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Unwinding the spiral of silence in rural America: looking backward with stories to plan forward

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Introduction: In regions where climate change is perceived to be a controversial topic, people often self-silence rather than explore their concerns by speaking with others in their local social networks. The "spiral of silence" is a social feedback loop in which individuals are reluctant to speak about an issue because they believe they hold a minority opinion, leading to anxiety and fear, which prohibit action. Facilitating conversations about climate change is therefore a crucial step for researchers concerned with enhancing adaptive capacity. The goal of this paper is to provide a road map for engaging rural communities in conversations about their lived experiences with and local knowledge related to climate and water-related risks (e.g., drought). Our research focuses on unwinding the spiral of silence through community engagement to address the following questions: 1. How do rural Wyoming community members perceive recent climate conditions and water-related risks; and 2. How do rural Wyoming community members perceive and discuss future climate scenarios?

Methods: Our first research question is addressed through analysis of results from a statewide survey, which are used to develop prompts for a scenario planning workshop to support the second research question. Our second research question is addressed through transcription and coding of recorded discussions and responses during and after participatory scenario planning workshops in key communities around the state.

Results: Results from the statewide survey indicate that respondents largely agree that all seasons are getting warmer than in the past and that drought is the dominant water risk of concern; however, there is uncertainty about community preparedness. Inclusion of prompts in our participatory scenario planning workshops that were aligned with statewide survey results allowed shared communication opportunities among community members and identified local knowledge of past drought events and associated adaptation strategies for the future.

Discussion: Our mixed-method approach provides an example for unwinding the spiral of silence in rural communities experiencing challenges and impacts of climate change.

KEYWORDS

spiral of silence, participatory scenario planning, rural, climate change, science communication, trust, uncertain water futures

1 Introduction

In regions where climate change is perceived to be a controversial topic, people often self-silence rather than explore their concerns by speaking with others in their local social networks. The "spiral of silence" is a social feedback loop in which individuals are reluctant to speak about an issue because they believe they hold a minority opinion, leading to anxiety and fear, which prohibit action (Noelle-Neumann, 1974; Taylor, 1982). Facilitating conversations about climate change is therefore a crucial step for researchers concerned with enhancing adaptive capacity. Such conversations about climate change and related risks in the rural western United States include multiple challenges such as understanding risk perceptions and building trust. Our research focuses on unwinding the spiral of silence through community engagement to address the following research questions: (1) How do rural Wyoming community members perceive recent climate conditions and water-related risks?; and (2) How do rural Wyoming community members perceive and discuss future climate scenarios? We incorporate mixed-method approaches beginning with a survey to assess risk perception (RQ1), that informed the design of participatory scenario planning workshops (RQ2). We sought to identify willingness to share stories about past experiences of climate and drought, from which to discuss adaptive strategies for future climate hazards. Based on our statewide survey, rural community members identified drought as the climate risk of greatest concern. Our participatory workshops created a space where community members could both reflect on past droughts and consider ways they have, in the past, and could navigate in the future, the hazards they are likely to experience as climate continues to warm.

This research incorporates a variety of theoretical and methodological approaches such as science communication; spiral of silence; participatory scenario planning; and mixed methods. Therefore, the paper proceeds with brief summaries of the most significant theories that informed our process and research questions. In methods, we discuss survey methods followed by workshop methods. In the results, we discuss survey results and workshop results. The discussion section allows us to connect theory with methods and results as well as providing lessons learned for future transdisciplinary public engagement of science. With the attention paid to theory, method and results, this paper serves as a roadmap for other transdisciplinary teams working on a variety of topics relevant to increasing community participation in climate adaptation. We discuss literature about the relationship of trust to the perception of risks; climate change as a long emergency and wicked problem; and note the turn by scientists to engage narrative methods to increase social discussions that can prompt action.

1.1 Science communication

Trust is important to communicate science (Kliskey et al., 2023), especially with regards to climate change in traditionally politically conservative rural communities. As discussed in Section 1.4, significant internal cultural demographics impact trust in climate science, especially in our case study region of Wyoming. Nationwide, white Americans are more likely than Black Americans, Hispanic Americans, and multiracial Americans, to say that climate change is caused by natural patterns in the Earth's environment. Additionally, Americans identifying as Christian, and Republican are also contributing factors to reduced trust in climate science (Public Religion Research Institute, 2023; Marlon et al., 2023). Nationwide, Evangelical Protestants have the lowest percentage of people who agree that recent climate change is caused by humans (Public Religion Research Institute, 2023). Pew public opinion data show that Republicans have less favorable and less trusting views of environmental research scientists compared to Democrats (26 to 51%, respectively) (Funk et al., 2019). These interrelated identities contribute to the complex relationship of religion and politics as co-factors in the cultural context of trust in climate science (Marlon et al., 2023).

Wyoming communities will not plan for climate resilience if they do not perceive themselves to be at risk; this is because actual physical vulnerability to climate change does not matter as much as risk perception in guiding people's behavior (Safi et al., 2012). Climate change communication strategies must therefore be grounded in an understanding of the psychological biases influencing how people perceive risk. The dangerously slow speed at which people, communities, and governments have responded to climate risks is understood in part to be a result of how effective these biases have been at dulling people's perception of the risks at hand. Psychological biases are understood in communications literature as "heuristics"—mental shortcuts for judgment and decision making (Plous, 1993). Our statewide survey was designed to assess perceptions and experiences related to climate and water-related risk. The overview below of relevant scientific communication biases and heuristics informed our workshop design and shortened the psychological distance to climate change for workshop participant.

We designed our workshops to reduce endpoint bias such as reducing the attention given to recent short-term weather events and encouraging the focus on the overall climate average trend of data (Hardy and Jamieson, 2017). We also took advantage of the "availability heuristic" and "affect heuristic" (Lorenzoni et al., 2007) by encouraging people to recall past climate-related events, such as drought (see Section 2.3.2.1). When people recall past disaster events, this makes the risk more available to their memory (Keller et al., 2006). It increases climate risk imaginability. We prompted participants to recall vivid, sensory details and emotions, enhancing the affect heuristic, to increase connection to personal and emotional experiences with climate change (Slovic et al., 2004) and shorten psychological distance to climate change by helping participants recognize local evidence of climate change based on their own experiences (Weber, 2006). Sharing stories about past droughts can reduce psychological distance to climate risks and evoke emotions. This can prompt subsequent discussion and action, thereby breaking down the spiral of silence (Gustafson et al., 2020). This allowed us to work with, rather than against, psychological biases.

1.2 Spiral of silence

Psychological bias can further enforce the absence of social discussion, especially for unpopular or perceived politically charged topics. Such absence of social discussion has been referred to as a "spiral of silence" where individuals remain silent or self-silence if they feel they are in a minority opinion (Noelle-Neumann, 1974; Taylor,

1982). The spiral of silence is manifested in the topic of climate change given that the scientific communication, issues, and solutions related to climate change are politically complex and challenging (Geiger and Swim, 2016), especially in politically conservative rural communities that have strong ties to energy production (Gurney et al., 2022). Indeed, results from a recent survey of Wyoming residents found that respondents did not accurately perceive their own community's public opinion about changing water resources in Wyoming; in fact, they underestimated community support for the belief in a changing environment, and they also underestimated the support for community preparedness to address changing water resources (Landreville, 2024). The survey results revealed that Wyoming residents overwhelmingly believe their climate and water resources are changing, but there is evidence of a spiral of silence occurring in their communities because of this misperception of the public opinion milieu. The survey results also showed people are not communicating about climate and water issues, which is reinforcing the spiral of silence in Wyoming communities (Landreville, 2024). As Fine (2024) demonstrates, having relational climate conversations that focus on action supports perceived efficacy (a person's belief in their ability to complete tasks and achieve desired outcomes) and predicts collective action.

Thus, working with community members to provide spaces where individuals can share their collective experiences and perspectives with each other about climate and associated water-related risks provides an opportunity to unwind the spiral of silence (Ettinger et al., 2023) and support collective learning and action regarding future climate hazards (Fine, 2024).

