



Original research article

Participant perspectives on effective elements and impacts of climate change adaptation workshops in the United States

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ABSTRACT

Communities in the United States are increasingly relying on place-based climate adaptation workshops to aid attempts to prepare for—and cope with—climate change, but there is limited empirical evidence about what participants believe these workshops can achieve and what elements they find most valuable. To begin addressing this gap, we sought to understand participant perceptions of effective workshop elements and outcomes across a wide range of locations and workshop formats. We surveyed participants in 33 place-based adaptation workshops that took place in the United States between 2017 and 2020. We sought to understand participants' perceptions of the outcomes of these workshops and the workshop elements that drove those outcomes. Results suggest that workshop participants commonly believed that they learned, strengthened their sense of efficacy, and deepened relationships with other workshop attendees. Participants identified specific climate actions resulting from the workshop, including knowledge dissemination efforts and project implementation. We argue that effective adaptation workshops can also expand reference groups and foster norms around climate change adaptation.

Practical implications

Place-based climate change adaptation workshops are an increasingly common approach used by communities to prepare for the impacts of climate change. Place-based adaptation workshops, which we define as *convenings or series of convenings designed to help multiple stakeholders develop strategies for adapting to climate change in a specific place*, vary widely in duration, structure, and scope, but they generally share some common attributes, such as facilitating groups to jointly assess risk, identify vulnerabilities, and design strategies for action. Workshops may focus primarily on specific sectors, such as natural resource management or urban planning, or they may bring together diverse stakeholder groups to focus on vulnerabilities, risks, and opportunities for action across sectors. In this study, we sought to understand prior participants' perceptions of the outcomes of place-based adaptation workshops they attended and the attributes of the workshops they felt were most important for catalyzing meaningful outcomes.

We conducted online surveys with participants and interviews

with facilitators and local conveners of 33 place-based climate adaptation workshops conducted between 2017 and March 2020 in the United States that lasted at least half a day and involved at least 10 participants. We excluded processes that encompassed entire states or larger regions, thereby limiting the sample to those focused on specific geographies within which tangible adaptation activities could reasonably take place.

The 33 workshops were attended by a total of 914 participants, 57 % of whom responded to our survey. We interviewed 67 facilitators and local conveners. Twenty of the workshops were focused on adaptation for specific natural areas, such as national parks or forests. Nine focused on urban settings, with two focusing on natural resources within an urban context (i.e., incorporating adaptation into a city's urban tree management plan and a university grounds management plan). One workshop focused on small communities within a broader rural context, and another included a mix of rural and urban communities. Seven of the workshops took place in California, three occurred in Colorado, and the remaining workshops took place within a mix of 17 other states.

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Our results reflect participants' perceptions that place-based adaptation workshops could achieve meaningful outcomes in at least four broad areas: *Learning, relationships, efficacy, and actions*. Participants reported learning both as individuals and within groups. This included learning *new information* about climate change and projected impacts; *new skills*, including how to enact strategies to adapt to climate change or where to access resources, and *new perspectives*, including shifts in thinking to encompass different geographic and temporal scales. Most participants felt they *strengthened relationships* during adaptation workshops. Participants reported that these changes occurred both within and across organizations and disciplines. In some cases, these enhanced relationships resulted in the formation of new groups or collaboratives, or improved communication within the network of people working in climate adaptation in the area. Participants also indicated that the workshops they attended enhanced feelings of *self- and collective-efficacy*. That is, they felt that the workshop strengthened their belief that their actions will have an impact, both as individuals and as a group working together. Finally, participants identified three kinds of actions that resulting from workshops: *intermediate products* stemming from workshops, such as workbook outputs and assessments; *plans, projects, and initiatives*, such as incorporating climate adaptation into formal planning documents or changes to practice; and actions related to *knowledge distribution*, such as sharing informational resources or giving presentations about climate adaptation. Fifty-eight percent of respondents reported that the workshop they had attended contributed to local climate adaptation actions. Only 2 % of respondents reported that the workshop they attended did not advance adaptation in the area, and 41 % expressed uncertainty.

Participants' perceptions of workshop elements that positively influenced outcomes can be broadly categorized as relating to opportunities for *varied interactions with a diverse group* of participants; the availability of *useful materials and opportunities to practice* using them; the roles of *high-quality facilitators*; and a focus on *real-world, local applications linked to ongoing responsibilities* or projects. Participants valued workshops where attendees brought a range of backgrounds, roles, and areas of expertise. They also valued seeing both new and familiar faces at workshops and having time to both strengthen existing relationships and develop new ones. They valued variety in the kinds of opportunities for engagement during adaptation workshops, including breakout groups, expert presentations, open discussion, report-outs of breakout activities, and time for networking and collaboration. They especially valued opportunities to try out tools, data, and other materials shared during the workshop. Participants also highlighted the value of high-quality facilitation in adaptation workshops and identified a range of useful roles facilitators can perform, including creating a structure for the workshop with a clear agenda and objectives; advancing the workshop by keeping people on track, taking notes, and organizing logistics; sharing their own expertise and helping frame the overall orientation of the workshop; and enabling positive social processes by balancing power dynamics and promoting participation. Finally, participants valued workshop content oriented around real world applications linked to their ongoing work, responsibilities, and projects. This included a focus on concrete examples, locally applicable research, success stories, specific strategies tailored to their context, and scenario planning that focused on exploring a range of possible futures.

Our findings suggest that as the need for climate adaptation grows, place-based workshops could play an important role. Effective workshops convene key actors with diverse perspectives and provide tools, examples, and data calibrated to the needs of the participants. They can advance learning for adaptation, strengthen networks, enhance feelings of efficacy, and contribute to a range of action outcomes.

Data availability

Data will be made available on request.

Introduction

Climate change adaptation is “the process of adjustment to actual or expected climate and its effects in order to moderate harm or take advantage of beneficial opportunities” (IPCC, 2022). At its core, climate change adaptation constitutes an effort to manage change, and, therefore, can be considered an ongoing evolutionary process rather than movement toward a predetermined endpoint (Stein et al., 2013). Although there is no one-size-fits-all approach to climate change adaptation, some similarities have emerged in the ways different regions and sectors are planning for adaptation. These approaches include engaging stakeholders in the process; sharing best practices; and promoting iterative, action-oriented learning (Bierbaum et al., 2013). Organizations and communities are increasingly relying on educational and capacity-building events, such as place-based climate adaptation workshops, to aid these efforts (Biagini et al., 2014). We define place-based adaptation workshops as *convenings or series of convenings designed to help multiple stakeholders develop strategies for adapting to climate change in a specific place*.

