



Using scale and human agency to frame ranchers' discussions about socio-ecological change and resilience

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ABSTRACT

Resilience is becoming the dominant discourse in research and policy on climate change as well as wider social-ecological change. Resources and assets alone are often not enough to support resilience, especially in the context of multi-scalar change. Human agency, that is the ability to act and make choices that produce desirable outcomes, is critical to responding and thriving in the face of social-ecological change, however agency remains underexplored in the social-ecological change and resilience literature. We use a local knowledge approach to understand the role of human agency in shaping resilience to complex multi-scalar social-ecological changes. This research draws on focus groups and interviews with ranchers and land managers in seven different focal landscapes across the American West to understand how ranchers articulate social-ecological change in western rangelands, how they describe their own agency in responding to such changes, and how local knowledge of agency and social-ecological change can strengthen conceptions of resilience. Ranchers expressed more agency in addressing observed ecological and climatic changes but less agency in navigating multi-scalar sociological, political and land use changes as these processes unfold at scales far beyond the ranch. Several ranchers also provided examples where scale jumping or increasing community human agency created pathways for resilience to multi-scalar processes. This analysis has two main implications for resilience interventions. First, resilience is a complex negotiation of interconnected and multi-scalar processes and climate resilience cannot be separated from other ongoing economic and social processes. Second, human agency is a critical component of resilience that allows for negotiations of multi-scalar social-ecological changes.

1. Introduction

Resilience is becoming the leading framework in research and public policy for understanding how people and social-ecological systems can survive, transform, and thrive in the face of present and future climate and social-ecological change. The popularity of resilience has also been met with a growing debate over the meaning of resilience and its ability to map out equitable and socially just responses to global environmental change (Cote and Nightingale, 2012; Moser et al., 2019). Cognizant of these weaknesses, many scholars still argue that resilience can be productive for integrating diverse perspectives on how people experience and respond to social-ecological change. Resilience can be understood as a middle-ground or a boundary object between social and

environmental sciences as well as science and policy (Brand and Jax, 2007; Cote and Nightingale, 2012). It can be useful to use resilience as an avenue for interdisciplinary dialogues and knowledge creation rather than analyzing resilience as a framework or an imposed technical category (Walsh-Dilley and Wolford, 2015). This allows for a proliferation of multiple ways of pursuing resilience and being resilient according to the values and visions of people living through social-ecological change (Goldman et al., 2018; Simon and Randalls, 2016; Walsh-Dilley and Wolford, 2015). One of the underexplored dimensions of resilience is human agency, that is the ability to act and make choices that produce desirable outcomes (Brown and Westaway, 2011). Resources and assets alone do not ensure resilience (Eakin, 2014); human agency has a critical role in shaping adaptation choices

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and actions. The role of human agency in resilience also needs to consider the multi-scalar nature of social-ecological change. Efforts to increase resilience at a local level can overlook the ways multi-scalar social-ecological processes can both serve as a limitation or an opportunity to bolster resilience (Nightingale, 2015). In our research on social-ecological resilience of ranchers in the American West we find that connecting human agency and scale opens up new ways to explore resilience.

Ranching in the American West is a practice under considerable transformation. Ranchers include individual, family and business communities that manage grazing livestock across the grasslands, shrubland, savannas, and prairies that comprise rangelands (Sayre et al., 2013). Climate and land use change, including urban expansion, and expanding recreation in public lands are altering rangeland ecologies and spaces (Briske et al., 2015; Brunson and Huntsinger, 2008; Martin et al., 2019; Swette and Lambin, 2021). Additionally, ranching economics are being reconfigured by price volatility and consolidations in meat industries (Specht, 2019). Ranchers possess intimate knowledge of rangeland social-ecological systems and actively respond to and create change (Espeland et al., 2020; Knapp et al., 2020; Marshall and Smajgl, 2013; Wilmer and Fernández-Giménez, 2016). For example, they move livestock in response to changing forage and water availability; develop water infrastructure; and utilize grazing strategies that shape vegetation, wildlife habitat, and livestock production outcomes (Brugger and Crimmins, 2013). They do so on public and private lands under a complex set of economic conditions, policies, and cultural practices. The position of ranchers gives them a particular form of situated knowledge about rangeland system transformation, as well as the opportunities and barriers to building resilient livelihoods, communities, and identities. And while researchers are increasingly paying attention to the local knowledge ranchers possess about weather, plant community and livestock interactions in developing solutions to rangeland management questions (Briske et al., 2011), there is less recognition of ranchers' local knowledge of how climate and ecological change are in relationship with sociological, political, and land use change.

In this paper we investigate rangeland social-ecological resilience from the point of view of cattle ranchers. We center the local knowledge of ranchers from communities across the US West related to their experiences with multi-scalar social-ecological processes and their own capacity to maintain ranching livelihoods and identities. Local knowledge encompasses the knowledge developed by a group of people over time within a unique environmental and sociocultural context (Naess, 2013). Local knowledge is valuable for exploring adaptation and resilience to social-ecological change, especially in the context of drought and climate, as local knowledge amalgamates climate, human, and environmental processes together across specific constructions of space and time (Brace and Geoghegan, 2010; Klenk et al., 2017; Clifford and Travis, 2018). Using a qualitative approach (Sayre, 2004) to examine seven locations across the West, we explore two central questions:

- 1) How do ranchers articulate social-ecological change in western rangelands?
- 2) How do ranchers describe their human agency in responding to multi-scalar changes?

2. Agency and scale in resilience

The literatures on both scale and human agency in social-ecological systems can provide more diverse and socially informed approaches to resilience. Here we present an analysis of how concepts of scale and human agency are used in social-ecological change and how they are used to critique and inform resilience frameworks. We also discuss how resilience discourses are used in rangeland literature and the need for more local knowledge approaches to resilience that integrate social and ecological processes across scales.