1.3 Participatory scenario planning

Participatory scenario planning (PSP) is a rapidly growing strategy used to increase public engagement with science (PES) and is the foundation for our workshop design. One of the known shortcomings of some PES projects acknowledged in PES literature is "the absence of clearly defined audience-specific behavioral goals and associated objectives" in PES activities (Du et al., 2024). Our clearly defined, audience-specific behavioral goals are to unwind the spiral of silence in rural Wyoming communities by providing an action-oriented PSP. PSP is widely recognized as a strategy to increase public participation in planning processes, such as planning for a warmer future (Goodspeed, 2020).

People are more likely to rely on scenario-based (narrative) information than on frequentist (statistical) information when making judgments about risks (Hendrickx et al., 1989). PSP generates social discussions of local concerns and explores solutions based on local values that stakeholders develop, thus improving the chance for actionable implementation (Buchecker et al., 2013; Williams et al., 2023). Research demonstrates the effectiveness of PSP for supporting adaptation (Star et al., 2016); its effectiveness in rural and agricultural contexts (Murphy et al., 2016; Taebe and Watson, 2024); in Mountain Social Ecological Systems (Thorn et al., 2020); and with programs led by Extension networks at land-grant universities (Clark et al., 2023). Like Clark et al. (2023), we leveraged the established UW Extension network to deliver workshops, benefiting from Extension professionals' cultural capital in their local communities.

1.4 The case of Wyoming

Wyoming is the most rural state in the contiguous U.S. with just under 600,000 people (U.S. Census Bureau, 2024), yet it includes important headwaters for the Snake-Columbia, Platte-Missouri, and Green-Colorado Rivers. What happens with climate, and in particular precipitation, in Wyoming has local, regional, national and international implications. As the third driest state, its semi-arid climate results from a mix of mountainous and high plains geography; variable polar jet stream storm delivery; and its distance from major water sources (Shinker, 2010). The state is highly dependent upon spatially and temporally variable precipitation (snowpack and rainfall) to support energy production, tourism, and irrigation for agriculture—the state's top three industries (Shinker et al., 2010). Anthropogenic warming in Wyoming has been evident over the last several decades and has outpaced natural temperature trends and variations seen over thousands of years (Shuman, 2012). These temperature increases have impacted Wyoming's water resources through melting of snowpack in mountainous headwaters and increasing drought (Nicholson et al., 2018).

Recalling the discussion of trust in science (Section 1.1), many demographic factors in Wyoming contribute to the need to build trust in Wyoming for effective PES. Wyoming is majority white (83%, U.S. Census Bureau, 2024), Christian and Republican. Specifically, 71% of Wyomingites identify as Christian and 27% among the Christians are Evangelical Protestant (Pew Research Center, 2024). Wyoming is a deeply conservative state--81% of registered voters belong to the Republican Party. Despite these demographics, the reality is more nuanced. A resounding 90% of respondents in a 2022 survey reported believing that climate change is happening, though half of respondents did not believe that recent warming is caused by humans (Western et al., 2023). This suggests that Wyomingites are increasingly ready to engage in conversations about and adaptations to climate change, even if there is uncertainty about the causes of climate change. It also indicates that individuals' reluctance to discuss climate change may be driven by underestimating the prevalence of support for scientific consensus about climate change within their communities (Geiger and Swim, 2016) and/or driven by the misperception of public opinion on climate change in their respective Wyoming communities (i.e., they think their opinion that the climate is changing is in the minority, when, in fact, it is actually a majority opinion) (Landreville, 2024). Finally, as in other mountain social environmental systems (Thorn et al., 2020), Wyomingites have a keen sense of place and understanding of the state's unique climate and mountain ranges as sources for the water resources that support their livelihoods and economies. As noted in rural sociology, there is a nature and nuance to climate change skepticism in the Rocky Mountain region, and our workshop is designed to work with the "complex tapestry of socially shaped beliefs" (Haltinner and Sarathchandra, 2021).

With our focus on representing local community perspectives, the workshops addressed associated water-related risks with rising temperatures. Our emphasis on water-related risks provided a bounded discussion that reflected the community valuation of water-related risks as a prosocial topic of concern for everyday discussions. Water-related risks (e.g., droughts, floods) become touchstones for family and community recollections of their capacity to rise to meet existential threats (Greene, 2021). In our workshops, we did not refer

directly to climate change because the term climate change rests on a decidedly polarized discursive landscape explored above (Section 1.1). Explicit references to anthropogenic climate change are controversial in Wyoming; hence, we worked to avoid the spiral of silence that prohibits social discussions by people who are otherwise curious about the impacts of warming temperatures, especially on limited water resources.

1.5 Research purpose and contribution

The goal of this paper is to provide a road map to engage rural communities in conversations about their lived experiences with and local knowledge of climate and drought. Our research contributes methodological approaches and examples of unwinding the spiral of silence by building trust through communication and community engagement. Our contributions are relevant given the public is concerned with rising temperatures but report that they are not openly discussing it for reasons that include reluctance to speak about issues perceived as controversial (Clark et al., 2023; Hayhoe, 2022). Despite the importance of addressing climate change, about 2/3 of Americans report that they never or rarely discuss this topic with others (Leiserowitz et al., 2021) and 55% of Wyomingites never or rarely share information about climate issues (Landreville, 2024). This creates several interrelated problems. Without robust public deliberation, communities are left vulnerable to the deleterious impacts of rising temperatures (Williams et al., 2023). The absence of social discussions contributes to the phenomenon of *self-silencing,* when an individual does not think others share their concern, as evidenced by Landreville's (2024) survey results of Wyoming residents. This creates a positive feedback loop which can lead to a *spiral of silence* (Noelle-Neumann, 1974), reinforced by emotions that prohibit action, such as fear and anxiety (Clark et al., 2023; Stoknes, 2014). Providing a safe, constructive, and productive environment in which people can feel comfortable discussing this politically charged topic can help to overcome the spiral of silence (Ettinger et al., 2023).

One of the challenges generated in a spiral of silence is that it sustains a social atmosphere of misunderstandings about others' opinions [i.e., what Sparkman et al. (2022) call "pluralistic ignorance"]. Our scenario planning workshops serve as an antidote to this challenge by creating a social space for conversations that are not happening naturally. The heterogenous voices, including avowed climate skeptics, are a strength rather than a threat for unwinding the spiral of silence, recognizing that local perspectives and values are deciding factors in the sustainability of adaptation policies (Casagrande et al., 2007). In our workshops, community members discussed the deleterious impacts of past droughts and rising temperatures. This facilitated participants' recognition of their shared experiences and concerns.

2 Methods

We used a sequential explanatory mixed methods design that integrated quantitative and qualitative approaches (Creamer, 2018). The quantitative approach included a statewide survey with closed- and open-ended questions, and the qualitative approach included PSP workshops with open-ended questions. Upon statewide survey analysis, the team discussed the survey results and used the results to guide the PSP workshop design (see Section 2.2.2). Both the survey and PSP workshops were vetted and approved through the University of Wyoming's Institutional Review Board. Table 1 lays out the methods used to address our research questions, participants, instruments used for data collection, and goals.

2.1 Participants

2.1.1 Statewide survey

Our statewide survey participants resulted from survey requests that were sent via email to 732 participants who were identified through the Wyoming Survey and Analysis Center (WYSAC) WyoSpeaks panel. The WyoSpeaks panel was created via a random selection of panel members from a universal frame (as opposed to web opt-in panels, monetary incentive panels, mall intercepts, surveys on a webpage, etc.). As a result of this probability sampling, all Wyoming residents have an equal selection for the panel, and the resulting panel composition is close to the Wyoming population distribution based on basic demographics of county, gender, and age. Our final survey sample was 557 participants (see demographics in Table 2).

2.1.2 Scenario planning workshops

Workshop participants were recruited through professional networks including the University of Wyoming's Extension, Sustainable Agriculture Research and Extension Center (SAREC), and regional conservation districts and contacted by phone and email. We attempted to balance workshop participant demographics with our survey demographic, see Table 2. Participant professional affiliations were representative of state and local government as well as private industry, agriculture, and religious leaders. The workshops took place in Powell, WY, situated in Park County, part of the Wind-Bighorn River basin; Sheridan, WY, situated in Sheridan County part of the Tongue River basin; and Torrington, WY, situated in Goshen County part of the Platte River basin. In total there were 27 community

TABLE 1 Overview of research questions, participants, methods, and goals.

