A Political Ecology of "Water in Mind": Attributing Perceptions in the Era of Global Climate Change

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(Manuscript received 9 November 2010, in final form 31 August 2011)

ABSTRACT

This article explores how researchers can apply social science methods and theoretical frames to capture how place-based communities are perceiving and responding to the immediate effects of global climate change. The study focuses on research with Viliui Sakha—native horse and cattle breeders of northeastern Siberia, Russia, who are increasingly challenged by one of global climate change's most prevalent effects: altered water regimes. By applying the theoretical framework of political ecology, the article shows how researchers can better understand how affected peoples have, in this case, "water in mind" via their histories, cosmologies, and management practices of water. Such awareness can inform research activities and findings, facilitate effective adaptation, and, ultimately, affect policy. Given the widespread emphasis on adaptation, including the urgent need for, increasing interest in, and funding support for transdisciplinary research projects on adaptation, and the facilitative role researchers and policymakers can play in adaptation, this move to understanding and integrating a population's shifting perceptions—in this case, of water in mind—into research is fundamental.

1. Introduction

The world community now largely accepts that unprecedented global climate change is real and that it is a result of human activity (Parry et al. 2007). The focus has shifted to how to adapt to and mitigate it (Dovers 2009; UNDP 2010). Numerous summits, conventions, conferences, board meetings, and working groups have and continue to convene and produce protocols, bills, recommendations, memorandum of understandings (MOUs), and agreements addressing mitigation, such as the United Nations Framework Convention on Climate Change Conference of Parties (UNFCCC COP) resolutions, the Kyoto Protocol, the Copenhagen Accord, recent U.S. Senate bills on climate change policy, and the Clean Development Mechanism (CDM). But mitigation is a long-term process and, despite best efforts, as climate change proceeds, even with substantial reductions in greenhouse gases and deforestation, many world ecosystems will be irrevocably altered. The recently proposed protocol[1] to protect and resettle "climate refugees" is clear evidence that major relocations will be necessary (Hulme et al. 2008; Biermann and Boas 2008), with some estimating that 200 million people will have to relocate as a result of climate change impacts by the year 2050 (Biermann and Boas 2008, p. 10). In the meantime, adaptation is taking priority in international climate research and policy initiatives. Physical and social scientists alike are actively contributing to setting the research priorities and approaches to facilitate effective adaptation (Parry et al. 2007; Crate and Nuttall 2009).

One of the main effects, as climate change proceeds, is the unprecedented alteration of earth's water regimes[2] (Anderson et al. 2008; Stohlgren et al. 2007; van Dam 2003). Bates et al. (2008, p. 3) wrote on water resources:

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DOI: 10.1175/WCAS-D-10-05006.1

[1] Scholars and activists are promoting "a separate, independent legal and political regime created under a Protocol on the Recognition, Protection, and Resettlement of Climate Refugees to the United Nations Framework Convention on Climate Change," although no legal action on this has yet been taken (Biermann and Boas 2008).

[2] Throughout my text I have adopted this cited authors' term "water regimes" to refer to the overall movement of water years-through an ecosystem as we know it through the water cycle.

> Observational records and climate projections provide abundant evidence that freshwater resources are vulnerable and have the potential to be strongly impacted by climate change, with wide-ranging consequences for human societies and ecosystems.

Effects of these altered water regimes are amplified in climate-sensitive areas (high latitude, high altitude, near sea level, etc.), mainly inhabited by place-based peoples, defined, for the purposes of this article, as human populations that depend directly and daily upon their local environment for their physical, cultural, and spiritual sustenance.[3] Chief Intergovernmental Panel on Climate Change (IPCC) climate scientist Bob Watson, at the spring 2008 World Bank workshop on the social implications of climate change, stated that the main issue of climate change for affected communities is changing precipitation patterns (B. Watson 2008, personal communication). These same place-based populations often do not interpret and understand their world on the basis of a western scientific model but instead on the basis of a situated knowledge (Nygren 1999; Nuttall 2004, p. 207).

In the last few years, climate research, from a diversity of climate-sensitive world regions, documents increasingly altered water regimes that are affecting local peoples, plants, and animals (Thomas and Twyman 2005; Salick and Byg 2007; Crate and Nuttall 2009). In many cases researchers are working toward ascertaining how their research communities perceive these changes. One prominent example is high-latitude research where anthropologists strive to interpret local place-based people's perceptions of changes in water regimes (Cruikshank 2005; Henshaw 2009; Ogilvie 2005; Marino and Schweitzer 2009). For example, Cruikshank (2005) shows how inhabitants of the Yukon consider glaciers sentient beings. Interdisciplinary research on freshwater in northwest Alaska emphasizes that the ways participants talk about freshwater are surprisingly diverse and, because they are all Inupiaq (of the same cultural group), cultural difference did not explain this diversity but rather daily use of and seasonal interactions with water (P. P. Schweitzer and E. Marino 2008, personal communication). High-altitude contexts provide a second prominent example of research into perceptions of altered water regimes (Orlove et al. 2008, p. 8; Bolin 2001, 2009; K. Dunbar 2008, personal communication; K. Yager 2008, personal communication). Accordingly, Inge Bolin's research with Quechua in the Andes shows how a people's cosmology and belief are affected by changing water regimes. Quechua historically made long pilgrimages to carry pieces of the sacred glacier to new places in order to "grow" new glaciers. However, they have recently stopped this practice because of the rapid glacial retreat due to climate change (Bolin 2009). These and other research show that local populations perceive changes in local water regimes brought about by global climate change as a function of their history, cosmology, and past–present management practices of water, and also by new narratives introduced by media sources, researchers, local and regional policy efforts, and other outside sources (Marino and Schweitzer 2009; Rosen 2007; Krupnik et al. 2010; Orlove et al. 2008; Strang 2004). I use the phrase "water in mind" as shorthand throughout the paper to represent such perceptions originating from this variety of sources.

As research on issues of altered water regimes due to global climate change with place-based peoples proceeds, more and more researchers are tasking themselves not only to understand how communities have water in mind within local contexts, as detailed above, but further to bring to light *why* it is important to contextualize and to understand these changing perceptions (e.g., for more successful adaptations, relocations, research participation, etc.). For example, Kate Dunbar's work in highland Peru emphasizes how researchers need to first become familiar with the when, where, and how local communities understand such rapid, large-scale environmental change and that these "better understandings of current responses to climatic changes, strategies for water management and perceptions of future change will assist in the creation of robust adaptation incentives across governance scales" (K. Dunbar 2008, personal communication). Such investigations reveal the "friction" that results with the confluence of different aspects of power, such as governments, international agencies, researchers, the communities themselves, and so on, as these newly chaotic water regimes become increasing sources of stress to environments and communities (Tsing 2004).

Given the current emphasis on adaptation, urgent need for, increasing interest in, and funding support for transdisciplinary research projects on adaptation, and the facilitative role researchers and policymakers can play in adaptation, this move to understanding and integrating a population's shifting perceptions, in this case, of water in mind, into research is fundamental. It behooves us to understand how affected peoples have water in mind via their histories, cosmologies, and management practices of water, to inform research activities and their findings, facilitate effective adaptation, and, ultimately, to affect policy. Researchers need conceptual frameworks to interpret

[3] My use of the term "place-based peoples" is founded on the understanding that 1) place orientation is a feature of all people's experience of their environment (Norton and Hannon 1997) and 2) that peoples who depend upon subsistence production for all or part of their livelihood would directly depend upon and experience their environment.

local perceptions of water in order to develop and adopt policies that recognize and strengthen the multidimensional role that water plays in communities around the world.