2.1. Resilience and scale

Scale can be understood to describe size, level, or relation and is treated differently in ecological and social sciences, leading to different approaches in observing scale and understanding it as something that exists or something that is socially constructed (Ahlborg and Nightingale, 2012; Sayre, 2015). Social, political, economic, and ecological processes are interrelated, but also operate at different scales or levels and are often mismatched (Sayre, 2015). In the social-ecological literature, scalar mismatches occur when the scale of environmental change and the social management are mismatched to the point that functions of the social ecological system are disturbed or lost (Cumming et al., 2006). Considering the multiple geographic and temporal scales affecting social-ecological systems, which scales and levels are identified and prioritized in research and natural resource management are political choices (Ahlborg and Nightingale, 2012). Ahlborg and Nightingale (2012) developed the concept of knowledge scales to highlight that knowledge of individuals and communities have particular spatial and temporal dimensions. They also point out that while these scales of knowledge embody particular scale-dependent interests, knowledge of the world around them is fundamentally multi-scalar.

Besides having multi-scalar knowledge, local actors are also not constrained to operate at a particular level. Social actors are often able to jump scales, that is, alter “the level at which some process occurs (be it decision-making, enforcement, or the production or distribution of some valued good) in order to secure a desired outcome” (Sayre, 2005, p. 285). Grassroots organizing and environmental activists have been successful in challenging existing power relations by creating new networks, alliances, and jumping to higher national or international scales of governance (Green, 2016; Hoogesteger and Verzijl, 2015; Perreault, 2003).

Resilience discourses sometimes overlook or simplify how threats and adaptive capacity act at multiple scales. This can be traced to the concept's roots in ecology and the resultant emphasis on biological or evolutionary adaptation, a framing that fails to recognize that people have the capacity to transfer the effects of ecological change across both geographic and temporal scales (Davidson, 2010). MacKinnon and Derickson (2013) argue that resilience discourses frequently place the onus of resilience on individuals and communities while ignoring wider global processes. This obscures sources of both socioecological change and adaptation and avoids examining at what scale change is occurring and at what scale might interventions increase resilience (Ingalls and Stedman, 2016; MacKinnon and Derickson, 2013). For example, Rathi's (2020) research on agricultural resilience in India demonstrates that sources of resilience for farmers are not limited to agricultural communities with many rural families relying on urban areas as important sources of resilience.

Resilience can be understood as a contested process where power and values of diverse stakeholders create trade-offs across both space and time (Chelleri et al., 2015; Meerow et al., 2016). Ashkenazy et al. (2018) trace the impacts of resilience interventions in fourteen farming and rural communities and highlight the trade-offs in resilience moving across temporal and spatial scales from farming households to urban regions. Thus, evaluating whether a specific adaptation increases resilience can depend on the scale of analysis. Finally, Nightingale (2015) points out that to promote a resilient world “we need to be thinking and acting across scales, recognizing how we are connected rather than separated, and placing greater demands on both the state and private sector to redistribute resources” (p 206).

2.2. Resilience and human agency

Human agency is described as the ability to make choices and act with the belief that these choices will produce desired outcomes (Brown and Westaway, 2011; McLaughlin and Dietz, 2008). Agency highlights the autonomy, purpose, and creativity of individuals (Lister, 2004). It

not only captures the choices people make, but also their hopes, values, and expectations, and intentions behind these choices. Bandura (2000) identifies the perceived efficacy of choices as a key aspect of human agency, for “unless people believe that they can produce desired effects and forestall undesired ones by their actions, they have little incentive to act” (p 75). These aspects of human agency explain why resources and capacity alone are not enough for people to make beneficial choices in the face of social-ecological shocks and crises (Benessaiah and Eakin, 2021; Brown and Westaway, 2011; Eakin, 2014).

Theories on agency and social ecological change are frequently framed by Lister’s (2004) work on agency and poverty (Brown and Westaway, 2011; Coulthard, 2012). Lister identifies different forms of agency and distinguishes between *personal agency*, which focuses on decisions made by an individual, and *political and citizenship agency* (or collective agency) that applies to collective decisions made by groups of people. Different dimensions of agency are inter-related and self-reinforcing and shape whether adaptation choices focus on coping, adapting, or transforming in the face of social-ecological change (Brown and Westaway, 2011). In building the resilience of livelihoods and communities, both individual and collective agency are important for adaptation and transformation (Chen et al., 2020; Pelling and Manuel-Navarrete, 2011). In their research on agency and transformation in response to crisis, Benessaiah and Eakin (2021) demonstrate that different forms of agency build upon each other to bring about collective change.

Human agency informs ideas of resilience by exploring how individuals and groups navigate adaptive decisions (Béné et al., 2011; Cote and Nightingale, 2012; Davidson, 2010). Conceptions of resilience based on systems ecology are critiqued for overlooking human agency and people’s ability to anticipate and plan for change, postpone impacts of change across space and time, use imagination and creativity to foster new adaptations, create societal inequalities due to unequal distribution of human agency, and increase societal well-being through collective agency and action (Davidson, 2010). Focusing on human agency provides insight into how people may or may not be resilient to social-environmental change.

2.3. Resilience and rangelands

Rangelands are globally significant social-ecological systems in terms of their contributions to social, cultural and economic systems, biodiversity, and food production (Millennium Ecosystem Assessment, 2005; Reid et al., 2014). Rangelands form a fundamental natural resource base for ranching in the western US and also cover vast areas of public lands managed for multiple use. In conventional range science discourse, *rangeland resilience* has traditionally implied continuity of the status quo, rangeland-based family ranch operation, producing calves and yearlings for feeding and slaughter, and the associated rangeland, pasture and farmed agro-ecosystems (Brunson and Huntsinger, 2008). This settler colonial system of production and management is based on an operational model that proliferated throughout western North America following European settlement as the beef industry took shape (Bennett, 1969; Brunson and Huntsinger, 2008; Charnley et al., 2014; Specht, 2019). Broader conceptualization of working rangeland resilience now recognize traditional family ranches are just one of many alternative states in these systems. Others include those where private lands are taken out of production agriculture and/or grazing is excluded from public lands, or those where land and decision making rights are taken back by Indigenous peoples. In considering rangeland resilience as an ecological (Stringham et al., 2003) or social-ecological question (Chen et al., 2018; Hruska et al., 2017; Reid et al., 2014), rangeland scholarship has generally operated under the hypothesis that the development of management frameworks and ranch-scale systems research will enhance ecological sustainability, and that ecological sustainability is directly connected to ranch profitability, community well-being, and persistence or resilience of ranching social-ecological

systems (Brunson and Huntsinger, 2008).

