Strengthening monitoring and evaluation of multiple benefits in conservation initiatives that aim to foster climate change adaptation

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Abstract
As the need to monitor and evaluate progress on climate change adaptation is increasingly recognized, practitioners may benefit from applying lessons about effective monitoring from the conservation field. This study focuses on monitoring conservation interventions that aim to foster climate change adaptation by assessing: what ways practitioners are adopting best practices from monitoring and evaluation (M&E) in conservation; what practitioners are monitoring in relation to reported outcomes; how monitoring comprehensiveness varies in practice and what factors enable more comprehensive monitoring; and practitioner views on what could improve M&E of adaptation actions. We conducted this study using a portfolio of 76 adaptation projects implemented across the United States and employed a mixed-methods design that included document analysis, an online survey, and semi-structured interviews. The majority (84%) of projects reported social outcomes at project completion in addition to ecological outcomes (100%), but monitoring plans focused primarily on ecological and biophysical changes. Only 21% of projects connected monitoring metrics to a theory of change linking actions to expected outcomes. Involvement of an external research partner was identified as a key factor in supporting more comprehensive monitoring efforts. Results provide applied insights for enhancing delivery of social and ecological outcomes from adaptation projects, and suggest research pathways to improve monitoring and effectiveness of climate-informed conservation.

Keywords
adaptation, climate change, evaluation, monitoring, nature-based solutions

1 | INTRODUCTION
Rapid growth in adaptation responses to climate change has occurred in recent decades; such efforts are further accelerating given the urgency for action, as the world addresses the intertwined effects of climate change, biodiversity loss, and the COVID-19 pandemic (Arnott et al., 2016; Saghir et al., 2020). Practitioners, funders,
and governments alike stress the importance of tracking progress and outcomes of adaptation initiatives. However, many factors challenge implementation of this recommendation: lack of consensus on actions that constitute adaptation; lack of agreement about best methods for data collection and analysis (e.g., determining appropriate indicators and baseline data); feasibility of using a counterfactual; and difficulty of attributing outcomes to specific activities (Ferraro & Pattanayak, 2006; Owen, 2020). Whereas assessing mitigation outcomes generally relies upon one indicator (i.e., the balance of greenhouse gas emissions to and removals from the atmosphere) (Griscom et al., 2017), measuring progress in and outcomes of adaptation requires consideration of multiple dimensions (e.g., social and ecological) that interact across time and space (Donatti et al., 2020).

In the early 1990s, conservation practitioners began to focus more on monitoring and evaluation (M&E), given escalating pressures from donors, researchers, and media to assess whether or not actions were accomplishing intended goals and objectives (Ferraro & Pattanayak, 2006; Redford et al., 2018). No longer was the adage “trust us; we are doing good work” sufficient to satisfy supporters and society at large (Margoluis et al., 2009). The same can be said today about climate change adaptation practice. Increasing investments in nature-based solutions—solutions to societal challenges that involve working with nature (Seddon et al., 2020)—and support for “climate-smart” conservation (Hansen et al., 2010) has elevated interest in tracking progress and assessing outcomes (Donatti et al., 2021) of adaptation efforts that aim to benefit people, ecosystems, and biodiversity under changing climate conditions.

This enhanced focus on M&E within climate-informed conservation is also driven by a shift in conservation practice away from one focused on maintaining historical or current conditions (Heller & Zavaleta, 2009) toward transformative, future-looking approaches (Corlett, 2016; Heller & Hobbs, 2014; St-Laurent et al., 2021) involving relatively novel actions (e.g., climate-adapted seed transfer [O'Neil et al., 2017]). Targeted learning about the effectiveness of these new, innovative actions is essential for assessing their readiness for broader adoption. Heightened interest in achieving co-benefits for people also means practitioners are now often expanding project objectives to leverage linkages between ecosystem services and human-wellbeing (Chan et al., 2011; Milner-Gulland et al., 2014). As the need to monitor and evaluate progress on climate change adaptation is increasingly recognized (Ford et al., 2013), practitioners may benefit from applying lessons learned about effective monitoring from the conservation field more broadly.

There is no one-size-fits-all when it comes to approaches for effective monitoring in conservation (Danielsen et al., 2005); M&E design should be tailored to a project’s specific goals and objectives (Noss, 1990). Despite this customization, there are best practices that have emerged from the conservation field’s focus on M&E, as well as lessons learned from other fields, such as public health and social services (Stem et al., 2005). Effective conservation monitoring programs often include: (1) good questions; (2) a conceptual model of an ecosystem or population; (3) strong partnerships between scientists, policymakers, and managers; and (4) frequent use of data collected (Lindenmayer & Likens, 2010). Action-oriented monitoring addresses a particular hypothesis, for example, or management question (Lindenmayer & Likens, 2010; Nichols & Williams, 2006). A theory of change is used to describe the sequence of outcomes that is expected to occur as a result of an intervention; the most common representations of theories of change are logic models and results chains (Margoluis et al., 2013). Logic models systematically and visually present the perceived relationships between resources used to operate a project or program (inputs), the activities implemented (outputs), and the intended changes (outcomes) (Foundations of Success, 2009). Indicators (i.e., measurable surrogates for environmental end points such as biodiversity) need to be carefully selected in a complementary set that can provide answers to guiding monitoring questions (Noss, 1990) and clearly linked to the theory of change. Evaluating effectiveness focuses on whether or not actions achieve results; when effectiveness measures are linked to a theory of change, the information can also help practitioners determine whether and how actions need to be adjusted when desired results are not achieved (Redford et al., 2018).

