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Prepared in cooperation with the Bureau of Land Management, U.S. Department of Agriculture Forest Service, and National Park Service

Southeastern Utah Federal Lands Science Needs Survey



Scientific Investigations Report 2026–5027

U.S. Department of the Interior
U.S. Geological Survey

Cover. Lavender Canyon, San Juan County, Utah. Photograph by M. Allison Stegner, January 29, 2014.

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Conversion Factors

U.S. customary units to International System of Units

Multiply	By	To obtain
	Area	
acre	0.004047	square kilometer (km^2)
square mile (mi^2)	2.590	square kilometer (km^2)

International System of Units to U.S. customary units

Multiply	By	To obtain
	Area	
square kilometer (km^2)	247.1	acre
square kilometer (km^2)	0.3861	square mile (mi^2)

Datums

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Abbreviations

BLM	Bureau of Land Management
FS	U.S. Department of Agriculture Forest Service
NEPA	National Environmental Protection Act
NPS	National Park Service
SEUG	Southeast Utah Group
USGS	U.S. Geological Survey

Southeastern Utah Federal Lands Science Needs Survey

By M. Allison Stegner,[1,2] Jonathan Argov,[3] Liz A. Ballenger,[4] Kimberly Hartwig,[4] Laura Martin,[5] Gerald I. Wakefield,[4] Rebecca A. Weissinger,[4] and Michael C. Duniway[1]

Abstract

Evidence-based scientific information can help support defensible decision making in the management of public lands. This report sought to identify current (2024–25) Federal agency research needs in southeastern Utah and to synthesize common management challenges and questions across jurisdictional boundaries. We implemented a science needs assessment focused on lands managed by the Bureau of Land Management (BLM), U.S. Department of Agriculture Forest Service (FS), and National Park Service (NPS) in southeastern Utah—the area delineated by BLM's Canyon Country District Office, portions of the FS Manti-La Sal National Forest, and Southeast Utah Group NPS units. U.S. Geological Survey (USGS) researchers met with and surveyed BLM, NPS, and FS staff in 2024 and 2025 to understand their science needs and preferred modes of information delivery. The USGS's approach may be unrepresentative in terms of which topic areas were addressed, but the responses nevertheless highlight challenges and high-priority research areas that could contribute positively to agency decision making. Common management challenges and areas where additional research could be beneficial to land managers include the effects of climate change, recreation effects and visitor behavior, hydrology and hydrologic changes due to anthropogenic pressures, and the capacity for inventory and monitoring across essentially all resource types. Research on site-specific restoration techniques and their outcomes was also a common theme. In this report we discuss ways in which researchers can increase the extent to which their work could be actionable for resource managers and provide suggestions for potential priority research areas for the study region.

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Plain Language Summary

Managing public lands presents many complex decision-making challenges. The authors of this report met with and informally surveyed Bureau of Land Management, National Park Service, and U.S. Department of Agriculture Forest Service staff to better understand their science needs and preferred modes of information delivery to aid in decision-making. The assessment focused on lands managed by these agencies in southeastern Utah, specifically through the Bureau of Land Management's Canyon Country District Office. Climate change, especially drought, and recreation were among the most common management challenges identified. Development pressure (for example, from mining, energy development, recreation infrastructure, or urban expansion) and invasive species were also common management concerns.

Introduction

To effectively manage public lands amidst ongoing natural and human-generated pressures, evidence-based scientific information can help support defensible decision making. The use of science in decision making is also required by law (Carter and others, 2024; White House, 2025). Science can be actionable and effective when coproduced with land managers and when a specific management decision is articulated from the outset (Beier and others, 2017). The applicability of science to decision making often increases with greater specificity to the region or ecosystem of interest. Yet some of the pressures on public lands take place at spatial scales that span multiple management units and agencies (Aslan and others, 2021; Stegner and others, 2026b). Cooperative and complementary approaches among agencies could better support strategies to contend with these regional pressures while saving time and money by preventing repetitive work. Indigenous perspectives and traditional ecological knowledge, supported by thousands of years of evidence-based observation, are also central to the stewardship of public lands and form the bedrock of Tribal comanagement (Congressional Research Service, 2023).

This work sought to identify current (2024–25) Federal agency research needs in southeastern Utah and to synthesize common motivations and questions across management boundaries. To achieve this, the U.S. Geological Survey (USGS) assessed science needs focused on lands managed by the Bureau of Land Management (BLM), U.S. Department of Agriculture Forest Service (FS), and National Park Service (NPS) in southeastern Utah—the area delineated by the extent of BLM's Canyon Country District (fig. 1). To help develop our approach, we received advisory input from the Science Committee of the Canyonlands Natural History Association, a nonprofit based in Moab, Utah, that provides funding and support to public lands in southeastern Utah.

