The Cultural Theory of Risk for Climate Change Adaptation

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ABSTRACT

The way in which people perceive climate change risk is informed by their social interactions and cultural worldviews comprising fundamental beliefs about society and nature. Therefore, perceptions of climate change risk and vulnerability along with people's ''myths of nature''—that is, how groups of people conceptualize the way nature functions—influence the feasibility and acceptability of climate adaptation planning, policy making, and implementation. This study presents analyses of cultural worldviews that broaden the current treatments of culture and climate change mitigation and adaptation decision making in communities. The authors use insights from community-based climate research and engage the Cultural Theory of Risk conceptual framework to situate community understandings of, and responses to, climate impacts. This study looks at how the issue of climate change manifests socially in four cases in the United States and Tuvalu and how ideas about climate change are produced by the institutional cultural contexts across scales from the local to the global. This approach helps us identify local and regional priorities and support the development of new relationships for adaptation research and planning by helping to diagnose barriers to climate change adaptation, assist improved communication through framing/reframing climate issues based on shared understandings and collective learning, and help move from conflict to cooperation through better negotiation of diverse worldviews.

1. Introduction

The role that culture plays in contemporary climate change adaptation is not a well understood or studied area (Adger et al. 2009). Yet, culture, the full range of learned ideas and behavior patterns that are acquired, shared, and modified by people as members of a society, is ever present, guiding and lending meaning to perceptions of climate risk, decisions about whether to address climate change, and if deciding to take action, what it will be. Culture is present at many levels, and institutional cultures also carry significance for addressing

climate adaptation, for example, informing how priorities and metrics for success are set and evaluated. While still understudied, climate researchers are increasingly recognizing that culture is critical to understand in order to address climate change through adaptation (and mitigation) policy and planning measures (Gerlach and Rayner 1988; Rayner 1991; O'Riordan and Jordan 1999; Kahan and Braman 2006; Adger et al. 2013). Understanding the role of culture in risk perception, decision making, and behavior has been investigated in related contexts, including environmental risks such as pollution, nuclear power, and greenhouse gas reductions (Douglas and Wildavsky 1982; Gerlach and Rayner 1988; Rayner 1995; Slovic and Peters 1998; Thompson and Rayner 1998).

Here our focus on culture and climate change adaptation is primarily at the local, community level and on the institutional contexts and cultures that express different collective ''voices'' or perspectives about natural resource management (Thompson and Rayner 1998). By institutional cultures we mean the preferences and priorities that are determined by how an institution is

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socially organized (section 2). We define climate change adaptation as collective, strategic, purposive behavior in response to or anticipation of climate change risks and impacts (Bennett 1976; Smithers and Smit 1997). While adaptation happens across geopolitical scales, it is at the local level where most climate adaptation actions occur through managing and governing natural resources.

To understand adaptation to climate change as a cultural process we engage the Cultural Theory of Risk (CTR), originally developed by anthropologist Mary Douglas and colleagues (Douglas 1966; Gross and Rayner 1985; Rayner 1992; Douglas and Wildavsky 1982). While there are multiple theories about how culture informs people's perceptions of risk, decisions, and behavior, here we specifically focus on CTR, as we believe it can provide a useful heuristic and has explanatory power for understanding the role of culture in climate change adaptation. The theory helps to explain how social organizations and institutional cultures frame risks differently and how those different framings create respective ''voices'' about climate change risks and responses in various public forums. According to CTR, how risks are framed corresponds to different types of worldviews. Worldviews are the constellation of values and beliefs about how society should be organized. CTR holds that there are four competing worldviews (egalitarian, hierarchist, individualist, and fatalist; explained in more detail below), which function as culturally informed classification systems so that ''[p]eople select awareness of certain dangers to conform with a specific way of life'' (Douglas and Wildavsky 1982, p. 9). Douglas' work was informed by an earlier classificatory British anthropology where individuals and societies were thought of as having relatively immutable associations and preferences; however, the evolution of CTR has shown that people change their risk preferences based on different contexts and experiences over time (Spickard 1989; Rayner 1992; Bellamy and Hulme 2011). This is consistent with an understanding of culture that is dynamic and emergent (Wolf 1982). As such, this is a fundamentally different understanding of culture and risk perceptions than the essentialist framing where cultural risk perceptions are inherent in individual personality traits or cognition.

Also, important for our argument are ''myths of nature,'' which underpin perceptions about environmental and climate risks (Schwarz and Thompson 1990). Myths of nature describe how the relationship between society and the environment is configured and different ways that nature functions, including how the climate system works (O'Riordan and Jordan 1999; Hulme 2009). Following Thompson et al. (1990), we use the term myths of nature to refer to the narratives, beliefs, and social constructions that determine cultural interpretations about how nature and ecosystems function (e.g., as opposed to other definitions of myth that connote false beliefs or heroic tales). This is an important distinction because it does not imply that any one myth is right or wrong, rather each is a partial representation of reality (Thompson et al. 1990). Climate solutions will be more effective when they reflect the multiple voices and views on nature held by groups of people who will need to sanction or will be affected by the measures.

2. The cultural theory of climate change risk

CTR argues that certain forms of social organization are associated with each of the types of worldviews. Different forms of social organization therefore view and manage risks differently (Rayner 1992). This can lead to conflict between groups with different institutional cultures about how they recognize risks and approach solutions (Thompson and Rayner 1998). CTR thus explains conflict as arising from mismatched worldviews about how risk is identified and managed. As such, it is the social organization of institutions, rather than the threat itself, that determines what risks are recognized, the process for obtaining social consent about each risk, and how liabilities and benefits arise (Wildavsky 1982; Rayner 1984; Gross and Rayner 1985). This understanding contrasts with conventional views of risk analysis, communication, and management that frame risk as quantitative probabilities of certain extreme events— information that is then transmitted from information producers to receivers who will then manage the risk accordingly. Such risk framing ignores that risk communication and management are predicated on shared meaning and trust among individuals who make up the communities and institutions where policies are made and implemented (or not) (Rayner 1992). Rayner (1984) presents three main kinds of institutional cultures for risk management and a set of principles and perceptions that go along with each of the three that result in certain types of institutional structure:

1) Market individualist: entrepreneurial, competitive, or market organization where individualism and competition are key to market success. Examples of this culture type are predominant in the business sector and corporate America.
2) Hierarchical bureaucracy: differentiated roles are seen to contribute to the functioning of the whole, characterized by rules and routine procedures to maintain the system. Federal regulatory agencies in the United States are examples of this, such as the Environmental Protection Agency and Department of Energy.

