Chapter 3

Fielding Climate Change in Cultural Anthropology

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Introduction

Within the last ten years, anthropologists have become involved in climate research to an unprecedented degree (Batterbury 2008; Brown 1999; Magistro and Roncoli 2001; Rayner 2003; Strauss and Orlove 2003). Three conditions are responsible for this development: the irrevocable transformations that climate change is bringing to the people and places traditionally studied by anthropologists (Boko et al. 2007), the general recognition of the importance of research on the human dimensions of climate change (Vogel et al. 2007), and the growing opportunities for anthropologists to participate in interdisciplinary climate application and adaptation research (Roncoli 2006).

To this challenge anthropology brings its core theoretical tenet: that culture frames the way people perceive, understand, experience, and respond to key elements of the worlds which they live in. This framing is grounded in systems of meanings and relationships that mediate human engagements with natural phenomena and processes. This framing is particularly relevant to the study of climate change, which entails movement away from a known past, though an altered present, and toward an uncertain future, since what is recalled, recognized, or envisaged rests on cultural models and values. Individual and collective adaptations are shaped by common ideas about what is believable, desirable, feasible, and acceptable (Nazarea-Sandoval 1995; Rappaport 1979). Anthropology's potential contributions to climate research are the description and analysis of these mediating layers of cultural meaning and social practice, which cannot be easily captured by methods of other disciplines, such as structured surveys and quantitative parameters.

This chapter examines a number of studies that exemplify the way anthropologists have engaged with various aspects of climate change. We do not intend to present a comprehensive review, but we seek to identify the epistemological and methodological approaches that have led to particularly valuable insights. We recognize that a great deal of research on climate change and its effects on cultural systems and social organization has been

carried out in archaeology (Balter 2007; Kuper and Kropelin 2006; Migowski et al. 2006; Richerson 2001), historical ecology (Crumley 1994; McIntosh et al. 2000; Oldfield 1993), and cultural ecology (Bogin 1982; de Menocal 2001; Peterson and Haug 2005). In this chapter, however, we focus on the ways that cultural anthropologists address present-day issues related to global climate change, issues that are confronting both local communities and global scientific and policy communities with unparalleled urgency and severity (Batterbury 2008).

Our discussion begins by highlighting the distinctiveness of ethnographic fieldwork as a way to gain insights into the relationship between climate and culture. For the remainder of the chapter, we focus on four overlapping axioms that elucidate the different ways cultures engage their world through the prism of climate change: how people perceive climate change through cultural lenses ("perception"); how people comprehend what they see based on their mental models and social locations ("knowledge"); how they give value to what they know in terms of shared meanings ("valuation"); and how they respond, individually and collectively, on the basis of these meanings and values ("response"). In the conclusions, we argue that, since climate change is about global fluctuations and interconnections, cultural anthropologists are challenged to broaden their field horizons and venture out on uncharted epistemological terrains. At the same time, given the ideological and politicized nature of climate science and its influential role in policy decisions that affect the lives of indigenous communities, marginalized groups, and the poor, anthropologists should stand firm in their tradition of committed localism and ethnographic reflexivity (Marcus 1995).

Being There

Ethnographic fieldwork, based on extended periods of residence and research at a community level, has been anthropology's dominant approach to capture the elusive domains of cultural meaning and practice. Anthropology's emphasis on fieldwork and participant observation stems from the recognition that engaging in daily life and social relationships provides a contextual understanding of cultural realities that cannot be captured by structured survey methods alone (DeWalt and DeWalt 2002; Jorgesen 1989; Shensul et al. 1999). Fieldwork allows for a slower accumulation of evidence and understanding and for key insights to arise unexpectedly, during experiences that allow glimpses of how the world is perceived and experienced by local peoples—for example, while participating in ancestral rituals in Tanzania (Sanders 2003), witnessing impacts of El Niño drought on daily life in Papua New Guinea (Ellis 2003), or drinking early morning coffee with Maryland crab fishermen (Paolisso 2003). While ethnographic interviewing and participatory research techniques are also deployed to elicit information on various issues, it is this full immersion in fieldwork that constitutes anthropology's trademark tool.

"Being there" is increasingly being embraced beyond anthropology by other social scientists, such as sociologists and cultural geographers who work on vulnerability and adaptation to global environmental change. In describing methods used to gather data for her ethnography on climate and economic change in rural Mexico, geographer Hallie Eakin (2006, 213) acknowledges that "some of my greatest insights into the livelihoods of farmers in the Puebla-Tlaxcala Valley came from simply being there: helping with the harvest, chatting with mothers outside the primary school, attending a wedding celebration or school graduation. None of these methods and data sources would have been sufficient on their own to understand the full complexity of the farmers' vulnerability." Accordingly, most chapters in her book open with accounts of fieldwork events or conversations that provided clues to crucial aspects of climate vulnerability, risk management, and adaptive capacity. In particular, field interactions provided her with insights into the way livelihoods are infused with cultural meanings and adaptations reflect agency in the way people endeavor to make the best out of their circumstances. Also trained as a geographer, Petra Tschakert (2004a, 2004b) has conducted fieldwork in rural communities in Senegal, illustrating the value of participatory methodologies in eliciting farmers' views of climate change, its causes, and its impacts (Tschakert 2007b). By comparing conceptual models of farmers and "experts," she highlights where they diverge and where they may complement each other through collective learning. She also applies ethnographic methods to identify soil fertility strategies with carbon sequestration potential, and then uses soil measures to assess their potential for carbon sequestration and economic analyses and agent-based modeling to assess their feasibility and profitability for different wealth categories of farmers (Tschakert 2007a). Her approach is noteworthy for highlighting how African farmers can participate in mitigation efforts, rather than merely adapting to climatic changes.