Adaptation workshops vary widely in duration, structure, and scope, but they generally share some common attributes, such as convening groups to jointly assess risk, identify vulnerabilities, and design strategies for action (Brunner & Nordgren, 2012). Workshops may focus primarily on specific sectors, such as natural resource management (e.g., McCrum et al., 2009; Stein et al., 2014) or urban planning (e.g., McEvoy, van de Ven, Blind & Slinger, 2018), or they may bring together diverse stakeholder groups to focus on vulnerabilities, risks, and opportunities for action that transcend sectors (Plate et al., 2020; Tuler, Dow & Webler, 2020). Workshops may also serve as spaces where groups deepen relationships and share knowledge (Stern et al., 2020).

Given the scale at which climate adaptation will likely be necessary over the coming decades, there is a need for additional empirical evidence about the practices that make it effective. In response to this need, we address the following research questions:

- 1) What do participants in place-based climate adaptation workshops believe they have accomplished?
- 2) What elements of these workshops do participants believe most catalyze outcomes?

Literature review

Climate adaptation is a process, not merely a destination, and as such, it can challenge concrete or linear conceptualizations of outcomes and success (Vogel et al., 2014). The breadth of contexts in which adaptation efforts are undertaken further complicates aspirations for universal metrics of adaptation success (Ford et al., 2015; Leiter et al., 2019). However, studies of adaptation initiatives and related collaborative processes have identified several broad categories of outcomes that could be indicative of successful adaptation (Smit & Wandel, 2006; Owen, 2020). These outcomes reduce vulnerability by strengthening social, economic, and environmental systems. They also enhance adaptive capacity, which is the ability of a system to respond to, cope with, or recover from hazardous conditions (Owen, 2020; Smit & Wandel, 2006).

Drawing on insights from prior research, we focus on four categories of outcomes that might result from climate adaptation workshops: learning outcomes, relationship outcomes, efficacy outcomes, and action outcomes (Stern et al., 2020; Bandura, 2000). These elements are thought to be necessary, but not sufficient, for the successful

management of climate adaptation processes (Baird et al., 2016; Thaker et al., 2016; Tàbara et al., 2010). They can unfold at individual and collective levels and in a nonlinear manner (McEvoy, van de Ven, Blind & Slinger, 2018). These outcomes may also influence one another. For example, collective learning could result in strengthened relationships among participants, and undertaking adaptive actions could, in turn, contribute to enhanced feelings of efficacy (Doherty & Webler, 2016). Each outcome area is discussed in greater detail below.

Learning outcomes

We consider three domains of learning: declarative, procedural, and perspective-shifting knowledge production (Kaiser & Fuhrer, 2003; Nguyen et al., 2019; Wals & Corcoran, 2006). Declarative knowledge relates to understanding of facts, information, concepts, or interactions (Cooke, Salas, Cannon-Bowers & Stout, 2000). It is akin to “know-what” knowledge and to Bloom’s factual and conceptual dimensions of knowledge (Anderson & Krathwohl, 2001; Garud, 1997). In a climate adaptation context, relevant declarative knowledge could include understanding climate projections for a geographic area and the risks to different categories of valued assets. Procedural knowledge relates to understanding the “steps, procedures, sequences and actions” necessary to undertake an action and aligns with “know-how” knowledge (Cooke et al., 2000, p. 153). Procedural knowledge relevant to climate adaptation could include methods and techniques that help individuals and groups respond to current and projected climate impacts, such as knowledge about how to use structured decision-making tools or how to implement alternative irrigation strategies during a drought (Truelove et al., 2015). Perspective-shifting knowledge describes altered meaning structures or frames of reference (Mezirow, 1997). Wals & Corcoran (2006) identify four perspectival shifts for sustainability, which are potentially relevant for climate adaptation: transdisciplinary (including perspectives of different professions, or academic disciplines), trans-cultural (understanding perspectives across cultural, racial, ethnic, religious and other boundaries), transtemporal (broadening the perspective to include the past, present, or future), and transgeographic (adopting a perspective considering a wider or different geographic scale). Perspective shifts can be triggered by changes in declarative or procedural knowledge, but do not automatically follow from learning within those domains.

Learning can occur at individual and collective levels. Individual learning occurs independently within a person, such as when someone reads a book about climate change adaptation, or when a group of interested citizens attend a documentary screening and each draw their own conclusions. In contrast, Gerlak and Heikkilä (2011) define collective learning as a group process that may include acquiring, evaluating, and sharing knowledge within a group as well as the products resulting from the process, such as shared ideas and understandings. Collective learning and related concepts, such as social learning, are thought to be especially important for environmental management and frequently constitute goals of participatory adaptation planning processes (Armitage et al., 2008; Mayer et al., 2005; Newig et al., 2010). In a dynamic social-ecological systems context, collective learning might lead participants in a planning process to develop a more comprehensive, shared understanding of all stakeholders’ priorities and to select different adaptive actions as a result (Suškevičs et al., 2018).

Declarative, procedural, and perspective-shifting learning by individuals or a collective are on their own often insufficient for spurring collective action (Hansen et al., 2003; Heberlein, 2012; Kellstedt et al., 2008). Other attributes of collaborative processes—such as relationship attributes of the collective, efficacy beliefs, values, and norms—and contextual factors—such as political climate or salient environmental impacts—are also critical variables linked to decision making and behavior (Bandura, 2000; de Vente, 2016; Stern, 2000; Stern, 2018).

Relationship outcomes

Relationships profoundly influence collective processes (Powell & Grodal, 2005; Provan & Milward, 1995; Nowell et al., 2017; Stern & Coleman, 2015). Climate adaptation workshops and related community-based climate change adaptation planning processes can instigate shifts in the network structure and the qualities of relationships among the actors involved in climate adaptation (Baird et al., 2014). Potential changes to the quality of relationships include dimensions of trust (Coleman & Stern, 2018), awareness of network function and structure (Schiffer & Peakes, 2009), and perceptions of goal alignment (Drath et al., 2008), among other aspects. These shifts in relationships can, in turn, influence other outcomes. For example, in a study of a multi-stakeholder sea-level rise management initiative in Maryland, Teodoro et al. (2021) found that relationships built on a foundation of reciprocal understanding, respect, and influence were associated with enhanced understanding of climate risk, impacts, and potential adaptive actions. Climate adaptation workshops offer one tool to influence the relational attributes of a collective, through a range of workshop elements, such as facilitated dialogue, small-group work, or informal conversations during breaks. These elements could allow workshop participants to establish and evaluate new connections and deepen existing ties within an adaptation-related context. Strengthened networks and deepened relationships constitute an important outcome of adaptation workshops and may contribute to other critical outcomes, such as feelings of efficacy, commitment to joint action, learning, and action (e.g. Slinger et al., 2023).

