



NATIONAL
CONSERVATION
LANDS

Prehistoric Trackways

National Monument

New Mexico
Science Plan

U.S. Department of the Interior
Bureau of Land Management

Prehistoric Trackways National Monument Science Plan

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1: INTRODUCTION AND SCIENTIFIC MISSION

1.1: Purpose of NCL Science Plans

The National Landscape Conservation System (NLCS) was administratively established in 2000 and legislatively codified in the Omnibus Public Land Management Act of 2009 (PL 111-011 2009). It was subsequently renamed National Conservation Lands (NCL). The system encompasses nearly 900 units spread across approximately 27 million acres of public lands managed by the Bureau of Land Management (BLM) in the US Department of the Interior (USDI). The BLM is mandated to conserve, protect, and restore the outstanding cultural, ecological, and scientific values of NCL units. Scientific investigation can aid in the conservation, protection, and restoration of these lands; and therefore, science is strategically planned and organized within NCL units.

The objectives of NCL units' science plans are to:

- Identify the scientific mission of the unit;
- Summarize past scientific efforts in the unit, i.e. the scientific background of the unit;
- Identify the priority needs and management issues within the unit that can be addressed by scientific inquiry;
- Define a strategy for accomplishing the scientific goals of the unit;
- Develop science protocols to, for example, ensure that scientific inquiry does not negatively impact the long term sustainability of the unit and its resources;
- Create a system to organize scientific reports; and,
- Help and promote the integration of science into management.

The science plans of NCL units are considered "living" documents and should be revised and updated frequently. Scientific needs that emerge during the course of implementing a science plan may be added to the plan on an as-needed basis to meet the unit's scientific mission. This science plan will be used as the basis for conducting science in Prehistoric Trackways National Monument.

Science has been defined within the BLM several times (USDI, BLM 2007a, 2008a). For this plan, science is defined as the study of natural and social phenomena using repeatable observations or experiments. In the context of land management, scientific data are collected, analyzed, or synthesized to increase knowledge and support decision-making. Within NCL units

there is an expectation for “identifying science needed to address management issues, communicating those needs to science providers, and incorporating the results into the decision making process.” (USDI, BLM 2007a)

1.2: Unit and geographic area description

The Prehistoric Trackways National Monument (PTNM or Monument) lies in the Robledo Mountains, a north-south trending fault block some 6-10 miles northwest of Las Cruces, New Mexico. The mountains are characterized by uplifted blocks, rugged, steep canyons, and southward dipping escarpments. Elevation varies from 5,876 feet on Robledo Mountain to about 4,100 feet at the south end of the Planning Area. The Robledo Mountains are characterized by an arid, continental climate with mild winters and warm to hot summers. Summer daytime temperatures often exceed 100 degrees Fahrenheit. Average annual precipitation is slightly less than 9 inches per year; however, a wide variation is characteristic of the climate. Most rainfall occurs during late summer months in the form of thunderstorms which are usually short duration, but can be very intense resulting in flash flooding.

In 1987, a major deposit of Paleozoic Era megatrackways, or numerous and spatially extensive fossil footprints, was discovered in what is now the PTNM. The trackways contain footprints of numerous amphibians, reptiles, and insects (including previously unknown species), plants, and petrified wood dating back approximately 286 million years, which collectively provide new opportunities to understand animal behaviors and environments from a time predating the dinosaurs. In 1990, Senator Jeff Bingaman and Congressman Joe Skeen introduced the prehistoric trackways study legislation. The legislation was passed and in 1993 BLM contracted with the Smithsonian Institution which in turn subcontracted with the New Mexico Museum of Natural History and Science to conduct a study and report on the significance of the trackways discovery.

In 2008, Senator Bingaman introduced legislation to designate the trackways as a National Monument. . . “In order to conserve, protect, and enhance the unique and nationally important paleontological, scientific, educational, scenic, and recreational resources and values of the public land...” That Legislation was passed as part of the Omnibus Public Land Management Act of 2009 and designated 5,280 acres as the Prehistoric Trackways National Monument.

There are two terms that will be used in this document to describe areas being addressed; they are Analysis Area and Planning Area. This Science Plan focuses specifically on the Planning Area, which consists entirely of the 5,280 acres of public land within the designated National Monument (Figure 1). The Analysis Area is defined as Doña Ana County, which includes the PTNM, 10 Wilderness Areas, 11 Areas of Critical Environmental Concern (ACECs), and several towns. The Analysis Area includes both public, private, other government land, and consists of about 2,436,595 acres.

Vegetation in the Planning Area is sparse, dominated by grasses and Chihuahuan Desert shrub species. A few oneseed juniper (*Juniperus monosperma*) trees are sparsely scattered, primarily along the north slopes and arroyos. Shrubs include mesquite (*Prosopis glandulosa*), viscid acacia (*Vachellia vernicosa*) and catclaw mimosa (*Mimosa aculeaticarpa* var. *biuncifera*), with scattered Parry's agave (*Agave parryi*) and various cacti. Faunal components of the Planning Area are typical of the Chihuahuan Desert but also include species that may be found along the Rio Grande and the nearby farming areas in the Mesilla Valley. Species numbers include approximately 100 species of birds, 40 species of mammals and 20 species of reptiles (USDI, BLM 2012).

The Analysis Area includes the Robledo Mountains Wilderness (designated wilderness in 2019; Dingell Act 2019), which consisting of 12,876 acres. A portion of the Wilderness (approximately 789 acres) is within the Monument. The Wilderness was previously designated as a Wilderness Study Area (WSA) in 1980 as a result of the initial inventories mandated by section 603 of the Federal Land Management Policy Act (FLPMA). The area has been managed to preserve its wilderness character since then. However, in the mid 90s it was discovered that unauthorized off-highway vehicle (OHV) use was occurring which was degrading these values. This use was curtailed and directed south outside of the WSA. As a result, the scars created by the use are slowly healing. Additional information is available in the PTNM Analysis of the Management Situation (USDI, BLM 2012). The Robledo Mountains WSA was changed to a Wilderness Area on March 12, 2019, when the President enacted into law the John D. Dingell, Jr. Conservation, Management and Recreation Act (S.47 Bill, Sec. 1201, Organ Mountains-Desert Peaks Conservation), designated 10 new Wilderness Areas within the Organ Mountains-Desert Peaks and Prehistoric Trackways National Monuments.