By and large, scholarship on ranching resilience has focused at the ranch scale. For example, climate-adaptation research has identified strategies for ranch risk mitigation and adaptation (Derner et al., 2018; Espeland et al., 2020). Espeland et al. (2020) reviewed research on rancher and pastoralists’ climate risk reduction strategies, including immediate hazards (fire and drought) and “slower paced” hazards (land degradation and economic insecurity). They characterized potential adaptations as profit and return options, land use, and herd management strategies, and noted the need for dynamic management of forage supply and demand, while noting the value of economic diversification and social networks.

Thus, the rangeland resilience literature emphasizes ranch or pasture scale decision-making (e.g., concern about climate adaptive capacity, Espeland et al., 2020) to maintain a particular status quo. This perspective isolates the scale of decision-making from larger structural or global drivers of social and economic change (Specht, 2019). Conceptual recognition of the relationship between broader scales of change and rangeland resilience beyond the farm gate may help resolve the mismatch in scale between rangeland social and ecological theory, and create new possibilities for a reimagined, resilient future in these systems. Efforts to historicize and contextualize helps us better see larger scale drivers of change in these systems and start to reimagine other futures for rangeland landscapes and peoples (Hruska, 2020; Sayre, 2017, 2018; Sluyter, 2012).

Recognizing the need for more approaches to resilience that are grounded within experiences of communities experiencing social-ecological change (Goldman et al., 2018), we engage with ranchers’ view of the concept as a way to contextualize, complicate, and ground social-ecological threats and adaptations through local knowledge and experience. Doing so provides insights into changing rangeland social-ecological dynamics and scales (Sayre, 2004) because ranchers and pastoralists are experts that understand the cumulative impacts of multi-scalar ecological and social change on rangelands (Sherren and Darnhofer, 2018; Wilmer et al., 2016; Yeh et al., 2017). Past research on social aspects of rancher resilience also demonstrates the value of gathering ranchers’ perspectives on gendered, cultural and personal growth aspects of resilience (Wilmer et al., 2016; Wilmer and Sturrock, 2020). By gathering and presenting our assessment of ranchers’ and land managers’ knowledge of resilience, we seek to offer a novel and grounded perspective of scale and human agency that connects social and climatic and ecological drivers and adaptations.

3. Methods and analysis

We collaborated with regional Cooperative Extension, university, and federal agency researchers working as part of a larger USDA NIFA funded project (grant number 2018-68002-27923) to select seven ranching community cases (see Fig. 1 - map), which the team came to refer to as “focal landscapes.” The selected landscapes represent a gradient of rangeland ecological zones in semi-arid and arid climates. They also represent a variety of land tenure patterns and socioeconomic contexts for ranches and rural communities.

The project was conducted collaboratively by an interdisciplinary team with backgrounds in geography, applied climatology, Extension, and rangeland ecology. An important component of the project’s design was recruitment of a “local convener” in each of the focal landscapes, often a local county extension agent. These collaborators provided local connections, context, and social and cultural insights. We worked with these local conveners to arrange focus group discussions with 4–12 ranchers with 20 or more years of experience in ranching in each focal landscape. In Colorado the local convener was also a researcher (Wilmer). Conveners also helped recruit 1–2 local public rangeland managers from state or federal land management agencies for separate interviews, except in Nebraska, a state where ranching is predominantly done on private lands. In total, 51 ranchers and 12 public rangeland

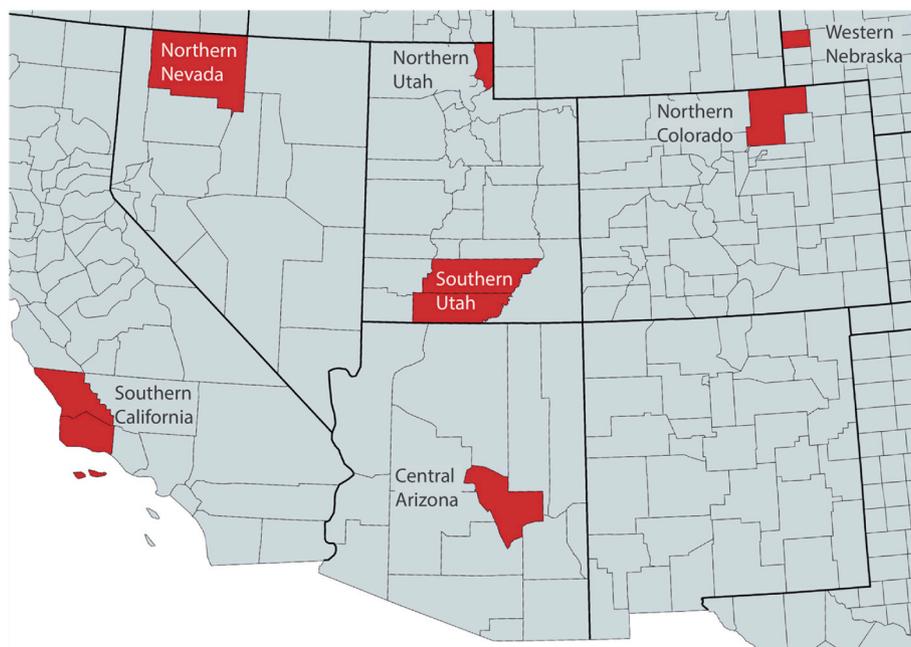


Fig. 1. Map of focal landscapes.

managers participated in 10 focus groups and 9 interviews (see Table 1).

In teams of two, we conducted in-person focus groups and interviews in 2019. After obtaining informed consent, we audio recorded the semi-structured focus group discussions, each of which took approximately 2 h. Questions covered threats to ranching, corresponding opportunities and adaptations, and changes in threats over the past 20 years (See APPENDIX for the focus group protocol). We asked ranchers to walk us through ranching decisions over a typical production year, and to describe an ideal weather year. In separate meetings we interviewed public land managers from each site (except Nebraska) with a parallel interview protocol.