Research question	Participants	Instrument	Goals
1. How do Wyomingites perceive water-related risks?	Statewide citizens and stakeholders within hydrology and ag networks.	Statewide survey.	Identify perceptions of climate and water-related risks. See results Section 3.1.
2. How do rural Wyoming community members perceive and discuss future climate scenarios?	Stakeholder members in three Wyoming communities.	Participatory Scenario Planning Workshop, including slides, scripts, participant discussion questions, and exit survey.	To provide space for community discussion, shared experiences, and strategies for possible water futures. See results Section 3.2.

TABLE 2 Survey participant demographics.

Demographics	Percentage of sample
Age	
18–24	9.2%
25–34	14.4%
35–44	13.3%
45–54	17.2%
55–64	20.3%
65–74	15.8%
75+	9.8%
Gender	
Men	47.6%
Women	52.4%
Education	
<HS, HS Grad	8.1%
Some College, AA	35.4%
Bachelor's Degree	31.4%
Graduate Degree	25.1%

member participants in three different PSP workshops between November 2023 and January 2024.

2.2 Survey and workshop design

The statewide survey incorporated closed- and open-ended questions (see Supplementary material for the survey questions that were used in our analysis), and it comprised discipline-specific questions as well as cross-disciplinary questions. In this section, we present the cross-disciplinary portions of our statewide survey that were relevant to the development of our PSP workshop design.

2.2.1 Statewide survey design

As a team, we designed questions about climate and water-related risks. Through team discussions we agreed upon the length; best practices for style of questions; and reasonable limits of participant attention given our respective ambitions for gathering information. We discovered points of synergy where questions were of interest and overlapped across fields. For example, a question about where respondents sought out their information about water-related risks was recognized as important for the entire team for our understanding of the potential to unwind the spiral of silence.

2.2.2 Scenario planning workshop design

To unwind the spiral of silence, we used PSP in our workshops, informed by science communication and the statewide survey results. While some PSP models are normative and meant to deliver a plan or a strategy, our workshops were designed to foster "social learning" in which scenarios function as reflexive tools to develop strategic practices of social learning (Wilkinson and Eidinow, 2008). We selected an exploratory, rather than normative model, emphasizing narrative and dialogic processes that drive decision making and permit "the inclusion of multiple, diverse voices and sets of knowledge in crafting what are in effect collaborative stories and visions of the future" (Murphy et al., 2016, p. 35).

Our PSP design for the Wyoming context incorporated a temporal innovation that was inspired by (1) academic literature in the psychology of science communication (see Section 1.1) and (2) the statewide survey results (see Section 3.1). Traditional PSP approaches have a general "futures" orientation. We supplemented this by first having community members look backward at their past experiences (see Section 2.3.2.1) and then look forward toward possible water futures (see Section 2.3.2.2). We made this decision because the survey results indicated that an overwhelming percentage of Wyoming residents have experienced at least one water-related natural hazard, with 83% of Wyomingites experiencing drought in their communities in the last 20 years (see Section 3.1 for more survey results). Thus, the survey results revealed that Wyoming residents have stories to share about their lived experiences related to water and climate. In the workshop, we expected participants to be able to share these experiences and stories, which would then establish the foundation and build trust of their past experiences as a shared knowledge base. The subsequent questions that we posed to participants in the workshop would encourage them to communicate shared values about their abilities to overcome water and climate challenges in the future.

Also, the temporal innovation allowed us to work with human nature in sharing past experiences, specifically to enhance the availability and affect heuristic (e.g., remembering and activating feelings) and reduce the distance heuristic (e.g., linking past and future), which the literature recommends for more effective science communication. By sharing memories of drought they experienced, we were able to work with the availability heuristic—the memories were available to them—to activate the imagination of possible water futures. Survey results also revealed Wyomingites are concerned that drought and wildfire will affect their community in the next 5 years, which informed our workshop design to link past to future. This PSP innovation strengthened memories of shared experiences, which served to reduce psychological distance (which otherwise creates a hurdle for thinking about future climate change). Moreover, our survey results indicated that Wyoming residents generally reported low levels of risk perceptions of water-related natural hazards impacting themselves and their families (see Section 3.1.1) and low levels of emotion regarding water-related natural hazards (see Section 3.1.3). Both results reveal the psychological distance that needed to be closed for workshop participants to imagine possible future scenarios. Given these survey results, we designed our workshop questions to encourage participants to reflect on the feelings of their experiences to create a connection and a safe space where participants could share their emotions. For example, sensory-oriented questions that help evoke emotional reflection were posed by the workshop moderators (e.g., how did the landscape look and feel?).

Our workshop design also incorporated traditional PSP futures thinking by presenting participants with two future water scenarios. In linking past and future in our workshop design, what can otherwise be a crippling resistance to thinking about future uncertainties is alleviated by discussing shared past experiences. By coupling the past scenario with two future scenarios we created the social space in our workshops that helped to unwind the spiral of silence.

From a facilitation perspective our team consisted of a lead facilitator who was the script reader and overall discussion organizer;

a timekeeper and digital audio recorder; and a note taker in the front of the room who captured participant comments on poster boards. Once participants signed informed consent to record workshop activities, the facilitators introduced team members in attendance; described the workshop activities; and invited participants to introduce themselves in one-to-two-minute introductions in which they were asked to respond to the prompt "What brought you to today's workshop?" We presented guidelines for constructive dialog and asked for suggested revision and agreement to the guidelines which were incorporated where provided. We described how the results would be shared. These activities attended relationships; built dialog among participants and with facilitators; and initiated some participant ownership over the discussion. Activities like these can build trust and create a safe environment for sharing opinions (Krueger and Casey, 2014).

To build resilience into our model, all team members who reside in Wyoming learned the workshop script so that we could be most flexible and agile in scheduling workshops. No person on the team was considered indispensable for a workshop to proceed. Our climate scientist provided answers at the back of the script to questions that we anticipated participants might ask in case she was not in attendance. With 3–4 members of the team present at each workshop, we helped the lead facilitator field questions, and we acknowledged our limits and willingness to consult with experts to return to questions we did not feel able to answer.

2.3 Data collection

2.3.1 Statewide survey data collection

Survey data was collected by WYSAC at the University of Wyoming in May and June 2022 using the Qualtrics web-based survey platform. WYSAC provided the final survey results in an SPSS data file in July 2022.

2.3.2 Scenario planning workshop data collection

Primary data collection for our PSP workshops included guided discussion questions presented in a think-pair-share format (Lyman, 1981) for participant partners to discuss, take notes, and share back to the workshop group for further discussion. This "think-pair-share" approach provided an opportunity for cooperative learning (Lyman, 1981) from the two main active parts of the workshop: Part 1. Looking Back (Section 2.3.2.1.); and Part 2: Planning Forward (Section 2.3.2.2). These two parts include data collection from workshop recordings that were transcribed and coded for analysis of perceived risk, vulnerability, and adaptation (see Section 2.4.2).

Secondary data collection for our PSP workshops came from a brief post-workshop evaluation survey. The survey's purpose was to show what participants took away from the experience and to assess the value of scenario planning workshops. Participants were asked how their understanding of potential water futures had changed because of workshop participation and whether they felt prepared to engage with their communities on this topic. Additionally, we asked what types of potential impacts on water resources would prompt them to prepare for future changes in temperature and precipitation. Our post-workshop survey also included a series of Likert-scale items designed to assess the value of scenario planning workshops in unwinding the spiral of silence. These questions include, "I am prepared to engage in discussions on potential future water scenarios"; "I am prepared to help my community understand potential futures regarding future water scenarios"; and "I think scenario workshops are effective ways to help Wyoming communities anticipate potential future water scenarios." Both data coded from workshop transcriptions as well as postworkshop surveys treated responses as participant number rather than personal identifiable attributes, thus ensuring participant anonymity.