One mechanism by which relational outcomes of adaptation workshops could influence subsequent action is through processes of norm formation and reference group expansion. Norms are socially prescribed standards for behavior, and they are associated with many climate-related behaviors (Nolan, 2021). Reference group theory helps explain the process by which climate adaptation workshops could foster norms around climate adaptation and, in turn, promote collective action. Reference groups are the groups with whom individuals share cultural and normative commitments (Merton, 1968). Individuals use reference groups to help shape their values and attitudes about situations, and, as such, they are powerful drivers of beliefs and behaviors. Reference groups may be familiar individuals, such as family or co-workers, or more distant referents, such as politicians or thought leaders. Individuals can shift their reference groups over time, and events such as adaptation workshops could serve as venues where reference groups are updated and expanded.

Efficacy outcomes

People are more likely to act if they believe their actions will have impact, i.e., if people have a strong sense of efficacy (Bandura, 1982, 2000; Milfont, 2012; Thaker et al., 2016). Changes in beliefs about efficacy thus constitute another possible workshop outcome. Efficacy beliefs can involve perceptions of both individual and collective capacities. Self-efficacy beliefs encompass a person’s perceptions of their own ability to carry out a specific action and achieve desired outcomes (Bandura, 1982). Collective-efficacy beliefs relate to an individual’s assessment of a group’s overall capacity to do and achieve the same (Bandura, 2000).

In the domain of climate adaptation, van Valkengoed & Steg (2019) found that people’s self-efficacy beliefs were positively associated with adaptive behaviors such as seeking information about climate-related hazards, supporting climate adaptation policies, or taking preparatory actions. Similarly, other researchers have found that higher levels of perceived collective efficacy were correlated with greater collective climate action, including participating in community activities to safeguard water resources (Thaker et al., 2016). Research suggests that learning can contribute to feelings of efficacy by building on prior experiences, abilities, and goals. Increased feelings of efficacy can, in turn,

contribute to enhanced learning in an iterative “success cycle” (Brooks & Shell, 2006; Seel, 2011). Thus, the combination of deepened knowledge and strengthened efficacy beliefs could synergistically spur adaptive action when aligned with participant goals. This process may be especially powerful when relationships and commitments are also strengthened. However, while belief in efficacy may spur more action, it does not guarantee the action taken will reduce climate vulnerability. Evaluations of the degree to which actions actually reduce climate vulnerability were beyond the scope of this study.

Action outcomes

Scholars have articulated a broad range of adaptation-relevant actions that vary depending on the specific context within which adaptation is taking place (Biagini et al., 2014; Owen, 2020; Stults & Woodruff, 2017). These include capacity building and educational efforts; management and planning initiatives; organized advocacy and outreach; changes to practice, such as improved soil management techniques or integrated pest management; reforms to policies, codes, and zoning requirements; provisioning of information or adaptation technology; developing warning/observing systems; conducting research; and installing physical or green infrastructure. Although some adaptation workshops may aspire only towards educational outcomes, many are designed to move toward plans and actions within these action strategy areas. Adaptive actions can be taken by individuals (such as someone seeking information about climate projections in order to reduce their vulnerability or planting different crop varieties) or collectives (such as groups developing an adaptation plan or drafting new policies).

Attributes of successful climate adaptation workshops

Evidence suggests that specific elements of an adaptation workshop's design and content could promote outcomes that help advance adaptation. Across a range of professional-development and social-ecological contexts, scholars have identified attributes of events that are associated with enhanced outcomes. These elements include delivering materials matched to participant needs; eliciting long-term commitments; and promoting highly interactive processes, establishing clear objectives, and providing sustained support after the event (Lauer et al., 2014; Roche et al., 2009).

Effective facilitation can advance workshop outcomes through a range of avenues, including by fomenting deliberative processes, promoting trust, keeping participants on task, and helping collectives balance scientific understanding with other priorities (Coleman & Stern, 2018; de Vente et al., 2016; Turner Li et al., 2016). A recent study of the perceptions of climate adaptation workshop facilitators identified consensus-based valued practices for conducting climate adaptation workshops (Stern et al., 2023). These included strategies for before, during, and after a workshop. Prior to a workshop, key suggestions included identifying local champions; deepening facilitators' understanding of participant values, culture, goals, and knowledge; developing locally-relevant examples; and understanding contextual factors, such as extant management and planning structures. To effectively conduct adaptation workshops, facilitators suggested emphasizing clear goals and objectives, adjusting information and materials to match participants' level of knowledge, drawing on skilled presenters, sharing relevant success stories and using current and complete information. Additional suggestions included setting clear rules for interaction to ensure everyone has a voice, building in time for open discussion, being flexible and equipped with backup plans, eliciting commitments for post-workshop actions, and keeping the agenda realistic. Suggested strategies post-workshop included sharing relevant materials, such as documentation of workshop outcomes and priorities, developing a concrete plan for post-workshop action including roles, responsibilities, and timelines for future steps.

This study seeks to identify the learning, relationship, efficacy and

action outcomes that participants in place-based climate adaptation workshops believe resulted from the gathering they attended. We also seek to identify the attributes of adaptation workshops that participants indicate were most important for catalyzing those outcomes.

Methods

We selected candidate workshops for the study through several avenues. First, we solicited workshops from a panel of expert adaptation-workshop facilitators who participated in a related Delphi Study designed to elicit expert opinion on best-practices for adaptation workshops (Stern et al., 2023). This Delphi study was conducted from February 2019 to March 2020 with 22 adaptation workshop facilitators. In addition to the workshops identified by Delphi participants, we sent out calls on listservs and platforms used by adaptation workshop facilitators, including the Climate Adaptation Knowledge Exchange (CAKE) and the American Society of Adaptation Professionals (ASAP). Finally, we sought additional workshops via snowball sampling; we asked the facilitators of adaptation workshops in our sample for suggestions about additional workshops to include, and we followed leads with other workshop facilitators. Our goal was to identify as many workshops as possible that fit our criteria, described below.

We included workshops that were conducted between 2017 and March 2020. We selected this range to allow enough time for meaningful action to result from a workshop, but not so much time that participants would be unlikely to recall specifics about the event. Data collection for this study took place between July 2020 and March 2021. We included workshops attended by multiple stakeholder groups that took place within the United States, involved at least 10 participants, and lasted for a least half a day. We excluded processes that encompassed entire states or larger regions, thereby limiting the sample to those focused on specific geographies within which tangible adaptation activities could reasonably take place.