Evaluating conservation outcomes has always been difficult. Monitoring programs can be ineffective or fail, for example, due to an absence of driving questions, poor design, failure to properly articulate what indicators to monitor and why they are important, an inappropriate assumption that there is a single approach to monitoring that is uniformly applicable to all projects, as well as lack of funding to maintain long-term efforts (Lindenmayer et al., 2013; Lindenmayer & Likens, 2010). Conservation practice has also struggled to capture information learned from actions and to feed that information back into adaptive management of projects (Sanchirico et al., 2014). Very practical considerations for practitioners include the resources required (i.e., human, financial, technical) for setting up M&E systems (Ford et al., 2013), data accessibility and quality (including the common lack of baseline data and a counterfactual; Leagnavar et al., 2015), and longer-term monitoring after implementation.

Climate change adds further complexity to these M&E challenges. Climate change is a long-term and dynamic process; therefore, the effects of interventions may not be apparent for decades (Bours et al., 2015). The
adaptation community—broadly defined as anyone theorizing, designing, planning, implementing, or evaluating initiatives aimed at supporting the process of adjustment to an actual or expected change in climate and its impacts (IPCC, 2007; Owen, 2020)—typically relies on indicators that are used as near-term proxies to infer potential outcomes in M&E (Arnott et al., 2016; Ford et al., 2013). As such, project tracking often focuses on outputs (i.e., actions taken) and processes (i.e., how a project is managed) (Dilling & Romsdahl, 2013; Washington et al., 2014). Other categories often considered in M&E of conservation and also relevant to adaptation include: ecological integrity (Ervin, 2003); economic efficiency (Frondel & Schmidt, 2005) and the impacts of initiatives on people (e.g., Salafsky & Wollenberg, 2000). Further challenges to effective M&E in adaptation include: the scope of potential impacts (e.g., socio-economic, ecological, biophysical, and institutional), and difficulty in making causal inferences from actions implemented (Klein et al., 2005; McKinnon & Hole, 2015), among others.

Although challenges surrounding the implementation and measurement of effective adaptation remain persistent and multiple, progress has been made (Owen, 2020). Moser and Ekstrom (2010) identify barriers that can impede adaptation processes and as well as facilitating factors, such as leadership to initiate and sustain the effort and resources—particularly during the science-heavy planning and management (i.e., implementation and monitoring) phases. Some guidance documents (e.g., Bours et al., 2014; Stein et al., 2014; Swanston & Janowiak, 2016) stress the need for flexibility in the use and selection of metrics, considering more than just the “before” and “after,” and being clear about the purpose (i.e., tracking for accountability, guiding implementation through adaptive management, and/or assessing longer-term outcomes and effectiveness) from the onset of the strategic planning process. Others (e.g., Donatti et al., 2021) also recommend involving local communities and stakeholders in monitoring effectiveness as a standard of best practice and analyzing monitoring results to make changes, iteratively, to the actions being implemented.

This study seeks to better understand what practitioners are actually doing to evaluate conservation interventions that aim to foster climate change adaptation—henceforth, referred to as “conservation adaptation” initiatives—and identify opportunities for improvement. We focus on four central questions: (1) In what ways are practitioners using best practices from M&E in conservation to guide monitoring plans in conservation adaptation initiatives?; (2) What are practitioners monitoring and how in relation to reported outcomes?; (3) How does monitoring comprehensiveness vary in practice and what factors enable relatively comprehensive monitoring effort?; and (4) What is the range of views that practitioners offer on ways to improve conservation adaptation M&E efforts?

To address these questions, we examined a portfolio of 76 conservation adaptation initiatives that were led by non-governmental organizations (NGOs) and implemented in ecosystems across the United States between 2011 and 2017. Our mixed-methods approach included document analysis of project proposals and final reports, an online survey, and semi-structured interviews with current or former employees of organizations that led project design and implementation. Our results provide insights from on-the-ground action that can be used by practitioners and funders of conservation adaptation initiatives to improve monitoring at the project level, facilitate tracking over time, and support delivery of both social and ecological outcomes—as interests to deliver on both mount. In addition, our findings underscore the urgency in addressing the relative lack of research on assessing the effectiveness of climate interventions (Morecroft et al., 2019).

By focusing on only NGO-led efforts, this study offers an initial yet valuable look at the state of M&E in conservation adaptation, with insights that may be useful to a broader range of actors and in guiding more comprehensive future research.

2 | METHODS

2.1 | Sample frame

We conducted this study using the portfolio of projects funded by the Wildlife Conservation Society (WCS) Climate Adaptation Fund (CAF). The CAF, supported by a grant to WCS from the Doris Duke Charitable Foundation, provided $19 million in funding for 104 adaptation projects between 2011 and 2019. Projects apply innovative adaptation strategies, engage local community members, and implement projects in partnership with agencies, universities, NGOs, and local, state, federal, or tribal governments. They have confronted diverse impacts from climate change, such as coastal erosion, drought, wildfire, and flooding, in a range of terrestrial, coastal, and aquatic ecosystems across 40 states and U.S. territories. We excluded from our analysis the 26 projects that were awarded grants in 2018 and 2019, as work was in progress at the time of our research, and thus, could not offer comparable data on M&E to those projects that were already completed. We also excluded two projects from 2012 that were not completed, leaving 76 projects for analysis.

Since its inception, the CAF has consistently encouraged monitoring—in application materials, presentations,
and conversations between staff and prospective applicants—to facilitate desired outcomes and learn about the efficacy of adaptation actions implemented. Applicants were encouraged to design projects with SMART (specific, measurable, attainable, realistic, and time-based) objectives (Bjerke & Renger, 2017), asked to connect proposed actions to expected near- and longer-term outcomes, and asked to describe monitoring plans (Appendix S1); grantees were also required to include communications activities that could scale up approaches, share learning with the adaptation field or provide other benefits. CAF did not explicitly require M&E to be eligible for funding nor offer prescriptive guidelines for doing so; however, all funded projects included some form of a plan to monitor outputs and/or outcomes. As one of the most extensive datasets of projects that span a decade of conservation adaptation work in the United States, the CAF portfolio offers a unique opportunity to examine how conservation practitioners may be creatively monitoring and evaluating adaptation at the project level and assess what factors could enable more comprehensive monitoring or improve M&E efforts.

