. (2010) show that both approaches to research are key in producing a holistic picture of environmental change.

TEK and Political Ecology

In discussing the benefits of TEK research, Berkes (2012) states, "Western scientific methodology is merely one way, and not the only way, to acquire knowledge." However, it is important to note that TEK is entirely Eurocentric in its conception, as indigenous communities would never consider their knowledge and livelihoods to be "TEK" or "ecological calendars." TEK as a concept was birthed from the desire to stitch back together the false dichotomy between nature/culture, but it has been argued that to delineate between indigenous knowledge and western knowledge is to create another false dichotomy, as these ways of knowing overlap in many ways (Agrawal 1995). Further, some scholars question whether or not its place in policy and scholarship is actually perpetuating this dichotomy (Nadasdy 1999). As Nadasdy points out: in academic circles, people say that integration between these different "ways of knowing" is difficult because one (TEK) is holistic and intuitive, and the other (western) is reductionist and analytical, and that these two are often incompatible. However, focusing on the problems of this integration as being technical "ignores the political dimensions of the issue of knowledge integration," such as existing power relations between the state and indigenous communities, and is therefore inadequate. Further, when TEK researchers focus exclusively on the technical difficulties of integrating distinct knowledge systems, they "help to obscure the power relations that shape the production and use of the knowledge they study" (Nadasdy 1999).

Additionally, many western scientific concepts have actually been taken from indigenous communities by Eurocentric thinkers, and it is only recently that indigenous peoples have begun to assert ownership and self-determination over their own "traditional knowledge" and its use (Smith 1999). As Linda Tuhiwai Smith, Māori scholar, argues, "from the vantage point of the colonized, a position from which I write and choose to privilege, the term 'research' is inextricably linked to European imperialism and colonialism" (Smith 1999). Elizabeth Middleton's piece, "A Political

Ecology of Healing," which won the Eric Wolf Prize in Political Ecology, speaks to the need for work with indigenous communities to incorporate theory about "coloniality," which is distinct from "colonialism" in that "coloniality refers to the ways in which the political, epistemic, racial, and cultural hierarchies that were set in place during the colonial era remain entrenched in power relations and subjectivities," while colonialism can be held to certain spaces and times. Middleton argues that "one cannot understand human-environment interactions within formerly colonized communities without an explicit examination of coloniality from critical ethnic studies" (Middleton 2010).

Broadly, political ecology is an interdisciplinary area of scholarship that examines the social, political, and economic contexts for human-environment relations (Robbins 2004). In the last chapter of *Sacred Ecology*, Berkes encourages the field of TEK to engage with political ecology because "the use of indigenous knowledge is *political* [in that] it threatens to change power relations between indigenous groups and the dominant society" (Berkes 2012). Although TEK scholars, like Berkes, regularly discuss issues of ownership of indigenous knowledge as political, they often fail to address the perpetuation of embedded colonial structures that continue to affect and appropriate communities' indigenous knowledge. A decolonial feminist political ecology framework is of value to TEK scholarship because it addresses systemic and perpetual issues of power relations.

Decolonial Feminist Political Ecology and Indigenous Feminisms

Though political ecology focuses on disproportionate access to and control over resources on the basis of class and ethnicity, it has been criticized throughout its history for its lack of critique on gender dynamics and the role of women and other marginalized groups in the creation of knowledge systems and decision-making (Rocheleau and Edmunds 1997; Buechler and Hanson 2015). The feminist political ecology (FPE) framework was developed to address this. FPE

recognizes that the structures of science and environmentalism are and have been dominated by men and, in practice, FPE "treats gender as a critical variable in shaping resource access and control, interacting with class, caste, race, culture, and ethnicity to shape processes of ecological change, the struggle of men and women to sustain ecologically viable livelihoods, and the prospects of any community for 'sustainable development'" (Rocheleau and Edmunds 1997).

Similar to political ecology, TEK scholarship has also been criticized for its disregard for knowledge as gendered experience. In 2000, at the Women's Caucus to the UN Commission on Sustainable Development, Lebner and Gregoire (1999) acknowledged the urgency in bridging gender analysis and TEK research. Among the recommendations they outlined for moving forward in the preservation of biocultural diversity and the development of sustainable livelihoods were:

- "Recognize traditional knowledge as a 'gendered science', which would help "legitimize and strengthen rural women's and men's separate, shared and interlocking knowledge as tools to shape their own futures" (Wangari et al. 1996);
- Ensure that women are not simply 'added' to the Convention on Biodiversity but rather that biodiversity is redefined in broader, more inclusive and fluid terms. This "implies a definition based on the diverse experiences and the distinct sciences of many different groups" (Rocheleau 1995); and
- Rectify the gender bias in many organizations and programs working with TEK."

Berkes (2012) gives gender only a single mention in his entire book (Chapter 3, page 58), citing Hunn (1993) who quotes Rocheleau (1991), in a list of one of nine precautions in the study of TEK: "half or more of Indigenous ecological science has been obscured by the prevailing 'invisibility' of women, their work, their interests and especially their knowledge." Nakashima et al.'s (2012) book, *Weathering Uncertainty*, which aims to give an overview on trends and challenges in TEK and climate change research and draws broadly on current research, only mentions gender dynamics twice, once citing the same quote by Rocheleau. In the other mention of gender dynamics in TEK

research, Nakashima et al. quote the 2011 United Nations Human Development report, which states that despite women's disadvantages of having historically restricted rights, limited access to resources, and little voice in decision-making, "the gender equality dimension has thus far been little considered in the literature on climate change and indigenous knowledge (Nelson and Stathers, 2009)." The relative lack of attention to issues of gender dynamics in TEK scholarship is surprising. It is clear that more scholarship is needed at the TEK-FPE nexus.

It is important to note here that "feminism" is not a space that many indigenous peoples feel comfortable aligning themselves with because it is often positioned from white, academic worldviews and has a tendency to erase indigenous perspectives (St. Denis 2007). Oftentimes, indigenous peoples view "indigenous feminism" as a paradox, because feminism is a colonial construct, which inherently aims to oppose indigenous tradition and is considered by many to mean sacrificing cultural tradition. Additionally, many indigenous scholars and activists have found feminism irrelevant to their lives or communities because power dynamics of male domination, such as legally sanctioned violence against women, are not universal and have not held a place in many indigenous communities. In contrast, many indigenous societies have historically given high status to women (Monture-Angus 1995). However, there are a number of indigenous scholars and activists who still label themselves as "feminists" in response to patriarchal structures within and among native communities that oppress women and gender non-conforming people. Verna St. Denis, a Cree scholar, had previously rejected feminism on its erasure of the social, economic and political structures that make women's experiences so varied, especially those of Aboriginal women. Through her own analyses of inequality, however, she came to value feminist scholarship of both white women and women of color (St. Denis 2007). At the 2002 Aboriginal Feminism Symposium, a gathering of Aboriginal "feminist" scholars and activists, St. Denis stated that "the way to defend claiming the Aboriginal feminist identity begins by saying patriarchy and sexism is a problem in our

community – not just a problem of generic colonialism" (Green 2007). Thus, the term "indigenous feminisms" has been used as a space to explore indigenous perceptions of gender dynamics, and is defined by Green as a field of inquiry that brings together "feminism and anti-colonialism, to show how Aboriginal peoples, and in particular Aboriginal women, are affected by colonialism and by patriarchy" (Green 2007).

The framework of decolonial feminist political ecology (DFPE), developed by Rocheleau and Nirmal, gives us the tools to resituate TEK analyses within a feminist critique of power dynamics, while acknowledging coloniality as a central factor that informs people's relations to place and the transmission of ecological knowledge (Rocheleau & Nirmal 2015; Nirmal 2017). While the indigenous feminisms framework reminds us to acknowledge the varied experiences of indigenous women and men within a diversity of contexts, DFPE "places indigeneity and indigenous politics squarely within the realm of political ecology analyses" (Nirmal 2017). The DFPE framework asks us to critically examine the production of knowledge structures themselves, adding analyses of gender and coloniality to the textures of knowledge systems and their creation.

CRITICAL METHODOLOGIES

The objective of this thesis is to understand the elements of ecological calendars in Savnob and Roshorv. To do this, I turn to the methodologies of critical ethnography, and to Kassam's "human ecological lens" to frame my analysis (Kassam 2009). The pairing of critical ethnography and the human ecological lens helps us examine multi-scalar factors that influence ecological knowledge and perceptions of climate change.

Critical Ethnography

Critical ethnography methodologies guided the data collection and influenced choices made in the field. Critical ethnography recognizes that theory is intrinsically linked to methods, and its methods are deeply reflexive, drawing on participant observation, open-ended or semi-structured interviewing, and critical textual analysis (Madison 2012). In our case, we used collaborative workshops, semi-structured interviews, interview-based mapping, guided walks, and participant observation to generate our dataset. Critical ethnography was chosen as a foundational methodology because it gives us tools to analyze the use and construction of ecological calendars in particular ecological and historical settings. The descriptive nature of this methodology allows for a deep understanding of the complex connectivity of human-ecological systems. Critical ethnography gives particular focus to multi-scalar spatial and temporal influences on ecological calendars in the Pamirs, such as changing political economies, shifting food systems, and impacts of social structures, such as gender, on the retention and transmission of ecological knowledge. Critical ethnography calls for the researcher to remain reflexive and adaptable to changes as they present themselves in fieldwork and in analysis. It is also considered essential in critical ethnography to be aware of one's own positionality and inherent biases, as these too are embedded within ever-changing multi-scalar

contexts (Madison 2012). Among my own inherent biases are my education in a Eurocentric tradition, my position as a white, American researcher, and my feminist worldview.

The Human Ecological Lens

In my analysis, I employ the human ecological lens (HEL) developed by Karim-Aly Kassam and illustrated in his book, *Biocultural Diversity and Indigenous Ways of Knowing* (Kassam 2009). The function of the HEL is to resituate our human socio-cultural experience in the foundation of broader, interwoven ecosystems. This method sits well within the theoretical frames of Traditional Ecological Knowledge and Decolonial Feminist Political Ecology scholarship, in that it advocates for an understanding of pluralism; that is, the inherent complex connectivity of the world we inhabit. It brings together what we often intuitively separate, such as a community and the individual, and places the individual in a holistic perspective. Kassam illustrates the human ecological lens with four central principles: diversity & perception, relations, context, and *phronesis*, or practical wisdom (Kassam 2009). Kassam's human ecological lens aims to address the gap between exclusively biological or cultural dogmas and to demonstrate their connectivity.

METHODS

Preparation

The Bartang valley in the Pamir Mountains of Tajikistan was chosen as a research location based on Karim-Aly Kassam's previous research, which revealed former use of ecological calendars in the region (Kassam et al. 2011). The specific research sites for this fieldwork, the villages of Savnob and Roshorv, were chosen during the summer of 2016 by the Ecological Calendars for Climate Adaptation in the Pamirs (ECCAP) research team. During this time, the ECCAP research team engaged with community members in Savnob and Roshorv through meetings and group discussions to solidify working partnerships.

In preparation for summer 2017 fieldwork, I took courses in qualitative research methods, indigenous studies, GIS & Persian language. Using frameworks already established by Dr. Kassam and his colleagues from work on ecological calendars in Standing Rock and Lake Oneida, fellow MS student, Kayla Scheimreif, and I created workshop guides, semi-structured interview guides, interview recruitment scripts, and informed consent guidelines for use in our respective field sites (Appendices A-D). The interview and workshop documents were written to serve as flexible guides for research, with an understanding that the questions asked would be open-ended and subject to change based on the interests and expertise of the interviewee or workshop participant. Dr. Kassam, Kayla, and I also applied for Institutional Review Board (IRB) approval, and were granted an IRB exemption on March 16th, 2017, on the basis that the subject of our research is "ecological calendars [rather than] human subjects" (Appendix E).

Data Collection

Collaboration

To examine current use of ecological calendars and perceptions of climate change in the Bartang Valley, we used a variety of qualitative research methods. Our data collection consisted of community workshops, semi-structured interviews, interview-based mapping exercises, guided walks in order to identify plant species, and participant observation. From June 19th to July 12th, 2017, Kayla Scheimreif and I were in the villages of Savnob and Roshorv conducting field research. There were approximately 182 families living in Roshorv and 56 families living in Savnob during the time of our data collection.

At times, we were also accompanied by other members of the ECCAP team: Dr. Cyrus Samimi, climatology professor and researcher, University of Bayreuth, Germany; Isabell Haag, Dr. Samimi's PhD student, University of Bayreuth; Tobias Kraudzun, PhD Candidate and scholar of pastoralist systems in the Eastern Pamirs, Freie Universität Berlin; Dr. Simone Mereu, agroecology researcher, Euro-Mediterranean Center on Climate Change; and Dr. Karim-Aly Kassam, our advisor, Cornell professor, and ECCAP project PI.

Our community-based translators, Shahlo Saradbekova (Savnob), Topchibek Bekov (Savnob), Saradbek Tohirbekov (Roshorv) and Tohir Saradbekov (Savnob & Roshorv) helped us immensely to accomplish our research. They acted as translators and as guides and community research partners. They initiated contact with community members for the workshops and interviews, and contributed clarifications and insights throughout our field research.

Locals from Savnob and Roshorv who participated in our research were primarily men, and the sample of participants was almost entirely comprised of people over the age of fifty (see: Table 1 and Table 2 in Findings chapter). Though efforts were made to recruit both men and women, older men were more readily willing and able to participate. This gender disparity may have to do with

gender-based work roles, wherein Pamiri women are more often responsible for taking care of the children and providing meals for their families, in addition to farming and herding, which limits their availability throughout the day. It may also have to do with women defaulting to their husbands for local ecological knowledge, which I discuss in depth in the conclusion. The disparity in age may also have been related to work roles. Though many young people were around Savnob and Roshorv, they were busy helping their families with activities like building houses, repairing roads, harvesting fodder, herding livestock, etc. Additionally, since we looked to recruit participants who were considered to be particularly knowledgeable about agriculture, hunting, herding, etc., we were referred to the older people in the village. These limitations of participants' gender and age have influenced the findings presented in this thesis.

Workshops

Two community workshops were held: Savnob on June 20th and Roshorv on June 27th. The purpose of the workshops was to introduce the ECCAP project to community knowledge holders (farmers, herders, hunters, gardeners, teachers, village leaders, and elders), initiate the research process with interested knowledge holders, and make connections with these individuals to begin semi-structured interviewing. Prior to the workshops, meetings were held between ECCAP leadership and local leadership to affirm partnerships and seek guidance on who would be knowledgeable participants in the workshops. The meetings were led by Dr. Kassam and included Village Organization leadership as well as the local Khalifas (religious leaders). Invitations to the workshop were based on one's ecological or knowledge-based professions, such as herder, farmer, teacher, etc. Recruitment for the workshops was led by Dr. Kassam, Tobias Kraudzun, Shahlo Saradbekova (in Savnob), and Tohir Saradbekov and Saradbek Tohirbekov (in Roshorv). Recruiters made an effort to include both men and women. The workshop in Savnob had 19 participants, four

of whom were women, and the workshop in Roshorv had 18 participants, three of whom were women.

At each of the workshops, Dr. Kassam described the goals of the project and discussed the importance of community partnership. A meal was then served, followed by a discussion about local ecological calendars and their illustrations as a seasonal round. A seasonal round is the graphical representation of an annual ecological calendar, which is composed of place-specific agricultural, ecological, climatic, and socio-cultural events. The seasonal rounds we created at the workshops acted as visual aids in correlating the timing of livelihood and ecological events, and also became starting points for our conversations during the semi-structured interviews.

Figure 3: Drawing seasonal round at Roshorv workshop 2017
Photo by: Dr. Cyrus Samimi

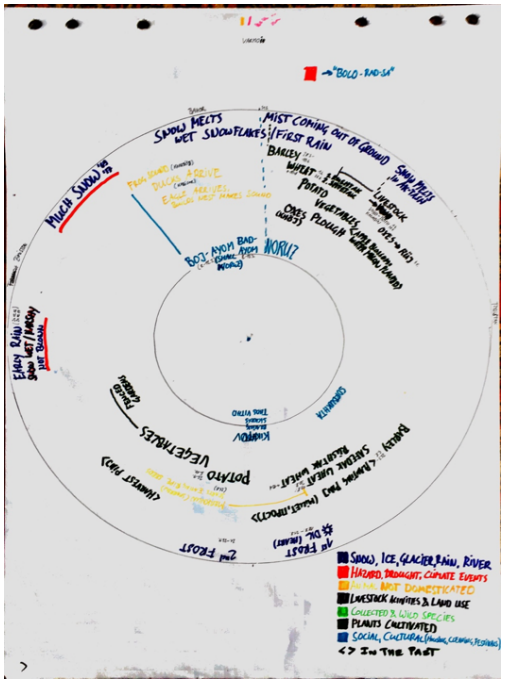


Figure 4: Example of seasonal round Savnob Workshop 2017

In each workshop, Dr. Kassam asked questions about local ecological calendars to prompt the discussions, but the workshop format allowed space for the conversations to take on their own forms. In Savnob, Tobias Kraudzun drew the seasonal round, Shahlo Saradbekova and Topchibek

Bekov translated, and Kayla Scheimreif and I transcribed the discussion. In Roshorv, I drew the seasonal round, Tohir Saradbekov translated, and Kayla Scheimreif and Isabell Haag transcribed.

Semi-structured interviews

Following the workshops, we began semi-structured interviewing in Savnob and Roshorv, which became the bulk of the data collection process. The pool of interviewees was largely those who had shown interest in participating at the community workshops. However, we used the snowball sampling method to recruit people who had not been at the workshops, wherein an interviewee would recommend someone else in the community to talk to, based on their experience or expertise in areas relating to ecological calendars (Small 2009). We held interviews in Savnob from June 21st – 24th, and from July 7th – 8th, and in Roshorv from June 29th – July 7th. We completed 37 interviews in total, 17 in Roshorv (three women, 14 men) and 20 in Savnob (six women, 14 men). The interviews lasted between 45 minutes to 2.5 hours, with an average length of 90 minutes. The interview length depended on how long the interviewee wanted to meet.

We began each interview with informed consent recorded on an audio recorder, based on the informed consent guidelines. Working in partnership with Kayla, one of us would guide the interview by asking questions, while the other would transcribe the conversation on the laptop. If only one of us was able to be present during the interview, that person would take notes throughout the interview, and add transcription later using the audio recording. At the end of each interview, we gave a box of tea to the interviewee as a token of appreciation. After the interviews were over, we finalized the transcriptions together using the audio recordings.

Though we entered into our fieldwork with semi-structured interview guides, we chose which specific questions to ask during an interview based on the occupation, knowledge, and interests of the interviewees. In interviews, we focused specifically on the timing of livelihood

activities, the behavior of plants and animals through the seasons, patterns of temperature and precipitation, and observed impacts of climate change. We paid particular attention to components of the food system. It became clear during the interview process that to fully understand ecological calendars in Savnob and Roshorv, it was essential to understand the human ecology of local food systems; that is, the complex connections between the ecological, socio-political, historical, and communal structures at work. Multiple iterations of the interview guide throughout our fieldwork reflect this process of reflexivity and discovery.

Interview-based mapping

In 11 of the interviews in Roshorv, we engaged in interview-based mapping following the semi-structured interview. If the interviewee mentioned specific geographic locations, we would engage in mapping to spatially situate their human-ecological activities. We asked interviewees to mark places on the map that were important for their livelihoods. For herders, we asked them to mark which pastures they used. For hunters, we asked them to locate their hunting grounds. For gatherers of wild plants, we asked them to mark where they gathered the plants that were most important for them. We used Markus Hauser's "The Pamirs – a tourist map of Gorno-Badakhshan, Tajikistan," at the 1:500,000 scale. We used map-making to elicit discussions that were not always accessible in the oral interview form, so the mapping was just as much about the process as it was about the product. Images of these interview-based maps are attached in the appendices (Appendix F).

Figure 5: Interview-based mapping in Roshorv; Photo by: Kayla Scheimreif

Guided Walks & Participant Observation

Guided walks and participant observation were valuable methods of data elicitation outside of the semi-structured interview form. If an interviewee wanted to physically show us ecological phenomena in the landscape they had been discussing, or if we wanted them to point something out to us, like the identification of a specific plant, we would have them take us on a guided walk. During these walks, we had opportunities to photograph plants and ask questions about their local names and uses.

Figure 6: Guided walk with Saradbek in Roshorv; Photo by: Kayla Scheimreif

Because ecological knowledge exists in direct interaction with the environment, some of the most insightful information we happened upon came out of informal conversations, or participant observation. In these conversations, information was shared in a way that was more fluid than directive question-asking in interview form. Guided walk and participant observation data was recorded using handwritten field notes.

Species Lists

While in the field, we created species lists of plants and animals to serve as an organizational tool for future data analysis. We used these lists to organize species-specific data that were mentioned in interviews, guided walks, and participant observation. The species lists contain the common name, Latin name, Pamiri (local) name, Tajik name, and Russian name of the species (if

known), the time of harvest/gathering (if applicable), notes on its usages, whether or not it could be an ecological indicator, and a photo identifier (if available). Species lists were integrated into the dataset to give detail to the findings.

Data Analysis

Interview and workshop transcripts (including illustrated seasonal rounds) were combined with handwritten field notes to create the dataset. For analysis, the data was coded using ATLAS.ti software. I began analysis using a coding schema that had previously been developed by the Kassam Research Group during ecological calendars research at Standing Rock and Lake Oneida. An open coding method was used to incorporate additional, place-specific codes for the data from Savnob and Roshorv. 24 code groups and 317 individual codes were developed in this process. Code groups and codes were used to organize the writing of the findings section and develop the illustrated ecological calendars for each village.

Ethnographic Fieldwork: A Personal Account

During the planning of our research, Kayla Scheimreif and I decided to do our field research together. My research was based in the villages of Savnob and Roshorv in Tajikistan, and hers in the village of Sary Mogol in Kyrgyzstan. To give each other support in the field, and to align our research protocols so that the data would be more easily comparable, we travelled together and assisted one another in carrying out the research. We worked first in Savnob and Roshorv in Tajikistan for a month, and then traveled to Kyrgyzstan to work in Sary Mogol for the second month.

Although Kayla and I were assisting each other in the field, and our conversations shaped the research, I was primarily responsible for data collection in Tajikistan, and she for the work in

Kyrgyzstan. This meant that I led the development of interview questions and protocol for the Savnob and Roshorv interviews (based on the adapted interview guides). In Tajikistan, I usually conducted the interviews and asked the questions, while Kayla took notes. These responsibilities were reversed in Sary Mogol.

Many of our lessons learned occurred during the fieldwork in Tajikistan, which took place first, so we were more confident during our time in Kyrgyzstan. It took the first two weeks of interviewing in Tajikistan to hone in on a set of questions that was most valuable for us and the people we were interviewing. The research in Kyrgyzstan benefitted from this process, as we did not have to do as much rewriting of the interview questions there.

Kayla and I were accompanied during our first two weeks in Tajikistan by other members of the ECCAP team. During this time in Savnob and Roshorv, the climatologists, Dr. Samimi and Isabell Haag installed new weather stations, repaired old ones, and obtained soil moisture and temperature data. Dr. Mereu mapped agricultural fields and collected data from farmers on their 2016-2017 dates for planting and harvesting of potatoes, wheat, and barley. Tobias Kraudzun supported the various teams and provided logistical expertise while working on his own research, and Dr. Kassam met with community leaders to develop partnerships and helped run the workshops. While the ECCAP team was together in Tajikistan, we all lived in a small guest house run by the Regional President of the Village Organizations, Mamadsho, whose family provided us with meals. While at Mamadsho's, the seven of us lived in close quarters, eating, sleeping, and recreating in a single room. Working and living alongside these scientists contributed to my personal experiences in the field as well as the research itself, and gave me a greater sense of the project in its entirety.