Two studies of sub-Arctic regions, Susan Crate's (2008, 2006b) political ecology of Viliui Sakha, agro-pastoralists of northeastern Siberia, Russia, and Julie Cruikshank's (2005) ethnohistory of Yukon Territory First Nations peoples, exemplify the epistemological value of long-term involvement with and deep personal commitments to particular communities. Even as they conduct multisited ethnographies, the researchers' studies build on applied efforts to produce educational and advocacy resources for local people, such as educational and documentary materials on local history, language, culture, and environment (Crate 2006a, xiii-xiv; Cruikshank 2005, x-xi) and generate knowledge that is brought to bear in land claims negotiations between an indigenous people and the central government (Cruikshank 2005, 287). These intimate ties with research communities allow the coproduction of ethnographic narratives that involve both local experts and research partners. These cases suggest how long-term participant observation can develop into engaged ethnography.

Anthropologist Sarah Strauss (2003) takes the significance of "being there" into the realm of weather observation and forecasting. Writing about the development of a national weather service in Switzerland, she points out how the work of volunteers who record local weather data supports the generation of scientific knowledge about regional and global weather phenomena by professional meteorologists. Yet, in order to make sense of scientific forecasts, lay users must recontextualize them based on intimate knowledge of their particular localities. Generalizing from her Swiss material to other cases, Strauss notes that "farmers, sailors, mountain guides, and others, who make their living by their skills at navigating nature's complex rhythms and random disturbances, know that to trust the weatherman's forecast *alone* is to cast one's lot to the wind—there is no substitute, no matter how sophisticated, for being there." (Strauss 2003, 55). Along these same lines, Roncoli et al. (2003) show how the collective experience and sustained observation of nature helps African farmers to interpret scientific seasonal climate forecasts in ways that are adaptive in their immediate context. When anthropologists head to the field they seek to grasp this level of experiential competence found among the members of the communities in which they work. "Being there" enables them to gain a much greater depth of insight into those systems of practice and meaning that define such communities, be they subsistence farmers or research scientists.

Perception

By emphasizing collective experience and cultural framing, anthropology gives voice to folk narratives of climate change, expanding the discussion beyond the broader spheres of earth sciences, policy debates, and media headlines. Visual and sensory perceptions are key elements of the folk epistemology of climate (Strauss and Orlove 2003). The human body's senses are important avenues through which people get to know their local weather in its particular manifestations, such as rain, hail, snow, wind, and temperature. For example, rain may be experienced corporeally and emotionally by seeing, hearing, feeling, and even smelling. Biologist and ethnoscientist Gary Nabhan (2002) describes how indigenous inhabitants of the arid American Southwest and of northwestern Mexico note with delight that after rare rainstorms, "the desert smells like rain." In Uganda, farmers might see clouds in the sky and, based on their color and shape, know whether it will rain; they may feel the wind and, based on its direction or strength, recognize whether it will bring rain or chase it away; they may hear thunder and see lightning flashes on the horizon and, based on their orientation, predict whether the storm will head their way; they may feel heat at night, and, based on its intensity and the time of year, discern whether planting time is approaching (Orlove et al. under review).

Anthropological research on the modes and shifts of collective attention highlights how public understandings of climate events and of climate

science incorporate local agency and meanings (Broad and Orlove 2007; Vedwan 2006). In communities that rely on natural resources for their livelihood, people are keenly watchful of the landscape and quickly discern climatic anomalies and their effects. Farmers in the Sahelian region of West Africa point to shrinking water bodies, disappearing plants and crops, and changing settlement patterns as evidence of reduced rainfall over the last three decades of the twentieth century (Tschakert 2007b; West et al., in press). In many parts of the world, trees, wind, and birds have been subjects of attentive scrutiny by local farmers who rely on them to predict seasonal rainfall. But where climate change is eroding the reliability of such indicators, public attention may shift from them to different, external sources of information, such as radio and television weather forecasts (Roncoli et al. 2002). On the other hand, in areas where rainfall variability is becoming an increasingly severe problem, such as the humid tropics of southern Uganda, farmers are becoming more attuned to environmental clues to orient their planting choices (Orlove et al., under review). For example, while discussing their expectations for the upcoming rainy season, Ugandan farmers stressed the need to be alert as not to be "tricked" by the climate, meaning not to misread signs and be caught unprepared. This element of concentrated attention is sometimes translated in the Luganda language as *amaanyi*, the same term that denotes mental and physical effort, including energy, resolve, and confidence, traits that are upheld as essential to coping with uncertainty.

Ethnographic interviews and participant observation provide important entry points into ways which reveal the phenomena that people use as evidence that climate is changing. Some expressions of climatic change are especially salient due to their striking visibility, such as diminished snowfall or glacial retreat (Orlove et al. 2008; Vedwan and Rhoades 2001). For example, in a study in the western Himalayas, Vedwan and Rhoades (2001) interviewed apple farmers about the reasons for declining production. If farmers spontaneously mentioned climate change, researchers followed up by asking what specific aspects had changed and what caused such changes. Farmers identify changing snowfall events, specifically shifts in its timing and intensity, as the main evidence that climate is changing. Such changes were framed largely in terms of variation in snowfall: for example, they point to increasing occurrence of late snowfall as a sign of variations in rainfall or temperature. The salience of snowfall highlights the significance of visual indicators in farmers' understanding of apple-weather interactions, particularly regarding how weather variability affects fruit color and appearance. Such sensitivity to subtle changes in the environment allows farmers to contribute understanding of local manifestations of global climate change.