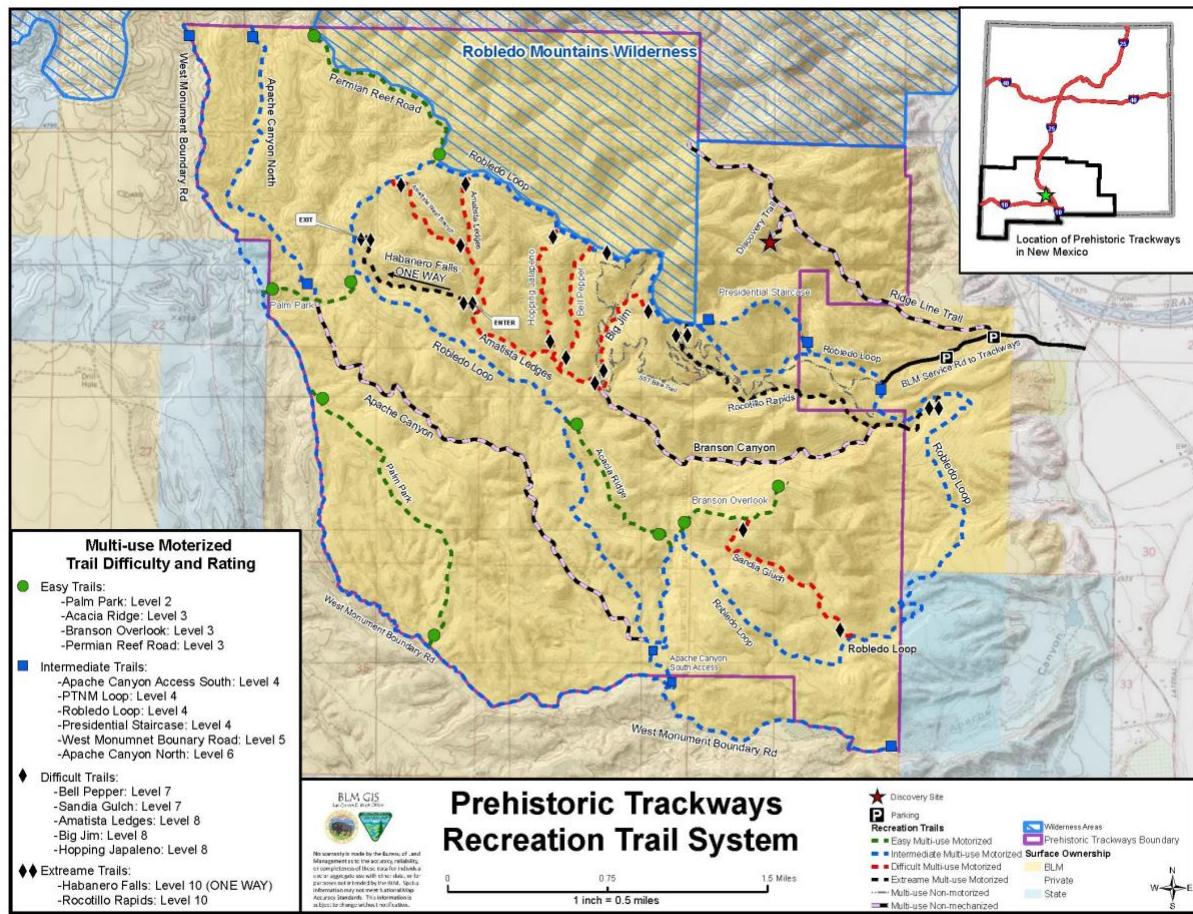


Figure 1: Map of the Prehistoric Trackways National Monument recreation trail system and surrounding lands.

1.3: Scientific Mission of the Unit

Per the 2009 designating legislation, PTNM was designated “to conserve, protect, and enhance the unique and nationally important paleontological, scientific, educational, scenic, and recreational resources and values of the public land”.

The specific scientific focus of PTNM is on paleontological resources, as the Paleozoic Trackways Scientific Study Report (Lucas, Hunt and Hotton III, 1994) states:

...evaluation indicates the Robledo Mountains tracksites are the most scientifically significant Early Permian tracksites known. The diversity, abundance and quality of the tracks in the Robledo Mountains is far greater than at any other known tracksites or aggregation of tracksites. Because of this, the Robledo tracks allow a wide range of scientific problems regarding late Paleozoic tracks to be solved that could not be solved before.

Beyond the paleontological focus, additional scientific studies on PTNM can provide information to managers and help ensure that the authorized uses do not negatively impact PTNM’s conservation mission or other objects of value.

2: SCIENTIFIC BACKGROUND OF THE NCL UNIT

2.1: Completed research and science available on PTNM

Research is considered for the following Science Areas, slightly modified from management categories outlined in the Resource Management Plan (RMP; USDI BLM 2014) : Air Quality, Geology, Soils, Water Resources (including groundwater, surface water, tanks/ponds, erosion), Paleontology, Cultural Resources, Vegetation, Wildlife, Special Status Species, Livestock Grazing, Wilderness, Recreation, Visual Resources, and Socioeconomics.

2.1.1: Air Quality

BLM Point of Contact (POC): Gordon Michaud

Topic: Fugitive Dust Control

Principal Investigators: NMED Air Quality Board

NMED developed a fugitive dust rule in conjunction with the mitigation plan to detail mandatory measures to abate certain controllable sources in Doña Ana and Luna Counties. NMED Air Quality Board adopted the rule on October 26, 2018.

- [20.2.23 NMAC, Fugitive Dust Control](#) (Applicable in Dona Ana and Luna Counties only)

Topic: Implementation of the Travel Management Rule Gila National Forest; Air Quality Specialist Report.

Principal Investigators: Carolyn Koury and Brian Park

Air quality on public lands is potentially affected by land management and development activities both on and off the forest. Air pollution can affect human health, reduce visibility, and contribute to acidic deposition in sensitive, high-elevation locations. This analysis reviews any potential effects for authorized motorized vehicle travel on the Gila National Forest to impact National and State Ambient Air Quality Standards (AAQS), to degrade air quality by more than any applicable Prevention of Significant Deterioration (PSD) increment, to affect Class I Wilderness areas, or to cause or contribute to visibility impairment beyond any existing conditions (Koury and Park 2013). Air pollutants related to travel management activities can include vehicle emissions and fine particulate matter created primarily by fugitive dust from vehicle travel over a dry and unpaved road surface. Local and regional air quality is discussed in the following sections as well as a discussion of potential impacts to health (i.e., violating standards) and regional visibility.

Topic: Air Resources Technical Report for Oil and Gas Development

Principal Investigators: BLM

The purpose of this document is to summarize the technical information on air quality and climate change relative to all Environmental Assessment (EAs) for Application for Permit to Drill (APD) and Lease sales. The intent of this document is to collect and present the data and information needed for air quality and climate change analysis pertaining to oil and gas development (USDI, BLM 2018). This information can then be incorporated by reference into the site-specific National Environmental Policy Act (NEPA) documents as necessary. In addition, data is included in the appendices which can be incorporated into the site specific analysis included in the APD EAs.

2.1.2: Geology

BLM POC: Colin Dunn

Topic: Geologic Mapping

Preliminary geologic mapping of the area surrounding the Robledo Mountains occurred in the 1950s into the early 1960s (Kottlowski, 1953, 1960, 1963; Dane and Bachman, 1961). These maps were primarily regional in scale, and lacked detail at the scale of PTNM. Seager *et al.* (1987) also mapped regionally, but at a scale that allowed for more detail within the Robledos Mountains. As the ichnofossils became known and studied, localized geologic mapping was produced (Lucas *et al.*, 1995, 1998a, 1998b). The most detailed map was produced by Seager, *et al.* (2008), which includes for the first time on a map, the subdivided Hueco Formation. Most recently, Lucas *et al.* (2015) published a modified version of Seager *et al.* (2008) that follows their stratigraphy.

Topic: Sedimentary Stratigraphy

There are two different schools of thought of Permian stratigraphy in the Robledo Mountains: Those that follow Kottlowski (1960, 1963) and those that follow Jordan (1971, 1975). Those that follow Kottlowski (Durr, 2010; Hawley, 1975; Hawley, *et al.*, 1975; LaMone *et al.*, 1971, 1975; Mack, 2007; Mack and James, 1986; Mack *et al.*, 1988, 1991, 1993, 2003, 2013; Seager *et al.*, 1976, 1987, 2008; Wahlman and King, 2002) refer to the Permian Hueco as a formation, subdivided by informal members (lower, middle, Abo tongue, and upper). Those that follow Jordan (Berman, 1993; Braddy, 1998; Cook, *et al.*, 1998; Falcon-Lang, *et al.*, 2014; Hunt and Lucas, 1998c; Hunt, *et al.*, 1995c; Kozur and LeMone, 1995a; Krainer and Lucas, 1995; Krainer,

et al., 2015; Kues, 1995; Lerner and Lucas, 2015; Lucas and DiMichele, 2015; Lucas, et al., 1995, 1998a, 1998b, 1998c, 2005, 2015a, 2015b; Voigt, et al., 2013b) refer to the Permian Hueco as a group, subdivided into four formations (Shalem Colony Fm, Community Pit Fm, Robledo Mountains Fm, and Apache Dam Fm). The two schools disagree where the “lower”/“middle” and Shalem Colony/Community Pit division sits stratigraphically.

Topic: Volcanics

Volcanic units within the Monument have received little study, save for general descriptions and noted on geologic maps (Hawley, et al., 1975; Seager et al., 1976, 1987, 2008; Mack et al., 1993; Lucas et al 2005, 2015b; Lucas and DiMichele, 2015).

2.1.3: Soils

BLM POC: Gordon Michaud

Topic: Web Soil Survey

Principal Investigators: USDA

Web Soil Survey (WSS) provides soil data and information produced by the National Cooperative Soil Survey (USDA, NRCS 2017). It is operated by the USDA Natural Resources Conservation Service (NRCS) and provides access to the largest natural resource information system in the world. NRCS has soil maps and data available online for more than 95 percent of the nation’s counties and anticipates having 100 percent in the near future. The site is updated and maintained online as the single authoritative source of soil survey information.

Topic: Cryptogam Study

Principal Investigator: New Mexico State University Professor Nicole Pietrasik

During Fiscal Year 2018 and Fiscal Year 2019 a cryptogam inventory was initiated at 26 locations within the Organ Mountains_Desert Peaks National Monument, collecting 120 samples and identifying 76 morpho species of cyanobacteria representing 47 genera. In addition to the cyanobacteria collection, a lichen survey was conducted at the same locations and yielded an estimated 100 species to date. A budget proposal has been written for Fiscal year 2020 and Fiscal Year 2021 to continue the study.

