

SCIENTIFIC OPPORTUNITIES IN THE NATIONAL LANDSCAPE CONSERVATION SYSTEM

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ABSTRACT

The National Landscape Conservation System consists of unique and beautiful places across America's landscapes where identified resources and values are protected and science is highlighted. The mission of the National Landscape Conservation System (NLCS), which is managed by the Bureau of Land Management and is often referred to as the agency's National Conservation Lands, is to conserve, protect, and restore nationally significant landscapes for their cultural, ecological, and scientific values. This clear inclusion of science in the NLCS mission sets the stage for individual units to serve as places of learning, teaching, discovery, and innovation. Science is an integral part of managing the National Conservation Lands, and science conducted within and across the more than 900 units that make up the NLCS can inform and influence conservation and public land management well beyond its boundaries. Here, we highlight seven core aspects of National Conservation Lands that present valuable science opportunities: (1) the scientific values for which individual units are designated; (2) the many other resources, objects, and values within units; (3) the value of units as "control" sites for understanding the effects of activities such as mineral extraction that commonly occur elsewhere on multiple-use public lands but are often prohibited within National Conservation Lands; (4) the value of units for studying the effects of activities such as recreation that regularly occur and may be intensified on National Conservation Lands; (5) the high visibility of units, which draws strong interest and engagement from scientists, partners, and the public; (6) the functioning of the units as a network managed for a common purpose, which provides an opportunity to explore cross-cutting science questions across widely varying contexts and geographies; and (7) the opportunities units provide to promote and apply Indigenous Knowledge to scientific research to manage natural and cultural resources. Because of all of these characteristics, National Conservation Lands can serve as hubs for basic and applied science that can inform management of all public lands and resources into the future. We highlight these science opportunities through examples from existing units and suggest two actions that could help further science activities and impact on National Conservation Lands.

INTRODUCTION

The Bureau of Land Management's National Landscape Conservation System

Public lands comprise just over one-third of America's land base, providing abundant and diverse opportunities for recreation, critical habitat for conserving rare and declining species, and important energy, mineral, timber, and other resources. The Bureau of Land Management (BLM) manages the largest area of American public lands—more than 245 million acres—and within its portfolio is the National Landscape Conservation System (NLCS).

The NLCS was established in 2000 and legislatively codified in the Omnibus Public Land Management Act of 2009 (16 USC §7201 et seq.). NLCS lands "conserve,

protect, and restore nationally significant landscapes that have outstanding cultural, ecological, and scientific values for the benefit of current and future generations" (16 USC §7202(a)). The NLCS encompasses approximately 38 million acres and includes 31 national monuments, 25 national conservation areas (NCAs) and similar designations, 750 wilderness areas and wilderness study areas, 81 wild and scenic rivers, and 19 national scenic and historic trails (BLM 2025a). These lands are often referred to collectively as BLM's National Conservation Lands. In this article, we use the term "National Conservation Lands" where possible for simplicity, but use the formal name—National Landscape Conservation System or NLCS—as needed (e.g., when referring to policy or legislation).

Press releases, high-profile visits, and other public events and information often accompany the designation of new units in the NLCS. Congressional or presidential designation of new units is often only possible following years of heightened public exposure and advocacy, which can bring heightened attention to management for resource managers, non-governmental organizations, and the public. Managers may also collect more baseline data in newly established units to strengthen the knowledge base for future protection and management (e.g., through BLM's Assessment, Inventory, and Monitoring program; Toevs et al. 2011), and recreation visits may increase as a result of heightened public awareness and new or expanded visitor facilities (Smith et al. 2021).

The role of science on National Conservation Lands

Science information and the scientific process, including diverse knowledge systems, inform and guide management decisions about the conservation, protection, and restoration of the values for which NLCS units were designated. BLM emphasized the importance of science on National Conservation Lands by first developing a science strategy (BLM 2007) that informed the broader strategy for integrating these lands into the larger system of public lands managed by the agency (BLM 2011). BLM identified four key objectives to make this focus on science a tangible reality: (1) promote scientific study within units; (2) implement a standard process for permitting and reporting scientific research within units; (3) communicate the results of scientific study internally and integrate this knowledge into management decisions; and (4) communicate scientific findings externally (BLM 2007).

