Drought Adaptation and Climate Change Beliefs among Working Ranchers in Montana

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ABSTRACT

Agricultural producers may be particularly vulnerable to climate impacts, such as drought. To better understand how ranchers respond to ongoing drought and the relationship between climate change beliefs and drought adaptation, in-depth interviews with working ranchers were conducted. Ranchers described drought conditions as unprecedented and detailed the interacting impacts of drought and nonclimatic stressors. They viewed adaptation as critical and employed a wide range of responses to drought, but lack of financial resources, risks associated with change, local social norms, and optimism about future moisture created barriers to change. Most ranchers attributed drought to natural cycles and were skeptical about anthropogenic climate change. Many ranchers likened current drought conditions to past droughts, concluding that conditions would return to ''normal.'' A belief in natural cycles provided a sense of hope for some ranchers but felt immutable to others, reducing their sense of agency and efficacy. Taken together, climate skepticism, optimism about future conditions, lack of financial resources, and a limited sense of agency might be reducing investments in long-term adaptation. However, the relationship between climate change beliefs and adaptation action was not entirely clear, since the handful of ranchers adapting in anticipation of long-term drought were skeptical or uncertain about anthropogenic climate change. Further, most ranchers characterized adaptation as an individual endeavor and resisted government involvement in drought adaptation. In the context of climate skepticism and antigovernment sentiment, strategies to scale up adaptation efforts beyond the household will only succeed to the extent that they build on local norms and ideologies.

1. Introduction

Agriculture is especially vulnerable and sensitive to climate change (Hall and Wreford 2012; McLeman et al. 2008). Climate change impacts to farming and ranching will likely influence rural futures around the world and potentially compromise global food security (Zhao and Running 2010; Miller et al. 2013). In the western United States, climate change has already been linked to declining snowpack, earlier snowmelt, more frequent drought, lower late summer streamflow, and increased interannual variability—trends that are expected to continue and worsen throughout the twenty-first century (Chambers and Pellant 2008; Pederson et al. 2011). Climate change impacts on grazing are particularly important in the United States, where 27% of the land area is rangeland and grassland pasture used to graze livestock (Nickerson et al. 2011). Sayre et al. (2012) argue that livestock production on U.S. rangelands is an

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important and potentially sustainable form of diversified agriculture. In addition to producing food, rangelands provide important wildlife habitat, recreational opportunities, open space, and ecosystem services (Maczko et al. 2011; Huntsinger and Oviedo 2014). Thus, effective adaptation on rangelands is important for social, economic, and ecological reasons.

There is a large body of research on the impacts of climate change on agriculture at national or regional scales, but very few studies explore the ways that individual producers or households adapt to specific, localized climate change impacts, such as drought (Head et al. 2011; Miller et al. 2013). To fill this gap, we examined the views and practices of working ranchers in Montana, including how they understand and respond to ongoing drought, and the relationship between climate change beliefs and adaptation to drought.

2. Literature

On U.S. rangelands, climate change is expected to produce directional shifts in vegetation and increases in invasive plants (Julius and West 2008), as well as new conditions and no-analog systems (Morgan et al. 2008). Droughts in the region typically result in decreased forage production both during and for several years after droughts end, due to compromised seedling growth, soil erosion, and lower-quality forage (McDougald et al. 2001). In addition to decreased forage production and more invasive weeds, during droughts ranchers struggle with less water for irrigation and cattle in the mid–late summer and altered fire regimes (Chambers and Pellant 2008).

It has long been recognized that changing weather conditions pose both risks and uncertainties for ranchers (see, e.g., Whitson 1975). Because they cannot completely eliminate such risks, ranchers manage and mitigate risk over a period of many years with the assumption that variability in profits and productivity is unavoidable (Crane et al. 2010). And, like other agricultural producers, ranchers experience climate-related changes, such as drought, concurrent to other stressors (McLeman et al. 2008). Drought, in military terminology, acts as a ''threat multiplier,'' exacerbating existing challenges related to low or fluctuating commodity prices, unmanageable debt, rising land prices, and changing range conditions. According to Leichenko and O'Brien (2002, 2008), these interacting stressors create ''double exposures'' that deepen vulnerability to climate change.

Adaptation has been advanced as a process or means to mitigate the local impacts of climate change. White et al. (2001, p. 21) define adaptation as the ''ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.'' But adaptation is more than an adjustment to external stimuli. Adaptation is embedded in a social, political, economic, institutional, and biophysical context involving interacting climatic and nonclimatic processes that both enable and constrain adaptive actions (i.e., the interacting stressors and double exposures described above) (Adger et al. 2012; Thornton and Manasfi 2010; Moser and Ekstrom 2010).

Most adaptation happens at household, local, and regional scales, and it responds to the specific impacts of climate change, such as drought, that occur in particular places. Agricultural adaptation to climate change will likely occur at multiple scales and involve numerous actors, including state and federal government agencies, nongovernmental organizations (NGOs), industry groups, and individual agricultural producers. Range management and extension specialists have documented a range of adaptive actions that ranchers employ in response to drought, including moving cattle to better pastures, developing new water sources, controlling invasive plants, purchasing supplemental feed, culling herds, weaning calves, diversifying income streams, restoring and maintaining forage and soil, developing more efficient grazing systems, improving herd quality, and planning for contingencies (Hamilton 2003; McDougald et al. 2001).