2.2 Data and analyses

We employed a sequential mixed-methods research design that used document, survey, and semi-structured interview data. First, we conducted a content analysis of two types of documents—proposals and final reports—that project proponents (N = 76) submitted to the CAF before implementation and after completion. Analysis followed a combined inductive and deductive approach (Patton, 2002): from the proposal documents, we inductively identified categories for outputs and outcomes to be monitored and associated indicators; from final reports, informed by key constructs of interest in the M&E literature (e.g., as reviewed above), we deductively coded information on monitoring follow-through over the course of implementation, reported outputs and outcomes, use of baseline data, and plans for continued M&E after project completion. We also used a deductive approach to examine aspects of M&E plans, such as indicators selected, use of baseline data, and evidence of M&E best practices including linking indicators to a theory of change or question-driven approach and clearly stated purpose (e.g., accountability, adaptive management, and/or effectiveness).

Second, we used an online survey (n = 30, Table 1) to further investigate the extent to which grantees carried out their monitoring plans and planned longer-term monitoring programs, identify the challenges they faced, assess their views on M&E, and reconcile missing information from documents. We collected a total of 32 completed surveys covering 30 projects (39% project response rate; two projects received two completed surveys that were compared; closed-ended and Likert-scale questions did not differ and open-ended answers were consolidated). The survey (deployed in 2020, 1–7 years post-project completion) was designed using a novel set of 16 criteria for evaluating the success of conservation adaptation projects (St-Laurent et al., 2022). The 16 criteria are organized into four categories: (1) use of information, (2) project management, (3) ecological and social outcomes, and (4) advancing the field of adaptation (e.g., capacity-building, changes in rules and policy). The complete survey included 56 open-ended, multiple-choice, ranking, and Likert-scale questions and took between 1 and 2 hours to complete. In this study, we focus only on those sections of the survey that covered M&E criteria, which comprised a total of 12 questions (Appendix S2).

Finally, we invited survey respondents to participate in semi-structured interviews. Respondents from 19 projects participated in an interview (63% project response rate). The objective of the interview protocol (Appendix S3) was to confirm and clarify information collected from the document analysis and surveys, fill in any missing details to avoid errors of omission, as well as gain further insights into lessons learned and enabling factors for M&E. We analyzed interviews inductively to allow for emergent themes and patterns, and deductively with a similar approach to that used in the document analysis. All interviews were conducted by the second author with one respondent, except for one interview that involved two participants from the same CAF project (both interviewees had previously completed the survey). All interviews took place by videoconference and were audio-recorded and transcribed verbatim.

Coding of qualitative data (documents, open-ended survey questions, verbatim transcripts from interviews) was conducted within NVIVO (Version 12). We used descriptive statistics, such as proportions, to summarize the content of open-ended questions from the survey and document analysis.

To assess the relative rigor of monitoring plans, we used all datasets and developed a scoring system for comprehensiveness. Assessing comprehensiveness relied heavily on survey data (n = 30), and follow-up interviews (n = 19) allowed us to clarify any questions in that dataset. The “comprehensiveness” criteria included: (1) use of a question-driven approach and/or linking indicators to a theory of change, conceptual model, or results chain; (2) clarity of purpose in early planning (including accountability, adaptive management, and effectiveness); (3) alignment between selected indicators/metrics and project goals (highly aligned, somewhat aligned, not aligned); (4) baseline data used to assess a project’s performance; (5) whether or not a project successfully completed their monitoring activities; and (6) whether or not
a project had plans to continue monitoring after project completion (Figure 1). We drew from the document analysis, survey data, and interviews to assign each project a score between 0 and 2 for each of the criteria. We then calculated an aggregate score that illustrates the comprehensiveness of each project’s monitoring effort and explored variation by whether or not an academic partner was involved in monitoring, by type of organization leading the project (national as one operating across the United States through multiple chapters or state offices; regional as one locally-based, focusing its work in the immediate area where the project was implemented), and across ecosystems. We hypothesized that academic partner involvement and national organization leadership would be associated with more comprehensive monitoring, given added capacity. We used proportions to assess patterns in variation and nonparametric statistical analysis (Wilcoxon Signed-Rank Test and Kruskall–Wallis Test) to assess significant difference between the average scores for the six comprehensiveness criteria. We present quotes to illustrate important themes and, when appropriate, use proportions to show how many respondents discussed these themes. We attribute quotes with unique identifiers (R1-S to R32-S for survey; R1-I to R19-I for interviews; R1-19 completed both interview and survey).

### 3 | RESULTS

We present our results in four sections to address: (1) what ways practitioners are using best practices to guide monitoring plans; (2) what is being monitored and how in relation to reported outcomes; (3) how monitoring comprehensiveness varied and what factors enable relatively comprehensive monitoring effort; and (4) the range of views that practitioners offer on ways to improve conservation adaptation M&E efforts.

#### 3.1 | Using best practices to guide monitoring plans

In proposals, 66% of projects described elements of a theory of change, conceptual model, or results chain within their monitoring plan. However, only a third of those project had plans to continue monitoring after project completion (Figure 1). We drew from the document analysis, survey data, and interviews to assign each project a score between 0 and 2 for each of the criteria. We then calculated an aggregate score that illustrates the comprehensiveness of each project’s monitoring effort and explored variation by whether or not an academic partner was involved in monitoring, by type of organization leading the project (national as one operating across the United States through multiple chapters or state offices; regional as one locally-based, focusing its work in the immediate area where the project was implemented), and across ecosystems. We hypothesized that academic partner involvement and national organization leadership would be associated with more comprehensive monitoring, given added capacity. We used proportions to assess patterns in variation and nonparametric statistical analysis (Wilcoxon Signed-Rank Test and Kruskall–Wallis Test) to assess significant difference between the average scores for the six comprehensiveness criteria. We present quotes to illustrate important themes and, when appropriate, use proportions to show how many respondents discussed these themes. We attribute quotes with unique identifiers (R1-S to R32-S for survey; R1-I to R19-I for interviews; R1-19 completed both interview and survey).