The visual and narrative representations that people evoke when describing their environments provide unique insights for an anthropological study of the human dimensions of climate change. In their investigation of

cultural perceptions of environmental change surrounding Mount Shasta in northern California, Wolf and Orlove (2008) allowed interviewees to express at length their views and feelings about the mountain. Analysis of those responses shows that perceptions varied according to the respondents' birthplace, residence, experience, and worldview. For example, locally born people emphasized utilitarian functions (e.g., the mountain as provider of water), while those who moved in were more attuned to aesthetic and spiritual meanings and more likely to mention the snow and glaciers that give the summit its characteristic "whiteness." Orlove et al. (2008) highlight the role of glacier-covered peaks as visual icons of both nature and culture. Powerful symbols of unspoiled, unconquered nature, glaciers attract tourists and mountaineers from different parts of the world. At the same time, they are emblematic of cultural identities, featured in official imagery of cities and countries that claim a particular relationship to mountains and glaciers. The massive glacierized peak of Mt Ararat, for example, is depicted in Armenia's coat of arms and serves as a symbol of the Armenian people and nation, of their greatness and of their indomitable will to survive. The representations, sense of attachment, and economic importance of mountains and glaciers contribute to shaping the way local people respond to accounts of climate change from scientists, government agencies, and other organizations. Yet, while a great deal has been written on glacier retreat, very little empirical research has been conducted on human responses to its varied impacts (Orlove et al. 2008).

Anthropologists have used interactive visual methods to elicit local understandings of impacts of climate change and to stimulate reflections on adaptive responses at the community level. Working in the highlands of Ecuador, Rhoades et al. (2006, 2008) examine historical paintings, photographs, and other documents, including accounts of early explorers and climbers. These illustrate the gradual disappearance of glaciers and snow fields covering the Cotacachi volcano, a place of great cultural significance to surrounding communities. These images were then used to elicit local peoples' stories and commentaries about the climatic changes that have transformed the face of the mountain and the surrounding landscape. The researchers also constructed a three-dimensional physical model of the watershed, including the volcano, and used it to stimulate direct discussions of environmental change. At the end of the project, when the model was transferred to the community, local people proceeded to paint the volcano's peak white, an action that affirmed the cultural significance of the mountain in face of the loss of identity and control over its natural resources. The whiteness of the snow was a constant reference point in people's collective memories and oral histories, which related to the mountain as an animated and feminine presence ("Mama Cotacachi"). In popular imagination, the lost snowcap on her summit was seen as a sign of her fading beauty and youth. As she declines, so do people's sense of well being and social harmony (Rhoades et al. 2008, 2006).

The personification of landscape features reflects a view that nature *includes* humanity and culture, rather than being juxtaposed to them. In this perspective, which has historically been central to the worldview of some indigenous people of Arctic and sub-Arctic regions, natural elements such as glaciers, mountains, seas, and animals are seen as sentient beings, having agency, emotions, and interest in human affairs (Cruikshank 2005; Laidler 2006; Nadasdy 2005; Krupnik and Jolly 2002). Though the environment can be observed, explored, exploited, and managed by humans and altered by climatic change, the same environment can also respond in favorable or punishing ways. Drawing on travelers' reports, old illustrations, folk narratives, clan histories of First Nations peoples, and, in particular, the life stories of indigenous women elders in the Yukon Territory, Cruikshank (2005, 2001) braids a multistranded account of climate change as seen from a myriad of vantage points. The cast of characters include nineteenth-century travelers, scientists, environmentalists, and explorers whose itineraries trace global connections of colonial expansion ranging from Alaska to Africa. Early ethnographers are also featured among human actors, as one voice among many rather than as authoritative sources. Among the main protagonists and the chief narrators, as both the center and the source of the stories, are the glaciers, whose emptiness and whiteness denote an imaginative space where recollections of the past and projections to the future meet. This textuality of landscape and seascape embodying collective experiences of climatic change is highlighted by other anthropologists of Arctic regions. By building on Nuttall's concept of "memoryscapes" (Nuttall 1991, 1992) and by combining paleoecology, archaeology, and oral history, Henshaw (2003) documents how Inuit place-names encode information on fluctuating ice conditions, wildlife behavior, and other natural phenomena that help orient people's movements over the territory and transfer cultural knowledge across generations.

Knowledge

In indigenous epistemologies, seeing and knowing are understood as closely related. Youth often learn technical practices by actively watching and practicing with adults (Barnhardt and Kawagley 2005; Laidler 2006). Elders are vested with authoritative knowledge, because those who have lived many years have seen things, including climate events, changes, and impacts, like the Sahelian droughts and famines of the 1970s and 1980s (Roncoli et al. 2002; West et al., in press), or the surging glaciers and perilous migrations of the "Little Ice Age" (Cruikshank 2005). Thus, open-ended interviews with local elders and recording of life histories are often used in anthropological research to elicit local knowledge and cultural memory (Crate 2006a, 2006b; Cruickshank 2005).

Research on indigenous environmental knowledge has a long-standing tradition in anthropology and ranges from ethnoscience, to applied anthropology, to the more recent political ecology and environmental movements

(Nazarea 2006)[1]. A wealth of studies document the importance of indigenous knowledge in agricultural development and environmental management (Brokensha et al. 1980; DeWalt 1994; McCorkle 1989; Rhoades and Bebbington 1995; Richards 1985; Sillitoe 1998; Stevenson 1996; Thompson and Scoones 1994; Warren et al. 1995) and its resilience in the face of commercialization and government control (McDaniel et al. 2005). Farmers' knowledge and experience are being increasingly recognized as valuable assets for building the resilience of rural livelihoods to climate variability and change (Nyong 2007; Stigter 2005). The Fourth Technical Assessment of the Intergovernmental Panel on Climate Change (IPCC) emphasizes the value of indigenous knowledge systems for climate predictions, adaptive management, and policy making, and calls for more studies in this area (Boko et al. 2007).