Some scholars differentiate between reactive or short-term coping responses and proactive adaptations that restructure or even transform operations for the long-term (e.g., see Smit and Skinner 2002). However, actions that are successful over the short term may be less effective or even maladaptive over the long-term, making it difficult to determine which responses constitute short-term coping that maintain the status quo and which responses effectively anticipate longer-term change and build long-term resilience (Moser and Ekstrom 2010; Nelson et al. 2007). For example, increasing debt could constitute a short-term coping mechanism that might be maladaptive, if it creates an incentive to overgraze in future drought years in order to make payments. However, a loan to transition to drought-tolerant grass or livestock breeds, to diversify an operation, or to purchase additional rangeland to increase the long-term sustainability of a ranch might actually be transformative. A temporary reduction in herd size might constitute short-term coping but a more permanent reduction could restore grasslands and build resilience to drought over the long term. The efficacy of longer-term herd size reductions hinges on the extent and severity of drought over time and market conditions (e.g., the price of beef, the price of hay, and the cost of

inputs) that affect ranchers' ability to be financially sustainable with fewer livestock. Thus, specific responses need to be evaluated over long time scales (Thornton and Manasfi 2010).

Effective adaptation depends, in part, on adaptive capacity, or access to social, human, institutional, natural, and economic resources, and the ability of an individual or group to mobilize those resources to respond to change (Wall and Marzall 2006). Adaptive capacity hinges on a range of assets and endowments, such as social networks, access to relevant knowledge, appropriate policy, available funding, control of natural resources, and mechanisms for collective action. Because these assets and endowments operate at multiple, interacting scales, the resources available to households may differ from those available to social groups, communities, and governments. Further, different types of adaptation actions require mobilizing different capacities at different scales, meaning that some responses are available to households, while others require collective action.

For agricultural producers, decisions about adaptation are influenced by a range of political, social, and economic factors occurring at multiple scales, including commodity prices, trade policy, government programs, available technology, family finances, risk perception, and social norms (Smit and Skinner 2002; Reid et al. 2007). In an analysis of drought adaptation in the 1930s in Oklahoma, McLeman et al. (2008) found that adaptation to climate stressors did not occur in isolation of nonclimatic stressors; synergies between these two swamped adaptive capacity with overwhelming negative results. They concluded that programs designed to address nonclimatic stressors, such as policies to stabilize commodity prices, farm income, and employment, can assist adaptation to drought by building overall adaptive capacity. Thus, the multiple or "double" exposures demonstrated by Leichenko and O'Brien (2002, 2008) may also provide multiple leverage points for improving adaptability.

Interestingly, physical vulnerability to climate impacts does not necessarily increase risk perception, which appears to be mediated by both climate change beliefs and political ideology (Saleh Safi et al. 2012). Several studies have found that farmers and ranchers typically attribute local environmental changes, such as drought, to local stresses rather than global climate change (Liu et al. 2014; Milne et al. 2008). In a study in Ontario, Canada, Reid et al. (2007, p. 630) found that most farmers were unaware and/or unconcerned about climate change, and that the farmers "who are more concerned and aware of the climate change risks are more likely to make efforts to prepare and to take anticipatory actions to reduce risks than those who are less concerned or skeptical." Raymond and Robinson (2013) found that while rural landholders were capable of adjusting to farm risks, they were more likely to respond to short-term risks that had a direct impact on their operation rather than the longer-term risks related to climate change. Thus, ranchers who believe in and are concerned about climate change may be more likely to pursue adaptive actions that anticipate long-term change. Further, natural variability may delay adaptation (Schneider et al. 2000) because the high degree of natural variability in the weather masks climate change trends and thus discourages farmers from engaging in anticipatory adaptation based on climate projections (Hulme et al. 1999).

A number of studies have linked perceptions of climate risk with political identity and ideology, concluding that conservative or individualist world views correlate with less concern about climate change (McCright and Dunlap 2011; Kahan et al. 2011). According to Maibach (in Cooney 2010, p. 6), "political ideology and some deeply held worldviews related to political identity are currently the biggest factors that determine a person's view of climate change." When Americans were recently asked about the causes of warming over the last century, 55% attributed warming to human activities, while 41% said that warming was due to natural causes (Gallup 2015). Recent research indicates that individuals attribute local changes, such as warmer winters, to either natural variation or anthropogenic climate change based on their climate change beliefs, beliefs that are heavily influenced by political ideology (McCright et al. 2014). Ascribing specific changes, such as drought, to natural cycles rather than anthropogenic climate change is common among climate skeptics (Hobson and Niemeyer 2013). Thus, the political ideologies and world views of ranchers may influence their views on the causes of drought and the need for long-term adaptation.

Most research on climate change and agriculture in the global north examines climate impacts on productivity and yield at regional or national scales with a focus on technical, agronomic, and top-down initiatives (Head et al. 2011; Miller et al. 2013). Very few studies examine the adaptive responses of producers or the processes of autonomous adaptation at the local scale, indicating a need for research on the social, cultural, and political complexities of adaptation at the household scale (Head et al. 2011; Miller et al. 2013; Thornton and Manasfi 2010). To help fill this gap, we examined the ways in which working ranchers in Montana responded to drought—one of the most important climate-driven stressors in the western United States. Similar to Head

et al. (2011), we used drought as a window into rancher responses to climate change because drought is a local, tangible impact with important consequences for producers. We utilized a qualitative, descriptive case study approach to build knowledge of decision-making in real-world situations (Kandlikar and Risbey 2000). More specifically, we investigated the views and practices of working ranchers in Montana, how they understand and negotiate drought, how they are impacted and how they respond, and how their adaptation decisions relate to their ideas about anthropogenic climate change. Drawing on Adger et al. (2009), we examined the ways that past experience, risk perceptions, social norms, and climate change beliefs enable individual or collective action and/or limit adaptation.