This paper provides an example of how the theoretical framework of political ecology may be useful to understand and to contextualize shifting realities in climate-sensitive world regions among place-based peoples confronted with unprecedented global climate change—in this case, confronted by altered water regimes. Although political ecology is a highly specific focus on, in short, how ecological issues are politicized, the field has a range of applications and is founded in both geographic and anthropological analyses. For the purposes of my analysis, I base my analysis on an anthropological approach (for full explanation of approach, see section 2, below). Through case analysis I explore water in mind, analyzing field data highlighting the history, cosmology, management practices, and contemporary water issues for Viliui Sakha—agropastoralist horse and cattle breeders of northeastern Siberia, Russia.

First I briefly overview relevant political ecological theory, then discuss a political ecology of water in mind. Next, I use the political ecology of water in mind in the context of a case study, beginning with some local context and background on the project, field data, and central findings that show that issues of altered water regimes are the main concern of the local effects of global climate change for inhabitants. I next analyze inhabitants' four main explanatory stories, which are used to explain the prevalent water issues, to tease out how history, cosmology, management practices, and power determine how inhabitants perceive the changes and have water in mind. I then explore further questions that a political ecology of water in mind can potentially clarify and the need to develop a conceptual framework. I conclude with a call to the larger audience of climate researchers and policymakers to consider how applying a political ecology of water in mind can facilitate greater understanding across stakeholder groups and, in the end, result in more effective adaptation for place-based people confronted with unprecedented altered water regimes due to the local effects of global climate change.

2. Engaging political ecological analysis

Why political ecology? Given that nature is "always constructed by our meaning-giving and discursive processes,[4] so that what we perceived as natural is also cultural and social" (Escobar 1999, p. 2) and that local perceptions "exist in dynamic tension" with the material and discursive reality in which people live their lives (Vedwan 2006, p. 8), with that reality constantly evolving based on power relations, it is crucial to understand perceptions within both the local sociocultural context and the broader dimensions of power.[5] To these ends, it is fitting to use political ecological inquiry for this study to the extent that it examines a cultural group's economic, social, and political realities, their physical environment, and influences on that cultural group of more external actors such as states, governments, and systems of knowledge. Political ecology examines the broader dimensions of power that can only be fully captured when working across the multiple scales of resource use to consider the many regional, national, and international dimensions (Zimmerer and Bassett 2003, p. 288). Political ecology is also relevant to this study focus because it investigates the interplay of power relations and knowledge construction and can be used to argue "that knowledge production and material practices are conjoined in such a manner as to perpetuate or generate environmental problems and even 'crises' for socially disadvantaged groups" (Bryant 1998, p. 88). Lastly, because political ecology is inherently interdisciplinary, bridging the natural and social sciences and "has led to results that challenge dominant interpretations of the causes of environmental degradation and contest prevalent prescriptions for solving such problems" (Paulson et al. 2003, p. 205), it should be useful in climate change research, itself an inherently interdisciplinary endeavor.

That said, it is important to acknowledge that political ecology, perhaps since its inception, has not been without its critics. Earlier critiques revolved around political ecology's inability to treat properly and conceptualize the "political" (Bryant and Bailey 1997; Peet and Watts 1993; Peet and Watts 1996; Paulson and Gezon 2005, 27–28). In recent years, it has been subject to widespread criticism, including a continued dissatisfaction with the subfield's weakness in policy engagement (for more, see Muldavin 2008; Robbins and Bishop 2008; Blaikie 2008) and a growing concern about its shallow engagement with ecology—at issue for at least a decade but still unresolved (Vayda and Walters 1999). I would argue that, despite these criticisms, political ecology remains a powerful tool that will only improve as we continue to apply it and critique that application. Like Forsyth (2003) argues, environmental issues and politics are "coproduced," and there are blatant connections among them. It is in this spirit of refining this tool that I proceed with the following analysis.

[4] Escobar is referring to the ways we think and express that thought through discourse.

[5] See Vedwan (2006, p. 11) for an explanation of how I am using "power."

Toward a political ecology of water in mind

Social science focuses on water, outside of economics and water resources policy, are few and those that specifically look at perceptions, meanings, and understandings even fewer (Giblett 1996; Mosse 2003; Oestigaard 2005; Trawick 2003; Strang 2004, 2006; Orlove 2002; Donahue and Johnston 1998; Whiteford and Whiteford 2005; Ioris 2009; Gibbs 2010). Additionally, foci that deal with greater abundance, as this one does, are even fewer.

Although much remains to be done engaging the social and cosmological meanings of water, I argue that anthropology and its practitioners are uniquely poised to investigate climate change's unprecedented water regimes—to investigate what affected peoples are seeing these water regime perturbations *with,* how they are framing these changes (Quinn and Holland 1987), or to take into account a people's belief system and cosmology in addition to understanding the more mechanical adaptive strategies of a people (Rosen 2007). Other recent research indicates an increasing interest in these investigations of water for the diversity of cultures inhabiting climate-sensitive world areas undergoing water regime changes because of climate change.

> The meanings themselves—water as the spirit, as life, as social, connective substance, as wealth and power, as generative source and regenerative sea, as nature, id, emotion and unconscious—all of these permeate the interactions that people have with water. Sometimes near the surface and visible, sometimes deeper and out of sight, they seep into every decision made about water use, wash over every aesthetic, religious or acquisitive vision of water, and swirl in powerful undercurrents in every quarrel about ownership, access and control of water resources (Strang 2004, p. 245).

My point here is not to purport that all contemporary place-based peoples believe and/or live by the worldview and myths/stories/proverbs of their ancestors—this would be naïve. But as Strang alludes to above, it would also be naïve to purport that they no longer have any ties to their ancestral worldview, myths, stories, and proverbs. I claim the middle ground—that place-based peoples frame their world, in this case in their perceptions and responses to uncertain water regimes, with understandings and adaptations based upon an ancestral past and a contemporary lived experience. Researchers have long substantiated how ''tradition'' as a broader category for cosmology, worldview, myth, stories, and proverbs is both retained from one generation to the next and also reinvented as it evolves with changing times (Glassie 1975; Hobsbawm and Ranger 1983). Therefore, the integration of worldview and cosmology in the context of human–environment adaptation is essential to understand the ways that a culture perceives altered water regimes. However, it is not enough.

Researchers need to consider cosmologies, worldviews, and human–environment adaptations in the context of modernity and power for a fuller understanding and to communicate local contexts to policymakers, businesses, and other stakeholders involved in the management of resources including water. Espeland (1998)'s work with the Yavapai people in the Southwest specifically deals with conflicts of modernity and belief systems from the perspective of a native group with the government, powerful local interests, and other stakeholder groups. This requires an understanding of colonial histories and attending to questions related to the center versus the margin, the powerful versus the powerless, and the privileged position of authoritative knowledge over local knowledge (see Kothari 2001).

To inform understandings of power and control at all levels, we need to examine local manifestations of inclusion, exclusion, and decision making (Foucault 1980; Paulson et al. 2003). In effect, the local can be viewed as a microcosm of regional, state, or even global forces where power ''functions in the form of a chain,'' with larger-scale forces built upon a foundation of countless smaller-scale actions, down to the individual (Foucault 1980, p. 98). For this analysis I focus on two of the four forms of power that Wolf describes, specifically the two he describes as ''explaining the world we inhabit and therefore the task of anthropology'' (Wolf 1990, p. 587; Ennis-McMillan 2006). The first is power that controls the more localized settings in which people interact (tactical or organizational), and the second is power that shapes the broader social, economic, and political arenas in which organizational power plays out (structural). By first locating and detailing these forms of power, we can next observe where they work in confluence and where they contradict each other.