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projects (21% overall) clearly detailed linkages between inputs, outputs, and outcomes, and closely tied their monitoring plans in line with best practices in M&E from conservation. Most simply noted short-term benchmarks that could assess progress toward anticipated outcomes. 26% of projects articulated driving questions; almost all of those projects also used a theory of change to some extent.

### 3.2 What is being monitored and how in relation to reported outcomes

Analysis of the final reports revealed that the majority (84%) of the 76 projects reported social outcomes at project completion, in addition to ecological outcomes (100%). While ecological and biophysical indicators were more commonly linked to goals and reported outcomes—especially among projects that included a theory of change in their monitoring plan—use of indicators to assess social outcomes clearly lagged. Social outcomes reported included knowledge mobilization (e.g., media-related learning, mediated learning experiences such as workshops that facilitate adaptation dialogue and/or practice), community engagement and capacity building, fundraising, increased recreational access for underserved communities, and beneficial changes in management plans or actions. Of projects completing the survey, 22 (73%) indicated their project offered positive impacts to people and society. These included ecosystem services such as reduced fire and flood risk, recreational benefits, economic benefits, spiritual or cultural benefits, and carbon storage and sequestration.

Despite these reported co-benefits to people, monitoring for co-benefits was rarely included in the original monitoring plan or discussed in final reports. Monitoring plans focused primarily on tracking ecological and biophysical changes using a breadth of indicators, such as seedling survival, species diversity and abundance, water quality, temperature, and flow (Table 2; Appendix S4). Practitioners selected these indicators in relation to outcomes and outputs, such as habitat restored or carbon stored. Only 15% of projects planned to collect data related to social outcomes, such as changes in knowledge, perceptions, values, or behaviors, and human well-being linked to restoration activities. Engagement was one social outcome that was associated with specific monitoring plans, including indicators such as the number of people attending workshops or volunteering to help with implementation (e.g., planting). When asked specifically in the survey about monitoring for co-benefits, several respondents noted further evidence of positive impacts for people—some of which was quantitative (e.g., river-use surveys, plant biomass as an indicator of livestock forage) and some anecdotal (e.g., noticing changes in trail use, claiming the site “looked better” for improved aesthetic).

| Category                                      | Score                                                                 |
|-----------------------------------------------|----------------------------------------------------------------------|
| Question-driven approach and use of theory of change | 2 = Question-driven approach AND use of theory of change  
1 = Question-driven approach OR use of theory of change  
0 = No question-driven approach nor use of theory of change |
| Clarity of purpose in planning                | 2 = Clarity of purpose in all of the following criteria: accountability, adaptive management, and effectiveness  
1 = Clarity of purpose in one or two of the following criteria: accountability, adaptive management, and effectiveness  
0 = No clarity of purpose in any of the following criteria: accountability, adaptive management, and effectiveness |
| Indicators/metrics                            | 2 = Cover all aspects of project’s objectives  
1 = Cover some aspects of project’s objectives  
0 = No indicators/not mentioned |
| Baseline data                                 | 2 = For all indicators  
1 = For some indicators  
0 = No baseline/Not mentioned |
| Completion of monitoring                      | 2 = Successfully completed the monitoring plan  
1 = Successfully completed part of the monitoring plan  
0 = Not completed/not mentioned |
| Monitoring after project completion           | 2 = Exhaustive plan for long-term monitoring  
1 = Less exhaustive long-term plan/exhaustive short-term plan  
0 = No monitoring after project/not mentioned |

**Figure 1** Rating framework to assess monitoring comprehensiveness of CAF projects
| Outputs and outcomes | Examples | Indicators from monitoring plans |
|----------------------|----------|----------------------------------|
| Adaptive forestry practices or climate-informed silvicultural management implemented | Facilitated regeneration | Seedling survival; subcanopy and understory species; canopy cover; forest structure and composition |
| | Prescribed burnings, altered fire management regime, treatment for fire resistance | Bird diversity and abundance; plant diversity and abundance (e.g., herbaceous plants); area; plant density; natural fuels; number of large/open-grown trees; height, quality, and visual impacts of cattle grazing |
| | Thinning | Tree density; community composition; spatial structure |
| Carbon stored | In restored soils | Total carbon content |
| Changes in knowledge, perceptions, values, or behaviors* | Land-owner adoption of adaptation practices; increased value of ecosystem or desire for restoration | Values and perceptions of focal ecosystem; attitudes toward restoration; number of land-owners; climate change awareness; recreational use; comprehension of subject; increased understanding of project need |
| Engagement* | Participation in project implementation (e.g., planting) or outreach workshops | Number of people attending workshops or volunteering; website visitation; pre/post workshop comprehension |
| Facilitated or assisted migration | Salt marsh | Vegetation composition; habitat used by target bird species; soil condition and nutrients; marsh elevation |
| | Biocrusts in drylands | Percent cover and diversity of biocrust species.; soil stability; infiltration; nitrogen and carbon content in surface soils; presence of biocrust inoculum beyond target area. |
| Installations or constructions | Cultivation fields (e.g., biocrust) | Area |
| | Beaver dam analogues, instream woody material | Retention of fine sediment; streamflow; water temperature; fish populations |
| | Earthen terraces, bank, or shore stabilizations | Bank stability; stream discharge; water temperature; vegetation cover and herbaceous species; fine sediment deposition |
| | Exclosures, fencing, or cages to reduce habitat degradation or assist tree establishment | Herbivory; vegetation cover; number and diversity of bee groups or other target species; tree survival |
| | Erosion control or rock structures | Number completed; percentage of channel backfilled with sediment; instream turbidity |
| | Flow gauges, wells, infiltration basins, water control structures | Number installed; water quality; baseflow; channel morphology; macroinvertebrate populations; water level |
| Habitat created, enhanced, or reconnected | Barrier removal or replacement (e.g., roads, low-head dam) | Number of structures; fish/wildlife populations; habitat geomorphology; streambed and channel characteristics |
| | Corridors or stream channels | Length; vegetation cover; fish/wildlife populations; flow |
| | Ponds, pools, or dams (by beavers) | Number of pools; pool area, depth; wetland vegetation/riparian plants |
| | Living shorelines | Reef areal dimension, height; oyster density and size-frequency distribution; tidal flows; shoreline loss/gain; profile/elevation change; density of marsh vegetation; water quality (e.g., temperature, dissolved oxygen, salinity, pH, depth and turbidity) |
| Human well-being* | Linked to restoration activities | Household participation in planning and decision-making; education |
| Improved water management and hydrological processes | Reduced water loss, improved groundwater recharge and water storage | Channel morphologic adjustment; streamflow; discharge, stream corridor water availability; temperature; fish populations; groundwater elevation; wetland vegetation/riparian plants; wildlife re-establishment |