3. Research methods

We conducted in-depth, semistructured interviews in three landscapes in Montana, each of which had experienced drought during the last 10–15 years. In total, 30 interviews were conducted with 35 ranchers (5 interviews were conducted with couples), including 5 interviews in the Big Hole Valley, 5 interviews in the Blackfoot Valley, and 20 interviews on the Rocky Mountain Front (the Rocky Mountain Front was emphasized due to more severe and prolonged drought conditions). Participants were purposively selected from a long list of potential interviewees generated through multiple and diverse contacts in each study site (Brandenburg and Carroll 1995). To access a diversity of views and practices, we selected ranchers from various age groups, with different size ranches, and with different types of operations (e.g., commercial cow/calf operation vs grass-fed niche operation). All ranchers who were contacted agreed to an interview. The sample includes approximately 10% of the ranches in these study sites. This small, purposive sample means that research results are not statistically generalizable (i.e., conclusions cannot be drawn regarding the proportion of ranchers who hold the different views described below). Rather, in-depth interviews provide an understanding of the range of views in a particular population and build detailed knowledge of particular case studies, which in turn informs social theory (Burawoy 1998).

Ranchers are defined here as individuals or families who self-identify as working ranchers *and* rely on livestock production for income generation. Most ranchers in these landscapes are cattle producers whose families settled on their property in the late nineteenth or early twentieth century. Ranches range from 2000 to 50 000 acres (1 acre = 4046.86 square meters) and run 100–2000 head of cattle. In this arid environment, 10 000 acres and 500 head of cattle are often necessary to support a family. The study sites are primarily composed of undeveloped ranchlands and a handful of small communities (ranging in population from 30 to 1800). Working ranches still dominate these areas, even though some large properties have been sold to amenity owners–newcomers and absentee owners who purchase ranchlands for the wildlife, scenic beauty, recreation opportunities, and privacy. Because of their short tenure and their lack of economic dependence on ranching, amenity owners were not included in this study.

Ranchers were asked questions about their ranch and livestock operations, the nature of recent droughts and local ecological change, the impacts of drought on individual households and the broader community, ranching practices in response to drought, perceptions of risk, future drought planning, local collective action, resources required to adapt, government programs, causes of drought, and anthropogenic climate change. An interview guide ensured comparability between interviews (Patterson and Williams 2002), but participants also had opportunities to bring up topics and ideas that were not covered in the interview guide. While we did not directly measure behaviors, ranchers talked extensively about adaptive practices during interviews, providing details about a range of actions taken in response to drought.

Interviews were recorded, transcribed verbatim, and analyzed using a process of coding that linked concepts to data through reading and rereading of transcripts, interpretations, and social theory (Strauss and Corbin 1990). From this process 43 codes emerged, ranging from *natural cycles* to *adaptation practice* to *amenity owners*. Coding of individual interviews was followed by detailed across-interview analyses to reveal patterns and differences. The interview excerpts below provide detail about rancher views and practices, as well as empirical evidence to support the interpretations articulated in this article. Each interview excerpt is numbered to indicate which research participant is quoted.

4. Findings

a. The local consequences of drought

Ranchers described drought conditions as ''prolonged'' (17) and ''continual'' (2), with less snow in the winter, earlier snowmelt, reservoirs not filling, springs drying up, and less rain in the summer [parentheses around a number denote research participant; i.e., (17) is participant number 17]. According to this sixth-generation rancher, ''last year was the worst grass year that I had seen since I've been ranching. . .By the first of part of June, everything was brown. It was just

fried. . .By the first week of July, if you drove out across a field, the grass where you drove. . .would turn to powder'' (11). Another rancher reported, ''We've had springs that dried up that were never dry in my memory'' (12). Some ranchers described drought conditions as unprecedented, saying ''this year's different, and in the past 10 years [it's] gotten worse'' (5). Observed impacts on rangelands included the expansion of nonnative invasive weeds, the emergence of new weeds, the decline of desirable grasses, and increased competition between cattle and wildlife for forage.

While some ranchers asserted that current conditions were unprecedented in their experience, many viewed the current drought as similar to those experienced by family members in the past, saying ''they went through the same thing we're going through'' (10). This kind of ''historical knowledge'' that ''old-timers. . .passed onto their families'' gave ranchers a sense of ''how it really gets bad and how there is no grass'' (4).

A few ranchers saw drought as a ''tremendous opportunity'' (6), saying ''we've got to be learning all the time'' (12) and ''you really become creative'' (24). And, there were instances where less rain and snow allowed for more outdoor work to be accomplished throughout the year, or where milder winters meant less hay was required. However, there was widespread acknowledgment that ongoing drought conditions were causing severe economic hardship for ranchers, who were forced to reduce their herd size, purchase hay at high prices, and lease additional rangelands. As a result, incomes were reduced and debt increased. Economically, drought was compounded by a host of existing pressures, including the rising cost of inputs and the fluctuating and often low price of beef. Because ranchers felt that they were barely scraping by, drought was characterized as able to ''break you in just one fell swoop. . .totally knock you right off the wall'' (24).