All audio files were transcribed and imported into a qualitative data analysis software. We used a codebook organized to identify threats and adaptations in a) climatic and ecological and b) social realms. Three of the authors initially coded 3 common transcripts to refine the codebook and ensure intercoder reliability. After coding was completed, we summarized focal landscape cases, organizing each code in a table, and described the qualitatively distinct aspects of the threats and adaptations in a narrative format. Throughout the coding and analysis process the entire author team contributed feedback into the developed narratives. We took steps to bolster the trustworthiness of the findings by following a structured process of thematic analysis (Nowell et al., 2017) with methods following Lincoln and Guba (1985). To further ensure our findings reflect what we gathered from our conversations, we made several efforts to re-engage with project participants. First, project participants were invited to a digital outreach workshop held in 2020 (Dinan et al., 2021), where our preliminary results were presented. Next, in an effort to develop a project output that was accessible to a

Table 1
Participant distribution.

Study Site	Ranchers	Public Land Managers
Southern Utah	9	4
Southern California	9	2
Northern Utah	4	3
Northern Nevada	9	1
Central Arizona	5	1
Northeastern Colorado	9	1
Western Nebraska	6	N/A
Total	51	12

wider audience, we produced a web-based StoryMap, the contents of which were presented to participants from each of the focus groups for feedback and input (Walsh et al., 2022).

4. Results: Rancher’s descriptions of social-ecological change

Our analysis yielded four dimensions that are affecting the future viability of ranching: changing ecological conditions, economic conditions, ranching communities, and rangeland users and uses. These dimensions of change reflect ranchers’ knowledge and experiences of how rangeland social-ecological systems are changing as well as their descriptions of their ability and agency to respond, adapt, and transform in response to the changes.

4.1. Changing ecological conditions

The focus groups and interviews provided rich narratives about the risks of dynamic ecological and weather conditions. This variability is a defining feature of rangeland-based livestock systems in the American West, and is only intensifying with changing climatic and land use patterns. These dynamics included wildfire, droughts, and the cascading effects of invasive plant species, which bring complex financial, social, and emotional challenges for ranchers. In California, one rancher described the impact of the 2012–2016 drought: “Obviously, the weather is the biggest portion just because it dictates how many animals, you’re able to run year to year, and then that gets your profitability from year to year” (California Rancher 03). Land managers and ranchers also identified invasive species and altered fire cycles as a growing threat to the future of ranching. Invasive plants such as cheatgrass are transforming forage quality for cattle and also increasing the frequency of fires across parts of the sagebrush biome (Reeves et al., 2018).

Study participants expressed a relatively high level of capacity to adapt to ecological and weather dynamics. This included conservative stocking (“understocking” or “stocking for a drought year”). A California producer explained, “When I was younger, I was bolder or dumber, I guess. But my stocking rate, it was just what it should not have been. So, I’ve adapted over time to really being conservative as far as my resources that are available to me” (California Rancher 05). Ranchers also discussed moving cattle to access variable forage, or storing or purchasing additional feed.

Some ranchers described using market-based or federal program-based risk reduction strategies such as Pasture, Rangeland, Forage (PRF) insurance, a federally subsidized policy purchased through private insurance companies and commonly called “drought insurance.” One long term drought adaptation strategy also discussed was improving the genetics of cattle through artificial insemination to breed more feed-efficient cattle. While some ranchers expressed desire to focus on drought-adapted breeds, they pointed out their meat was difficult to sell.

Producers expressed frustration with public land management policies and procedures that hinder adaptation to changing ecological conditions. For example, in Nevada, where access to water rather than land has long defined land tenure arrangements (Carr Childers, 2015), ranchers discussed increased “environmental litigation” and bureaucratic red tape limiting the installation of water infrastructure. A Nevada rancher explained that “*We’re almost all well water down in our allotments. Very few springs and creeks. And the state of Nevada fights with BLM [Bureau of Land Management] over water rights and we’re in the middle. And it is really hard to drill. It’s expensive to drill a well anyway but the red tape you have to go through to get permission to drill a well from the BLM and then through the state also. It takes a long time*” (Nevada Rancher 04). The procedures for approving infrastructure development can take years and is limited by agency staff turnover and lack of trust. However, some communities had seen collaborative efforts to overcome these barriers. A Central Arizona rancher described the benefits of a public agency collaboration in installing a solar water pump: “*Who would’ve thought I’d put a solar pump on a windmill? It’s been there since late 1800’s. But that’s pretty cool because when I run out of water, I’ve got feed and now I’ve got permanent water ... I’ve got more deer, I’ve got more dove, I’ve got more pigs, I’ve got more wildlife than I had before directly a result of somebody willing to help me, help the land*” (Arizona Rancher 03).

4.2. Changing economic conditions

Economic threats identified by the ranchers included the consolidation and volatility of global markets, the rising costs of ranching inputs, and the increasing difficulty to earn enough income through ranching.

Ranchers emphasized the global nature of beef markets, with beef prices influenced by supply and demand for beef, international commodity trading, investments, and futures. A California rancher explained, “*We are constantly questioning ourselves about what our knowledge is. Before we thought this is what changes the market: supply and demand. You know, that used to be that. And it’s not. It’s the futures and stuff*” (California Rancher 08). Across our study sites, ranchers described the difficulties of adapting to an increasingly complex economic landscape of international markets and investments.

Ranchers also noted the ongoing changes and consolidation in beef supply chains. For example, the consolidation of local markets and the packing industry was described as driving up cattle transportation costs. A California rancher said, “*a lot of the infrastructure is moving out of town. You have to travel further for them - sales barns, equipment ...*” (California Rancher 09). A Nebraska rancher pointed out that the consolidation of packing houses has a disproportionate effect on cow-calf and yearling ranchers, “*It seems like somebody sneezes at the packing level and it kills everybody on down the line. You know, like a fire or whatever*” (Nebraska Rancher 05). The ongoing changes to supply chains contributed to concerns over decreasing options in how cattle are transported and sold.