Until recently, relatively few studies in the indigenous knowledge literature directly focused on climate (Katz et al. 2002; Roncoli et al. 2002; Ingold and Kurttila 2000; Sillitoe 1996).[2] This may be due to the fact that, while recent research on local ecological knowledge is propelled by concerns about environmental conservation and intellectual property rights, knowledge about climate cannot be managed, transferred, appropriated, or consumed the same as cultural or natural resources. Cultural anthropologists have used different approaches to explore local knowledge of climate. Ethnoscientific research sought to understand local knowledge as a system of taxonomies and classifications (Atran 1985; Posey 1984, 1986; Hunn 1982; Berlin et al. 1974). Using ethnographic techniques such as free listing, sorting, ranking, and triads, anthropologists have documented how farmers distinguish many different types of clouds, rains, winds, and other phenomena (Roncoli et al. 2002; Sillitoe 1996). In the process of eliciting these typologies, basic principles underlying cultural notions of climate are revealed. For example, in categorizing rain events, Sahelian farmers look at the duration, distribution, and timing of precipitation, suggesting that the latter is understood in terms of process rather than amount of rainfall. Farmers appreciate rains that occur during the night and last several hours, allowing for rainwater to infiltrate and for soil to remain moist for several days (Roncoli et al. 2002). Climate variation is perceived in relation to salient categories, such as the decreased frequency of "big rains" that fall in July and August over the Sahel (West et al., in press) and the early snowfalls that favor apple production in the western Himalayas (Vedwan and Rhoades 2001).

The detection of anomalous patterns of wind, rain, hail, snow, frost, and temperature hinges on local understandings of time. By revealing the ways that people organize cyclical and linear time into meaningful segments, linguistic anthropology elucidates the kinds of variations people are able to discern and adapt to (Puri 2007). Seasonality is the most basic scaffolding of people's sense of time, not only structuring perceptions of fluctuations in resource availability but also deployment of adaptive responses. Comparing data from twenty-eight language groups, Orlove (2003) examines the names

and attributes of seasons and their subcomponents. All the language systems in this sample have names for seasons, which are defined by atmospheric and environmental indicators, though in some areas the notion of the calendar year was a colonial introduction. Even in equatorial regions that register minimal seasonal variation, ethnometeorological knowledge includes a rich terminology for the cyclical manifestation of climatic events during the year (Sillitoe 1996). In agricultural, pastoral, and fishing communities, where seasonality shapes livelihoods, climate change is often understood in terms of deviations from a cognized normative calendar. Seasonal calendars are often used in ethnographic research as a way of eliciting and systematizing local knowledge of climate, although Vedwan and Rhoades (2001) caution that they need to be treated as conceptual models rather than as factual representations of climate-related events and activities.

Researchers have studied the traditional practices that indigenous peoples use to forecast seasonal variability in order to increase the reception, understanding, and use of scientific forecasts (Roncoli 2006). Local predictive systems are relevant to climate change research as they point to the salient parameters and normative frameworks of seasonal variation. Methods such as open-ended interviews and focus groups with farmers, elders, and local experts have been deployed in order to elicit rich repertoires of shared and specialized knowledge based on environmental observations and ritual practices (Luseno et al. 2003; Roncoli et al. 2002; Eakin 1999; Finan 1998; Huber and Pedersen 1998), while surveys have been used to assess the distribution of such knowledge in the population. By showing that knowledge is embedded in systems of social relations and cultural meanings, anthropologists counteract the common tendency to reduce it to decontextualized inventories of signs and beliefs. For example, surveys point to the quality and quantity of fruits from certain wild trees as among the forecasting indicators most commonly mentioned by African farmers (Kihupi et al. 2003; Phillips et al. 2001). But ethnographic research clarifies that farmers do not rely on random observations of generic specimens, but rather on the sustained observation of particular trees that stand near their homes and farms as constant witnesses to the unfolding of social life and seasonal time (Roncoli et al. 2002).

Anthropologists have begun to explore the empirical relation between local knowledge and climate phenomena. Efforts to link ethnographic and meteorological data remain hindered by several challenges, including a) the dearth of long-term data series for local indicators, such as fruiting of wild tree species or behavior of birds or insects; b) the difficulty of operationalizing local experiences of climate variability and change in ways that permit a correlation with scientific records; and c) the discrepancies in the spatial scale and time-frame of local experiences and decisions on the one hand and of regional and global processes on the other. Some researchers have sought to address these challenges through interdisciplinary research and innovative

research design. A study on the ethnoclimatology of Andean communities in Peru and Bolivia combines analyses of ethnographic, historical, agricultural, atmospheric, and astronomic data to show that traditional forecasts, which use observations of the Pleiades star cluster in June to forecast the onset of the rains in October and November, are reasonably accurate and based on natural phenomena (Orlove et al. 2002, 2000). Conversely, research among the Twareg pastoralists of Niger found a lack of correspondence between climate data and local perceptions of climate impacts (Sollod 1990).[3] In this study, pastoralists' qualitative assessments of rainfall and pastoral life were coded according to a 1–9 point Likert scale, ranging between catastrophe and celebration, and then compared with the rainfall record for the previous forty years (Sollod 1990, 272). Findings suggest that rainfall alone is not a reliable indicator of stress but needs to be contextualized by parameters relevant to pastoral habitats.

Anthropologists Marcela Vásquez-León, Colin West, and Timothy Finan pioneered comparative analysis of farmers' perceptions and meteorological records in two contexts, representative of dryland environments—the American Southwest (West and Vásquez-León 2003) and the Sudan-Sahel region of West Africa (West et al., in press). In both cases, researchers used open-ended interviews and fieldwork interactions to elicit farmers' views of climate variability. Drawing on their results, the researchers constructed culturally specific indices of climatic variability that they then compared to meteorological data from local weather stations. The analysis shows concordance between the two cases, suggesting that people are indeed able to discern climatic changes, beyond the limited timeframe of weather fluctuations (West and Vásquez-Léon 2003; also Puri 2007). People's assessment of climate variation, however, are grounded in localized contexts and processes of livelihood adaptation and can, therefore, diverge from regional trends inferred from scientific technologies, such as remote sensing imagery and global circulation models (Rautman 2004; West et al., in press). Multiple sources of information—drawing on qualitative and quantitative methods, spanning local and regional scales, and covering both folk and expert knowledge—are needed to develop a holistic understanding of climate change.

