

**SCIENCE PLAN**  
**FOR**  
**VERMILION CLIFFS NATIONAL MONUMENT**  
**AUGUST 2014**



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## 1. Introduction and Scientific Mission

### 1.1. Purpose of NLCS Science Plans:

The National Landscape Conservations System (NLCS) was administratively established in 2000 and legislatively codified in the Omnibus Public Land Management Act of 2009 (PL 111-11). The system, also referred to as the National Conservation Lands, encompasses nearly 900 units spread across approximately 27 million acres of public lands managed by the Bureau of Land Management (BLM). The BLM is mandated to conserve, protect, and restore the outstanding cultural, ecological, and scientific values of NLCS units. Scientific investigation can aid in the conservation, protection, and restoration of these lands; and therefore, science is strategically planned and organized within NLCS units.

The objectives of NLCS 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 NLCS 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.

Science has been defined within the BLM several times (BLM, 2007; BLM, 2008). 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 NLCS 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.” (BLM, 2007)

This science plan will be used as the basis for conducting science in Vermilion Cliffs National Monument (VCNM).

### 1.2. Unit and Geographic Area Description

VCNM was created on November 9, 2000 by Presidential Proclamation (#7374) to ensure protection of its wide variety of biological objects and rich human history, which have been preserved by remoteness and limited travel corridors (Appendix 1). VCNM contains unique

geologic features such as Coyote Buttes, vast cultural and historic resources, spectacular vistas from the Paria Plateau and Paria Canyon, diverse flora and fauna, and offers visitors opportunities to experience solitude. VCNM is located in northern Coconino County, Arizona in the eastern most portion of the BLM's Arizona Strip Field Office. It contains 279,566 acres of BLM-administered lands, of which 89,598 acres is the Paria Canyon/Vermilion Cliffs Wilderness (see map pg. 5).

The Resource Management Plan (RMP) for VCNM and associated Record of Decision was signed January 29, 2008. The RMP clarifies the intent of the Proclamation and the objects identified therein. The objects identified by the RMP are (BLM, 2008b, pg. 1-19):