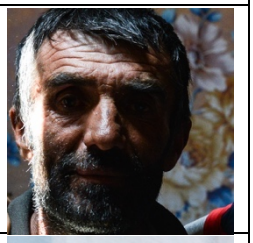
Living in the communities of Savnob, Roshorv, and Sary Mogol, with host families in the communities where we worked, was an essential part of the ethnographic fieldwork process. While it

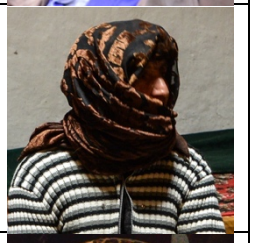
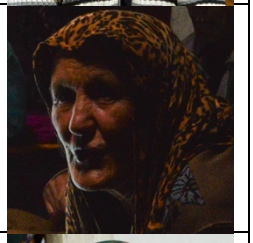
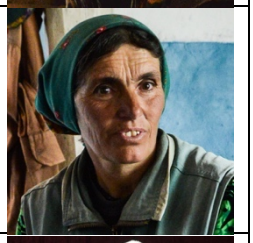
was important to learn and collaborate with our fellow scientists, it was just as important to engage community members at a more personal level once the rest of the ECCAP team had left. Kayla and I made our closest connections with people during this time. This allowed for an openness for us to connect with local people on a more informal level, which provided an opportunity for us to be included in community events such as a traditional wedding, and evenings where we talked about our homes and played music together. Some of the most profound insights were made through these informal interactions.

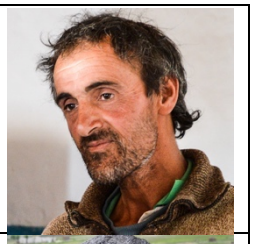
FINDINGS

In this chapter, I've recounted content that people in Roshorv and Savnob discussed in the space of workshops, interviews, map-making, guided walks, or during participant observation. The following descriptions gives us a sense of patterns of knowledge regarding ecological calendars and climate change, but it must be reiterated that this is the first phase of the project, and this information will be used primarily to inform future research within the ECCAP project.

Table 1: Roshorv Participants

	First Name	**Surname**	**Profession**	**Year of Birth**	**Participation**	**Photo**
1.	Lalbek	Shakarshoevich	Hunter	1968	Interview, Workshop	
2.	Porshanbey	Orshormamadov	Russian language teacher, Farmer	1950	Interview, Workshop	
3.	Cholok	Sufovich	Hunter	1949	Interview	[No Photo]
4.	Passor	Kazelov	Tajik literature teacher, Farmer	1930	Interview	
5.	Saradbek	Tohirbekov	English teacher, Gardener	1950	Interview, Workshop	

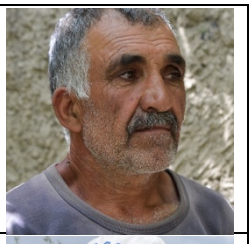
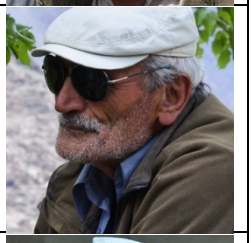
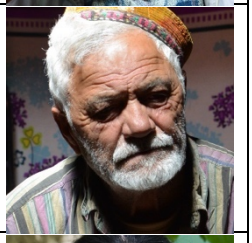
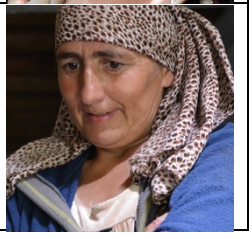
6.	Sadonsho	Daoletmirov	Herder, Farmer	1939	Interview	
7.	Navruzkhatun	Shaikhova	Herder	1945	Interview, Workshop	
8.	Jamal	Nazarmamadova	Herder	1958	Interview, Workshop	
9.	Mobegim	Doutovna	Herder	1966	Interview, Workshop	
10.	Abdulrasul	Qurbonovich	Farmer	1936	Interview, Workshop	
11.	Karamsho	Kurbonovich	Farmer	1960	Interview	[No Photo]
12.	Khujanazar	Shugonovich	Volleyball teacher, Farmer	1952	Interview, Workshop	
13.	Shozodalal	Ayomovich	Former kinomekanik, Farmer	1938	Interview, Workshop	

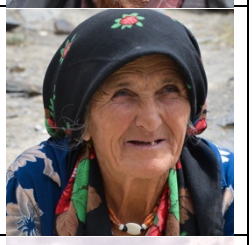
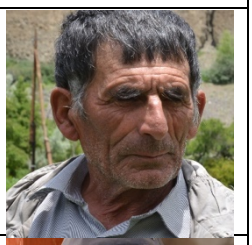
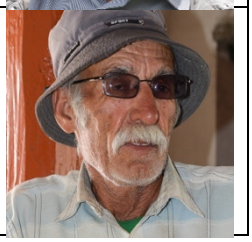
14.	Zubujin	Kholmamadov	Geography teacher, Gardener	1968	Interview, Workshop	
15.	Shomunir	Jamalov	Farmer, Herder	1960	Interview, Workshop	
16.	Janob	Sangilichov	Khalifa, Farmer	Unk.	Workshop	
17.	Zarinatsho	Khujanazarov	Village organization leader	Unk.	Workshop	
18.	Vatansho	Mirzoev	Physician	Unk.	Workshop	[No Photo]
19.	Saidbek	Baktaolatov	Driver, Farmer	1935	Interview	[No Photo]
20.	Khudobek	Kazelov	Librarian, Farmer, Musician	1964	Interview	[No Photo]

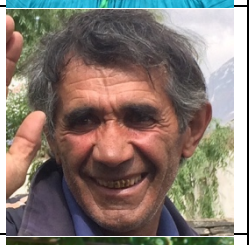
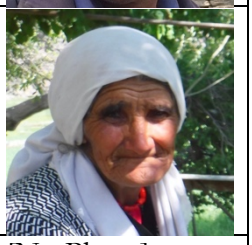
Photos by: Tobias Kraudzun & Kayla Scheimreif

Table 2: Savnob Participants

	First Name	**Surname**	**Profession**	**Year of Birth**	**Participation**	**Photo**
1.	Bakhtibek	Boshaev	History teacher	Unk.	Workshop	[No Photo]

2.	Mulkabek	Alifbekov	Biology teacher, Gardener	1965	Interview, Workshop	
3.	Sarkori	Rahmatbekov	Khalifa, Mathematics teacher	1958	Interview	
4.	Kosembek	Guldasteshoev	Hunter, Roadworker, Pensioner	1948	Interview, Workshop	
5.	Odilkhon	Ayubov	Biology teacher, Farmer	Unk.	Interview, Workshop	
6.	Mulomalek	Alifbekov	Veterinarian, Soviet administrator	1949	Interview, Workshop	
7.	Shahlo	Saradbekova	English teacher	Unk.	Workshop	
8.	Chilla	Nurmamadova	Tajik language teacher	1978	Interview, Workshop	

9.	Kholmirozo	Jafarkuliev	Veterinarian, Local historian, Pensioner	1938	Interview, Workshop	
10.	Riswonova	Bakor	Librarian, Medicinal plants knowledge holder, Farmer, Pensioner	1950	Interview, Workshop	
11.	Topchibek	Bekov	History teacher, English teacher, Tour guide	1971	Interview, Workshop	
12.	Qandak	Mirshaibov	Chief of Farm Organization in Aktash, Yak Herder	1960	Interview, Workshop	
13.	Ayubov	Gulayoz	Teacher of handicrafts, Pensioner	Unk.	Interview, Workshop	
14.	Marvori	Mamadbekova	Farmer	1949	Interview	[No Photo]
15.	Gulzorkhon	Egamov	Ecology teacher	Unk.	Workshop	
16.	Ekbolsho	Dustambuev	Russian teacher, Orchardist	1955	Interview, Workshop	

17.	Qurbon	Shoguniev	Orchardist, Former Village Organization President	Unk.	Workshop	
18.	Olomali	Yormonov	Principal of School, Former Khalifa, Farmer, Hukumat employee	1968	Interview, Workshop	
19.	Soatnazar	Gulzorkhonov	Meteorology station manager, Farmer	Unk.	Workshop	
20.	Aslibegum	Sarkorieva	Farmer, Orchardist	1971	Interview, Workshop	
21.	Mamadsho	Guliev	Regional Village Organization president	Unk.	Workshop	
22.	Solaymoshoeva (Artismo)	Morodbegim	Yak herder	Unk.	Interview	
23.	Ilchibekova	Gulbahor	Farmer	1968	Interview	[No Photo]
24.	Mastale	Egamovich	Geologist, Roadworker	1956	Interview	[No Photo]
25.	Schokoman	Schobozev	Electrician, Farmer	1969	Interview	[No Photo]

Photos by: Tobias Kraudzun & Kayla Scheimreif

Section One: Roshorv Ecological Calendar

> *"Sole kinakust az bahoresh ma'alom."*
> A gradual warming of spring brings predictable summer weather; but if the spring does not warm gradually, the rest of the summer will be aberrant too.
>
> – Khudobek, Farmer from Roshorv

Figure 7: Roshorv village from above

Climatic Context

The village of Roshorv lies in an expansive valley near the base of steep, glaciated mountains at roughly 3,100 meters in elevation. Roshorv is situated beneath Fjenko glacier, Grumgujumailo glacier, and Lapnazar glacier. In local language, Roshorv is described as *sarad*, which means "high elevation" (Savnob interview: Ekbolsho), and *frokh hoftob*, which means "wide land with a lot of sun" (Roshorv interview: Cholok).

Roshorv's vast, exposed landscape, high elevation, and close proximity to glaciers greatly influences its agriculture and the lives of the people there. Due to the cold wind and frost that accompanies Roshorv's landscape most of the year, people plant later than in other villages in the Bartang, which in turn affects the seasonal rhythm of herding, harvest, and other subsistence activities (Roshorv interviews: Khujanazar, Cholok). Other villages in the Pamirs at the same elevation as Roshorv cannot grow wheat and barley because these villages are often situated in narrow valleys without much sunlight. In contrast, the sheer expanse of Roshorv's landscape allows for 14 hours of sun during the peak of summer, providing enough sunlight and warmth to grow wheat and barley in its short growing season, while the glaciated mountains above the village warm the land below by reflecting sunlight (Roshorv interviews: Cholok, Zubujin).

Irrigation from glacial melt is an essential component to maintaining agriculture in Roshorv (Roshorv interviews: Jamal, Khujanazar). While cold water is considered beneficial for growing healthy, pest-free wheat, barley and potato crops, farmers in Roshorv need particularly warm weather to balance the cold temperature of the glacial melt irrigation (Roshorv interviews: Khudobek, Passor, Navruzkhatun, Karamsho).

Figure 8: Irrigation canal in Roshorv

Awakening of Spring

A *varmoi* is a marker in a solar calendar that Bartangi people use as a tool to tell time, and to know that spring has arrived. In Roshorv, the surrounding mountains are used as a *varmoi*, whereas villages that can't see the mountains as well, like Savnob, will build a *varmoi* from rocks (Roshorv interviews: Shozodalal, Khudobek, Navruzkhatun). In the workshop in Roshorv, Karamsho mentioned that a *varmoi* is used to count where the sun is in the body (Roshorv workshop: Karamsho). According to Shozodalal, Kala is an ancient place in Roshorv where people will go to

see time on the mountains (Roshorv interview: Shozodalal). For Khujanazar, the sun rising over the mountains is a sign of spring. In the winter, he said, the sign rises above the mountains towards the South, and in the spring, it rises between two peaks, called *Bthanak* (*Bthan* is a local word that means a V, or two humps) (Roshorv interview: Khudobek). In three interviews, farmers mentioned that although a *varmoi* was used more in ancient times, they still look to it to tell time today (Roshorv interviews: Khujanazar, Shozodalal, Khudobek).

Boj ayom is a traditional celebration that marks the coming spring and the beginning of plowing season in Roshorv (Roshorv workshop: Porshanbey, Karamsho, Saradbek). *Boj ayom* is celebrated around February 8-15th (Savnob workshop: Saradbek). In the workshop, Saradbek mentioned another element of the *Boj ayom* celebration called *Khuj pokhta* or *Khuj zueste*. To determine the timing of this celebration, the Khalifa, the religious leader of the village, uses a book called *Soat noma. Soat noma* is a time-keeping book and can be translated literally as *soat* = watch or clock, and *noma* = letter or script. The Khalifa uses the *Soat noma* in other occasions as well to predict the best time to hold celebrations or religious events, for example, the best time to celebrate a wedding, or to put a new baby in his or her cradle (Correspondence: Nazrulo Saradbekov). According to Saradbek, to determine *Khuj pokhta*, the Khalifa uses the *Soat noma* to determine the time to look for the orientation of a seven-star constellation (possibly Pleiades). This constellation is comprised of three stars that have a negative quality, three stars that have a positive quality, and one that is neutral, called *merikeh*. More research will be needed to explain what these positive, negative, and neutral qualities mean. When the Khalifa sees two positive stars in one corner, this indicates that it is time to take the oxen to the fields to begin plowing. At this time, the women prepare a special bread called *khuj pokhta*, which is made with milk and oil. Then, the oxen are taken inside the house, and the farmer gives a piece of the bread to the oxen to eat. The farmer then massages the ox's horns with oil, and the oxen are taken to the fields to ceremonially plow a small piece of land, about three

meters wide. The farmer then recites a prayer and seeds the land. After *Khuj pokhta*, people wait for good weather to begin fully plowing and seeding the land (Roshorv workshop: Saradbek). Following *Boj ayom* and *Khuj pokhta*, the celebration of the vernal equinox, *Navruz*, indicates the arrival of spring (Roshorv interview: Saidbek).

A climatic sign that winter is ending is when snow is frozen during the night, like ice, and during daytime it is soft. This period of time is also characterized by snow becoming wetter, freezing at night, and forming a crust during the day that people can walk on (Roshorv interviews: Abdulrasul; Roshorv workshop: Janob, Khujanazar, Saradbek). Around this same time, grass begins to green around the spring in Roshorv from which people collect their drinking water (Roshorv workshop: Saifidin). The *zird gulak* (*Taraxacum officinale*, dandelion) is the first flower to appear when the snow melts and is a symbol of coming spring (Roshorv interview: Saradbek). Spring is also marked by *obdow*, which is a time of rapid warming when snow melts and runs swiftly in the irrigation channels. The land is still frozen during *obdow*, so people have to wait until after *obdow* is finished and the snow is melted to plow and plant. A warm spring brings *obdow* early, but if there is a lot of snow, it may not happen until mid-April or later (Roshorv interview: Porshanbey).

Five interviewees mentioned the arrival of *kurak*, a black duck, to the river in Yapshorv, as a sign of spring (Roshorv interviews: Cholok, Porshanbey, Saidbek, Saradbek, Navruzkhatun). Yapshorv is a village situated below Roshorv in the Bartang River valley. When the duck arrives, usually a few days before *Navruz*, the word will spread from Yapshorv and this becomes a sign for the Roshorv people that spring has arrived (Roshorv interviews: Cholok, Porshanbey, Saidbek). *Kurak* comes when the weather is foggy and rainy. According to Saradbek, the ducks feel the warmth of spring and know it is time to come (Roshorv workshop: Saradbek). After the *kurak*, two other ducks arrive: *mosch* and then *kabitsor*. In Yapshorv, some people will hunt them, so they don't stay long before heading on to Lake Sarez (Roshorv interview: Porshanbey). We were unable to

determine the common English or scientific names of these ducks, so more research will be needed in this area.

Seven individuals mentioned the whistling sound of the *tsatsao* bird (*Tetraogallus himalayensis,* Himalayan Snowcock) as an indicator of spring (Roshorv interviews: Cholok, Shozodalal, Khudobek, Abdulrasul, Porshanbey, Saradbek, Mobegim). The *tsatsao* has a high voice and makes a cooing sound that one can hear "from every pasture from every direction" (Roshorv interview: Abdulrasul). This sound can be heard when the spring rains begin to come, usually around the end of March or beginning of April (Roshorv interviews: Cholok, Shozodalal, Abdulrasul). If the year is *khujka sol*, which means a year with no snow, the *tsatsao* can be heard earlier (Roshorv interview: Shozodalal). According to Abdulrasul, people wait to plough until after the song of the *tsatsao*. In the spring of 2017, a number of people did not hear the *tsatsao*, or heard very few, because of the heavy snowpack that winter followed by a late spring (Roshorv interviews: Abdulrasul, Porshanbey). Abdulrasul said that this was the only year in his lifetime that he hadn't heard the voice of the *tsatsao*. Both Porshanbey and Khudobek told us that they hadn't heard the *tsatsao* in spring 2017, but that their wives had heard it in late April and they hadn't believed them. Several people noted that this was likely due to a lack of food, and many *tsatsao* may have died because of the harsh winter (Roshorv interviews: Abdulrasul, Porshanbey, Saradbek). However, the missing sound of the *tsatsao* didn't deter people from beginning their agricultural activities: "The people know the time to plow. They waited for a few days, didn't hear the *tsatsao*, and knew that maybe they all died so we went and ploughed anyway" (Roshorv interview: Abdulrasul).

After the *tsatsao*, the *babub* (*Upupa epops,* Eurasian Hoopoe) arrives in Roshorv when the land is free of snow, usually in April. Local people say that it has become spring when the *babub* arrives in the village (Roshorv interviews: Saradbek, Shozodalal, Shomunir). Abdulrasul told us that the *babub* comes after plowing, when the wheat and barley begins to grow (Roshorv interview: Abdulrasul).

The *mandozak* (swallow; black in color, brown on end of wing) bird arrives in Roshorv in spring, leaves for part of the summer, and comes back again in autumn (Roshorv interview: Saidbek). Another migratory bird that comes to Roshorv is the *thorwathich* (*Coloeus monedula*, Eurasian Jackdaw), which is a small black bird that stays during the summer and leaves at the end of September (Roshorv interviews: Cholok, Saradbek). According to Saradbek, this bird appears in April and stays for just a couple weeks before departing. They are usually seen looking for food, like worms and grubs, in irrigation ditches when the water is low (Roshorv interview: Saradbek).

Porshanbey said that people know that spring is coming when the hunters go to the pastures and can stay there during the night because it is warm enough (Savnob interview: Porshanbey). All of the hunters we interviewed in Roshorv noted that springtime is the easiest time to hunt ibex, because they come to the lower pastures when the snow melts and the grass becomes green (Roshorv interviews: Cholok, Lalbek, Abdulrasul, Porshanbey).

Farming Activities Begin

When the weather is gradually warming, snow is gone from the farmland and the soil has begun to thaw, it is time to begin farming activities on the land (Roshorv workshop; Roshorv interviews: Sadonsho, Jamal). Generally, plowing is said to begin on or around *Amal*, April 1st, which is nine days after *Navruz* (Roshorv workshop; Roshorv interviews: Passor, Saidbek, Khudobek). *Amal* means: "when the earth becomes alive" (Roshorv workshop: Saradbek). Although plowing begins around *Amal*, several people noted that the timing of plowing is dependent on weather and ground temperature (Roshorv workshop: Porshanbey, Khujanazar, Karamsho). If people begin to plow and the land is still frozen, they will wait until it has thawed further to plow. When the weather is colder, farmers will wait until midday for the sun to warm the land before beginning plowing activities (Roshorv workshop: Janob, Karamsho, Zubujin).

The exact timing of plowing varied among interviewees. Saradbek mentioned that old men with oxen in the western side of the village plow first because the snow melts there before it melts in the rest of the village (Field notes). According to Cholok, every year from March 20-25th, the snow is gone from the village and he begins to plow on *Amal*. According to Saidbek, his grandfather told him that the best time to plow is after *Amal*, between April 11-18th (Roshorv interview: Saidbek). Karamsho said that he knows it is time to plow when he can throw a stone on his farmland and it stops when it hits the ground instead of bouncing (Roshorv interview: Karamsho).

The spring of 2017 was an anomalous season – snow wasn't gone from most of Roshorv's farmland until mid-April, and planting took place roughly 20 days later than normal (Roshorv interview: Cholok). If seeding is pushed back as late as early May, it is still possible to plant barley, but it will be too late for wheat for most farmers (Roshorv interview: Sadonsho). Two people mentioned that in years with a cold spring or a lot of snow, they will put *bijens* (refers to ash, dust, silt, or soil of any kind) on their land to speed up the melting process if the snow has not melted by early April (Roshorv interviews: Abdulrasul, Khudbek).

In Roshorv, the order of seeding is wheat, then barley, then peas followed by potatoes and other vegetables like carrots and onions (Roshorv workshop). A number of people said that in normal years, seeding of wheat begins around April 10th (Roshorv interviews: Sadonsho, Mobegim, Shozodalal, Shomunir). Karamsho heard from his grandfather and other older farmers in the village that April 15-18th is the time to seed wheat, and if you seed any earlier, the weather might become cold again (Roshorv interview: Karamsho). There are two kinds of wheat grown in Roshorv: *safedak* (white wheat) and *rushtak* (red wheat). *Safedak* is grown more widely than *rushtak*, because *rushtak* requires more water and warmer weather (Roshorv interviews: Saidbek, Sadonsho). The two varieties are often grown in rotation, switching between the two each year. When we asked why people still grow *rushtak* in Roshorv, Saidbek told us that it is because they want to continue to have

viable seeds in case the climate gets warmer (Roshorv interview: Saidbek). People who grow both the *rushtak* and *safedak* varieties of wheat plant *rushtak* about ten days before planting *safedak*. When it is a late spring, like the spring of 2017, it can be too late to grow *rushtak* (Roshorv interview: Jamal).

The exact time of planting depends on the temperature and quality of soil. Individuals in the workshop agreed that they check the temperature of the soil with their hands at a depth of 10-15cm to feel if it is warm enough to seed (Roshorv workshop: Saradbek, Khujanazar). According to Khudobek, *schop* describes soil that is soft and wet. When the *schop* begins to dry, he knows that it is time to plant (Roshorv interview: Khudobek). Jamal said that Roshorvi people know it is time to plant when they put their hands in the soil and it feels warm (Roshorv interview: Jamal). Cholok said that he puts a nail into the ground to see if it is still frozen. If the nail goes into the soil to a depth of five centimeters, it is warm enough to plant (Roshorv interview: Cholok).

After the seeding of wheat is finished, barley is seeded directly after. Peas are seeded together with barley, or sometimes before (Roshorv workshop: Cholok; Roshorv interview: Navruzkhatun). Barley is planted with peas for the nutrients it provides (Roshorv interview: Saidbek).

After peas and barley have been seeded, potatoes are planted (Roshorv workshop). There are three main varieties of potatoes planted in Roshorv: *kardinal*, *joidore* (local variety), and *jirgatol*. They are all planted at the same time, but the *kardinal* variety is early-ripening and is ready to harvest in July, while the others are ready during autumn harvest in late September (Roshorv interview: Lalbek). Though people said that they plant potatoes at varying times between the end of April and late May, Saradbek noted in the workshop that potatoes need to be planted when the soil temperature is 8°C at a depth of 12cm. If they are planted in colder soil, they will not grow until the soil has warmed (Roshorv workshop).

Other vegetables like onions, carrots, and cabbage are planted roughly one month after the wheat is seeded (Roshorv interview: Jamal). Some individuals start vegetables in greenhouses to be

transplanted. Onions, for example, are grown to be 10-15cm tall before they are transplanted to the fields (Roshorv workshop: Saradbek, Khujanazar). Before the year 2000, no one in Roshorv grew carrots or onions because they believed they couldn't with the cold climate, so they would get vegetables from relatives in Yapshorv and other villages. A few years after the Tajik Civil War ended, in an effort to establish food security, a woman named Svetlana was sent from Russia by the Aga Khan Foundation to Roshorv and brought carrot, onion, and cabbage seeds, and she taught people in Roshorv that they could grow these vegetables (Roshorv interview: Passor).

Saidbek spoke of a period of time called *broth*, which falls around May 8-9th, and refers to the end of the cultivation period in the Bartang valley. He told us that he had heard from the oldest people in the village that if someone plants during a period of *broth*, they will have a very good harvest. Two or three days after *broth* is called *pasbroth*, which means that it is past the deadline for cultivation. In a *khujka sol* year, one with minimal snow, one must plant during *broth* because it will be warmer then with more water available. According to Saidbek, each year every farmer plants the portion of their land that is furthest from their irrigation during *broth*. The section of land planted during *broth* is rotated each year, and is the last section of land to be irrigated. Saidbek only plants barley during *broth* (Roshorv interview: Saidbek).

The amount of time it takes to seed the land is dependent on the amount of land a family has, and on the quality of its soil. Farmland is usually divided into rich, average, and poor soils, and generally families have 400 square meters of land with rich and average soil, and 200 square meters of poor land per person. About 50% of poor quality land is used for *gharj* (*Onobrychis* sp.) and other fodder crops, while the other 50% is kept as uncultivated grassland (Roshorv workshop: Saradbek). The timing of planting is also dependent on peoples' primary ecological professions. For example, since Mobegim is a herder, she plants her garden early and quickly, over the course of a few days, so that she can move livestock to the pastures (Roshorv interview: Mobegim). Lalbek, a herder and

hunter, says that he is always in Aktash in the early spring, and relies on his neighbors to tell him when to come back to the village and plant his crops (Roshorv interview: Lalbek). Jamal also mentioned that she plants her vegetables based on when her neighbors start to plant theirs (Roshorv interview: Jamal).