To locate the sources of power and actors therein, I use three fundamental questions that, according to Bryant (1998) and Bryant and Bailey (1997), much of political ecological inquiry is developed from:

1) How do certain actors exert control over the environment of other actors?
2) How are power relations made manifest in the physical environment?
3) Why, how, and to what degree do weaker actors resist stronger actors?

To investigate the political ecology of water in mind I first establish a baseline understanding of human–environment interactions (adaptation, both physical and cultural–cosmological) then use the three questions to reveal issues of power. I begin with background on my research communities and project.

3. Case study

a. Background

To provide background for this analysis, I focus here on specific details of Sakha land tenure and the place of water in the Sakha ecosystem, since both are key to understanding the issues related to 'water in mind'. Sakha are relative newcomers to their subarctic homeland, considering that their Turkic ancestors transmigrated from central Asia to southern Siberia circa tenth century, then up the Lena River to their present inhabitance in several waves between the twelfth and fourteenth centuries (Ksentofontov 1992). They adapted a southern nomadic horse and cattle breeding subsistence to the subarctic by living extensively across the sparse subarctic ecosystem, practicing seminomadism between a summer and a winter home, keeping their cows in barns nine months of the year, and harvesting substantial hay for fodder. They were successful based on a highly stratified social structure with wealthy Sakha ''toions'' (elite clan heads) claiming extensive pasturelands and hay fields to maintain large horse and cattle herds. Toions maintained rights to their lands, passed them on to their kin, and reaped ''rents'' from smaller herd owners who used parcels in return for a percentage of hay or animal produce.

Life in the subarctic meant adapting to an environment of continuous permafrost. Surface water is found in the over 2000 rivers and streams and approximately 100 000 lakes across the Sakha Republic. Lakes are so plentiful that Viliui Sakha say there are as many as stars in the sky and refer to them as ''the eyes of the earth.'' The lakes are full of sobo (Carassius carassius), a type of carp and a major food supplement for Viliui Sakha to this day, and surrounded by highly productive hayfields; the entire complex is referred to as ''alaas'' and is the main homestead unit of pre-Soviet Viliui Sakha clans (Hutchinson 1957, p. 100). Rivers also play a vital role in Viliui area hydrology. The main river, the Viliui, winds for 1643 miles from its headwaters in the adjacent Krasnoyarsk Krai to its meeting with the Lena River. This water system is fed by numerous other rivers and streams that run by the intensive spring thaws and torrential summer rains. Although surface waters are limited compared to temperate systems, the area stays saturated because of the low evaporation rates of the sub-Arctic climate, its short summers, and long periods of continuous ice cover on water bodies.

In the Soviet era, inhabitants of the former Soviet Union, either overtly or covertly, were forced to abandon their individually held rights to the state, including land rights (Fondahl 1998; Balzer 1999; Golonev and Osherenko 1999; Grant 1995). In the late 1980s, the former USSR restructured its economy and became linked to global markets. Several months following the demise of the USSR, President Boris Yeltsin passed major legislation to decentralize control and to privatize collective enterprises and farmland (Wegren 1998), resulting in the transformation of massive Soviet-period state farms into several categories of state-subsidized agricultural enterprises (Buckley 1995). Village authorities were to allocate use of land according to state norms, with first priority to peasant farming cooperatives, intended to produce a surplus for local markets, then to village reserve lands for emergency use, then to be divvied up among private households for subsistence production. Although in the post-Soviet period there have been discussions of privatizing land, the extent to which local subsistence would be undermined as land was purchased by foreign interests has kept this from becoming a reality in the Sakha region. To date, land remains the property of the state with individuals maintaining usufruct rights based on a household-level hay field allotment that they maintain via an annual nominal fee (Crate 2003).

In the last 10 yr the Viliui regions of western Sakha, northeastern Siberia, Russia have received above-average annual precipitation, and regional and national data show that the increased precipitation rates are a direct result of global climate change (Fedorov and Konstantinov 2008, 2009; Anisimov et al. 2008; Peterson 2002). In collaborations with regional climate scientists in the capital city, Yakutsk, we were able to document ongoing regional and international research, showing how global climate change is unprecedentedly affecting the Viliui regions. Studies show, for example, the extent and pace of permafrost degradation, of an unprecedented increase of water on the land, and the preponderance of permafrost ice wedges in the Viliui regions, making these areas one of the most susceptible to permafrost degradation (Fedorov and Konstantinov 2008, 2009). This research also shows that the source of almost half the water on the land is melting permafrost.

Rural Viliui Sakha are finding it increasingly difficult to adapt their subsistence to this increasing water. Local inhabitants are challenged by the inundation of hayfields, gardens, and pastures, which prevents use of substantial land areas and harvesting of essential resources; changes in the quality and quantity of snow, preventing hunters and horse herds from accessing winter food; increased flooding that rots homes and other buildings and ruins transportation ways; and disrupted rain patterns in the temperate months that create droughts in spring and dampness in harvest times, affecting hay production (Crate 2008, 2009).

b. Methods

Since 1991, I have worked with Viliui Sakha communities of the western Sakha Republic, northeast Siberia, Russia (Crate 2006a) (Fig. 1).

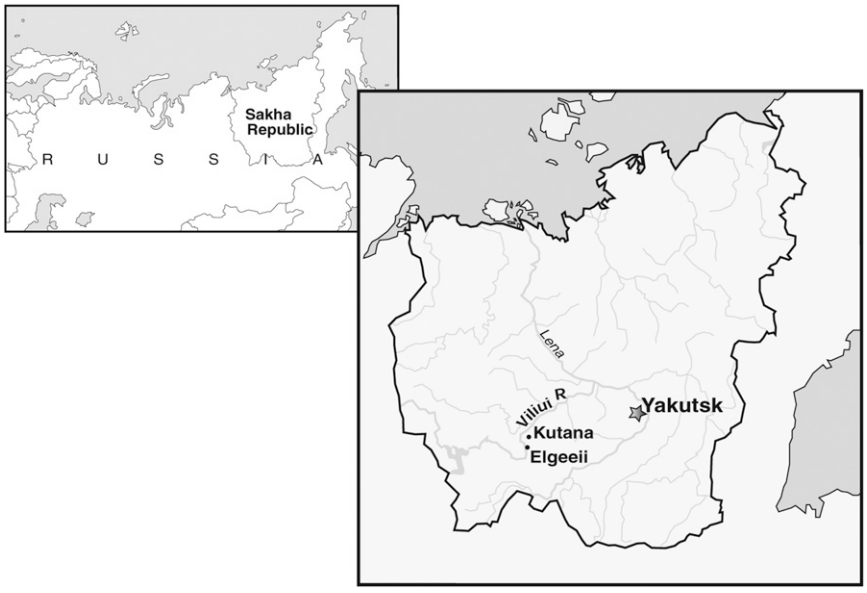

FIG. 1. The contemporary Sakha Republic, above showing its location within the Russian Federation and to the right showing the location of the capital city, Yakutsk, the Viliui River, the Suntar regional center, and the base research villages: Elgeeii and Kutana.

The case I present here is based on a continuing research project involving a four-village, three-year collaborative effort with the active participation of village inhabitants, native specialists and field assistants, an in-country research community, and international collaborators. The impetus to study the local effects of climate change was community-initiated and based on a major finding of a 2003–06 community sustainability research project.[6] In response to the final question of our 2005 survey, intended to gauge the extent to which inhabitants had consensus about local definitions of sustainability generated in focus groups and interviews the year prior, we asked participants to tell us about ''anything else that was of concern'' for them. Ninety percent expressed concern about changes in weather patterns, timing of seasons, and the like that increasingly threatened both their subsistence activities and place-based cultural livelihoods (Crate 2006c, 2008). In response, we spent the remainder of that field season interviewing 33 elders about the changes and discussing inhabitants' desire to collaborate on a project focused on those changes. Based on those data, we developed a full project tasked to understand local observations, perceptions, and responses; to assess regional climate data; and to coproduce knowledge via knowledge exchanges, which were community meetings engaging local inhabitants, local and regional policy makers, and regional scientists.