A strategic science planning process is required by policy within national monuments and NCAs, a subset of National Conservation Lands. The core focus of science planning is to identify science needs related to the resources, objects, and values for which the national monuments and NCAs were designated; assessment, inventory, and monitoring; restoration; and landscape-level challenges and issues (BLM 2017).

BLM has a long history of working with partners to pursue a shared vision for the lands, waters, and resources that it manages. Science activities are no different. Partnerships are highlighted in science activities on National Conservation Lands that range from establishing protocols for monitoring values in units to engaging the public to assist with science to understand the effects of planning and management on adjacent lands (BLM 2007).

The focus on science and its use on National Conservation Lands (BLM 2012a, 2017) resides within a broader focus on science in the BLM as a whole. BLM manages federal public lands for multiple and diverse resources, uses, and values, including accommodating current demands for resource uses, meeting land health standards (43 CFR §4180.1), and sustaining yield of renewable resources (43 USC §1701–1787). As a result, decision-making in the agency is complex and often controversial. The agency is committed to integrating science into its management and decision-making processes (Kitchell et al. 2015). Environmental laws—including the National Environmental Policy Act (NEPA; 42 USC §4332(2)(A)), the Endangered Species Act (16 USC §1533(b)(1)(A)), and the Clean Air and Water Acts (42 USC §7408(a)(2), 33 USC §1314(a)(1))—all require agencies to use science in their decisions. Increasingly, agencies are also encouraged to include Indigenous Knowledge as an aspect of best available science (Department of the Interior 2023). Together these laws and commitments to use science across all federal agencies provide a strong and broad foundation and context for meeting the science mission of BLM's National Conservation Lands.

Goal

In this article, we highlight seven core aspects of BLM's National Conservation Lands that present unique and valuable science opportunities. We illustrate some of these opportunities through examples from individual units, and we conclude the article by suggesting two actions that could be considered to help more fully realize the science potential of our National Conservation Lands.

SEVEN CORE ASPECTS OF NATIONAL CONSERVATION LANDS PRESENT VALUABLE SCIENCE OPPORTUNITIES

1. The scientific values for which individual units are designated

Scientific values have been referenced for more than a century in laws related to public lands managed by BLM, including the National Conservation Lands. Most recently, the Omnibus Public Land Management Act of 2009 codified the purpose of the NLCS, which is “to conserve, protect, and restore nationally significant landscapes that have outstanding cultural, ecological, and scientific values for the benefit of current and future generations....” Much earlier, the Antiquities Act of 1906 referenced a related term, authorizing the president to protect “historic landmarks, historic and prehistoric structures, and other objects of historic or scientific interest” by designating them as national monuments. The Wilderness Act of 1964 defined “wilderness,” in part, as potentially containing “ecological, geological, or other features of

scientific, educational, scenic, or historic value.” The Wild and Scenic Rivers Act of 1968 emphasized the protection of “aesthetic, scenic, historic, archaeological, and scientific features.” Most broadly, the Federal Land Policy and Management Act of 1976—the organic act of BLM—declared that all public lands managed by the agency will “be managed in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values....”