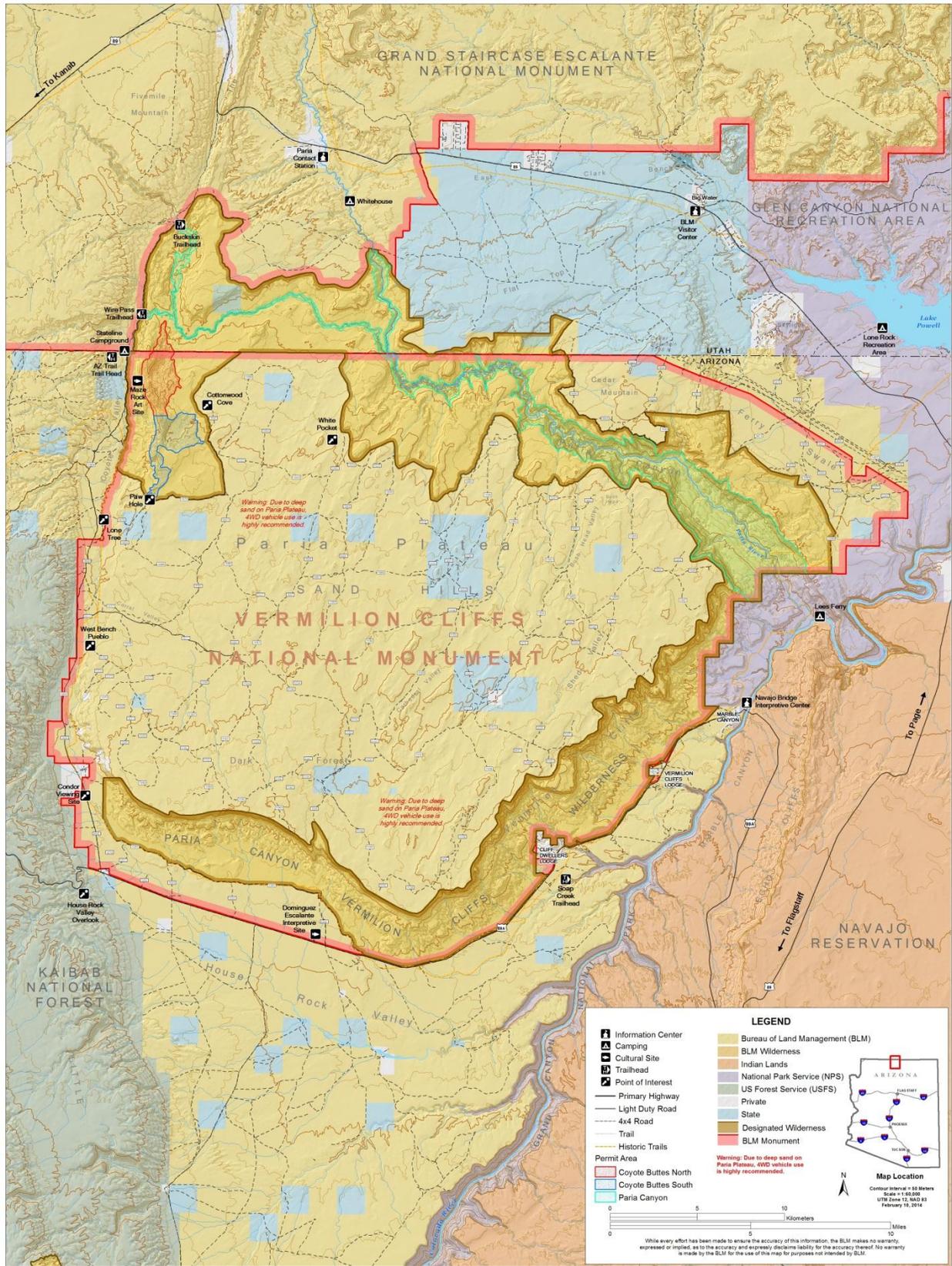
- Wildlife including California condors, bighorn sheep, pronghorn antelope, mountain lions, raptors, and fish and;
- Archaeological evidence displaying a long and rich human history spanning more than 12,000 years;
- Historic resources, including evidence of early European exploration, ranches, homesteads, mines, and roads;
- Sandstone slick rock, rolling plateaus, and brilliant cliffs with arches, amphitheaters, and massive walls;
- Cold desert flora and warm desert grassland;
- Remote and unspoiled landscape with limited travel corridors, and;
- The Paria River and widely scattered ephemeral water sources and springs.

The RMP provides a balance between authorized resource use and the protection and long-term sustainability of sensitive resources and/or monument objects. Per the RMP, scientific research is an authorized use in VCNM in order to contribute to managing natural and cultural resources and achieving desired future conditions (BLM, 2008b, pg. 2-88, DFC-SR-01).

### 1.3. Scientific Mission

The scientific mission of VCNM is to:

- Support the conservation, protection, and interpretation of monument values and objects identified in the Presidential Proclamation and the RMP.
- Allow and encourage pertinent science, across diverse disciplines and time-scales, that can:
  - Inform and evaluate management decisions;
  - Improve and maintain ecosystem resiliency and function;
  - Maintain diversity and viability of plant and animal populations; and,
  - Preserve and understand geologic processes and cultural and historical resources.
- Support investigations into the level of impact of stressors on the integrity of monument objects, including how landscape level compounding stressors such as climate change affect monument objects.
- Be responsive to the BLM's National Conservation Lands 15-year Strategy and Arizona BLM's National Conservation Lands 3-year Strategy.



Map of VCNM and Surrounding Area

- Serve as a model system for surrounding areas so that scientific findings can be exported to other landscapes on both federal and non-federal lands.
- Support the Kane and Two Mile Ranches Applied Research Plan.
- Support the Friends of The Cliffs Science Strategy and Plan.
- Support the Kaibab-Vermilion Cliffs Heritage Alliance mission.
- Support ongoing efforts by the Peregrine Fund and Arizona Game and Fish Department to study the California condor and the condor reintroduction program's effectiveness.

## **2. Scientific Background**

### **2.1. Kane and Two Mile Ranches Applied Research Plan**

In 2005, Grand Canyon Trust, based in Flagstaff, AZ, obtained federal grazing permits that comprise the majority of lands in VCNM and the North Kaibab Ranger District of the U.S. Forest Service. In association with these permits, Grand Canyon Trust also holds title to the private lands within the allotments on their livestock grazing permits.