We began this new project in December 2007 with our first summer field research taking place in 2008 and focusing on what changes the communities at large were observing and how they were perceiving and responding to those changes. To these ends, we chose two main social science methodologies: focus groups and semistructured interviews. The former allowed us to solicit data from inhabitants of a more general nature concerning the changes, and the latter allowed us to ask more in-depth questions about specific observations found more universally. We worked with a research assistant in each village, someone recommended to us by the administration, to invite individuals to participate. We first conducted two focus groups (one group all males and the other group all females, each with two members from each of three age groups—youth 18–25, middle 26–55, and elder 56+—for a total of six in each group) in each of the four villages, for a total of eight focus groups and 60 interviews. In focus groups, we first asked participants to list on paper the changes they have noticed, how long they have noticed each, what time of year each occurs, what they thought was causing each, how each affects their lives, and how they have/are adapting to each. Once participants completed their charts, we had group discussion by creating a comprehensive group chart on the board (see Fig. 2).

It is important to note, although probably not a surprise, that what we achieved in each group varied widely. We set

[6] For both projects I serve as project principal investigator (PI) with funding by National Science Foundation (NSF) Office of Polar Programs/Arctic Social Sciences. I also refer to the project work from this point on as ''we'' since this is a collaborative project.

FIG. 2. Research assistant Prokopiy Yegorov facilitates consolidation of the women's focus group session in Kutana village.

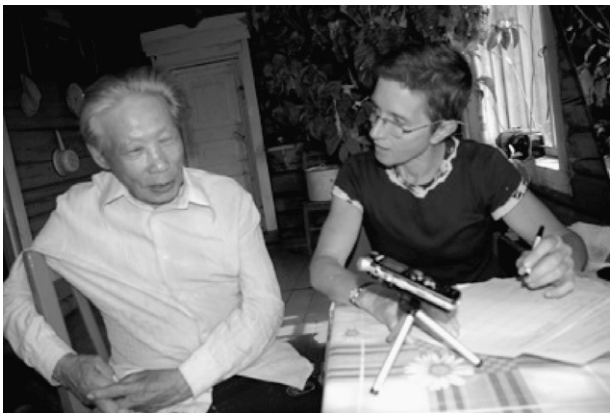

FIG. 3. The author interviews elder Bahalai Mikhailovich Nikolaev in the Khoro village.

focus groups to a two-hour limit; some groups required more time than others to fill out their individual sheets, while other groups went off on tangents in discussion that themselves were rich with valuable data and stories. We came away with three discrete data sources: 1) audio recordings of the focus group discussions, 2) individual written data sheets, and 3) consolidated group charts. Once we completed the focus groups and had some time to do some initial analysis of the data, we returned to each village for semistructured interviews, asking some of the same questions as in focus groups with some additional ones to clarify finer points and details (see Fig. 3).

Unlike the focus group sessions, interviews varied in length (30–75 min) and depth, with youth interviews tending to take less time and have less data and elders' interviews lasting longer with more data. We recorded interviews when there were particularly compelling stories to illustrate points made. In addition to these two methodologies employed in the research villages, we also worked closely with several scientists who are actively engaged in climate research in the Sakha Republic to consolidate regional climate data and to assess the extent to which contemporary policy addresses local climate issues.

We returned from our first summer field season with a wealth of data on observations, causes, effects, future projections, and local–regional policy initiatives. Based on these data and our field work experience we decided to focus on developing a framework to interpret local perceptions and responses to the highly altered water regimes due to the local effects of climate change. For the purpose of this article, I next present our summer 2008 findings, showing the extent to which observed changes involve unprecedented changes in Viliui Sakha's water regime, the main ''stories'' that inhabitants use to explain those changes, and their perceptions of the future as changes progress.

4. Results and analysis

a. Main changes, effects, and causes

By gauging both how many wrote each change and the level of agreement in group discussions and across interviews, we found strong consensus (94% of both focal group and interview participants reported) on nine observations, namely 1) winters are warm, 2) the land is flooded with water, 3) lots of rain, 4) summers are cold, 5) more floods, 6) seasons come late, 7) lots of snow, 8) temperatures change suddenly, and 9) fewer birds and animals. Changes in the water regimes are a dominant feature of what inhabitants are observing and what they talked about. In focus group discussion and interviews, participants repeatedly spoke about the challenges they faced because of the inundation of hayfields, gardens, and pastures that prevent use of substantial land areas and harvesting of essential resources; changes in the quality and quantity of snow, preventing hunters and horse herds from accessing winter food; increased flooding that rots homes and other buildings and ruins transportation ways; and disrupted rain patterns in the temperate months that create droughts in spring and dampness in harvest times, affecting hay production. Visual documentation also captured the preponderance of water issues (see Figs. 4 and 5).

In our inquiries about how participants were adapting to the various changes, we found that changes in water have that meant extra time and energy are required to accomplish their daily and annual tasks. To adapt to the inundation of their hayfields, inhabitants said they would cut the hay on the hay field edges if the water was not so high; find other areas to cut hay, often pooling their hay land resources with kin in other villages; try to drain some of the water from their fields by digging ''khoryy'' (canals); wait until the water froze and cut hay on the ice; feed their herds more purchased grain; and, in lieu of being able to

FIG. 4. This former hayfield has transformed into a lake because of inundation by water.

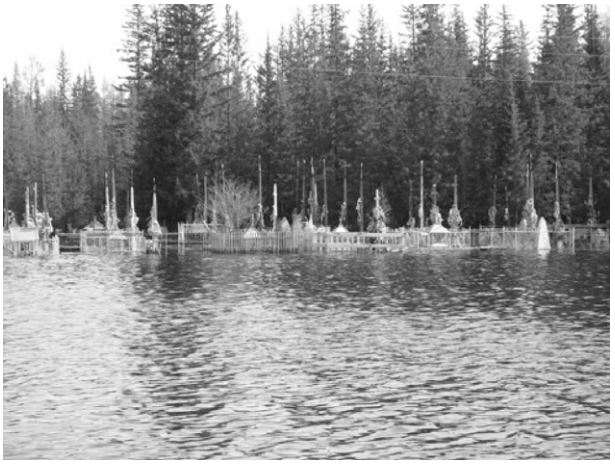

FIG. 5. Spring floods not only threaten infrastructure but also sacred areas.

find enough fodder through these other means, slaughter some or all of their herd. To adapt to water issues in the home, participants are replacing their home's wooden foundation if it is rotting,[7] maintaining a barrier and canal system around their yard to keep water out, and, in more extreme cases, relocating to a different house if their home is flooded. Inhabitants adapt to the impassability of travel routes by seeking out other ways to reach distant resources, often involving taking very long roundabout circuits, regularly having to forfeit reaching their destination if unable to find a passable route. Horse keepers talked about adapting to the increase in snow, which both prevents their herds from reaching their fodder under the snow and from being successful in birthing, by keeping their herds close to their household so they can assist. Households adapt to this increased snow by shoveling almost constantly throughout the winter as opposed to the typical routine of shoveling in early winter and early spring when snow falls. Adaptations to wet hay at harvest time included salting hay, working the hay more to facilitate drying, and using techniques like spreading hay over fences and building structures specifically to allow more air to circulate and cure the hay.

In both focus groups and interviews we asked participants what they thought the future would bring if these changes in local water regimes continued as they are for the next 10–20 yr. The question in itself instilled a sense of fear in most respondents. Repeatedly participants responded by saying "yyga barabit" (literally, "we will go under water").