TABLE 1. Three institutional culture types. Adapted from Rayner (1984), Rayner and Cantor (1987), Thompson and Rayner (1998), and Hulme (2009).

Institutional characteristics	Market individualistic	Hierarchical bureaucracy	Egalitarian
Ideal transactional mode	Competition	Routine procedures	Cooperation
Keys to success	Innovation and timing	Promotion through grades	Social and environmental balance
Driving values	Expansion	System maintenance	Equality
Decision making about risk	Individual judgment	Committee based; routinized procedure	Consensus based on extended public argument/dialog
Liability	Loss spreading	Redistributive	Strict fault system
Trust	Successful individuals	Long-established formal institutions	Participatory institutions
Myths of nature	Benign	Tolerant	Fragile
Views of climate	Naturally variable	Manageable within limits	Climate change tipping points, collapse

3) Egalitarian group: emphasis is on cooperation rather than competition, decisions are made by consensus, and social solidarity and equality are highly valued. Many Native American and environmental advocacy nonprofit organizations exemplify this culture.

Characteristics of each of the three types of institutional subcultures are outlined in Table 1.

In the next section, we will discuss the analytical framework for understanding these institutional cultures that will then be used to discuss the case examples in section 3.

a. Grid-group analysis and the myths of nature and climate

The types of worldviews in CTR are derived by understanding social organization along two dimensions: that of "group," or social bonding, and that of "grid," or social rules (Douglas 1982; Schwarz and Thompson 1990). The group dimension describes the degree to which people affiliate themselves with a bounded social unit. The group dimension charts a continuum between a low group position where people are autonomous, self-reliant individuals unattached to a bounded social unit and a high group position where social bonds and group identity are emphasized. The grid dimension describes the degree to which groups ascribe and accept externally imposed rules, regulations, or prescriptions on social relations. The grid dimension draws a continuum between a low grid position in which there are few accepted rules and regulations and a high grid position in which there is significant social stratification and rule-based structure (Gross and Rayner 1985; Tansey and O'Riordan 1999; Spickard 1989).

Culture and nature are coconstitutive and mutually influencing systems and therefore must be analyzed in tandem (van der Leeuw and Redman 2002; van der Leeuw 2000). This is particularly evident in cultural perceptions of environmental risks. In the mid-1980s, there was an important development in CTR. The four worldviews were mapped to four corresponding myths of nature based in large part on the work of ecologists such as C. S. Holling and P. Timmerman (Holling 1986; Thompson et al. 1990; Timmerman 1986). As stated above, myths here are not falsehoods, but are rather social constructions or models of reality—each of which is a partial representation of the whole. Bringing the myths of nature into CTR served to broaden the understanding of perceptions of environmental risks to include conceptual models about how the natural world actually works and how society and nature interact that correspond to each of the worldviews and institutional structures. The grid-group dimensions form intersecting perpendicular axes that describe the four idealized worldviews and myths of nature (Fig. 1).

The market individualist worldview is low group and low grid with weak social bonds and little need for social structure. The corresponding myth of nature is that nature is benign and will autoadjust to human actions. They tend to view climate as naturally variable and that humans cannot change this natural process (Thompson and Rayner 1998). The fatalist worldview is low group and high grid with weak social bonds and resigned to a stratified society governed by rules. Fatalists tend to be the disenfranchised in society and some of the most vulnerable (Thompson and Rayner 1998). As such, they are typically not involved in policy or resource management processes (hence, the three instead of four institutional cultural types herein). For them, nature and climate are capricious and fundamentally random and unpredictable. The hierarchist bureaucratic worldview is high group and high grid with strong social bonds that are primarily vertical and governed by numerous rules. Accordingly, nature (and climate) is manageable and tolerant of some human influence and will thus accommodate human action to a point and such "tipping points" can be identified by scientific experts. The
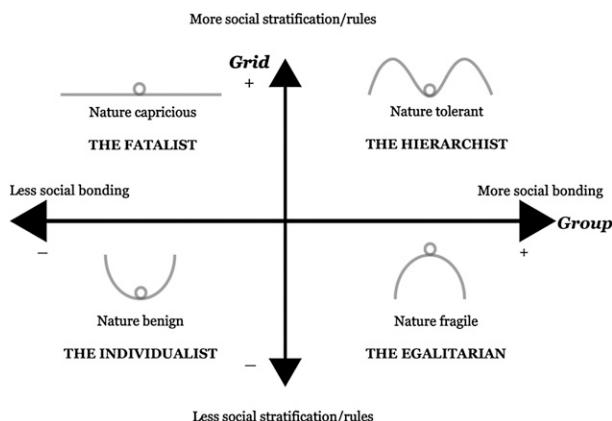
FIG. 1. Four worldviews and myths of nature.

TABLE 2. Nature Myths about Climate. Adapted from Hulme (2010)'s *Why We Disagree about Climate.*

Nature benign (market individualist): climate system is favorable to humans; will always find its equilibrium on its own

Nature fragile (egalitarian): climate system lies in a delicate balance; human insult can lead to collapse

Nature tolerant (hierarchist bureaucratic): climate system is controllable to a certain degree; climate risks not trivial, however, to manage for equilibrium we need better predictive capabilities

Nature capricious (fatalist): the climate system is inherently

egalitarian group worldview is high group and low grid with strong, communitarian social bonds between people subscribing to few strict rules and a general philosophy of collectivity. The corresponding myth of nature is that nature is fragile and in a precarious balance with society (Jones 2011; Douglas 1996). They tend to view the relationship between humans and nature as lying in a delicate balance, prone to human influence leading to a collapse. Table 2 describes how each myth of nature characterizes the climate system.