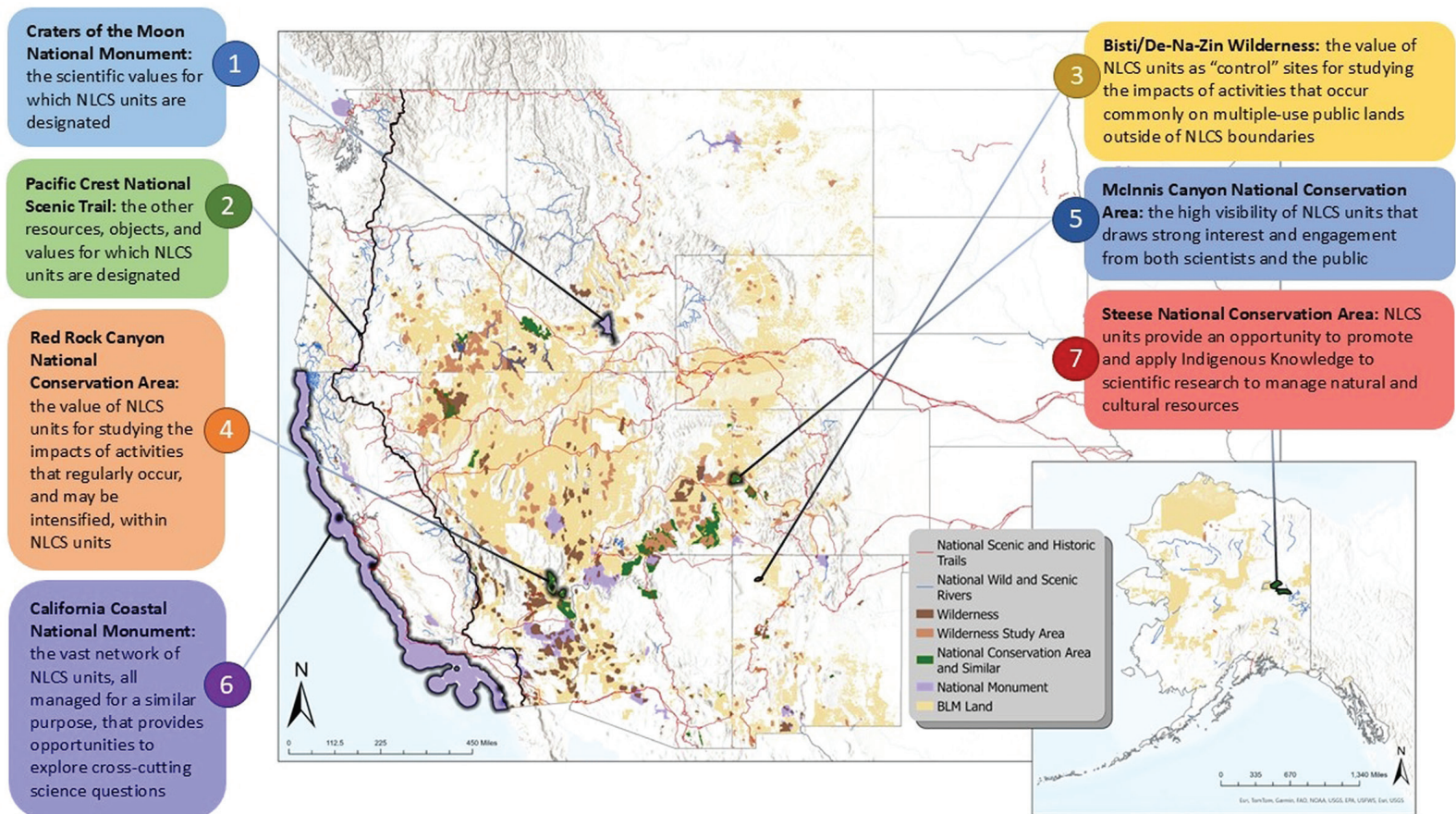
Scientific values are sometimes explicitly called out in a unit’s proclamation or enabling legislation. For example, the proclamation for the boundary enlargement of Craters of the Moon National Monument (Figure 1) in Idaho states: “The unusual scientific value of the expanded monument is the great diversity of exquisitely preserved volcanic features within a relatively small area.”

More often, scientific values of a unit are referred to using related terms such as “scientific interest” (the

term used in the Antiquities Act of 1906). For example, the proclamation for Grand Canyon-Parashant National Monument in Arizona states: “The ponderosa pine ecosystem in the Mt. Trumbull area is a biological resource of scientific interest, which has been studied to gain important insights regarding dendroclimatic reconstruction, fire history, forest structure change, and the long-term persistence and stability of presettlement pine groups.”