Our field research shows that the data we received from our scientific collaborators in Yakutsk, mentioned previously and pertaining to how global climate change is playing a significant role in the Viliui regions in permafrost degradation and increased water on the land, are largely unknown in the affected communities and therefore will provide essential explanations for local observations. The following section uses political ecological inquiry to explore how power is integral to keeping this information not only unavailable but out of mind.

b. The explanatory stories

As mentioned above, our data analysis to understand how participants explained the causes of the changes in water showed that there are four main explanatory stories. Here they are discussed with more detail. When asked what they thought the cause(s) of the changes were, four main explanatory stories emerged: 1) wet year–dry year "natural" cycles, 2) the Viliui reservoir, 3) too much "technika," and 4) global climate change.

1) WET YEAR–DRY YEAR NATURAL CYCLES

The wet year–dry year natural cycles explanation posits that the altered water regimes of present are a normal part of the ecosystem conditions to which Viliui Sakha ancestors[8] developed specific adaptations. When Sakha's Turkic ancestors relocated in the north from southern Siberia, they continued to practice "nulustur" (water management), specifically either draining lakes

[7] This is an extremely time- and resource-intensive job, requiring the removal of the floors throughout the house, removal and replacing of foundational wood, and the replacement of floors. Inhabitants of the Kutana village, one of our four research villages, reported that because of the high flood waters in the last years, half of all households in their village have needed to replace their home's foundation.

[8] When I use the terms "ancestors" and "ancestral adaptation," I am referring to the specific practices that Sakha developed to live successfully in the subarctic. To some extent, many of these were all or partially lost in the Soviet period, but are being revived and relearned in the post-Soviet context (for more on this, see Crate 2006a).

and fields in times of floods or holding water in fields in times of drought (Ermolaev 1991). Contemporary Sakha booklets and newspaper articles remind Sakha of these cycles in the wake of increasingly challenging water regimes, referencing current trends to be a part of the complex of alternating wet–dry years that come in 3-, 7-, 40-, and 100-yr increments (Kondratev 2007; Sirdik 2006).

Participants who ascribed to this explanation felt there was nothing anyone could or had to do—that no one can stop nature and the cycles would come around. Several commented that it would be a mistake to drain the fields completely during the wet time because it would result in an absolute drought when the dry cycle came around. Many added that they worried about angering the spirit of the water if too much draining was done, highlighting their belief and cosmological understanding of the issue. They emphasized that living through this watery time was more a matter of individual initiative, many referencing all the ways that their ancestors adapted to times of high waters, including ''wolba'' or cutting hay in the water, ''muus oto'' or cutting hay after the ice freezes in the lakes and ponds, feeding herds with other fodder including ground-up shrubs and trees, and moving households temporarily to the headwaters to cut hay and pasture their herds. Some called for more community work to make ''khoryy'' or canals like they did in the Soviet and pre-Soviet times. They said that only if they have strong canalization work to canal the water to the river can they continue to live here.

2) The Viliui reservoir

The majority of participants felt that the altered water regimes were due to the presence of the Viliui reservoir (referring to the reservoir for the Viliui hydroelectric station, or Viliui GES). Participants explained that the reservoir's huge water surface creates steam that forms clouds that come to their areas, keeping the Viliui regions' climate artificially warm in winters and cool in summers, and increasing precipitation year round of rain and snow. Many also commented that the increase in water issues in the last few years could be explained by the recent opening of GES's third generator, which further expanded the reservoir's volume and surface area. However, hydrological and meteorological studies focusing on the effects of the Viliui GES on the surrounding areas clearly shows that the reservoir affects only a microclimate area directly adjacent to the reservoir (Shadrin 1984; Nogovitzin 1985).

One important point of departure to better fathom this response and how relatively universal it was is how Viliui Sakha continue to feel deceived by the state. Integral to the Soviet propaganda generated to justify the building of the Viliui GES was how residents ought to view it as a source of pride of the Soviet state or the Viliui regions' local manifestation of building communism and one united Soviet people. Then, along with ''perestroika'' and ''glasnost'' in the late 1980s, came the truth. Granted, the more dependable source of electricity in comparison to village diesel generators was a welcome benefit. However, inhabitants' long-held concerns that diamond development was impoverishing their environment and health were verified. This abuse of political power and the way it contributed and even caused environmental degradation by obstructing the river's natural ebb and flow, contaminating its water with heavy metals and phenols, and conducting underground nuclear tests, two of which resulted in substantial aboveground fallout, etc., catalyzed local coalitions who expressed their rage and demanded retribution but to no avail (Crate 2002a). This abuse of power and also the direct way it damaged the ecology remains in the living memory and still clouds people's outlook and understandings. To this day, residents retain a chip on their shoulders, and continue to blame the Viliui GES for anything different from normal.

3) Too much technika

A third explanatory story for altered water regimes is that there is too much human activity and technology or, in colloquial terms, ''too much technika.'' ''From the 'technika' that people use that is fouling the air'' (anonymous Sakha elder). The majority who held to this explanation were elders, some of whom were born before fossil-fuel-burning technologies had come to their homelands. Over the course of their lives they have witnessed major changes in how daily life is lived and how work is performed (Crate 2002b, 2006b). They have also witnessed this technological advance as spectators of the outside world with a keen understanding of how it impacts their local lives: ''They go into the cosmos too much and are mixing up the sky—and from too many rockets and atomic bombs—when I was young they didn't go into the cosmos—and we knew the weather—it rained when it was supposed to—now the climate is all mixed up'' (anonymous elder Sakha).

In many ways, the contextual foundation of this explanatory story mirrors that for Viliui GES except here it is more disperse of a reference. With the response of ''too much technika,'' inhabitants are still complaining about the Soviet state's drive to technology and industry—to ''catch up with the West'' at all costs, even to the abuse of the natural environment and people's belief. Although inhabitants understand the benefits of technology, they also observe how it not only despoils their local environment but, in this case, interferes with the cosmos—the planetary and celestial movements that,

based on their knowledge, are one of several sources of orientation and weather prediction.

4) GLOBAL CLIMATE CHANGE

Only four participants explained that the altered water regime changes are due to contemporary global climate change. The few in this group were either highly literate, being avid readers of regional, national, and international newspapers, or were students studying in the capital city who were home for the summer. They talked about causes including the overall warming of the earth's system, higher global temperatures, the sun being hotter than before and creating more clouds and precipitation, the permafrost melting that caused water on the land to increase, humidity arriving from the Arctic Ocean, and more cyclones that bring water.

5. Applying a political ecology of water in mind

With these explanatory stories in mind, I next apply a political ecology of water in mind by first exploring Viliui Sakha's adaptations, both physical and cultural–cosmological, then by addressing the three questions to reveal issues of power.

a. Developing a baseline understanding of human–environment interactions (adaptations, both physical and cultural–cosmological)

1) VILIUI SAKHA ECOSYSTEM CONTEXT/ ADAPTATION TO WATER REGIME

Plants, animals, and people have developed specific mechanisms to access sufficient water (Crate 2006a). To access water, Viliui Sakha utilized the surface waters of adjacent rivers and lakes. In winter they melted ice or snow, the latter by making a ''tammakh'' (literally ''water drop''), a forked branch packed solid with snow and hung by their hearth fire above a birch bark bucket to capture the water (Maak 1994). In winter they took their animals to drink directly from the surface waters through an ''oibon'' or hole cut in the ice, which was kept open by insulating it on top with several layers of animal hides when not in use. Viliui Sakha also situated their houses to accommodate the hydrology of their region, locating their winter homes on parcels of higher relief to protect them from inundation of water during the spring thaws and their summer homes adjacent to alaas to have accessible water close at hand for themselves and their herds.