Drought conditions were widely believed to be causing social and psychological stress, resulting in tensions within families and between neighbors. As this rancher reports:

> I see a lot of depressed people. . .It's almost like going to a funeral sometimes. It's kind of like you're mourning the loss of. . .if you've been on a place that's been in your family for 80 years, and you're the one to lose it. . .That's kind of a horrible thought. (28)

Another rancher reported that ''tensions are really high'' and that there's ''more drinking than ever before because they don't know how to fix the problem'' (24).

Increased fighting over water illustrated one of the ways that drought increases conflict between neighbors. During drought years, ranchers often needed to irrigate earlier in the season and for many more weeks as compared with wetter years. At the same time, drought conditions limited the amount of water available for irrigation. Thus, during the drought, already existing tensions over water rights and allocations intensified. As one rancher said, ''you're much more aware of your water rights'' (4) during a drought.

b. Responding and adapting

Ranchers responded to drought in a variety of ways. To keep their operations afloat, many resorted to costly measures, such as purchasing hay, leasing additional rangelands, and hauling water for cows to drink. Ranchers were also investing in longer-term changes to improve water systems, diversify their operations, and bring down costs by reducing inputs, changes that they might pursue even in the absence of drought. In most cases, ranchers did not differentiate between short-term coping behaviors and more strategic long-term adaptations. As discussed above, it is difficult to evaluate the long-term efficacy of particular actions for particular ranching families. Thus, we make only provisional judgments regarding whether specific responses constitute short-term coping or build long-term resilience.

Many of the typical responses to drought increased debt, exacerbating the financial pressure described above and resembling coping more than adaptation. For example, during drought years, hay pastures are far less productive and ranchers often purchase hay at a ''ridiculous price'' (29). One rancher stated, ''it's going to probably take five to six years to pay [last year's] hay bill off'' (11). To generate capital to respond to drought or to make up for lost income, some ranchers responded by selling portions of their ranch. According to one rancher, 20%–30% of the ranchers on the Rocky Mountain Front have sold off bits of land in the last 10 years, rather than ''let their cows go'' (17). Drought was also seen as a factor in ranch turnover, as entire ranch properties were being sold in part due to drought. In all three study sites, ranch properties were almost always sold to amenity owners for prices that most ranchers could not afford. The transition of ranch properties to amenity owners was widely perceived to compound drought stress through higher land prices that limited ranchers' ability to purchase additional acres, but some ranchers suggested that the availability of land to lease from nonranching neighbors could help take the pressure off the home ranch during dry years.

To earn additional income, some ranchers diversified their operations. They raised goats, sold horses, bred dogs, and started outfitting businesses. This rancher described how diversification allowed him to weather ongoing drought, saying:

> Just being a little bit versatile. . .we market quite a few different types of livestock. . .selling a few things in the off seasons and having kind of a steady cash flow. And we may last a little longer by doing that. (15)

Ranchers discussed innovation and ''out-of-the-box'' (6) thinking as critical to adaptation, acknowledging that ''we've got to get out of this deal where we're just selling calves to the markets'' (28). To save money, some ranchers intentionally reduced their inputs. They ran fewer cattle, started raising smaller breeds, and calved later to reduce the amount of hay they fed.

Drought was impacting rangelands, making it harder to be a ''good steward'' (the phrase ''steward'' or ''stewardship'' was used by more than half of the interviewees as shorthand for managing ranchlands in ethical and environmentally sustainable ways). In some cases, ranchers were overgrazing in order to sustain their herd size and, as a result, some areas were ''hammered'' (29). One rancher described this situation:

> We normally try to rest 25% of our land, and we just weren't able to do that last year, and that really is hard. Because then it usually takes about five or six years of good management to try to get the grass back to where it was. (11)

Many ranchers acknowledged that years of high precipitation would be required to restore rangelands. In contrast, some ranchers stated that they had not overgrazed, instead reducing their herd size in order to improve range conditions and better weather future drought:

> When you live in a semi-arid region, you have to manage for dry years. . .Take care of your grass. . .I guess you're preparing for a drought if you're preparing for just the next year. . .our grass is kind of our bank account. If we use it all up, there's nothing saved for next year. And if you can leave some of it and let it build up, you can get through those kinds of things. . .We have always strived to take good care of our pastures and we're still in good shape. . .we've cut numbers. (10)

While reducing herd size could build ecological resilience, enabling more sustainable ranching in the face of ongoing drought, some ranchers were concerned about the long-term consequences of this strategy. As one rancher explained, ''If it continues to get dry, we'll continue to sell off cows until we don't have any cows left, I guess'' (16). Another claimed that while he could steward his land better by reducing his stocking rate, then ''I couldn't feed the family'' (19). Many ranchers faced tough trade-offs between ecological resilience (reducing herd size to sustain grasslands) and financial resilience (overgrazing to sustain a reasonable family income).

While not the norm, a handful of ranchers were transforming their operations in ways that clearly anticipated long-term drought. One rancher described his plan to ''helicopter spray portions of the place and then reseed it with a good grass that's going to do well in drier conditions'' (4). Another rancher dug a well far below the water table; rather than stopping at 60 ft, he drilled down to 120 ft, so that ''as the water table shrinks, we've still got plenty of water'' (16). One rancher suggested that resting a third of their pastures would no longer work under changing conditions and they might ''have to bump that up to half'' (7).