2.3.2.1 Scenario planning workshop part 1: looking back

The first part of the workshop was designed to enliven risk perception, build shared knowledge, and increase trust among participants to feel comfortable sharing their opinions. The facilitator invited participants to remember a drought or other water hazard they had experienced in the past 20 years—what they saw, heard, smelled, felt, and how they had adapted. The workshop built a social space for discussion of memories and recollection of sensual, visceral details that relate to emotions experienced during times of water-related risks. Examples of visceral memories included remembering smells and visuals of smoke from large fires; recalling the distance from their own house to a wildfire; and feeling the economic impacts from drought, including the strong negative emotions surrounding lost crops or high meat prices. These emotional and visceral recollections of past environmental events can be even more powerful experiences for politically conservative people because conservatives tend to use and respond to a past temporal orientation more than liberals (Baldwin and Lammers, 2016).

By asking people to recall visceral memories, psychological distance to climate risks is reduced and emotions are evoked, which prior literature shows can drive people to action (Gustafson et al., 2020). Such personal and shared narratives can serve as powerful forms of evidence because they present the lived experiences of others, which may make it more difficult for the scientific narrative regarding the warming trend to be discounted (Nisbett and Ross, 1980; Reinard, 1988; Slater and Rouner, 2002). Additionally, personal testimonies about drought and adaptation shared among people from the same Wyoming community can be more effective than external expert testimony at influencing attitudes (Gustafson et al., 2020). Sharing stories about participants' personal experiences of memorable water-related risks has the added benefit that personal stories strengthen trust and community ties, which are indicators of local communities' climate resilience (Rockenbauch and Sakdapolrak, 2017; Clark et al., 2023).

Participants were then shown Figure 1 depicting average statewide maximum temperature and precipitation trends from 1921 to 2021 (NOAA National Centers for Environmental Information, 2024) and asked to reflect on anything that stood out to them. Shifting the focus to the past century and the trendline helped reduce endpoint bias and directed their attention to the more powerful risk of rising temperatures. After asking participants what they noticed, including high points, low points, trend lines, and answering questions about the timeline, participants were asked to consider a list of questions, using a think-pair-share approach, about how historical drought affected themselves as individuals, their families, and their community; how historical drought made them feel; and how they responded during those extremes. Throughout the sharing process, facilitators made connections between the stories and the graphs, thus building a shared perception of the validity of their experiences in

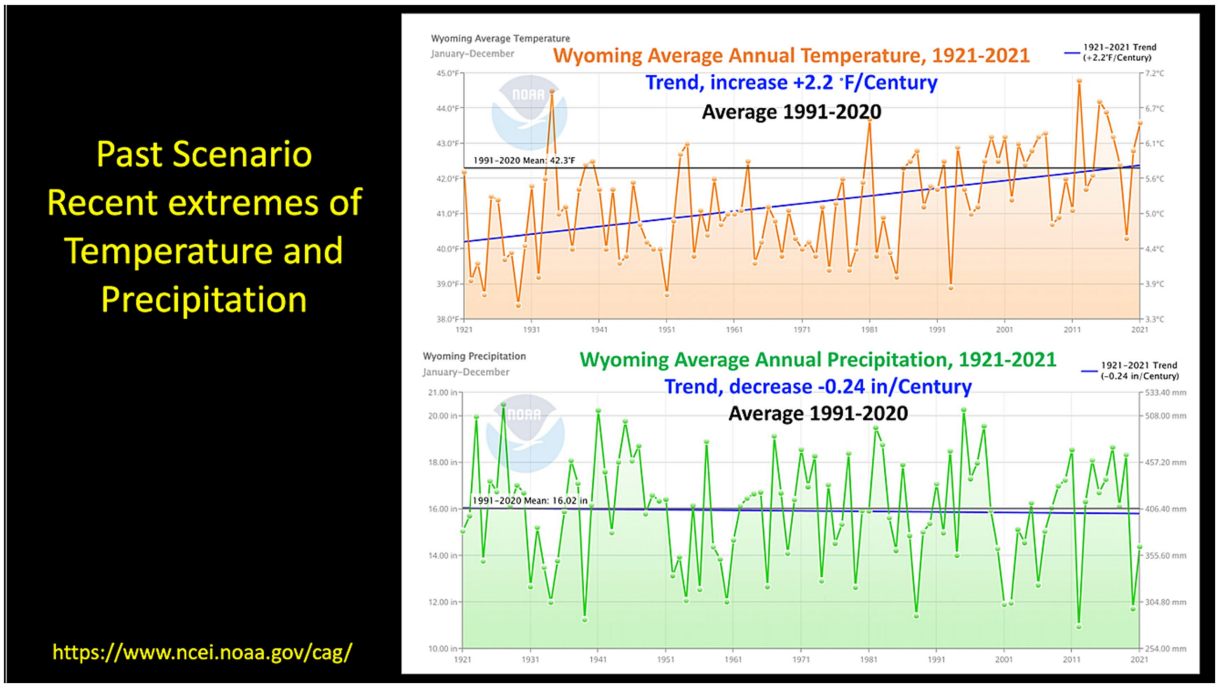

FIGURE 1
Workshop graphic for "Past Scenario" showing Wyoming statewide average annual temperature (top), and precipitation trends 1921–2021, compared to 1990–2020 long-term mean. Data from NOAA National Centers for Environmental Information (2024).

relation to the validity of the historical NOAA data. The geophysical fact that the temperature trend line is rising is one of the basic scientific truths we hope to establish through this experience of telling stories and connecting them to the graph and its trend line.

2.3.2.2 Scenario planning workshop part 2: planning forward

The second part of the workshop was designed to collect data to address our second research question: How do rural Wyoming community members perceive and discuss future climate scenarios? Participants were asked to transition from thinking about the past as shown in the century-long time series from Figure 1, to consider the spatial distribution of past, present, and future temperature trends by viewing two side-by-side maps of Wyoming developed from the U.S. Climate Resilience Toolkit Climate Explorer (U.S. Federal Government, 2023) (Figure 2). The left side of Figure 2 shows a static map of the average daily maximum temperatures across Wyoming for the 30-year period from 1961 to 1990. To compare past average daily maximum temperatures with present and projected future temperatures in Wyoming, we created an animated map sequence of average daily maximum temperatures for each decade between 2020 and 2090 (right side of Figures 2A–H). Future average daily maximum temperatures are based on conservative modeling estimates provided in the Climate Resilience Toolkit (U.S. Federal Government, 2023).

To emphasize future temperature changes, we included a stationary arrow to the left of the legend representing the static image of 1961–1990 average daily maximum temperatures (Figure 2, left column) along with a dynamic color-coded arrow on the right of the legend for each decade in the animation illustrating future temperature increases (Figure 2, right column). This dynamic legend provides a secondary visual cue (Lin and Atkinson, 2011) emphasizing a continuation of future temperature increases across time and space seen in the animated map sequences.

The cartographic animation in Figure 2 represents an example of dynamic communication of science to non-expert audiences through narrative transportation (Green and Brock, 2000). The use of cartographic animations allows participants to visualize changes in temperature across time and space simultaneously that might otherwise not be apparent with time series (such as Figure 1) or individual static images (Shinker, 2010). Maps of temperature are easily relatable because they illustrate the role of elevation and temperature gradients (note dark blue colors that highlight cool temperatures associated with the mountainous topography of Wyoming). Additionally, Wyomingites are familiar with the topographic landscape of their state, so maps representing temperature provide a strong visual cue of the spatial distribution of temperature for our participants. Especially compelling are animated maps that demonstrate an increase in temperature across high-elevation mountainous terrain where snowfall is an important water resource. People in Wyoming are used to watching high-elevation snowpack as a measure of future water security or risk. Figure 2 also functioned as a hinge in the narrative arc of the workshop, accomplishing the pivot from the known and experienced data of the past, pictured on the left static map of Figure 2 (average maximum temperatures from 1961–1990), to the futures-oriented animated map playing the model-generated projected warming on the right (average maximum temperatures from 2020 to 2090). The future modeling on the right side of Figure 2 depends critically on—and cannot exist without—the historical data depicted on the left. The historical data alone on the left of Figure 2 cannot prepare us for unprecedented futures. Our