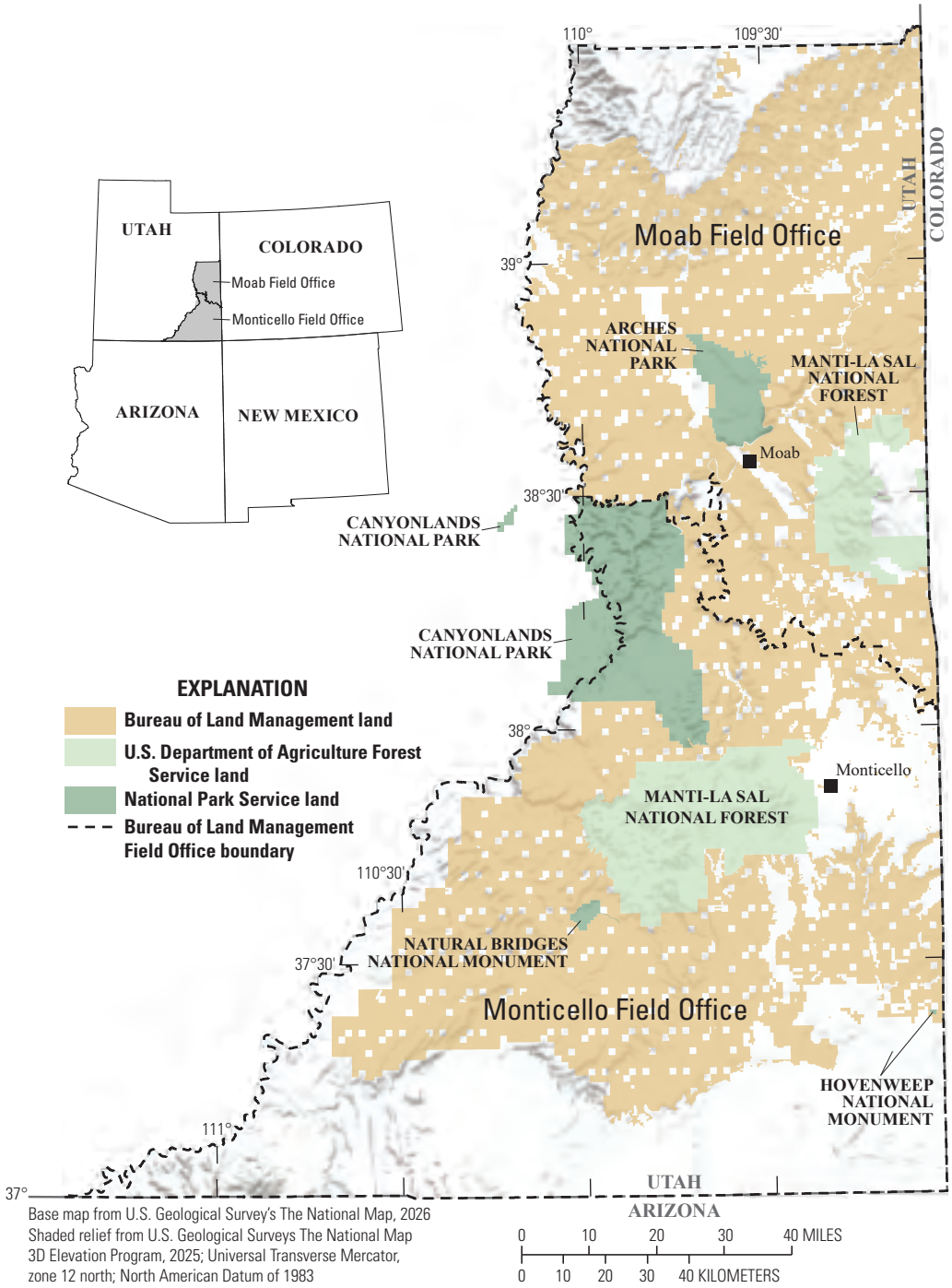


Figure 1. Map showing southeastern Utah and Federal lands encompassed by the study. The Bureau of Land Management Moab and Monticello Field Offices together form the Canyon Country District Office. Only National Park Service Southeast Utah Group units are shown here.