Interestingly, ranchers suggested that adaptability and the need to respond to changing conditions characterize the entire enterprise of ranching, from everyday decisions to longer-term planning. They described their work in this way: ''Improvise, adjust. We got to. If we don't, we're sunk,'' (8) ''it's just adapt, adapt,'' (4) and ''it's always changing'' (12). At the same time, most of the ranchers we interviewed were not pursuing dramatic or long-term changes. Ranchers acknowledged that they are typically slow to change and adopt new ideas and practices, saying ''one of the biggest things that a lot of ranchers have [a] problem with [is] adapting'' (6) and that ''most of us can't change in mid-stride'' (30).

Some ranchers talked about the ways in which tradition and cultural norms might limit innovation. As this rancher explained:

> If purple cows were the perfect cow, some people wouldn't have them, because ''I ain't going to run purple cows,'' even if it meant going broke with a black cow. So it's that kind of stuff. . .goes absolutely hand in hand with the drought. (6)

Accordingly, ranchers might hold onto traditional practices that are no longer adapted to current conditions and fail to make necessary changes in the context of drought. In addition to the barriers that some cultural traditions posed, ranchers also focused on the practical risks involved in adopting new practices. As this rancher reported, ''I'm not going to try and guess what's going to happen five years from now and try to run my operation that way because if I make the wrong guess, then I'm in trouble'' (16) (interestingly, this was the rancher who dug the deeper well). Another rancher described the risks associated with change, saying ''any time you do anything new or different, you're going to make mistakes. . .some of those mistakes are so costly that it may just sink your boat'' (17). In some cases, incremental change was seen as more desirable, ''because you can always back out'' (4). There was an interesting tension between the widespread acknowledgment of the importance of being able to adapt to changing conditions

and both the cultural and practical barriers to adopting new practices.

c. Autonomy, collective action, and government programs

In discussing drought, ranchers readily focused on political–economic forces occurring at multiple scales, from the effects of trade policy on the price of beef to debates over country of origin labeling. However, ranchers clearly saw the individual or family as the appropriate or desirable scale for adaptation. While there were some notable exceptions (described below), ranchers did not draw extensively on local social networks or engage in collective action to formulate responses to drought. Most ranchers said that they did not work with other ranchers to address drought because ''they're independent, and they don't want to work together,'' and ''it's all individual. . .we've never really organized'' (13). This rancher went on to describe how rancher independence can inhibit collaboration:

> It's real hard to get grouped together to do much, because we love this lifestyle because we can. . .call our own shots and work when we want. . . But that independence also makes it very difficult to get together and network and do those kinds of things. (13)

Some ranchers saw the lack of communication between ranchers as problematic. As this rancher suggested, ''people don't talk outside the ranches. That's the problem. . .People get in trouble, and you don't know about it'' (4). One rancher suggested that the current level of isolation might be relatively new and explained that neighbors used to help one another more, especially with activities such as haying. In contrast, a few ranchers argued that effective communication between ranchers was actually the norm, claiming that ranchers often talk to each other about things that work and have a good support network, despite not being formally organized. They suggested that drought had made people more aware of what other ranchers were doing to adapt to changing conditions. That said, being independent was widely regarded as a very important part of rancher identity and ranchers tended to see adaptation as an individual endeavor. As one rancher stressed, ''that's one thing about a rancher; he has a real tough time having somebody tell him what to do with his place'' (25).

Political ideology, more specifically antigovernment sentiment, also had an impact on how government programs to address drought were regarded and utilized. Many ranchers did not perceive that there was much available in the way of government programs or support during a drought, despite acknowledging the existence of disaster relief programs (federal disaster relief programs can include emergency loans, grace periods for unpaid insurance premiums, support for moving water to livestock, and access to grazing and haying lands; www.disasterassistance.gov). Every rancher who spoke about the disaster relief program described it as a failure. Ranchers suggested that payments came too late, funds were inadequate, and programs were inefficient. These ranchers described themselves as ''pretty much on their own'' (4) and said that the assistance available was a ''pittance'' (19), ''diddly squat. . .not even a drop in the bucket'' (24), and ''too little too late'' (10). While some argued that the federal government had ''saved'' ranchers, many suggested the government wanted to control individual ranches through aid, saying that ''they want to manage the whole outfit'' (14) and that if ''all the agencies would leave the rancher alone, he'd be so much better off'' (18). However, several ranchers recounted positive experiences with the Natural Resources Conservation Service's Environmental Quality Incentives Program (EQIP), which provides financial and technical support for improvements to water systems.

Some ranchers disputed that drought is a disaster and resisted the notion that the government should be involved. As this rancher stated:

> But that thing right there that says this is a disaster, you're a victim of disaster, therefore we want to help you. That's a good enough idea, but it hasn't been a disaster. It happened to be dry this year. And it's because you're unprepared to deal with it, and you [need to] be prepared and need to be flexible so that you can deal with it. It's not the taxpayer's problem. (6)

Another rancher made a similar argument, suggesting that unpredictable events like hurricanes, fires, or tornados are disasters requiring federal aid, but that drought in drought-prone landscapes presented a different situation:

> When you live in an area that has 13, 14 inches of rainfall, and when it drops down to 7 or 8 over a number of years, I don't know that it's a time that you should be really looking for the government to help you. . .I think people have to help themselves. (10)

Even though many ranchers accepted federal funds for improved water systems, government was broadly viewed as making ranching more difficult and there was little faith in or support for government assistance either to help weather the short-term impacts of drought or to assist in changing operations to adapt to future drought.