2.1.4: Water Resources (groundwater and surface water)

BLM POC: Corey Durr

Topic: Hydrological Analysis

Principal Investigators: Johanna Blake (USGS)

Inventories and modeling are currently being conducted on adjacent watersheds to the PTNM, which constitute the first comprehensive landscape level analysis in the area. Two objectives were identified with this cooperative agreement with the USGS: 1) compile and interpret existing soil- and water-resource data within the Monument, and 2) provide a basic assessment of the surface hydrological impacts of selected alternatives to current land-use and infrastructure. The scope of the project covers data compilation, map development, modelling exercises, and a final report.

2.1.5: Paleontology

BLM POC: Colin Dunn, Paleontologist

Topic: Vertebrate Ichnofossils

Vertebrate ichnofossils have been known to occur in the Robledo Mountains since the 1930s, but it was Jerry MacDonald, in 1987, that brought them into the national and international consciences (MacDonald, 1995). The vertebrate ichnofossils have been studied (or mentioned) at length in the intervening decades (Berman, 1993; Braddy, et al., 2003; Breithaupt, et al., 2019; Dunn, 2016, 2019; Dunn, et al., 2018; Haubold et al., 1995; Hunt and Lucas, 1998a, 1998b, 1998c, 1998d, 2015; Hunt, et al., 1993; Hunt, et al., 1994a, 1994b; 1995a, 1995b, 1995c; Lerner and Lucas, 2015; Lucas and DiMichele, 2015; Lucas, 1998; Lucas, et al., 1995, 1998a, 1998b, 2005, 2015a, 2015b; MacDonald, 1995; Minter and Braddy, 2009; Minter, 2005; Schult, 1995a, 1995b; Voigt and Lucas, 2015; Voigt, et al., 2013a, 2013b). Most recently, Lucas et al. (2015a) performed a conservative reanalysis on the NMMNHS collections and concluded that eight tetrapod ichnogenera have been described in the Robledo Mountains Formation.

NMMNHS holds 775 tetrapod footprint specimens collected over 48 localities within PTNM. Of those, only ~40% can be identified with certainty. Of that 40%, 90% belong to three ichnotaxa: *Batrachichnus salamandroides* (temnospondyl amphibians), *Dromopus lacertoides* (raeoscelids), and *Dimetropus leisnerianus* (pelycosaurian-grade synapsids). The remaining have been identified as *Matthewichnus caudifer* (microsaur lepospondyls), *Hyloidichnus bifurcatus* (captorhinomorphs), rare *Amphisauropus kablikae* (seymouriamorphs) and

Natalacerta missouriensis and *Robledopus macdonaldi* (basal non-diapsid eureptilian tracks) (Voigt and Lucas, 2015). Other vertebrate ichnotaxa include *Undichna* (fish swimming trace), and *Lunichnium rotterodium* and *Characichnos* (tetrapod swim traces) (Minter and Braddy, 2009; Voigt and Lucas, 2015; Dunn et al., 2018).

Topic: Invertebrate Ichnofossils

Along with the vertebrate ichnofossils, invertebrate ichnofossils have been described and studied since the early 1990s (Braddy and Briggs, 2002; Braddy, 1995, 1998; Hannibal, et al., 2005; Hunt, et al., 1993, 1994a, 1995c; Kozur and LeMone, 1995b, Lucas, et al., 1995, 1998a, 1998b, 2005; Mack, et al., 2003; Minter, 2005). This culminated in a comprehensive report on the ichnology of the Monument by Minter and Braddy (2009). Since then, Lucas et al. (2013) described a scorpionid resting trace, the first of its kind from the Permian, and Lerner and Lucas (2015) described a new ichnoassociation (*Selenichnites*).

The Robledo Mountains Formation is host to numerous invertebrate trackways, dominated by arthropods. Ichnotaxa include: *Dendroidichnites*, *Diplichnites* and *Diplopodichnus* (myriapods), *Kouphichnium* (xiphosurids), *Lithographus* (pterygote insects), *Octopodichnus* (arachnids), *Palmichnium* (eurypterids), and *Tonganoxichnus* and *Stiaria* (apterygote insects) (Minter and Braddy, 2009). Ichnotaxa associated to invertebrate resting traces include: *Lockeia*, *Rotterodichnium*, *Selenichnites*, and *Alacranichnus* (Minter and Braddy, 2009; Lucas et al., 2013).

Ichnotaxa associated with arthropod grazing include: *Striatichnium* and *Stiallia*. Other invertebrate grazing trails include *Cochlichnus* and *Treptichnus* (Minter and Braddy, 2009). Other invertebrate ichnotaxa include *Augerinoichnus* (horizontal and coiling burrow) and the typically deep marine *Spirorhaphe azteca* (Minter and Braddy, 2009).

Topic: Invertebrate Body Fossils

Invertebrate body fossils have been mentioned repeatedly in the studies of the Robledo Mountains. However, only Kues (1995) provided a systematic description of some of the marine taxa encountered in the Robledo Mountains Formation.

Topic: Vertebrate Body Fossils

To date, no vertebrate body fossils have been reported from PTNM. However, exposures of the Abo Formation in the Caballo Mountains to the north (correlative with the Robledo Mountains formation) have produced both ichnofossils and vertebrate body fossils (Vaughn, 1976).

Topic: Paleobotany

Initial studies of paleobotany focused on the occurrence of algae (LeMone, et al., 1967) in the marine sediments, or early conifer ichnofossils that accompany the vertebrate and invertebrate ichnofossils in the terrestrial sediments (Kozur and LeMone, 1995a; Lucas, et al., 1995, 1998b, 2005; MacDonald, 1995). Tidwell and Muzing (1995) did the first research of the petrified wood, however the bulk of the research was conducted more recently (DiMichele, et al., 2007, 2015a, 2015b; Falcon-Lang, et al., 2014, 2015; Krainer, et al., 2015; Lucas and DiMichele, 2015; Lucas, et al., 2015a, 2015b; Voigt, et al., 2013b).

2.1.6: Cultural Resources

BLM POC: Mara Weisenberger

Topic: Historical Heliograph Site

Heliograph stations were utilized in the southern areas of Arizona and New Mexico. The purpose was for communication from place to place. Morse code was used shutter movement communicated through the mirrors for faster transmission where U.S. mail or telegraph could not get to specific locations with urgency. Mirror communication could also be flawed as well. In a report submitted to the Wilderness Society Sacred Sites Research, Inc. they discussed LA #38622 a heliograph site was situated on the lookout point of the Robledo Mountains, just outside of the PTNM boundary. The U.S. Army used the site from 1886-1890 at Fort Seldon during the height of pursuing Geronimo in the Southwest. It was documented by the El Paso Archaeological Society in 1975. Remnants of metal poles and concrete pad are all that remains of the heliograph site. Present day modern communication towers reside on the heliograph site. (Miller et. al. 2017).

2.1.7: Vegetation

BLM POC: Patrick Alexander

There has been no research focused specifically on the vegetation of the Monument. The following works include research on nearby areas that are applicable within the Monument as well, or summaries of vegetation in New Mexico generally.

Topic: New Mexico Vegetation

The primary published work on the vegetation of New Mexico generally was written by Dick-Peddie (1993), and includes generalized descriptions of the past and current vegetation in the Monument area, as well as coarse vegetation mapping.

Topic: Plant Ecology of the Jornada Experimental Range

Research on diverse topics related to plant ecology and management has been ongoing at the Jornada Experimental Range, ca. 10 miles northeast of the Monument, since 1912. Research at the Jornada Experimental Range focuses primarily on the ecology of bajada, alluvial fan collar, alluvial plain, and playa landforms rather than on the sedimentary mountains that make up most of the Monument. Summaries of plant ecology research at the Jornada are available in Havstad et al. (2006) and Gibbens et al. (2005).

Topic: Vegetation of White Sands Missile Range

White Sands Missile Range, ca. 20 miles east-northeast from the Monument, includes sedimentary mountains similar to those of the monument. Muldavin et al. (2000) classified and mapped the vegetation throughout the missile range.

Topic: Prehistoric Vegetation of Bishops Cap Hills

The Bishops Cap Hills are sedimentary mountains similar to, and ca. 20 miles southeast of, those of the Monument. Van Devender and Everitt (1977) report vegetation of the Bishops Cap Hills from ca. 10,500 years ago based on data from packrat middens.