Other events that take place in the late spring are the birthing period of Marco Polo sheep around the 15th of May (Roshorv interview: Lalbek), and the blossoming of Apricot trees around May 20th (Roshorv interview: Khudobek).

The end of planting activities in Roshorv prompts the movement of livestock to pasture. If the animals aren't taken to pasture before the seeds begin to grow, they will eat the crops and destroy the land (Roshorv workshop: Vatansho, Shomunir, Porshanbey, Lalbek; Roshorv interviews: Cholok, Navruzkhatun, Sadonsho). The time to move the animals to summer pastures is usually between the end of May and June 5th (Roshorv workshop). Herders from Roshorv spend three to four months in summer pastures, from late May until sometime in September, depending on the weather (Field notes). Mobegim and Jamal are both herders whose job it is to take other people's animals to the summer pastures. Mobegim said that people usually begin to ask her to take their animals around May 20th, and that they move to the high pastures every year at the same time, around May 26-27th (Roshorv interview: Mobegim). These specific dates are remnants from times of Soviet collective farming (Savnob interview: Sarkori). Jamal will take livestock to Shirinilga, Momil, and Schoyagal pastures near Roshorv in the spring, summer, and autumn. Sheep are sheared before they leave for pasture in the spring (Roshorv interview: Jamal).

Summer Settles In

In summer, after the animals have been moved to pasture, people in Roshorv work tending to their farmland and gathering plants for fodder and medicine. *Gharj* (*Onobrychis* sp.), a staple fodder

crop, is mowed in Roshorv twice each summer, around June 15th and at the end of August or beginning of September (Roshorv workshop: Khujanazar). Since Roshorv is surrounded by large swaths of agricultural land, much of it is in *gharj* cultivation, and Roshorvis often trade or sell *gharj* to nearby villages, like Savnob, that don't have as much space for growing fodder (Field notes).

Roshorvis collect wild plants in the village as well as in nearby pastures in the summer. *Kuhi*, a cold-adapted grass that grows in high pastures where ibex are found is gathered from the mountains in July and is used as fodder when there is not enough grass for the livestock (Roshorv interviews: Mobegim, Khujanazar). *Kakhschavergul* (*Erigeron sp.*, *ramashka* in Russian) is found in nearby pastures and is gathered for stomach problems and is made into a tea (Roshorv interviews: Jamal, Mobegim, Karamsho, Khujanazar). *Seschjuthum*, a mint (*Mentha* sp.), is gathered from the nearby of Shoyagal and Schatzdara valleys and is used for breathing at high elevations (Roshorv interviews: Jamal). Another mint, *khuchef gharj* (*Mentha* sp.) is made into a poultice for broken bones and is also made into a tea to drink (Roshorv interviews: Jamal, Porshanbey, Khudobek). *Kaisarkhula* (unknown sp.) is also collected to make into a poultice for broken bones (Roshorv interview: Khujanazar). *Valadol woschak* (unknown sp., *chibrets* in Russian) is collected for breathing at high elevation, and *davlen woschak* (unknown sp.) is used for fevers (Roshorv interviews: Mobegim, Navruzkhatun). *Charefs* (unknown sp.) is gathered for muscle pain and is made into a tea or a poultice (Roshorv interview: Karamsho). *Rag woschak* (*Plantago major* L., plantain), is used for healing the skin from cuts and stings (Roshorv interview: Shomunir). *Virn*, yet another mint (*Mentha* sp.), is collected for tea and as fodder for animals (Roshorv interviews: Karamsho, Jamal). According to Saradbek, there are twenty uses for *virn*, which include: burning to celebrate the return of someone after a long absence, before moving into a new home, when a baby is put into the cradle for the first time, and before reciting from the Quran (Roshorv interview: Saradbek). *Yob* (unknown sp.) is also gathered for burning to cleanse a space and is used during religious holidays and weddings (Roshorv

interviews: Jamal, Karamsho, Porshanbey, Sadonsho, Khudobek). According to her grandfather, Jamal said that the best time to collect these plants is between June 10th and July 10th, when they have flowered (Roshorv interviews: Jamal). Mobegim said that she collects wild plants between June and August, and only collects them when they have flowered (Roshorv interview: Mobegim).

While herding in the high summer pastures in Aktash, Lalbek said that he gathers *nakhchir woschak* (golden root, *zalatoikoren* in Russian), *bonafshoigul* (unknown sp.) for dry eyes, and *pushtai piaz* (wild onion) for food (Roshorv interview: Lalbek). Karamsho said that he can only collect *nakhchir woschak* in the high mountains, but most of the other wild plants that people use can be found in pastures closer to Roshorv (Roshorv interview: Karamsho).

Ibex give birth in June, when the higher pastures turn green, and they begin to slowly come down the mountain to find the best place for their young (Roshorv interviews: Lalbek, Cholok). Cholok, a celebrated hunter in Roshorv, said that when his grandfather taught him to hunt, he was told to climb to the pastures in June when they would start to turn green (Roshorv interview: Cholok). Around the same time that the baby ibex are showing up in the pastures, the *chukar* (partridges) are giving birth and beginning to nest in the valley near Roshorv. Cholok said that it has always been this way (Roshorv interview: Cholok).

July is the time when the *kardinal* potato variety is ready for harvest (Roshorv interview: Lalbek). July, around the 20th, is also the time of harvest for mulberries (Roshorv interview: Saradbek).

In mid-summer, when the weather begins to warm rapidly, snow and glacial melt fills the rivers. In heavy snow years, this is the time of flooding. According to Saradbek, when he was young and the *Thiu Dara* (Crazy River) would flow three times, his family would know that the apricots in Yapshorv would be ready, and they would travel there to buy them (Field notes).

In a number of interviews, extreme heat in August was mentioned as a hazard to agriculture (Roshorv interviews: Khujanazar, Karamsho, Khudobek, Zubujin). Three interviewees mentioned that this happens in August, but that it is fairly uncommon and happened most recently four years ago (Roshorv interviews: Khujanazar, Karamsho, Khudobek). When this heat wave strikes, wheat and barley crops will bolt, causing the grain to not develop further (Roshorv interview: Khudobek). Rapid warming will also cause glaciers to melt quickly, transporting sediment into irrigation channels. In these instances, people must water their land in the early morning before sediment is washed into the channels (Roshorv interview: Karamsho). If the melt is even more extreme, runoff like "black water" will come from *Thiu Dara* and Lapnazar valleys and "cover the land with a black clay-like substance that acts like plastic" (Roshorv interview: Zubujin). If this happens, water cannot permeate the land and the harvest will be poor (Roshorv interview: Zubujin).

The hunters that we interviewed all agreed that August is the best time to go to the high pastures to hunt ibex, Marco Polo sheep, marmots, *tsatsao*, and *chukar*, because they are fat from their hearty summer diets. Cholok spoke of his personal hunting ethic, saying that he will only hunt the biggest ibex in the autumn, and leave the smaller ones for the following year (Roshorv interview: Cholok). Hunting season lasts throughout the autumn, until December (Roshorv interviews: Cholok, Porshanbey, Lalbek).

Arrival of Autumn and Harvest

According to Saidbek, summer is over when people in Roshorv notice that a waterfall that they can see from the village has frozen, which usually happens in mid-August (Roshorv interview: Saidbek). Autumn is also the time when Roshorv will see its first snow. The western part of the village will usually get rain while the eastern part will get the first snow (Roshorv interview: Cholok).

Cherry trees in Roshorv ripen roughly two weeks before apricot trees do. When they

become red and are nearly ready to harvest, the *charthoch* (*Passer montanus*, Eurasian tree sparrow) will eat the cherries (Roshorv interview: Saradbek). The local variety of apple ripens between mid-August and mid-September. Saradbek has grafted the local apple variety to an apple tree from Khorog and has noticed that while the local apple loses its flavor when it is very ripe, the grafted kind can stay on the tree until early October without losing its color or flavor (Roshorv interview: Saradbek).

Saradbek and Passor both told the story of Saradbek's father, Tohirbek Tohirbekov, who was the first person to plant trees in Roshorv. Before this, people thought that fruit trees couldn't be grown in Roshorv's exposed, high elevation landscape. Tohirbek brought apple and apricot trees from Yapshorv and tried to cultivate them for many years before they gave fruit. Now, 10-12 families in Roshorv have apricot trees. Most of the apricot trees are ripe at the end of August or beginning of September, though one variety from Yems village ripens in October (Roshorv interviews: Saradbek, Passor). Zubujin told us that his apricot trees used to ripen around August 20th, but are now ripening in early August. He told us that it is possible that it is a different variety that ripens that early, but made sure to acknowledge that he is recognizing a shift in the timing (Roshorv interview: Zubujin).

Peas are the first field crop to be harvested, when the plant becomes green and then yellow. Next is barley, which is ready to harvest when the spike becomes completely white and the seeds become too hard to bite through. Passor mentioned that when farmers mow their barley early, in August, and leave the land fallow for the rest of the summer, this ensures a good harvest on that piece of land the following year (Roshorv interview: Passor). He also noted that if you mow your barley late, you may have to contend with rain or snow harming the crop.

Wheat is harvested after barley, when the spike bends down due to its weight, and the seeds are too hard to bite (Roshorv workshop: Khujanazar, Cholok). According to Khudobek, it is time for him to mow wheat when the apricots in Roshorv are ready to harvest (Roshorv interview:

Khudobek). In some years, there is a cold period, called *schtzewen*, that lasts a few days in September and harms the wheat and barley crops (Roshorv interviews: Saidbek, Khudobek). After the wheat and barley is harvested, it is threshed by hand, with oxen, or with a tractor (Field notes; Roshorv interview: Abdulrasul)

When the wheat and barley seeds are ripe and ready to harvest in late August or early September, the *mekhnul* bird (finch) will come to feed on grain during the harvest. The *mekhnul* arrives first in villages with warmer climates and earlier harvests, like Yapshorv, and will then travel to villages like Roshorv with later harvests. The *mekhnul* will stay for 10-12 days, and after the harvest is over, it disappears for the winter (Roshorv interviews: Saradbek, Abdulrasul, Porshanbey, Shomunir).

Potatoes and other vegetables are harvested just before animals return from the summer pastures (Roshorv workshop: Saradbek, Cholok, Karamsho). The harvest is usually completed by the end of September or early October (Roshorv interviews: Sadonsho, Karamsho, Shomunir, Tohir).

Sadonsho told us that the *mandozak* bird (swallow) arrives in the autumn in Roshorv and comes "like a person to your door, and then the people know that it is time to bring animals back to Roshorv from summer pasture" (Roshorv interview: Sadonsho). According to Sadonsho, the *mandozak* comes in autumn and doesn't eat grain from the land. Saradbek, on the other hand, said that the *mandozak* comes early in August and only passes through (Roshorv interview: Saradbek).

When it becomes too cold or snowy in the lower summer pastures, herders will decide that it is time to move the animals back to Roshorv (Roshorv interview: Jamal, Navruzkhatun). Herders know that the autumn is coming when the grass in the pastures begins to yellow. This is when marmots begin to disappear from the pastures, so the wolves are hungry and pose the biggest threat to livestock at this time (Roshorv interview: Mobegim, Jamal). Between late August and late

September, streams freeze and snow begins to accumulate in the high summer pastures, like Blankaik, so herders will move to lower pastures, like Khufak, Kyzyl Taqoi, and Bashbolong (Roshorv interviews: Sadonsho, Mobegim). The freezing of the stream is a signal to Mobegim to move the livestock to lower pastures (Roshorv interview: Mobegim). When it is time for the livestock to be finally brought back to Roshorv for the winter, people from the village hike to the lower summer pastures to help with the move (Roshorv interview: Sadonsho). Once sheep return to the village from the summer pastures, they are sheared a second time (Roshorv interview: Jamal).

Autumn is the primary time to collect firewood from nearby forests for the winter because there is too much other work to be done in the summer (Roshorv interviews: Lalbek, Jamal). Lalbek mentioned that he brings firewood from the forest past Ghudara using a lorry car in autumn (Roshorv interview: Lalbek). Shomunir told us that since there is no forest near Roshorv, people also collect low-lying desert shrubs, such as *tsish* or *tsuthm* (varieties of wormwood) that grow around the village to use as firewood (Roshorv interview: Shomunir).

Winter Quiet

Winter in Roshorv is marked by cold and snowfall (Roshorv interview: Navruzkhatun). When the weather turns cold, the migratory birds that arrive in spring will leave Roshorv to fly south. Magpies and eagles spend the winter around Roshorv, and they make nests at the top of the surrounding mountains in early spring (Roshorv interview: Cholok).

Sheep give birth throughout December, and goats give birth from end of February through early March (Roshorv interview: Mobegim). During collective farming, there was selective breeding over ten to fifteen days, then the males and females were separated. Now, the animals are not separated, so kidding and lambing happens over a longer period (Roshorv workshop: Mobegim).

Cows usually give birth December through February, but they also calve in summer pasture (Roshorv workshop: Saradbek, Vatansho, Cholok, Navruzkhatun).

Winter is the season when people are focused keeping warm at home instead of working on the land (Roshorv interviews: Jamal, Karamsho). Porshanbey noted that there is a month called *chilla*[1], which is the coldest time of winter. During this time, people use a lot of firewood in their home, and they know that *chilla* is over and spring is coming when you only need a small fire in the stove to heat your home (Roshorv interview: Porshanbey).

Section Two: Perceptions of Climate Change in Roshorv

"If we had no glacier, we would not be able to live here." – Khujanazar, Farmer

Warmer now

Six individuals in Roshorv told us that they believe the weather is getting warmer (Roshorv interviews: Lalbek, Mobegim, Zubujin, Porshanbey, Khudobek; Savnob interview: Olomali). According to Zubujin, in 9th grade he went to visit the glacier behind Lapnazar with his parents. When he went back in 2014, he found that the glacier had receded 150 meters. Porshanbey, too, spoke of how the Fjenko glacier has gotten smaller. Both Zubujin and Olomali mentioned that children in Roshorv used to wear warmer clothes in the winter than they do now. Both Lalbek and Khudobek told us that in their experiences, in the past twenty years, all four seasons have gotten warmer, and the winters have gotten less snowy. Khudobek mentioned that *schtzewen*, a cold period that happens in September and can kill wheat and barley, happens less now than it used to. Lalbek

[1] The winter *chilla* mentioned here refers to the Persion *chella*, a period of forty days. "While in Sufism, the *chilla* refers to an exact period of forty days of seclusion and meditation, in the context of this calendar, forty days is more flexible and akin to the idea of many days. Nonetheless, the import of the term *chilla* retains its Sufi character when we consider forty days as a period of "being lost" in the desert" (Kassam et al. 2011).

said that twenty years ago, it was impossible to grow wheat in Roshorv, but now wheat grows. According to Olomali, it is recent that apricots, carrots, onions, and tomatoes have been able to grow in Roshorv. Porshanbey said in the past, that farmers would harvest wheat and barley in October, but now the harvest is in August.

Colder now

Seven interviewees in Roshorv told us that the weather is colder now than in the past (Roshorv interviews: Jamal, Navruzkhatun, Karamsho, Passor, Sadonsho, Saidbek, Shozodalal). Four individuals said that they believe the weather is colder because there is less glacial and snow melt in the rivers in summer (Roshorv interviews: Navruzkhatun, Karamsho, Passor, Sadonsho). Each of these interviewees stated that the past was so much warmer that they couldn't cross the river in Roshorv at certain times in the summer because of the excess of glacial and snow melt. According to Jamal, the weather became colder in Roshorv about ten years ago. Both Jamal and Sadonsho mentioned that they are worried about the long winters and late springs affecting the ability of the wheat crop to ripen in time for harvest (Roshorv interviews: Jamal, Sadonsho). Shozodalal said that beginning ten years ago, there has been more snow each winter (Roshorv interview: Shozodalal).

The winter of 2016-2017 had an anomalously large amount of snowfall in the Bartang valley. Thirteen interviewees mentioned the past winter as an unusual weather event, many of them saying that they don't remember a winter as hard as this one (Roshorv interviews: Shomunir, Navruzkhatun, Karamsho, Abdulrasul). Saidbek noted that it was the most snow they'd seen since another hard winter in 1969 (Roshorv interview: Saidbek).

Increased variability

Khudobek told us that changes in the weather are happening more rapidly now than in the past. He said that there used to be more regular weather, but now there is more change in weather within shorter periods of time. Zubujin also said that there are more changes now than in the past (Roshorv interviews: Khudobek, Zubujin).

No change

Both Mobegim and Khujanazar said that variability in weather patterns are just as frequent now as when they were younger (Roshorv interviews: Mobegim, Khujanazar). Karamsho, Jamal, and Khujanazar all mentioned that there is a short rainy season in Roshorv in May, and that the frequency and amount of rain hasn't changed in their lifetimes (Roshorv interviews: Karamsho, Jamal, Khujanazar). Saradbek, Porshanbey and Khujanazar spoke about how the weather always gets warmer and then colder, and that there is no particular pattern (Roshorv interviews: Saradbek, Porshanbey, and Khujanazar). Porshanbey told a story that encapsulates this sentiment and a general sense of hope for good weather and good harvests:

> "In the 10th or 11th century, people were emigrating from Roshorv to the northern part of Tajikistan. At that time, the people's lives were difficult. Watanay was an old man living in the village at that time. The people went to Watanay and asked him for advice: they asked if they should move away from Roshorv or not. That spring was very late, and they said that maybe they would have to move from Roshorv. Watanay said, "but we have a god." So the people stayed and planted, and they had a very good harvest. I did this too this year. It was a late spring, but I still planted, and maybe I will have a good harvest." (Roshorv interview: Porshanbey)

Section Three: Microclimatic Variation in Roshorv

The northeastern part of Roshorv village is the closest to the glacier, which causes their planting and harvesting times to be 5-10 days later than the southwestern part of the village, which remains warmer (Roshorv interviews: Cholok, Khujanazar). Saradbek told us that the older men on the western side of the village are the first to plow (Field notes). In the autumn, the northeastern part of the village will have its first snow, while the southwestern part will only get rain (Roshorv interviews: Cholok, Jamal).

Although farmers who have land closest to the glacier have to contend with cold and frost, they also have better access to water resources (Roshorv interviews: Jamal, Saidbek). Saidbek mentioned issues with water access a number of times, noting that Roshorv has a lack of water in general, which he attributes to its growing population. His land is located far from the source of glacial melt, which poses a problem to him and his neighbors, especially when the weather is cold and the glaciers are not melting (Roshorv interview: Saidbek).

However, when the climate is too wet in Roshorv, this can be damaging to the crops. This is why the presence of a rainbow in the spring or summer is a bad sign in Roshorv – it means that the crops will be affected (Roshorv interview: Passor). According to Saradbek, the flat topography of Roshorv's farmland and its clay-rich soil captures moisture and creates the wet soil conditions for diseases and pests to form, like white mold on the spikes of wheat plants (Field notes: Saradbek).

Differences in soil types across Roshorv affect the quality and timing of agriculture. Passor told us that there are four kinds of soil in Roshorv: *jourai*, a red, strong soil that you cannot grow anything in; *rigen*, a warm soil with stones mixed in, which gives an early but poor harvest because of its warmth; *rushthok*, a red soil that gives the best harvest; and *namaken*, a salty soil that develops into *rushthok* over time (Roshorv interview: Passor). A number of interviewees spoke of the land in the oldest part of Roshorv, Bobakalon, as the best soil in Roshorv because it has been cultivated since

ancient times (Roshorv interviews: Khujanazar, Zubujin, Passor, Karamsho). The rich soil in Bobakalon allows for slower crop growth, so this land is planted earlier and harvested later than other land in Roshorv (Roshorv interview: Passor, Khudobek). According to Passor, the harvests yield twice as much as in other parts of the village (Roshorv interview: Passor). Those who spoke of the richness of soil agreed that as one moves further from the center of Roshorv, the soil becomes poorer and rockier in quality (Roshorv interviews: Jamal, Khujanazar, Zubujin, Passor, Karamsho).

Section Four: Savnob Ecological Calendar

Climatic Context

Savnob village is situated in a verdant pocket of the Bartang valley at roughly 2660 meters in elevation. It is surrounded by arid, rolling hills that quickly become steep mountains scattered with boulders and sandy shoots of erosion. The village is defined by parceled fields of wheat, barley, potatoes, alfalfa, and other vegetables, while nearby hills are speckled with green vegetation, mostly small shrubs used for fuel and fodder. The name *Savnob* means warm water. Its name refers to the spring on the west end of the village that provides the majority of Savnob's water for drinking and irrigation. A network of canals and slate-rock dams navigate spring water throughout the village, so from afar it is a thickly vegetative oasis in an arid, rocky landscape. Savnob's elevation and topography designates it as a *poitakht* village, which was described by locals to mean it has a warmer climate than villages that are more exposed or at higher elevations, like Roshorv: "The geographical location makes it warm. The *poitakht* villages are lower in elevation, and they are settled in valleys, whereas Ghudara, Passor, and Roshorv have more open landscapes" (Savnob interview: Olomali).

Figure 9: Savnob village from above

Savnob's unique *poitakht* climate greatly impacts its agriculture. "The snow melts very early here, right after Navruz. We plow 20 to 25 days earlier than other villages like Roshorv. It is possible to grow cucumbers and tomatoes here" (Savnob interview: Ekbolsho). The ability to grow fruit trees extensively is also a defining characteristic of *poitakht* villages (Roshorv interviews: Jamal, Navruzkhatun; Savnob interviews: Kosembek). According to Navruzkhatun, who lives in Roshorv, *poitakht* "means that they have everything" (Roshorv interview: Navruzkhatun).

Savnob's *poitakht* climate means that farmers need cold summers to have a good harvest (Savnob interviews: Mulomalek, Mastale, Kosembek). According to Mastale, if all four seasons in Savnob are cold, it is good for the agriculture because the irrigation water from the spring is warm

(Savnob interview: Mastale). If the summer weather is too hot, the spring water will also be hot, and the mix of warm water and warm weather will destroy the wheat and barley crops (Savnob interviews: Kosembek, Mastale, Sarkori). In Savnob, barley is planted before wheat because it needs cold, wet soil, whereas in Roshorv, wheat is planted before barley (Savnob interview: Ayubov).

While Savnob's spring-fed irrigation system allows for growing an abundance of crops, there is less available water than in glacial or snowmelt-fed systems, like Roshorv (Savnob interview: Olomali). With less available water, Savnob has a village-wide irrigation schedule, where people are allowed to water their land every five days (Savnob interview: Olomali). Savnob's climate also brings more rainfall than other villages in the Bartang valley. This heightens the potential for pests that harm field crops (Savnob interviews: Kholmirozo, Mulomalek, Topchibek). Sometimes, there is a lot of rain in July and August, which can kill barley and wheat crops (Savnob interview: Sarkori).

Awakening of Spring

Three individuals mentioned that winter has ended when the frog arrives people in Savnob hear the sound of its call (Savnob workshop: Bakhtibek, Shahlo; Savnob interview: Odilkhon). Shahlo referred to the frog sound in correlation with the cultural event, *Boj ayom*, which occurs around the 8th-12th of February. She said that the frog sound comes first, and then it is time for *Boj ayom*. In the workshop, we were told that *Boj ayom* is a time to celebrate the coming season of plowing and planting. During *Boj ayom*, people bring farmers' tools to their homes, make the plow from wood and hang it from the beams, put white flower on the five pillars of the home, and begin plowing (Savnob workshop). According to workshop attendees, people visit each other in their homes during *Boj ayom* and wish each other, "*shogun bahor*" which means "happy spring" (Savnob workshop). For this celebration, women cook a dish called *cochi*, which is made from milk, water, and *rushtak* wheat flour (Savnob interview, Marvori). Another celebration that happens in early

spring in Savnob is *Osh imom*, which means "water running in the channel." It is celebrated when the first water arrives in the spring, when the irrigation channels that flow throughout the village are opened. At this time, an animal sacrifice happens.

Many interviewees characterized the ending of winter by the warming of the weather and the effect of warmth on snow and frozen ground (Savnob interviews: Mulkabek, Qurbon, Mulomalek). Mulkabek mentioned that he knows spring is arriving when there are big, wet snowflakes. Qurbon said that it is when the first rain comes. Mulomalek noted that winter is ending when the sun shines brightly, and a few individuals in the workshop were in consensus that it is when the light of the sun hits a particular point of the *varmoi* though were unsure which point it was (Savnob workshop). Seven individuals mentioned specifically that winter has ended when the snow melts (Savnob interviews: Malomalek, Aslibegum, Mastale, Marvori, Ilchibekova, Ekbolsho, Chilla). Ekbolsho noted that after *Navruz* the snow is usually melted. According to Chilla, as soon as the snow melts, it is time to plant.