CTR offers an analytical framework for identifying and examining culture clashes, such as those between groups of climate change "believers" and "deniers" and exposes how risk perceptions form that align with values and ways of life. This can then inform understanding about how and why climate change is embedded in the "culture wars" in the United States (and elsewhere) that leads to gridlock on climate policy issues (McCright and Dunlap 2003; Hunter 1991; Ellis and Thompson 2000; Kahan et al. 2011; Brunner and Lynch 2010). Policy preferences are most strongly influenced by value commitments derived from grid-group orientation, which has been found to be stronger predictors of policy preferences than political party or ideology or other sociodemographic variables (Leiserowitz 2006; Pendergraft 1998).

b. The CTR approach for understanding community-level climate adaptation

While CTR is increasingly applied by cultural theorists and other scholars interested in climate change, we believe the approach has lost some of its explanatory rigor by moving away from descriptions of local communities and their institutional dynamics with regard to the environment, including the omission of myths of nature. Our goal in this paper is to discuss the value of using community-based, ethnographic methods along

with the myths of nature concept to understand community preferences in climate change adaptation (Douglas 1996; Douglas and Wildavsky 1982). Ethnographic, community-based methods are the suite of social science methods that provide an empirical approach to understanding culture and cultural phenomena through field work, such as in-depth interviews, participatory observation, and discourse analysis, among others (Winterhalder and Smith 1981; Bernard 2002). As an approach, this enables the researcher to empirically observe, document, analyze, and make sense of human culture and communities, their values, belief systems, behaviors, and other social constructions (Bernard 2002). Placing attention at the community level enables a focus on the local scale and a holistic approach in which nature and society are linked. Our approach to CTR also benefits from prior research by environmental anthropologists who have investigated the cultural processes that mediate social relationships with their environments, especially in the context of environmental change and resource management conflicts (e.g., Blount and Kitner 2007; Crate 2011b; Paolisso and Dery 2010).

Engaging CTR at the community level allows insights into why climate change and the policies designed to address it, including adaptation and mitigation, are often controversial and even polarizing within and between different societies or groups within a society. CTR demonstrates that divisions over the cause and solutions for climate change are much more complex and nuanced than, for example, liberal Democrat versus conservative Republican politics (Jones 2011). In the following section, we offer examples from our own case study analyses to demonstrate how the explanatory insight offered in applications of CTR elucidate how people experience and respond to issues related to climate change. The approach has real-world applications because by understanding how people perceive risks, we can, in turn, understand what actions make sense to take—and will be socially acceptable—to lessen the risks. We argue that this approach can help us with diagnosing barriers to climate change adaptation, assisting better communication

through framing/reframing climate based on shared understandings and collective learning, and helping move from conflict to cooperation through better negotiation of diverse worldviews.

3. Human–nature relationships and myths of nature: Lessons from community-based climate research

Community-based climate change research that utilizes ethnographic methods provides a way to understand the causes, consequences, and cures of climate change from the perspective of those most affected (Crate 2011a). Here we present insights from our field research using ethnographic methods (in-depth interviews, participant observation, and discourse analysis) that the authors conducted in four places that stand to be among the earliest and most adversely affected by climate change impacts and policies, namely, Alaska and Tuvalu, as well as places that are also reliant on natural resources but situated in very different cultural and governance contexts, Colorado and Oklahoma. More specifics on the four cases are in Table 3 (also, see McNeeley 2009; Lazrus 2009). As with Douglas' analysis on different societies' perceptions of environmental pollution and impurity (Douglas 1966), our work with local, small-scale communities in marginal environments presents notions of risk, vulnerability, causality, and culpability in culturally relevant ways. In particular, here we map our data onto the worldviews and myths of nature of CTR as an organizing principle in order to demonstrate the utility of the approach for understanding climate and adaptation policy perspectives.

In this section, we discuss some examples from our empirical work in various institutional settings for natural resource management—subsistence and wildlife management in rural Alaskan indigenous communities, establishment of a marine protected area in an island

TABLE 3. Details on the four cases.

Place	Researcher	Field dates	No. of interviews
Alaska	McNeeley	2004–09	25
Tuvalu	Lazrus	2006	56
Oklahoma	Lazrus	2012	38
Colorado	McNeeley	2010/11	45

community in Tuvalu, and water resource management settings in Colorado and Oklahoma (see Fig. 2 for study locations). Predominant culture types and their voices in each management context are discussed, though we acknowledge that there can be individuals or subgroups within each institution that do not ascribe to the predominant culture and who often struggle as minority voices in their respective institutions. For the purpose of our argument, we focus on the predominant representative voices.

a. Interior Alaska

In the remote, rural interior of Alaska in the subarctic, boreal forest ecoregion, small indigenous villages are scattered throughout the region, which are entirely off of the road system and are only reachable by boat or plane. In the Koyukuk–middle Yukon region of the Alaskan interior, there are Koyukon Athabascan tribes who have a mixed cash–subsistence economy, but still rely heavily on the harvest of wild foods (McNeeley 2009). They are long-term residents of the region who live in close relationship with the land. The tribes maintain many cultural and spiritual traditions, though they are also modern in many ways (electricity, satellite television, Internet, etc.). Alaska Natives have a tense postcolonial relationship with the U.S. federal and Alaska state governments, especially regarding land ownership and the regulatory system for subsistence and wildlife management.