While ranchers on the Rocky Mountain Front rarely spoke about collective efforts to address drought, a handful of ranchers from the Blackfoot and Big Hole

Valleys told a different story. Both the Blackfoot and Big Hole Valleys had established local collaboratives with programs focused specifically on in-streamflow and drought management. In the Blackfoot Valley, many ranchers participated in a local, voluntary ''shared sacrifice'' (3, 7) program to leave water in the river for downstream irrigators. In the Big Hole Valley, some of the ranchers worked to ameliorate the impacts of drought on the Arctic grayling, which, if listed under the Endangered Species Act, could result in significant reductions in water available for irrigation. Some ranchers in these two valleys suggested that they benefited from ''working together'' (14) with federal agencies, which provided them access to grant money for improved irrigation systems, riparian restoration, and support for hauling water and digging deeper wells. One Big Hole rancher was surprised by how many ranchers had signed up for the federal program, saying ''I had the opinion that most people were so independent and such rugged individualists in this area that they wouldn't do this sort of thing'' (12). It is important to note that although the Rocky Mountain Front had experienced much worse drought conditions than either the Big Hole or the Blackfoot, ranchers on the Front were less amenable to government programs and less involved in collaborative efforts to address drought. The Rocky Mountain Front is a larger landscape with multiple watersheds, which might make collaboration more challenging.

d. Drought, natural cycles, and climate change

Most ranchers characterized drought as part of a natural cycle, arguing that it was normal for some years to be wetter and some drier. Ranchers suggested that droughts ''would come and go,'' (4) that ''it's all a cycle. . .and we'll have good years along with bad'' (10). As this rancher explained:

> We've noticed in the last few years it seems like it's been pretty dry. But the other day I was up monitoring our forest allotment. . .I sat by a tree and I just decided to count the rings when I was eating lunch. . .and some of them are pretty wide and some of them are small. And so it's interesting over the years, as you look at that, drought is certainly nothing new to the West. (14)

Most ranchers shared the view that drought was simply part of the western landscape and a necessary hardship for ranchers. Drought was not only natural and cyclical, it was unpredictable. As this rancher explained, ''Most ranchers live one day at a time, and you go from there. I mean, for me to predict what's going to happen, I can't tell you what it's going to do tomorrow. So it's pretty hard'' (16). For many of these ranchers, natural variability in precipitation was expected, but conditions would necessarily, eventually return to ''normal'' (23, 12). Ranchers who believed that drought was ''cyclical'' argued that it was not going to ''every year get worse and worse and worse and worse'' (14). At the same time, however, many ranchers argued that current drought conditions were much more severe than in the recent past. The fact that the drought was unprecedented over the last 100 years or so did not necessarily contradict assumptions that it was part of a natural cycle.

Ranchers expressed a range of views about anthropogenic climate change and on whether drought conditions would continue. According to many ranchers, ''it doesn't matter whether it's human-caused'' because ''the effect is the same'' (11). Most ranchers were skeptical, arguing, as detailed above, that climate changes all the time and that the region goes through cycles and periods of drought. The view that drought was a result of natural cycles was often used to contest anthropogenic climate change. Most ranchers suggested that climate science was still uncertain, and some argued that it was ''arrogant'' (27, 28) to think that humans could influence the earth's climate. One rancher conveyed this view with much enthusiasm:

> Now all [these] educated idiots go on this global warming. Good Lord, that'll put a wrinkle in their head. For Christ sakes, it's been going on since Christ was a child. . .they don't have a clue how many ice ages we had. . .It's a cycle. It'll change. . .don't believe in global warming at all. (18)

Interestingly, the handful of ranchers investing in longer-term adaptation were either similarly skeptical of anthropogenic climate change or very uncertain about the causes of drought. One of the ranchers committed to cutting herd size to ensure rangeland health was deeply skeptical, saying ''It's just a cycle. We've been through it. The world's been through it so many times before. . . humans aren't significant enough to change the climate'' (10). The rancher who dug a deeper well was uncertain, saying ''I haven't made a decision as to whether this drought that we're in right now is man caused or if it's just Mother Nature doing her thing again.'' (16) Similarly, both the rancher who suggested needing to rest half of his pastures in the future instead of just a third and the rancher who planned to reseed his ranch with grass species better adapted to drought were undecided regarding the role of humans and natural cycles in local drought.

e. Optimism, agency, and planning

A strong belief that drought was caused by natural cycles led to a sense of optimism for many ranchers. In other words, even in the face of ongoing or worsening

drought conditions, many ranchers held on to the belief that it would rain and that things would improve, calling this ''the old 'it'll get better next year' syndrome'' (28). As this rancher explained:

> You have to be optimistic. I guess you always, even no matter how dry it gets, you kind of seem to know that sooner or later you're going to get rain and things will get better. At least hope so. . .You just hold out and you hope it comes. (15)

Many ranchers continued to ''hope for the best'' (17, 23, 26, 29), expressing optimism that they might be ''on the uphill swing moisture-wise'' (29), that ''it's going to rain next spring,'' (11) and ''all it takes is some rain and some snow'' (28). As this rancher described, ''every time it just gets to the point of being so bleak that you're about ready to cash it in, you get just enough rain to keep your hopes up'' (19). For many ranchers, optimism about future moisture was a coping mechanism justified or framed by the belief in natural cycles.