Clearly, scientific values within units provide unique and valuable opportunities for research. Yet despite references to and examples of scientific values in more than a century of federal laws and designating language for units, we could find no definition of the term in those documents. To provide clarity for readers, for the purpose of this article we adopt a definition of “scientific values” that is in part derived from definitions provided by Law Insider (lawinsider.com, accessed 22 October 2024) and in Florida state regulations (Ch 18-20 Florida Aquatic Preserves, §18-20.003(60)). We define “scientific

FIGURE 1. Units of the Bureau of Land Management (BLM) National Landscape Conservation System (NLCS). A selection of units highlighted in this article are indicated in black outlines. Callout boxes note the numbered section of this article referring to the unit, and the scientific opportunity for which it is highlighted. MAP SOURCES: ENVIRONMENTAL SYSTEMS RESEARCH INSTITUTE, INC., TOM TOM, GARMIN, FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, US GEOLOGICAL SURVEY. © OPENSTREETMAP CONTRIBUTORS, AND GEOGRAPHIC INFORMATION SYSTEM USER COMMUNITY, ENVIRONMENTAL SYSTEMS RESEARCH INSTITUTE, INC., US GEOLOGICAL SURVEY



values” as objects, qualities, features, resources, processes, species, or places that have the potential to contribute significant information to the body of scientific knowledge that is not available elsewhere.

2. The other resources, objects, and values within units

Every unit contains resources, objects, values, qualities, or features (hereafter objects and values, for brevity) for protection in relation to its overarching designating law or its enabling legislation or proclamation. For example, the proclamation language for Cascade-Siskiyou National Monument in Oregon describes some of its objects and values:

With towering fir forests, sunlit oak groves, wildflower-strewn meadows, and steep canyons, the Cascade-Siskiyou National Monument is

an ecological wonder, with biological diversity unmatched in the Cascade Range. This rich enclave of natural resources is a biological crossroads—the interface of the Cascade, Klamath, and Siskiyou ecoregions, in an area of unique geology, biology, climate, and topography.

Learning about these objects and values through scientific study is critical to ensuring that they are properly protected and managed. One way this occurs is through the development of science plans for national monuments and NCAs, which provide further insights into objects and values identified as priorities for future study. For example, the science plan for Steese NCA in Alaska includes needs that focus on the two special values identified for the unit in its designating language: Birch Creek and caribou range. The plan

FIGURE 2. Jurassic National Monument in central Utah includes in its designating language reference to its outstanding paleontological research opportunities, and it has indeed yielded thousands of dinosaur fossils. Designating the area as a national monument emphasized the importance of both the resources there and management that protects the value of those resources for research. **JEREMY T. DYER**



describes a need to develop a water quantity or water quality monitoring strategy for Steese NCA watersheds, including Birch Creek Wild and Scenic River, and to develop and implement an effective monitoring program for caribou range in the NCA and range-wide to identify key habitat areas and attributes, potential impacts to those habitats and to caribou utilization, and mitigation and management strategies (Haddix et al. 2023). The science plan for Santa Rosa and San Jacinto Mountains National Monument in California identifies a core need to determine the distribution of cultural sites, including agave roasting pits, habitation sites, and food gathering areas, including through interviews with Tribal Elders (University of California Riverside Center for Conservation Biology 2016).

Beyond national monuments and NCAs, other NLCS units foster scientific opportunity as well. Wild and scenic rivers are managed to protect “outstanding remarkable values” that are identified in the river’s comprehensive river management plan (Diedrich and Thomas 1999). Wilderness areas are managed for the preservation of their “wilderness character,” defined as five qualities: natural, undeveloped, untrammeled, containing outstanding opportunities for solitude or primitive and unconfined recreation, and potentially containing “ecological, geological, or other features of scientific, educational, scenic, or historical value” (16 USC §1131(2)). National scenic trails add meaning and deep cultural considerations across landscapes, as managers are directed to provide for the enjoyment and appreciation of the resources, qualities, values, settings, and uses for which trails were designated (BLM 2012b). Managing these areas as intact natural systems or as longstanding travel corridors enables cultural and ecological connectivity, which are essential for preserving human heritage and biodiversity, and provides significant science opportunity. For example, studies along the Pacific Crest National Scenic Trail that runs north from the border with Mexico through California, Oregon, and Washington to the Canadian border (Figure 1) have provided key insights into the demographics, values, and social worlds of long-distance hikers along with technology use, educational strategies, and perspectives on permitting and enforcement (Lum et al. 2019; Goldenberg et al. 2023).