After interviewing workshop facilitators to assess the suitability of candidate workshops, we worked with facilitators to obtain contact information for workshop participants. We then emailed participants an invitation to an online Qualtrics survey. We emailed a follow-up reminder to nonrespondents one week later and sent a final request two weeks after our initial email. These research protocols were approved by the Virginia Tech. Institutional Review Board. We address possible biases that may have resulted from our methodology in the limitations section, below.

Survey overview

The survey contained both closed- and open-ended questions related to respondent perceptions of workshop elements and outcomes, their involvement in climate adaptation efforts, and the current state of adaptation efforts in the area. We analyzed open-ended questions to identify concepts, themes, insights, and nuances beyond those captured by closed-ended items. The lead author coded these responses through an iterative process of identifying and refining themes, then augmenting with additional codes on subsequent passes through the data (Bailey, 2017; Miles et al., 2018). The codes were discussed and vetted with co-authors throughout the coding process. Here, we describe the key measurements and analyses associated with each research question.

RQ1: What do participants in place-based climate adaptation workshops believe they have accomplished?

We assessed learning, relationship, efficacy, and action outcomes through open- and closed-ended questions. We first asked participants to opine on any meaningful outcomes that they felt happened specifically because of the workshop and that might not have happened otherwise. These write-in responses were coded qualitatively. We considered outcomes to be instances of individual learning when respondents indicated changes to their own understanding or knowledge. We considered reported outcomes to be instances of collective learning when respondents

reported the development of shared understanding within a group or identified changes in understanding or knowledge within multiple workshop participants. Relational outcomes were identified by participants reporting changes in network characteristics or altered relationships with other workshop participants.

We further assessed perceived self- and collective efficacy using closed-ended survey items. We asked participants to respond to the question: “Did the workshop enhance any of the following things for you?” for the following items:

- Your confidence that you can work effectively on adaptation in your area
- Your confidence that the people working on adaptation in your area can achieve success

Response categories were composed of a three-point Likert-type scale, with answer choices *Not at all*, *Somewhat*, and *A great deal*.

To further assess action outcomes, we first screened respondents by asking them whether they still lived or worked in the workshop’s target location and whether they felt they could meaningfully comment on what has happened since the workshop. This was done to account for individuals who may have moved away or became disengaged after the workshop. We asked those who passed the screening, “Did the workshop help stimulate adaptation actions in the area?” Response categories were composed of a four-point Likert-type scale, with answer choices *Not at all*, *A minor amount*, *A moderate amount*, and *A major amount*. We included an additional response option: *I am unsure of the workshop’s impact*. For each item, we report the percentage of respondents selecting each option across all workshops.

RQ2: What elements of adaptation workshops do participants believe most catalyze workshop outcomes?

We assessed participant perceptions of effective workshop elements through one open-ended and one closed-ended question. The open-ended question asked survey respondents to opine on the most effective components of the workshop they attended. Responses to this question were qualitatively coded. We then presented survey participants who still lived and worked in the workshop focal area and felt that they could comment on workshop outcomes with five workshop elements identified as important drivers of workshop outcomes in prior research (Stern et al., 2020). We asked them to indicate the extent to which each element had a positive influence on workshop outcomes. The elements were:

- The quality of the facilitator
- Pre-existing relationships between workshop attendees
- Realistic strategies developed during the workshop
- Commitments that people made during the workshop
- Leadership by specific individuals after the workshop

Response options were *No meaningful positive influence*, *A minor positive influence*, and *A major positive influence*. For each item, we calculated percentages for the extent of positive influence. We also calculated the proportion of respondents who selected each response option from each workshop. We share the range for all workshops with response rates of 50 % or higher. Although there is no agreed-upon standard for a minimum adequate survey response rate, we feel that if at least half of those who attended a workshop responded to our survey, the range of their answers would capture much of the breadth of participant experiences and perspectives for each workshop (Babbie, 1973; Draugalis et al., 2008).

Results

We identified 33 climate adaptation workshops that met our criteria, which were attended by a total of 914 participants. Attendance ranged from 10 to 61 participants, averaging 28. Workshops were held in-

person and ranged in duration from a half day to four days. Some of the multi-day workshops were noncontiguous, such as a two-day vulnerability assessment followed weeks or months later by a follow-up planning workshop. Others included activities outside the workshop itself, such as preliminary planning calls or sustained support from workshop organizers after the workshop. Several convenings were structured as a series of shorter sessions that occurred at regular intervals. Nine workshops took place in 2017, eight in 2018, 11 in 2019, and five in 2020. Twenty workshops were focused on adaptation for specific natural areas, such as national parks or forests. Nine focused on urban settings, with two focusing on natural resources within an urban context (i.e., incorporating adaptation into a city’s urban tree management plan and a university grounds management plan). One workshop focused on small communities in a broader rural context, and another included a mix of rural and urban communities. Seven of the workshops took place in California, three occurred in Colorado, and the remaining workshops took place within 17 additional states. Details on each workshop are provided in Table 1.

We received 431 responses to our survey, for a global response rate of 57 % of the participants for whom we had contact information. Response rates from participants in specific workshops were variable. In 21 of the 33 workshops, our response rates were at or above 50 %. Workshops whose response rate fell below this threshold are indicated with an asterisk in Table 1 and were excluded from workshop level-analyses. To examine possible impacts of the non-response bias in our sample, we compared respondents and nonrespondents by professional sector for

Table 1
Overview of climate adaptation workshops.

	State	Year	Focus	Duration	# Respondents/ # Participants emailed
1	SC	2017	Natural area	4 days	5/16 ^a
2	CO	2017	Natural area	3 days	9/21 ^a
3	GA	2017	Urban setting	1 day	10/18
4	CA	2017	Natural area	4 days	16/22
5	CA	2017	Natural area	2 days	4/7
6	WI	2017	Natural area	2 days	32/43
7	GA	2017	Natural area	2 days	13/15
8	CA	2017	Natural area	1 day	7/18 ^a
9	CA	2017	Natural area	2 days	8/19 ^a
10	ME	2018	Natural area	2 days	7/23 ^a
11	FL	2018	Natural area	2 days	13/17
12	NC	2018	Urban/Rural setting	9 3–4-hour sessions	11/35 ^a
13	NY	2018	Natural area	2 days	17/23
14	MI	2018	Natural area	1.5 days	16/25
15	WY	2018	Natural area	3 days	8/14
16	VA	2018	Urban setting	1 day	10/33 ^a
17	CA	2018	Natural area	0.5 days	5/10
18	AK	2019	Rural setting	4 days	8/28 ^a
19	CO	2019	Urban setting	1 day	4/7
20	FL	2019	Urban setting	5, 2–3-hour sessions	10/24 ^a
21	TX	2019	Urban setting	2 days	12/33 ^a
22	CO	2019	Urban setting / Natural area	1 day	18/23
23	NE	2019	Natural area	2 days	18/31
24	WI	2019	Natural area	2 days	17/25
25	NM	2019	Natural area	3 days	8/10
26	SD	2019	Natural area	3 days	7/12
27	ID	2019	Urban/Rural setting	1 day	6/19 ^a
28	CA	2019	Natural area	1 day	16/27
29	AK	2020	Rural setting	3 days	4/19 ^a
30	MD	2020	Urban setting	6, 1.5–2-hour sessions	11/22
31	CA	2020	Urban setting / Natural area	3 days	20/31
32	MD	2020	Natural area	2 days	34/55
33	AZ	2020	Natural area	2 days	22/28