Steps to Help Support Actionable Research

Actionable research is research that can inform decision-making in land and resource management. Steps that can help support the development of actionable research and to help ensure that research findings are available to managers could include:

- Coproduce research questions with, or source them from, managers and decision makers.
- Identify in advance the specific decisions or actions that could benefit from the research, and understand the context (for example, policy, legal framework, and so on) in which decisions are made.
- Seek input from land managers in designing field experiments to ensure that the field sites and experimental treatments are relevant.
- If working in partnership, hold at least one in-person meeting of partners and stakeholders.
- When summarizing research results, generate numeric values, figures, maps, and tables that directly support management-relevant decision thresholds.
- Distill or summarize research findings for a resource management audience.
- Publish open access.
- Present research at symposia and workshops attended by managers, or arrange meetings with managers or extension agents.

Our project was two-pronged: first, we met with and informally surveyed Federal land management agency staff (BLM, NPS, and FS) to understand their general science needs and preferred modes of information delivery. Initial feedback from agency staff helped guide this portion of the project. The purpose of the federal agency staff survey was to identify agency research needs and to synthesize common motivations and questions across management boundaries. Second, we summarized landscape-level drivers of change, evaluated the drivers' exposure throughout southeastern Utah, and quantified the vulnerability of this study region to drivers of change (Stegner and others, 2026a; Stegner and others, 2026b). Here, we report on the first step: the outcome of the agency surveys. This report summarizes perspectives on research needs shared by Federal land management agency staff at the time of the survey. It is intended to be used primarily by interested researchers and funders and is not meant to be a comprehensive review of Federal scientific research priorities. Furthermore, this synthesis of land manager perspectives could be complemented by additional perspectives. Because the research that is ultimately most relevant to land management may not always be evident, continued research and input from scientists may draw attention to different but equally relevant research needs.

Study Area

The study area includes BLM and FS lands (Manti-La Sal National Forest) within the BLM Canyon Country District Office, and Southeast Utah Group (SEUG) NPS units (Arches and Canyonlands National Parks, Hovenweep and Natural Bridges National Monument; fig. 1). Other Federal lands within the BLM Canyon Country District Office include those managed by the Bureau of Indian Affairs and Department of Defense, but they were not evaluated for this study. State and private lands are also not addressed in this study.

Methods

U.S. Geological Survey (USGS) researchers met with staff from SEUG NPS, BLM Moab and Monticello Field Offices and Canyon Country District Office, and FS Manti-La Sal District between May 2024 and August 2024 to discuss the format and purpose of this assessment, general science needs, and preferred modes of information delivery for research results. Staff were surveyed between October 2024 and January 2025 and were asked two open-ended questions through an online form. The questions as stated in the form were as follows:

Thinking about the next 5–10 years,

- What are the greatest resource management challenges related to your work or area of expertise?
- What are the most pressing unanswered research questions related to your work or area of expertise?

The survey was sent to individuals identified by the agencies as resource experts available to participate: 6 individuals were from NPS, at least 13 were from BLM (the survey was forwarded to an unknown number of staff within the Monticello BLM), and 2 were from FS. Participants were asked to provide about 5 challenges and about 5 questions; they were instructed to include any topics related to natural or social sciences. Their responses were summarized by the resource affected in the following categories: species, ecological communities, and ecosystems; hydrology and waterways; livestock grazing and range management; cultural resources; paleontological resources; air quality; recreation; and communication and institutional systems. (The phrase "Institutional systems" refers to political, social, or agency systems for decision making and management.) Responses were simplified and combined when multiple comments addressed the same issue. Occasionally, a management challenge was moved into the "research questions" category if the challenge presented itself as an information gap. Survey respondents were invited to review this report and join as coauthors.

Results

We met with 13 individuals from BLM, FS, and NPS and received survey responses from 10 individuals across all three agencies and one group response from SEUG NPS. We have not quantified which areas of expertise or responsibilities are represented in the results for the following reasons: (1) we did not stratify our sample to target specific job series or expertise, (2) responses were optionally anonymous, and (3) we received 10 responses from at least 21 requests. Therefore, these results can be interpreted as a small and potentially unrepresentative sampling of management challenges and research needs for southeastern Utah. A recent study developed approaches to identifying science needs that avoid these biases by assessing agency documents and legal challenges (Carter and others, 2024), which could be a potential future step for this study region. Nevertheless, the responses gathered here reveal challenges and high-priority research areas that could contribute positively to agency decision making, as well as priority areas for research funding.