3. The value of units as “control” sites for studying the effects of activities that occur commonly on multiple-use public lands outside of units
BLM’s organic act—the Federal Land Policy and Management Act—states that public lands managed by the agency are to be managed under the principles of multiple use

and sustained yield except that “where a tract of such public land has been dedicated to specific uses according to any other provisions of law it will be managed in accordance with such law” (43 USC §1732(a)). NLCS units are an example of this exception, and certain uses and activities are typically prohibited or limited to protect the values for which a unit was designated. For example, subject to valid existing rights, wilderness areas like the Bisti/De-Na-Zin Wilderness in New Mexico (Figure 1), are withdrawn from mineral entry (the ability to explore for, discover, and acquire rights to extract valuable minerals on public lands under the Mining Law of 1872) as of the date of designation, and public motorized and mechanized uses are prohibited. Often, these types of uses or development activities continue to be authorized on lands around the unit, which may be managed by BLM or by other federal, state, or local agencies or other entities for multiple uses and sustained yield. As a result, lands and waters in close proximity can have starkly contrasting levels of specific types of activities, presenting a valuable study opportunity.

The strongest scientific studies for understanding the nature and magnitude of effects from different activities or disturbances require both control and treatment (impacted) sites. Control sites are similar to the site being assessed in all respects except for the disturbance or treatment of interest. Control sites are necessary to establish cause-and-effect relationships between disturbances and changes in resources of concern and thus are critical to gaining a clear understanding of how different types of uses and activities may affect resources. In BLM, a solid data foundation within and outside of NLCS units strengthens their ability to serve as control sites. BLM inventories and monitors terrestrial, lotic, and riparian and wetland systems on all lands (Toevs et al 2011), with some NLCS units receiving an intensified level of sampling that provides an even stronger, long-term data foundation.

Opportunities for NLCS units to serve as control sites abound. For example, road development is often limited in units, providing opportunities to study the effects of road development in similar ecosystems outside the unit. Vegetation treatments may be limited in NLCS units because they involve prohibited uses (e.g., motorized use in a wilderness area) or because of their potential to negatively alter the scenic character of a unit. In these cases, the units can serve as control sites to help researchers better understand the effectiveness of those vegetation treatments in similar areas outside of the units in achieving wildlife or habitat goals.

4. The value of units for studying the effects of activities that regularly occur, and may be intensified, on National Conservation Lands

Research that focuses on activities that occur both within and outside of NLCS units can help inform management decisions across all public lands. For example, researchers from the University of New Mexico, in partnership with Colorado Parks and Wildlife, BLM, Rocky Mountain Bighorn Society, and Wild Sheep Foundation, studied the effects of recreation on bighorn sheep in Dominguez-Escalante NCA in Colorado (Evans 2024). The results of this work are invaluable to local managers, but also provide insight into recreation decisions on other lands where sensitive populations of bighorn sheep could be in conflict with new activities and developments.

Recreation opportunities are a major focus in many NLCS units, and recreation may increase after designation (Smith et al. 2021). For example, Red Rock Canyon NCA (Figure 1) just outside of Las Vegas, Nevada, hosts several million visitors annually and has implemented a reservation system to better manage this high volume of visitation. Recreation opportunities there are varied, including going on scenic drives, rock climbing, hiking, taking guided tours, picnicking, road and mountain biking, horseback riding, camping, off-roading, geocaching, star gazing, and hunting (Figure 3). High volumes of recreators create challenges for maintaining high-quality visitor experiences (Jones and Hoversten 2002), and impacts of recreation on resources and landscapes are of increasing concern (Sarmiento and Berger 2017; Jordan et al. 2025). The popularity of Red Rock Canyon NCA also brings high visitation to the La Madre Mountains Wilderness Area within the

FIGURE 3. Recreators at Red Rock Canyon National Conservation Area just outside of Las Vegas, Nevada. NESSA FAYRAM



unit, whose location allows many people to enjoy the wilderness landscape but also creates challenges for managing the wilderness area (Marion 2016).

Livestock grazing also often remains an authorized use within units, and its impacts have been studied in Las Cienegas NCA in Arizona (Caves et al. 2013). Other activities such as motorized and mechanized vehicle use are prohibited in part or all of many units but allowed to some degree in others. For example, use of motorized vehicles in Sloan Canyon NCA in Nevada is permitted on designated roads and trails. This variability in levels of vehicle use allowed within, between, and outside of units provides an important opportunity to design studies to understand the impacts of different levels and types of vehicle use on sensitive resources (e.g., Custer et al. 2017) and how those impacts may be compounded by other uses or mitigated by management.