The *zird gulak* (*Taraxacum officinale*, dandelion) was mentioned by several individuals mentioned as the first flower to appear in spring (Savnob interviews: Aslibegum, Chilla, Topchibek). Chilla said that the *zird gulak* usually appears in February or March and is dependent on the snow.

Arrival of the Birds

Four people said that the arrival of ducks from the south was an indicator of spring (Savnob interviews: Baktibek, Shahlo, Schokoman, Mulomalek). These individuals noted that the ducks come first, followed by other migratory birds. Mulomalek was the only person to describe specific ducks and told us that their migration patterns are dependent on the weather: "There are three ducks that come in the springtime. *Churpai* is black all over and has no webbing on its feet; *sholtakar* has a red crest the rest of its body is brown; *kabitsor* is brown and red, and is smaller than a goose. They all

come in spring, nest here, and leave in the fall." (Mulomalek, Savnob interview). More research is necessary to determine the common English or scientific names of these ducks.

The arrival of the *zhil zhilok* bird (*Motacilla alba*, White Wagtail) to Savnob was mentioned as a distinct sign of spring and plowing time by people in the workshop as well as seven interviewees (Savnob workshop, Savnob interviews: Chilla, Odilkhon, Kosembek, Sarkori, Ayubov, Topchibek, Mastale). The *zhil zhilok* arrives in March, before plowing and *Navruz*. According to Topchibek, the *zhil zhilok* arrives just after the first dandelion appears in Roshorv. Sarkori told us that the *zhil zhilok* leaves when plowing is finished, though Topchibek said it stays until September (Savnob interviews: Sarkori, Kosembek, Ayubov, Topchibek).

The *mandozak* (swallow) also arrives in early spring (Savnob interviews: Kosembek, Topchibek, Mastale, Schokoman). The *mandozak* arrives just a few days after the *zhil zhilok*, leaves during the summer, and comes back in August during the harvest (Savnob interviews: Kosembek, Mastale). Two individuals, Mastale and Schokoman, mentioned the *khofta* bird (*Cuculus canorus*, Common Cuckoo), that also comes in the spring. Mastale says that the bird comes around the 5-10th of April, before the *zhil zhilok*. Schokoman, on the other hand, said that the *khofta* comes in May, during plowing. Schokoman was also the only person to mention the *kharga* (crane) which he said arrives in May during plowing as well (Savnob interviews: Mastale, Schokoman).

The arrival of the *babub* to Savnob (*Upupa epops*, Eurasian Hoopoe) was mentioned by six interviewees as an indicator of spring (Savnob interviews: Sarkori, Chilla, Odilkhon, Kosembek, Ayubov, Topchibek). Odilkhon noted that the *babub* comes after the *zhil zhilok*, while Kosembek said that it arrives a few days after the *mandozak*. Topchibek said that the *babub* comes after the *zhil zhilok* but leaves before it does. He notes that the *babub* is very sensitive to the weather.

Topchibek and Mulkabek both mentioned the sound of eagles nesting on the mountain as another sign of spring: "Eagles make nests in very dangerous places in the mountain, where no one

can go. In early spring, around April and the time of plowing, they begin to shout, and we know that it is their time of nesting" (Savnob interviews, Topchibek).

Farming Activities Begin

Navruz is celebrated on the vernal equinox, March 21st, to welcome the new year. It was noted in the workshop that oxen used to come out for plowing on *Navruz*, but now this is happening later (Savnob workshop). Though in almost every interview *Navruz* was mentioned as the beginning of a new year and coming spring, six individuals noted specifically that the date of *Navruz* (March 21st) was in and of itself a sign of spring and a cue to begin plowing and planting (Savnob interviews: Mastale, Ilchibekova, Ayubov, Marvori, Riswonova, Mulkabek).

Following *Navruz* is the celebration of *Amal* on April 1st. People in Savnob said that in "normal" years, snow melts after the *Navruz* celebration and plowing begins during Amal on April 1st (Savnob workshop, Interviews: Ilchibekova). Four individuals marked *Amal*, April 1st, as the time to begin plowing (Savnob interviews: Ilchibekova, Ekbolsho, Ayubov, Mastale). Ayubov said that initiating plowing on *Amal* comes from ancient times (Savnob interview, Ayubov). Others noted that while this is the general date to think about plowing, there is variability based on the weather. Both Mastale and Ekbolsho stated that while people usually plow on April 1st, this spring 2017, the harsh weather pushed him to begin plowing and planting on April 10th (Savnob interviews: Mastale, Ekbolsho). Ilchibekova agreed that in "normal" years, plowing begins during *Amal*, though this can vary significantly with weather (Savnob interview: Ilchibekova).

During the workshop, people agreed that the appearance of steam from the ground, due to the warming of the land and the drying of the soil, is indicative of spring and the time to plow and plant (Savnob workshop). According to Kosembek, steam was used as a seasonal indicator in ancient times, and while some people still use it, it is not as widely used today as it used to be

(Savnob interviews, Kosembek). Riswonova, Kosembek, and Odilkhon all mentioned in their interviews that the steam always appears on *Navruz*, or just before, during the period of *tarozu* (March 18-21st). However, other interviewees alluded to this phenomenon being subject to variability. Marvori said that this year, in spring 2017, the steam came in early March, while Riswonova said that it didn't happen until April 10th this year (Savnob interviews: Marvori, Riswonova). Sarkori said that he didn't see the steam until April 18th (Savnob interview: Sarkori).

When *namok*, wet soil, has a warm, partially dry quality, this denotes that it is time to plow and plant in Savnob. Eight individuals mentioned that they know to plant after the land is clear of snow, when the soil has become warmer and drier (Savnob interviews: Marvori, Ekbolsho, Mastale, Riswonova, Kosembek, Sarkori, Mulomalek, Kholmirozo). According to Ekbolsho, this usually happens around March 25th, while Sarkori told us that in spring 2017, the soil was still too wet to plow on April 8th. Both Mulomalek and Kholmirozo said that they know it is time to plant when the soil is above 10 °C, though they feel the soil temperature sensorially: "When we plow, we feel the soil with our hands and feel the warmth. Then we know it is time to plant" (Savnob interviews, Kholmirozo). Ekbolsho and Mastale also illustrated the sensorial when determining if the soil is ready for planting, by looking at the land to see that it is drying out. They both said, "You can see that the land drying out" (Savnob interviews: Ekbolsho, Mastale). According to Riswonova, there is variability in the timing of soil drying among farmland in Savnob: "When we see the steam coming, we begin to plow on higher ground, because the snow melts and it becomes dry there faster" (Savnob interview: Riswonova). Marvori said that she knows it is time to plow when the old men in the village come out with their oxen to the fields, and this spurs others in the village to do the same (Savnob interview, Marvori).

After the initial cues of steam and the drying of soil, the schedule of planting activities follows in sequence. The annual planting cycle in Savnob begins with barley, followed by wheat,

then potatoes and other vegetables. In the workshop, people said that the time to plant barley is when one feels heat coming from the ground (Savnob workshop). Sarkori told us that, according to the oldest people in the village, people in Savnob need to plant barley early, in late March, because the weather is supposed to be cold (Savnob interview, Sarkori). Savnob, being a *poitakht* village, needs a colder, wetter climate to plant barley in, so that is why people in Savnob plant barley earlier than in Roshorv (Savnob interview, Ayubov). Riswonova mentioned: "Most of the people here don't grow barley. Most people here grow wheat. When I plant barley, someone else might be planting wheat at the same time" (Savnob interview, Riswonova).

Riswonova also described planting variability in terms of access to resources: "The people don't all have oxen, so we have to share the oxen, and that is why we plant until the end of April" (Savnob interview: Riswonova). According to Sarkori, he didn't have oxen to plow this year, so he borrowed his neighbor's oxen when he was done plowing, which is why he planted barley later than usual (Savnob interview: Sarkori). Ekbolsho also mentioned his place in this sharing network: "I have an ox, so I first plow my land. If my neighbor doesn't, then he will borrow my ox after I plow, and then the other families" (Savnob interview: Ekbolsho).

Gharj (*Onobrychis sp.*), a staple fodder crop in Savnob, is planted during barley planting, but only has to be reseeded every 10-15 years (Savnob workshop). *Gharj* is planted along with barley in the same plot for the nutrients they provide one another. Then, barley is harvested in August, while the *gharj* continues to grow on that plot of land (Savnob interview: Qandak).

In Savnob, wheat is planted in sequence after barley. According to workshop attendees, wheat can be planted from April 1st – May 25th, and is usually planted around ten days after planting barley (Savnob workshop). However, the later wheat is planted, the more likely it is to be eaten in the autumn by the *mekhnul* (finch) and other migratory birds (Savnob workshop). There are two main varieties of wheat in cultivation in Savnob, both of which are local varieties: *rushtak* (red wheat)

and *safedak* (white wheat) (Savnob workshop, Savnob interview: Odilkhon). Most people who were interviewed said that they only plant *safedak* wheat, but mentioned that *rushtak* it is planted earlier in the spring than *safedak* (Savnob workshop).

In several of interviews, individuals spoke of Savnob's climate as not ideal for growing *rushtak* wheat anymore (Savnob interviews: Ekbolsho, Kholmirozo, Topchibek). In two interviews, we were told that people don't plant *rushtak* in Savnob because the warm spring water causes it to develop rust, pathogenic fungus (Savnob interviews: Kholmirozo, Topchibek). "In the past, I got a very good harvest [from *rushtak*] because the water was colder then. As the water started getting warmer, rust happened more frequently, so I stopped growing *rushtak*" (Savnob interview: Kholmirozo). As noted earlier, *rushtak* is an essential ingredient for a dish called *cochi*, which is made for the celebration of *Boj ayom* (Savnob interview: Marvori). The loss of *rushtak* in Savnob due to a warming climate is also a loss of culture.

Potatoes are the next crop to be planted after wheat. People in Savnob often buy their potato seeds from Roshorv, because of Roshorv's colder weather (Savnob workshop, Savnob interview: Ekbolsho). After potatoes, all of the other vegetables are planted (onions, carrots, cabbage, beets, etc.) (Savnob workshop, Savnob interviews: Chilla, Ilchibekova, Khomirozo). This is also when vegetables that were started in greenhouses are transplanted to the fields (Savnob interviews: Riswonova, Mulkabek).

Birthing of Livestock

Three people spoke about livestock giving birth between March and July (Savnob interviews: Aslibegum, Qandak, Topchibek). Aslibegum said that yaks and cows are born in March and April, and told us that the goats are born between March and May. Qandak, a yak herder and chief of the Farm Organization in Aktash, said he goes to the high pastures of Aktash in April to watch the birth

of the yaks, to learn how many yaks are born, how many have died over the winter, and how the herders have spent their winter. He says that the female yaks give birth from April to July, and that once they are born, the calves are taken from their mothers and kept at camp, while the females are free to roam during the day and come back to their calves at night (Savnob interview, Qandak).

Topchibek mentioned that chickens give birth in Savnob in May and June, and this is the time that foxes begin to come into the village and attack the chickens. Since people in Savnob do not have good places to protect their chickens from the foxes, only a few people keep chickens. Mountain Societies Development Support Programme (MSDSP) brought chickens to Savnob in 2007. Before then, no one in the village kept chickens (Savnob interview, Topchibek).

Blossoming of Fruit Trees

Nine individuals spoke about the blossoming of fruit trees as a sign of spring (Savnob interviews: Kosembek, Chilla, Ekbolsho, Ilchibekova, Kholmirozo, Mastale, Ayubov, Schokoman, Topchibek). Apricots, apples, mulberries and cherries were the most commonly mentioned cultivated fruits in Savnob.

Apple, apricot, cherry, mulberry and peach trees have relatively similar blossoming times, and a number of people noted that the blossoms were 8-10 days late this year because of the harsh winter (Field notes). Kosembek, Ekbolsho and Chilla all agreed that in general, the fruit trees begin to blossom in late April, while Ilchibekova said that they usually start to blossom in mid-April, but this year the blossom time was two weeks later (Savnob interviews: Kosembek, Ekbolsho, Chilla). Kholmirozo commented on how his fruit trees blossomed later this year, by one week, noting, "if the weather is dry, they will blossom very early" (Savnob interview, Kholmirozo). On the other hand, Kosembek said that the fruit trees always blossom in late April, and "even this year with the hard winter, they blossomed at the same time" (Savnob interview, Kosembek).

When asking about the specifics of blossom times, there was much variability in responses. The general sequence of events can be summed up by a quote from Ekbolsho: "In late April and early May, the apricots and apples blossom. The mulberry blossoms a few days after the apricot, and the cherry blossoms two or three days before the apple and apricot" (Savnob interview, Ekbolsho). Topchibek, however, specifically noted that the cherry blossoms at the same time as the apricot. Schokoman expressed that his apple trees blossom 1-2 weeks after his apricot trees, and Kholmirozo's apple trees seemed to blossom almost a month later than his apricots (Savnob interviews: Topchibek, Schokoman, Kholmirozo). According to Schokoman, just five people in Savnob have peach trees, which came from Basid and blossom in early May (Savnob interview, Schokoman).

In the past, when apple trees were blossoming, it was time to plant *pinj* (millet), but *pinj* is no longer planted in Savnob. Kholmirozo remembers the exact date he last planted millet, on June 5th, 1984. "This was the last year I planted millet because I lost the seeds. The Aga Khan Foundation (AKF) had a special program for growing millet here. After cutting barley, we used to plant millet. It did not have enough time to mature before the livestock came back, so it did not grow well here." Odilkhon saves *pinj* seeds in case they can one day plant it again in Savnob (Savnob interviews: Kholmirozo, Odilkhon).

Summer Settles In

When snow first melts in areas surrounding Savnob, between early April and late May, large livestock, yaks and cows, are taken to nearby forests of Voyd-Buth or Kanabin. In the workshop, it was mentioned that large livestock are taken to these forests before the insects arrive in spring, and it was also mentioned that if there is enough grass, herders do not take the animals to the forest

(Savnob workshop). Oxen and donkeys are taken to a nearby pasture in Ruj after plowing finishes, which is generally around May 5th (Savnob workshop).

In late spring, when most of the snow has melted, the small livestock (goats and sheep) are taken to the summer pastures (Savnob workshop). The people of Savnob choose a herder to take the small livestock to the high pastures for the summer, and sometimes give their livestock to relatives in Roshorv because of Roshorv's easier access to summer pastures (Savnob interviews: Sarkori, Qandak). Herders usually leave the village around May 20th, but this also depends on whether or not there is heavy rain, which can be difficult for small livestock. The date of May 20th for bringing livestock to the summer pastures is a relic of Soviet-era collective farming (Savnob interviews: Qandak, Sarkori).

The small livestock that stay in Savnob for use over the summer are taken to nearby pastures by a work-sharing rotation of herders from the village. Sarkori said that he would bring livestock to pasture in all four seasons if it weren't for the snow in the winter. In years with less snow, they are able to bring the livestock to pasture for more of the year (Savnob interview: Sarkori).

Yaks remain in the high pastures of Aktash through the winter unless one is needed in Savnob (Savnob interview: Qandak). Qandak, a chief yak herder from Savnob, said that they know that summer begins to get warmer and to move to the top of the pasture in Aktash when the ibex gives birth, which is around June 5th in Aktash (Savnob interview: Qandak). According to Sadonsho, if the smaller livestock was brought to the high pastures of Aktash, they would eat all of the grass, and because the yaks pose a threat to the smaller livestock: "In 1995-1998, this decision was made. All of the Bartangi people decided together not to bring livestock to Aktash territory anymore because the yaks are somewhat wild and they will attack the smaller livestock" (Roshorv interview: Sadonsho).

After animals are brought to the summer pastures, people in Savnob feel that summer has arrived (Savnob interview: Aslibegum). Sheep mate in June and July when they are taken by herders to the summer pastures (Savnob interview: Aslibegum). Summer is also denoted by the presence of many birds and flowers that have come back, and when both wild and domestic plants are growing more fully (Savnob interviews: Aslibegum, Topchibek). In early summer there is a rainy season, which sometimes affects the wheat by knocking down the stalks (Savnob interviews: Ekbolsho, Riswonova). By August, snow has melted and wild grasses have grown to their fullest (Savnob interview: Odilkhon).

Summer is also the time when pests arrive. Two interviewees mentioned that the arrival of mosquitos was a sign of summer. Mulkabek said that mosquitos used to appear from June until August, but now they are not appearing as much due to heavier winds in the summertime (Savnob interview: Mulkabek). Topchibek, however, said that there were many mosquitos around at the time of our interview with him (July 8th), because it was very warm and mosquitos like warm places, especially near the river (Savnob interview: Topchibek).

Chilla and Kholmirozo mentioned that the *chirum* (gray grub) arrives in the summer and eats potatoes, onions, cabbages, and tomatoes. Chilla said that the pest comes at the same time every year, between the end of June and the beginning of July, while Kholmirozo said that it only comes sometimes (Savnob interviews: Chilla, Kholmirozo). Kholmirozo said he doesn't use insecticides on the *chirum*, and Chilla said that she used an insecticide for the *chirum* for the first time this year that she bought from the village of Rushan. Usually, she uses *hamochathed*, the ash of *teresken* (*Krascheninnikovia ceratoides*), to kill any insects, which she said only works sometimes (Savnob interview: Chilla).

Several individuals mentioned the *mur* (caterpillar) as a pest that eats cabbage leaves, as well as onions, tomatoes, and potatoes, in the summer (Savnob interviews: Mulomalek, Odilkhon, Chilla,

Topchibek). *Mur* lays eggs on the cabbage leaves, where caterpillars emerge in the summer and autumn (Savnob interviews: Odilkhon, Mulomalek). The caterpillar comes when the weather is warm, and not in cold and rainy summers (Savnob interviews: Mulomalek, Chilla). The *mur* eats apples and apricots as well, but doesn't affect the wheat and barley (Savnob interview: Mulomalek). Mulkabek showed us his grafted apricot trees, and told us that the *mur* do not eat the grafted apricot variety, and the grafted trees produce bigger and sweeter fruits (Savnob interview: Mulkabek). The *zadush* (grasshopper), on the other hand, eats everything, including wheat and barley (Topchibek, Mulomalek). *Zadush* affect the crop in Roshorv from time to time, but do not show up as often in Savnob (Savnob interview: Mulomalek). Topchibek also mentioned an insecticide that people buy from Rushan to spray on the cabbage and apricot leaves (Savnob interview: Topchibek). According to Odilkhon, there are more insects now than in the past that destroy vegetable crops because the cold has not been killing the insects (Savnob interview: Odilkhon).

Joth is the time around summer solstice, when the days begin to become shorter (Savnob interviews: Riswonova, Mulkabek). "When we hear the cranes screaming from their nests in the mountains, we know that it is *joth*, the time when the days become longer. Some people say that the cranes become blind during this time. This time is foggy" (Field notes, Mulkabek). According to Riswonova, *joth* signifies the time for collecting *virn* (mint): "*Virn* is collected now, in late June. We call this time *joth*. This is when the days become shorter than the nights, around summer solstice, and the weather becomes hotter. I don't know how long this period is. It might be for fifteen days" (Savnob interview: Riswonova).

Summer is the primary time when wild plants are gathered in and around Savnob. The following plants and their uses were each mentioned multiple times in Savnob interviews as important wild plants to be gathered in the summer: *kaisarkhula* (unknown sp., used in a wrap for broken bones), *nakhchir woschak* (golden root, *zalatoikoren* in Russian), *chabir* (unknown sp., four

merous, multistaminate), used for scratches and as internal medicine, made into a tea for tuberculosis, used to warm a cold body), *shilkha* (sorrel), *zira* (*Bunium persicum*, black cumin, used in tea and as a spice in *pilau*, local dish; used for headaches), Chamomile (unknown local name), *kakhschavergul* (alpine daisy, *ramashka* in Russian, used for stomachaches, colds and coughing), *rag woschak* (*Plantago major* L., plantain, *padarojnik* in Russian, used for cuts and stings), *yob* (unknown sp., used as a tea for stomachaches, burned in religious celebrations), and *virn* (*Mentha* sp., mint, used for tea and stomachaches). (Savnob interviews: Odilkhon, Aslibegum, Marvori, Kosembek, Riswonova, Chilla, Ekbolsho, Ilchibekova, Olomali, Mastale). Other wild plants that were mentioned just once in interviews were: *pukht* (unknown sp., used as a soap for cleaning clothes), *charefs* (unknown sp., used for muscle pain), *gamch* (wild onion, used in food), *tsakh* (wild onion, used in food), *valadol woschak* (unknown sp., *chibrets* in Russian, used for breathing at high elevation), *wadar* (unknown sp.), juniper root (unknown local name, used in tea for stomach aches), *aschar* (*Rosa canina* L., dog rose, hip used for tea), and *khuchef gharj* (unknown sp., used to heal broken bones for humans and animals) (Savnob interviews: Aslibegum, Chilla, Ekbolsho, Kosembek, Mastale).

According to Aslibegum, the best time to gather wild plants is in June and July. When the flower of the plant itself is open, you know that it is ready to be gathered (Savnob interview: Aslibegum). Chilla said that she collects *kakhschavergul* at the end of July and collects *zira* and *virn* in nearby pastures, or by the brook in Savnob, at the end of August (Savnob interview: Chilla). Riswonova noted that *shilkha* is gathered when it grows tall and the flowers begin to fall, but for *chabir* she said that there is no particular sign from the flowers or leaves that tell you that it's time to gather it (Savnob interview: Riswonova). *Zira*, *virn*, and *rag woschak* were all said to be found in Savnob, but there are different varieties of *virn* in the nearby pastures (Savnob interviews: Olomali, Chilla, Ekbolsho). The pastures of Ruj, Thorgal, Zhuzhuf, and Chawif were all mentioned as places outside of Savnob to gather important wild plants in the summertime (Savnob interviews: Ekbolsho,

Ilchibekova, Mastale, Olomali). Olomali and Mastale both said that they gather plants when they drive their livestock to the pastures (Savnob interviews: Olomali, Mastale).

The gathering of wild fodder for livestock to feed used over the winter is an essential summer activity as well (Savnob interviews: Riswonova, Mulkabek). *Teresken* (*Krascheninnikovia ceratoides*), *lavlivosh*, *khuvd woschak*, *sadikhs*, *ravs*, *ug*, and *spafneg* are all types of wild fodder that grow in the mountains and are gathered during the summer to feed animals through the winter (Savnob interviews: Mulkabek, Riswonova). Though *virn* (mint) and *shilkha* (sorrel) are gathered for human consumption, they are also used as fodder for the animals (Savnob interview: Riswonova). *Chamoth* was mentioned by Qandak as being a plant that is good for livestock and makes the animals' wool better, but it was also noted by someone in Roshorv as a plant that is dangerous for livestock and if they eat it they go blind (Savnob interview: Qandak, Roshorv interview: Zubujin).

While gathering wild plants did not come up in a number of interviews, two individuals explicitly said that they do not gather wild plants, or that their grandparents used to but that they don't anymore (Savnob interviews: Solaymoshoeva, Kosembek).

> "The people here don't have any information about [gathering wild plants] and how to use the plants that grow in the pastures. This was only in the past, in ancient times. During ancient times, food was a problem. People didn't have enough harvest for one year. Then, the people would climb to the pasture and gather things to eat there. People don't need to do this anymore" (Savnob interview: Kosembek).

Marvori spoke about two domesticated plants that have been used as medicine in the past: *shagarm* (turnip root) and *zagir* (root vegetable, like a carrot, not planted anymore). "*Shagarm* is used for itching (the root is eaten). I remember that we grew watermelon, melon, turnip, *pinj* and *zagir* from 1965-1968. *Zagir* was useful for women during childbirth. It would make people strong and able to get up from the bed and would help with lactation." (Savnob interview: Marvori).

When we asked Marvori if she had noticed any change in the timing of wild plants' life cycles over her life, she said: "When the *ashar* (dog rose) began to flower, the people would begin to plant *pinj* and turnip. Now, the *ashar* plant flowers in mid- to late June so it is not used for *pinj*. Some people just planted turnip now (around June 24), during the flower time of *ashar*" (Savnob interview: Marvori). In a conversation with Mulkabek, he told us that the *aschar* blossoms when water comes to the pastures in Ruj valley (Field notes).