Several topics emerged recurrently, regardless of the resource affected. Climate change—especially drought—and recreation were mentioned as management challenges for almost every resource. Information gaps related to recreation effects touched on the social and physical sciences. Several respondents emphasized that better educating the public about responsible enjoyment of public lands—from preventing damage to fragile resources to changing social norms around online information sharing—could help protect resources. Development pressure (for example, from mining, energy development, recreation infrastructure, or urban expansion) and invasive species were also common management concerns. Almost universally, increasing the capacity for inventory and monitoring was noted as research that could aid decision making. Other frequently cited research priorities focused on developing site-specific restoration techniques and evaluating their outcomes. In the following eight sections of this report, we summarize the major themes that emerged from the surveys within each topic category. Detailed management challenges and research topics can be found in Appendix 1.

Species, Ecological Communities, and Ecosystems

Common themes among management challenges to species, ecological communities, and ecosystems were the effects of various anthropogenic drivers (climate, recreation, development, and so on) on wildlife and habitats. Research priorities are varied, but recurrent topics include the effects of climate change, site-specific effects and approaches to restoration, and targeted inventory and monitoring of species.

Many consequences of climate change are represented among the research gaps, ranging from the level of the individual (for example, physiological properties) to the species level (for example, species distributions) and population-level processes (for example, forest regeneration). Additional questions relate to how biotic interactions (for example, invasive species and disease) and physical processes (for example, erosion) are being altered, and which tools land managers can use to respond (for example, through assisted migration).

Questions related to restoration fall into two groups: (1) how to best administer restoration in response to various activities or pressures (for example, recreation, solar development, and invasive species); and (2) the effects of restoration itself. One respondent asked: “Where can active management make a difference? What are the most effective management strategies? Are restoration efforts successful and what does success look like? […] Science to indicate whether a current policy or management strategy is ineffective or harmful.” Information with local relevance could help address these issues. Finally, inventory, monitoring, and basic ecological science—particularly with respect to sensitive species—could inform decision making.

Hydrology and Waterways

Management challenges with respect to hydrology and waterways revolve around maintaining water quality and availability—such as instream flows, springs and groundwater-dependent ecosystems, and seasonal wetlands; natural climate dynamics; and anthropogenic demands in the face of climate change and anthropogenic pressure (in other words, increased extraction). Research gaps fall into four broad categories: (1) inventory and monitoring of water resources, including developing new monitoring tools; (2) baseline research on water quality in general, and with respect to development like oil and gas; (3) the effects of climate change on watersheds and hydrology (for example, changes in channel morphology, flood intensity, water quantity, and so on); and (4) baseline research on groundwater dynamics (for example, flows, residence time, and aquifers) and the effects of anthropogenic activities like development, pumping and extraction, and management decisions (for example, dam operations).

Basic inventory and monitoring work, particularly regarding groundwater, could aid decision making. As one survey respondent stated,

> “Gathering baseline data is critical to understanding potential impacts from climate change and water extraction actions. It is also important in securing water rights to protect water resources in the future. […] A comprehensive inventory of water resources […] would be invaluable [to] NEPA analysis of impacts to water for any proposal.”

While the potential future effects of climate change on water availability are difficult to predict and introduce many unknowns, regional hydrologic dynamics and the effects of current (2024) anthropogenic uses are also uncertain. Ethnographic and socioeconomic studies could help inform risks posed by human use and frame pertinent cultural and

social mechanisms, including the cultural significance of water resources to local and (or) descendant Indigenous communities. Detailed water quality data for streams and springs in high-priority areas could also be an asset to decision making, as could greater insight into how climate change might affect water availability. The development of new technologies or tools was suggested as one method for improved inventory and monitoring. Finally, the effects of water management, like dam operations, on channels and sediment load, and how this management intersects with the consequences of climate change, are areas of interest.

Livestock Grazing and Range Management

Questions in our survey related to livestock grazing are at the core of range management: How can we distinguish the effects of livestock from other effects (for example, climate), and what are the livestock carrying capacities for grazed lands? As one respondent noted, "Collecting, analyzing, and evaluating effective monitoring data sets to make informed decisions for natural resource management" is a substantial management challenge; although livestock effects and carrying capacity have been studied extensively, reliable ways of translating research findings to individual allotments could aid management.

Cultural Resources

Cultural resource protection in general was identified as a management challenge, and certainly there are multiple processes—for example, erosion—that present ongoing threats to cultural resources and sensitive areas like burials and sacred shrines, both mentioned by survey participants. Damage to these sites, which represent the heritage of Indigenous groups, was of concern to respondents because of potential effects on the ability of those groups to continue their cultural practices. The effects of climate change were also noted as a serious threat to Indigenous communities and their cultures as certain culturally significant plants, animals, and especially water resources become less accessible.