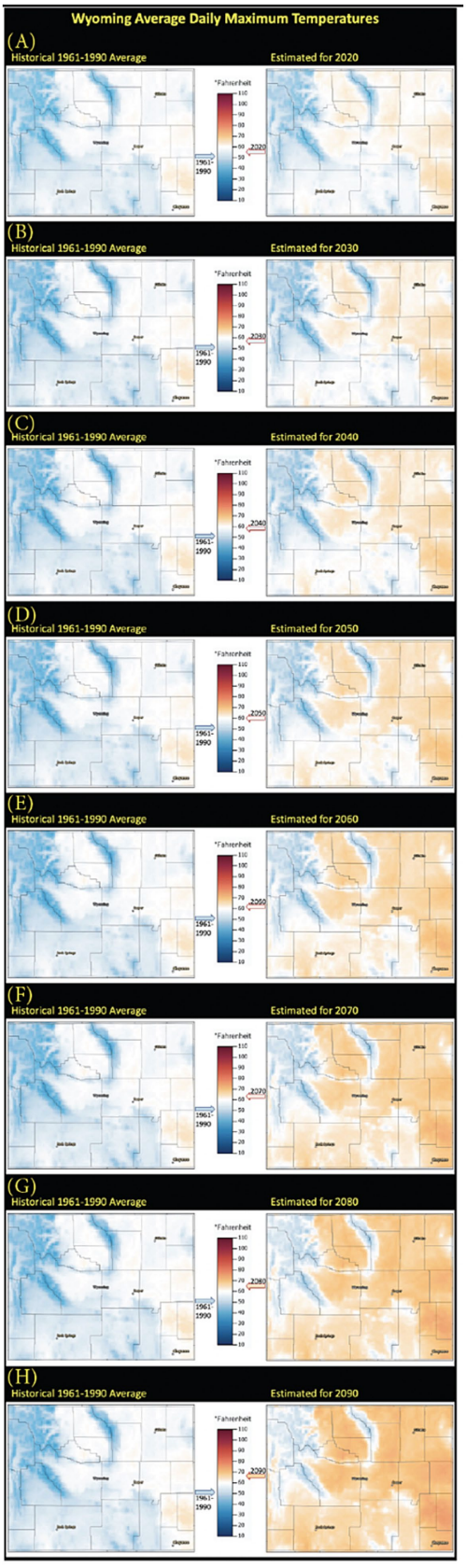

FIGURE 2
Still images from animated graphic used in workshop representing Wyoming average daily maximum temperatures **(A)** 1961–1990 average (left) and estimated for 2020; **(B)** 1961–1990 average (left) and estimated for 2030; **(C)** 1961–1990 average (left) and estimated for 2040; **(D)** 1961–1990 average (left) and estimated for 2050; **(E)** 1961–1990 average (left) and estimated for 2060; **(F)** 1961–1990 average (left) and estimated for 2070; **(G)** 1961–1990 average (left) and estimated for 2080; **(H)** 1961–1990 average (left) and estimated for 2090. Data from U.S. Federal Government (2023).

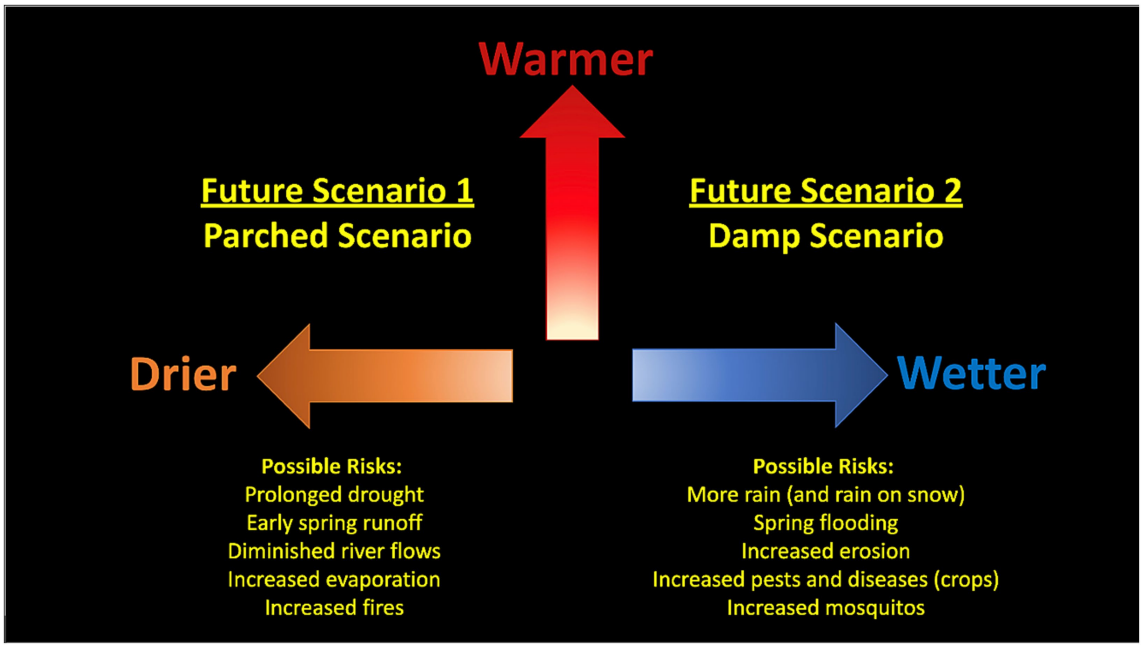

FIGURE 3
Workshop graphic for future scenario 1, parched (left); and future scenario 2, damp (right). Parched scenario represents warmer-than-present temperatures and drier-than-present conditions. Damp scenario represents warmer-than-present temperatures and wetter-than-present conditions.

innovation of pairing static historical data with animated future-projected warming was designed to transition the workshop from looking backward to planning forward.

After playing the animation in Figure 2 for several cycles and answering questions, we allowed time for reflection. Facilitators from all three workshops reported on the impact this animated slide appeared to have based on participant responses, from intense attention given to the slide, to comments about the seriousness of its significance. After allowing some time to take in Figure 2, facilitators moved forward to the future scenarios visual, Figure 3 stating, "With that animation in mind, we are going to consider a warmer future in Wyoming that is either drier or wetter than the past."

In Figure 3, the central vertical arrow represents temperature and points in one direction, indicating the inevitable future warming seen in the animation. Although the climate is warming, precipitation projections for the western U.S. are less certain (Fifth National Climate Assessment, 2023). The scientific certainty of the established warming trend is coupled with uncertainty regarding precipitation, producing two possible futures: warmer- and drier-than-present conditions (Parched Scenario, Figure 3, left side); or warmer- and wetter-than-present conditions (Damp Scenario, Figure 3, right side). A minimal list of five possible risks associated with each scenario are listed at the bottom of Figure 3. The facilitator provided minimal details when introducing the two scenario narratives to reduce the possibility of suggesting impacts that do not match local experience. We sought maximum freedom for the participants to bring their knowledge to bear and reduce the possibility that the narrative would produce counterarguing or negative emotional arousal from dissonant (counter-attitudinal) "outsider" or "expert" narrative (Kaplan and Dahlstrom, 2017).

The facilitator directed participants first to the future Parched Scenario and invited them to consider a list of questions (think-pair-share) about potential impacts and responses. The facilitator then asked participants to consider and share reactions about the future Damp Scenario. Participants iterated on the same questions about impacts, feelings, and strategies three times during the workshop, increasing their familiarity with and facility in considering these questions in a social conversation.

2.4 Data analysis

2.4.1 Statewide survey data analysis

To address our first research question, data analysis of our statewide survey focuses on themes of risk perception; community preparedness perceptions; emotions; and communication habits. The descriptive statistics (percentages, means, and standard deviations) of responses for these themes were identified from our statewide survey. To aid in the development of our PSP workshop instrument that addresses our second research question, we analyzed results from our statewide survey that focus on emotions and communication habits.