^a Indicates adjusted survey response rate below 50%.

the subset of workshop participants for whom we had this information (269 workshop participants, representing 29 % of total participants). We categorized these participants within seven sectors: Federal government (n = 45), state government (n = 65), local government (n = 26), academia (n = 59), nonprofit (n = 53), tribal (n = 17), and private sector (n = 4). We ran a chi-square test of independence to examine the relationship between sector and survey response. The result was statistically significant, $X^2(6, N = 269) = 19.91, p = .003$. Post hoc analysis suggested that workshop attendees affiliated with local government disproportionately responded to the survey, whereas attendees affiliated with academic institutions disproportionately did not respond. Other groups did not differ in their response rate.

Workshop outcomes

Learning outcomes

Open-ended responses about learning were first categorized as individual or collective. Individual learning outcomes were described by the respondent as occurring within a single person. Learning outcomes were considered collective outcomes when participants explicitly stated that the change in knowledge or understanding was shared by more than one participant. Individual outcomes were further coded as procedural, declarative, or perspective-shifting learning outcomes. Few of the collective outcomes were easily classifiable as procedural, declarative or perspective-shifting. For example, one respondent noted that “*We also have a shared understanding and language,*” clearly reflecting collective learning, but not distinguishing between declarative or procedural knowledge, nor indicating a collective shift in perspective. Only four responses coded as collective learning were further classifiable. In each case, they aligned with procedural knowledge. For example, one respondent described a group’s newfound understanding of “*the use of forestry management as a specific tool for achieving climate adaptation and mitigation.*”

Individual and collective learning outcomes across all 33 workshops are described in Table 2. The most frequently reported learning outcomes were enhanced knowledge about climate projections and adaptation processes. Seven respondents reported generic learning outcomes, such as “*I learned a lot.*” We did not report these responses among the outcomes described in Table 2. Two respondents reported unique declarative learning outcomes, also not included in the table: *learning that affirms current approaches* and *learning about areas beyond the control of workshop participants*.

Relationship outcomes

Seventy-nine participants (18 % of respondents; including participants from 84 % of workshops) described strengthened networks and relationships in response to the open-ended prompt. Participants reported that these changes occurred both within and across organizations and disciplines. In some cases, these enhanced relationships resulted in the formation of new groups or collaboratives. For example, one respondent wrote: “*I met several folks at the meeting that I’m now actively collaborating with.*” Three respondents highlighted improved communication – for example, “*The most important thing was getting people from the various groups... in the same room talking about the same thing. We often talk past each other in these important issues, and the workshop both helped us to build relationships, and started a common vocabulary, or at least expectations for how future conversations might happen.*” Six respondents felt that the workshops they attended offered opportunities for potential progress toward diversity, equity and inclusion (DEI) outcomes. One respondent noted, for example: “*The workshops were very important for bringing Native American concerns for vulnerable natural resources to the fore. Workshops help to build solidarity and collaboration between the BLM and USFS on one side and members of the concerned public, other agencies, etc.*” Five respondents reported that workshops strengthened the

Table 2

Individual and collective learning outcomes.

Knowledge domain		Learning outcome	Example	n
Individual	Declarative	Knowledge about climate projections & impacts	<i>I learned about current research looking at which tree species that are not currently dominant in my region will do well in warmer climate conditions.</i>	43
		Knowledge about how to adapt to climate change	<i>I got a much deeper understanding of the challenges facing our urban forests and some of the ways to mitigate the impacts of climate change on this vegetation.</i>	50
		Knowledge about where to access resources for climate projections and adaptation	<i>Better understanding of what knowledge base is available about our forest, climate projections for... our region, and what climate analog regions to look at given those projections.</i>	17
	Procedural	Understanding of the skills, tools, and processes for climate adaptation	<i>I learned about a rapid climate vulnerability assessment and how to conduct one.</i>	14
		Understanding about how to communicate effectively about climate change and adaptation	<i>I learned a greater sense of how to convey the importance of the climate issue to the people my organization represents.</i>	14
		Knowledge about engaging in collective action processes	<i>I think it was informative for me as an early-career researcher (late-stage PhD student) to see how multiple organizations (state and federal government scientists, academic researchers, etc.) came together and identified common goals and priorities when it came to climate change.</i>	5
Perspective shifting	Perspective shifting	Shifts in focus or broader changes in thinking and understanding	<i>The Emergency Manager got a broad perspective with which to prioritize the City’s preparedness efforts for countering the various threats/risks.</i>	30
			<i>The realization that culture and cultural impacts aren’t normally part of the CC conversations, workshops, etc. and it was important to change that.</i>	

(continued on next page)

Table 2 (continued)

Knowledge domain	Learning outcome	Example	n
Collective	Development of shared understandings among participants	<p><i>Collaborative thinking, including getting differing points of view from folks in differing workplaces.</i></p> <p><i>—</i></p> <p><i>We were able to work together to assess potential impacts... to key resources. We also came up with some management strategies to respond to those impacts, and in some cases, came to the realization that we needed to “let some things go” that would be out of our control.</i></p>	39

network of actors engaged in climate adaptation by spreading norms around adaptation: “One outcome was a demonstration of the [staff’s] commitment to climate change adaptation. It is really important to see this engagement and commitment and should represent an example for other land managers.”

Efficacy outcomes

Participants indicated that the workshops they attended enhanced feelings of self- and collective-efficacy. In response to closed-ended survey items 35 % of respondents reported that the workshop they attended enhanced their sense of self-efficacy a great deal, and 33 % of respondents indicated the same impact on their sense of collective efficacy (Table 3). Ninety-six percent of survey respondents felt that the workshop they attended at least somewhat enhanced their sense of self- and collective-efficacy. Five respondents focused on enhanced feelings of self-efficacy in their open-ended responses. For example, one respondent noted, “I gained confidence and was inspired to include considerations for climate change in my work.” Another explained strengthened feelings of collective efficacy: “One of the exercises about what we could do in our current role to improve/strengthen combating negative climate effects was eye opening. It helpful to hear what others in my group felt they could do and weigh that against what I think/thought I could do.”