A relatively new challenge identified is the online disclosure of location and other information about sensitive archaeological sites, drawing more visitors to these sites. Respondents asked, How do we change the social mores regarding sharing of sensitive information online? More inventory and monitoring could also help protect cultural resources.

Paleontological Resources

In broad terms, the greatest management challenges identified with respect to paleontology are protecting paleontological resources from erosion, educating the public, and increasing inventory and monitoring. Updating the BLM's Paleontological Fossil Yield Classification tool (BLM 2016, 2022)—used to guide decision making, among other things—is an additional challenge. Aside from inventory and monitoring, identified research topics were more academic in nature and could advance our understanding of earth history.

Air Quality

Air quality received less attention in our survey, perhaps reflecting the array of agency expertise among our respondents. Dust was identified as a concern and an area where more information could be an asset.

Recreation

Recreation appeared throughout the survey responses as a challenge and priority area of research. However, recreation is also a core service provided by public lands, and managing the rising numbers of visitors, new recreational activities, and changing use patterns was identified to help ensure that recreation harmonizes with other land uses and resource protection. Questions related to recreation range from the practical and researchable—Where are visitors going and how do we keep them safe?—to verging on existential—How do we ensure that public lands continue to thrive while hosting more and more people?

Communication and Institutional Systems

The challenges related to communication and institutional systems that were identified by respondents are in many ways central to effective land management: How do we coordinate across agencies, engage Tribal Nations, overcome political hurdles, or choose among contradictory scientific evidence? New research is likely to be only a part of the solution, and respondents mentioned that new technologies, rigorous workflows, and research which informs defensible management decisions could be most helpful. Although some of these challenges may be peripheral to scientific research, researchers could benefit from considering how their work intersects with these topics. For example, respondents noted that researchers may be well positioned to provide guidance on how their data can be effectively presented to members of the public in the support of specific management decisions. Conversely, by reflecting on the political impediments to certain management actions prior to initiating a study, a researcher could, for example, alter their study design to include tests of more realistic management options.

Suggested Science Priorities for Funding Agencies

The survey results reported here draw attention to several areas of high-priority research; however, there may be pressing areas of research that are beyond the science priorities listed below, so we emphasize that this is not comprehensive and we direct readers to Appendix 1 for further details. An ongoing dialog between agency staff, researchers, and funding agencies could help to identify these additional research needs as they arise. Furthermore, we have not extended this survey to Indigenous representatives for a variety of reasons, principal among them a desire to respect relationships and structures formed between the land management agencies and Tribes who are involved in comanagement. Potential future work could undertake a similar exercise to gain insight into the Indigenous perspective on these questions.

Based on survey responses and conversations with agency staff, we highlight the following research areas as science priorities:

- Recreation effects and visitor behavior
- Restoration techniques and efficacy
- Hydrologic dynamics, especially across large spatial scales
- Inventory and monitoring
- Climate change

Research that focuses on processes over which land managers have some control are preferable. For example, although land managers cannot control climate change, they can make science-supported decisions within a framework of understanding how changing climate might affect resources. Projects that follow the guidelines of actionable research outlined in the following section may better align with agency research needs regardless of the topic. For example, research funders could consider the general areas provided here in reviewing grant applications. Additionally, funders could consider developing funding calls that are targeted to some of these topics while leaving open-ended space for other project areas.

Suggestions for Supporting Actionable Research

Researchers, funders, and resource managers can consider ways to support the development of actionable research that can be used in resource management decision making (refer to the "Steps to promote actionable research" sidebar in this report). Two common issues with the application of primary literature to management are that either the question was approached in a way that does not translate easily to decision making, or the context of the study was too different from the applied scenario (Pullin and others 2004). To promote research that can lead to useable products, researchers and decision makers can communicate before a study is initiated. One strategy is for researchers to coproduce research questions with, or source them from, managers and decision makers (Matzek and others, 2014 and references therein; Bisbal and Eaton, 2023). Conversely, land managers may consider approaching researchers with relevant expertise and proposing a specific project or collaboration (Pullin and others, 2004). Prior work has shown that the applicability of research to decision making increases when the research team identifies in advance the specific decisions or actions that could benefit from the research, and understands the context (for example, policy, legal framework, and so on) in which decisions are made (Beier and others, 2017; Bisbal and Eaton, 2023). If working in partnership, at least one in-person meeting of partners and stakeholders can be an asset (Beier and others, 2017).