2.4.2 Scenario planning workshop data analysis

To address our second research question, the workshops were audio recorded with express permission from the participants according to IRB protocol through signed waivers ensuring anonymity. Recordings were transcribed verbatim, first by using NVivo auto-transcription, then editing any errors from the auto transcription output by hand. These transcriptions were peer reviewed by two people in the research group for thoroughness. Post-workshop surveys were collected, scanned, and transcribed manually by the same two people for consistency. Both the audio transcription and written instruments were deductively coded for prevalent themes in NVivo using a predetermined codebook (IPCC,

2014). Coding is a common method used in qualitative research to investigate common and differing themes between categories, participants, and participant groups (Krueger and Casey, 2014). The initial step in our coding procedure involved creating a codebook tailored to topics related to perceived risk, vulnerability, and adaptation (Table 3). We assigned overarching codes (e.g., nodes) to the transcripts such as level of response (e.g. adaptive, community, environmental) to past or future hazard conditions. Once primary coding was complete, we used thematic analysis to explore patterns and groupings of codes within the data to identify themes shared between the three workshops. As we analyzed the three transcripts and the corresponding post-workshop survey, we continuously updated the codebook to include new codes and themes that emerged during the process (Table 4).

3 Results

Our mixed methods approach provides an example for unwinding the spiral of silence in rural communities experiencing challenges and impacts with climate change. Here we provide preliminary results from our statewide survey of Wyoming community members (Section 3.1) which were used to address our first research question (How do rural Wyoming community members perceive recent climate conditions and water-related risks?), and to develop prompts for our PSP workshops. Our statewide survey results provide context on community perceptions of climate and water conditions, risk, preparedness, underlying emotions (affect), and communication habits. Results from our PSP workshops (Section 3.2) address our second research question (How do rural Wyoming community members perceive and discuss future climate scenarios?). Results from our PSP workshops identify the value of perseverance and adaptability as important for having endured recent drought and in preparation for future drought. Based on our post-workshop exit surveys, our results indicate such PSPs are useful tools for providing community members with an opportunity to share stories and experiences of resiliency to past drought. In this way, we have provided a forum to unwind the spiral of silence for rural community members to prepare for future drought.

3.1 Results from statewide survey

Respondents largely agree that all seasons are getting warmer than in the past, which is confirmed with statewide climate data from NOAA used in our PSP workshops. Over 75% of respondents completely or somewhat agreed that drought is increasing in their communities; and rivers, lakes and reservoirs are lower in the fall season. Over 50% of respondents agree that rivers, lakes and reservoirs are warmer in summer than in the past. When asked which climate hazard (drought, storms, wildfires, floods) they have experienced, a majority of 83% experienced drought. Looking into the future, 92% of

TABLE 3 Participatory scenario planning workshop participants with associated town and county; river basin; number of participants and affiliation information.

Town (County)	River Basin	# of Participants and Affiliations
Powell, WY (Park County, WY)	Wind-Bighorn	9 (Gov/t/conservation $n = 3$; Farmer/Rancher $n = 2$ Agricultural bank lender $n = 1$; Tourism/recreation $n = 1$; Education $n = 1$; Local civic/social organization $n = 1$)
Sheridan, WY (Sheridan County, WY)	Tongue	9 (Farmer/Rancher $n = 2$; Local business $n = 2$; Tourism/recreation $n = 1$; Religious $n = 1$; Education $n = 1$)
Torrington, WY (Goshen County, WY)	North Platte	9 (Farmer/Rancher $n = 3$; Education $n = 3$; Gov't/conservation $n = 2$; Agricultural bank lender $n = 1$)

TABLE 4 Example summary table illustrating coding procedure, including parent theme with nodes, definitions, and example codes from transcripts.

Parent theme	Nodes	Definition	Example codes from transcripts
Drought risk perception	Perceived Risk	Beliefs about potential harm or the possibility of a loss. It is a subjective judgment that people make about the characteristics and severity of a risk.	Risk to family income/livelihood; risk to crops/livestock
	Vulnerability	The predisposition to be adversely affected, barriers to adaptation (IPCC, 2014)	Lack of resources; Location more prone to impacts
	Adaptation	Process of adjusting to current or expected climate changes to mitigate harm or capitalize on opportunities (IPCC, 2014)	Adjust stocking rates, sustainably use water

respondents were at least "moderately" concerned about drought in the next 5 years. The following results related to perceptions of risk and community preparedness, emotions, and communication habits support our research questions. See Supplementary material for additional descriptive statistics.

3.1.1 Risk perceptions

Respondents reported greater perceptions of water-related risks to the environment (plants and animals) than to themselves personally. A majority of respondents (69.1%) see "a lot" or "an extreme amount" of risk that water-related risks pose to plants and animals, compared to 21.6% who reported "a moderate amount" and 9.3% reported "none" or "very little." Yet, few respondents (18.2%) think water-related risks pose a large risk to them personally; 32.5% reported "a moderate amount" of personal risk and 49% reported "none" or "very little" risk.

3.1.2 Community preparedness perceptions

Respondents are unsure if their community is prepared to address future water-related risks. Most respondents are unsure (43.5%) if their community has the necessary information to address future water-related risks, with 28.5% of respondents agreeing their community has the necessary information and 28.1% disagreeing. Most respondents are unsure (54.7%) if support is available in their community to offset the costs of water-related risks, with 31.2% of respondents disagreeing that support is available and only 14.1% agreeing support is available. Even though Wyomingites are unsure if their community is prepared, many open-ended survey responses welcomed community preparedness. This respondent statement illustrates the preparedness desire: "This issue needs to be addressed at a more local and statewide level so everyone can try to get on the same page."

3.1.3 Emotions

When asked to consider a variety of emotions that respondents felt about water-related risks in their community, Wyoming residents generally reported low levels of all emotions. When making comparisons among the emotions, worry and hopefulness emerged as top emotions. Also, when asked about their levels of interest and alertness to water-related risks, people expressed even higher levels than worry and hopefulness. Some (19.5%) respondents felt "a lot" or "extremely" worried about water-related risks in their community, and 25.3% of respondents felt "moderately" worried. More than half of respondents (55.3%) reported being "not at all" or "very little" worried, while 20.2% of respondents felt "a lot" or "extremely" hopeful about water-related risks in their community. Almost the same number of respondents felt "moderately" hopeful (39.9%) and "not at all" or "very little" hopeful (39.8%). A similar split of 34.6% of respondents felt "a lot" or "extremely" alert about water-related risks in their community and 34.3% of respondents felt "moderately" alert. Slightly less than a third of respondents (31.1%) felt "not at all" or "very little" alert. Like the percentage of people who have experienced recent droughts, 45.1% of respondents felt "a lot" or "extremely" interested about water-related risks in their community and a third of respondents (33.0%) felt "moderately" interested. 21.8% of respondents felt "not at all" or "very little" interest. The following statement is an example of worry from one openended response in the survey: "Over the past 10 years, I have noted a definite decrease in the water levels at Glendo, Horseshoe Bend, Boysen and Alcova [reservoirs]. I have lived in Wyoming all my life and it saddens me to see this decrease." An example of hopefulness from one respondent: "Water is an issue but I'm hopeful we can find solutions and get better with our use."

3.1.4 Communication habits

Respondents rarely communicate about water-related risks and similarly spend little time talking about how to deal with water-related risks. Respondents spend little time talking about how to deal with water-related risks in their area: 57.6% reported "none" or "very little," 26.7% reported "some," and 15.7% reported "a lot" or "a great deal." Likewise, respondents spend little time sharing information about water-related risks in their area: 48.5% reported "none" or "very little," 26.7% reported "some," and 24.8% reported "a lot" or "a great deal." This statement from a survey respondent demonstrates Wyomingites' uncertainty about where to turn and how to inform themselves: "This might be more about how I seek out information than about how information is actually distributed, but I do not feel very well informed at all about local water issues, and I would not know who to vote for or what things I should be advocating to make sure we do not screw ourselves over in the near future."

3.2 Results from participatory scenario planning workshops

Across the three Wyoming communities where we held our PSP workshops, the most frequently perceived risks were risks to the community's safety and wellbeing; risks to family income/livelihood; risks to crops/animals; and risks to local ecosystems. The most frequently cited vulnerabilities were that their location was more prone to climate-related impacts because it is already an arid region. The variability of water availability was the second most cited vulnerability that affects Wyoming's main economic sectors. And finally, the third most frequently cited vulnerability was a lack of resources (e.g., increased costs and lack of water), and the inability of the system to cope with change (e.g., crops need specific temperature and moisture to thrive). The most common adaptive responses to the scenarios were to sustainably manage water; limit water use in residential areas; and limit water use in agricultural areas. Wyomingites are no strangers to drought. In all three workshops we heard versions of the phrase, "We've always gotten through the challenges, and we always will." This sentiment reflected the resilience of the community, and their shared pride in personal independence coupled with neighborly cooperation as the source of their strength. These statements also support the relatively high levels of "hopefulness" that the statewide survey results revealed. When asked to consider the future parched scenario, participants across the three communities shared the attitude of "we have always just adapted and will continue to adapt." Across the three communities, participants' past experiences with climate in Wyoming were very similar to the future parched scenario, which allowed participants to think about the ways they adapted in the past and apply those strategies to the future.