Valuation

People's perceptions and knowledge systems are framed by cultural contexts with which they ascribe meaning and value to what they see and know. This understanding has led some anthropologists to question efforts to systematize indigenous knowledge into decontextualized and discrete data sets and subordinate it to validity standards established by Western scientific institutions (Agrawal 1995; Nadasdy 1999; Nuttall 1998; Purcell 1998, 1999; Purcell and Onjoro 2002). While the integration of indigenous and

scientific knowledge may be useful in developing adaptive systems, such projects are sometimes animated by a view of knowledge as a transferable package of skills and technologies, devoid of the cultural values that make it meaningful to those who depend on it for their livelihood (Cruikshank 2005; Nadasdy 2005). This issue is especially irksome in areas where local sovereignty and state bureaucracies clash over environmental management, contrasting very different ways of thinking about and valuing landscape and wildlife. Anthropologists working in Arctic and sub-Arctic or alpine regions, for example, illustrate how animals, mountains, glaciers, and other landscape features are conceived by local people as more than assets to be managed or measured. They are rather to be embraced as part of a moral universe that includes both humans and nature, and their decline, due to unsustainable use or to climatic change, is mourned as a loss of cultural identity and meaning (Rhoades et al. 2008; Salick and Byg 2007; Crate 2006a, 2008; Cruikshank 2005; Nadasdy 2005; Nuttall, et al. 2005).

In many communities, weather and climate are understood as part of a universe infused with spiritual significance. Perturbations are often interpreted in terms of violation of religious, moral, and social norms (Salick and Byg 2007; Vedwan 2006; Ellis 2003; Sanders 2003; Roncoli et al. 2002). At the same time, global environmental change is seen as threatening the integrity of the spiritual world and its benevolent relationship to humanity (Crate 2008). Accounts of environmental and climatic change are often embedded in moral and mythological discourse and should not, therefore, be taken at face value (Ellis 2003). Cultural and spiritual values shape people's attitudes towards remembrance of the past and predictions of the future. Weather patterns of the past may be idealized in nostalgic recollections of one's childhood and serve as a cognitive framework for remembering significant events (Harley 2003). Religious convictions induce Muslim farmers in Burkina Faso to see efforts to predict rainfall as a lack of humility and trust in God (Roncoli et al. 2002). But it is not only aboriginal communities in marginal environments who attribute spiritual and moral values to nature. Among crab fishermen of the East Coast of the United States, for example, the unpredictable nature of weather and weather-dependent resources is valued as a way to ensure that God remains in control of creation and to restrain humans from plundering the latter because of greed (Paolisso 2003). In discussing perceptions of climate change and glacial processes around Mount Shasta, the mountain that contains the largest glaciers in California, Wolf and Orlove (2008) note that many people comment on the spiritual value of the mountain, and speak of the mountain itself as acting consciously, for example, purposefully sending avalanches to destroy ski areas built in pristine areas.

It is as important to understand environmental values in industrialized countries, which produce most of world's greenhouse gases and have a major political role in addressing climate change, as in the developing world.

In one of the first anthropological studies exploring such issues, Kempton et al. (1995) show that Americans' attitudes towards the environment are framed in terms of widely shared religious beliefs, ethical principles, and social obligations (e.g., to one's descendants) as well as by utilitarian considerations. The researchers found this framing to be not only for environmentalists but also for a wide range of social groups with different relationships to environmental resources, including people employed in sawmills, coal industry, and dry cleaning, and the general public in California. Similarly, Henning (2005) used phone interviews with consumers and experts, such as municipal energy advisers and employees of utility companies, to study the underlying cultural values and social goals shaping attitudes toward energy use in Scandinavia. Her research demonstrates that desire for autonomy and flexibility and idealized notions of private and public space define the way that users expect and evaluate comfort and convenience, a logic that diverges from the strictly economic reasoning embraced by the professionals.

Such studies are noteworthy in that they demonstrate the value of ethnographic methods, such as open-ended interviews and discourse analysis, in uncovering unanticipated issues and underlying cultural models.[4] These studies also venture beyond the habitual domain of anthropology by turning the analytical gaze on the researchers' own culture and, in some cases (Henning 2005; Kempton et al. 2005), on communities that are defined in terms of common interests, collective action, or consumer behavior rather than physical localities and kinship bonds. By including industry professionals and policy makers among their informants, they also chart important new territory for the ethnography of climate change.

Scientific communities themselves are increasingly an important site of anthropological research. Drawing theoretical inspiration from science and technology studies (Jasanoff and Wynne 1998; Shackley and Wynne 1995, 1996), researchers are beginning to interrogate scientific debates and practices and to demonstrate how they are no less shaped by cultural perceptions and social context than indigenous knowledge systems. They note that the production and circulation of scientific research is as shaped by cultural and political factors as other human activities. This strand of research does not aim to undermine the validity of scientific analysis, but it denies the nature of scientific analysis as objective, culture-free statements about external reality, and it shows that this analysis takes place in a specific cultural milieu with its own set of values, assumptions, and power dynamics. Building on several years' experience as an anthropologist employed in climate research institutions and on hundreds of interviews with climate scientists and decision makers, Myanna Lahsen illuminates the social construction of scientific authority in climate research and policy (Lahsen 2007a, 2007b, 2005a, 2005b). Her work, like other work in recent decades (Shapin and Schaffer 1989; Latour et al. 1986), challenges the notion of science as a value-free process in pursuit of an objective truth, and shows that ideology and power

configure particular understandings and uses of science. Even among climate scientists, different ideas about the relationship of science and technology and about the role of science in society underlie assessments of what constitutes good science and what knowledge is worth making public (Lahsen 1998; Shackley et al. 1998). In the case of Global Circulation Models, which are widely used to generate projections of climate change, Lahsen (2005a) finds that the intense personal investment modelers make in developing models, the fragmented nature of the modeling process, and the highly competitive funding environment in the United States all hinder modelers' ability to realistically represent, and even perceive, the models' accuracy (see also Shackley 2001).