Some ranchers had adapted to these changes by operating in specialty or niche markets (raising high grade, organic, or grass-fed beef), downscaling operations, and diversifying their income. In Southern Utah one rancher discussed the amount of work that goes into dealing with specialty markets like organic and grass-fed beef, “*Niche markets are a viable theme. You just have to market the market, the niche market, really wisely*” (Southern Utah Rancher 05). The importance of off-ranch or diversified income was a common theme across all our focal landscapes. A rancher in Southern Utah explained that with few exceptions, “*every*

person that runs in this valley is either retired from a job or still working. They have had to go off farm to survive” (Southern Utah Rancher 03). In Northern Utah and Colorado, energy development provided significant economic support for ranchers. A rancher in Northern Utah said that oil leases allowed ranchers to invest in their ranches and support their households, and that “*This valley would be pretty bad off if it hadn’t been for oil money*” (Northern Utah Rancher 03). Though some of the economic adaptations were effective, the stress and tremendous effort required to make ranching profitable was a common discussion point. A Utah rancher explained “*I played with everything to try to get my cattle to where I think it will work, and it’s a challenge ... Is the juice worth the squeeze? All the effort you go into it, do you see the return?*” (Northern Utah Rancher 01).

4.3. Changing ranching communities

The third dimension of change is related to the social transformations within ranching communities, including ranch and rangeland consolidation, challenges to entering agriculture as a young person, and a decrease in young people who see ranching as a viable livelihood. Fewer cattle operations and an aging population drives changes in the populations, economic opportunities and cultures of rural communities interdependent with ranch operations. These challenges were a prominent concern across our focal landscapes. An aging ranching population prompted discussion about who was interested in keeping operations active, how they might do that, and the challenges they faced.

Multi-generational livestock producers we spoke to valued the history of the operations in their family, and wished for their family’s relationship with the land to continue. A fourth-generation rancher in Nebraska said, “*It seems to be kind of a cool thing to preserve, and you would like to see that continue through your kids, and grandkids, and stuff*” (Nebraska Rancher 04). However, succession was frequently brought up as a serious threat to the vision of continued future ranching generations. Several ranchers explained that their children were not interested in living far away from urban amenities, working without time to enjoy family and recreation, or could not afford to get into ranching. A land manager in California identified succession as one of the biggest threats to ranching, “*I don’t know what’s going to happen to some of our places that got the 70, 80-year-old permittee that doesn’t have interested children. Will it get sold to developers, wine industry?*” (California Public Land Manager 02). Many ranchers commented that their children saw ranching as a stressful lifestyle that demands hard physical work for little economic gain. In some locations, especially Coastal California, rising land values further complicated succession plans. As a California rancher explained, “*I see a real problem with keeping these ranches intact generationally. You’ve got a bunch of kids, you’ve got all of a sudden a bunch of owners and they’re urban people and they see a big investment in that real estate and they don’t see much of an investment coming back from the sale of cattle*” (California Rancher 01).

In our focus group, the challenges of succession and demographic change within ranching communities prompted a range of responses. Some people acknowledged that their children would not take over the ranch, and that their land would eventually be subdivided and sold. In Arizona participants described several ranches where operations had ceased without identified successors. On the other hand, several people identified viable pathways to support future generations of ranchers, and the communities upon which ranchers depend. In Nebraska, the need to make ranching more appealing for the next generation was raised by one rancher: “*I’ve got two kids. I want them both to have something to stick around for. I think that’s one thing we’ve done a poor job [with] in rural America, is trying to promote our kids to stay. I was always told, ‘Get out of here, and go do something else.’*” (Nebraska Rancher 04). In California, ranchers also spoke of creating conservation easements as way to ensure the long-term survival of ranching in the region. Contemplating the future, one rancher felt relieved as “*the ranch is in conservation easement, so I feel pretty good. I’ll live on it, die on it, and then it’s up to my*

kids. And if they don't, somebody else will live and die on it" (California Rancher 04).

4.4. Changing rangelands users and uses

The fourth dimension of change we identified relates to changing land use, including who owns, accesses, and sets goals and policies for rangelands. Both public and private-lands based ranchers discussed impacts on their operations from dynamic public uses of rangelands, especially recreation and hunting, changes in public environmental values and policy, and the challenges of maintaining or growing access to ranges under growing demand for other land uses.

A common challenge identified by ranchers with public lands grazing permits was the increase and qualitative change in recreational and hunting uses of public lands. A Northern Utah land manager explained, "*The weeds that they [recreationalists or hunters] bring, or the running their cows around that they do, the ability to get to the most remote spot to go shooting and blast a bunch of stuff and leave all the trash behind ... Anyway, the recreation has made a big difference to now compared to 20 years ago*" (Northern Utah Land Manager 01). Ranchers who operate on public lands noted that increasing numbers of hikers, hunters, and off-road vehicle drivers lead to more public interactions and frustrations from destruction of fences, intruders driving cattle away from water, and hunting and target shooting around cattle.

In addition to changes in direct rangeland uses, changing societal perceptions of ranchers and grazing effects on rangeland ecosystems emerged in several conversations. In a few discussions this was described as more public "eyes" on ranching. A land manager in Colorado explained,

Even in the last five years, our office has received a lot more just general inquires, even in the form of official inquiries through the FOIA [Freedom of Information Act] process, of how are you grazing, when are you grazing, where are you grazing? What's happening with the birds? Why do we have stock tanks? Why can't we target shoot everywhere? Just an increased interest in how it's used. Not necessarily in a negative light, but I think, in the future, moving forward, there's going to be more people that are looking at how ranching is conducted out there (Colorado Public Land Manager 01).

In general, the ranchers we spoke with saw shifting perceptions of environment and public lands. The difficulties with increased litigation between environmental groups, government agencies, and ranchers regarding grazing, as well as interactions with wild horses and predators was a common theme. A rancher in Nevada explained, "*The cost of threat of litigation by anti-grazing groups now is a real risk to us and the agencies as well. The agencies are scared to make a decision that is going to end up in court. So, they just don't make any decisions, it's the safest bet*" (Nevada Rancher 08).