3.2.1 Results from envisioning past and future drought scenarios

In discussing past drought experiences and envisioning future warmer scenarios, participants shared and relived their predominant emotion: worry (coded an average of 68 times across the three communities); this finding from the workshops supports the statewide

survey results that identified worry as top emotion. Despite perpetuated worry from stressors like wildfires and a lack of water for agricultural livelihoods, community participants also shared sadness, hope, calm, conviction, and enthusiasm as the most coded emotions after worry. These shared emotions, connected through shared experience, amplify individual and collective voices and encourage open and earnest dialog about climate and water-related risks and their impacts on rural Wyoming communities. For instance, a couple of Sheridan workshop participants echoed their optimism for adapting to drought, as they have in the past. One mentioned, "I'm pretty optimistic, you know, for my industry—cattle and agriculture." Participants shared their concerns and shifted toward constructive discussion on how their communities can become more adaptive and proactive in the face of drought instead of silencing voices through fear, anxiety, and worry.

In examining social adaptations to past and future scenario drought conditions, we coded most frequently the importance of perseverance and being as adaptive as possible. The third most common code was neighbor and community support, illustrating value placed on supporting community members outside of the family during stressful times. By recalling the shared value of their resilience as a community, the unique context of Wyoming culture was acknowledged as a strength. Our results illustrate how combining past and future scenarios in one workshop enhanced the availability and affect heuristics, thereby reducing the distance heuristics (Part 1 Looking Back).

One of the most important overall results from our workshops is the relational communication that ensued between participants at all three workshop locations. This is notable given: (1) The conservative nature of Wyoming, as stated in Section 1.4; and (2) Our statewide survey results confirmed the existence of a spiral of silence in which people reported they did not speak with others about recent climate and water-related risks. Our workshop data indicates participants discussed issues that they likely did not talk about before in a public group setting. Additionally, participants consistently and productively discussed both past and future water-related risks during workshop Parts 1 and 2. Collectively participants shared stories about their pasts, and from that space of shared social knowledge and trust, they proceeded forward, applying prior adaptive capacity to consider future adaptations. This relational communication created a narrative transportive environment, from the past to the future. Thus, the workshops and ensuing discussions themselves were opportunities to build trust for both participants as well as facilitators. Although, the post-workshop evaluation survey should have included an explicit question about trust, nevertheless, post-workshop evaluation survey results (Section 3.2.2) show over 70% of participants willing to engage in future scenario workshops, which is an indication of trust in our methodologies. Additionally, participant engagement throughout the entire workshop engendered trust, helping lead to the unwinding of the spiral of silence observed in our statewide survey results. In other words, the lively and rich discussion we captured in our workshop data would not have been possible without participant trust, both in each other, and the trust engendered by the workshop design.

3.2.2 Post-workshop evaluation survey results

After each workshop, we asked participants to reflect on their experience with a brief post-workshop evaluation survey. The survey's purpose was to show what participants took away from the experience and to give us a way to assess the value of scenario planning workshops. Participants were asked which scenario—the Parched or the Damp—was more likely to occur in their location. They were also asked how their understanding of potential future scenarios had changed because of workshop participation and whether they felt prepared to engage with their communities on this topic. Additionally, we asked what types of potential impacts on water resources would prompt them to prepare for future changes in temperature and precipitation.

Of the 27 community workshop respondents from their respective communities of Torrington, Sheridan, and Powell, 21 participants took the evaluation survey. Based on responses, 67% of participants shared that they learned more about future water scenarios; 71% declared they are prepared to engage in future scenario workshops; and 86% wished to help their communities understand the potential futures (i.e., Parched or Damp). At least 64% of participants agreed that they were more likely to prepare for potential future changes in temperature that would impact water resources if the changes were more likely to impact them. The specific impacts most often cited as important were (listed in descending order) personal water consumption and use; reservoir depth and stream flows; and community.

Participants' comments that suggest the value of the workshop for unwinding the spiral of silence include their responses to a question asking them about their most crucial takeaways from the workshop: "Understanding different peoples [sic] opinions on how water patterns will affect them."; "The way people think about the future."; "$ Communities need funding to be prepared to handle adverse climate change and increasing natural disasters."; "Big picture—who is responsible, where does the money come from, etc."; "That discussion of such things is important."; "Being prepared for uncertainty is probably the best approach for every potential scenario."; "It is important to work together in preparing for future weather conditions. Also, it is very hard to imagine what the implications of future wetter scenarios would be." These comments suggest that the workshop lowered pluralistic ignorance (which is the idea that people think their thoughts are different from other members of their group which generates a social level of ignorance); reduced the distance bias as people considered impacts to their families, lifestyles, and communities; and opened their imaginations to consider financial implications for adapting at a community scale; as well as the difficulty of imagining an unprecedented possible wetter future.

These post-workshop survey results demonstrate that participants were engaged in the topic and discussion. We can also confirm anecdotally that during post-workshop conversations, participants expressed deep appreciation for the opportunity to participate, as did Extension professionals and facilitators. Suggestive of our success in unwinding the spiral of silence, 91% of respondents agreed or strongly agreed to the statement: "I think scenario workshops are effective ways to help Wyoming communities anticipate potential future water scenarios." In the open-ended comments section of the post-workshop survey, 12 respondents highlighted the need to prepare and adapt to a changing climate, no matter the conditions; and four respondents described the value and utility of listening to others' perspectives on these issues. Our results suggest a connection between scenario planning design, in support of storytelling, which builds trust in positive and open communication that contributes to unwinding the spiral of silence in rural communities.

4 Discussion

The overarching goal of our mixed methods study that integrated statewide survey results and scenario planning workshops was to engage community members in conversations on water-related risks (e.g., droughts) to unwind the spiral of silence associated with future climate change risks. By achieving this, we allowed for the possibility of enhanced co-production of adaptation strategies for greater community resilience in the face of increasing temperature and variable precipitation. Facilitator and participant reflections on the workshop provide an early indication that the social learning space cultivated adaptive capacity and began to unwind the spiral of silence.

4.1 Reflections on theory, methods, and research goals

This research contributes to theories of science communication, unwinding the spiral of silence, and participatory scenario planning in rural areas. Reflecting on our approaches related to science communication theory, we increased trust with our community members by working with, rather than against, their perceived biases. With regards to the spiral of silence theory in rural communities that have strong ties to energy production, our community-based workshops provide an opportunity to support shared experiences, collective learning, and action. Reflecting on PSP theory, our workshop activities reduced end-point bias, took advantage of the availability and affect heuristic, and shortened participant's psychological distance to climate change. Additionally, our PSP workshops had clearly defined audience-specific behavioral goals and associated objectives. We benefited from the efficacy of narrative as a modality by having participants tell stories, thus improving the chance for local engagement and action. We make space in the workshop for multiple and conflicting narratives—those local narratives most essential for co-production of adaptation plans that reflect local values—without compromising the fundamental information our climate scientist and hydrologist bring to the table: it is getting warmer, which impacts the water cycle, making water futures more uncertain.

Our mixed methods approach using statewide survey results was useful to support the design of our PSP workshop instrument and scenarios. Reflecting on our PSP methodology, we incorporated an innovation of allowing participants to look back and share their experiences with past drought to build trust and confidence before moving into forward-looking scenarios. We incorporated a second innovation of using cartographic animations (Figure 3) as a narrative transport tool that provides a pivot for connecting past experiences to imagining future risks. The pro-social topic of water, introduced in our PSP workshop Part 1, was ushered into a discussion that transitions into future warmer temperatures that are woven into the scenario narrative of Part 2. By incorporating our innovations into our PSP workshops, we succeeded in creating social conversations in which participants discussed impacts and strategies in two possible warmer futures. By focusing on participants' personal and economic relationships to water and respecting their place-based knowledge of past responses to water-related risks, we created spaces for participants to collectively unwind the spiral of silence.