The uncertainties inherent in climate predictions allow some latitude for spinning or contesting the meaning of scientific knowledge, a fact that underscores the importance of understanding the social and cultural processes of its production and circulation (Broad and Orlove 2007; Broad et al. 2007a, 2002; Pfaff et al. 1999). In the context of modern geopolitics, ambiguities and contradictions surrounding climate science become political weapons in negotiations between developed and less-developed countries or among key actors within countries. Examples include the struggle between conservation-oriented NGOs and a central government favoring environmentally destructive development in Brazil (Lahsen 2007b), or between an embattled president and political constituencies in Peru (Broad and Orlove 2007). Basic societal values, such as the perceived objectivity and fairness of scientific practice, influence the reception and use of scientific information by policymakers and the public at large. This can be seen in ethnographic research that elucidates how an interplay of subjective judgments, cultural meanings, and political agendas can shape representations of and responses to climate science, be they climate change projections (Lahsen 2007b), El Niño-based seasonal forecasts (Broad and Orlove 2007; Roncoli et al. 2003) or extreme weather advisories (Broad et al. 2007a, Sherman-Morris 2005).

Response

Understanding the interactions of culture and climate, and in particular the role of perceptions, knowledge, and values as elements of these inter-actions, brings us to focus on adaptive responses. Several anthropologists emphasize that, while information on cultural meanings and attitudes can be elicited through various methodological techniques, it is primarily through ethnographic research of climate-centered practices in localized contexts that we can really understand their livelihood significance (Puri 2007; Vedwan 2006; Vedwan and Rhoades 2001). As for other kinds of indigenous technologies and environmental knowledge, climate adaptations enacted by rural producers are often based on what Richards (1993) terms "performative knowledge," a competence that is ingrained in farmers' time-honored and

place-based experience rather than encoded in abstract principles. Among African dryland farmers, for example, responses to climate variability consist of iterative sequences of improvised strategic adjustments rather than of the implementation of consciously established plans that can be articulated a priori (Batterbury 1996). In other words, farmers do not formulate a strategy for the growing season, based on their expectations of what the climate might be, and then proceed to carry out. Rather, they get their bearings by scrutinizing the environment during the weeks that lead up to the onset of the rains, and continue to do so until the viable planting time is over, a process that relies on a mix of sensory intuition, cumulative experience, and learned skills (Roncoli et al. 2001; Orlove et al., under review).

While it cannot be assumed that current practices for coping with climate variability will easily translate into long-term adaptations to climate change, valuable insights can be gleaned from understanding the contexts and processes that contribute to adaptation to climate variability (Eakin 2006). Because these strategies are complex and culturally embedded, they are not easily captured by snapshot assessments and structured surveys. Participant observation and in-depth interviewing are more suited to elucidating the intricate decision-making processes and the influences and negotiations that shape them (Roncoli 2006). Anthropology has a long-standing tradition of research on agricultural decision-making (Nazarea-Sandoval 1995; Gladwin 1989; Barlett 1980). Decision tree modeling has been productively used to describe and analyze adaptive strategies by African farmers and pastoralists (Little et al. 2001; Roncoli et al. 2000). This approach has enabled researchers to identify critical junctures where climate affects livelihood decisions and where management practices might be modified to adapt to different climate scenarios, showing how future options may progressively narrow as choices are made. Ethnographic research on decision making can help researchers recognize the material and institutional constraints that hinder adaptation, the trade-offs inherent in different options, and the criteria and considerations that influence choices among them. For example, adaptive decisions may be shaped not only by climate conditions and economic constraints, but also by livelihood needs and goals (e.g., a health crisis or desire for education) and by cultural values (e.g., preferences for certain staple foods, cultural identity invested in a pastoralist lifestyle).

Fieldwork among farmers and pastoralists reveals that adapting to climate variability often involves balancing risk and uncertainties in one area with those in other areas (Roncoli et al. 2001). In making livelihood decisions, people constantly juggle different kinds of risk, not only related to climate variation but also to livestock disease, price fluctuations, violent attacks, legal prosecution, and social marginalization. Efforts to mitigate one type of risk may expose households to a set of different threats, as in the case of pastoralists who respond to drought by migrating to areas

where they may face harassment (Crane 2006; Little et al. 2001). In this context, diversification of options, flexibility of responses, and tactical decision making are recognized as key determinants of household resilience (Thornton et al. 2007; Tschakert 2004b, 2007a; Eakin 2006; Mishra 2003). This capacity hinges on the availability of resources that allow for swift adjustments to fit changing environmental and economic conditions. In Sahelian farming communities, for example, this flexibility is afforded by access to landholdings that have different soil conditions and water retention capacities; the ability to mobilize experienced and disciplined labor at short notice; and the timely availability of viable seed, liquid capital, and productive technology (Tschakert 2007b; Ingram et al. 2002; Roncoli et al. 2001; Batterbury 1999, 2001). Among African pastoralists, mobility is key to survival, allowing access to grazing areas, water sources, favorable markets, and safe routes, but timely information and support networks are essential for exercising these options (Thornton et al. 2007; Galvin et al. 2001; Little et al. 2001). These adaptive capacities are grounded in cultural identities and social relations that are mediated by kinship and community.