Topic: NMSU Species Data Mining

See section 2.1.9 below

2.1.8: Wildlife

BLM POC: Jesarey Barela and Mara Weisenberger

Topic: NMSU Species Data Mining

See section 2.1.9 below

Topic: Preferred Habitat of Desert Bighorn Sheep in the San Andres Mountains, New Mexico

BLM POC: Mara Weisenberger

This field study was initiated in April 1975 and continued through August 1976 (Sandoval 1979). The preferred habitat consisted of a series of broken cliffs, ledges, deep canyons, and rock outcrops. These areas were designated as the cliff habitat type and accounted for 70 percent of the sheep observations. Slope gradients between 20 and 60 percent received 65 percent of the utilization. Preferred habitats had a 41 percent ground cover. Shrubs made up 24 percent, grasses comprised 14 percent, and forbs accounted for 3 percent of the ground cover. The vegetation in these areas was an overstory of shrubs dominated by mariola (*Parthenium incanum*), skeletonleaf goldeneye (*Viguiera stenoloba*), and mountain mahogany (*Cercocarpus breviflorus*). The understory consisted mostly of grama grass (*Boutetoua* spp.), needle grass (*Achnatherum* and *Hesperostipa* spp.), and muhly grass (*Muhlenbergia* spp.). A close relationship was apparent between sheep distribution and the availability of water and escape terrain. Eighty-eight percent of the sheep sighted were within 1,500 m (1,640 yd) of water, and 76 percent of the sheep sighted were within 100 m (109 yd) of cliffs or rock outcrops. Direct interspecific competition with mule deer (*Odocoileus hemionus*) was evident. Seventy-four percent of the bighorn diet and 76% of the deer diet were composed of mountain mahogany, globemallow (*Sphaeralcea* spp.), and bladder pod (*Lesquerella purpurea*). Spatial competition was alleviated somewhat by the topography of their preferred habitat, with bighorn occupying rougher terrain.

Topic: Evaluating Bighorn Habitat: A Landscape Approach

BLM POC: Mara Weisenberger

Used Geographic Information Systems (GIS) to measure habitat and impacts for rocky Mountain and Desert Bighorn sheep on landscape scale in New Mexico. Potential suitability and current suitability were determined for each study area. Habitat components measured for desert bighorn sheep in southern New Mexico included total habitat, escape terrain escape terrain contiguity, and water availability. (Dunn, 1996).

Topic: Precipitation, Density, and Population Dynamics of Desert Bighorn Sheep on San Andres National Wildlife Refuge, New Mexico

BLM POC: Mara Weisenberger

In arid environments, plant communities and consequently herbivore populations are strongly dependent upon precipitation, which is highly variable seasonal- ly and annually. We conducted a retrospective exploratory analysis of desert bighorn sheep population dynamics on San Andres National Wildlife Refuge (SANWR), New Mexico, 1941-1976, by modeling sheep population size as a function of previous popu- lation sizes and precipitation. Precipitation limited populations of desert bighorn sheep on SANWR primarily in a density-independent manner by affecting production or survival of lambs, likely through influences on forage quantity and quality. Habitat evaluations and recovery plans for desert bighorn sheep need to consider fundamental influences on desert bighorn populations such as precipitation and food, rather than focus solely on proximate issues such as security cover, predation, and disease. (Bender & Weisenberger. 2005)

**Topic: The restoration of desert bighorn sheep in the Southwest, 1951–2007:
factors influencing success**

BLM POC: Mara Weisenberger

The restoration of desert bighorn sheep (*Ovis canadensis*) to abundant populations at the end of the twentieth century following historic low numbers during the first half of the same century is a testament to the North American Model of Wildlife Conservation. We evaluate the relative influence of management activities on several populations and suggest insights into the efficacy and limitations of restoration and management activities. (Wakeling et al. 2009)

Topic: **Occupancy and habitat correlates of javelinas in the southern San Andres Mountains, New Mexico**

BLM POC: Mara Weisenberger

Javelinas (*Pecari tajacu*) are expanding their range northward in the southwestern United States, but little is known of habitat relationships in northern populations. Researchers used occupancy modeling and maximum entropy modeling of data collected from a camera-trapping grid to investigate javelina occupancy and identify habitat correlates associated with presence in the southern San Andres Mountains of south-central New Mexico. Presence of javelinas was most strongly associated with areas in close proximity to permanent water sources; with overstory or high shrub canopies of riparian, oak–mountain mahogany, or pinyon–juniper; and with low (<6%) slopes. Circadian patterns of behavior indicated that javelinas were primarily diurnal during colder months and nocturnal during warmer months. Expansion of javelina occupancy may be related to a slight trend in increasing minimum winter temperatures, because severe winters were hypothesized to limit the northern distribution of javelinas. Additionally, javelinas appear dependent upon a tree or shrub overstory, ideally associated with riparian corridors, to mitigate heat stress associated with occupancy of Chihuahuan Desert habitats. (Bender et al. 2014).

Topic: **Wintering Bird Density and Habitat Use in Chihuahuan Desert Grasslands**

BLM POC: Mara Weisenberger

In January 2007, Rocky Mountain Bird Observatory (RMBO), together with Universidad Autónoma de Nuevo Leon, initiated a first-ever, region-wide pilot survey to inventory, research and monitor wintering birds in Chihuahuan Desert Grassland Priority Conservation Areas (GPCAs) in Mexico. This effort was refined and expanded in January and February of 2008 and 2009. An immediate and broad array of conservation solutions are needed to slow and reverse current trends in Chihuahuan Desert grassland loss. Continued avian inventories and monitoring will allow the BLM to identify spatiotemporal patterns of abundance, species habitat requirements, important wintering areas and land use changes, while continuing to provide an avenue for outreach and education. (Arvind et al. 2010).

Topic: Breeding Bird Communities and Nest Plant Selection in Chihuahuan Desert Habitats in South-Central New Mexico.

BLM POC: Mara Weisenberger

Study authors (Kozma & Matthews 1997) examined the significance of arroyo-riparian habitat to birds in the Chihuahuan Desert of south-central New Mexico. Nest density in arroyos was more than twice that of uplands (0.64 nests/ha versus 0.27 nests/ha). Torrey yucca (*Yucca torreyi*), javelina bush (*Condalia warnockii*), and little-leaf sumac (*Rhus microphylla*) were the most frequently used nest substrates, even though these shrubs were among the lowest in density. Maintaining this habitat and protecting sparse shrub species used as nest substrates may have long term importance in managing Chihuahuan Desert bird communities. (Kozma & Mathews 1997).

Topic: Effects of including non-breeding bird species on predicted bird distribution for conservation planning in New Mexico

BLM POC: Mara Weisenberger

Study authors (Thompson et al. 2001) compared biodiversity estimates including non-breeding birds to estimates including only breeding birds in terms of estimated patterns of species richness. Inclusive and breeding bird richness estimates agreed about general location of some species-rich areas and the most species-poor areas in the state, but were less comparable for intermediate areas of bird occurrence. Their analyses indicated that only assessing breeding distribution does not reliably predict relative importance of areas used by birds throughout New Mexico and should not be used exclusively to identify potential gaps in conservation for land-use evaluation and planning. (Thompson et al. 2001).

Topic: Satellite Image Texture and a Vegetation Index Predict Avian Biodiversity in the Chihuahuan Desert of New Mexico

BLM POC: Mara Weisenberger

Predicting broad-scale patterns of biodiversity is challenging, particularly in ecosystems where traditional methods of quantifying habitat structure fail to capture subtle but potentially important variation within habitat types. Here, study authors (St. Louis et al. 2009) tested the importance of habitat structure (i.e. fine-scale spatial variability in plant growth forms) and plant productivity

(i.e. amount of green biomass) for predicting avian biodiversity. Study authors used image texture (i.e. a surrogate for habitat structure) and vegetation indices (i.e. surrogates for plant productivity) derived from Landsat Thematic Mapper (TM) data for predicting bird species richness patterns in the northern Chihuahuan Desert of New Mexico. Results highlight that texture measures from Landsat imagery were useful for predicting patterns of bird species richness in semi-arid ecosystems and that image texture is a promising tool when assessing broad-scale patterns of biodiversity using remotely sensed data. (St. Louis et al. 2009).

Topic: Restoration Practices Have Positive Effects on Breeding Bird Species of Concern in the Chihuahuan Desert

BLM POC: Mara Weisenberger

Woody plant encroachment into grasslands is a global concern. Efforts to restore grasslands often assume that removal of woody plants benefits biodiversity but assumptions are rarely tested. In the Chihuahuan Desert of the Southwestern United States, study authors (Coffman et al. 2014) tested whether abundances of grassland specialist bird species would be greater in plant communities resulting from treatment with herbicides to remove encroaching shrubs compared with untreated shrub-dominated areas that represented pretreatment conditions. Vegetation in treatment areas had higher perennial grass foliar and basal cover and lower shrub foliar cover compared with untreated areas. Several regionally declining grassland specialists exhibited higher occurrence and relative abundance in treated areas. Results indicate that shrub removal can have positive effects on grassland specialist bird species, but that a mosaic of treated and untreated areas might be most beneficial for regional biodiversity. (Coffman et al. 2014).