The region comprises a mosaic of land ownership between the tribes, the state, and the federal
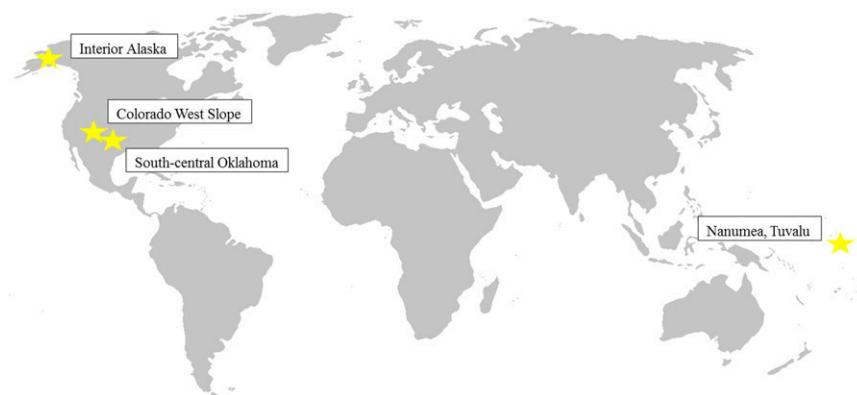

FIG. 2. Case study field sites.

government—largely U.S. Fish and Wildlife Service (USFWS) refuges surround the villages in the Koyukuk–middle Yukon region with the remaining lands owned either by the state of Alaska or regional native corporations. Because of this, there exists a mix of constituencies in the context of subsistence and wildlife management that generally fall into the three institutional culture types: 1) the egalitarian tribal communities; 2) the hierarchical bureaucracies of the state and federal government regulators; and 3) the market individualists of the Board of Game and "outside" sport hunters—mostly white, male, and commercially oriented.

Social relations between the constituencies occur in the context of various meetings and the regulatory process for the management of wildlife and subsistence activities, such as the state and federal advisory committees and the boards of game meetings. The constituents are in ongoing conflicts about the regulatory system, which controls the tribes' access to land and natural resources across space and time. The climate and seasons are changing, and this impacts the ecological responses of the resources they depend on, such as moose rutting behavior and hunter harvest success, which has changed with recent warming trends (McNeeley and Shulski 2011). As a result, since the late 1990s the tribal communities have been requesting regulatory changes to the hunting season to allow them more time to hunt moose when warmer falls push the season later; however, the hierarchical bureaucracy of the state and federal agencies has been a barrier to the flexibility the tribes need to adapt to climate change (McNeeley 2012).

In rural, Alaska Native communities, the predominant culture is egalitarian with a communal social structure (i.e., land ownership, access to resources) based on long-standing indigenous cultural principles of collectivity (Berger 1985; McNeeley 2009). This cultural worldview sees nature as fragile. Traditional belief systems reflect this worldview, such as the Koyukon Athabascan notion of *hutlaanee,* which means taboo or self-restraint in terms of how humans treat the natural world (McNeeley 2009; Nelson 1983). The belief is that humans are in a delicate balance with nature, and mistreatment of nature results in "bad luck" in harvest and even the possibility that starvation or death can occur. In other words, food security and overall human well-being are predicated on proper, ethical behavior toward nature. This includes behavior toward animals, and as such, they are prohibited by their own worldview to speak badly about animals. Each animal is afforded a certain respect and treatment, even in death, according to that animal's preferences, as one Koyukon elder describes: "My grandpa taught me to take care of those animals after they die or they won't come back. Like bear and wolf bones, we don't throw that any place, we burn them on dry land. And water animals you take them back to the lake. That's the way we take care of the land."

Yet, the tribes must live within a superimposed, hierarchical regulatory system for subsistence and wildlife management that is dominated by the agency bureaucracy of the Alaska dual state/federal system. Because this hierarchical management style conflicts with the egalitarian worldview, there are ongoing tensions between tribes and the federal/state power over local control (Nadasdy 2003; Cruikshank 1998; McNeeley 2012). It is in this context that conflict occurs around these opposing worldviews on climate change and result in devaluing indigenous observations of the relationships between the changing weather, impacts on nature, and the ultimate effect on their success in the harvest of wild foods. In response to a petition from the tribes to change the moose hunting regulations to account for changing seasons, a bureaucrat denied them and stated, "There is some agreement that additional data is needed before a determination could be made concerning that recent warmer than-normal fall temperatures are part of a long-term climatic pattern" (WIRAC 2006, p. 90) This reflects the hierarchical view that preferences quantitative, western science above local knowledge and experiences. Another example of the culture clash is the regulatory system where a commercially oriented, individualistic Board of Game makes decisions that are based on accounting for individual harvest (bag limits) and the economic value of commercial hunting, a system that is ill fitted for a communitarian society where a small number of community hunters provide wild harvested foods shared among members of an entire village or tribe (Anderson et al. 2004). As a result, there are many cultural and regulatory barriers for finding common solutions to climate change in this context, thereby impacting both local livelihoods and government agency resource conservation goals (McNeeley 2012; Moser and Ekstrom 2010).

b. Nanumea, Tuvalu

Nanumea is the northernmost atoll of Tuvalu, an archipelago nation of low-lying coral islands and atolls spanning over 400 miles of the Pacific Ocean. The Polynesian community of approximately 600 people is accessible only by boat. Supplies and travelers are transported by an interisland boat that visits the outer islands once or twice a month. Like the Koyukon Athabascan tribes, Nanumeans thrive on a mixed cash–subsistence economy, dominated by fishing, taro farming, and raising pigs. Despite their remote location, contemporary Nanumean culture is strongly influenced by colonial and postcolonial forces; most of the population is Christian, and, also like the Alaskan tribes, people on Nanumea

enjoy access to electricity, Internet, and education up to secondary school (after which students may move to boarding schools on other islands). Yet, Nanumean culture also remains distinct, even from the other Tuvaluan island communities. A strong origin story provides a deep sense of belonging and informs the structure and practices of the local government composed of a chief, a circle of seven elders known as the *Toku Fitu,* and a traditional assembly of elders known as the *Falekaupule.*

The local leaders work alongside the national government of Tuvalu. As a United Nations–designated least developed country, the Tuvaluan national government has many external interactions with regional and international governments and development agencies. These institutional constituencies cover different scales and hold different worldviews: 1) egalitarian Nanumean community represented by the *Toku Fitu* and *Falekaupule* and 2) hierarchical bureaucratic international development agencies.