In 2011, Grand Canyon Trust helped form the Kane and Two Mile Ranches Research and Stewardship Partnership via a Memorandum of Understanding. The Research and Stewardship Partnership consists of the BLM (including VCNM), U.S. Forest Service, Grand Canyon Trust, Arizona Game and Fish Department, Northern Arizona University, University of Arizona, and U.S. Geological Survey. Other government agencies and non-governmental organizations will be added to the partnership as it continues to develop and expand. This collaborative partnership developed the "Kane and Two Mile Ranches Applied Research Plan" (Research Plan). The purpose of the Research Plan is to outline "an integrated research agenda designed to inform land and resource management with sound science, enhancing the ability of management agencies to work with their partners and the public to integrate conservation objectives with the sustainable use of public lands on the Colorado Plateau."

The Research Plan calls for:

- Establishing reference conditions and refining baseline soils and ecological site information;
- Exploring livestock management strategies through designed experiments and rigorous observational studies;
- Examining effects of range management on wildlife species and wildlife habitat;
- Identifying environmental and management drivers of cheatgrass invasion;
- Developing and testing of effective methods for restoring arid and semi-arid rangelands; and
- Developing landscape-scale tools and applications for monitoring and adaptive management.

A more detailed narrative of research topics and how they will be addressed can be found in the Research Plan and associated "Research Design" (Appendix I of the Research Plan), both of

which are incorporated by reference into this Science Plan. A copy of the Research Plan can be obtained by contacting the VCNM Science Coordinator (see Appendix 2).

The Research Design lays out a framework of scientific/management infrastructure needed to carry out the research questions outlined in the Research Plan. There are three design elements in the research design. These design elements comprise a multi-tiered approach to experimentation, from large to fine scale.

- Design Element 1 (implemented): Pasture-scale experimental and control areas. This will be used for landscape scale experimentation.
- Design Element 2 (not yet implemented): Replicated Enclosure/Exclosure Pairings. These would be used for experimentation that requires more intensive management or replication than pasture-scale research. Enclosure/exclosure pairings would be approximately 50-100 acres in size depending on location and vegetative productivity. The location, required planning and environmental review documents, and funding for materials need to be completed and secured before implementing this design element on BLM lands. The U.S. Forest Service has authorized exclosures on the Kaibab Ranger District and is in the implementation phase of the project.
- Design Element 3 (not yet implemented): Experimental Plot Arrays. These would be used to address fine-scaled processes that govern dynamics of ecological systems. The arrays can be used for a variety of purposes from studying invasive species to climate change. Though there are currently no experimental plot arrays in VCNM, but they are currently being planned and implemented on land outside the monument.

Several research projects from the Research Plan are on-going:

- NRCS Ecological Site Inventory
  - *Primary Investigator:* Natural Resource Conservation Service (NRCS). The project was funded by the NRCS.
  - *Background and Purpose:* Update the soil survey for the Paria Plateau. The original soil survey has inaccurate climate, soil, and ecological site mapping and does not meet the current needs of the BLM.
  - *Findings and Status:* Field work for the project was completed in 2012 and 2013. Field work confirmed the need for greater detail and more accurate information than what the current survey offers. A final report and revised draft ecological site descriptions are expected in 2014.
- Flora of Vermilion Cliffs National Monument/Budding Botanist Program
  - *Primary investigator:* Grand Canyon Trust in partnership with Friends of The Cliffs, Brigham Young University, Desert Botanical Garden, and the Arizona Natural Heritage Program. The project was funded through grants from BLM's NLCS Research Support Program and National Fish and Wildlife Foundation.

- *Background and Purpose:* Collect, inventory, and map plant specimens and populations within the boundary of VCNM, including the Paria Canyon-Vermilion Cliffs Wilderness. Inventory trips focus on previously unsampled and under-sampled areas.
- *Findings and Status:* Field work was completed in 2012 and 2013 with a final report expected in 2014.
- Raptor, Songbird, and Bat Surveys
  - *Primary Investigator:* Grand Canyon Trust in partnership with BLM, Whitman College, Friends of The Cliffs, and U.S. Forest Service. Partial funding for the project came from BLM's NLCS Research Support Program.
  - *Background and Purpose:* Establish baseline population information on songbirds, raptors, and bats in VCNM. This baseline data will aid future studies of wildlife populations and their interactions with other resources and resource uses.
  - *Findings and Status:* Field work for songbird and raptor surveys was completed in 2013. A final report is expected in 2014. Bat surveys were initiated in 2013 and are ongoing. The research has been funded again in 2014 to expand the scope of the surveys.