Reflecting on our research questions, results from our statewide survey provided context on perceptions of seasonal warming and water-related risks that we used in our PSP workshop instruments. By facilitating discussions about water-related risks (as a proxy for climate change), the workshops also provided participants with an accurate understanding of what others in their community perceive and believe about the topic, thus addressing science communication and uncertainties presented in our introduction. This project made space for storytelling in local communities. One respondent noted they had never heard one of the stories shared about narrowly averting a tragedy before, though they were familiar with the people in the room. There was significant laughter, warmth, earnestness, and dialogical social learning reported from all three workshops. We argue that the enthusiastic engagement that resulted during all our workshops was possible because our workshop design engendered trust among peers to discuss the inevitability of warmer futures. In doing so, we circumvent evidence of self-silencing due to the misperception of public opinion about others' beliefs of climate and water changes (Landreville, 2024). Our innovative past/future workshop structure, designed by our interdisciplinary research team, was anchored in local knowledge (e.g., Sherpa, 2014) for the purpose of building trust among our Wyoming community members, even though our statewide survey results indicated high levels of self-silencing.

4.2 Lessons learned

Three key lessons were learned from the scenario workshops: (1) leverage existing relationships between local Extension professionals and communities; (2) attempt to recruit a diverse range of community voices and focus on creating opportunities for dialog rather than seeking consensus; and (3) interpret participants' personal experiences with water-related risks and their curiosity about climate data as an opportunity to establish source credibility.

4.2.1 Leverage existing relationships of local extension professionals

We assembled the workshop invitation lists based largely on the recommendations of Extension professionals and our previous knowledge of and interactions with the local communities. Our workshop design focused on trust; therefore, partnering with Extension professionals was a necessity for bringing community members who trusted those professionals to the table. By working with Extension professionals, we recognize a potential bias or lack of diversity present in our participant pool; however, building trust was at the forefront of our PSP design. In the context of Wyoming, as a predominantly rural state, reliance on local Extension professionals in assembling the workshop invitation lists was vital to our project's success. Our local Extension contacts also attended the workshop in their home community as participants. This contributed to making the other participants comfortable and setting the tone for a productive, informative, and engaged discussion (Clark et al., 2023).

4.2.2 Recruit a diverse range of voices and focus on creating conversation (not consensus)

We sought representation from a diverse range of occupations and economic sectors. Participants were ranchers, agricultural service

providers, city/county employees and elected officials, soil and water conservation district employees, land-trust representatives, land-use planners, employees from state/federal land-use agencies, bankers, and real estate sector. By promoting conversations among participants with diverse perspectives, the focus groups reduced misunderstandings about others' opinions.

Although workshop participants were diverse, they may not have been truly representative of overall community views on water-related risks or climate change. Future workshop recruitment should include networks outside Extension professionals, such as Chamber of Commerce, Head Start, or religious organizations to increase diverse community voices, especially those most vulnerable to water-related risks or climate change impacts. One workshop invitee declined to participate due to the perceived bias of our group toward a "climate agenda." There may have been other invitees who failed to respond to our invitation request for similar reasons.

However, some participants expressed—and were comfortable expressing—both skepticism about the science and diverse views regarding the causes of changes in temperature and precipitation, suggesting that our invitation and framing of the event did not discourage individuals with diverse views from attending and participating. The questions and alternative views raised during the workshops opened novel spaces for conversations that were rich with variability. The workshops raised nuanced, locally relevant perspectives, thereby providing participants with a more accurate understanding of the broader social perception of risks. Indeed, many participants decided to stay and keep talking to other participants after the formal conclusion of the workshop by the moderator.

Finally, our goal when recruiting participants was not to provide a representative snapshot of the community's views on climate change. Regardless of whether participants' views on climate change were as diverse as possible, we opened up a space for conversations that were not naturally occurring with people who cohabit a rural community, thus meeting the project objectives.

4.2.3 Establish source credibility

When workshop participants first viewed Figure 1, they asked where and how the climate data was generated. Thus, researchers must anticipate that participants will be curious about the sources of scientific data used in scenario descriptions. It is critical to view participant questions about climate data as opportunities to establish source credibility (i.e., expertise/competence and trust/warmth) as opposed to viewing participant questions in a negative, skeptical, or combative manner. We suggest that facilitators introduce slides with clear communication about the agency or researchers who collected the climate data. Be prepared to provide details that reveal the accuracy and reliability of climate data. This will enhance the participants' perception of expertise and competency. Facilitators should also be prepared to respond to questions about climate data with appreciation, respect, and personal narratives or connections to the collection of the climate data. This will enhance trust/warmth with the participants. As Fiske and Dupree (2014) note, using a curious-minded educational approach is more effective in building trust in science than using a persuasive approach. Scenario workshops can create spaces for productive and trustworthy relationships among researchers and community members if source credibility is established by respecting participants' curiosity about climate data.

4.3 Next steps

This project had three parts, (1) to assess perceptions of recent climate extremes (drought) through a statewide survey; (2) to develop a scenario planning workshop instrument; and (3) to assess perceptions of future climate extremes through targeted community-based scenario planning workshops. Our overarching goal was to identify shared risk in a narrative modality of storytelling to unwind the spiral of silence and facilitate co-production of adaptive capacity. From a research perspective, the workshops provide a positive, descriptive assessment of rural agricultural community perspectives on potential future impacts of increasing temperatures forcing changes in the hydrologic cycle associated with greater uncertainty about precipitation [e.g., when it arrives seasonally; how it arrives (rain or snow) and how much arrives]. Finally, from an Extension and outreach perspective, the workshops provided us with guidance on what additional information and research will best meet stakeholder needs.

Many participants and involved Extension professionals expressed interest in continuing workshops for themselves and others they thought would be interested. The research group may conduct additional workshops in other Wyoming communities, ideally at the invitation of local community members. Alternatively, the workshop format, script, visuals, and participation elicitation methods deliver a replicable process that other groups (local Extension professionals, public planners, or similar) can utilize in other communities and for other hazards to begin conversations around actionable adaptation strategies. Adoption of workshop materials by others would result in location-based evolutions needed to grow meaningful grassroots responses to future climate change.

To conclude, the following principles were the basis of our workshops. First, many individuals in rural regions such as Wyoming are reluctant to speak about climate change because they believe they hold a minority opinion, leading to anxiety and fear, which prohibits action. We consequently sought to make a social space where participants learn more about the beliefs and opinions of others in their community, thereby reducing pluralistic ignorance. Second, our team understands anthropogenic climate change and does not compromise on presenting the science. We consequently delivered the following scientific understanding through scenario narratives: Warming temperatures coupled with precipitation variability equals enhanced water-related risks. Framing the workshop in terms of pro-social attitudes about discussing water-related risks allowed us to engage with community members. Third, local knowledge of past events and associated adaptation and mitigation strategies impact and inform current perceptions of risk. We specifically include local knowledge of past events and associated adaptation and mitigation strategies in the workshop design. Finally, interpersonal activities that reduce barriers to communication between climate and adaptation sciences and outreach networks may support preparedness activities. Thus, we allowed best practices in science, risk, and science communication to guide the workshop format, script, and visuals, allowing us to work with rather than against human nature. The value of providing space for deliberative dialog cannot be overstated. Participatory scenario planning moves participants from sitting alone with questions and concerns about their experiences to thinking and discussing with others about how they would plan, mitigate, adapt, and respond. Our open-ended questions did not push workshop

participants to normalized answers, allowing them the latitude to move into solutions as part of their deliberation. It is a strength of our context to work with people who express skepticism and denial, not a weakness. Public participation in climate adaptation cannot proceed without bridging this divide.

Data availability statement

The datasets presented in this article are not readily available because the presenter script for this study can be found in Supplementary material. Post-workshop evaluation surveys remain confidential under University of Wyoming Institutional Review Board Protocol#20230223KL03494. Requests to access the datasets should be directed to klandre@ncsu.edu.

Ethics statement

The studies involving humans were approved by the University of Wyoming Human Subjects Research Review Board. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fclim.2025.1398452/full#supplementary-material

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