Table 3
Extent to which the workshop enhanced self- and collective-efficacy.

Outcome Area	Item		Not at all	Somewhat	A great deal	n
Self-Efficacy	Your confidence that you can work effectively on adaptation in your area	Total Range ^a	4 % 0–14 %	61 % 38 %–100 %	35 % 0–56 %	325
Collective-Efficacy	Your confidence that the people working on adaptation in your area can achieve success	Total Range ^a	4 % 0–25 %	63 % 42 %–86 %	33 % 14 %–58 %	325

^a Indicates the range in the percentage of respondents from individual workshops who selected each answer option.

Action outcomes

Participants’ open-ended descriptions of actions stemming from the workshop fell into three broad categories: *intermediate products* (actions and outputs that arose primarily during the workshop process, such as analyses, brainstorming, or preliminary planning); projects, plans, and initiatives (such as incorporating climate adaptation into formal planning documents, changes to practice, research and monitoring initiatives, new undertakings, or greater involvement in ongoing adaptive processes); and outcomes related to knowledge distribution (such as additional adaptation workshops, publications, or sharing informational resources). Sample responses for each of these outcomes are presented in Table 4.

In closed-ended responses (Table 5), respondents were somewhat circumspect when asked about the degree to which the workshop they attended stimulated adaptation actions: 41 % of respondents were unsure of the workshop’s impact. More than half (53 %) of respondents felt the workshop had a minor or moderate impact. Only 5 % of respondents indicated that the workshop made a major contribution to adaptation action in the area.

Effective elements of adaptation workshops

Participants’ perceptions of workshop elements that positively influenced outcomes can be broadly categorized as relating to opportunities for varied interactions with a diverse group of participants; useful materials and opportunities to practice using them; the roles of high-quality facilitators; and a focus on real-world, local applications linked to ongoing responsibilities or projects. Table 6 presents qualitative coding results of participants’ write-in responses detailing specific aspects of these elements. Participants’ responses to closed-ended questions about workshop attributes are detailed in Table 7. Results from these open- and closed-ended questions largely aligned.

Participants valued workshops where attendees brought a range of backgrounds, roles, and areas of expertise. They also valued seeing both new and familiar faces at workshops. In response to closed-ended questions, 45 % of respondents indicated that pre-existing relationships between workshop attendees had a major positive influence on workshop outcomes, and an additional 47 % indicated that these relationships had a minor positive influence (Table 7). Relationships that were formed or strengthened during the workshop also contributed to workshop outcomes: 43 % of respondents indicated a major positive influence, and an additional 45 % reported a minor positive influence.

Participants valued variety in the kinds of opportunities they had to engage in adaptation workshops, including breakout groups, expert presentations, open discussion, report-outs of breakout activities, and time for networking and collaboration. They especially valued opportunities to try out tools, data, and other materials shared during the workshop. For example, one participant reported that they valued “Going through the Adaptation Workbook and being able to take the workbook back and have that resource available when making climate adaptation plans within our individual agencies or entities.” These materials were particularly useful when they were linked to participants’ work responsibilities, as one participant noted: “being able to apply the information directly to OUR work was highly effective.” Participants also noted that tools served as a focal point for interactions: “[the workbook] inspired dialogue, critical thinking and hard conversations about project design and implementation and also walked us through using a structured process for incorporating climate resiliency into out project design and implementation.”

Participants also highlighted the value of high-quality facilitation in adaptation workshops and identified a range of supportive roles facilitators can perform. In closed-ended responses, 77 % of respondents reported that the quality of the facilitator had a major positive influence on their workshop’s outcomes (Table 7). In open-ended responses, participants indicated the ways facilitators contribute to adaptation

Table 4
Action outcomes.

	Outcome	Example quotes from survey	n
Intermediate products	Assessment and strategies plans developed during the workshop	<i>Taking the time (we never have enough) to really sit down and think about and figure out how to include climate adaptation practices in my work was the largest outcome</i>	32
Projects, planning & initiatives	Incorporation of climate adaptation into formal planning documents	<i>Included specific suggestions and ideas from the Climate Adaptation workshop in our species management plans.</i>	33
	Changes to practice	<i>We identified locations... that could provide climate change refugia for target species. We are able to target monitoring at those locations to see how conditions and species change. We are also able to deter high visitation from those areas.</i>	7
	Individual involvement in ongoing climate projects	<i>Some attendees were more actively involved in the Resilience Project afterwards than they were before the workshop.</i>	4
	Development of adaptation tools for use by workshop participants and others	<i>During one of the many fruitful discussions during the workshop, the need for a menu of adaptation options for non-forested wetlands was identified. My group adopted this as a project and after several years of dedicated work just recently published this menu, which is being used at current adaptation workshops. ... and ... have also formed a fabulous partnership co-leading adaptation workshop around Wisconsin, developing other helpful adaptation resources, and promoting demonstration sites.</i>	4
	Research and monitoring initiatives	<i>One result is a follow up research project on climate change refugia for parks across the... region.</i>	3
	Proposals for grants and research	<i>I was able to use the results of the workshop to develop a solid study proposal for [a grant solicitation].</i>	1
	Infrastructure projects	<i>Several projects in the town have been addressed and completed... These projects include replacement of two deteriorated storm drain culvert boxes and repairs to storm drainpipe... Town Council also approved funding to purchase a DR Equipment Commercial Vacuum for the purpose of cleaning ditches within the town.</i>	1
Knowledge distribution	Sharing information beyond the workshop, additional meetings or workshops.	<i>The workshop prompted important discussions in our region. It resulted in more information circulating to the public regarding resilience.</i>	8

Table 4 (continued)

Outcome	Example quotes from survey	n
Publications (peer-reviewed and white papers)	<i>There will be a publication coming out of the workshop, which will add to our best available scientific information.</i>	5

Table 5

Extent to which the workshop helped stimulate adaptation actions in the area.

	I am unsure of the workshop's impact	Not at all	A minor amount	A moderate amount	A major amount	n
Total	41 %	2 %	23 %	30 %	5 %	304
Range ^a	0–75 %	0–12 %	11–50 %	0–60 %	0–11 %	

^a Indicates the range in the percentage of respondents from individual workshops who selected each answer option.

Table 6

Participant perceptions of effective elements of climate adaptation workshops.