Ranchers in our focus groups also described how changing ownership and uses for ranchlands are reshaping possibilities across the region. Ranchers in both Southern California and Southern Utah linked the influx of new industries and urban development with rising land values that price out small cattle operations. This has impacted land values and the availability of services for the cattle business such as sale yards. A California rancher explained, "*the sales yard closed down because of the influx of the grapes coming in - less cattle, less reason to have it*" (California Rancher 08). The consolidation of smaller ranches into larger, more commercialized operations, or the sale of ranches to amenity or hobby ranchers continues to reshape existing ranchers' opportunities for growth, profitability, and flexibility across the region.

Many of those we spoke with found it difficult to identify successful adaptations to shifting land use and public perceptions. Several ranchers pointed out that education was needed to change perceptions of the environmental impacts of cattle grazing and the role of ranching in the food system. A Northern Utah rancher explains, "*I think that's one of the things that is a big challenge to us, is to educate people in what we do and why*

we're doing it" (Northern Utah Rancher 01). While the notion of educating the public was raised several times, there was very little discussion about how this might be achieved. In one case, a California producer described hosting college students on his ranch. Generally, however, study participants had a difficult time identifying any strategies for addressing the challenges and conflicts associated with competing land uses.

5. Discussion

The four dimensions of change reflect findings that are well documented in the rangeland literature. Examples include research documenting drought impacts and management (e.g. Macon et al., 2016; Roche, 2016; Wilmer et al., 2016; WoodmanseeMacon et al., 2021), impacts of rising land prices for future ranching generations (Haggerty et al., 2018), and cultural clashes from changing cultural values towards range landscapes (Huntsinger and Hopkinson, 1996). Surveys of ranchers in California also indicate that ranchers are often more concerned with social and economic changes over ecological changes (Roche et al., 2015). In our analysis, we bring together these descriptions of change and adaptation to foreground rancher's knowledge of their own resilience to social-ecological changes across rangelands. This depiction of resilience centers on interviews with largely white male ranchers and does not include the knowledge of other rangeland stakeholders such as Indigenous communities, Hispanic ranchers, and ranch labor (Bruno et al., 2019; Brunson et al., 2021), therefore presenting a picture of resilience for a specific subset of the livestock producing community within a larger rangeland social-ecological system that is composed of many different communities.

The literatures on scale and human agency provide important critiques of resilience as a framing for how people can survive and thrive in face of social-ecological change. Resilience discourses can flatten scale and overlook the ways global multi-scalar processes can constrain or foster local adaptation and resilience (Nightingale, 2015). Resilience discourses can also discount the ways in which human agency at both individual and collective levels can guide adaptation decisions as well as transform systems (Brown and Westaway, 2011; Davidson, 2010). In using a local knowledge approach to resilience, based on the knowledge and experience of ranchers navigating multi-scalar social-ecological change, we found that connecting human agency with scale opens up new ways to consider resilience. How ranchers articulate their own human agency amongst these inter-related and multi-scalar processes of change illustrates that there are multiple challenges and pathways to being resilient.

In centering ranchers' knowledge and experiences with ongoing ecological and social changes affecting ranching, we identified what resilience might mean for ranchers and what they are being resilient to. The four dimensions of change we identified demonstrate rangelands as a social-ecological system that is undergoing complex and interrelated social and ecological transformations. These four dimensions divide and categorize these changes for analysis, however the complexity of the ranch- and community-level view of resilience frequently arose from intersections between the four dimensions of change. For example, ranchers in our interviews pointed out that economic considerations foreclose what may appear to be obvious responses to a biophysical threat like drought. Installing a robust drinking system for cattle can enhance cattle access to forage and water in drought, but the upfront bureaucratic challenges and costs can be prohibitive. Similarly, more widespread adoption of drought-adapted cattle breeds would appear to be a sensible adaptation, but that strategy is often rejected because those breeds do not meet the market demand for conventional breeds.

We also found that changes in ranching communities—like the retention of young people in ranching—ripples through the economic, land use, and ecological dimensions we identified. The phenomenon of fewer young people staying in these communities and going into ranching creates succession challenges, which can contribute to ranch

consolidation, development, and shifts in public grazing (Brunson and Huntsinger, 2008). The dimensions of change we identified are useful for parsing the various pressures on and opportunities and agency available to ranchers and ranching communities, but the intertwined nature of these pressures and opportunities is fundamental to understanding the long-term resilience of ranching as a livelihood and an identity in the communities we visited.

5.1. Resilience and scales of knowledge

We find that ranchers' view of resilience traverses the temporal and geographic scales typically addressed in agricultural resilience discourse and research. Social-ecological change and ranchers' own resilience to such change were often articulated across multi-generational time scales and geographic scales that reached beyond agricultural land. Many ranchers emphasized the goal of keeping ranching as a family practice for multiple future generations. During introductions in our focus groups, ranchers often highlighted how many generations their family was involved in ranching. Several ranchers did not identify ranching success by the size of financial profits or the size of herds, but by maintaining a ranching livelihood that could be handed down through the next generations. For example, when asked about what he would like to see in the future for his ranch, a California rancher explained "*There's always progress, but a lot of the properties we have now, luckily, aren't quite in the limelight of anything, production wise. I'm just trying to preserve stuff for the next generation*" (California Rancher 08). Ranchers' understanding of resilience was often measured on generational terms, not annual or seasonal scales. Similarly, conversations of socioecological change and adaptation were not confined to the borders of the ranch or even within rangelands. Their own resilience was determined by their ability to adapt in response to broader dynamics such as global commodity markets, public land use trends, ex-urban development, and cultural values of urban populations.

The local knowledge of the temporal and geographic scales of what resilience means to ranchers emerged from these conversations. These reflect the local community's knowledge scales of resilience (Ahlborg and Nightingale, 2012). Ranchers described socio-ecological change that threatens the continuation of their livelihoods as experienced within local geographic boundaries of the ranch, such as the changing plant communities on a pasture, as well as at scales beyond rangelands, such as international beef market fluctuations. Similarly, ranchers also listed adaptation options that range from ranch-scale interventions, such as installing water infrastructure, to interventions at wider scales, such as investing in beef marketing. Ranchers are in relationships with processes that are simultaneously local, regional, and global, and that represent both challenges and sources of adaptation. Resilience is not contained at one scale, but can be understood as a product of interactions and exchanges across scales (Nightingale, 2015).