(Continues)
Twenty-one percent of all projects provided little or no information on their monitoring results in final reports, making it difficult to determine whether they had carried out intended plans from that information alone or assess short-term outcomes from data. Monitoring and/or associated analyses were commonly still underway. Supplementing missing information with survey and interview results, we found 70% of all projects monitored as planned (and, in a few cases, further developed or expanded upon what was originally intended); 14% deviated from plans by reducing scope or delaying; 16% remained unknown. Those that were not able to execute their monitoring as planned noted that the two-year grant timeline proved challenging for keeping plans on track, especially if weather events impacted the timing of when implementation could occur. Limited resources (e.g., funds and staffing) were also highlighted as a driving factor for reducing monitoring scope.

### 3.3 How monitoring comprehensiveness varied and what factors enable more comprehensive monitoring efforts

The comprehensiveness of monitoring efforts varied across ecosystem types. All projects in forest or desert ecosystems scored as comprehensive or highly comprehensive, whereas projects implemented in grassland and savannah, inland aquatic, and coastal aquatic ecosystems demonstrated a wider range of monitoring comprehensiveness (not comprehensive to highly comprehensive). The involvement of an academic partner—representative of a research arm external to the leading organization—was identified as a significant enabling factor for more comprehensive monitoring efforts ($Z = 66, p = .05$). All of the evaluated projects that had academic partnerships scored as comprehensive or highly comprehensive; 79% of projects without academic partnerships scored similarly, with the remaining accounting for those with not comprehensive or somewhat comprehensive monitoring (Figure 2). We did not find a difference in the proportion of regional and national organizations with highly comprehensive and comprehensive monitoring. Overall, we found significant differences in the performance of the projects against the comprehensiveness criteria (Kruskall–Wallis $H(5) = 26.7, p <.001$), with projects performing best against the criteria for completion of monitoring (score of 1.7), indicators and metrics (1.7), baseline (1.5), and long-term monitoring (1.4), and performing relatively worse against question-driven approach and/or use of a conceptual model, and clarity of purpose in early planning (1.1) and monitoring after project completion (1.2) (Appendix S5).

| Outputs and outcomes                             | Examples                                      | Indicators from monitoring plans               |
|-------------------------------------------------|-----------------------------------------------|------------------------------------------------|
| Invasive species controlled, treated, or removed | Mechanical, chemical, or manual removal       | Abundance of invasive species; native plant establishment |
| Land/habitat protected                           | Microhabitat, critical corridors              | Area; easements secured                        |
| Land/habitat restored                            | Desert springs or inland streams              | Erosion; water retention and soil moisture; diversity of native plants; plant survival rate; water temperature; topographic and vegetation features using high-resolution imagery (e.g., drone) |
| Forest ecosystem                                 | Tree density; shrub cover; canopy closure; herbaceous plant abundance, photo points; bird abundance and community composition |
| Wetland                                          | Seasonal abundance of bird populations; water quality (e.g., salinity, nutrients); native plant abundance and diversity; abundance and diversity of aquatic invertebrates or amphibians |
| Plantings                                        | Climate-adaptive native vegetation, native vegetation | Percent cover; density; vegetation growth; community composition; photo points |
| Cover or alternative crops, habitat             | Area                                           | Seeds per target species; survival rate        |
| Seeds collected or propagated                    | Survival; growth and vigor; canopy cover; community composition; cages removed from mature trees |
| Seeds, seedlings, shrubs, or trees              |                                               |                                               |
| Reintroductions                                  | Beavers                                       | Number of colonies established; water temperature; streamflow |

*Monitored social outcomes.
Follow-up interviews provided further insight into the critical role that partnerships play in strengthening monitoring efforts by: (1) providing an internal champion to promote the value(s) of monitoring, encourage effective methods, and help garner both internal and external support (e.g., financial support, capacity, interest in use); (2) supporting a learning-by-doing approach and expectation for monitoring; (3) facilitating engagement of local people and communities to assist; (4) enabling work to be targeted in strategic locations; and (5) supporting the design of monitoring efforts that are feasible to implement and useful for benchmarking. Accessing sites can prove difficult in some geographies and weather conditions, and there are often long, ecosystem response times before desired changes can be observed. Thus, some interviewees argued that selecting feasible locations for monitoring as well as prioritizing actions in places where short-term changes can indicate progress were important for designing a project more likely to meet its objectives.