Topic: Breeding Bird Distribution in Chihuahuan Desert Habitats

BLM POC: Mara Weisenberger

The study was conducted on the Long Term Ecological Research (LTER) exclosure located at the southern end of the Jornada del Muerto Plain in Dona Ana Co., New Mexico. Twenty-eight species were found, of which the 13 more common were examined in detail. Study authors (Naranjo and Raitt 1993) compared mean densities of all species among four transects and among three physiognomically distinct habitats. Bivariate correlations between grassland birds and an increase in plant cover in open areas and between scrub birds and the increase in diversity of plant life-forms. (Naranjo and Raitt 1993).

Topic: **Characterization of Vegetation and Small Mammal Communities in Chihuahuan Desert Grasslands**, Masters Thesis.

BLM POC: Mara Weisenberger

This study evaluated relationships between desert grassland vegetative and environmental characteristics at 17 study sites on the San Andres National Wildlife Refuge and the Chihuahuan Desert Rangeland Research Center. Perennial grass cover, rock cover, canopy gap, bare ground and total dead vegetation were the most important discriminating variables that explained site clusters. Results revealed that vegetation differences were not clearly explained by differences in environmental variables, and convergence of vegetation types was observed on sites with differing environmental characteristics. (Seeley 2004).

Topic: **Winter Activity of Bats over Water and along Flyways in New Mexico**

BLM POC: Mara Weisenberger

During colder months in temperate regions, non-migratory bats are suspected to remain relatively inactive during hibernation. Geluso (2007) examined activity of bats November-March in a region of North America with moderate winter temperatures. Bats were captured in nets over water and along flyways in southern and central New Mexico. Body masses of most species were lowest in March. During the study, activity of bats was positively, but not significantly, correlated with ambient air temperature at dusk. In this region of North America, many individuals of several species do not hibernate for the entire winter nor do they migrate from the region (Geluso 2007).

2.1.9: Special Status Species

BLM POC: Jesarey Barela and Patrick Alexander

Topic: **NMSU Species Data Mining**

Principal Investigator: Ken Boykin, New Mexico State University

Collaboration with Co-Principal Investigators from the Departments of Anthropology, Biology, Geography, Geological Sciences, and Animal and Range Sciences at New Mexico State University. This grant was originally awarded by the BLM on September 19, 2017 for Resource Management Planning Support for the OMDPNM. The goal of the five-year Assistance

agreement is to develop a geospatial database based on the synthesis, collection, and analysis of new field and remotely sensed data that will contain information about human and environmental resources drawn from the fields of archaeology, botany, geography, geology, paleontology, and zoology. The database will supply information needed for citizen science and public engagement and will aid the development of the OMDPNM RMP.

Topic: Northern Aplomado Falcon Survey Work

Principal Investigator: Ray Meyer, La Tierra Environmental Consulting

This project involves protocol surveys and nest monitoring on public land throughout the Chihuahuan Desert in the Las Cruces District. The project involves surveying and monitoring breeding success of the Northern Aplomado Falcon population, a species listed as endangered under the ESA. The project includes an assessment of habitat and monitoring nesting/fledgling success. (La Tierra Environmental Consulting, Ray Meyer)

Topic: Occurrence and Habitat use by *Leptonycteris* bats in the Southwest

BLM POC: Mara Weisenberger

This is an unfunded BPSS project proposal by John Barnitz in conjunction with New Mexico State University for two years of long-term monitoring of populations of *Leptonycteris* spp. in New Mexico, as well as their roost sites, and their main plant resources (agave) in this region, in order to determine the effects of climate change on this endangered species. This project is in the Analysis Area for PTNM.

Specific goals include:

1. Document arrival and departure times, relative abundance, and population structure of *Leptonycteris nivalis* and *Leptonycteris yerbabuenae* in southwestern New Mexico.
2. Document ambient temperature, humidity and precipitation (outside only) outside and inside of identified *Leptonycteris* roosts.
3. Document food plant resources of *Leptonycteris* spp. in New Mexico.
4. Document flowering phenology of main *Leptonycteris* food resources (*Agave* spp.).

Topic: Sensitive vegetation species

There is no ongoing research on special status plants. One BLM Sensitive species is known to occur in the Monument, night-blooming cereus (*Peniocereus greggii* var. *greggii*). This is at the periphery of the range of this taxon and only one individual has been seen. No other special status plants are known or likely to occur in the Monument.

2.1.10: Livestock Grazing

BLM POC: Jesarey Barela

Topic: Chihuahuan Desert Rangeland, Livestock Grazing, and Sustainability

Proper management of livestock grazing is sustainable and in many cases improves resources. Poorly controlled livestock grazing when unmanaged, leads to resource destruction. This applies to mining, logging, farming, wildlife grazing, and recreation as well as livestock grazing. (Holechek 1991).

Topic: Moderate and light cattle grazing effects on Chihuahuan Desert rangelands

Range condition, vegetation production, composition, and cover were compared between lightly and moderately grazed rangelands in the Chihuahuan Desert in southwestern New Mexico to determine if these levels of utilization were sustainable in this area. Compared to light use, moderate use increased shrub cover and reduced total standing crop and cover of grasses, forbs, and black grama (*Bouteloua eriopoda*), an important grass species in this area. Over the 13 year study, the lightly grazed pasture increased in range condition, whereas range condition on the moderately used pasture declined, probably due to the lower stubble heights remaining after moderate utilization which decreased survival of perennial grasses. These results suggest that light use (25-35% use of key forage species) on arid grasslands is sustainable while moderate use will cause range degradation, however, the authors caution that even light use in drought years will cause range degradation and grazing management in these areas should be adapted to forage and weather conditions (Holechek et al. 2003)

Topic: Range Management: Principles and Practices (Holechek et al. 2011)

This book is to introduce students to the science of range management, coupling the latest concepts and technology with proven traditional approaches. It captures the fundamentals and perspectives of the key subjects in the field of range management.

2.1.11: Wilderness

BLM POC: Edna Flores

On March 12, 2019, Bill S.47 - the John D. Dingell, Jr. Conservation, Management and Recreation Act was signed into law. The bill included 10 new wilderness designations for Prehistoric Trackways and Organ Mountains-Desert Peaks National Monuments. Seven of the ten areas had been previously designated and managed as Wilderness Study Areas but had no known scientific studies related to their designation.

2.1.12: Recreation

BLM POC: Edna Flores

Topic: Recreation Experience Survey

Principal Investigator: Tim Casey, Colorado Mesa University

Recreation Experience Baseline Study was conducted in the nearby OMDPNM in the Spring of 2017 by the University of Alaska Fairbanks, New Mexico State University, and Colorado Mesa University. The study was an effort to assess characteristics, desired experiences, desired benefits, and management of visitors to the Monument. The data gathered would be incorporated into the Resource Management Plan for the Organ Mountains-Desert Peaks National Monument. The study concluded that the majority of visitors have had positive experiences and were satisfied with their visit. However, visitors noted that services could be improved with the addition of restroom facilities, visitor centers, developed campgrounds, and more BLM-provided information (Fix et al 2018). The completed published report can be found on the Natural Resource Center website of Colorado Mesa University at <http://www.coloradomesa.edu/natural-resource-center/NRC-Reports/national-conservation-lands.html>.

2.1.13: Visual Resources

BLM POC: Edna Flores

Topic: Visual Resources Inventory

Principal Investigator: Environmental Planning Group, Phoenix AZ

Visual Resources Inventory of OMDPNM and the surrounding landscape was conducted in the Fall of 2017 by the BLM and the Environmental Planning Group (EPG) out of Phoenix, AZ. The intended results of the inventory were to examine the visual resources within OMDPNM boundaries in greater detail compared to the LCDO VRI inventory conducted in 2010.

Approximately 573,537 acres of land were surveyed and recorded for baseline conditions. Following the BLM Visual Resource Management System, EPG classified 81,903 acres as Class IV VRM, 255,234 acres as Class III VRM, and 236,403 acres as Class II VRM (EPG 2018). This VRI will be incorporated into the OMDPNM Resource Management Plan. However, VRM classes will need to be adjusted during the planning process to incorporate the newly designated wilderness areas as Class I VRM. The changes will directly affect the current PTNM VRM classes in the Robledo Mountains portion of the Monument.