Our conversations with ranchers portray how changes at both local and system-wide scales affect ranching livelihoods and practices. When we compare the threats and adaptations identified by ranchers across the individual ranch and system-wide scales, we see a disparity among the scales and levels of adaptation (see Table 2). There is a scalar mismatch between the threats to ranching and the interventions in response to such changes. Most of the adaptations listed by ranchers were adaptation to ecological change. Supplemental feed, moving or selling cattle, and investing in long-term drought strategies like water infrastructure and cattle genetics are all relatively common responses that can bolster long-term drought resilience. On the other hand, social and economic threats to ranching such as youth outmigration, consolidation of the beef packing industry, or inflexible public land management regulations occur at a scale which ranchers expressed little capacity to influence. Ranchers described more options for action within the space of their own pastures, but expressed little ability to change the outcomes of system-wide processes such as urban expansion or changing societal values towards public land access and management.

Table 2

Identified threats to ranching and adaptations from focus groups and interviews.

Resilience Theme	Threats	Adaptations	
	Examples	Scale of adaptation	Examples
Changing ecological conditions	drought, blizzards and extreme events, precipitation timing, fire, invasive species (e.g. cheatgrass, wild horses), brush encroachment, predators	System-wide Individual Ranch	collaborate with public agencies and wildlife groups for funding and infrastructure, drought insurance water infrastructure, water hauling, supplemental feed, improve cattle genetics, understocking, change calving season, grazing management video marketing, vertical integration income diversification, increase meat quality, organic beef markets, decrease input costs (labor, size of operation), off-ranch income
Changing economy	volatile beef market, beef packer consolidation, high cost of labor, high input costs, thin profit margins, availability of loans, small operations cannot support a family	System-wide Individual Ranch	conservation easements, succession planning, improve work/life balance
Changing ranching community	aging demographics in ranching, increasing land prices, migration of youth to urban areas, low economic gain not attractive to younger generation	System-wide Individual Ranch	increase agricultural literacy (college students, recreationists) conservation easements
Changing rangeland users and uses	public land management priorities and inflexibility, changing cultural values towards public land and ranching, rising land prices, increased recreation use	System-wide Individual Ranch	

5.2. Resilience and human agency

Ranchers' descriptions of ongoing change and their response to such changes not only reflect multiple scales of resilience, but also the role of human agency in shaping resilience to social-ecological change. In their review of the concepts of agency and resilience in the context of environmental change, Brown and Westaway (2011) point out that too often scholars overlook issues of individual agency. While individual actions—for example management decisions at the scale of a ranch—can help build resilience in rangelands systems, larger processes like changing rural economies, exurban development, politically-charged public lands management decisions, and a host of other factors may ultimately limit the agency of individual actors to increase their own adaptive capacity. Across the four dimensions of social-ecological change, ranchers made a distinction between threats that they could respond to and those they were ill-equipped to address. A rancher in Arizona neatly summed up the categories of threat he and many of those we spoke with face: "*it seems to me part of agriculture is that you live in a risk environment anyhow and I think you break the threats down into two, those you can control and those you can't*" (Arizona Rancher 03). Similarly, a rancher in Southern Utah explained, "*You can handle the weather. Even the weeds, when you were talking about the weeds. You can spray, you can go out there and you can do something about it. It's the stuff that you can't do something about*" (Southern Utah Rancher 02). This breakdown between problems that can be controlled and those that cannot are a reflection of how much agency ranchers have in their resilience to social-ecological change.

Consistently across our focal landscapes, ranchers expressed less ability to directly respond to changes and risks stemming from markets, social change, and government policies that are experienced at system-wide scales than the risks created by the weather and changing ecological conditions (see Fig. 2). In describing the challenges with drought and other ecological impacts on ranching, ranchers identified many different choices they had in controlling drought impacts, such as supplemental feed, installing water wells, insurance, and improving cattle genetics. Ranchers also described more cross-scale adaptations to environmental change. These included both private and public drought insurance programs and working together with conservation groups to improve land conditions. Not only are there many adaptation choices to ecological change, but ranchers expressed confidence in positive outcomes from these choices. On the other hand, when describing how to manage social and economic risks such as the problem of succession, ranchers had a harder time describing successful adaptive actions. They mentioned creating conservation easements or taking steps to make a ranching lifestyle more attractive for younger generations, but some worried that they had no recourse to ensure that their families continue ranching or that their land would still be used for ranching in the future. The apparent lack of agency in responding to social, economic, and political changes are a reflection of the scale of these changes. They are system-wide challenges and ranchers perceive limited ability to be resilient to these changes.

In their work on grassroots scalar politics, Hoogesteger and Verzijl (2015, pp. 14–15) ask if “scales constrain the agency of ‘local’ actors” and “to what extent can ‘local’ actors overcome these scalar constraints to agency?” Applying these questions to ranchers’ responses to social-ecological change in rangelands reveals resilience to be a fragile concept, one vulnerable to many changing multi-scalar processes and where ranchers have limited ability to work across scales. The inability to affect change outside of the boundaries of the ranch was a common theme in our focus groups and interviews. Examples of collective agency or attempts to jump scales were not often cited, though ranchers and land managers did provide a couple examples of attempts to increase resilience by working at a system-wide level or increasing community agency (see Table 2 for listed system-wide adaptations). Some of these examples included giving presentations at supermarkets in urban areas as well as to college students to increase urban awareness of how ranchers work. One rancher discussed his efforts to educate federal level agencies responsible for natural resource management about the challenges of ranching,

People in Washington, DC don’t know a damn thing about the western United States. I swear to God. And it goes all the way down

through the agencies. I don’t care who you put at the top of the agency. The agency is run by the next couple of levels down underneath it. And how do you get to those people is beyond me. Most of them are eastern folks. They do not have a clue. I’ve hauled people out here from Washington DC, agency people, and I’ve driven them around the state of California and they didn’t have a clue . . . We have to get to the point where we have inputs from the ground up through our agencies, as far as these programs are concerned (California Rancher 01).