Despite attempts at optimism, many ranchers expressed a sense of futility, suggesting that they had little control over the situation and very few options. Ranchers said that they had ''very little choice'' (4) and suggested that there was ''no solution'' (24) and ''nothing we can do about it'' (5, 16, 23). They characterized drought as ''something you can't fight'' (16). As this rancher put it, ''why didn't it rain?...I don't know and I don't care-. . .doesn't matter, I can't do anything about it.'' (6) Many ranchers connected their lack of agency explicitly to the view that drought was caused largely by natural cycles, arguing that no one can control the weather and, as a result there was very little they could do to solve the problem. So, while belief in natural cycles resulted in hope for some ranchers, for others it engendered a sense of futility and lack of control.

While most ranchers were not engaged in long-term planning for ongoing drought, many acknowledged the importance of having at least a semblance of a plan and the value of looking ahead and planning for different future scenarios. However, the view that drought is unpredictable and not under the rancher's control meant that most ranchers felt that they could only plan and adapt to a certain extent. In practice, there was a lot of variation in planning. Some ranchers suggested that ''You have to do some real drastic things when you're dealing with drought, you have to plan ahead'' (14) and ''you need to have a drought plan'' (6). The rancher who dug a well 120 ft deep, for example, planned for the worst, despite acknowledging that he could not predict the future and was uncertain about the existence of anthropogenic climate change. Others said, ''I don't have a plan...I don't really have an answer, I just say trying to get by'' (5). In response to a question about planning for drought, this rancher said, ''As far as a long-term plan, I don't have enough grass. . .enough water, I don't know how you plan for that'' (1). The sense of futility and lack of agency colored many responses to questions about planning for future drought. Further, in response to questions about planning, many ranchers argued that they simply lacked the capacity, ''the resources, the money,'' (4) given the financial hardships caused by drought and other stressors.

5. Discussion and conclusions

Similar to previous studies (e.g., McLeman et al. 2008), we found that hardships caused by drought were seen by ranchers as inseparable from a broader set of economic, social, and environmental pressures interacting at multiple scales, forces or barriers that create an ''adaptation envelope'' that shapes future options and trajectories (Wyborn et al. 2015). More specifically, ranchers negotiate a range of cultural, financial, and political barriers as they respond to drought. Cultural barriers include local ranching norms that constrain adaptation options and ideas about rancher independence that limit social networking and collective action. Financial barriers create an overall lack of resources for both short-term coping and long-term change, generated by low beef prices, high input costs, and unmanageable debt. Political barriers include anti-government sentiment that constrains participation in government programs and ideas about anthropogenic climate change that encourage a belief that ''normal'' or wetter conditions will resume. Ranchers readily acknowledge that changing their operations in anticipation of future drought involves risk. The barriers described above, in particular a marked lack of financial resources, may discourage risk taking.

Despite these barriers, ranchers were responding in a variety of ways to drought, pursuing changes consistent with those outlined in the range management and extension literature (e.g., see Hamilton 2003; McDougald et al. 2001). Short-term coping strategies appear to be increasing debt (e.g., through the purchase of expensive hay), decreasing income (e.g., through the reduction of herd size), and otherwise limiting future options (e.g., through overgrazing and selling land). Many ranchers face difficult trade-offs between building ecological resilience by lowering herd sizes and investing in rangeland health, or building financial resilience by maintaining herd sizes and overgrazing to sustain family income. In some cases, ranchers appeared to be making long-term changes by diversifying operations, reducing inputs, and preparing for future drought. However, it is

difficult to determine which responses are effective over the short and long terms, and which reinforce the status quo versus transform ranches and communities into more sustainable and resilient systems.

Amenity migration illuminates the interaction of local and nonlocal forces and the difficulty of determining whether particular changes are coping, adaptive, or transformative. Ranch turnover is influenced by local drought along with numerous nonclimatic stressors. Amenity migration is driven by nonlocal cultural processes, including renewed interest in rurality and economic forces, such as the availability of disposable income for some socioeconomic groups. When ranches sell to wealthy amenity owners, the price of land skyrockets and the remaining ranchers are unable to expand their ranches to adapt to lower rangeland productivity. At the same time, more lands are available for leasing, creating options for ranchers who need access to additional grass during dry years. Thus, under certain conditions amenity migration may create a double exposure that deepens vulnerability by limiting access to land. Under other circumstances, amenity migration may help buffer the impacts of drought on ranchers, decreasing vulnerability and increasing adaptive capacity at the community or landscape scale.

Most ranchers in this study attributed drought to natural cycles and were skeptical that anthropogenic climate change was driving local drought conditions. Similar to previous studies (e.g., Liu et al. 2014; Milne et al. 2008), ranchers saw drought as a local change or stressor rather than part of a global process like climate change. These ranchers adhered to a sort of historic range of variability, implying that local conditions cycle or shift around a historic mean, eventually returning to ''normal.'' Ranchers viewed drought as a risk or threat, but many ranchers envisioned future drought risk as similar to past drought risk. Multiple generations of ranchers and family stories of previous droughts support the belief that conditions will improve, as most ranchers could recall past droughts and the return of wetter years. Local ecological knowledge and family histories are reinforced by beliefs that local changes, such as drought, are driven by natural cycles as opposed to climate change.