Forty-seven percent of survey respondents indicated that they strongly agreed that the project generated information through ongoing M&E to validate and/or test the efficacy of the adaptation actions in achieving its adaptation goals. In open-ended questions, respondents commonly mentioned partnerships with universities or agencies that strengthened their effort, and often supported longer-term monitoring. Partnerships were most commonly discussed as the primary enabling factor for comprehensive monitoring efforts and effective monitoring, and interviewees noted a breadth of benefits (Table 3), including, for example, facilitating longer-term monitoring. In discussing how to develop partnerships, interviewees highlighted the need for building relationships early by reaching out to researchers or professors with relevant expertise, carefully exploring mutual interests and goals to align informational needs of practitioners implementing the project with research interests and to fill gaps for practitioners, where needed; and to leverage secured funding to strengthen overall M&E effort. Benefits came not only from academic partners but from other collaborations; establishing a research arm for monitoring was most important—whether it be with a university, government agency, science-based organization, or through multiple partnerships that add capacity.

3.4 | The range of views that practitioners offer on what could improve M&E

To improve M&E of adaptation projects, interviewees described a suite of recommendations (Table 4) as they apply to practitioners and funders. For practitioners, interviewees highlighted the importance of establishing and maintaining long-term relationships with funders, the need to develop partnerships early in any proposed project, fully embedding monitoring in institutional...
standards of practice, including budget allocations, and also, leveraging the upside and opportunities that monitoring provides (e.g., demonstrating project success and engaging broader constituencies to enable scaling and broader adoption). For funders, participants in our study suggested extended project timelines, adding support for

**TABLE 3** Benefits that partnerships (e.g., academic, government agency, science-based organization) can provide for M&E of conservation adaptation initiatives, as described by interview participants

| Benefits offered                                              | Illustrative quotes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Additional resources (e.g., funding and staff capacity)       | “...[Our partner] trained everyone on how to do that assessment. And then I know the other partners used that methodology as well. That was for the main monitoring that was done.” [R19-I] “It was way more compelling for [our organization] when we were getting money to do the work, to be able to say we were testing these hypotheses rigorously and it was way more compelling for [our partners] getting money for research to say that they had applied questions that were meaningful to ranching communities and agencies.” [R10-I] |
| Bolster analysis and publication capacity                     | “You have an incredible backbone for analysis and publications.” [R4-I] “We kind of met the bar and anything else [our University partners] were able to test, publish on, or use for modelling or method papers...was above and beyond. They could kind of run with that.” [R10-I] |
| Consistency in data collection                                | “I actually think what we’ve done...is perfect, to tell you the truth, because we have [our partner] running the monitoring, and it’s really consistent [over many years]. That consistency means you need less of a sample size. You have more on the ground knowledge. That consistency is super important.” [R4-I] |
| Engage more people in adaptation                              | “It was overwhelming: the amount of volunteers—hundreds of volunteers—that worked on this project.” [R6-I] |
| Improve access to and use of relevant data                    | “There’s a lot of a continuation of monitoring that these partners were already doing...I think that our partners were excited that this project gave them the resources to be able to spend time together looking at different management and undertaking different management approaches, but then also building out their understanding with the ongoing assessments and sharing all of that information with each other.” [R19-I] |
| Increased return on investment; greater scale of impact        | “I don’t think that if you were to try [this] again without the sort of partnership in place that we had, I don’t think you would get, you know, 15 springs restored for the price of two, for example... When you’re a singular actor, things can only scale so far. And so having that collaborative infrastructure in place is kind of an important component for that.” [R3-I] |
| Learning-by-doing; using monitoring to inform actions          | “The monitoring has allowed us to see that there’s two sites that just did not respond like we thought they should. And we need to learn from those. The learning part, the research part of it is, “How can we take this in and improve our knowledge? ... If you want to start in a new place, you want a quick response because quick response feeds the machine.” [R4-I] |
| Reduce risks of implementing new actions                      | “So that’s adaptation, right? Some of it is going to work. Some of it’s not, and that’s fine. That’s okay—especially in these initial innovative, inherently risky projects where we have never tried [the approach] before. But we are hoping it will work based on our best effort and knowledge, with as many thoughtful agency and other partners that we can bring together.” [R7-I] |
| Rigorous design (e.g., increased likelihood for baseline or paired sites), or expanded scope | “We are scientists in our program, but we are not we do not have expert experimental design skills, for example. And this really was an experiment in a working forest context. So having [external help] was incredible. Because the questions we were asking were fundamentally about genetics, having a geneticist on our team made a lot of difference as well.” [R17-I] |
| Support for continued monitoring                              | “We are no longer actively monitoring accretion and subsidence of the peat, but the equipment is still there. It’s something that [our research partner] may pick up in the future... You need such long-term datasets to draw...conclusions about...incremental change.” [R5-I] |
TABLE 4  Recommendations from interview participants for improving M&E of conservation adaptation projects

| Audience | Recommendation |
|----------|----------------|
| Practitioners | Build relationships with funders to support multi-year, long-term efforts |
| | Develop partnerships early and leverage partnerships (e.g., additional funding and capacity, reduced risk of new practices) |
| | Embed monitoring in operations as a standard of practice (e.g., budget for monitoring, manage projects as a portfolio with cycles for monitoring) |
| | Foster an improved public perception of the value(s) of monitoring |
| | Use monitoring as proof-of-concept (e.g., demonstrate project success, bolster investment in actions and monitoring) |
| | Use monitoring for learning-by-doing and adaptive management, rather than focusing only on endpoint assessment |
| Funders | Ask monitoring partners to share information and results directly with funders supporting implementation |
| | Extend project timeline and/or offer continued monitoring support for longer-term evaluation |
| | Increase flexibility to account for learning-by-doing or challenges (e.g., delays in implementation) |
| | Require monitoring and allocate funding directly for M&E |

monitoring and monitoring requirements for a portion of funds, and last but not least, building and promoting a no-regrets culture of “learning-by-doing” so as to foster innovation under uncertainty.