Tuvalu faces numerous challenges from climate change including food, water, and human insecurity due to sea level rise, ocean acidification, and other climate impacts (Nurse and McClean 2014). Because of their deep climate susceptibilities and development status, Tuvaluan communities attract a great deal of attention from international development agencies (Lazrus 2012). Nanumea, like other communities, hosts several local projects that bring the community and local government, national government, and international agencies together in various configurations. However, each of these constituencies represents a different worldview, potentially leading to misaligned procedures, priorities, and goals. The Nanumean community's motto, ''unity of heart,'' reflects their egalitarian culture of equality and belonging, which is also embodied in ideas of *lotofenua* (community heartedness) and *alofa* (love and compassion, similar to the Hawaiian notion of *aloha*) (Chambers and Chambers 2001). Collective decision making is institutionalized in the traditional island *Falekaupule*, including the *Toku Fitu*, which, guided by the idea of unity of heart, retains responsibility for the management of natural resources while some other management areas have been taken over by the national government (Lazrus 2009). In natural resource management, the *Falekaupule* seeks to maintain a balance between social activities and the ephemeral environmental conditions consistent with the fragile view of nature (Chambers and Chambers 2001). According to Nanumean worldviews, social indiscretions among important community members can adversely influence environmental processes, for example, leading to an infestation of pests in the Nanumea lagoon or even climatological phenomena like the onset of a drought.

The distinct worldviews of the *Falekaupule* and hierarchical international agencies is illustrated by the creation of a marine protected area (MPA) in the lagoon at the center of the Nanumea atoll in 2006, funded by an international development agency and facilitated on Nanumea by a conservation officer from Funafuti, Tuvalu's capital. Community-based marine protected areas have mixed rates of success in terms of increasing biomass and preserving ecosystem effects following large-scale disturbances, yet they are currently very popular environmental and climate adaptation projects among international development funders (Graham et al. 2008).

The externally funded implementation of MPAs fits well with the hierarchical bureaucratic priorities of establishing science-based institutions based on set procedures to monitor success. In this case, the funders allowed the community members to request the establishment of the MPA and select the specific site that may improve its chances for success and longevity. A series of community wide workshops were held, and three potential sites were selected with input from various community representatives including fishermen, women, and elders. Ultimately, an area of the lagoon was selected where giant clams had once been plentiful but no longer grew. The clams face overharvesting as well as problems from climate change–induced sea temperature rise and ocean acidification. The site was considered to be easily enforceable since it can be seen from the village area. Only in a final meeting with the executing officer of the MPA were the *Toku Fitu* explicitly involved, although members of the *Falekaupule* had participated as community members in the workshops.

During the discussion with the *Toku Fitu* about selecting the site for the MPA, the elders expressed the importance of incorporating the understanding of the delicate relationship between the powers of the island chief and the natural world. The conversation turned to speculation about if the MPA could, in fact, achieve recovery of the clams or if it would instead take a change in the position of chief. Regardless of their concern, the *Falekaupule* and *Toku Fitu* approved the MPA thinking that even if it did not bring back the giant clams it could possibly have other benefits to the lagoon. In the case of the MPA, the egalitarian local leaders and hierarchical international agency had different priorities and views about how society and nature interoperate; however, the MPA was established, nonetheless. As of 2014, it is still in place and being enforced, although the clam population has not yet recovered (Job and Ceccarelli 2012).

In this case, community members and development agencies agreed to implement the plan, but for different reasons. CTR helps identify the reasons that were most meaningful to community leaders wanting to maintain

the Nanumean relationship to nature. It points to the importance of incorporating local understandings about the connection between nature and culture, thereby potentially avoiding an erosion of the meanings that maintain cultural integrity for local communities and their livelihoods. It is also important to help ensure the success of the program based on measures of success acceptable to both the development agencies and the locals.

c. South-central Oklahoma

South-central Oklahoma in the U.S. Great Plains region straddles the transition zone between wet and dry regions to the east and west, respectively. The area's water resources are sensitive to drought and changes in precipitation, such as the Arbuckle–Simpson aquifer, which is recharged by precipitation and feeds numerous artisanal springs and rivers and is the source of water for several municipalities (Christenson et al. 2011; Ojima et al. 2012). Dryland ranching, which is highly dependent on precipitation since it does not use irrigation, is one of the main livelihood activities in the area, and the lakes and streams provide opportunities for recreation and wildlife habitat. Climate science indicates that drought conditions and competition for water resources will likely become more prevalent in the area in the future as temperatures warm (Shafer et al. 2014).

While the case studies from Alaska and Tuvalu illustrate differences between local communities and outside institutions, community-based research in south-central Oklahoma reveals discord among groups of people holding different worldviews within the communities that rely on the aquifer for water. Recently, proposed water management that puts limitations on the amount of groundwater that individuals can withdraw from the Arbuckle–Simpson aquifer has become a divisive topic cleaving through community relations (Layden 2013). In the state of Oklahoma, groundwater is considered private property that belongs to the overlying surface owner, although it is subject to some regulation by the Oklahoma Water Resources Board (OWRB), the state's scientific and management water agency. The three main constituencies involved in the Arbuckle–Simpson aquifer water disputes are: 1) an egalitarian public interest group, Citizens for the Protection of the Arbuckle Simpson Aquifer (CPASA), committed to protecting water resources; 2) market individualist landowners who are against OWRB management of water on private property; and 3) hierarchical bureaucratic state and federal agencies, primarily the OWRB.

On one hand, the public interest group CPASA, composed of individuals from throughout the region, is invested in protecting the area's water resources and has lobbied state and local officials for more restrictive water management by emphasizing the common social good and fragility of nature in their discourse. Members promote collective action and are vocal in town meetings in attempts to garner support and demonstrate collective will, using concepts and terms such as "protect," "sustain," and "equality." This group illustrates egalitarian principles, holding that protecting water resources will enhance the communities' resilience to drought impacts and maintain water resource for future generations. CPASA has a formal membership; member fees support lobbying activates, and members meet regularly to hear updates about state and municipal plans for water management. Members are encouraged to attend public meetings and write to state and municipal water managers.