2.1.14: Socioeconomics

BLM POC: Mara Weisenberger

The PTNM Resource Management Plan and Final Environmental Impact Statement (2014) analyzes the current conditions and trends related to the social and economic environment of the Analysis Area, including population and demographic changes, potential environmental justice populations, and local economic conditions (USDI, BLM 2014).

2.2: Ongoing research and science on Prehistoric Trackways

Notable ongoing research projects on the Prehistoric Trackways NCA are highlighted in Table 1.

Table 1. Ongoing Research in the Prehistoric Trackways NCA

Science Area	Research Topic/Question	Research Description
Air Quality	None	None beyond what is described in section 2.1
Geology	None	None
Soils	<i>Cryptogrammic crust study</i>	See section 2.1.3 for details
Water Resources	None	None beyond what is described in section 2.1
Paleontology	None	None beyond what is described in section 2.1
Cultural Resources	None	None beyond what is described in section 2.1
Vegetation	<i>NMSU Mapping Study</i>	This project is aimed at developing general-purpose species modelling approaches that are more conceptually sound than existing alternatives and do not require a lot of per-species fine-tuning or development. Using species presence / absence data from AIM monitoring plots and Patrick's plant diversity photopoint data for Organ Mountains – Desert Peaks National Monument as a whole, they are working on modelling of all plant species present in these data sets, and combining species-specific models to allow mapping of vegetation types that are relevant to particular management questions, for instance aplomado falcon habitat, United States National Vegetation Classification units, areas that are likely to have vegetation that could carry fire.
Wildlife	None	None beyond what is described in section 2.1
Special Status Species	None	None beyond what is described in section 2.1
Livestock Grazing	None	None beyond what is described in section 2.1
Wilderness	None	None beyond what is described in section 2.1
Recreation	None	None beyond what is described in section 2.1
Visual Resources	None	None beyond what is described in section 2.1
Socioeconomics	None	None beyond what is described in section 2.1

3: MANAGEMENT DECISIONS AND SCIENCE NEEDS

Table 2 describes desired future science needs and associated management decisions

Table 2. Science Needs in the Prehistoric Trackways National Monument

Science Area	Desired Research Topic/Question Description	Priority level	Related Topic area/Management Decision
Air Quality	None currently identified	NA	
Geology	Consensus of geologic formation boundaries between Lucas et. al and Seager et al.	High	Ideally this would occur first before further paleontological inventory and research to reduce confusion in the future scientific literature
	Remeasure type sections for completeness (no "covered interval" in sections)	Low	
	Refined geologic mapping following consensus	Low	
	Exact locations of all previous measured sections (Mapped)	Low	
Soils	How to manage without soil information	Medium	
	Possible to do an Order 1 Soil Survey	Medium	Majority of the PTNM has soil map units with miscellaneous areas. The miscellaneous area like Rock Outcrop have no soil interpretations.
	Ecological Site Descriptions	Medium	PTNM currently has the Veg State Layer, which identifies an ecological site. Soil information is required to assist with land mgmt.
Water Resources	None currently identified	NA	
Paleontology	Marine Invertebrate Inventory for Apache Dam Formation ("upper" Hueco)	Medium	PRPA requires the BLM to inventory all administered lands for paleontological resources. This will unlock further research opportunities, and may increase the sensitivity of this geologic formation to adverse impacts
	Marine Invertebrate Inventory for Robledo Mountains Formation ("Abo Tongue")	Medium	PRPA requires the BLM to inventory all administered lands for paleontological resources. This will

			unlock further research opportunities, and may increase the sensitivity of this geologic formation to adverse impacts
	Marine Invertebrate Inventory for Community Pit Formation ("middle" Hueco)	Medium	PRPA requires the BLM to inventory all administered lands for paleontological resources. This will unlock further research opportunities, and may increase the sensitivity of this geologic formation to adverse impacts
	Marine Invert Inventory for Shalem Colony Formation ("lower" Hueco)	Medium	PRPA requires the BLM to inventory all administered lands for paleontological resources. This will unlock further research opportunities, and may increase the sensitivity of this geologic formation to adverse impacts
	Biostratigraphic work in the marine formations	Low	
	Further inventory of Jerry MacDonald's localities not in NMMNHS database	High	Monitoring/resource protection and future research requires accurate locations of paleontological resources. Many of these sites have not been evaluated for research/education/interpretation qualities
	Ground-truth all NMMNHS localities (NAD errors)	High	Monitoring/resource protection and future research requires accurate locations of paleontological resources
	Pedestrian Inventory of Camp Rice Formation	Medium	PRPA requires the BLM to inventory all administered lands for paleontological resources. This will unlock further research opportunities, and may increase the sensitivity of this geologic formation to adverse impacts
	Pedestrian Inventory of Palm Park Formation	Medium	PRPA requires the BLM to inventory all administered lands for paleontological resources. This will unlock further research opportunities, and may increase the sensitivity of this geologic formation to adverse impacts

	Pedestrian Inventory of Quaternary sediments	Medium	PRPA requires the BLM to inventory all administered lands for paleontological resources. This will unlock further research opportunities, and may increase the sensitivity of this geologic formation to adverse impacts
	Identify museums that hold paleontological resources from PTNM	High	
Cultural Resources	Complete Inventory of cultural resources	Medium	
Vegetation	Understanding the ecology and control of invasive species. Species in this category on the Monument include: <i>Salsola tragus</i> , <i>Sisymbrium irio</i> , <i>Erodium cicutarium</i> , <i>Eragrostis lehmanniana</i> , and <i>Schismus barbatus</i> .	Medium	For the purposes of this topic, "invasive species" means "meets the definition established in Executive Orders 13112 and 13751, but is not listed as a noxious weed under the relevant weed acts." Further work is needed to understand what habitats are susceptible to invasion by these species, what management actions we can take to reduce the likelihood of invasion, and how to control them once they have become established.
	Pollinator research. We have very little information about which pollinators occur within the Monument or what management actions on our part would be likely to help or harm their diversity and abundance	Medium	Pollinator conservation has been an increasing focus of BLM policy since the Presidential Memorandum of June 20, 2014.
	Noxious Weed Surveys. Surveys are needed to determine how widespread and abundant the two species in question are within the Monument.	Medium	At least two species listed by NMDA pursuant to the Noxious Weed Management Act of 1998 are known to occur in the Monument: <i>Peganum harmala</i> and <i>Tamarix</i> spp.
Wildlife	Bat Survey Work	Low	Conduct surveys for potential active bat roosts within PTNM using NA Bat protocols. If active roosts are found, we could begin looking at population estimates, forage ranges, to protect and maintain a healthy ecosystem. Use national

			standard crush as North American Bat Protocol for surveys.
Special Status Species	No priority research for plants currently identified	Low	Future research related to BLM special status plants specifically related to the Monument are unlikely to be a priority due to the very limited occurrence of special status plants in the Monument. Night-blooming cereus (<i>Peniocereus greggii var greggii</i>) is the only documented special status plant species in PTNM; 10 specimens have been documented along the Ridgeline Trail.
	No priority research for animals currently identified	Low	Future research related to wildlife special status species is a low priority as there are no documented occurrences of any in the Monument. The eight potential wildlife special status species in PTNM include one lizard, two birds and five bats. If funding becomes available, we will conduct an inventory for these species.
Livestock Grazing	None currently identified	NA	Future livestock grazing research is unlikely to be a priority.
Wilderness	None currently identified	NA	
Recreation	Carrying capacity study for recreation sites.	Medium	Carrying capacity study would provide BLM with information and numbers on OHV activity and how it relates to possible resource damage.
Visual Resources	None currently identified	NA	
Socioeconomics	None currently identified	NA	

4: MEETING SCIENCE NEEDS

An effective internal organization is necessary to strategically identify and address science at PTNM. The internal organization is effective if it promotes **interdisciplinary** awareness among staff and scientists. Specifically, communication around management on the Monument among scientists and management specialists in different disciplines is critical for successful incorporation of science.