Efforts to increase local input into federal agencies are efforts to jump scale and exert influence over the priorities of higher-level national agencies.

Ranchers also gave a few examples of increasing community agency by partnering together with other groups or by coming together as a community of ranchers. For example, several ranchers worked with conservation and hunting groups to install water tanks and improve the conditions of pastures. One rancher explained how installing water tanks together with hunting groups increased his drought resilience, “Arizona Mule deer society, they want to see more mule deer. The Elk Society they want to see more elk and all. They all have their agenda, but the end result is we all help each other” (Arizona Rancher 01). In Northern Utah, several ranchers are working cooperatively and moving their cattle together as one unit across all of their pastures. “The old rancher I was telling you about, that talked about the drought? He says, “nobody wants to put any skin in the game”. What’s happened in the last 20 years, it amazes me that we’ve been able to, as community wide, what we’ve been able to accomplish” (Northern Utah Rancher 01). Working together as a community, these ranchers were able to invest in water infrastructure, improve the economics of ranching, and improve the conditions of their pasture – thus increasing their overall resilience. Ranchers in the project also explained they had more options when negotiating with public land agencies over grazing regulations as a group. Though they cited several significant drawbacks to cooperative ranching, working together increased their community agency and improved their overall resilience in ways that were not attainable when facing challenges as a solo rancher.

6. Conclusion

In this research we employed an approach that centers the knowledge and experiences of ranchers and land managers across the US West. From our analysis, we highlight two main points, with implications for the development of interventions that seek to increase resilience in agricultural and rural communities. First, resilience involves a complex

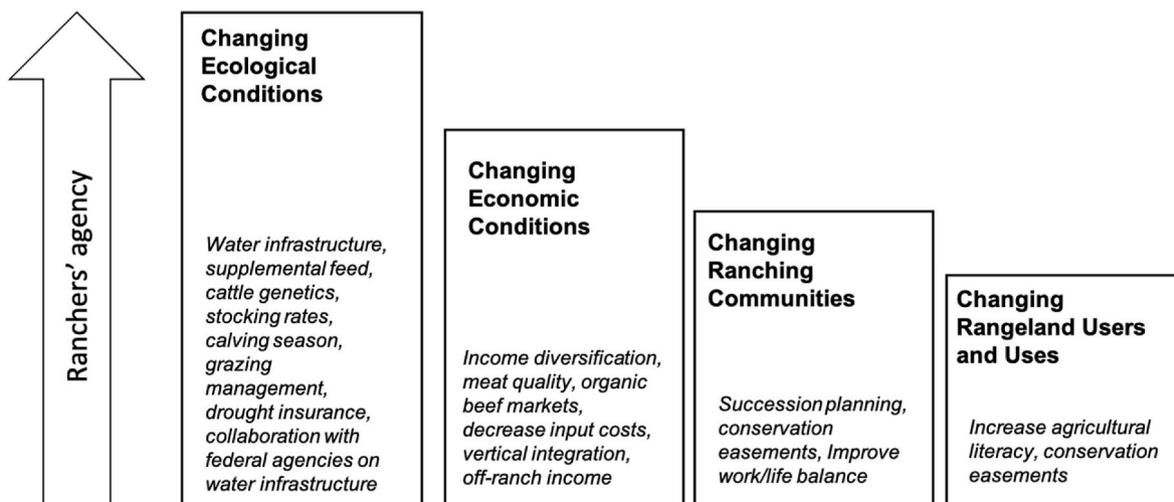


Fig. 2. Identified adaptation responses to different dimensions of social-ecological change from focus groups and interviews.

negotiation of interconnected and multi-scalar processes. Ranchers and local land managers narrated struggles to maintain ranching practices and livelihoods amidst multiple pressures from changes in ecological, economic, social, and land use conditions that span multiple geographic and temporal scales. In this light, we ask if it is naïve to expect efforts that address a single dimension of ranching resilience, such as drought or invasive species to bear significant improvements in resilience given the constraints imposed by other dimensions such as economics, community and land use and users?

Second, human agency is a critical component of resilience that allows people and communities to negotiate complex, multi-scalar social-ecological changes. When analyzing resilience, it is easy to become lost trying to trace how different social-ecological processes interact at multiple scales. However, scales are socially constructed and human agency allows people and communities to renegotiate scale and what it means to be resilient. We found that ranchers expressed limited agency in the face large scale social-ecological threats, though a few provided examples of increasing agency by scale jumping or through partnerships that increased community agency.

Resilience as a concept is popular because it suggests that there are ways to adapt and thrive in the face of not only known, but also unknown future pressures and challenges. Understanding that there can be more than one way to be resilient suggests that increasing multiple forms of human agency can provide more opportunities pathways to resilience. Each of the four dimensions of change we identified in this project are currently accelerating. Efforts that are meant to ensure long-term resilience of social-ecological systems like western rangelands will increasingly need to integrate the challenges to resilience rooted in agency and scale that we have described. Our work suggests that efforts meant to help ensure resilience of individual ranches or even livestock-producing communities are less likely to succeed if they do not carefully account for both cross-scale interactions and the ability of people in these systems to deal with threats that are far beyond their spheres of influence.

CRedit author statement

Christina Greene: Conceptualization, Methodology, Investigation, Formal Analysis, Writing – Original Draft; Hailey Wilmer: Conceptualization, Methodology, Investigation, Formal Analysis, Writing – Original Draft, Writing – Review and Editing; Daniel Ferguson: Conceptualization, Methodology, Investigation, Formal Analysis, Writing – Original Draft, Writing – Review and Editing; Michael Crimmins: Conceptualization, Methodology, Investigation, Writing– Review and Editing; Mitchel McClaran: Conceptualization, Methodology, Investigation, Writing– Review and Editing, Funding Acquisition.

Declaration of competing interest

None.

Data availability

The data that has been used is confidential.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jrurstud.2022.11.001>.

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