Element area	Element	n
Diverse interactions	Breakout groups: Small-group discussion and activities	76
	Expert presentations: Panels and lectures from subject-matter experts	44
	Networking: Opportunities for networking and collaboration	38
	Discussions: Discussions among participants (in plenary or unspecified)	27
	Report-outs: Presentations to plenary on breakout processes and findings	16
Focus on real world, local applications linked to ongoing responsibilities or projects.	“Real world” focus: Examples and case studies (success stories and failures); focus on participants' own projects	52
	Applicable research & evidence: Climate projections and research scaled to relevant geographic area or workshop focus	29
	Adaptation strategies: Specific approaches for taking action	12
	Scenario plans: Focus on exploring a range of possible futures	12
Diverse participants	Multiple perspectives: Participants with a range of backgrounds, expertise, experience, and roles	51
Useful materials and opportunities to practice	Tools, menus & other resources: Workbooks, websites, and other material shared during the workshop	19
	Practice using resources: Opportunities to try using material shared during workshop	14
Roles of quality facilitators	Creating a clear structure: Clear organization, agenda, and objectives	10
	Advancing the workshop: Keeping people on track, taking notes, logistics	8
	Framing & knowledge: Directing workshop orientation and sharing facilitator expertise	6
	Enabling social processes: Balancing power dynamics, promoting participation	4

workshops. Skillful facilitators create a clear organizational structure for the workshop by developing realistic agendas and objectives; advance the workshop by keeping people on track, taking notes, and attending to logistics; share their own knowledge and expertise and frame the

Table 7

Extent to which workshop elements had a positive influence on workshop outcomes.

Element		No meaningful positive influence	A minor positive influence	A major positive influence	n
The quality of the facilitator	Total	3 %	21 %	77 %	261
	Range ^a	0–25 %	0–43 %	50–100 %	
Pre-existing relationships between workshop attendees	Total	8 %	47 %	45 %	260
	Range ^a	0–40 %	0–86 %	14–83 %	
Realistic strategies developed during the workshop	Total	7 %	49 %	44 %	259
	Range ^a	0–29 %	0–100 %	0–83 %	
Leadership by specific individuals after the workshop	Total	21 %	49 %	30 %	254
	Range ^a	0–38 %	17–100 %	0–67 %	
Commitments that people made during the workshop	Total	25 %	57 %	18 %	257
	Range ^a	0–50 %	17–100 %	0–50 %	

^a Indicates the range in the percentage of respondents from individual workshops who selected each answer option.

workshop's overall orientation; and enable social processes by balancing power dynamics and promoting participation. For example, one participant noted that the facilitators "...brought people together to communicate effectively. No matter how much you know or have to offer, if a meeting of minds is not facilitated properly, you will not make any progress." Another wrote that "expert moderation was an important factor in framing the discussion and development of local resilience criteria."

Finally, participants valued workshop content oriented around real world applications linked to their ongoing work, responsibilities, and projects. This included a focus on concrete examples, locally applicable research, success stories, specific strategies tailored to their context, and scenario planning that focused on exploring a range of possible futures. For example, one participant lauded workshop segments "where participants came with real world issues and we discussed how to plan and address them, [and] presenters who discussed projects that they had completed."

Three respondents—each from a different workshop—reported that the workshops they attended did not produce meaningful outcomes. They identified two reasons they felt the workshops failed: Participants lacked expertise necessary for meaningful contributions, and the structure of the workshop was poorly aligned with the goals of the gathering.

Discussion

Adaptation workshop outcomes

Our results suggest that workshop participants find value in the events they attended and that workshops can play a meaningful role in climate change adaptation. Participants identified a range of meaningful workshop outcomes, including learning, relationship, efficacy-related, and action outcomes. Learning that took place during workshops included the development of shared understandings among participants, as well as individual procedural, declarative, and perspective-shifting learning. Relationships were formed and strengthened during adaptation workshops, with some participants reporting the creation of new groups and collaborations. Participants also indicated that the workshops they attended enhanced their feelings of self- and collective-efficacy. These findings align with previous literature that identified workshop outcomes related to learning (e.g., de Vente et al., 2016),

relationships (e.g., Phadke et al., 2015), and efficacy (e.g., Olabisi et al., 2022).

Study participants attributed a range of action outcomes to the workshops they attended. They reported that workshops contributed in meaningful ways to planning processes, spurred additional knowledge seeking and sharing, and—less consistently—led to concrete adaptive actions. The most common action outcomes were intermediate products developed during the workshop process itself, such as the creation of vulnerability assessments or adaptation strategies. Another frequently reported outcome was the incorporation of adaptation strategies into formal planning documents. Other action outcomes, such as infrastructure projects, longer-term changes to practice, and research and monitoring initiatives, were reported less frequently. These tended to be relatively low-cost endeavors that were within the power of individuals or small groups to undertake, such as replacing storm culvert boxes or deterring natural-area visitors from entering designated climate refugia. Beyond their primary adaptive functions, these "small wins," could also contribute to a sense of efficacy and accomplishment, build capacity for further action, and develop constituencies for future efforts (Termeer et al., 2013; Termeer & Dewulf, 2019). Larger initiatives, which often require substantial planning, permitting, and funding, may reach fruition over longer time-horizons than our inquiry allowed.

Although most survey respondents were willing to attribute specific outcomes to the workshops they attended, 41 % were unsure of their workshop's impact. This uncertainty may be because workshops take place within broader contexts of other ongoing, long-term activities and planning efforts, which can complicate the attribution of specific outcomes to an individual workshop (Tuler et al., 2020). Alternatively, participants may have thought that subsequent projects and initiatives could have occurred irrespective of whether the workshop they attended took place. Regardless, the range of outcomes attributed to workshops—and the fact that only 2 % of respondents reported that the workshop they attended did not advance adaptation in the area—suggest that participants generally believed workshops can promote meaningful outcomes.

Valued workshop elements

Participants highlighted workshop elements that they felt most powerfully catalyzed outcomes, including the ability to engage with a diverse group of participants, opportunities to practice deploying locally-relevant data and tools, and well-facilitated processes. Respondents valued workshops that afforded opportunities to learn with and from their peers in breakout groups and discussions. Workshop outcomes were also reportedly enhanced by the participation of individuals whose experience and expertise were appropriate for the workshop context. The presence of familiar faces at workshops as well as opportunities to develop new relationships were both reported to improve to workshop outcomes. These findings align with prior research on team management (Parise and Rollag, 2010) and professional networks (Bodin et al., 2019), which suggests that preexisting connections can help enhance the formation of new relationships among indirectly linked individuals and contribute to group performance.