When developing the study framework, advice from land managers in designing field experiments can help to ensure that the field sites and experimental treatments are relevant to management (Matzek and others, 2014). Engaging Tribes on research design can also lead to mutually beneficial partnerships with Tribal ecologists, botanists, hydrologists, and cultural specialists, which can help identify potential opportunities for assisting with implementation. Matching the spatial and temporal scales of the research to those of the management decision at hand can help increase applicability to management (Beier and others, 2017) or reasonably foreseeable management trends. Although not relevant for all studies, using citizen science or participatory research can bring research closer to the end user (Matzek and others, 2014). Finally, when deciding how to gather, summarize, and present information in publications, a researcher can generate numeric values, figures, and tables that directly support management-relevant decision thresholds.

Access to research is a widely acknowledged barrier for agency staff who do not always have library or journal access (Pullin and others, 2004) and have many demands on their time beyond reviewing the peer-reviewed literature (Pullin and others, 2004; Matzek and others, 2014; Carter and others, 2024). Managers commonly use research syntheses (Pullin and others 2004), so science compilations, summaries, syntheses, and meta-analysis products that are specifically designed for use in decision processes could be used (Haddaway and others, 2017; Bisbal and Eaton, 2023; Martin and others, 2023; Carter and others, 2024). In our conversations with land managers, people expressed that although citing a journal article is helpful for supporting decision making to a point, often it is more valuable to have deliverables like maps, tables with clear benchmark values, or visual data. Simplified deliverables with clear conclusions could help explain how and why a decision was made.

Other ways to reduce impediments to research access can include distilling or summarizing research findings for resource management readership rather than (or in addition to) for a scientific journal (Carter and others, 2024), and many journals now allow inclusion of a lay summary as part of a peer-reviewed publication (Matzek and others, 2014). Agency staff we spoke with particularly appreciated articles that include a section on management implications. When possible, researchers could publish open access (Fuller and others, 2014; Matzek and others, 2014; Carter and others, 2024) or could make their work freely available (for example, sent directly or posted to sites like ResearchGate; Carter and others, 2024).

Finally, researchers can seek opportunities to communicate directly to their audience by presenting research at symposia and workshops attended by managers or by arranging meetings with managers, extension agents, and so on (Pullin and others, 2004; Matzek and others, 2014). Finding opportunities to communicate may be easier if the researcher has sought input from land managers from the outset. Agency staff with whom we spoke had positive experiences with researchers who developed relationships with them over multiple studies, and who came to the agency office or other local venues to speak directly to managers about the research and specific management actions indicated by their results.

With the growing interest in coproduced and actionable science, some research funders are adopting protocols to amplify the extent to which the work they fund is actionable. The following could be considered:

- Grant applicants who supply a letter of support from a resource management partner which aligns with the guidelines for coproduction of research questions described above could be prioritized.
- Grant applicants could be asked to describe what management decision(s) the proposed research can inform and how data can be interpreted or presented for use in decision making.
- Grant recipients could include a summary of research findings for resource managers or a management implications section in their final report.
- Grant recipients could engage in at least one mode of communication to a public or resource management audience, for example, a public presentation.

Summary

Evidence-based scientific information can help support defensible decision-making in public lands management. Often, pressures on public lands take place at spatial scales that span multiple management units and agencies. Cooperative and complementary approaches among agencies could better support strategies to contend with these regional pressures while potentially saving resources by preventing repetitive work. This work identified current (2024–25) Bureau of Land Management, U.S. Department of Agriculture Forest Service, and National Park Service research needs in southeastern Utah and synthesized common motivations and questions across management boundaries. The U.S. Geological Survey met with and informally surveyed Federal land management agency staff between October 2024 and January 2025. Staff were asked two open-ended questions about their greatest resource management challenges and most pressing research questions during the next 5–10 years. Their responses were compiled and summarized according to the resource affected in the following categories: species, ecological communities, and ecosystems; hydrology and waterways; livestock grazing and range management; cultural resources; paleontological resources; air quality; recreation; and communication and institutional systems.

Climate change—especially drought—and recreation were among the most common management challenges for nearly all resources. Development pressure (for example, from mining, energy development, recreation infrastructure, or urban expansion) and invasive species were also common management concerns. Many survey respondents noted that more inventory and monitoring data could also aid decision-making. Other frequently cited research priorities focused on developing site-specific restoration techniques and evaluating their outcomes. We highlight the following research areas as identified science priorities by Federal resource managers: (1) recreation effects and visitor behavior, (2) restoration techniques and efficacy, (3) hydrologic dynamics, (4) inventory and monitoring, and (5) climate change. Projects that follow the guidelines of actionable research may better align with agency research needs and may more readily inform management decisions.