4 | DISCUSSION

The most striking findings from our results were the factors influencing monitoring comprehensiveness, particularly with respect to use of a theory of change, conceptual model, or results chain and clarity of monitoring purpose, and the recommendations that emerged from practitioners on how to improve M&E in conservation adaptation practice.

Although we found evidence of best practices from M&E in conservation being used, such as connecting indicators to a theory of change or driving question, the fact that relatively few practitioners discussed both in their monitoring plans or tightly linked indicators to expected long-term outcomes (rather than simply focusing on short-term benchmarks) suggests room for improvement. Selection of ecological (and social) indicators at project onset could benefit from greater clarity of linkages. This shortcoming in the field of adaptation practice today is similar to that observed earlier in conservation practice, as often monitoring programs were poorly designed at the beginning or failed to adopt features of successful programs, including question-driven approaches (Lindenmayer & Likens, 2010).

We also found that partnerships with a university, government agency, or another science-based organization could help practitioners overcome some of the challenges to adaptation M&E by adding technical skills to strengthen the design and bolstering capacity. These challenges, for example, include the general difficulties of monitoring intervention outcomes (e.g., through use of counterfactuals or baseline data) and of simply getting monitoring implemented (Abrahms et al., 2017; Margoluis et al., 2009; Noss, 1990; Redford et al., 2018). Partnerships alone cannot surmount the persistent challenge in evaluating adaptation with respect to its long time horizons (Bours et al., 2014) that many interviewees also identified. However, the benefits they offer enable more comprehensive monitoring efforts and adoption of some of the best practices identified in the conservation literature to date, including rigorous design and frequent use of data (Lindenmayer & Likens, 2010). Leveraging partnerships—early, as study participants recommended—may offer a pathway to more comprehensive monitoring programs within conservation adaptation practice, particularly as practitioners ramp up the implementation of nature-based solutions to meet adaptation and mitigation targets. Partnerships between managers and researchers from multiple local, state, federal, and tribal organizations have also been found to benefit project progress in habitat restoration (White et al., 2021). To support effective partnerships, it will likely be necessary to align motivations and reward systems early in the collaborative process (Gibbons et al., 2008), since the factors that motivate scientists (e.g., peer-reviewed publications, scientific novelty, and testing theories) are not necessarily the same as for practitioners (e.g., acres of land conserved or restored, re-establishment of healthy ecosystems, or wildlife populations). In adaptation, there is also a growing trend toward co-production, where scientists and resource managers work together to produce knowledge that supports development of practices and policies (e.g., Boon et al., 2019).

Leadership is critical in initiating the adaptation process and sustaining momentum over time; when there is no mandate or public demand for adaptation, leaders are required to initiate and maintain the process (Moser & Ekstrom, 2010). The same could be true for monitoring, as our results reveal that leadership is important at two
levels: (1) internally, for implementing organizations to recognize its value, incorporate it into project implementation, and utilize and learn from benchmarks; and (2) by the external partners that provide additional capacity and expertise. Results from studies analyzing adaptation initiatives in various contexts reveal similarly relevant components for good practice: strengthening institutional partnerships; engaging local individuals and communities in adaptation design, research, and implementation; and strong leadership, including connective leadership that brings people together in a collaborative strategy (Hughes, 2015; Meijerink et al., 2015; Vogel et al., 2017).

The observed variation in M&E comprehensiveness across ecosystem types may be influenced, in part, by better data availability and more developed methods for some ecosystems over others. Forests in the United States, for example, have been monitored for decades under a national system (Riitters et al., 2013); thus, the availability of baseline data and breadth of tested methodologies for tracking ecological changes can strengthen methods for assessing (and comparing) treatment effects. Our sample size for coastal aquatic ecosystems, however, was too small to provide any insight. The fact that projects tended to score lower on long-term monitoring is reflective of a persistent challenge in conservation monitoring writ large, given constraints to securing research sites, funding, and capacity over time. We had expected that national organizations would score higher for comprehensiveness, given higher capacity, but we found regional organizations to be as performant or potentially even more so. This could be explained by the additive role of partnerships, particularly for smaller organizations that develop collaborations and outsource M&E early in the adaptation planning process. It could also be explained by factors other than partnerships. Local or regional organizations may apply more local knowledge, enabling, for example, selection of strategic sites for monitoring or indicators better suited to their goals that balances out any limits on internal capacity or scientific expertise.

Conservation adaptation projects often provide co-benefits to people, but in our study they were generally not tracked throughout project implementation nor reported in detail at project completion. Final reports, post-project surveys, and interviews revealed that conservation adaptation practitioners are thinking about co-benefits for people more than one would assume from their project proposals; however, monitoring of these social benefits was rarely described in project documents. The lack of clear linkages between social adaptation (i.e., reducing the vulnerability or enhancing the adaptive capacity of people to climate change; Chia et al., 2016) and ecosystem adaptation (i.e., ensuring the resilience of ecosystems to climate change) in project design, implementation, and monitoring may be indicative of siloed fields practice. In a review of 110 adaptation initiatives, Owen (2020) identified three categories of adaptation activities: social, institutional, and physical and structural. Although ecosystem-based adaptation activities, such as restoration and conservation, commonly co-occurred with institutional adaptation activities (i.e., changes in ecosystem management programs or policies), they did not frequently overlap with social adaptation activities (i.e., educational, behavioral). More than half of the initiatives examined by Owen (2020), however, demonstrated enhancement of social relationships and community well-being.

Better monitoring of co-benefits will require both innovation and resources to develop and enact appropriate methods. Multiple measures may be necessary to ensure different dimensions of well-being, for example, are being assessed (Mbamu et al., 2021). Such tracking, however, could facilitate increased return on investments for conservation initiatives. Society has demonstrated its willingness to pay for land management activities that offer benefits to well-being through the protection of open-spaces (e.g., Sander & Polasky, 2009). A thriving natural environment is fundamental to adaptation in every human enterprise (Global Commission on Adaptation, 2019). Conservation practitioners may need to broaden objectives and monitoring plans at project onset to harness the potential co-benefits their initiatives could offer over time.