On the other hand, some private land owners see an opportunity to sell their groundwater out of basin to the expanding metropolitan areas to the north and south and oppose the proposed water management. These landowners are not organized into a formal group, but maintain strong communication through existing structures such as the area Farm Bureaus and Cattlemen's Association. Demonstrating the market individualist position, these community members prefer private management of the water on their property with limited oversight of the OWRB. These community members emphasize the rights of property owners to manage their own resources and describe nature as tolerant and accommodating of human action so that there is no need to reduce the amount of water withdrawn from the aquifer because it will not be depleted. They argue that because the aquifer had long provided water to the region, there is no reason to think that it will cease to do so. To these community members, enhanced water management represents infringements of individual property rights that they call "un-American" and "socialist."

The present water conflict arose when concern over the amount of water being withdrawn from the Arbuckle–Simpson aquifer in south-central Oklahoma was brought to the attention of state senators by the public interest group. This resulted in the creation of Senate Bill 288, which placed a moratorium on individuals selling water to distant consumers until the results of a multiyear, multimillion dollar hydrological study could be produced to determine the maximum allowable yield of the aquifer (Christenson et al. 2011) and until appropriate regulations were put in place. Public comment at a formal hearing on the completed hydrological study was acrimonious. Egalitarian and market individualist perspectives, from the public interest group and land owners, respectively, were strongly opposed, inhibiting consensus solutions between stakeholders. For example, the scientific results of the study were under scrutiny at the hearing and opposing factions perceived the role of science

differently. Those aligned with the public interest group erred on the side of caution and accepted the proposed maximum annual yield as part of a larger strategy to protect the resource while landowners interested in selling their water questioned the accuracy of the study's design and results, thereby discounting the proposed management strategies based on the study in favor of trusting that the resource could be managed without increased regulation.

d. West Slope, Colorado

In northwest Colorado, montane forests and sage steppe grasslands host ranching and coal mining communities mixed with recreation and tourism livelihoods (e.g., boating and ski industry). The Yampa-White River basin region is ecologically diverse upstream and downstream with the upper basin a mostly alpine and subalpine forested region, and the lower basin and most of the White River basin sagebrush steppe and shale desert. Precipitation varies from east to west, but most of the region is a semiarid climate with limitations in water availability in drought years, so tensions exist around water allocation and use between the various groups (McNeeley 2014).

Western U.S. water law is based on the prior appropriation doctrine, which is a "first in time, first in right" system where older, senior water rights have priority over newer, junior uses. Increasing pressures from population growth, energy extraction, and production and climate change are resulting in an awareness of a potential lack of water availability to meet current and future needs. The question of how best to manage limited water resources must get negotiated between the various water users and managers in the region. This happens in a variety of ways, but a recent adaptation in water governance was the creation of the basin round table process in 2005 by the Colorado Water for the Twenty-First Century Act (CO HB 05–1177). The act reframed and reorganized water governance from a system historically dominated by special interests and conflict to a system of more equitable, collaborative negotiation and cooperation. This happened through the creation of regional basin round tables and an Interbasin Compact Commission that bring citizens across all sectors and regions into a public discourse process where difficult water management issues are addressed (Sibley 2013). In northwest Colorado, the Yampa-White Basin Roundtable (YWBRT) meets quarterly with special meetings when necessary. The YWBRT comprises representatives of all the various sectors (ranching, energy, recreation and tourism, municipalities, and environment), which brings a mix of constituent cultures involved in managing water resources. In general, the constituencies in water management are 1) market

individualist ranchers and the energy and mining (largely coal) industry; 2) bureaucratic water resource regulators; and 3) egalitarian recreation and tourism/environmentalists (e.g., Friends of the Yampa River).

Similar to the Oklahoma case, in rural, ranching communities on the west slope of Colorado, there exists tension within and between communities as well as between federal and state government agencies and local communities where water is the resource that connects places and different scales of governance (i.e., local, state, and federal). A diversity of worldviews about how best to manage water coexists in this region that manifest through watershed management and governance forums. Market individualists believe the water should be used for production and put to "beneficial use," which is, in fact, the philosophy on which Colorado water law is predicated. However, egalitarian environmental groups believe that a portion of the water should be left in the stream for riparian ecosystem health and recreation. Often in the middle of these groups are the agency regulators who have to abide by the hierarchical bureaucratic system for distributing the water among the users.

These disparate worldviews also manifest in interviews about the risk of climate change. For example, during an interview, a local rancher and leader in water resource management voiced an individualist worldview about climate change policies to reduce greenhouse gas emissions: "I guess what I don't like is that it's kind of a control thing from 'here's how we're gonna [sic] manipulate the thing and the situation to cause this to happen sooner'—in an overall erosion of individual liberties and property rights and all that goes with it."

This individualist's perspective on environmental risk management contrasts with other stakeholders in the region that have a more egalitarian/nature fragile viewpoint and, as such, view the risk of climate change and needed policies very differently. For example, in another key stakeholder interview, he stated his opposition to the market worldview by voicing a perspective where nature has limits: "We've reached a point where we're in a scarcity situation. We don't have abundance. Our whole economic situation, the concept of capitalism, the concept of free market, the concept of progress is based upon a presumption of abundant, infinite resources. And that is completely unsustainable. We are nearing an environmental tipping point."

In the beginning of the BRT process, the relationship between the constituents was acrimonious, especially when it came to matters of nonconsumptive uses of water (recreation and environmental health). As part of the state-mandated BRT process, each round table was asked to conduct a nonconsumptive use study for their respective basins. Because the concept of nonconsumptive

TABLE 4. Case example constituencies and climate adaptation strategies.