Nosh Boz

For cherries, harvest is in late June and early July (Savnob interview: Mastale), while apricot and apple harvest is in late July and early August (Savnob interviews: Kosembek, Ilchibekova, Ayubov, Topchibek). According to Mulomalek, there are early ripening apricot varieties, which are ready to harvest in July, and some ripen later. Chilla stated that she harvested her apricot and apple trees in late August last year, and thinks that with the late winter this year she wouldn't harvest until September (Savbnob interview: Chilla). With later-ripening apricots, migratory birds will eat the fruit and leave the seeds on the stem (Savnob interview: Mulomalek). Ayubov noted that the apricot harvests in *poitakht* villages are ten days ahead of one another as you move downstream and down in elevation. For example, Yapshorv, the next *poitakht* village downriver from Savnob, will be eating apricots ten days before Savnob, and Basid, the next *poitakht* village downriver from Yapshorv, will be eating apricots ten days ahead of Yapshorv (Savnob interview: Ayubov).

Our most adventurous experience in the Bartang valley was initiated by our discovery of the meaning of *nosh boz*, which refers to "ripe apricot" as well as "time of flooding" (Savnob interview: Topchibek). When we awoke in Roshorv on the morning of July 8th, we were told by our host, Saradbek, that the *Thiu Dara* was running, whose name means "crazy river." Saradbek told us that when he was young, and the *Thiu Dara* would flow three times, they would know that the apricots in

Yapshorv would be ready, and they would travel there to buy them (Field notes). He also told us that we should try to get out of the Bartang valley in the next few days, or else we would be stuck due to road washouts. We still had work to finish in Savnob, so we left Roshorv to conduct a few more interviews in Savnob before heading out of the Bartang Valley to our next field site in Kyrgyzstan. Sure enough, when we arrived later that day in Savnob, we were welcomed by sweet, fresh apricots at Mulkabek's house. Mulkabek told us that when the apricot is ripest, the water in the river is highest and floods the roads, so we'd better leave soon if we didn't want to get stuck (field notes).

We learned how the ripening of apricots is correlated with a period of rapid warming, when glacial waters melt so rapidly that the roads in the Bartang valley wash out and limit access to and from mountain villages like Savnob and Roshorv. After a day and a half of wrapping up interviews in Savnob, we set out by car in the early morning of July 10th, aiming to travel east up the Bartang Valley and over Kok Jar Pass, because the roads to the west to Khorog, the way we came, had already been destroyed. Roughly 20 miles past Ghudara village, the highest village in the Bartang valley, we were met by a missing road that had become a swift cut bank of the Bartang river. We waited in limbo for three days between Ghudara and the road ahead, while road workers from Ghudara worked tirelessly to rebuild the road each day, only for the river to rise from rapid glacial melt and wash out the road again by night. On the evening of the third day, filled with boundless gratitude for the people of Ghudara for clearing the road and feeding us in the meantime, we were able to pass the washout and make our way over Kok Jar Pass by nightfall and across the border to Kyrgyzstan the following day.

Arrival of Autumn and Harvest

Though crop harvest usually happens in late summer and fall in Savnob, *gharj*, like other wild fodder plants, is harvested throughout the summer. According to Qandak, there are four *gharj* harvests: the first on June 5th, followed by harvests on July 15th, September 1st, and early October. People know that the *gharj* is ready to harvest when its flowers have bloomed 30-70 percent (Savnob interview: Qandak).

In Savnob, barley is harvested before wheat. In the workshop, attendees agreed that barley is harvested from the 25th of July to the 5th of August, and *safedak* wheat is harvested from the 10th of August to the end of August. *Rushtak* wheat is harvested ten days after *safedak* (Savnob workshop). However, there is variation in harvest times among individuals. Schokoman said that he cuts barley between the 10th and 15th of July, and cuts wheat from July 25th to the beginning of August (Savnob interview: Schokoman). Odilkhon said that his grain harvest usually lasts until the 15th or 20th of August, but that this year due to the late winter, it may last until early September. Topchibek and Mulomalek both said that they harvested barley and wheat in mid- to late- August in 2016, while Sarkori, Ekbolsho, and Mastale all said they harvested barley and wheat in mid-September in 2016 (Savnob interviews: Odilkhon, Topchibek, Mulomalek, Sarkori, Ekbolsho, Mastale).

The arrival of migratory birds that eat ripening grain was mentioned as a sign of autumn in seven interviews. *Mekhnul* (finch), *rashsid* (*Carpodacus erythrinus*, Common Rosefinch), *mandozak* (swallow; *lastochka* in Russian), and *khofta* (*Cuculus canorus*, Common Cuckoo) birds were all said to come to Savnob during the time of grain harvest (Savnob interviews: Artismo, Mulomalek, Odilkhon, Sarkori, Schokoman, Mastale, Ayubov). According to Mulomalek, the *mekhnul* and the *rashsid* come at the same time each autumn. In previous years, when the weather in the autumn was cooler, these birds would come at the end of August to eat the crops, and people would have to scare them away by playing drums or shaking a can of pebbles (Savnob interviews: Artismo,

Odilkhon, Mulomalek). Now, people are harvesting wheat and barley earlier, but the birds still come at the same time in late August and eat grain if it is available, or fruit from the trees (Savnob interviews: Mulomalek, Odilkhon, Sarkori). Odilkhon told us that the birds still come in autumn, but there are not as many as there were ten years ago. He thinks that this is the influence of climate change (Savnob interview: Odilkhon). The *charthoch* (*Passer montanus*, Eurasian tree sparrow) is a local bird that lives in Savnob year-round and also eats grain crops in the autumn (Savnob workshop, Savnob interviews: Odilkhon, Topchibek).

The return of cold weather to the summer pastures is the cue for farmers in Savnob to complete their harvest activities. Potatoes and other vegetables are harvested just before livestock arrive back to the village from summer pastures, because the crops will otherwise be eaten by livestock (Savnob workshop). This poses a problem in years when there is a late spring, like in the spring of 2017, because planting and harvesting times are pushed later. People need to harvest before the animals return from pasture, but they cannot harvest plants early because they will not last in storage over the winter if they are not ripe (Savnob interview: Odilkhon). If people in Savnob had other methods to protect their crops against livestock, like fences, they would wait even longer before harvesting their vegetables (Savnob Workshop; Savnob interviews: Aslibegum, Odilkhon). If the crop isn't ripe before the livestock come back, people will give their livestock to relatives in Roshorv or other villages for herding until the harvest is finished (Savnob interview: Topchibek). The potato and vegetable harvests usually take place at the end of September and beginning of October (Savnob workshop; Savnob interviews: Odilkhon, Riswonova, Marvori).

Herders know that it is time to return from summer pastures when the weather becomes colder, when ice forms in the morning in ice buckets or streams near camp, or when they see water levels declining in the streams (Savnob interviews: Qandak, Riswonova). When there is snow in the high pastures, livestock cannot be fed on the mountains and they need to move to lower elevation

(Savnob interview: Odilkhon). Herders may also decide to leave summer pastures when wolves begin to appear (Savnob interviews: Aslibegum, Topchibek). Now, with cell phones, shepherds can call to alert the village that it has gotten too cold or snowy in the pastures and that it is time to bring the animals back (Savnob interview: Qandak). Aslibegum noted that in the past, herders would return from the pastures 10-15 days later than they do now, closer to mid-October rather than late September, as it is now (Savnob interview: Aslibegum).

The presence of frost in Savnob is another indicator of coming winter and the need to finish the vegetable harvest (Savnob interviews: Mulkabek, Kosembek). Mulkabek mentioned two types of frost, the first is *khutsoon*, which is coldness, and comes from the 1st to the 10th of September. *Tamoku* (tobacco) can be destroyed by the first frost, but if they are watered just before the frost then they won't die (Savnob interview: Mulkabek). The second frost takes place around the autumnal equinox (Savnob interview: Kosembek).

After the harvest, the people of Savnob have a festival of thanksgiving called *Sol pokhta*, when farmers beat sickles together and say, "we will bear seed next year." There is also an animal sacrifice at this time, which is called *kikhtov* (Savnob workshop). Another festival that sometimes occurs between autumn and spring is called *Balog ordon*. This festival is takes place when something bad happens, such as an avalanche, and bad spirits need to be sent away from the home (Savnob workshop).

Winter Quiet

In Savnob, the coming of winter is marked by the time of harvest, days becoming shorter, the yellowing of tree leaves, and looking after animals after they come back from the summer pastures (Savnob interviews: Aslibegum, Chilla, Riswonova). Cows, goats, and yaks mate in the high pastures from late August to late September (Savnob interviews: Aslibegum, Qandak). The animals

that survive the summer and return from the pastures in September are more fit, and sheep give birth in Savnob in November (Savnob interviews: Odilkhon, Aslibegum). When the cold weather comes, in October or November, migratory birds like the *babub*, *khofta*, *rashsid*, and *mekhnul* leave Savnob (Savnob interviews: Ayubov, Sarkori, Mastale, Mulkabek). Snowfall marks the winter (Savnob interviews: Aslibegum, Chilla).

Though the winter is a period of rest in Savnob, there is still work to do. People feed their livestock multiple times a day, take care of housework, and keep their rooves clear of snow. When there isn't much snow, people can take their livestock to the winter pastures to save on stocked fodder (Savnob interviews: Riswonova, Qandak). When winter begins to turn to spring, usually around February, this is the hardest time for the livestock. This is when the animals have lost their weight, and fodder harvested in summer begins to run out. During this time, animals are fed the silage from barley and wheat as well as grain from barley from the past summer if it is available (Savnob interview, Qandak).

Qandak mentioned the period of roughly 40 days called the *chilla*, which marks the coldest, darkest time of the year. The *chilla kalom*, or big *chilla*, is from December 1st until the 20th, and is when the days are getting shorter than the nights. From December 20th until January 10th, when the days begin to get longer, this is called the *chilla khod*, or small *chilla* (Savnob interview, Qandak). Mulkabek noted that the land usually stays frozen during this time in December (Savnob interview, Mulkabek).

The 20th of January until 21st of January is called *qid*. This time indicates that everything during the winter has died and that things are now becoming alive again (Savnob interview: Qandak). Qandak told us: "I heard a story about a man who had a son. On the 20th of January the son went hunting and didn't come back. They said that if by sunrise he wasn't dead, then he would

return because the sun would come into the body of the man. By sunrise on January 20th, the weather was warmer, so he wouldn't catch cold" (Savnob interview, Qandak).

Section Five: Perceptions of Climate Change in Savnob

> "People in Savnob are especially concerned about the climate of Pamirs changing – they know this from the TV or radio. Some people go to Ruj valley and have observed the changes in the glaciers, and they have discussions about this." – Olomali, Teacher, Savnob
>
> "We saw on television that the weather is becoming warmer, that the glaciers are melting more than in the past, but we don't know if this is true." – Ayubov, Farmer, Savnob

Warmer now

Nine people we interviewed in Savnob stated or alluded to a warming trend for the climate in the Bartang valley (Savnob interviews: Odilkhon, Mulkabek, Solaymoshoeva, Kosembek, Ekbolsho, Kholmirozo, Mastale, Mulomalek, Porshanbey). Kosembek, Odilkhon, and Ekbolsho each mentioned that they know it is getting warmer because the glacier in nearby Ruj valley is receding. Odilkhon told us that they used to take the oxen to Ruj and walk across the glacier, but they can't cross over it anymore because it is melting. Kholmirozo said that *rushtak* wheat used to grow well in Roshorv, but that warm weather has made wheat rust more prevalent, so he can't grow *rushtak* anymore. Mulomalek told us that he knows the weather is becoming warmer because wheat is harvested in mid-August now, whereas it used to be harvested at the end of August, when the *mekhnul* and *rashsid* birds arrive. Mulkabek said that he knows it is getting warmer because elders from Nisur had told him that in the past it was so cold that the partridge would freeze on the tree, and now it is not as cold as that. Others mentioned that it just *feels* warmer (Savnob interviews: Solaymoshoeva, Topchibek, Mastale).

Colder now

In six interviews, people stated that overall, the climate in the Bartang valley is getting colder (Savnob interviews: Mulkabek, Qandak, Riswonova, Ayubov, Odilkhon, Ilchibekova). Mulkabek, Topchibek, and Riswonova all spoke about how they remember the weather being warmer as children. When they were children, Mulkabek and Topchibek both said that they would go swimming at the end of May until late September, but now that it is colder, children don't swim for as much of the summer. When Riswonova was younger, the weather was warm enough in Savnob to grow watermelon. Now, she says, people can't plant watermelon because of the changing weather. According to Odilkhon, the weather was so much warmer in the past that his father and grandfather would sleep in the mountains in the summer to escape from the heat and the insects it would bring. Mulkabek also mentioned that there are less mosquitoes now than in the past, but attributed this to increasing winds rather than temperature.

In ten interviews, the winter of 2016-2017 was mentioned as bringing an unusually large amount of snowfall for the Bartang valley, creating a late spring and affecting livelihood activities in Savnob (Savnob interviews: Mastale, Topchibek, Schokoman, Ilchibekova, Ekbolsho, Ayubov, Mulkabek, Odilkhon, Aslibegum, Chilla).

Increased variability

Five people noted that weather has gotten more variable (Savnob interviews: Ilchibekova, Marvori, Topchibek, Odilkhon, Mulkabek). According to Marvori, when she was younger, "the weather was not so warm and not so cold – it was milder" (Svanob interview: Marvori). Topchibek told us: "The seasons are changing. Now the winter is warmer, the spring is cloudy and windy, and the summer is cooler, but the autumn is becoming hot" (Savnob interview: Topchibek). Mulkabek

had a similar sentiment, stating that "the seasons are not staying in their place" and told us that the spring is becoming colder and the winter is becoming warmer (Savnob interview: Mulkabek).

Five interviewees specifically mentioned increasing winds affecting livelihoods in Savnob (Savnob interviews: Ilchibekova, Marvori, Kholmirozo, Aslibegum, Kosembek). Ilchibekova spoke of an increase in heavy winds bringing colder weather to Savnob. Marvori and Khomirozo mentioned that it is windier during plowing and harvest, which can knock down the wheat crop and lead to a poor harvest. Kosembek and Aslibegum both spoke about a strong wind that came in June about three years ago. Many large poplar and fruit trees in Savnob were destroyed by this wind.

No change

Three other individuals told us outright that they have not noticed any changes in the weather throughout their lifetimes (Savnob interviews: Chilla, Schokoman, Kholmirozo). Neither Riswonova or Aslibegum thought that changes in weather were more frequent now than in the past – they both said that unusual weather always comes and goes (Savnob interviews: Riswonova, Aslibegum).

Section Six: Microclimatic Variation in Savnob

There is an irrigation stream that divides Savnob into two sections: *wombi zamin* and *sai zamin*. *Wombi zamin* means "ancient land" and refers to the farmland south of the stream, which has been cultivated for the longest time and is considered to be the most fertile soil. *Sai zamin*, which lies north of the stream, means "new land," and has been converted from pastureland more recently. *Sai zamin* is mixed with more stones and has warmer soil (Savnob interview: Olomali). *Sai zamin* is

planted roughly 5-10 days before *wombi zamin*, and is harvested about 5-10 days earlier (Savnob interviews: Ilchibekova, Sarkori, Ekbolsho, Mastale). According to Ekbolsho, *sai zamin* needs to be planted when it is still a bit wet, because it dries out faster than *wombi zamin* (Savnob interview: Ekbolsho). *Wombi zamin* is considered to have a better harvest than *sai zamin* (Savnob interview: Ilchibekova, Kholmirozo).

Section Seven: Microclimates of Roshorv and Savnob

The climate of Roshorv differs from Savnob in that it is at higher elevation and is more exposed due to a lack of protection from rock outcrops and vegetation, unlike the *poitakht* villages. Some people in Roshorv mentioned that *poitakht* villages have an easier time of growing crops because they have naturally warmer climates and their irrigation systems are spring-fed (Roshorv interview: Lalbek, Jamal). However, some people Savnob feel differently. Olomali, a teacher in Savnob who grew up in Roshorv, thinks that it is more difficult to grow crops in Savnob, because there is less water available, so people have to abide by designated times to use irrigation. He also noted that in Savnob there is limited farmland available, so you have to do the best with what you have. In Roshorv, there is more space for experimentation (Savnob interview: Olomali).

As Jamal told us, one village's good weather for crops is another's bad weather. In *poitakht* villages, like Savnob, for example, cold weather can be tolerated by the crops because of the warm, spring-water irrigation, while a cold front in the summer or autumn would do serious damage to crops in Roshorv (Roshorv interviews: Jamal). Warm weather during the summer is critical to a good harvest in Roshorv, whereas a warm spell in Savnob would be harmful to their crop (Savnob interview: Olomali).

The variation in climates between villages like Roshorv and Savnob allows for adaptive capacity for the region. Since Roshorv has vast areas of land in cultivation, they are able to sell or trade fodder to *poitakht* villages with less space to grow fodder (Field notes). Olomali noted that barley grows well in *sarad* villages, while the wheat harvest in *poitakht* villages like Savnob is usually better, so villages like Roshorv or Ghudara will often exchange barley for wheat from Savnob (Savnob interview: Olomali). Roshorv's cold climate also makes for good potato seeds, so people in Savnob and other *poitakht* villages will get potato seeds from Roshorv and other high elevation villages for spring planting (Roshorv interviews: Karamsho, Saradbek; Savnob interviews: Odilkhon, Kosembek, Kholmirozo). Ilchibekova said that she learned from her elders in Savnob to use seeds from colder climates with colder water (Savnob interview: Ilchibekova). Kholmirozo, a veterinarian in Savnob, noted that because Roshorv's cold water kills soil pests, he will get new potato seeds from Roshorv every couple years (Savnob interview: Kholmirozo). *Poitakht* villages like Savnob can offer warmer-weather crops in exchange, like apricots, tomatoes, and cucumbers (Savnob interview: Mulkabek; Roshorv interview: Saradbek; Field notes).

ILLUSTRATED ECOLOGICAL CALENDARS

One objective of this thesis is to understand the elements of ecological calendars in Savnob and Roshorv. In the findings section, I described the elements of ecological calendars that were obtained from interviews, workshops, guided walks, mapping exercises, and through participant observation. In this chapter, I present these findings in visual form and in the next, I consider how the findings can inform future research.

I have organized elements of the ecological calendars into the following overarching categories: solar / celestial events, abiotic events, ecological events, and human activities. As is evident by the nature of ecological calendars, these categories are inextricably linked, and therefore it is somewhat artificial to consider them as discrete categories. However, these categories may serve the purpose to allow for the emergence of patterns for future researchers. The below categories and components are adapted from definitions that were written in collaboration with others in the Kassam Research Group at Cornell in November 2017 (Appendix G).

Category definitions:

- **Solar / celestial events** relate to cycles of the sun or other celestial bodies
- **Abiotic events** relate to weather and climatic patterns at a local scale, though often driven by solar or celestial cycles, such as the seasons
- **Ecological events** relate to living organisms as influenced by their abiotic landscapes
- **Human activities** refer to events performed by people, such as agricultural, livelihood and other cultural activities

From the above categories, I have deduced which components of the ecological calendars are **seasonal indicators**, **cues**, **cue-linked activities**, and **sequences.**

Component definitions:

- **Seasonal indicators** are solar/celestial events, abiotic events, ecological events, or human activities that signify the beginning or end of a specific season
- **Cues** are solar/celestial events, abiotic events, or ecological events that inform the timing of human activities based on direct observation or communication
- **Cue-linked activities** are human activities informed by specific cues
- **Sequences** are series of events that occur in a particular order.

* It is important to note that while seasonal indicators could potentially serve as cues, they are different from cues in that they are not currently linked with human activities in Savnob or Roshorv.

The future of this project will focus on examining potential links between seasonal indicators and human activities to build adaptive capacity for food and livelihood security. For example, while many people in Savnob noted the arrival of the *zhil zhilok* bird (*Motacilla alba*, White Wagtail) as a signifier of spring, this is not a cue, because it is not currently linked to human activity. Further research that includes plant ecologists, ornithologists, soil scientists, and other experts will be needed to understand how phenological changes are being affected by climate change, and whether certain seasonal indicators would act as valuable cues in the future.

Illustrated ecological calendars with the above categories and components outlined are below. Categories are illustrated by column, and components are illustrated by color. These calendars show the general chronology of events and activities, and give a sense of how they may be linked or influenced by one another. When events/activities are in the same row, it means that they are informed by one another.

KEY:
Seasonal indicators are highlighted in green
Cues are highlighted in blue
Cue-linked activities are highlighted in purple
Sequences are highlighted in orange (directly following the initial indicator of sequence)
Potential hazards are denoted by red text

Table 3: Roshorv Ecological Calendar

	Solar / Celestial Events	Abiotic Events	Ecological Events	Human Activities	Notes
SPRING					
	Sun rises over *Bthanak* (Local *varmoi* ; V shape between two mountain peaks to the south)				
				Khalifa determines *khuj pokhta* using *Soat noma* book	
	Mid-February			*Boj ayom* celebration	
		Soft, wet snow during day, frozen at night			
		Warm weather	Grass becomes green around (water) spring		
		Snow melts	*Zird gulak* (dandelion) appears		
		Foggy, rainy warm weather	*Kurak* (black duck) arrives in Yapshorv river (a few days before *Navruz*)		
	Navruz , Vernal equinox				
			Mosch and *kabitsor* (ducks) come to Yapshorv after *kurak*		
		Rapid warming --> Obdow, swift water runoff in irrigation channels			
		Spring rain	Sound of *tsatsao* (Himalayan Snowcock)	Begin plowing	If there is no snow, *tsatsao* is heard earlier
	Amal (April 1)				
		Stone stops on ground instead of bouncing		Begin plowing	
		Snow has melted	*Babub* (Eurasian Hoopoe) arrives		After plowing
			Mandozak (swallow) arrives		
			Thorwathich (Eurasian Jackdaw) arrives		Appears in April, stays for just a couple weeks
		Nail goes to soil depth of 5cm		Begin planting	
		Soil begins to dry and *feels* warm enough at 10-15cm		Begin planting	
				Plant wheat	*Rushtak* (red wheat) is planted ten days before *safedak* (white wheat)
				Plant barley	
				Plant peas	
	Late April - Late May	Soil temperature is 8°C at a depth of 12cm		Plant potatoes	

				Plant other vegetables (onions, carrots, cabbage, etc.)	
			Grass becomes green in lower pastures --> Ibex move to lower pastures	Easiest time to hunt ibex	
		Nights are warm enough for hunters to stay overnight in the pastures			
	Mid-May		Marco Polo sheep begin giving birth		
	Mid-May		Apricot trees blossom		
SUMMER	End of May, early June		Planting finished	Bring livestock to pasture	
	June		Higher pastures turn green --> Ibex give birth	Hunting begins	
	June		Partridges give birth, begin nesting near Roshorv		
	Mid-June			*Gharj mowed*	
		Presence of rainbow	Crops will be affected by disease and pests		
	Mid-June to August		Wild plants flower	Wild plants gathered	
	July	Rapid melting --> Rivers flood			
	July	*Thiu dara* flows 3 times	Apricots in Yapshorv are ripe	People get apricots from Yapshorv	
	July			*Kardinal* variety of potato harvested	
	Mid-July			Mulberries ready for harvest	
	August	Heat spell (uncommon)	Wheat and barley crops will bolt, affecting yield		
		Rapid warming --> black clay runoff	Covers farmland like plastic, water cannot permeat, affects crop yield		
	August		Animals are fat from summer diet	Best time to hunt ibex, Marco Polo sheep, marmots, *tsatsao*, and *chukar* (partridge)	
AUTUMN					
	August		*Charthoch* (sparrow) eats ripe cherries		
	August			Cherries harvested	
	Mid-August	Waterfall freezes			
	End of August			*Gharj* mowed	
	Late August to Late September		Apricots ripen (two weeks after cherries ripen)	Apricots harvested	
	August - September		Pea plant becomes green then yellow	Peas harvested	
			Mekhnul (finch) arrives		
	August - September		Barley spike becomes completely white and seeds become too hard to bite through	Barley harvested	
			Wheat spike bends down due to its weight, seeds are too hard to bite	Wheat harvested	
	September	Cold spell	Can harm wheat and barley crops		