2) VILIUI SAKHA WATER BELIEFS FOUNDED IN COSMOLOGIES AND WORLD VIEWS

Viliui Sakha's adaptation to the subarctic ecosystem is highly dependent on maintaining the proper relationships with the spirit world, in which they are part of an intricate web of plant, animal, human, and spirit relationships (Crate 2006a, p. 290). Viliui Sakha worldview postulates that the world has an upper, middle, and lower realm, each inhabited by various deities or, in the case of the lower world, by demons. Trees, rocks, water, words, and all things animate and inanimate are sentient. All people have the ability and responsibility to appease these various deities in the context of their daily interactions and ritual cycles. ''Oiuun,'' or shaman, individuals possessing supernatural powers, also play a central role in these interactions at certain times (Alekseev 1975; Crate 2006a).

Water is an important part of Viliui Sakha's spirit world. Like many indigenous, place-based peoples, they consider all parts of their natural world sentient or spirit filled. A commonly held understanding is ''Uu ichiileekh,'' meaning ''water has a spirit,'' and according to Sakha cosmology, humans need to pay respect to that spirit when they interact with it (Kulakovski 1979, p. 43). Rivers, lakes, and all surface water sources are considered as grandmother or ''ebe,'' a term of endearment used for all forms in nature that are larger than average—lakes, hay fields, rivers, etc. This is done both out of respect for the greatness of that resource, which they depend on for their subsistence survival, and as a customary way to protect the resource from harm (Pekarski 1958, his Table 1). When taking water for use and/or crossing water or using it as a mode of transportation, Viliui Sakha fed the spirit of the water and said certain words to appease it. Similarly, interactions with water for subsistence had specific rituals. The success of fishing was directly related to how well the fishers spoke to and served the water spirit—for example, in the community effort of ''mungkha'' or lake ice fishing. When Viliui Sakha arrived at their summer home, among the spirits they paid tribute to ensure a plentiful summer harvest was the spirit of the adjacent lake to whom they hung a symbolic ''salama'' to appease it. Viliui Sakha also called on a shaman to appease the water spirit when they worked with water—for example, to drain a lake to make more land area for hay to grow (Nikolaev 1970; Crate 2006a).

Viliui Sakha's creation myth begins with a world made up totally of water, which acquires its first area of land thanks to the activities of either an ''abaahi'' (evil spirit), swallow, or loon. Cows, Viliui Sakha's main source of meat and milk, are believed to have come from water. Water is also the medium to take away what is no longer wanted. For example, it takes away the ''bull of winter,''[9] bringing the long-awaited spring (Crate 2008). It is also

[9] A mythological beast whose arrival coincides with the coldest part of Sakha's winter (Crate 2008).

the medium that takes away death or ''uulu uuta'' (water of death). Sakha place a cup of water by the deathbed to let the soul jump into the water. One of the most famous Sakha folk tales, ''Old Woman Taal Taal,'' teaches that water is second in power only to the earth.

Sakha proverbs are rich with references to water. Amongst the many examples, two in particular illustrate well for our purposes. The first exemplifies the sentience of water in Viliui Sakha worldview: ''You can't see water as the river goes by but if a person speaks artistic words as the river runs by, it will braid itself in response'' (Kulakovski 1979, p.186). Another proverb that has been revived in the challenging post-Soviet economic times connotes water as an intimate entity: ''Keep water close and inlaws afar,'' which is explained to mean that water is necessary and will never offend or betray you compared to in-laws (Kulakovski 1979, p. 187; Crate 2006a).

b. Analyzing power relations using the three questions

Here I apply the three questions to the explanatory stories to understand how power relationships are implicit and to show how political ecology can interpret the stories and help to make sense of them in terms of modernity. Applying the three questions to the explanatory stories reveals how structural power has worked over history and especially in the Soviet period to limit Viliui Sakha's ability to adapt to altered water regimes and exert their own organizational power. People at the local level empower abuses of power from above and vice versa. The local manifestation of power looks like the higher level—it is a fractal, or resembles that on a higher level. Power itself is not different. What is different is the scale it is played out on. In other words, structural power limits the ability of organizational power to flourish at the local level.

Russian colonization imposed land and resource restrictions, Soviet collectivization and industrialization reorganized Viliui Sakha's spatial and environmental orientations, and the sudden lack of central control in the post-Soviet period further exacerbates perceptions and realities of altered water regimes. These frictions have both generated specific perceptions about environmental change and altered water regimes of global climate change and alsogenerated much fear and anticipation about the future.

1) How do certain actors exert control over the environment of other actors?

Russian colonization, Soviet-period collectivization, and industrialization and the post-Soviet socioeconomic downturn have all worked to disadvantage, and in some cases, undo Viliui Sakha's local adaptations to water regimes. Russians began colonizing Siberia in the mid-1600s and annexed native lands. This began the process of displacing Viliui Sakha from important water sources and land areas that had good water availability but also decreased the area they had to utilize in times of drought and flood. With the forced collectivization of the Soviet period, inhabitants had to move into larger and larger farming settlements, which distanced them from access to remote resources including water, pastures, and hayfields. Additionally, settlement and loss of land rights precluded their ability to move to other areas in times of drought or floods, which was a mainstay adaptive strategyin pre-Soviet times. Lastly, larger and larger settlements also made the pollution of water sources a growing problem.

The 1950s discovery and exploitation of diamonds in the Viliui regions similarly generated multiple water issues for Viliui Sakha. In the late 1950s, Soviet geologists discovered diamonds in the Viliui regions and soon constructed the Viliui hydroelectric station to generate sufficient electricity to mine and process the diamonds. In many ways similar to the forced collectivization of the time, Soviet diamond mining was done without any consideration of whether local populations would allow it or how they would be affected. In many ways these issues were not relevant in the context of the Soviet dream of building a nation of one people and catching up the country's military–industrial complex with the rest of the world. Propaganda promoting not only the importance to that ideal of the mining of Viliui diamonds but also the inherent pride it brought to Viliui inhabitants to be part of it (not as miners but as producers of food for the diamond colonies) was ubiquitous and successful (Crate 2002a, 2006a,d). The discovery and exploitation of diamonds on the Viliui, including the establishment of the Viliui GES, as I and others have argued, is a prime case of environmental colonialism to the extent that the local population's environment, and thereby their health, have been severely compromised in the name of economic development (Crate 2002a, 2006a; Tichotsky 2000).

The socioeconomic downturn of the post-Soviet period has worked to exacerbate these existing water issues since regional and village administrations, now responsible for their immediate vicinities (decentralization), cannot meet the need for canalization, water purification, and other activities necessary to relieve increasing water problems.

These power issues come to the fore in the wet years/dry years explanation to the extent that Viliui Sakha are not able to maintain their ancestral adaptive strategies that enable them to maneuver the cycles of wet and dry. They no longer live extensively across the landscape with

access to sufficient lands to be able to supplement their resources in times of drought or flood. They also do not have the freedom to move across the land as needed; for example, when lands are flooded, they adapted by moving with their herds to the headwaters. Since forced settlement, especially in the Soviet period, they no longer have the right to move across the landscape freely.

Too much technika is more of an indirect exertion of power from the outside world than the case of diamond mining. Viliui Sakha's regard of how ''they'' are using too much technika and going up in the cosmos too much expresses their regard to how the ''outside world'' is invading and affecting their relatively nontechnical world. At the same time, survival in most world contexts means using some level of technology, here citing the example of Inuit hunters using GPS and snow machines to continue to practice their historically based economy of reindeer herding and still make ends meet in the modern world. However, most of Viliui Sakha's references in this explanatory story are about the technologies not of their daily lives but of a world ''out there''—in the form of cosmic rockets and bombs. Many also tend to frame the too-much-technika explanation in the context of their regular planetary observations, discussing how the ''usual'' paths of stars and planets in the sky appear to them to have changed.