4.1: Science Needs Responsibilities

The Monument Manager and District Manager will serve as the overarching managers of scientific enquiries on the Monument. The role of Prehistoric Trackways Science Coordinator will be filled by the Monument Paleontologist. The Science Coordinator will work directly with the Monument Manager and District Manager to assist in this process, collaborating with appropriate BLM staff in the Las Cruces District Office (LCDO) and science partners. The roles of the Science Coordinator in relation to scientific inquiries on Prehistoric Trackways National Monument (PTNM) are:

- Serving as the point of contact for scientific inquiries, from both internal and external sources. Scientific inquiry proposals must be submitted in writing. Contact information for the Science Coordinator is listed in Section 11.
- Distributing information about new and ongoing research to the Interdisciplinary (ID) Team.
- Coordinating the processing of research permits for the Monument, working with resource specialists on PTNM and PTNM to (if applicable): identify the issues in conducting the research; ensure appropriate planning and environmental reviews are in place; and ensure appropriate mitigation measures and research permit stipulations are implemented. If appropriate, the Prehistoric Trackways Science Coordinator will also prepare the research permit for signature by the Monument Manager. Note that there may be instances when issuance of a permit for scientific research is best issued by a specific resource specialist, under whom the research areas falls. For example, Paleontological Resource Use permits are issued by the Regional Paleontologist in NMSO. Contact information for these employees is listed in Section 11.
- Coordinating internal/external scientific inquiries with the Monument Manager.

- Coordinating the inquiry process with the applicant and other scientific partner, if necessary.
- When appropriate, coordinating the process of requesting, administering, and utilizing BLM funds for proposed inquiries.

4.2. Collaboration and Partnerships

- Collaboration and open communication with existing and potential science partners is critical to the success of implementing of the Science Plan. This collaboration will ensure that research on Prehistoric Trackways is pertinent to the protection of Monument objects and future management decisions.
- Cooperative Ecosystem Study Units (CESUs) enable effective collaboration with universities. The Las Cruces District Office and PTNM are part of the Desert Southwest CESU Network, along with New Mexico State University. Specifically there is a financial assistance agreement in place.
- Current Scientific Partnerships with PTNM:
 - There is a Cultural Assistance program with NMSU
 - Las Cruces Museum of Nature and Science
 - New Mexico Museum of Natural History and Science (Albuquerque), which is the repository for PTNM collections.
 - County Museum of Los Angeles.
 - Smithsonian Institution - National Museum of Natural History

5: SCIENCE PROTOCOLS

5.1. General Science Guidelines

- Integrate the goals of 'Advancing Science in the BLM: An Implementation Strategy' whenever possible (BLM strives to further science in all we do and to link National science plan with other science plans).
- Scientific inquiries will comply with current and relevant agency laws and regulations.
- Scientific research should not detrimentally impact the long term health or sustainability of NCA objects or other resources of PTNM.
- Scientists initiating research projects within PTNM must be aware of existing data within the BLM and should incorporate these data into projects whenever possible.
- Proposed research will follow guidelines in the Department of the Interior's "Integrity of Scientific and Scholarly Activities" policy established in Departmental Manual Part 305 Chapter 3.
- External scientific projects, including UAV data collection, must apply for and receive a research permit from the Monument Manager in order to proceed (see section 5.2).
- All scientific inquiries will be presented to the ID team for review.

5.2. Authorization and tracking process

- Proposals, including those from the Research and Stewardship Partnership, will be submitted to the Prehistoric Trackways Science Coordinator.
 - The proposal (not to exceed 3 pages) will include the following:
 - Contact information of the principal investigator;
 - Background information of the question being studied (including any existing research);
 - Site locations, including any geospatial information;
 - Rationale for research;
 - Methods of conducting the research;
 - Timeline for field work;
 - Deliverables; and,
 - Outline of public outreach effort, if appropriate.

- The Monument Manager will review the proposal for completeness and consult with the appropriate BLM resource specialist(s) to determine the scientific validity and integrity of the proposal, and potential impacts to resources and resource uses.
- The Monument Manager will brief the District Manager upon receipt of request to conduct research. In coordination with the Monument Manager, the District Manager will determine whether the proposal:
 - Is consistent with this Science Plan;
 - Meets PTNM's scientific mission (see Section 1);
 - Conforms with PTNM's RMP; and,
 - Is consistent with other current and relevant agency laws and regulations.
 - In addition, for proposals from the Research and Stewardship Partnership, the District Manager and Monument Manager will coordinate with the partnership to ensure it meets the goals and objectives of the partnership.
- If the proposal is not accepted, the District Manager will provide written notification and justification to the applicant of the decision as soon as practical.
- If the proposal is accepted:
 - The District Manager will determine what, if any, NEPA analysis is required to carry out inquiry.
 - If a Categorical Exclusion or Environmental Assessment is needed, the District Manager will assign an ID Team (including a team lead/project manager) comprised of appropriate resource specialists.
 - Resource specialists will review the proposal to determine what mitigation or stipulations need to be included in the authorization (i.e. research permit).
 - When appropriate, the PTNM Science Coordinator will prepare a research permit for the applicant to be approved by the District Manager.
 - For paleontology specifically, permitting is handled by the Regional Paleontologist (currently in NM State Office), following the BLM 8270 Manual and Handbook for Paleontological Resource Management
 - The research permit will be sent to the applicant for review and signature. The permit will be returned to the District Manager for final signature and approval.

- Reporting for all scientific investigations will require:
 - Annual progress reports to be filed with the Monument Manager and appropriate BLM resource specialist.
 - A final report that includes an executive summary, research background and results; results' relevance to PTNM management; public outreach efforts; and copies of published papers resulting from the scientific inquiry.
- If permit stipulations are not adhered to, the research permit can be canceled, in writing, by the District Manager.

6: ORGANIZATION AND COMMUNICATION OF COMPLETED SCIENCE

6.1 Scientific Background Needed for Updates

- Section 2 of this report provides a brief summary of the scientific background of the unit, and provides citations to the relevant reports in the bibliography (Section 9) of this science plan. At every revision of the science plan, these sections will be updated.

6.2 Internal Communications and Tracking

- All reports described in Section 5 will be stored, organized, and shared on a share drive or sharepoint site, accessible to all staff on the LCDO. The Science Coordinator should strive to organize periodic presentations of scientific results to District Office staff.
 - Options to consider:
 - Put final science reports into state-level drive (once developed, i.e. not cultural resources/site locals).
 - Consider putting reports into the “Common Folder”
- All internal communications will be shared with the ID team.

6.3 Communication to the Broader BLM Organization

- The Monument Manager will comply, in a timely manner, with all requests for completed scientific investigations (e.g. reports, publications, etc.) from BLM Field, District, State, and Washington offices.
- PTNM Science Coordinator will upload final science reports into state-level drive (once developed, i.e. not cultural resources/site locals).
- Ongoing studies will be documented in the Monument annual report.

6.4 Communication of Scientific Results to the Public

- The Monument Manager, in coordination with the LCDO Public Affairs Officer and/or the State Public Affairs Specialist, will strive to make information on science projects within PTNM accessible to the general public. This includes posting updates on PTNM’s website in formats such as written descriptions of scientific inquiries or citations of published research; press releases; using social media websites like Facebook or Twitter; brown bag lunch presentations; leading field tours; participating in community outreach events, etc.
- LCDO has one of the only locally-managed Facebook pages, could be an outlet for science communication.

7: INTEGRATING SCIENCE INTO MANAGEMENT

7.1. Communications

- Direct communication between the District Manager, Monument Manager, Science Coordinator, scientists, and ID team.
- It is the responsibility of the Science Coordinator to ensure that scientific findings are communicated to the local resource specialist, the relevant State Office resource specialist, the State Office Science Coordinator, the Monument Manager and the District Manager via methods outlined in Section 6. Subsequently, the managers will be able to use the scientific information, as appropriate, in management decisions related to PTNM.

7.2. Integration

- Integrating scientific findings into management decisions should not end scientific inquiry into a specific topic.
- Science will be integrated into management decisions, particularly during the NEPA process, contract specifications, and terms and conditions language on permitting, to the best ability while working within existing policy and regulatory guidelines.
- Using science in the decision making process should provide an opportunity to identify future science needs to adaptively manage for certain objectives.

8: SCIENCE PLAN REVIEW AND APPROVAL

SIGNATURE PAGE

I affirm that I have read, understood, and approved the 2019 Science Plan for the Prehistoric Trackways National Monument.

This plan will be used as the basis for conducting science in Prehistoric Trackways National Monument. “Science” is defined in Section 1 of this plan.

As a living document, this plan will be updated as needed. Scientific needs that emerge during the course of implementing this plan may be added to the plan on an as-needed basis to meet the needs of the Prehistoric Trackways National Monument, and the Bureau of Land Management.