		Becomes cold/snowy in pastures (streams freez)	Grass in pastures becomes yellow; Marmots begin to disappear from pastures, so wolves begin to threaten livestock	Herders move livestock to lower pastures	
	Late September to early October		Potatoes and other vegetables harvested	Livestock return to Roshorv from pasture	
		First snow (in western part of village)			
				Firewood is collected from nearby forests	
	October			Yems apricot variety harvested	
	October			Khorog apple variety harvested	
WINTER					
		Cold and snow	Migratory birds leave		
	December		Sheep give birth		
	Chilla	Coldest time of year	Lots of firewood needed to warm house		
	December - February (but also in summer)		Cows give birth		
	Late February to early March		Goats give birth		

Table 4: Savnob Ecological Calendar

	Solar / Celestial Events	Abiotic Events	Ecological Events	Human Activities	Notes
SPRING			Frog sound heard	*Boj ayom* celebration	
			Water begins to run at the (water) spring	*Osh imom* celebration, irrigation channels are opened	
		Big, wet snowflakes			
		Sun shines brightly			
	Sun hits marker in *varmoi*				
		Warmth --> snow melts			
		First rain			
			Churpai , *sholtakar* , and *kabitsor* (ducks) arrive		
			Dandelion appears		
	Navruz , Vernal equinox		*Zhil zhilok* (White Wagtail) arrives		
			Babub (Eurasian Hoopoe) arrives		
			Mandozak (swallow), *khofta* (cuckoo), and *kharga* (crane) arrive		
			Sound of eagles nesting on the mountain		
	Amal (April 1st)	Weather warms --> Snow melts --> Steam comes from ground		Begin plowing	
	Mid-March to Mid-April	Soil is partially dry		Begin plowing	
		Soil feels warm (and is above 10 °C)		Begin planting	
	March - April		Cows give birth		
	March - May		Goats give birth		
	Late April - Early May		Apricot, apple, mulberry, cherry, and peach trees blossom		
			Plowing finishes	Oxen and donkeys are taken to pasture in Ruj	
		Heat coming from the ground, soil feels warmer and drier		Plant barley & *gharj*	
				Plant wheat	(ten days after barley)
				Plant potatoes	
				Plant other vegetables (onions, carrots, cabbage, etc.)	
			When there is not enough grass; Before insects arrive	Large livestock taken to nearby forests	
SUMMER	Late May		Planting finished	Small livestock taken to summer pasture	
	May - June		Chickens give birth		
	April - July		Yaks give birth		
	Early June		*Gharj* flower is 30-70 percent open	*Gharj* mowed	
	June	Weather warms	Ibex give birth	Herders move to the top of the pasture in Aktash	

	June - July	Weather warms	Pests appear [mosquitos, *chirum* (gray grub), *mur* (caterpillar)]		
	June - July		Sheep mate in summer pastures		
	June - July		Wild plants flower	Wild plants gathered (for medicine and fodder)	
	Late June - Early July			Cherries harvested	
	Joth, Summer solstice	Foggy weather	Sound of cranes in their nests	Time to collect *virn* (mint)	
	~June 24th	Water comes to the pastures in Ruj	*Ashar* (dogrose) begins to flower	Plant turnip	
	Nosh boz, Mid-July	Rivers begin flooding, roads wash out	First apricots are ripe		
	Late July - Early August			Apricot and apple harvest	
	Mid-July		*Gharj* flower is 30-70 percent open	*Gharj* mowed	
	Late July - Early August			Barley harvested	
	Mid- to Late-August			Wheat harvested	*Rushtak* (red wheat) harvested ten days after *safedak* (white wheat)
AUTUMN	Late August			Migratory birds return to eat ripe grain (*Mekhnul, rashsid, mandozak, khofta*)	
	Late August to Late September		Cows, goats, and yaks mate in the high pastures		
	Early September		*Gharj* flower is 30-70 percent open	*Gharj* harvest	
	Late September to Early October	Cold weather to summer pastures (streams freeze in pasture, ice forms in water buckets)		Livestock moved to lower pastures	
			Livestock moved to lower pastures	Potato and vegetable harvest	
		Frost in Savnob		Finish harvest	
			Harvest finished	Celebration of *Sol pokhta* (thanksgiving)	
	Early October		*Gharj* flower is 30-70 percent open	*Gharj* harvest	
WINTER		Avalanche, other bad/dangerous event		*Bolog ordon* festival	
		Cold weather	Migratory birds leave for the winter		
		Snowfall			
				Feed livestock	
				Housework	
	Chilla kalom, Dec. 1st to Dec. 20th	Darkest, coldest time of year; Land is frozen			
	Chilla khod, Dec. 20th to Jan. 10th				
	Qid, January 20-21	Sun comes into the body	Things become alive again		

For the purposes of discussing climate change adaptation in Roshorv and Savnob, I've drawn out cues and cue-linked activities in the tables below [Table 5: Roshorv cues and cue-linked activities; Table 6: Savnob cues and cue-linked activities]. Cues are significant to this research

because they are direct links between solar/celestial, climatic, or ecological events and agricultural or livelihood activities.

Table 5: Roshorv cues and cue-linked activities

Cue	Cue-linked Activity
Sound of *tsatsao* (Himalayan Snowcock)	Begin plowing
Thrown stone stops on ground instead of bouncing	Begin plowing
Nail goes to soil depth of 5cm	Begin planting
Soil begins to dry and *feels* warm enough to plant at 10-15cm	Begin planting Planting sequence: • Plant wheat [*rushtak* (red wheat) is planted 10 days before *safedak* (white wheat)] • Plant barley • Plant peas • Plant potatoes (when soil temperature is 8°C at a depth of 12cm) • Plant other vegetables (onions, carrots, cabbage, etc.)
Planting finished	Livestock taken to summer pastures
Grass becomes green in lower pastures → Ibex move to lower pastures and give birth	Hunting begins
Wild plants flower	Wild plants gathered for medicine and fodder
Thiu dara (crazy river) flows three times	Apricots gathered from Yapshorv
Wildlife look fat from summer diet	Best time to hunt ibex, Marco Polo sheep, marmots, *tsatsao* (Himalayan Snowcock), and *chukar* (partridge)
Fruit ripens	Fruit harvested
Pea plant becomes green then yellow	Peas harvested
Barley spike becomes completely white and seeds become too hard to bite through	Barley harvested
Wheat spike bends down due to its weight, seeds are too hard to bite	Wheat harvested
Summer pastures become cold and snowy, pasture streams freeze at night → Grass in pastures becomes yellow; Marmots begin to disappear from	Herders move livestock from higher to lower pastures

pastures, so wolves begin to threaten livestock	
Potatoes and other vegetables are harvested	Herders return with livestock to Roshorv

Table 6: Savnob cues and cue-linked activities

Cue	Cue-linked Activity
Frog sound heard	*Boj ayom* celebration
Water begins to flow from the spring	*Osh imom* celebration Irrigation channels are opened
Amal (April 1st)	Begin plowing
Weather warms, snow melts, steam comes from the ground	Begin plowing
Plowing finished	Oxen and donkeys taken to pasture in Ruj
Heat comes from the ground, soil *feels* warm and dry (and is above 10 °C)	Begin planting Planting sequence: • Plant barley & *gharj* (*Onobrychis* sp.) • Plant wheat (ten days after barley) • Plant potatoes • Plant other vegetables (onions, carrots, cabbage, etc.)
Not enough grass around Savnob	Large livestock taken to nearby forests
Planting finished	Small livestock taken to summer pastures
Gharj flower is 30-70 percent open	*Gharj* harvest (Four harvests during summer: early June, mid-July, early September, and early October)
Ibex give birth	Herders move to top of summer pastures
Wild plants flower	Wild plants gathered for medicine and fodder
Sound of cranes from their mountain nests	Gather *virn* (mint)
Water comes to the pastures in Ruj *Ashar* (dogrose) begins to flower	Plant turnip
Nosh boz (rivers begin flooding, roads wash out)	Apricots harvested
Fruit ripens	Fruit harvested
Barley spike becomes completely white and seeds become too hard to bite through	Barley harvested
Wheat spike bends down due to its weight, seeds are too hard to bite	Wheat harvested [*rushtak* (red wheat) is harvested 10 days after *safedak* (white wheat)]
Cold weather in summer pastures (pasture streams and water buckets freeze)	Livestock moved to lower pastures
Livestock moved to lower pastures	Potato and vegetable harvest
Cold in lower pastures, Frost in Savnob	Finish harvest
Harvest finished	Herders return with livestock to Savnob Celebration of *Sol pokhta* (thanksgiving)
Avalanche or other bad/dangerous event takes place	*Bolog ordon* festival

DISCUSSION

Ecological Calendars and the Human Ecological Lens

Here, I use the four pillars of Kassam's Human Ecological Lens (HEL) as a framework to analyze multi-scalar factors that shape ecological calendars in Savnob and Roshorv (Kassam 2009). Using the HEL, I have drawn out the four following topics for discussion: diversity of knowledge (Diversity and Perception), microclimatic and biological diversity (Relations), Soviet history (Context), and embodied knowledge (*Phronesis*). In addition to these areas of inquiry, I argue that human agency and its role in adaptive capacity must also be accounted for.

Diversity and Perception: Diversity of Knowledge

According to Kassam (2009), diversity is the foundation of sensory perception. Our senses are necessary to our recognition of difference in the world, and thus we perceive diversity based on personally refined senses. Individuals, both human and non-human, determine the distinctions which are important to them through perception, and their knowledge base is built from the interpretation of these differences. One's perception of diversity is intrinsic to being alive, and to erode diversity is not only to destroy human connectedness and connectedness with the world around us, but limits our ability to accumulate knowledge (Kassam 2009).

The Diversity and Perception pillar of the HEL requires us to think of multiple perspectives on ecological calendars and climate change within a village as a diversity of knowledge, which is beneficial for adaptive capacity (Kassam 2010). The differences in peoples' ecological professions within the community and related knowledge systems, such as herding or farming, influence their perspectives on ecological calendars and climate change. For example, although Lalbek (hunter) and Mobegim (herder) grow crops for subsistence, they both rely on farmers to determine when to plant

and harvest, because farming is not their primary ecological profession. Therefore, they do not have specific cues for planting and harvesting times within the ecological calendar, noting that they referred to their neighbors to determine when to plant and harvest. However, hunters and herders have specific cues for knowing the time to bring livestock to pasture, or to begin hunting season, and they provide these ecological services to their communities. Under changing climatic conditions, villagers can learn the different patterns and sequences of livelihood activities from one another. The rich diversity of approaches based on ecological professions provides for built-in adaptive capacity for climate variability.

Relations: Microclimatic and Biological Diversity

Relations, which are situated in perception, encompass a being's engagement with other humans, non-human entities, and the abiotic world. Relational thinking, therefore, extends beyond social systems and dissolves the nature-culture binary. Relationships are informed by one another, and in turn, individual beings are agents of their environments. In other words, a being "is" in relation to other beings and environmental factors, and not solely because of certain properties contained within. Human-ecological relations are in constant, active engagement with the world, and considering these relations is to study our earth as animate. Without relationships, such as the relationship between a being and its source of sustenance, animate life would not exist (Kassam 2009). Relations are central to ecological calendars – they are the linkages between biophysical phenomena that link sociocultural systems to the oscillations of the seasons. The relations tenant of the HEL prompts us look further, beyond how an individual's ecological knowledge varies from another's based on their relationship with their environment, to understand how microclimatic and biological diversity give rise to a diversity of knowledge systems within even a single village or community.

Consideration of the relations between microclimatic and biological diversity and the ecological knowledge that arises from this variability is essential in building ecological calendars. Effective cultivation of agricultural species, for example, requires knowledge of a crop's abiotic and biotic requirements, and, therefore, of the microclimatic characteristics of the landscape. Therefore, the relations between people and the specific microclimates that they engage with engenders a diversity of knowledge within the ecological calendar of a single village.

The biodiversity of cultivated crops adds nuance to ecological calendars, and this must be further researched in order to (re-)build usable ecological calendars. For example, fruit tree blossom and ripening dates varied greatly within both Savnob and Roshorv. A diversity of fruit tree cultivars originating from different places, or grafted locally, were mentioned as producing early and late ripening varieties of fruit species. Further, the relationship between cultivated varieties of fruit and other crops to the microclimatic zones of Roshorv and Savnob add an additional element of variability to their ecological calendars.

Variability of planting and harvesting times is often a function of microclimatic variability: the part of the village that contains one's farmland, whether this is affected by snowfall, ground temperature, water availability, or soil quality. Old men on the western side of Roshorv were said to plow first, and many people acknowledged a 5-10 day variation for plowing and planting between the western and eastern sides of the village based on the influence of microclimatic zones. In another instance, people in Savnob said they plow on higher land first because the soil dries out earlier than on lower land. Planting and harvesting times in Savnob were also informed by a distinction between *wombi zamin* (ancient cultivated land) and *sai zamin* (recently cultivated land). This shows how ecological knowledge systems are relations not only between communities and their larger ecosystems, but between individuals and the microclimates and biological diversity they work

within at the village scale. This gives further evidence to the inherent diversity of a village's ecological calendar.

Context: Soviet History

Everything in the natural world happens within spatial and temporal contexts. Perceptions and relations are based within contextual landscapes. Knowledge is therefore derived from the patterns created within the context of our direct experiences, and we develop our understanding of the world through these encounters (Kassam 2009). The context component of the HEL prompts us to move beyond the spatial contexts of microclimatic and biological relations, and to consider the spatio-temporal contexts of Soviet rule and post-Soviet restructuring of Savnob and Roshorv into the analysis of ecological calendars.

The influence of the Soviet Union was detrimental to the retention of ecological knowledge in Savnob and Roshorv. Shortly after the Tajik Autonomous Soviet Socialist Republic (TASSR) was formed in 1924, the villages of Savnob and Roshorv were forced into collective farming. By requiring people in the Bartang valley to shift agricultural systems from subsistence to collectivization, they were forced to forego the practice of subsistence-related ecological knowledge. Thus, this knowledge fell out of use.

During collective farming, people were primarily growing *gharj* and barley for fodder for livestock, while small portions of land were used to grow wheat and potatoes for food. Other food items were sold to the villagers as subsidized commodities provided by the Soviet government. In 1954, the vast majority of community members in Savnob and Roshorv were forced to resettle to Khomsangir District in the lowlands of Tajikistan for cotton cultivation. Those who spoke about this in interviews told us that the majority of people (50-60%) who were forced to emigrate to Khomsangir from the Bartang valley died because they could not adapt to the environmental

conditions of dirty water and hot weather. As the story goes, a man from Roshorv who was living in Khomsangir gathered money from the people and traveled to Moscow to give a letter to Stalin describing their need to return home. The letter explained that the people from the Pamir were dying, and Stalin allowed them to return to the Bartang valley, under the condition that they would continue collective farming operations for the Soviet Union (Roshorv interview: Saradbek). Kassymbekova, a historian scholar of this movement, considers this forced resettlement to be a "tool of Soviet state formation," wherein the Soviet government used human bodies in an attempt to stabilize the southern border to Afghanistan. Therefore, the dominant narrative (that this forced resettlement was for economic expansion through cotton cultivation) needs to be corrected (Kassymbekova 2011).

The Tajikistani Civil War, which lasted from 1992-1997, followed the collapse of the Soviet Union. During this time, roads between the Tajik Pamirs and the rest of Tajikistan were destroyed, and Bartangi villagers were essentially cut off from the rest of the world. This forced people in the Bartang valley to relearn subsistence skills, like farming and leatherworking, and to live independently of a collective government and its resources (Bliss 2006). After the end of the Civil War, there was a major attempt to reestablish food security in the Bartang valley, primarily with the humanitarian aid of the Aga Khan Foundation (AKF). A number of interviewees mentioned that vegetable seeds came from the AKF, while their knowledge of growing vegetables came from their parents or grandparents who had learned how to farm in Khomsangir.

Over the course of the influence of the Soviet Union and related traumas, the diversity of ecological knowledge in Savnob and Roshorv was lost. By forcing people to forego their subsistence-based ecological professions for jobs defined by the collective farms, individuals lost their unique relations with their environmental and microclimatic contexts and thus their diverse ecological knowledges were eroded. In interviews, many individuals used specific dates from the

Gregorian calendar to mark the timing of events, such as the date of May 26th to take livestock to pasture, or the date of June 15th for the first mowing of *gharj*. When asking about these specific dates, we were told that they are remnants of the collective farming calendar from the Soviet era, which shows the rift in ecological knowledge that has been created by forced collectivization.

Phronesis: Embodied Knowledge

Phronesis, first described in Greek philosophy by Aristotle as "practical wisdom," is the idea that knowledge is gained through direct, experiential learning. Knowledge is obtained through active participation and is often learned by being shared. One must engage with knowledge through experience to understand how it is applied, which is also the mechanism for it to be passed on. As Kassam discusses, the philosopher Gilbert Ryle indicates the difference between "knowing *that* and knowing *how*," acknowledging that "knowing *how* is embedded in experience" and "gained through performance" (Kassam 2009). The tenant of *phronesis* asks us to look at the knowledge of ecological calendars as process, which includes an experiential learning component. Knowledge as process also indicates that knowledge systems are dynamic and ever-changing. When knowledge is learned experientially, it becomes embodied and intuitive by the knowledge holder. Though this knowledge is embodied, it is not fixed, because through reiterative practice it adapts dynamically to changing conditions just as the knowledge holder does.

Though many elements of ecological calendars were articulated through interviews and workshops, there was a general sense of knowledge being held intuitively, and passed down through practice, rather than being able to be articulated. For example, one of the most directly important cues in both Savnob and Roshorv is telling when the soil is ready for the planting sequence to begin. In both villages, people said that only when the soil *feels* warm enough, then the people know when

to plant. This cue is an example of embodied knowledge: it is something that can only be learned through experience, through process.

In interviews, we would often hear the words "the people know." People plant, harvest and take animals to pasture because they *know* that it is time to do so. This shows that there is intuitive experience embedded in ecological calendars that may not be easy or necessary to quantify, classify, or verbalize. People in Roshorv and Savnob live within the oscillations of the season and to them, their ecological calendars are second nature. Many elements of this knowledge are intuitive, rather than quantifiable, and we must be able to incorporate this element of embodied knowledge into future iterations of ecological calendars.

When comparing currently used ecological calendars in Savnob and Roshorv to archival evidence describing Calendars of the Human Body in the Pamirs, it became clear that ecological calendars now are less embodied than they used to be. In the past, Pamiri ecological calendars were literally situated in the body, wherein the movement of the seasons and thus time itself was felt within various parts of the body, such as the nail or intestines or heart. The *Hisobdon,* or local keeper of time, would be responsible for this body calendar, and would alert farmers and herders to begin paying attention to their own microclimatic environments to begin their individual activities (Kassam et al. 2011). In contrast, currently used ecological knowledge systems are held by individual farmers, herders, hunters, etc. Additionally, these calendars are more cognitive and less embodied. For example, people in Savnob will hear the frog sound to know that plowing season will begin or will see a White Wagtail bird marking the arrival of spring. These indicators or cues initiate a system of time-telling, though this way of knowing is more reliant on cognitive associations and less on embodied knowledge like that of the Calendar of the Human Body.

Vestigial knowledge of Calendars of the Human body was evident our data collection. Interviewees would struggle to remember how the calendar used to work, mentioning parts of the

body that would be used, such as the toenail or the finger, but forgetting its association with telling time. Locals would often reminisce about their grandparents using this calendar, wishing that they could be there to recall how it was used. The extent to which embodiment is missing in current iterations of ecological calendars in Savnob and Roshorv is directly linked to the fact that Calendars of the Human Body fell out of practice due to the impact of imperialist forces over time, such as the occupation of the Soviet Union and the forced collectivization of agriculture. Without reiterative practice of ecological calendars, or *phronesis*, embodied knowledge was lost. Further, embodied knowledge has been altered by processes of climate change. Systems of profound change, such as imperialist rule and climatic variability, have created an alienation from habitat and from self.

Human Agency and Capacity for Resilience

I would like to add another tenant to this analysis of ecological calendars, which focuses on human agency and humans' capacity for resilience. Though influenced by perception and diversity, relations, context, and *phronesis*, peoples' *choices* about labor ultimately determine the sequence of activities within the frame of changing weather and seasons.

Considering current adaptive capacity in Savnob and Roshorv allows us to recognize the role of human agency within the structure of the ecological calendar. In Roshorv, we learned that the sound of the *tsatsao* indicated the time for plowing. In the spring of 2017, there was so much snow that people did not hear the sound of the *tsatsao* until later, and some people did not hear it at all. However, this did not deter people from beginning to plow. Further, if people begin to plow but the land is still frozen, they wait for the soil to thaw more. Additionally, some farmers will put ash, dust, soil, or silt on their farmland to help it thaw. In Savnob, if the spring comes late and harvest is not completed before the livestock need to return from summer pastures, people will give their livestock to friends or relatives in Roshorv to keep so that the harvest can be finished. It was also mentioned

by farmers in Roshorv that people are still growing *rushtak* wheat to save the seed in case the weather becomes warmer, and that people in Savnob will buy their potato seeds from Roshorv each year because of Roshorv's cold climate. The choices to share resources between villages, like seeds, or among villages, like the sharing of oxen for plowing, also influence the rhythms of ecological calendars. These examples show how members of Savnob and Roshorv villages are already adjusting to climatic variability in ways that enhance resilience of their food systems.

Perceptions of Climate Change

A recent paper (Knoche et al. 2017) about climate change in the Bartang valley describes contrasting evidence of warming, glacial extent, and runoff among the Northern, Southern, and Central Pamirs (location of the Bartang Valley), and it is clear that more research is needed at the local scale. Roughly 10% of the Pamirs are glaciated, while in the Bartang, 7% is glaciated and 95% of precipitation in the Bartang basin falls as snow in the winter or spring. Despite a general warming trend in the Pamirs of 0.2 degrees C per decade from 1950-2010, there has been a decline in summer temperatures since 1970. Large scale satellite-based studies examining glacial evolution show that some glaciers in the Pamirs are receding while others are advancing. While the Northern Pamirs have declining summer temperatures and consequent glacial mass gain since the 1970s, and the Southern Pamirs have increased river runoff and rapid glacial retreating, the Bartang River valley of the Central Pamirs shows no significant trends in runoff or glacial extent (Knoche et al. 2017). This study shows that *in situ* climate measurements specific to the Central Pamirs and Bartang Valley are key for climate change data collection in the Pamirs, which our project is currently addressing. Additionally, speaking with local community members experiencing climate change has given further insight to the necessity of localized climate research.

Perceptions of climate change varied greatly among interviewees in both Roshorv and Savnob. There was no clear consensus about whether the climate was getting warmer or colder, or becoming more or less variable over the course of peoples' lives. During our Savnob interviews, Topchibek stated a phenomenon that many people were describing: "The seasons are changing. Now the winter is warmer, the spring is cloudy and windy, and the summer is cooler, but the autumn is becoming hot" (Savnob interview: Topchibek). Many people spoke to this shifting of seasons, saying that early summer is windier, children cannot swim as early in the summer, watermelon cannot grow anymore in Savnob, and wheat and barley are harvested earlier now. This tells us that climatic change in the Bartang Valley, like instances of climatic change elsewhere, is more about the shifting of trends within seasons, where each season is becoming less characteristic of what it used to be.

Those who mentioned changing glacial extent noted that glaciers in nearby valleys have receded considerably. Warmer winters influence glacial extent by there being less snow accumulation. However, people in Savnob and Roshorv both mentioned that there is less glacial runoff and subsequent flooding in the summer now than in the past. This could be because there is less glacial melt available due to warming winters, but it could also be due to the summers becoming colder. Further, a number of people in Roshorv said that they thought the weather in the summer was becoming colder *because* the rivers used to flood. It is clear that *in situ* climate research as part of the greater ECCAP project will help us to answer these questions.

CONCLUSION

In this thesis, I have developed illustrated ecological calendars for Savnob and Roshorv, and have described cues and sequences that community members currently use to determine the timing of livelihood activities. I have also described current perspectives of climate change in Savnob and Roshorv. Further, I have used Kassam's (2009) Human Ecological Lens to explore topical areas that add complexity and nuance to research on ecological calendars: diversity of knowledge, microclimatic and biological diversity, the context of Soviet history, and embodied knowledge. In this section, I focus on the challenges and limitations of this research, and potential directions for future research to incorporate dimensions of gendered knowledge.

This thesis serves as preliminary research in building revitalized ecological calendars in Savnob and Roshorv. As the findings indicate, there is a wealth of information that the ECCAP team will be able use to begin (re-)building ecological calendars in Savnob and Roshorv. The next iteration of the research will be in the validation of the data collected in summer of 2017 with community members, to verify that the information has not been misrepresented, and that it has value for the communities. The future of the ECCAP project will focus on creating workable ecological calendars that integrate ecological knowledge with climatic, hydrological, and phenological data, developing university and high school curricula for continued adaptation of calendars, creating a knowledge-sharing platform to transfer knowledge between communities in different bioclimatic zones, producing multilingual publications, and hosting an international conference on ecological calendars for climate adaptation (Kassam et al. 2018).