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Appendix 1. Agency Survey Report

Detailed information summarized from the survey responses is presented below according to the resource affected in the following categories: species, ecological communities, and ecosystems; hydrology and waterways; livestock grazing and range management; cultural resources; paleontological resources; air quality; recreation; and communication and institutional systems. Management challenges and research questions are listed separately within each resource category. Survey responses were simplified and combined when multiple comments addressed the same issue.

Species, Ecological Communities, and Ecosystems

Species, ecological communities, and ecosystems include all biotic components of the landscape and their interactions.

Management Challenges

- Effects on wildlife from:
  - Climate change, especially drought
  - Recreation
  - Habitat loss and fragmentation
  - Energy and mineral development
  - Invasive species
  - Introduced ungulates
- Gaps in baseline inventory and monitoring data on species occurrences and distributions.
- Maintaining or improving the quality of aquatic and riparian habitat for native species.
- The increasing emphasis on vegetation fuels reduction without consideration for other resources.

Research Questions and Topics

- Climate change:
  - How might climate change shift species distributions, including refugia?
  - How vulnerable are species, communities, and ecosystems to climate change?
  - How might climate change affect invasive species?
  - How might climate change affect disease?
  - Will climate change lead to more Harmful Algal Blooms?
  - How might climate change alter physical processes such as biological soil crust degradation and weathering rates?
  - How might forest regeneration be affected by climate change?
  - How might climate change affect alpine habitats?
  - How might drought and increased heat load affect wildlife?
  - What are the value and implications of assisted species migration (and [or] genetic migration) in relation to climate change?
  - What are the effects of long-term drought and climate change on vegetation (shifting seed transfer zones, change in or reduction of suitable habitat, forage quantity and quality, restoration success), including special status species?
- Restoration:
  - What are the site-specific effects of recreation on wildlife and habitats, and what are the best ways to mitigate those effects?
  - What are the best ways to mitigate solar development effects on wildlife?
  - What are site-specific best practices for restoration (upland, riparian, alpine; and from a variety of pressures or past use), including invasive species management?
  - Implications or effects of management treatments and actions, including linking vegetation and habitat restoration effects to other trophic levels (for example, invertebrates and wildlife); or, for rivers, large-scale tamarisk treatments or channel modifications.
  - How can we update methods to treat invasive species?
  - What are the effects of herbicides on sensitive plant species?
  - What are the best ways to reintroduce American beaver (*Castor canadensis*) or mimic the effects beavers have on the landscape?
  - A better understanding of historical beaver distribution and abundance within the study area to inform low-technology, process-based restoration project potential.

- Inventory and monitoring, and basic ecological science:
  - Mexican spotted owls (*Strix occidentalis lucida*): acoustic monitoring validation, seasonal migrations, and use of habitat/patterns.
  - Arches National Park prairie dog (*Cynomys* sp.) colony baselines and associated burrowing owls (*Athene cunicularia*).
  - Migratory birds and which habitats in our parks are the most important stopovers.
  - Status and spatiotemporal trends of native and nonnative amphibian populations.
  - A better understanding of the effects of recreational use on amphibian populations in lotic and lentic systems.
  - What are the relations between plants and mycorrhiza in the context of understanding vegetation communities, restoration, and special status species conservation?
  - What is the habitat suitability and efficacy of reproduction or propagation of recently added special status species as conservation actions?
  - What are the unique pollinator and plant relations for sensitive species?

Hydrology and Waterways

This section addresses the quality, quantity, and movements of all surface water and groundwater in the study area.

Management Challenges

- Warming climate
- Aridification, megadrought, and changing precipitation patterns and hydrology
- Anthropogenic pressure

Research Questions and Topics

- Inventory and monitoring:
  - Research on groundwater, flow paths and residence times, watershed dynamics, seeps, and springs to understand how development and water extraction outside of public lands affects water resources within public lands. What is changing and why?
  - Groundwater monitoring, including monitoring of water levels in water wells during and after pumping, and effects from water well pumping on nearby springs.
  - Can we use remotely sensed data, like data from the Gravity Recovery and Climate Experiment (NASA, 2026), to better understand local groundwater resources in management-relevant ways?
  - What are the important groundwater recharge areas and travel times to local community municipal water systems, especially for communities that only have access to one aquifer (such as Castle Valley, Bluff, Mexican Hat, and White Mesa in Utah)?
  - Can we get high-quality estimates of upstream water withdrawals, maybe with remotely sensed data?
  - Ongoing spring inventory work, including site identification and description, with water flows and water quality information. This work could also include vegetation studies, impact assessments, restoration, macroinvertebrate surveys, and so on.
  - What is the interaction of upland vegetation and soil conditions on stream and groundwater conditions, by ecological site group?
- Water quality:
  - Analysis of radioactive elements in areas with historic or active mining activity (West Coyote Creek, La Sal Creek, Lisbon Valley area, Yellow Cat Flat area, Fry Canyon area, and so on)
  - Analysis of salinity levels related to oil or gas activity using water injection to enhance production (in other words, effects on the towns of Bluff and Montezuma Creek in Utah drinking water or nearby springs from the Aneth field to the Navajo Sandstone or the San Juan River)
- Climate change:
  - How might climate change affect the intensity of floods?
  - Which groundwater aquifers are most susceptible to the effects of climate change and degradation from human uses?
- Management:
  - Understanding flood events and predicting effects, like scouring in some areas compared to deposition in others.
  - Understanding sediment movement in rivers and tributaries, and changes to river geomorphology.
  - What dam release flow regimes least degrade channel complexity in rivers like the Green River?