Ultimately, the inconsistencies in reporting of data-driven results and ongoing timelines for monitoring at project completion made it difficult to compare outcomes across the portfolio or infer lessons about the efficacy of monitoring efforts. Standardized metrics have limited ability to take specific contexts into account (Leiter, 2015) and effective monitoring requires tailoring design to an individual project’s context and goals (Noss, 1990). However, improvements in monitoring practices could be made by encouraging and enabling broader adoption of best practices (including clear purpose to guide design, use of driving questions, and theories of change with metrics tightly linked to near-term benchmarks and expected longer-term outcomes), and more consistent sharing of M&E results to advance learning within the field. While our dataset offers an opportunity for an in-depth look at monitoring efforts in conservation adaptation projects led by NGOs in the United States and offers insights for improvement, the use of best practices and relative comprehensiveness of monitoring effort displayed by this portfolio of projects may not be representative of the larger field of practice. For example, in a pantropical dataset of organizations involved in tree
planting, a nature-based solution to climate change, only 18% of organizations in the study \((n = 174)\) mentioned monitoring on websites and in reports; only 5% mentioned survival rates of plantings (Martin et al., 2021).

5 | FUTURE RESEARCH

Partnerships with academic organizations were used as proxy for research partnerships, meaning that partnerships with other scientific organizations (e.g., science-based NGOs, government agencies, and private consultants) are not reflected in our quantitative analysis of patterns in monitoring comprehensiveness. However, many survey participants and interviewees highlighted the importance of research partnerships as an enabling factor that significantly enhanced their project’s monitoring effort. Further research could compare the roles of academic and non-academic partners in improving project M&E.

Our findings could be biased by effects of self-selection; it is possible that participants who decided to take part in our survey are not representative of the target population (i.e., all CAF projects funded between 2011 and 2017). Our subsample from the surveys \((n = 30)\) and interviews \((n = 19)\) could be biased toward relatively more successful projects if they were more likely to participate and share positive outcomes. However, this research leverages learning from projects implemented to enhance the scope of insight on concepts and best practices from the literature that are used in current practice. Future research could include applying similar methods to a larger sample of projects at a global scale to assess how organizations implementing conservation adaptation initiatives in various contexts are monitoring their projects and to what extent they may be employing best practices. Many CAF project leaders work closely with local, state, federal, and tribal governments. Whether or not monitoring efforts differ by project lead (e.g., local government vs. NGO) is also another priority for future research to gain understanding of broader adaptation practice. Further study of CAF projects could also include examining monitoring efficacy to assess the use of information generated, specific insights gained from analysis of ecological indicators, and effectiveness of actions over time. However, performance in the diversity of ecosystems where these projects take place was outside the scope of this study.

6 | CONCLUSION

Our study draws on lessons from on-the-ground adaptation projects and provides insights and recommendations for practitioners and funders to improve M&E of actions implemented. Developing a community of practice for shared learning has been difficult in conservation because conservation problems and actors are so varied (Schwartz et al., 2012). However, adaptation represents a rapidly growing niche within this community where well-designed learning and sharing of lessons are essential in the face of a changing climate. Enhancing learning through practice will be essential in order to rapidly upscale adaptation action (Currie-Alder et al., 2021). Finding avenues for practitioners to report results in more consistent and transparent ways—not only for accountability and adaptive management during project implementation, but for better understanding of intervention efficacy—is critical to determine the readiness of actions for broader adoption toward achieving adaptation goals for both nature and people.

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CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

AUTHOR CONTRIBUTIONS

Lauren E. Oakes, Guillaume Peterson St-Laurent, Molly S. Cross, and Shannon Hagerman conceptualized and designed the study. Lauren E. Oakes and Guillaume Peterson St-Laurent collected the data, with Elizabeth Tully assisting with documents specifically; Lauren E. Oakes, Guillaume Peterson St-Laurent, and Molly S. Cross conducted analyses. Lauren E. Oakes led writing, with Guillaume Peterson St-Laurent contributing to methods and results. Guillaume Peterson St-Laurent conducted all interviews. Molly S. Cross, Shannon Hagerman, and Tatjana Washington contributed to framing and discussion. All authors reviewed and revised the paper.
DATA AVAILABILITY STATEMENT
We conducted our study following the BREB guidelines (Behavioral Research Ethics Board) at the University of British Columbia, Canada (Ethics ID number H19-02949). Some data consists of successful grant proposals and reports submitted by unaffiliated organizations (hereafter “grant partners”) to the Wildlife Conservation Society Climate Adaptation Fund between 2011 and 2019. These proposals are owned by the Wildlife Conservation Society, but they contain grant partners’ confidential data and, in some cases, intellectual property (e.g., novel technology). These proposals are therefore treated in the same way than other sensitive data collected with human subject. It is BREB’s position that a breach of confidentiality of study participants (i.e., grant partners) has taken place when there is a failure to conform to the commitment that the researchers have made to the study participants when some or all the data has entered the public domain (i.e., the data has become available to any person who is not authorized to view or access the data). Thus, we shall not publicly disclose the raw research data in its original form (e.g., full grant proposals). However, if readers are interested in requesting raw data from proposals and reports, they can contact the lead authors, and data can be shared (removing such confidential information such as organization’s financial status) upon request. They must sign a non-disclosure agreement and comply with the BREB and the Wildlife Conservation Society’s guidelines for further use of the data. Readers may contact leoakes@wcs.org or leoakes@stanford.edu if they want to request data.

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**SUPPORTING INFORMATION**

Additional supporting information may be found in the online version of the article at the publisher’s website.

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