Challenges and Limitations

Though everyone we interviewed in Savnob and Roshorv articulated elements of what would constitute as an ecological calendar, many people said that they do not use explicit indicators

or signs from their environment to plan their activities or mark the changing of seasons. When asking Mulkabek whether he uses any signs in the environment that signify a shift from one season to the next, he replied: "I have no signs that I use. I heard from my father and grandfather that we must first plough and then plant barley and then plant wheat and then the potatoes and other vegetables. The potatoes came from Soviet times and not ancient times" (Savnob interview: Mulkabek). Similarly, Aslibegum referred to sequential planting schedules, rather than the use of ecological cues: "I don't know any of these signs. We begin our work in the spring, we know that spring is coming and then we begin our work. We start with the barley, and then we plant everything else after that" (Savnob interview: Aslibegum). When asking the same question to Qandak, he mentioned their use of the Gregorian calendar instead of the use of environmental cues: "No signs from nature, but I know that from the 21st of March it is a sign of the coming spring. 21st of March-21st of May is spring, 21st of June, July, August is summer, 21st of Sept-Nov is autumn, and 21st of Dec-Feb is winter." Then, he added: "Now we don't use a body calendar, but we use a Gregorian calendar. I think that the Calendar from the Human Body has become the calendar that we use now" (Savnob interview: Qandak). Although these individuals said that they do not use ecological calendars *per se*, many of them still retain language for these calendars, such as describing the sun traveling through the body during different times of the year.

As is evident by the findings and discussion chapters of this thesis, however, there are many elements of retained ecological knowledge, especially below the surface of interview-based questioning. For example, we learned that the time of apricots is also the time of flooding only when it affected our travel plans. Additionally, a number of components in the ecological calendars, such as the warm, dry *feeling* of soil denoting planting time, point to tactile, sensory, and nonverbal ways of knowing that can't be articulated well in interview form. These instances are evidence that spending more time at our field sites, while relying more heavily on participant observation and

guided walks methods rather than interviewing, might be a more effective way of researching ecological calendars in these communities.

The timing of our field research had a significant effect on coloring workshop and interview responses to questions. There had just been a harsh winter with extremely heavy snowfall, which was the vantage point from which we were gathering information about ecological calendars and climate change, which had an influence on peoples' responses to our questions. The timing of livelihood activities in the Pamirs are very dependent on winter snowpack. This could be one reason that there was a variability of responses relating to precipitation-dependent phenomena, such as the blossoming times of fruit trees or the timing of wheat and barley harvests. Also, the summer in Savnob and Roshorv is a very busy time with agricultural work. Though people were generous with their time, if we had gone at a time of year with less work, like in the winter, this may have evoked more thorough conversations.

The way we asked questions related to climate change and climatic variation also influenced the way they were answered. Generally, we would ask if people thought the weather was different now than when they were younger, and then we would ask how they were different, and whether changes are happening more frequently now than in the past. These questions were usually asked towards the end of the interview and became less developed conversations than our conversations about ecological calendars. This format may have elicited more simplistic responses than are necessary for truly understanding the nuanced complexity of climate change in the Bartang valley.

Additionally, language translation played a large role in shaping the information that ultimately populated our datasets. Translations are tied to the translator's background and experience, and as is the case in any work that is based on language translation, certain ideas and nuances are lost in translation.

Future Research: Incorporating a Decolonial Feminist Political Ecology Framework

Building on the Decolonial Feminist Political Ecology (DFPE) framework to create effective revitalized ecological calendars, we must first understand the multi-scalar factors that have affected and continue to affect the production of ecological knowledge systems in Savnob and Roshorv. While the HEL has aided in many important facets of this work, including a conversation on coloniality within the context of Soviet collectivization and forced internal migration, the DFPE allows us to take this framework a step further and incorporate gender as a critical element to understanding the transmission and retention of ecological knowledge.

The element of gender is a key component that has been missing in this research. While conducting fieldwork, it became evident to me that place-based ecological knowledge in the Bartang valley is gendered. While women are married and often leave their home villages as young women, men remain in their home villages to carry on the knowledge lineages of their fathers and grandfathers' families. This means that the place-based knowledge from a woman's childhood is left in their home village, so women learn local knowledge and livelihood practices from their husbands' families. Therefore, ecological calendars by nature retain patriarchal power dynamics.

When villagers, both men and women, indicated from where they gained knowledge, it was always stated that it came from the old men: "After Navruz, when the snow melts, and the old men come out with their ox to the fields, and the heat of the sun influences the land, we know that it is time to plant." It was also brought up in numerous interviews that girls are educated about agriculture and hunting differently than are boys. When asking one farmer if he taught his children to farm, he said: "I only have daughters, no sons, so I have not taught my children to farm." Another man, a hunter, noted that he only knew one woman who hunted, and it was out of necessity, because her dogs had surrounded an ibex when her husband was not home. Otherwise, a woman would never hunt.

The workshops and interview pools were dominated by men. In interviews, women were often shy and reserved, and would default to their husband's word if they were present. However, there were a few times when women spoke up because their husband did not know an answer to a question. In one interview, we asked if our interviewee had heard the *tsatsao* this year. He said he did not know, and then his wife chimed in, saying that she had heard one in late April. In a number of interviews with women, they noted that it is a man's duty to decide when to plant. When asking one woman what signs she uses to plant, she said: "I don't know about this, because usually the men decide when to plant. My husband and sons decide when to plant." Another woman said, "My father-in-law plants wheat, barley, and potatoes, so I don't know when they were planted."

This evidence shows that gender is a crucial component to building revitalized ecological calendars and must be taken into account in future iterations of this research. In their paper, which merges Decolonial perspectives with Feminist Political Ecology, Rocheleau and Nirmal (2015) articulate a future approach to science as one that "incorporates multiple perspectives not through an additive process but by understanding partial objectivities and situated perspectives." In the scope of ecological calendars in the Bartang valley, this exploration requires methodologies that focus on gaining insights on gendered spaces and knowledge systems. One way that this can be addressed in the data validation process is for researchers to meet with groups of women directly to understand how distinct, gendered knowledge systems function in Savnob and Roshorv. Additionally, in-depth collaboration with community researchers who are women could provide further insight into the spaces that women and women's knowledge occupy in Savnob and Roshorv. In developing school curricula, which is a goal for the future of the ECCAP project, we should look to women elders and community leaders to be a critical link in the building and dissemination of ecological knowledge back to the communities.

APPENDICES

APPENDIX A: Workshop Guide

Color Coding for Seasonal Round

Dark Blue: Snow, ice, glacier, rain, river
Black: Livestock activities &Land Use
Orange: Animal not domesticated (bird, mammals, fish)
Dark Green: Plants cultivated
Light green: Collected and wild species
Red: Hazards, drought and climate events
Light blue: Social cultural (housing, cleaning, maintenance, festivals)

Agenda:
1) Explanation of Ecological calendar and project partnership - Karim
2) Any question from the audience
3) Iftar Dinner
4) Begin working on seasonal round

Prompt questions
How do you know winter has ended?
When does the next season begin?
How many seasons do you have?

What kind of livestock do you have? When do you decide to move the animals from winter pasture?
When is the calving/lambing season?

What are the key crops that you grow? When do you plant them? When do you harvest them?

Have you noticed any change in the weather (unusual events) in the past 10 years?

APPENDIX B: Semi-structured Interview Guide

Ecological Calendars to Anticipate Climate Change
Semi-Structured Interview Guide for Bartang Valley of Tajikistan
Inclusion criteria: Participants must be 18 years old and residents of communities around the Bartang Valley of Tajikistan.
Duration of interview: approximately 90 minutes
Location: In the participant's home or at a community center

1. **Introductions** (5 minutes): Introduce the research team (field research manager and community researcher) and provide a brief overview of the research.
2. **Written informed consent** (10 minutes): Provide a copy of the form 'Written Consent for In Person Interview' and 'Contact Information Sheet' to the participant. Read the form together aloud, stopping to answer any questions. Collect the signed written informed consent form.
3. **Audio recording:** If the participant has signed the section giving permission to record the session with a digital audio recording device, turn it on to begin recording.
4. **Semi-structured interview** (60 minutes): For a semi-structured interview, the order of themes and topics is flexible based on the participant's responses. The following list includes sample questions organized by themes and responses. The questions selected for each interview will focus on those themes and topics to which the participant is most responsive with respect (i.e. sensitivity to diversity of knowledge).

Traditional Calendars

- Seasons
    - What are the important attributes of each season?
    - How do you know when one season is transitioning into the next?
- Lunar calendar (moon cycles)
    - Would you know the names of any moon phases or cycles [e.g. harvest moon]?
    - What are the important attributes of each month [Gregorian or other]?
    - How do people in your community use the moon cycles?
    - Has the use of the lunar calendar changed over the course of your lifetime?
    - Do the names of moon cycles still fit with the seasons they describe [e.g. if the name of the month refers to hunting, is that when people harvest]?
- Other points of reference
    - When does your calendar begin?
    - What are other important days or events in your calendar?

Community life

- When are important community meetings and events?
- What are important holidays and commemorative days?
- What are the faster-paced times of year in your community?
- What are the slower-paced times of year in your community?
- Have community activities changed due to weather or other seasonal changes?

Weather

- What are the most important weather events in your community? When do they usually occur? Why are these events important?
- Does the weather vary from year to year? How so?

- What are the most unusual weather events that you have seen in your lifetime? What time of year did these events occur? How often do these kinds of events occur?
- Does weather differ from place to place around the Bartang Valley? If so, how does it differ?

Plants

- Which are important plants for people in your community?
- Are these plants useful? What parts of the plant are useful? How are they useful?
- Are these plants abundant or rare? Are they becoming more or less abundant?
- Where are these plants found? In what kinds of places are they found? Are there specific sites where they are most abundant?
- [For domesticated plants]: When are these plants usually sown? How and when do you care for them? When do they usually produce leaves, flowers, and fruits? When are they harvested? How and when are they processed, stored, and distributed?
- [For non-domesticated plants]: When do they usually germinate and sprout? How and when do you care for them? When do they usually produce leaves, flowers, and seeds? When do they usually dry up, drop their leaves, or turn brown?

Animals

- What are the most important animals here? How are they important?
- What parts of the animal are useful? How are they used?
- Are these animals abundant or rare? Are they becoming more or less abundant?
- Where are these animals found? In what kinds of places are they found? Are there specific sites where they are most abundant?
- For domesticated animals: When do these animals reproduce? How and when do people take care of them? At what time of year are they sold or killed?
- For other animals: When do these animals give birth? When are the important times in their life cycle for you? Are these animals fished, trapped, or hunted? How and when are they prepared and stored?

Seasonal indicators and cues

- Are there signs from weather, plants or animals that indicate a particular time of the year?
- Are there signs from weather, plants or animals that indicate the transition from one season to the next?
- Are there signs from weather, plants, or animals that are used to decide when to conduct certain seasonal activities?
- Are there cases where a sign from one plant or animal indicates an activity related to another plant or animal [e.g. appearance of a berry indicates the fish are running]?

Climate change

- Over the course of your lifetime, has the climate around the Bartang Valley changed? How so?
- Has the weather become more or less variable? How so?
- Has the weather become more or less predictable? How so?
- How do you feel about the changes you have described? How have these changes affected you and your community? Have these changes had any negative repercussions? Have these changes opened up any new opportunities?
- How have these changes affected the plants and animals in and around the Bartang Valley?
- How do you expect the climate to change in the next 10 and 20 years?

- How can your community prepare and respond to climate changes?

5. **Additional sources of information** (5 minutes): Explain to the participant that you are conducting in person interviews with Elders and other knowledgeable community members from communities around the Bartang Valley. Based on their interview, ask if they would like to recommend anyone who would be able to provide additional information about the topics you have discussed.
6. **Closing** (5 minutes): Thank the participant for conducting the interview. Remind them to contact you or the project partners should they have any questions, suggestions, or concerns about the research.

APPENDIX C: Interview Recruitment Script

Ecological Calendars to Anticipate Climate Change
Recruitment Script for In Person Interview in Bartang Valley of Tajikistan

Hello [insert name]! This is [researcher's name]. I am a researcher working with Cornell University. How are you?

We are conducting a research project focused on ecological calendars. We are interviewing people about seasonal changes, including weather, plants, and animals. I am wondering if I might come interview you. Do you have a moment for me to explain our study?

We are studying how people plan their activities by observing the weather, plants and animals. For example, some people watch for certain plants to flower before they plant their own garden. Or some people wait for a "natural" sign before they go hunting or fishing. We are trying to find signs that are reliable indicators, and if these can help communities to prepare climate change. We hosted a focus group on this topic in [location] on [date], and several people at the focus group recommended that I speak to you.

These interviews last about 90 minutes. We ask questions about traditional calendars, community activities, the weather, plants, animals, and climate changes. If at any point you decide you'd rather not participate, we can always stop the interview without any problem. May I come to interview you?

> If positive: Wonderful! Are you available on [day] at [time]? Thank you! I look forward to seeing you on [day], at [time].
> If negative response: That's OK, I understand! It was my pleasure to speak with you. If you change your mind, I will be here for the next several months. Thank you for your time and have a wonderful day!

APPENDIX D: Informed Consent Guidelines

Ecological Calendars to Anticipate Climate Change

Written Informed Consent for In Person Interview in the Bartang Valley of Tajikistan

We are asking you to participate in a research study entitled "Ecological Calendars to Anticipate Climate Change". We will describe this study to you and answer any of your questions. This study is led by Karim-Aly Kassam of the Department of Natural Resources and the American Indian and Indigenous Studies Program at Cornell University. This study has been reviewed and approved by the Institutional Review Board at Cornell University.

What the study is about: This study is focused on the use of ecological calendars to prepare for climatic change. Ecological calendars are systems to keep track of time by careful observation of seasonal changes, such as the opening of a flower, the emergence of an insect, the arrival of a migratory bird, the breakup of ice in rivers and lakes, or the position of stars in the sky. Indigenous and rural communities across the world use their knowledge of seasonal changes to plan their activities, such as gathering berries, planting fields and gardens, hunting and fishing, raising animals, or organizing community events. This knowledge is increasingly important as communities face the local impacts of global climate change. The goal of this study is to compile and analyze knowledge about seasonal change in communities of the Bartang Valley, combine that knowledge with cutting-edge science, and generate ecological calendars to help communities prepare for to climate change.

What we will ask you to do: Our interview with you will last approximately 90 minutes. We will ask you questions about weather, plants, animals, and seasonal activities in your community. We will also ask you about the changes you have observed.

Taking part is voluntary: Your involvement in this study is voluntary. You have a right to refuse to participate before the interview begins, discontinue at any time, or skip any question that makes you feel uncomfortable, with no penalty to you, and no effect on your relationship with any of the individuals or organizations involved.

Risks and discomforts: We do not anticipate any risks or discomforts from participating in this research.

Benefits: There is no payment or other direct benefit from taking part in this study. We hope this research will directly benefit your community, by generating an ecological calendar that is useful to prepare for climate change. We will share all of the findings from this study with you as well as with community leaders.

Compensation: There will be no compensation for taking part in this study. As a mark of our appreciation and respect, we will provide a small gift of tea or coffee.

Confidentiality: Any information you share with us may be shared with the general public. If you give us your permission, we would like to use your name, in order to acknowledge your contributions to our research, both in our presentations and our publications. Otherwise, if you prefer to maintain confidentiality, we will ensure that our notes and other identifying information are

securely stored, and neither your name nor any other identifying information will be included in presentations or publications resulting from this research.

☐ I choose to maintain my confidentiality. I do **not** give my permission to have my name or any other identifying information associated with the information I provide during this interview.

☐ I consent to my name being used in association with the information I provide during this interview, including presentations and publications resulting from this research:

Signature: _____ Date: _____

Audio/Video Recording (only if consenting to the use of name above): With your permission, we would like to record our interview with you using a digital audio recorder. The audio recording and a transcription of our conversation would be archived. The recording and transcript of our interview would be accessible to the public upon request. You may still participate in this study if you prefer not to record our interview. In that case, I will document our interview in my field notes.

☐ I do **not** wish to have this interview recorded.

☐ I agree to have this interview recorded and I give permission for the recording and transcript to be archived.

Signature: _____ Date: _____

Photograph (only if consenting to the use of name above): With your permission, we would like to take your photograph with a digital camera. This photographed would be included in a publication to acknowledge your contributions to the research. You may still participate in this study if you prefer not to be photographed.

☐ I do **not** wish to be photographed during this interview.

☐ I agree to be photographed and I give permission for the photograph to be included in publications resulting from this research.

Signature: _____ Date: _____

If you have questions: If you have any questions at this moment, please ask me now. If you have any questions or concerns in the future, I am now providing you with an information sheet, which contains contact information for the lead investigator, other project partners, and an anonymous ethics hotline to report your concerns.

Statement of consent: I have read the above information, and have received answers to any questions I asked. I consent to take part in the study.

Signature: _____ Date: _____

Name (printed):

_____

Signature of person obtaining consent: _____ Date: _____

Printed name of person obtaining consent: _____

This consent form will be kept by the researcher for five years beyond the end of the study.

Cornell University
Office of
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p. 607-254-5162
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Institutional Review Board for Human Participants

Concurrence of Exemption

To: Karim-aly Kassam

From: Amita Verma, Director, ORIA

Approval Date: March 16, 2017

Protocol ID#: 1703006991

Protocol Title: Ecological Calendars and Climate Adaptation in the Pamirs (ECCAP)

Your above referenced request for **Exemption from IRB Review** has been approved according to Cornell IRB Policy #2 and under paragraph(s) 2, 4 of the Department of Health and Human Services Code of Federal Regulations 45CFR 46.101(b).

• Paragraph 2 allows to be exempted from IRB review research activities in which the only involvement of human subjects will be in the following category: Surveys/Interviews/Standardized Educational Tests/Observation of Public Behavior – Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior if: i) information obtained is recorded in such a manner that human subjects cannot be identified, directly or through identifiers linked to the subjects; or ii) any disclosure of the human subjects' responses outside the research would not reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability or reputation.

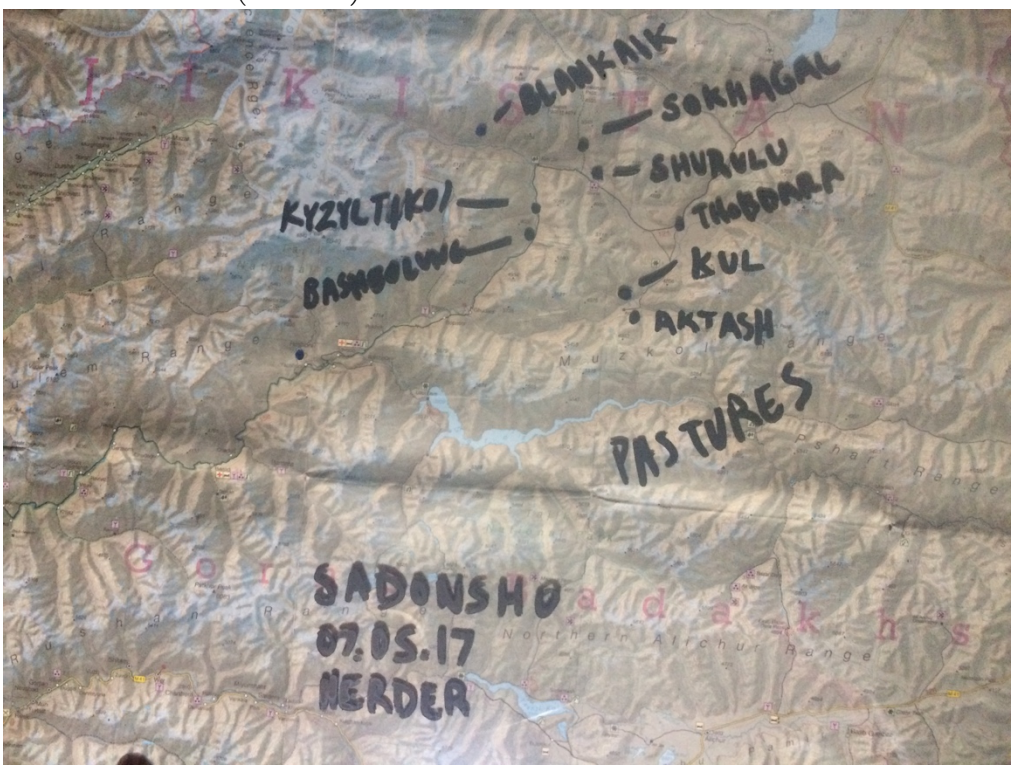
• Paragraph 4 allows to be exempted from IRB review research activities in which the only involvement of human subjects will be in the following category: Secondary Use of Pre-Existing Data (Data must exist at the time the research is submitted for review) – Research involving the collection or study of existing data, documents, records, pathological specimens or diagnostic specimens if: i) these sources are publicly available; or ii) the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

Please note the following:

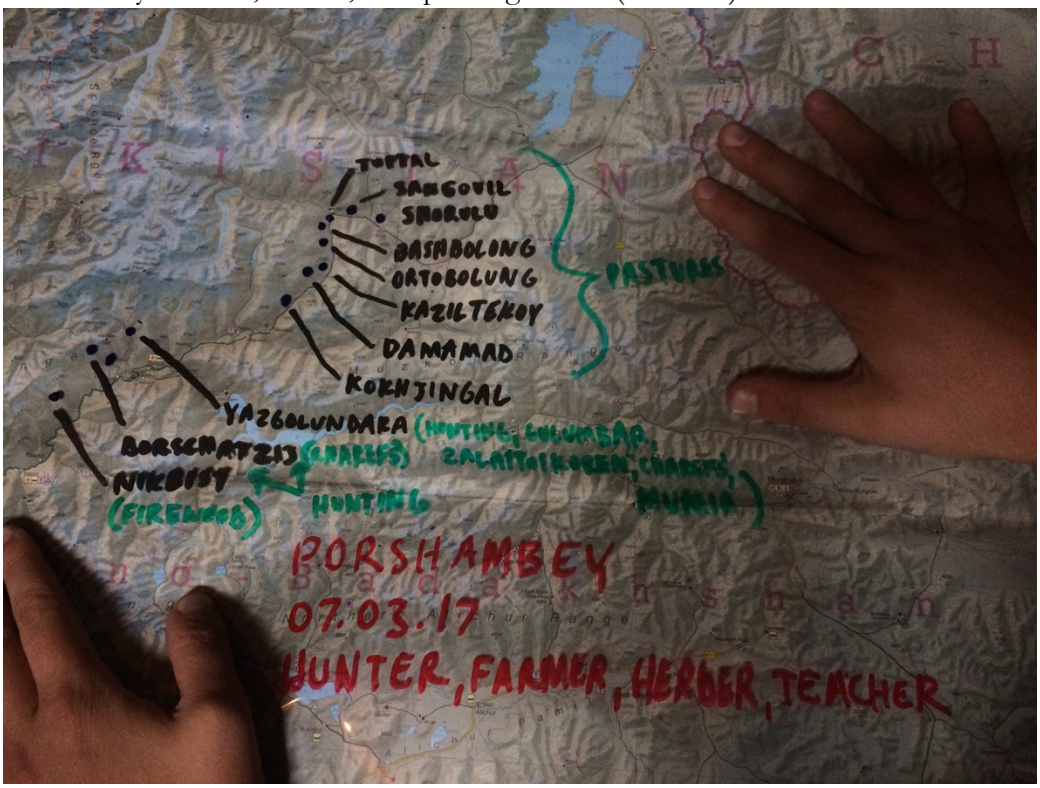
- Investigators are responsible for ensuring that the welfare of research subjects is protected and that methods used and information provided to gain participant consent are appropriate to the activity. Please familiarize yourself with and conduct the research in accordance with the ethical standards of the Belmont Report (http://www.hhs.gov/ohrp/policy/belmont.html).
- Investigators are responsible for notifying the IRB office of change or amendments to the protocol and acquiring approval or concurrence **BEFORE** their implementation.