Participants valued workshop content focused on real-world impacts, climate data scaled to a relevant geographic scope, and the use of project-based approaches and tools to develop realistic strategies linked to ongoing work responsibilities. Prior research suggests that adaptation planning tools—defined here as replicable, structured, formal methods to advance participant understanding—can help groups collectively define problems, generate possible solutions, and prioritize among them (Plate et al., 2020). In addition, a tight focus on local projections, impacts, and solutions can enhance workshop outcomes (Bormann et al., 2019; Plate et al., 2020; Schmitt et al., 2021; Tuler et al., 2020). In combination, with other valued elements, such as expert presentations and group discussion, these workshop features could encourage the formation of shared understandings. For example, participants reported

that using an adaptation workbook in a small group to walk through designing a project helped spur critical thinking and dialogue. By making the process of climate adaptation more “*tangible*,” as one participant put it, these workshop elements could also help enhance feelings of individual and collective efficacy. Participants also reported using the tools post-workshop as communication and instructional aids with their home organizations and external stakeholders. This may help explain why knowledge-sharing emerged as an important action outcome of adaptation workshops. Having experienced tools spurring effective dialogue during a workshop, participants may have felt emboldened to use them in similar ways afterward.

Workshop facilitation clearly matters for participants in our study. Harvey and colleagues suggest that facilitators’ primary role is “supporting people to change their practice,” and that facilitators’ functions lie along a spectrum, from “doing for” others to “enabling” others (2002, p. 585). “Doing for” others entails performing functions such as managing projects or providing technical assistance, whereas “enabling” relates to efforts to “explore and release the inherent potential of individuals” and groups (Harvey, 2002, p. 581). Many facilitators perform both roles, and adaptation workshop participants valued approaches related to both “doing for” and enabling” facilitation. Participants reported that facilitators performed “enabling” functions, such as helping to frame discussions, advancing social processes, and expediting participant goal formation and learning. Facilitators were also valued for performing “doing for” functions, such as ensuring that limited time was used effectively and that insights, ideas, and next steps were captured and carried forward. Facilitators’ efforts outside the workshop itself, such as shaping the agenda in collaboration with local partners and curating the tools and data with which participants would engage during the workshop, also undergird many of the other valued workshop elements. These findings align with prior research suggesting that facilitation can contribute to learning, conflict resolution, and enhanced trust, among other adaptation outcomes (de Vente et al., 2016).

Adaptation workshops as venues for norm formation & reference group expansion

Participants in the climate adaptation workshops in this study reported that they valued gaining broader exposure to additional disciplinary and cultural vantages as well as deepening relationships across those boundaries. This preference for collaboration and the prevalence of perspective-shifting and collective learning among workshop participants may be indicative of reference group expansion and norm formation in workshops. As participants experience shifts in their focus and understanding vis-à-vis climate adaptation and perceive the development of shared understandings among other attendees, they may also expand their reference group, which is the group with whom an individual shares cultural and normative commitments. In turn, this broadened reference group could contribute to the formation and reformation of norms around adaptation, buttress efficacy beliefs, and open new pathways toward adaptation solutions (Doherty & Webler, 2016; Stern and Coleman, 2015). This process could be especially effective in instances where climate change adaptation workshops include representation from a range of critical sectors such as energy, infrastructure, and the healthcare system. By providing a platform wherein adaptation-related norms penetrate sectors beyond those that have heretofore engaged deeply with climate change adaptation, workshops could accelerate adaptation across systems.

Study limitations

Several limitations should inform interpretation of this study. These include a relatively small sample of workshops ($n = 33$) and modest response rates (averaging 57 % of participants in each workshop), making it possible that self-selection bias may have impacted the results. People are more likely to respond to surveys when they are interested in

the subject matter (Groves et al., 2004; Fan and Yan, 2010). Thus, those who had positive experiences in a workshop or felt that the workshop contributed to meaningful outcomes may have been more likely to dedicate the time necessary to complete a survey about their experience. We expect this may have resulted in a positive bias for workshop evaluations and outcomes. We have little information about non-respondents, but our analysis of workshop participants’ professional affiliations suggests that attendees affiliated with local government responded to the survey to a higher degree than those affiliated with universities. Thus, our sample may overrepresent the perspectives of local government employees.

Because we rely on survey data for these analyses, we don’t know how often a particular workshop attribute or characteristics was present during a particular convening. Therefore, when respondents report what they think made the biggest difference, we may be missing things that might be critically important, but simply didn’t take place in these 33 workshops.

Two attributes of the timing of this survey complicate interpretation. First, we administered the survey during the COVID-19 pandemic, which likely impacted our results (e.g., actions delayed or derailed by COVID priorities or complications, networks altered by pandemic-related restrictions and job shuffling). Second, the range in time elapsed between when each workshop ended and when our data collection began pose an additional challenge. In instances where workshops occurred up to three years before we administered the survey, respondents might have struggled to recall the specific workshop and to articulate linkages between the workshop and outcomes. Conversely, when we administered surveys within a year of a workshop’s conclusion, longer-term workshop outcomes may not yet have manifested.

Thus, this study provides a snapshot into the possible outcomes of climate adaptation workshops and some of the elements that participants feel best catalyze those outcomes. It does not provide a representative picture of the general effectiveness of such workshops overall. To address some of these limitations and gain additional insights, future research could also attempt to untangle which aspects of adaptation workshops most contribute to improved outcomes by identifying commonalities and differences among workshop-level contexts, elements, and outcomes.

Conclusion

As the need for climate adaptation grows, place-based workshops may play an important role. Effective workshops convene key actors with diverse perspectives and provide tools, examples, and data calibrated to the needs of the participants. They can advance learning for adaptation, strengthen networks and broaden reference groups, enhance feelings of efficacy, and contribute to a range of action outcomes. As climate impacts become increasingly widespread, and the national conversation around climate change and the adaptation field continues to mature, climate adaptation workshops could serve as nexuses for the dissemination of norms and knowledge around climate adaptation and as springboards for enduring positive change.

CRedit authorship contribution statement

Caleb O’Brien: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Writing – original draft. **Marc J. Stern:** Conceptualization, Formal analysis, Funding acquisition, Methodology, Project administration, Supervision, Writing – review & editing. **Jennifer J. Brousseau:** Data curation, Investigation, Project administration, Writing – review & editing. **Lara J. Hansen:** Conceptualization, Funding acquisition, Project administration, Writing – review & editing. **R. Bruce Hull:** Conceptualization, Supervision, Writing – review & editing.

Declaration of competing interest

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Data availability

Data will be made available on request.

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