Field research in a wide range of field settings has shown that adaptation to climate variability and change is not only a function of technical solution. Rather it stems from a web of social reciprocities and obligations, which may be intentionally pursued or manipulated to secure access to resources and assistance at critical times (Nelson 2007; Puri 2007; Eakin 2006; Crate 2006a; Finan and Nelson 2001; Little et al. 2001; Nuttall 1992; Waddel 1975). A hallmark of economic anthropology, this understanding was developed and popularized during the 1990s as the "livelihood approach" (Scoones 1998). This approach builds on the core tenet that livelihoods involve more than the satisfaction of basic needs through direct production of material goods. Rather, livelihood draws on ties beyond the household unit and rests on social networks and institutions, human health and capabilities, knowledge and competences, as well as environmental resources and services. Different groups and individuals have varied combinations of rights, claims, privileges, and liberties that largely determine whether and how they may access and use these assets for their own benefit. But these configurations of opportunities and constraints are shaped beyond the farm and the household, by the policy and institutional arrangements fashioned by supralocal players, such as international development agencies, urban markets, and the state. The livelihood approach has often been applied to sustainable development and environmental management efforts, but rarely to climate adaptation (Keil et al., in press; Eakin 2006; Ziervogel and Calder 2003).

Understanding the decision processes by which households select and enact adaptive responses, and the institutional context that shapes those decisions, is important because even successful adaptations entail alternative risks and costs that may be borne by less powerful groups and sectors.

Within households, women, children, and the elderly may see their needs curtailed, their work burden increased, and their assets diminished or appropriated by others (Denton 2002; Roncoli et al. 2001). Ethnic or religious minorities, immigrants, lower castes, and the poor may face greater exclusions and hostilities as climate change impacts intensify competition over natural resources. For these marginal groups, resource access often rests on ambiguous rights and informal agreements that can be easily revoked at times of heightened demand (Peters 2004). Thus, the experience of climate change, the exposure to its negative impacts, and the efforts to ensure household survival are functions of one's social location and of the ability to negotiate positive terms of engagement from such a location (Eakin 2006; Finan et al. 2001). Fieldwork can play a key role in detecting these dynamics of power, conflict, agency, and resistance, while participatory methods such as livelihood assessments, vulnerability mapping, and free listing and ranking can uncover divergent perceptions and definitions of risk held by differentially positioned social groups (Roncoli et al., under review; Finan 2007; Tschakert 2007b; Finan et al. 2001; Little et al. 2001).

Heterogeneities in risk exposure and response capacity are constituted spatially as well as socially. Vertical and regional movements are critical attributes of resilience to climate impacts in mountain ecosystems (Orlove 2002; Rhoades 2006; Vedwan 2006) and in pastoral habitats (Thornton et al. 2007; Tyler et al. 2007; Crate 2006a; Galvin et al. 2001) respectively. The spatial nature of adaptation in these environments means that boundaries, territories, and passages also delineate a landscape of selective vulnerabilities and entitlements. The extent to which observations from field studies can be scaled up to regional levels is one of the greatest challenges faced by anthropologists working in climate adaptation research. Geographic information systems (GIS), remote sensing, and modeling tools have demonstrated their utility in generalizing localized information (Cliggett et al. 2007; Moran et al. 2007; Tschakert and Tappan 2004; Galvin et al. 2001; Moran and Liverman 1998). These methods can help document the intra- and interseasonal variation in resource availability and access and determine the landscape impacts of local adaptations, such as the expansion of cultivation into wetlands, rangelands, or marginal areas. This may be of particular value in high mountain ecosystems and extreme latitudes where climate change is having dramatic impacts (Meehl et al. 2007), and in the African drylands, which are characterized by a high degree of variability and well suited to pastoralist livelihoods (Trench et al. 2007).

Adaptation to climate variability and change is not only a matter of individual and household decisions. It also requires institutional and policy measures that support agricultural production, food security, water resource management, and infrastructural development (Broad et al. 2007b; Eakin et al. 2007). Among anthropologists, Tim Finan and his team have

spearheaded interdisciplinary research on the articulation of private and public responses to drought in northeast Brazil (Finan 2003; Lemos et al. 2002; Finan and Nelson 2001). The study combines multiple methods, integrating ethnographic fieldwork and a survey of about five hundred households; analysis of public documents and media reports; and an institutional analysis based on interviews with about fifty stakeholders including political leaders, bank managers, rural extension agents, labor unions, NGOs, and the media. The researchers analyze the process from the issuing of a drought forecast to the mobilization of drought relief, showing how scientific information is used in official discourses and decisions in ways that reinforce established patron-client relations. At the same time, constituencies can appeal to the alleged "neutrality" of science to counteract political favoritism and demand greater transparency of decision making (Lemos 2003; Lemos et al. 2002). The articulation of climate change and collective action is an increasingly relevant domain that has received relatively little attention by anthropologists, beyond research on environmental attitudes that may motivate and mobilize activism (Pendergast 1998; Kempton et al. 1995). In-depth ethnographic research in social movements can push this line of analysis further by elucidating the ways groups decide on strategic responses and how those responses help define new communities of practice in the politicized field of global climate change (Adger 2003).

Conclusions

By entering public discourse and affecting interconnected decision-making systems at multiple scales, from local to global, climate change is becoming an increasingly salient issue for cultural anthropology. Cultural anthropologists can draw on a diversity of intellectual traditions that provide resources for understanding perceptions, knowledge, values, and practices relative to global climate change. Ethnoscience pioneered the study of traditional environmental knowledge, documenting its significance in terms of sustainability and adaptation (Winkler Prins 1999; Warren et al. 1995; Moock and Rhoades 1992; Conklin 1954). Political ecology has broadened the scope by situating environmental change and natural resource management in relation to dynamic power relations from the local to the global level (Bebbington and Batterbury 2001; Bryant 1998; Blaikie 1994). Science and technology studies provide an analytical foothold for examining the production of scientific knowledge and its use in policy as social processes configured by a context of political and ideological struggles (Demeritt 2006, 2001; Miller 2004; Sarewitz 2000; Darier et al. 1999; Gusterson 1996).