Insights of this question to the global climate change story is more about how power relations have created a lack of locally relevant information for inhabitants to access and understand how this global process is effecting their local environments and altering their already compromised water regimes. Since 2005, when our team first began hearing local stories about changes in weather patterns and temperatures, we have compared the extent to which regional information about climate change can be found in the village level versus Yakutsk media sources. We have found that little, if any, of the information is reaching the villagers. In addition to how global climate change is affecting their environment and lives, they are also lacking in information pertaining to causes of the climate crisis—that it is the developed world that is generating the majority of greenhouse gases (GHGs) and the undeveloped world that is bearing the brunt of effects.

2) How are power relations made manifest in the physical environment?

Most obvious is the change in spatial orientation during the Soviet period—from living in family-clan homesteads and practicing a horse and cattle subsistence extensively across the landscape with relatively sufficient access to necessary resources to living in compact centralized villages with no land rights and depending on traveling to and from the resources necessary to subsistence. But this manifestation of power in the physical was not done in some homogenous, ubiquitous fashion in which all inhabitants were treated the same. There were specific political protocols to this physical change—most relevant being the leveling of the social strata. Similarly, this change could not have occurred without a very substantial source of power manifest in the local apparatus. In looking at these changes, it is clear how the structural power from Moscow was absolutely reflected in the organizational power on a local level. In the Viliui Sakha context, this Soviet mandate was extremely inviting to those who had nothing—who themselves and whose ancestors were unsuccessful horse and cattle agropastoralists. It was in their best interest to jump on the Soviet bandwagon and join the local cadre. Conversely, successful pastoralists were those with large herds and usufruct rights to local pastures. They, more often than not, were employers of the many poor whom they kept in good conditions. With the Soviet turn, these successful herders were branded ''kulaks,'' or enemies of the people. Here I can speak from personal experience. My Sakha in-laws came from a clan of successful herders who were forced to give over their centuries-old wealth to the state to work for the collective and later the state farm (Crate 2003).

The fall of the Soviet Union showed how these power relationships continued to play out. Those in power locally allocated the state farm resources unevenly to benefit themselves, their families, and colleagues. In the post-Soviet period, the cadres that were established in the Soviet period have been maintained to this day and have consequences on landscape and ecology. For example, in the post-Soviet period especially, there has been an increasing amount of roads and specifically roads built upon earthen tracks to prevent them from washing out and needing frequent repair, but, in the process, have the adverse effect of creating dams between fields and preventing the natural draining of hayfields. Similarly, with the end of the state farm system in the post-Soviet period also came the termination of canal building and maintenance on the state farm level to keep hayfields productive (i.e., drain when there is too much water and hold water during dry times).

Similarly, the physical impacts of the mining activities were many and, for the purposes of this analysis, I will limit them to those directly related to the reservoir. The damming of the Viliui River obstructs the natural ebb and flow of the entire river system and also created an artificial water reservoir that flooded thousands of acres of prime forests and fields and also forced the relocation of 600 people whose homelands were located in the reservoir's flood plain. The social and environmental

consequences were many and affect life in the Viliui regions to this day (Crate 2002a). Other physical manifestations of power include the pollution of the river, which imperils human health and fish populations; the lack of governmental efforts to supply populations with clean drinking water; and the inequitable living conditions Viliui Sakha must accept in comparison to residents of mining towns and cities where they have running water, central heat, etc.

In the too-much-technika story, many elder Viliui Sakha claim that the sun, moon, and stars are affected by all the ''going into the cosmos.'' Access to media accounts depicting wars, environmental catastrophes, journeys into outer space, and other ways that humans are altering the atmosphere and beyond show them these power relations. Global climate change, with its various unprecedented environmental changes, was for Viliui Sakha most pronounced in the altered water regimes resulting from the phenomena.

3) WHY, HOW, AND TO WHAT DEGREE DO WEAKER ACTORS RESIST STRONGER ACTORS?

The main resistance to the changes in land tenure was during the 1930s in the time of Joseph Stalin's forced collectivization. Kulak, as mentioned above, was an enemy of the people and the label given to the wealthier herders, many of whom refused to give up their herds and lands. In the early 1930s, Stalin gave them an ultimatum—either give over their holdings to the state or die. In the Viliui regions there was some local resistance that did result in deaths. However, the majority of kulaks conceded. So here we see that those who were once the stronger actors were put into the position of weaker actors with the Soviet power turn. They resisted to maintain their ancestral lineage of clan and herds. Most of them only resisted up to the point of facing death. Those who chose to live, in the process, had a new relationship with rights to resources. They not only relinquished extensive usufruct rights to lands but, in the process, also the management of the water and other resources of those lands.

Resistance to mining began with the era of glasnost (''openness/access to information''), Viliui inhabitants had access to information affirming what many had suspected—that diamond mining had imperiled their environment and health for decades (Crate 2002a). Citizens became actively involved in educating themselves about the environmental issues and formed citizen groups to protest further mining until the environmental injustices were corrected (Crate 2002a). There was some level of success until the government began discouraging such activism via threats to local economies, including regular radio broadcasts and newspaper stories about the regional diamond mining efforts and how they were the main source of transfer payments that funded local economies (Crate 2002a; Crate and Yakovleva 2008). If anything, there is now only passive resistance to the extent that Viliui Sakha refuse to engage in too much technika.

c. Fear as one outcome of disempowerment

Viliui Sakha have increasing fear about the immediate and future consequences of altered water regimes. During focus groups and interviews, when asked about what they thought the future would hold if changes continued as at present, most participants expressed their fear of going under water, repeating the common phrase yyga barabit (we will go under water). Many commented that if the altered water regime changes continue they will either need to give up herding to stay in their village or relocate to continue herding. However, Viliui Sakha, like many place-based peoples, are committed to their homelands. When asked whether they would stay and adopt other means of feeding themselves if water issues made herding impossible or relocate to continue herding elsewhere, the overwhelming majority chose the former. Those who live close to the river or other waterways were especially outspoken, talking about the spring 2008 flood and their fear, at that time, of being washed away. Fear was also evident in the research process. About 10% of interviewees were increasingly uncomfortable with answering in detail our questions about their thoughts of what the future would bring.

The fear factor of going under water is rooted in Viliui Sakha's historically based belief and cosmology. Sakha's creation myth portrays the earth as totally water in the beginning. This begs the question that if all was water before, could this inundation signify, on some level of a people's consciousness, the end of the world? Similarly, a proverb that several elders referred to during interviews and can be also traced to the literature «Тийиэхтэрэ оол уйэ5э, хаччa5a Буус байа5ал ириэ5э», which literally translates ''They will survive until the day when the Arctic Ocean melts'' (Pekarski 1958, p. 3422).

Fear is also an outcome of modernity, fed by contemporary media portrayals, which tend to misrepresent, skew, and/or sensationalize issues. For example, over the course of our summer 2005 field season we observed that the docudrama film *The Day After Tomorrow* was aired at least six times during that summer, in primetime. During that same year the regional paper headlined a story about three northern villages in the Sakha Republic that were inundated with water and inhabitants had to permanently relocate. The stories and news broadcasts failed to provide any explanation of the how and why of this unprecedented flooding. Additionally,

news broadcasts tend to focus on disasters, including floods, cyclones, wildfires, earthquakes, etc., in global, national, and regional contexts, which tends to skew an audience's idea of what is happening in the rest of the world. This in itself is very illustrative of the complex interplays of knowledge, authority, power, and center-to-margin issues.