Some science plans already speak to the need for this type of research. For example, the plan for Gunnison Gorge NCA in Colorado identifies a high-priority need to understand the impacts of multiple uses, such as off-roading, livestock grazing, and mountain biking, on Mancos shale soils; the specific nature of those impacts to sediment, selenium, and salinity production; and how those impacts can be mitigated (BLM 2013a). Science partners can apply for financial support to conduct these types of research projects through BLM's National Conservation Lands Management Studies Support Program. This funding specifically supports research that informs effective decision-making for BLM's National Conservation Lands and the purposes for which individual units were designated.

5. The high visibility of units, which draws strong interest and engagement from both scientists and the public

National Conservation Lands are magnets for scientists, managers, community partners, and the public for multiple reasons. The large number of units and area of land managed under this system makes for diversity in the values they represent and in the activities occurring in them, as well as in the geographies and resources that both scientists and the public can observe and study. The public and key partners and stakeholders also often actively participate in BLM land use planning processes for units, contributing their thoughts and sharing their priorities to influence future science activities and management decisions. For example, Cascade-Siskiyou National Monument received 1,094 comment letters during a 90-day period on its draft resource management plan/environmental impact statement (BLM 2024a).



FIGURE 4. Livestock grazing in Agua Fria National Monument in Arizona. **EMILIO CORELLA**

Public engagement can take other forms as well. For example, in 2020, McInnis Canyons NCA (Figure 1) in Colorado partnered with the local school district, Colorado Canyons Association, National Environmental Education Foundation (NEEF), and others to support student projects assessing invasive plant management mechanisms (NEEF 2022). Nearly 50% of student participants in the program came from economically disadvantaged rural communities, thereby increasing science engagement with members of the public who previously may not have had the opportunity to get involved. Because the project was centered around invasive plant management, monitoring, and the implementation of new methods and mechanisms, students were also able to provide valuable data to BLM that could inform future planning efforts.

Public participation in science on public lands has become easier and more readily accessible through the increased pervasiveness of citizen science projects and applications (Dickinson et al. 2012). Citizen science is a particularly important opportunity for both the participants and the agency because of the cultural, ecological, and scientific values that attract high volumes of visitors; the presence of species within units that can be easily monitored by the public; and, in some instances, the proximity of units to urban areas and other public lands. The US Forest Service, BLM, and National Park Service have partnered with Adventure Scientists to survey water quality on wild and scenic rivers across the country (Toshak and Roseberry 2023). Basin and Range National Monument in Nevada successfully engaged scientists, federal and state natural resource agencies, friends' groups, university partners,

and members of the public through a rapid biodiversity assessment (BioBlitz) in 2021. Despite being a relatively isolated monument, the project engaged over 100 participants and recorded more than 1,800 observations of 424 species (iNaturalist 2021). Rapid assessments like this allow for species inventories that previously may not have been achievable due to limited time, funding, or organizational capacity, while also broadening perspectives of the public about resources that are worth conserving (McKinley et al. 2017).

Beyond public engagement in the scientific process, NLCS units can also serve as hubs for collaborations with multiple partners, including other state and federal land management agencies, local communities, nonprofits, and Tribal partners, to explore science and management across landscapes. Paleontology in general, and in particular that which is carried out in Grand Staircase-Escalante National Monument in Utah, is one example where the science only occurs because of such partnerships (refer to Titus et al. 2025, this issue). These collaborations can foster unique perspectives in the science and planning process, increase awareness of National Conservation Lands and their significance, and contribute to further designations, all of which can strengthen and broaden long-term science partnerships.