Anthropological research on climate reflects the multidimensional nature of the impacts of climate change and the adaptive responses of humans to these impacts. As the studies reviewed in this chapter show, anthropological

research can illuminate cognitive, symbolic, and even linguistic aspects of climate change, as well as behavioral responses and power dynamics at both micro- and macro-scales. The use of ethnographic methods continues to be essential to capturing the full gamut of lived experiences and cultural meanings associated with climate. These approaches reveal how climate impinges on human life, not only through its impacts on wellbeing and livelihoods, but also as a dimension of collective narratives, structuring memories of the past and aspirations and anxieties about the future.

At the same time, the multiscale and long-range nature of climate change is leading anthropologists to field settings that do not always lend themselves to approaches familiar to anthropologists, particularly those that hinge on personal interactions and sustained observation of everyday life. This shift is not new to anthropology: for the last twenty years, the practice of "ethnography" has been expanding from physical localities, in which people have long-lasting social ties built on kinship and proximity, to multisited networks composed of people whose lives are connected and who share meanings and practices through media, institutions, and technology (Amit 2000; Marcus 1995, 1998). But an interest in climate change is beckoning anthropologists to explore new frontiers at the intersection of global science, governance, markets, and culture, where the tools of any one discipline are no longer sufficient to achieve a systemic understanding. In addition, anthropologists are increasingly practicing their discipline not only as independent academic researchers, but as professionals embedded in those institutions and supported by government or private sector funding.

Global climate change, therefore, confronts anthropologists with a host of challenges, although some are not entirely new to the discipline. To make effective contributions to interdisciplinary research, anthropologists must learn to collect and manage data in ways that are consistent with those of other scientific traditions. To make anthropological insights relevant to policy, anthropologists must translate them into programmatic prescriptions for decision makers. This shift will require immersion into systems of knowledge relative to climate science and attainment of new competencies and proficiency in the idioms of science and policy. It may also necessitate tactful negotiations on how research is conducted and how results are interpreted and disseminated. Anthropologists are well equipped to address these challenges, which are inherent to ethnographic fieldwork and to the discipline's epistemological grounding.

Yet it is also important that anthropologists do not compromise their intellectual identities and disciplinary traditions, and that they keep doing what their training, experience, and theoretical inclinations prepare them to do best. Anthropologists should continue to focus on local-level processes and on the consequences of policy and institutional decisions on individuals, households, and communities (Galvin 2007). By highlighting the

complexities, ambiguities, uncertainties, and conflicts that characterize vulnerability and adaptation to climate change, anthropologists can offer a necessary counterweight to the tendencies to reduce and simplify reality that sometimes characterizes economic analyses and environmental assessments. This emphasis requires them to educate the scientific community on the value of in-depth research based on nonrandom, small-sized samples, open-ended interviews, and face-to-face engagement of researchers and research participants that characterize ethnographic approaches.

As fieldwork is reconfigured in terms of multisited ethnography, institutional embeddedness, and advocacy-oriented research, anthropologists also come to face new ethical dilemmas that arise from potentially conflicting commitments and accountabilities to research participants, scientific peers, funding agencies, and employers (Marcus 1995). Anthropologists should maintain their long-standing critical discernment, and neither give into pressures to conform to value systems that prevail in other disciplinary or institutional contexts nor compromise on core ideals of cultural sensitivity and social equity. Given the ideological and political polarization surrounding global climate change, is imperative that anthropologists participate in scientific and policy debates with critical reflexivity. Doing fieldwork in the interstices of climate science, policy, and politics is as challenging as it is crucial, due to the difficulties that arise in studying culture and power within one's own communities and institutions.

Above all, if anthropology is to assert itself as an authoritative voice in climate change debates, engagement must go beyond the individual involvement of a handful of frontliners, many of whom, significantly, are working outside anthropology departments or even academia. Rather, the anthropological community should endorse climate change research as an urgent research priority for the discipline (Finan 2007; Lahsen 2007a). As the climate research and policy communities increasingly acknowledge the value of anthropological research, anthropology as a discipline also needs to recognize that participation in climate policy debates and efforts to build capacity for adaptation at all levels, from local communities to global institutions, are central to anthropology's intellectual mandate and field-grounded epistemology. In other words, engaged ethnography (Batterbury 2008) must be embraced as a vital way of "being there."

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Notes

1. In this chapter we use the qualifiers "local", "indigenous", "traditional", and "farmers" in association with knowledge as contextually appropriate. We not intend to analyze the plethora of terminologies or acronyms that have been used in various contexts (Antweiler 2004: 3–5). We also do seek to define such knowledge in itself or as opposed to science, although some general attributes may be recognized: for example, the fact that it tends to be holistic-integrative, place-based, orally-transferred, functional, habitual, dynamic, and, in various degrees, shared or specialized (Ellen and Harris 2000).
2. A World Bank database on indigenous knowledge has no keyword for climate: http://econ.worldbank.org/external/default/main?menuPK=633473&pagePK=64165395&piPK=64165418&theSitePK=469372
3. The Niger study used what the author (a veterinarian) refers as a "methodology . . . unusual for pastoral systems research" (Sollod 1990: 271). The interviews were carried out by an educated Twareg who could speak the language, dressed as a nomadic herder, traveled by camel, and spend the night in the pastoral camps, thus functioning as "an indigenous anthropological research agent."
4. The Kempton et al. (2005) study used quotes from open-ended interviews to construct statements that were later proposed for agreement or disagreement in the course of a survey. This inductive approach contrasts with that used by Pendergraft (1998) who draws on public discourse on environmental issues to formulate similar statements for a survey on individual and collective attitudes toward climate change (but fails to cite the previous study by Kempton et al.).

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