	Market individualistic	Hierarchical bureaucracy	Egalitarian
Alaska	Boards of Game Outside sport hunters	State and federal agencies [Alaska Department of Fish and Game (ADF&G) and USFWS]	Koyukon Athabascan tribes
Tuvalu	N/A	Many international development agencies	Nanumean community members
Oklahoma	Land owners interested in selling water	State and federal agencies [OWRB and U.S. Geological Survey (USGS)]	CPASA members
Colorado	Coal, oil, and gas industries Ranching organizations	Water resource regulators	Nonconsumptive water use groups (environmental; recreation/tourism)
Climate adaptation strategies	Autonomous	Probabilistic risk-based management or resilience approach	Fundamental transition; anticipatory, precautionary principle

uses is inherently political in the western United States (i.e., leaving water in the stream instead of diverting it for production of agriculture, municipal and industrial uses, or development), the process of valuing nonconsumptive uses brought conflict between the constituents, especially the market individual group and the egalitarian recreation and environmental group. However, over the course of a year plus, the process of regular meetings to discuss and negotiate ideas about the study resulted in compromise when the constituents learned to respect each other's worldviews and find a way to incorporate each of them into the study (Sanderson et al. 2012). The process went from one of being highly contentious between the different constituent groups to one using an innovative approach (i.e., the Watershed Flow Evaluation Tool) and producing a cutting-edge nonconsumptive use study, which even included considerations of future climate change and was ultimately accepted and endorsed by the YWBRT (Sanderson et al. 2012).

4. Discussion: Cultural theory of risk for climate change adaptation

The case examples above illustrate the utility of the CTR framework for understanding how institutional cultures differ regarding environmental risks and their solutions. As discussed previously, we approach CTR as a helpful heuristic for understanding how social solidarities create emergent properties of institutions (Thompson and Rayner 1998; Thompson 2003). Each example shows some diversity among the worldviews represented by the different groups. In the cases of Tuvalu and Alaska, the diversity is most apparent between community members (largely egalitarian worldviews) and outsiders (largely hierarchist or individualist worldviews), but even within the communities there is some diversity where, for example, more traditional views conflict with modern ones.

In the Oklahoma and Colorado case studies, there is considerable diversity of worldviews regarding resource management among community members, as Douglas observed, "In any community, there will be a continuing four-sided struggle among the constituent cultures" (Douglas 2003, p. 1351).

The diversity of worldviews within and among communities, organizations, and institutions points to the need for adaptation solutions that reflect multiple constituencies, worldviews, and approaches on climate adaptation strategies (Table 4). A holistic approach would incorporate all types of strategies—that is, some necessary and reasonable regulatory measures based on relevant science that also allowed for (or did not unnecessarily constrain) individuals' or groups' autonomous adaptation actions.

Verweij et al. (2006) refers to this approach as one that incorporates "clumsy solutions," which are defined as flexible and creative ways of organizing institutional arrangements and processes that are inclusive of the various worldviews and do not leave any group worse off. "Clumsy institutions are those institutional arrangements in which none of the voices—the hierarchical call for 'wise guidance and careful stewardship,' the individualistic emphasis on 'entrepreneurship and technological progress,' the egalitarian insistence that we need 'a whole new relationship with nature,' and the fatalist asking 'why bother?'—is excluded, and in which the contestation is harnessed to constructive, if noisy, argumentation" (Verweij et al. 2006, p. 839). In other words, where the organization of institutions can be such that it allows for the inclusion of all the voices in devising solutions, societies can move from conflict to cooperation. In the case of the Colorado basin round table process, the creation of a new institutional structure and process is leading to clumsy solutions for water resource management, whereas in Oklahoma to date no mechanism exists

that facilitates a process for clumsy solutions. As a result, the Oklahoma constituents remain adversarial and the Arbuckle–Simpson aquifer situation continues to be one of conflict.

We find that applying CTR to our case studies helps us to diagnose barriers to adaptation, identify potential ways to improve problem framing and communication, and see how communities can move from conflict to cooperation in adaptive governance. We elaborate on these three points with reference to the case studies below, showing how the steps to adaptation are inherently "clumsy" (Verweij and Thompson 2006).

a. Diagnosing barriers

The promise of building adaptive capacity to reduce climate change impacts and vulnerability has been undermined, in large part, by social barriers to adaptation (Adger et al. 2009; Moser and Ekstrom 2010). The barriers cross social dimensions of politics, economics, regulations, and divergent risk perceptions, among others (Bierbaum et al. 2013). Underpinning these barriers and the solutions to overcoming these barriers are cultural differences, such as those discussed in the cases above. In Alaska, regulatory barriers to climate adaptation hinder flexibility of the tribes to adapt to seasonal changes (McNeeley 2012).

Through the incorporation of CTR understandings of human–environment relationships that include, for example, Koyukon views on *hutlaanee* and luck, management and regulations would be more inclusive of local perceptions, priorities, and practices, which would improve the ability to meet management goals. This would include incorporating local egalitarian/nature ephemeral ideas about what these views mean, not just in terms of conservation outcomes, but also for management and regulatory processes. If locals felt their cultural views of nature and their related practices were respected and incorporated into management this would help overcome the barriers caused by cultural disconnects and build the social capital (relationships, trust, sharing of knowledge) so crucial for cooperative, collective action and planning to adapt to future climate change (McNeeley 2009). Specifically, for example, if the Alaska Board of Game meetings were restructured so that local tribal voices could be included throughout the entire process when regulations are actually being set (instead of just during the opening "community testimony" segment), decisions could be more inclusive of egalitarians. We do not mean to imply that this approach will be a panacea to overcome all of the structural inequalities in the government regulatory system, rather that this can at the very least help to diagnose barriers to effective management and perhaps even contribute to more shared solutions.

b. Framing and reframing climate risk

Prior research on risk perception and communication show that exposing people to hazard information does not automatically change how people perceive and respond to risks (O'Neill and Nicholson-Cole 2009; Douglas and Wildavsky 1982; Mileti 1993). When problem framing and risk communication reflect, at least in part, what is already perceived about a risk, including how nature functions, they will be more likely to be accepted. In the Tuvalu case, if solutions to climate change were reframed to prioritize cultural integrity, community solidarity, and other important factors for Tuvaluan decision making, then a more relevant and representative dialogue could take place, ultimately facilitating shared solutions for adapting to climate change.