6. The vast network of units, all managed for a similar purpose, which provides opportunities to explore cross-cutting science questions across widely varying contexts and geographies

BLM's National Conservation Lands include more than 900 units encompassing approximately 38 million acres across the United States. The NLCS context, in which

individual units are managed as part of a single system, can support science initiatives at the system level in addition to the science projects and activities that occur within individual units. Thus, the broad network of NLCS units presents significant opportunities to address key natural and social science questions that span diverse environmental contexts and geographies, including finding solutions for addressing impacts of growing public lands visitation pressures and energy development on sensitive resources and adapting public land management practices to changing climate and resource conditions.

Exploring science questions across the widely varying contexts and geographies within the NLCS has been largely aspirational to date. However, some units occur within larger national monuments that make them well suited to ask landscape-level questions, which could

foster the development of even larger network-level science efforts. For example, California Coastal National Monument (Figures 1, 5) protects the entire coast of California (1,352 km) within 12 nautical miles of shore (BLM 2013b). The monument also includes six onshore units—Trinidad Head, Waluplh-Lighthouse Ranch, Lost Coast Headlands, Point Arena-Stornetta, Cotoni-Coast Dairies, and Piedras Blancas—which vary in the objects and values they were established to protect. Cotoni-Coast Dairies (Figure 6), located just outside of the city of Santa Cruz, illustrates opportunities for connecting and working with neighboring state and local public lands and partners while also navigating collective challenges from visitation pressure, wildfire risk, and coastal erosion. Major events at such units, like the public opening of Cotoni-Coast Dairies this year, provide important opportunities to highlight connections, shared challenges, and the role that

FIGURE 5. California Coastal National Monument near Marina, California SARAH WHIPPLE





FIGURE 6. Cotoni-Coast Dairies, an onshore unit of California Coastal National Monument. BOB WICK

science partnerships can play in supporting coordinated management within and across units of the National Landscape Conservation System. Such partnerships can play critical roles in helping to conduct the broad, coordinated science and management actions needed to conserve our best remaining intact landscapes, increase their connectivity, and strengthen their resilience in the face of the complex pressures that accompany our shifting land uses, growing populations, and changing climate (Thorne et al. 2021).

7. Opportunities to promote and apply Indigenous Knowledge to scientific research to manage natural and cultural resources

National Conservation Lands often coincide with areas of cultural significance for Tribal Nations. Units may hold cultural significance because they are considered sacred by one or more Tribes, or because they are locations of significant use for subsistence or ceremonial gathering of resources. Tribal Nations hold deep knowledge

about the natural and cultural resources in NLCS units. Together, these factors provide opportunities for BLM to work together with Tribal Nations to answer questions of shared interest, co-produce knowledge, co-steward resources, and co-develop information for visitors. Co-production and co-stewardship between BLM and Tribal Nations increase the depth and breadth of scientific understanding and the durability of decisions, while honoring connections and relationships Tribal Nations have with these landscapes and upholding the Department of the Interior's trust responsibility (BLM 2022).

Tribal Nations often hold deep knowledge about culturally significant landscapes, referred to as Indigenous Knowledge. Indigenous Knowledge has been described as a body of observations, oral and written knowledge, practices, and beliefs applied to phenomena across biological, physical, cultural, and spiritual systems (Inuit Circumpolar Council Canada 2025). Indigenous

Knowledge has been recognized as one of the many important bodies of knowledge that contribute to the scientific, technical, social, and economic advancements of the United States and the collective understanding of the natural world (Department of the Interior 2023). Working with Tribal Nations has great potential to enhance BLM's understanding and management of these special places.

Collaborating with Tribes to produce visitor displays and other interpretive materials can increase the public's understanding of the cultural significance of these places to their first inhabitants. For example, at Sloan Canyon NCA, BLM staff collaborated with the Twenty-Nine Palms Band of Mission Indians of California, the Hopi Tribe, Moapa Band of Paiutes, Chemehuevi Indian Tribe, and Friends of Sloan Canyon to develop a junior ranger book (BLM 2024b). This book uses Indigenous language and is filled with activities that provide information about

cultural practices (such as sharing history through song and dance) and about the cultural significance of specific features found in the NCA, and communicates Indigenous values of ecological connectivity and respect.

NLCS units can be focal points of shared interest providing opportunity for BLM and Tribal Nations to co-produce knowledge and work together to identify and define scientific needs and priorities that can produce shared benefits. For example, priority science needs identified in the Strategic Science Plan for Steese NCA and White Mountains Recreation Area in Alaska (Figures 1, 7) include developing an improved understanding of the quality and quantity of subsistence resources and drivers of change (Haddix et al. 2023).