APPENDIX F: Interview-based maps

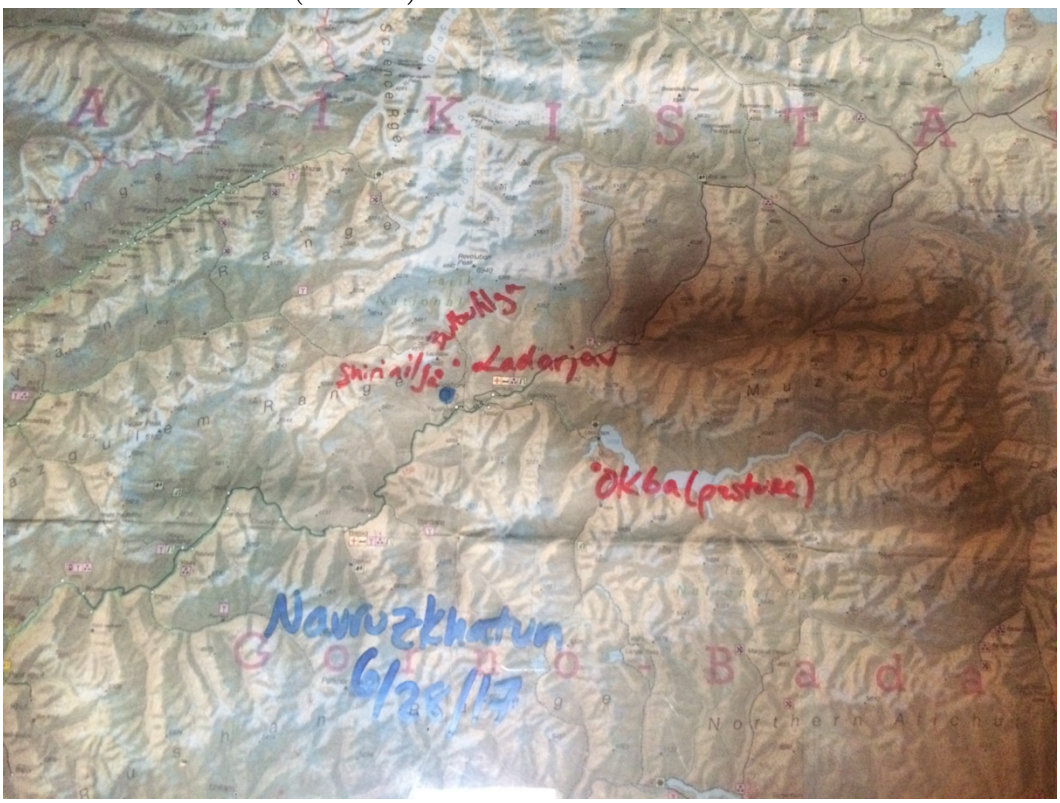
1. Sadonsho: Herder (Roshorv)



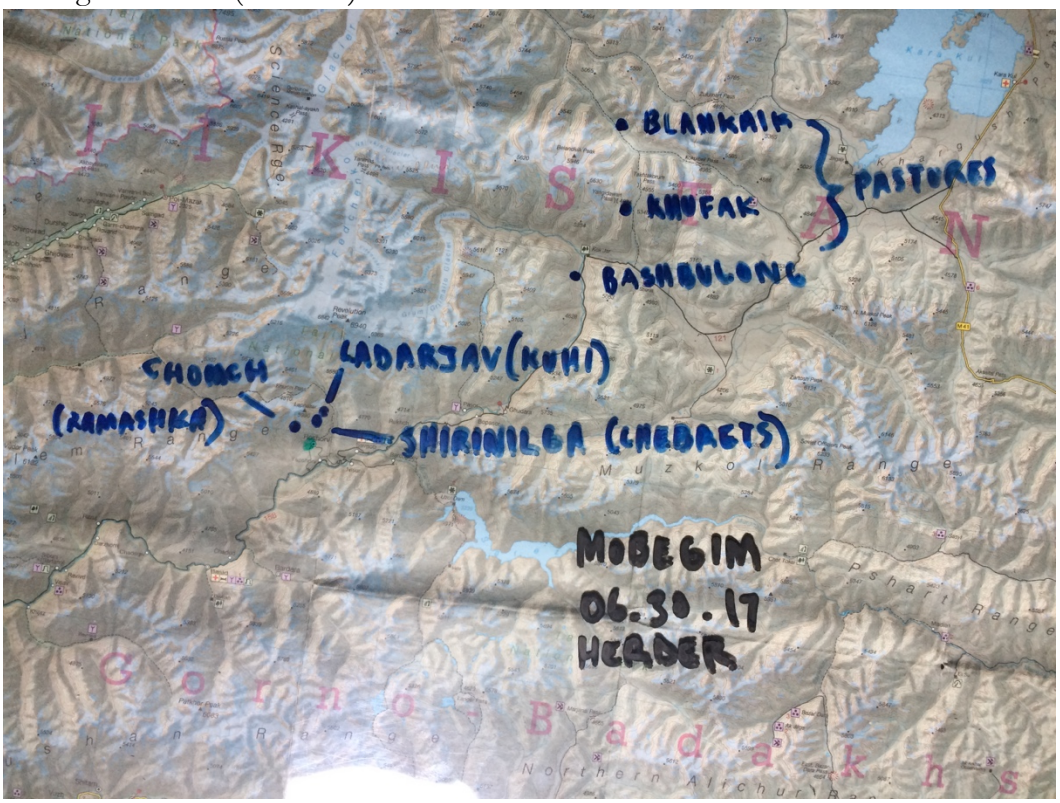
2. Porshanbey: Hunter, herder, wild plants gatherer (Roshorv)



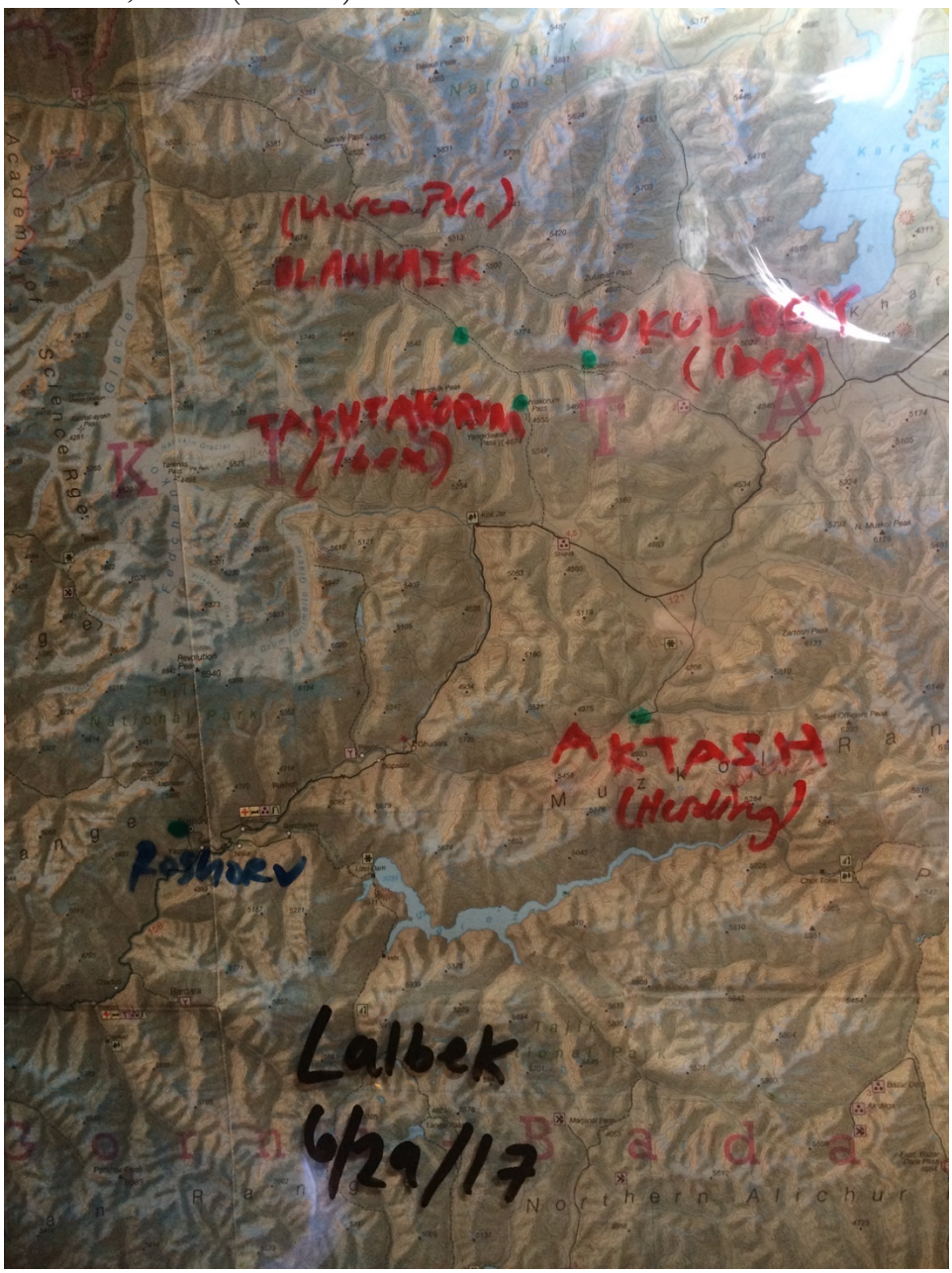
3. Navruzkhatun: Herder (Roshorv)



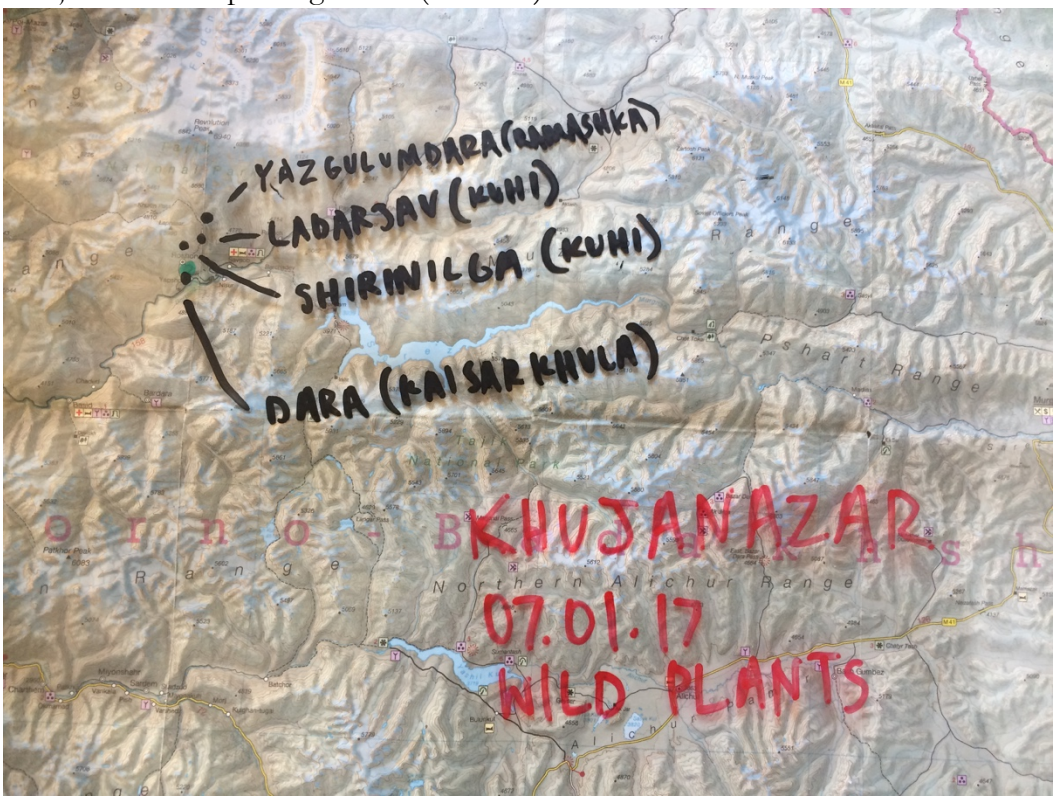
4. Mobegim: Herder (Roshorv)



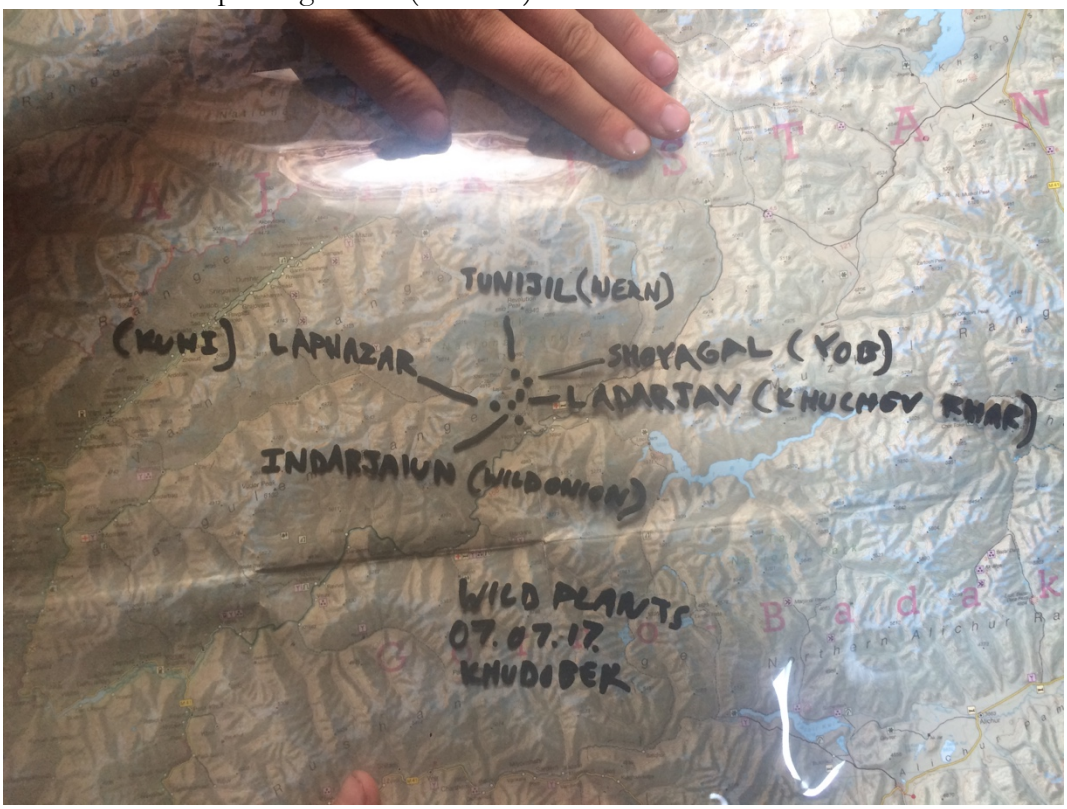
5. Lalbek: Herder, hunter (Roshorv)



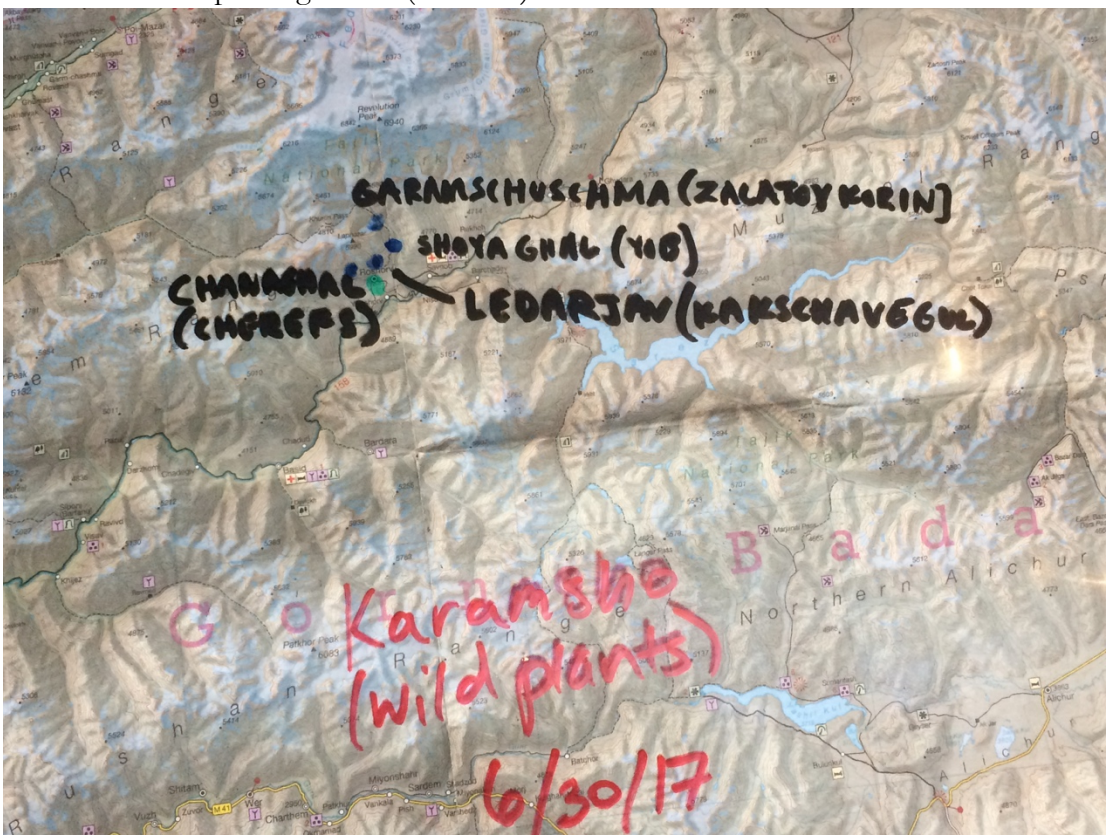
6. Khujanazar: Wild plants gatherer (Roshorv)



7. Khudobek: Wild plants gatherer (Roshorv)

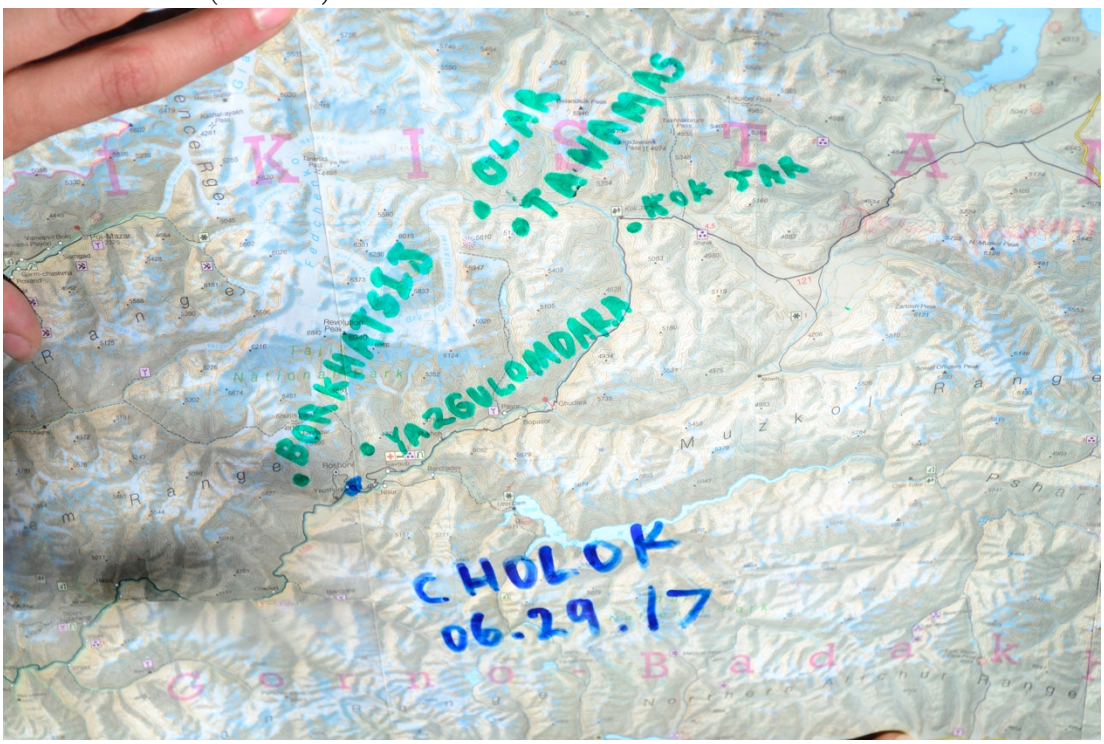


8. Karamsho: Wild plants gatherer (Roshorv)

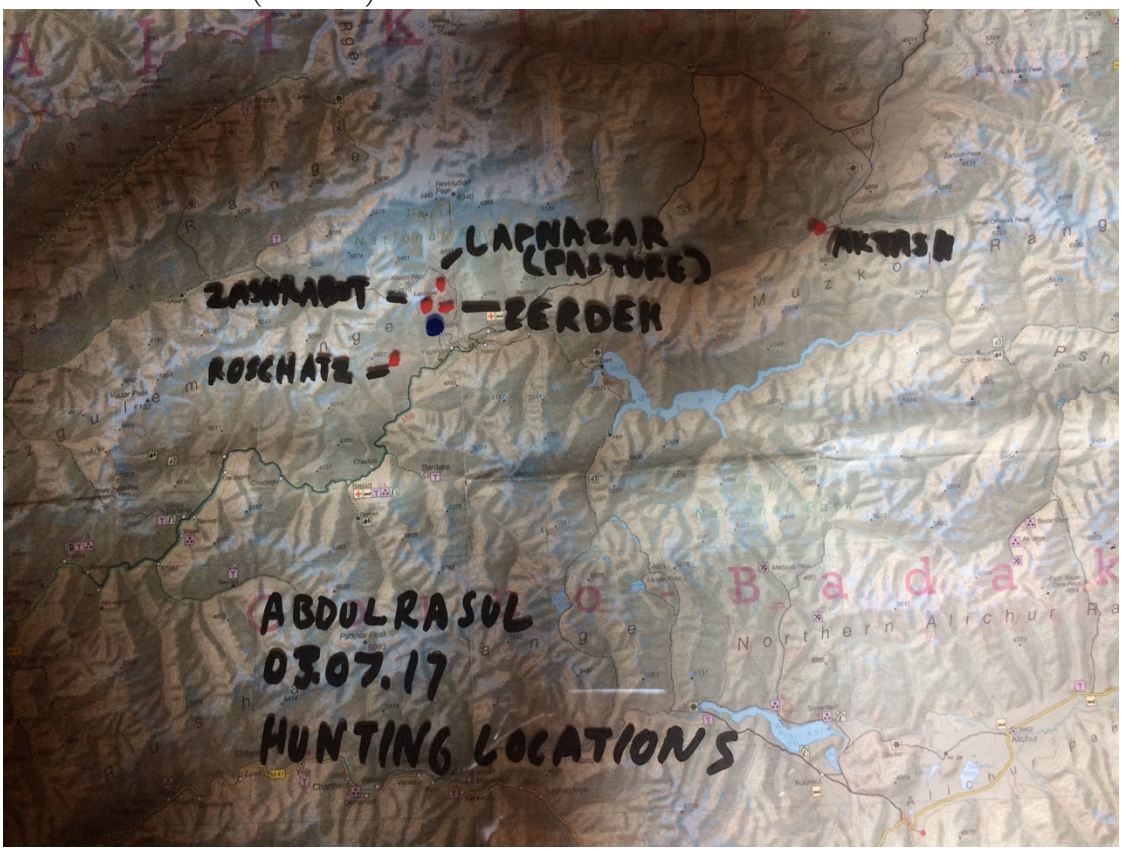


9. Jamal: Herder (Roshorv)

10. Cholok: Hunter (Roshorv)



11. Abdulrasul: Hunter (Roshorv)



APPENDIX G: Definitions from Kassam Research Group meeting November, 2017

Event: A discrete phenomenon that occurs at a particular point in time and place.
Season: A recurrent period of time that is perceived as distinct from other periods of time in a particular place based on criteria identified by a community.
Seasonal event: A recurrent phenomenon that occurs within a particular period of time (season) and place.
Seasonal indicator: A seasonal event that signifies the beginning or end of a season.
Synchrony: A relationship between events, such as the concurrence of two or more events at the same time**.**
Phenological indicator: A seasonal event that indicates the simultaneous occurrence of another seasonal event.
Asynchrony: A relationship between events, such that two or more events are known to occur at different times.
Sequence: A series of events that occur in a particular order.
Cause and effect: A relationship between sequential events, such that one event results in another event.
Cue: An event that informs the timing of human action, based on direct observation or communication.
Predictor: An event that provides information about the occurrence and/or quality of a future event.

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