## 2.2. Monument Objects and Scientific Understanding

The following is a list of monument objects, and associated scientific research.

- Wildlife (includes California condors, bighorn sheep, pronghorn, mountain lions, raptors, and fish):
  - California Condor (*Gymnogyps californianus*) reintroduction program:
    - *Primary investigator:* The Peregrine Fund and Arizona Game and Fish Department.
    - *Background and Purpose:* In the 1980s, there were only 22 condors remaining in the wild. Since 1996, The Peregrine Fund has released captive bred condors from a facility in VCNM. As of April 30, 2014, there were 75 free flying condors in the northern Arizona-southern Utah population. The Peregrine Fund, in partnership with Arizona Game and Fish, continues to monitor and study the birds.
    - *Findings and Status:* A comprehensive study of mortality in free-ranging California condors in 2012 (Rideout, et al., 2012) demonstrated that the leading causes of death in condors are anthropogenic, with lead poisoning being the most important. Evidence suggests that lead bullet fragments are causing increased blood lead levels in condors (Chesley, et al., 2009; Parish, et al., 2009; Church, et al., 2006). The Utah Division of Wildlife Resources and Arizona Game and Fish Department coordinate active lead reduction programs. Studies have been done to measure the effectiveness of those programs (Green, et al., 2008; Sieg, et al., 2009). These studies show that the participation in voluntary lead reduction programs has the same participation levels as the percentage of compliance with California's mandated ban on lead ammunition use.

- Northern Leopard Frog (*Lithobates pipiens*):
  - *Primary Investigator*: Arizona Game and Fish Department, and the US Fish and Wildlife Service.
  - *Background and Purpose*: The northern leopard frog is a Species of Greatest Conservation Need in Arizona and was petitioned for federal listing as threatened in 2006. The US Fish and Wildlife Service and Arizona Game and Fish Department established a refuge population on VCNM in 2011 at Soap Creek Tank 2, a reinforced natural water catchment. This population could serve as a source to supplement or re-establish the frog at extirpated sites or at sites within the species' historical range, as appropriate.
  - *Findings and Status*: The frogs at Soap Creek Tank 2 have been monitored annually since 2012. To date, the frogs are reproducing and subsisting in this habitat. They are showing a good diversity of size classes and phenotypes (unpublished data). The Grand Canyon Trust, through a grant with the Wildlife Conservation Society, is in the process of restoring springs on private lands within the monument boundary. These restoration efforts may provide additional habitat for northern leopard frog.
- Mexican Spotted Owl (*Strix occidentalis lucida*)
  - *Primary Investigator*: Montana State University.
  - *Background and Purpose*: During the 2013 Mexican Spotted Owl breeding season (i.e., between 15 March and 31 August) researchers from Montana State University (Willey, 2013) surveyed a 12-mile section of the Paria Canyon (from 4 miles above to 8 miles down from the confluence with Buckskin Gulch) and approximately 3 miles of Buckskin Gulch upstream from the confluence. The researchers adopted FWS' standardized protocol, which relies on night-time surveys, during which observers imitate a variety of spotted owl calls from calling stations to elicit an owl response (USDI, 2003).
  - *Findings and Status*: No Mexican spotted owls were detected in 2013 (Willey, 2013). However, habitat in much of the survey area was determined to be excellent. Lack of occupancy by spotted owls could have been due to the presence of several great-horned owl territories and/or low population levels (many historic nest sites throughout the Colorado Plateau were unoccupied in 2013). Very high temperatures and bright moonlit nights were also encountered during the surveys, which may have caused spotted owls to be unresponsive. Surveys have been repeated in 2014 with survey areas in Buckskin Gulch and upper Paria Canyon added. A report on 2014 survey efforts and results is expected in 2014. Additional funding for monitoring in 2015 has been obtained by the BLM.
- Archaeological resources (displaying a long and rich human history spanning more than 12,000 years)
  - Most archaeological research efforts conducted in VCNM have focused on a public use site called West Bench Pueblo. West Bench Pueblo is considered an Ancestral Puebloan

site that was used by generations of Puebloans as part of a strategy of household residential mobility (O'Hara, 2009). First recorded by archaeologists in 1967, research and excavation began in 2007. Work was coordinated through the collaborative group Kaibab Vermilion Cliffs Heritage Alliance (KVCHA).<sup>1</sup>