Name District Manager Las Cruces District Office	Date
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Name Monument Manager Las Cruces District Office	Date
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Name New Mexico NCL Lead New Mexico State Office	Date
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8: SCIENCE PLAN REVIEW AND APPROVAL

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Bill Childress
District Manager
Las Cruces District Office

9-23-2019

Date



Mara Weisenberger
Monument Manager
Las Cruces District Office

9-23-2019

Date



McKinney Briske
New Mexico NCL Lead
New Mexico State Office

1-8-2020

Date

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10: UNIT'S LEGISLATION

Calendar No. 53

110th CONGRESS
1st Session

S. 275

[Report No. 110-27]

To establish the Prehistoric Trackways National Monument in the State of New Mexico.

IN THE SENATE OF THE UNITED STATES

January 11, 2007

Mr. Bingaman (for himself and Mr. Domenici) introduced the following bill; which was read twice and referred to the Committee on Energy and Natural Resources

February 16, 2007

Reported by Mr. Bingaman, with amendments

[Omit the part struck through and insert the part printed in italic]

A BILL

To establish the Prehistoric Trackways National Monument in the State of New Mexico.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the “Prehistoric Trackways National Monument Establishment Act”.

SEC. 2. DEFINITIONS.

In this Act:

(1) MONUMENT.—The term “Monument” means the Prehistoric Trackways National Monument established by section 4(a).

(2) PUBLIC LAND.—The term “public land” has the meaning given the term “public lands” in section 103 of the Federal Land Policy and Management Act of 1976 (43 U.S.C. 1702).

(3) SECRETARY.—The term “Secretary” means the Secretary of the Interior.

SEC. 3. FINDINGS.

Congress finds that—

(1) in 1987, a major deposit of Paleozoic Era fossilized footprint megatrackways was discovered in the Robledo Mountains in southern New Mexico;

(2) the trackways contain footprints of numerous amphibians, reptiles, and insects (including previously unknown species), plants, and petrified wood dating back approximately 280,000,000 years, which collectively provide new opportunities to understand animal behaviors and environments from a time predating the dinosaurs;

(3) title III of Public Law 101–578 (104 Stat. 2860)—

(A) provided interim protection for the site at which the trackways were discovered; and

(B) directed the Secretary of the Interior to—

(i) prepare a study assessing the significance of the site; and

(ii) based on the study, provide recommendations for protection of the paleontological resources at the site;

(4) the Bureau of Land Management completed the Paleozoic Trackways Scientific Study Report in 1994, which characterized the site as containing “the most scientifically significant Early Permian tracksites” in the world;

(5) despite the conclusion of the study and the recommendations for protection, the site remains unprotected and many irreplaceable trackways specimens have been lost to vandalism or theft; and

(6) designation of the trackways site as a National Monument would protect the unique fossil resources for present and future generations while allowing for public education and continued scientific research opportunities.

SEC. 4. ESTABLISHMENT.

(a) In General.—In order to conserve, protect, and enhance the unique and nationally important paleontological, scientific, educational, scenic, and recreational resources and values of the public land described in subsection (b), there is established the Prehistoric Trackways National Monument in the State of New Mexico.

(b) Description Of Land.—The Monument shall consist of approximately 5,367 5,280 acres of public land in Doña Ana County, New Mexico, as generally depicted on the map entitled “Prehistoric Trackways National Monument” and dated June 1, 2006 *January 25, 2007*.

(c) Map; Legal Description.—

(1) IN GENERAL.—As soon as practicable after the date of enactment of this Act, the Secretary shall prepare and submit to Congress an official map and legal description of the Monument.

(2) CORRECTIONS.—The map and legal description submitted under paragraph (1) shall have the same force and effect as if included in this Act, except that the Secretary may correct any clerical or typographical errors in the legal description and the map.

(3) CONFLICT BETWEEN MAP AND LEGAL DESCRIPTION.—In the case of a conflict between the map and the legal description, the map shall control.

(4) AVAILABILITY OF MAP AND LEGAL DESCRIPTION.—Copies of the map and legal description shall be on file and available for public inspection in the appropriate offices of the Bureau of Land Management.

(d) Minor Boundary Adjustments.—If additional paleontological resources are discovered on public land adjacent to the Monument after the date of enactment of this Act, the Secretary may make minor boundary adjustments to the Monument to include the resources in the Monument.

SEC. 5. ADMINISTRATION.

(a) Management.—

(1) IN GENERAL.—The Secretary shall manage the Monument—

(A) in a manner that conserves, protects, and enhances the resources and values of the Monument, including the resources and values described in section 4(a); and

(B) in accordance with—

(i) this Act;

(ii) the Federal Land Policy and Management Act of 1976 ([43 U.S.C. 1701](#) et seq.); and

(iii) other applicable laws.

(2) NATIONAL LANDSCAPE CONSERVATION SYSTEM.—The Monument shall be managed as a component of the National Landscape Conservation System.

(3) PROTECTION OF RESOURCES AND VALUES.—The Secretary shall manage public land adjacent to the Monument in a manner that is consistent with the protection of the resources and values of the Monument.

(b) Management Plan.—

(1) IN GENERAL.—Not later than 3 years after the date of enactment of this Act, the Secretary shall develop a comprehensive management plan for the long-term protection and management of the Monument.

(2) COMPONENTS.—The management plan under paragraph (1)—

(A) shall—

- (i) describe the appropriate uses and management of the Monument, consistent with the provisions of this Act; and
 - (ii) allow for continued scientific research at the Monument during the development of the management plan; and
- (B) may—
- (i) incorporate any appropriate decisions contained in any current management or activity plan for the land described in section 4(b); and
 - (ii) use information developed in studies of any land within or adjacent to the Monument that were conducted before the date of enactment of this Act.
- (c) Authorized Uses.—The Secretary shall only allow uses of the Monument that the Secretary determines would further the purposes for which the Monument has been established.
- (d) Interpretation, Education, And Scientific Research.—
- (1) IN GENERAL.—The Secretary shall provide for public interpretation of, and education and scientific research on, the paleontological resources of the Monument, with priority given to exhibiting and curating the resources in Doña Ana County, New Mexico.
 - (2) COOPERATIVE AGREEMENTS.—The Secretary may enter into cooperative agreements with appropriate public entities to carry out paragraph (1).
- (e) Special Management Areas.—
- (1) IN GENERAL.—The establishment of the Monument shall not change the management status of any area within the boundary of the Monument that is—
 - (A) designated as a wilderness study area and managed in accordance with section 603(c) of the Federal Land Policy and Management Act of 1976 (43 U.S.C. 1782(c)); or
 - (B) managed as an area of critical environment concern.
 - (2) CONFLICT OF LAWS.—If there is a conflict between the laws applicable to the areas described in paragraph (1) and this Act, the more restrictive provision shall control.
- (f) Motorized Vehicles.—
- (1) IN GENERAL.—Except as needed for administrative purposes or to respond to an emergency, the use of motorized vehicles in the Monument shall be allowed only on roads and trails designated for use by motorized vehicles under the management plan prepared under subsection (b).
 - (2) PERMITTED EVENTS.—The Secretary may issue permits for special recreation events involving motorized vehicles within the boundaries of the Monument, including the “Chile Challenge”—
 - (A) to the extent the events do not harm paleontological resources; and
 - (B) subject to any terms and conditions that the Secretary determines to be necessary.
- (g) Withdrawals.—Subject to valid existing rights, any Federal land within the Monument and any land or interest in land that is acquired by the United States for inclusion in the Monument after the date of enactment of this Act are withdrawn from—

(1) entry, appropriation, or disposal under the public land laws;
(2) location, entry, and patent under the mining laws; and
(3) operation of the mineral leasing laws, geothermal leasing laws, and minerals materials laws.

(h) Grazing.—The Secretary may allow grazing to continue in any area of the Monument in which grazing is allowed before the date of enactment of this Act, subject to applicable laws (including regulations).

(i) Hunting.—

(1) IN GENERAL.—Nothing in this Act diminishes the jurisdiction of the State of New Mexico with respect to fish and wildlife management, including regulation of hunting on public land within the Monument.

(2) REGULATIONS.—The Secretary, after consultation with the New Mexico Department of Game and Fish, may issue regulations designating zones in which and establishing periods during which hunting shall not be allowed for reasons of public safety, administration, or public use and enjoyment.

(j) Water Rights.—Nothing in this Act constitutes an express or implied reservation by the United States of any water or water rights with respect to the Monument.

(i) *Water Rights.*—*Nothing in this Act constitutes an express or implied reservation by the United States of any water or water rights with respect to the Monument.*

SEC. 6. AUTHORIZATION OF APPROPRIATIONS.

There are authorized to be appropriated such sums as are necessary to carry out this Act.