But do people need to ''believe'' in anthropogenic climate change to engage in effective adaptation? Adger et al. (2009, p. 339) claim that ''individual adaptation hinges on whether an impact, anticipated or experienced, is perceived as a risk, and whether it should (and could) be acted upon.'' Similarly, Schneider et al. (2000) argue that adaptation decisions depend, in part, on beliefs that the climate is actually changing. While these assertions make sense, this study raises a number of questions about the complex relationship between climate change beliefs and the efficacy of adaptation to specific climate impacts, such as drought, over different temporal and spatial scales. It is unclear whether a belief in anthropogenic climate change actually influences the way ranchers respond to drought. Do ranchers who believe that drought is driven by climate change invest in longer-term adaptations, while ranchers who see drought as part of a natural cycle focus on short-term changes? In this study, only a handful of ranchers were pursuing adaptations that anticipated long-term drought, indicating that climate skepticism, optimism about future conditions, and a limited sense of agency might be reducing investments in long-term adaptation. However, the ranchers who were investing in longer-term adaptations were either deeply skeptical of anthropogenic climate change or very uncertain about the causes of drought. Additionally, if it is difficult to determine which adaptive actions will be effective over the long term, how should we evaluate the relationship between climate change beliefs and long-term adaptation?

At the same time, effective adaptation might require a reasonably accurate understanding of the drivers and nature of change. Ranchers might be more willing to invest in long-term adaptations if they anticipate that future drought will be deeper or more prolonged as compared with past drought, and if they recognize that anthropogenic climate change produces directional changes over large time scales. To the extent that the natural cycles argument fundamentally mischaracterizes the system and the nature of future drought, does a belief that drought is driven by natural cycles somehow constrain adaptation?

The relationship between different perspectives on the causes of drought and ranchers' sense of agency and efficacy is also complicated. For some ranchers, a belief that drought was part of a natural cycle engendered a feeling of hope, because conditions would improve. Other ranchers felt a sense of futility and a lack of control in the face of a cycle they could neither predict nor influence. However, it is unclear whether belief in anthropogenic climate change would be empowering, or whether it would simply reinforce the sense that forces beyond the control of individual ranchers were driving local drought conditions. This is a particularly important question because, as Hines et al. (1987) point out, if individuals do not perceive that they have the power to change and instead exhibit low self-efficacy, they may be unable to act upon threats. Thus, a deep sense of a lack of agency in combination with a lack of financial resources may help explain why so few ranchers have been able to pursue long-term adaptations.

A focus on household adaptation also brings scalar processes into focus. Most ranchers in this study characterized adaptation as an individual endeavor, leaving little room for collective action or government involvement. Consistent with the antigovernment sentiment widespread in the rural West, ranchers were typically critical of government programs and resisted the idea that government could play a beneficial role in mitigating impacts and facilitating adaptation, aligning their view of adaptation with their political ideologies and identities. But, given such limited financial resources, can ranchers successfully adapt as individuals or families? Some research suggests that the household may be more resilient and adaptive over the long term as compared with communities or nation states (Netting 1993). At the same time, the adaptation options available to ranching households are enabled and constrained by forces beyond their control, including national agricultural and climate change policies, global commodity markets and trade agreements, and state-level conservation programs. Joyce et al. (2013) argue that increased coordination between ranchers and federal agencies could reduce the impacts of drought and increase resilience. Access to nonlocal knowledge, networks, and resources is believed to increase adaptive capacity, but political ideologies that are antigovernment and individualistic may limit ranchers' willingness to draw on such resources.

Further, to the extent that ranchers' self-described independence limits opportunities for local collective action, neighbors may not exchange ideas or pool resources in ways that increase adaptive capacity. Social networks are often cited as a source of adaptive capacity (e.g., see Oliver-Smith 1996; Scheffer et al. 2002; Adger 2003). However, to the extent that drought increases community tensions and conflict between neighbors, social networks may be strained during prolonged drought, limiting options for collective action. If ranchers find a way to work together, they could become a powerful political force advocating for climate change mitigation and adaptation policies and for programs that benefit agricultural producers in meaningful ways (e.g., through improved insurance programs, new irrigation technologies, or funding to transition operations). However, this sort of collective action requires that ranchers envision that drought impacts them as a group, and that responses be scaled up beyond individual ranches.

Since many ranchers do not believe in anthropogenic climate change and are thus unlikely to support climate policy, strategies to mitigate the impacts of drought could instead target the nonclimate-related factors that make ranchers vulnerable to drought, a strategy recommended by Lemos (2007). In the case of ranching in the western United States, market volatility, low profit margins, invasive plants, the cost of inputs, and debt cycles create the kinds of double exposures that amplify risks and deepen vulnerability to climate change. Thus, some approaches to addressing future drought risk could include increasing irrigation efficiency, decreasing debt, lowering the cost of inputs, diversifying operations, and adopting more sustainable grazing practices. These are the types of "no regrets" strategies that yield benefits even in the absence of climate change, function well under a range of possible future conditions, and can be easily adjusted or abandoned in the short term (Hallegatte 2009; Lempert et al. 2006). However, many of these strategies would require government involvement and collective action beyond individual ranches, which could conflict with the independent nature of ranchers. Nascent support for government programs like EQIP and collaborative drought planning in the Big Hole and Blackfoot Valleys suggests a need for future research on how the nature of government programs and the experience of collaboration might influence partnerships across scales and sectors.

A number of scholars advocate for additional research focused on the processes of individual and autonomous local-level adaptation (e.g., Head et al. 2011; Miller et al. 2013). Such studies provide important insights into how adaptation factors in real places negotiate the complex mix of actors that influence adaptation decisions. Future research in this arena should focus on scalar interactions, in particular how local-level adaptation is enabled and constrained by forces interacting at multiple scales and which leverage points permit fruitful interventions to spur adaptation. Further, given widespread skepticism about anthropogenic climate change in the United States, additional research into the influence of climate change beliefs on the effectiveness of individual-scale adaptation is critical.

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