Communication about risk that does not highlight the priorities of those intended to receive the message may not be effective. For example, the risk of losing access to marine resources important to livelihoods in Tuvalu and needing to plan for a different future must be considered together with the risk of losing one's community and cultural integrity. Framing the long-term risks posed by climate change in such a way that they reflect the priorities of various worldviews and views of nature can help people pay attention and respond to the difficult problems presented by climate change (Lazrus 2009).

c. Moving from conflict to cooperation

CTR helps to explain why conflict arises over environmental risks and their proposed solutions. When different worldviews clash, the resulting conflict can be divisive and even serve to reinforce and entrench the opposing worldviews. In the ongoing controversy over the management of the Arbuckle–Simpson aquifer in Oklahoma, those for and against the increased regulations of water usage share little common ground. In community gatherings, such as the public hearing described above, community members become more and more deeply entrenched in their arguments founded on their disparate worldviews and mutually exclusive views of nature as either vulnerable or invulnerable to human influence.

In Colorado, where management of water is also divisive, conflict has, in many cases, been overcome in favor of cooperation. The Colorado Water for the Twenty-First Century Act, otherwise known as HB1177, created a basin round table process for building collaboration and mutual consensus across diverse and historically competing worldviews and interests (CO HB 05–1177). Rural agriculturalists, energy sector representatives, municipal, recreation/tourism, and environmental representatives regularly meet to collectively discuss how to make their basin(s) water resources sustainable

into the future. This has been an effective means for creating a mechanism for ongoing face-to-face discussions about water resource management and governance where opposing worldviews can be shared in a safe and supportive environment, which serves to build consensus as opposed to conflict. Implementing these types of mechanisms for ongoing dialog between culture types facilitates negotiations around shared resources via creating a collective knowledge and understanding of each other and different ways of viewing nature/culture.

This is not to imply a need for total agreement, just a respect and understanding about others' views and voices in a way that facilitates building relationships and trust (Verweij et al. 2006). Because in the case from Colorado the focus is water management, climate is inherently a big topic of discussion—therefore, learning about climate science is a necessary part of the process. Through the ongoing interaction with climate experts, two-way interaction between local experts and climate experts results in gradually increasing the collective understanding about climate. And the nature/culture understandings from the local perspective across the spectrum of worldviews and myths of nature help climate experts better understand how to work and communicate with locals from a place of mutual respect and understanding as opposed to the diametric opposition that often plays out in the media where actors are disconnected in time and space.

The case studies presented herein did not include examples of fatalist worldviews or institutional culture. In part, this is because fatalist groups do not typically engage in research or the type of resource management processes we present here, believing that the research and its outcomes will not make a difference to them (Thompson et al. 1990; Thompson and Rayner 1998). However, because this group may be among the most vulnerable to climate-related impacts because of their weak social networks and marginalization from decision authority, research on climate-related resource management issues might attempt to engage this group, and community-based approaches that allow for relationships of trust to be established may present the best options for doing so.

5. Conclusions

In sum, we view the analysis of the Cultural Theory of Risk as applied to climate change adaptation as necessarily requiring two things: 1) an understanding of people's cultural worldviews about social organization *and* nature, which determines how they see the climate system "working"; and 2) participatory, community-based approaches to analysis to understand the nuances of the relationship between culture, climate change, and

adaptation strategies. In doing so, this can contribute to more complete understandings of the underpinnings of how societies and their various institutions make decisions and policies about adaptation to the risks of climate change now and in the future. Another argument for integrating these insights from CTR into decision making is to inform collaborative partnerships in applied research projects whereby the key decision-making stakeholders participate from beginning to end in the research. By including them from the beginning, this can help to ensure the coproduction of research questions and knowledge as well as usable outcomes. In turn, this can help us with diagnosing barriers to climate change adaptation, assisting better communication through framing/reframing climate based on shared understandings and collective learning, and helping move from conflict to cooperation through better negotiation of diverse worldviews.

Climate research that brings CTR to bear on local resource management and climate adaptation contexts recognizes the role of culture in how people formulate policy preferences and accept or reject resource management decisions. Research on institutions and adaptive governance of common pool resources shows that across different environments and concerning different goods, including water, local users who collaborated with one another found a way to make better collective decisions than those who had regulations forced on them by outsiders (Ostrom 1990). The key approach to maintain long-term, sustainable resources is for stakeholders to work together and holistically to manage the resource. By extension, incorporating diverse values and community priorities as identified through CTR analysis can improve the social relevance and community compliance of local adaptation efforts and policies.

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CORRIGENDUM

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In McNeeley and Lazrus (2014), a production error resulted in the omission of a word at the end of Table 2 on p. 509. The last line of the table should read, ''Nature capricious (fatalist): the climate system is inherently unpredictable.'' Also, the reference in the Table 2 caption was identified incorrectly. It should be Hulme (2009), not Hulme (2010), as was originally published. The corrected table is shown on the following page.

The staff of *Weather, Climate, and Society* regrets any inconvenience this error may have caused.

REFERENCES

Hulme, M., 2009: *Why We Disagree about Climate Change: Understanding Controversy, Inaction and Opportunity.* Cambridge University Press, 392 pp.

McNeeley, S. M., and H. Lazrus, 2014: The cultural theory of risk for climate change adaptation. *Wea. Climate Soc.,* **6,** 506–519, doi:10.1175/WCAS-D-13-00027.1.

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TABLE 2. Nature Myths about Climate. Adapted from Hulme (2009)'s *Why We Disagree about Climate Change: Understanding Controversy, Inaction and Opportunity*.

Nature benign (market individualist): climate system is favorable to humans; will always find its equilibrium on its own

Nature fragile (egalitarian): climate system lies in a delicate balance; human insult can lead to collapse

Nature tolerant (hierarchist bureaucratic): climate system is controllable to a certain degree; climate risks not trivial, however, to manage for equilibrium we need better predictive capabilities

Nature capricious (fatalist): the climate system is inherently unpredictable