Working together to co-produce projects, activities, and knowledge of important subsistence resources can support community needs and increase understanding

FIGURE 7. Steese National Conservation Area in Alaska. CRAIG MCCAA, BLM



of how climate change may be affecting populations. Knowledge Holders can contribute to an improved understanding of ecology by providing current observations as well as knowledge that has been passed down for generations which, combined with tools such as climate or ecological models, can help better plan for the future (Herman-Mercer et al. 2020).

OPPORTUNITIES FOR FURTHERING SCIENCE IN THE NATIONAL LANDSCAPE CONSERVATION SYSTEM

BLM’s vision for the NLCS is “to be a world leader in conservation by protecting landscapes, applying evolving knowledge, and bringing people together to share stewardship of the land” (BLM 2011). The use of science to further conservation, protection, and restoration of these special landscapes is a cornerstone of the system. Science on National Conservation Lands is accomplished, in part, through developing and implementing science strategies for units, promoting a better understanding of the importance and value of science in decision-making, sharing science findings, enhancing the role of science partnerships in management, and engaging the public in scientific work (BLM 2011).

In this article, we have highlighted seven of the many valuable science opportunities that position NLCS units—individually and as part of the broader system—to

be hubs of learning, teaching, discovery, and innovation for all public lands (Figure 8). Many of these science opportunities have been demonstrated through past and current studies and partnerships, but many more remain to be realized. We hope that highlighting these opportunities can help to further promote and strengthen the role of science on National Conservation Lands.

Conducting science in NLCS units can be challenging, and agency funding and staff available to manage units and support research within them are often limited. As a result, science partnerships with other agencies, organizations, and universities are critical for conducting and sharing the science needed to inform management efforts. BLM has recently implemented a standard process to help the agency permit, track, and report on scientific research conducted by partners within units (BLM, n.d.). This process and information can help contribute to the agency’s goals to communicate science findings and integrate them into management, highlighting the value of units as science hubs that can reap benefits both for National Conservation Lands and for public and other lands far beyond the system boundaries.

We suggest two actions that could help strengthen the role of science on National Conservation Lands. The first lies in documenting the impacts for resource management of science conducted in units. Managers



FIGURE 8. Valuable scientific opportunities within the more than 900 units of the Bureau of Land Management’s National Landscape Conservation System (often referred to as National Conservation Lands) revolve around seven core aspects discussed in detail in this article: (1) scientific values; (2) other outstanding natural and cultural objects and values; (3) the value of units as control sites for studying effects of activities that occur elsewhere but are often prohibited within units (e.g., mining); (4) the value of units for studying effects of activities that are similar or even intensified within National Conservation Lands (e.g., recreation); (5) the high visibility of units that draws strong interest and engagement from scientists, partners, and the public; (6) the vast network of units, all managed for a similar purpose, that provides opportunities to study cross-cutting science questions across diverse contexts and geographies; and (7) the strong ties that Tribal Nations and Indigenous Peoples have to many units that makes them an ideal setting for exploring how Indigenous Knowledge can be promoted and applied to enhance our understanding and management of these special places.

PHOTOGRAPHS 1–4: SARAH WHIPPLE; 5: JEFF BRUNE, BLM; 6: BLM ALASKA; 7: BOB WICK, BLM

currently report on resource conditions and science activities in national monuments and NCAs each year (BLM 2017). Adding a short component to these reports that identifies how science activities have influenced planning and management can help both units and the system as a whole better track and share how science projects conducted in units are helping to further conservation, provide for compatible uses that protect NLCS resources and values (BLM 2011), and inform management of all public lands and resources.

The second action is updating the National Landscape Conservation System Science Strategy (BLM 2007), first published nearly two decades ago, to incorporate references to these seven core opportunities, providing inspiration and direction to the agency and science community at a national level. Working with partners and the public to translate these opportunities into action can help build a robust body of scientific evidence that can inform future efforts to conserve, restore, and learn from the National Conservation Lands—some of our most outstanding public resources and landscapes.

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