I argue that another contributing factor to the widespread fear among Viliui Sakha is that most inhabitants lack an understanding of how their local water issues are due, to a large part, to global climate change. Results from our 2009 survey to 10% of all village households (n = 67) show that 95% of participants have heard of global climate change, have known about it for the last 5–10 yr, and learned about it via radio, TV, and newspapers. However, they understand it as something that is not happening in their immediate context but rather out there in the rest of the world, clarifying that it is not a question of inhabitants knowing about the issue but that the issue has not been brought into their local context. Such locally contextualized information is available. Our in-country researchers' findings show that as global climate change proceeds there will be multiple issues in the Viliui regions, including increasing precipitation and water on the land (Fedorov and Konstantinov 2008, 2009).

Other place-based peoples encountering unprecedented environmental change due to climate change are also fearful. For example, studies in Greenland with hunting communities dependent on ice for their subsistence show that fear is a common issue (Hastrup 2009; Nuttall 2009). For Viliui Sakha, I argue that fear is a result of a history of the interplay of organizational and structural power that has worked to control Viliui Sakha physically and spatially vis-à-vis how they maintain their livelihood based on specific adaptations to their environment and to control them cognitively through misinformation about their environment, especially in the Soviet and post-Soviet periods. As a result, Viliui Sakha are left with little locally relevant information about the cause of the changes they are seeing nor any tangible means to address these changes.

6. Next steps

Political ecological inquiry is useful not only to capture how local inhabitants keep water in mind vis-à-vis its social–cosmological meaning and power relations but also to analyze perceptions about the future and responsibility for providing, controlling, and maintaining an appropriate water regime. Because friction, to a greater or lesser degree, is a byproduct of the enactment of power (Wolf 1990, p. 590). Clarifying perceptions of the ''what'' and ''why'' of altered water regimes also informs the perceptions and realities of the ''who'' that should wield organizational power over water; just how much friction is altered water regimes generating in local contexts? In other words, we move from asking how local inhabitants are perceiving altered water regimes resulting from the local effects of global climate change to asking among which actors (and at what scales) should power over water, its management, and related livelihood issues be shared?

Questions of who ultimately is responsible further reveal complex interplays of power. Interviews and surveys showed that most inhabitants put the responsibility on the regional and national government. Viliui Sakha comment that they can no longer negotiate their environment as in the past via adaptive strategies—some of which are hindered because of forced resettlement, others because dependence on the agro-industrial economy has resulted in a loss of local knowledge and work ethic, and others because dependence on the Soviet state taught people to wait for someone to make decisions for them.

Inhabitants link this directly with their powerlessness because of misinformation, especially in the Soviet period, of the increasing environmental dangers of an agro-industrial complex. The Viliui GES remains a symbol of government subversion in the Soviet period. After decades of Soviet propaganda that glorified the hydro dam in the name of Soviet people's progress, in the late 1980s inhabitants had first-time access to the data clarifying the environmental damage resulting from GES and the diamond activities on the Viliui. From that time on, GES has remained a way to explain phenomena that is outside Viliui inhabitants' lived experience (Crate 2009). Based on our fieldwork to date, it appears that, in lieu of locally relevant information on global climate change, most inhabitants also blame GES for these changes.

Regional research shows how the combination of diamond mining, deforestation, environmental degradation, population pressure, and nuclear contamination contribute to the complex of multiple stressors in the Viliui regions (T. Maksimov 2008, personal communication). Based on the data from our collaborations with in-country climate scientists, the global climate change explanation is the main source of the water changes for Viliui Sakha communities. Clearly there is a disconnect between what these scientists are finding and what local communities know. This is very important in terms of knowledge, epistemologies, and power, and is very illustrative of a political ecological perspective.

7. Conclusions

This paper is a preliminary exploration of how a political ecology of water in mind can be used to understand and to contextualize the shifting realities of research and life in climate-sensitive areas among place-based peoples.

I have shown how Viliui Sakha have, through their history and to this day, developed and maintained specific adaptations to the water regimes of their sub-Arctic homelands. Climate change has brought new water regime issues. However, we see via a political ecology of water in mind, by both establishing Viliui Sakha's cultural and physical adaptations and by asking the three questions to reveal issues of power, how political ecology can unravel the complexity of relationships that inform perceptions and, ultimately, understandings and responses. In the Viliui Sakha's case we see how contemporary perceptions of the local effects of global climate change tend to be skewed because of a history of disempowerment founded in alienation from cultural and physical adaptive strategies replaced by dependence on a paternal state that used misinformation as one tactic. We also see how this, in turn, has generated fear—an emotion that further perpetuates inaction and subservience. Viliui Sakha's disenfranchisement with being actively involved in managing and adapting to their changing water regimes (due to the historical processes of environmental, social, and industrial) and the lack of locally relevant information on the local effects of global climate change beg the question of whether Viliui Sakha's capacity to adapt to the new challenges of altered water regimes in part depends upon how their perceptions of cause and effect can be informed by an understanding of the local effects of global climate change.

This paper also shows ways in which the interdisciplinary reach of political ecology can be used to make sense of local-to-global interactions, to bridge forces acting at various levels, and to contextualize them in comparative and meaningful ways. This type of research can act as a guidepost moving forward to get a clearer picture of the realities of shifting forces in climate-sensitive areas, ultimately underscoring the need for changing research paradigms that account for the panoply of forces interacting in these sites. As such, it is necessary to understand ways in which political ecology can help to form the foundation of a different kind of research in these areas. Specifically, political ecology can inform research that is sensitive to cosmologies, ethnoecology, power, the environment, and that will work to reduce the friction generated as increasing amounts of research take place, thus helping to ensure the success of ongoing shifts in local adaptation, and contribute to more effective adaption, interdisciplinary research, and policy. Down the line, this type of analysis could also prove useful as global climate change progresses and has more apparent effects on western societies. Research documents how members of Western society have specific perceptions, beliefs, and attitudes about altered water regimes and other phenomena of the natural world (Wolf and Orlove 2008; Strauss 2003; A. Wutich 2008, personal communication). This evidence provides grounds to justify further developing the political ecological analysis set out here for the many human communities facing altered water regimes due to unprecedented global climate change.

For this broader application, this article's political ecology of water in mind needs to be understood as a work in progress. It, or some semblance thereof, can potentially be tested and reworked into a replicable form to be applied in the diversity of world regions, particularly where inhabitants of climate-sensitive world regions are presently facing the most extreme water regime changes. Through this reworking, we can potentially develop a political ecological framework to understand the shifting water regimes of place-based people in an age of climate change. Researchers can play a prominent role in affecting policy by bringing to light the need to attend to local contexts, thereby addressing the need for changing research paradigms that account for the multiple forces interacting in these contexts. My intent is to contribute to the collective understanding of how we all, including the communities affected by unprecedented water regimes and the transdisciplinary research teams and policymakers working with them, keep water in mind.

Acknowledgments. I first thank all Viliui region inhabitants, project collaborators, research assistants, and in-country specialists involved in the research that this article is founded upon. I also acknowledge the National Science Foundation (NSF) and my program officer, Anna Kertulla de Echave, Office of Polar Programs, Arctic Social Sciences Division for funding support. This article is mainly based on research from NSF National Science Foundation, Office of Polar Programs, Arctic Social Science Program Grant 0710935 "Assessing Knowledge, Resilience & Adaptation and Policy Needs in Northern Russian Villages Experiencing Unprecedented Climate Change." For feedback on earlier drafts, I thank Jennifer Collier, Barbara Rose Johnston, Mark Nuttall, Ben Orlove, Astrid Ogilvie, Jason Simms, Catherine Tucker, and Bruce Winterhalder. I want to add to that some extra kudos to Jason Simms for his extensive support. I am also indebted to Heather Lazrus and Randy Peppler, whose comments helped greatly in telling these stories to a wider audience.

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