- What are the implications or effects of management treatments or actions on dam operations, sediment loads, and timing of high flows?
- Studies to better analyze and understand the effects of potential management decisions on groundwater and surface water resources.

Livestock Grazing and Range Management

This section addresses the effects of livestock on rangeland ecosystems and physical processes, like erosion and hydrological dynamics.

Management Challenges

- Applying adaptive livestock management principles in consideration of the care and management of objects in the Bears Ears National Monument.

Research Questions and Topics

- How can we distinguish the effects of livestock compared to climate on ecological function?
- What are the true livestock carrying capacities for permitted grazing allotments?

Cultural Resources

Cultural resources here include archaeological and historic sites and culturally significant plants, animals, and water resources.

Management Challenges

- Social media sharing of nondisclosed archeological resources.
- Limited capacity to inventory and monitor archeological resources.

Research Questions and Topics

- How might climate change affect cultural sites, for example through increased flood intensity or erosion?
- How do we motivate social change so that disclosure of protected cultural sites online (especially on social media) is shunned?

Paleontological Resources

Paleontological resources describe evidence or remains of past life preserved in a geological setting.

Management Challenges

- Erosion: identifying paleontological resources before they degrade and slowing degradation at known localities.
- Educating the public about the value of paleontological resources, collecting rules, and how to report new finds.
- Updates to the Bureau of Land Management Potential Fossil Yield Classification tool.
- Limited capacity for inventory and monitoring.

Research Questions and Topics

- Inventory of paleontological sites.
- How are organisms preserved?
- How are organisms distributed in time and space and what does that mean for reconstructing ancient ecosystems?
- What are the phylogenetic positions of organisms and what changes of form and function occur through deep time?
- What are the mechanisms, process, and effects of the major extinction events?

Air Quality

Air quality describes the level of contamination or suspended particles in the air.

Management Challenges

- Dust affecting airsheds.

Research Questions and Topics

- Where are potential hotspots for regional dust emissions, what is their susceptibility to climate change, and which could affect parks?

Recreation

Recreation refers to all the ways in which people interact with public lands for enjoyment.

Management Challenges

- Visitor effects and expectations, including increases in visitation and changes in use patterns.

Research Questions and Topics

- How many visitors are going to remote locations and what are the effects?
- What is the nexus of environmental hazards (for example, geologic or hydrologic hazards) with visitor use areas?
- How do we prioritize both visitation infrastructure and preservation values?
- In the context of increasing development and human population, how do we sustain parks and public lands?

Communication and Institutional Systems

This section explores political, social, and agency systems for decision making and management, and communication among agencies, the public, and other groups.

Management Challenges

- Interagency management coordination, which effects water and groundwater, air quality, night skies, viewsheds and soundscapes, invasive species, wildlife habitat, wildlife migration routes, feral burros, recreation effects, ethnographic resources, and others.
- Political impediments to management, for example, reluctance or eagerness to list endangered species, or mandates for approval of solar and mineral development.
- There are too many models; it could be possible to justify any decision if you choose the model and parameters selectively.
- Supporting meaningful involvement of Tribal Nations in decision making without overburdening them.
- Effectively presenting the science behind management decisions to members of the public.
- Collecting, analyzing, and evaluating effective monitoring datasets to make informed decisions for natural resource management.

Research Questions and Topics

- Science to indicate whether a current policy or management strategy is ineffective or harmful: Where can active management make a difference? What are the most effective management strategies? Are restoration efforts successful and what does success look like?
- Use of new technologies to increase capacity and effectiveness of resource monitoring and condition assessments (for example drones, remote sensing, acoustic monitoring for Mexican spotted owl, and so on), as well as development of workflows to use these technologies.

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