- Investigations at other sites within VCNM have occurred in House Rock Valley on both private and BLM sites. The areas of Pinnacle Ridge and White Knolls on VCNM have also been investigated (McFadden, 2009).
- Other information on archaeological resources is due to BLM inventories done in conjunction with ground disturbing projects. Only a small percentage of VCNM has been scientifically surveyed for archaeological resources (less than 5%). Inventory and monitoring of resources is expected to continue, primarily driven by BLM proposed projects, potential vandalism, and other adverse impacts to significant sites. Inventory and monitoring is done in coordination with the Arizona State Parks Site Steward Program.
- Historic resources (including evidence of early European exploration, ranches, homesteads, mines, and roads)
  - Scientific knowledge of historic resources is limited in VCNM. Some historical background has been researched for the development of an Archaeological Class 1 overview (Altschul & Fairley, 1989), an overview of House Rock Valley and Eastern Arizona Strip (Spangler, 2007), and a privately published hiking and exploring guide which includes the Paria Plateau (Kelsey, 2010).
  - Most information on historic resources is available due to BLM archaeological inventories done in conjunction with ground disturbing projects and proactive surveys.
- Geology (sandstone slick rock, rolling plateaus, and brilliant cliffs with arches, amphitheaters, and massive walls)
  - Studies of the soft-sediment deformation Navajo Sandstone layer of the Colorado Plateau, in VCNM, have yielded possible terrestrial analogs in geologic studies on Mars. Research of polygonal crack systems can possibly be used to understand weathering patterns on Mars (Chan, et al., 2008) and studies of ferric oxide concretions (i.e. Moki marbles) can help interpret the role of water on Mars (Chan, et al., 2012).
  - Patterns of soft-sediment deformation in the Coyote Buttes area provide unique insights into environmental conditions in the region during the early Jurassic. The deformation indicates extraordinarily wet conditions for an active dune environment. Earthquakes in the area have triggered localized liquefaction controlling the distribution of deformation (Bryant & Miall, 2010). Other research in Coyote Buttes has studied other erosional forces, like wind and groundwater systems, that drive the

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<sup>1</sup> This partnership was formed to help protect and preserve the cultural resources of the eastern Arizona Strip. Supporting entities include BLM, Forest Service, Coconino County, Grand Canyon Trust, and Northern Arizona University. KVCHA has sponsored archaeological field schools at West Bench Pueblo.

visual features seen today (Loope, et al., 2008; Loope & Mason, 2009; Loope & Rowe, 2003).

- Studies in White Pocket have highlighted the importance of the dune topography, differential dune loading, and a shallow water table on dynamic deformation and liquefaction of lateral spreading and failure. White Pocket clearly demonstrates the dynamics of dune shape and a shallow water table in response to strong ground motion (Chan & Bruhn, 2014).
- Vegetation (cold desert flora and warm desert grasslands)
  - General Trends
    - *Primary Investigator:* University of Arizona in partnership with BLM.
    - *Background and Purpose:* Inventory and monitoring of vegetative communities drives the management of livestock grazing in VCNM. Short and long term indicators are used to evaluate livestock grazing impacts on vegetation in both cold and warm desert environments. Short term indicators include actual use (number of livestock for a specified amount of time) and key species utilization (how much of a particular plant species is used by livestock). Short term indicators can be used to link causal factors to long term issues. Long term indicators include range/vegetative trend. Trend studies can be used to extrapolate overall vegetative trends of a livestock pasture/allotment. Range trend studies are completed every 5 years, in partnership with the University of Arizona. These are used, in part, to determine whether an allotment is meeting Arizona Standards for Rangeland Health and Guidelines of Grazing Administration (BLM, 1997). Rangeland Health is not monitoring, but does provide a qualitative and comprehensive “snapshot” of an area’s ecological functionality.
    - *Findings and Status:* There are eight livestock grazing allotments either wholly or partially contained within VCNM: Sand Hills, Coyote, Soap Creek, Badger Creek, Ferry Swale, Bunting Well, Signature Rock, and House Rock. Three allotments (Sand Hills, Bunting Well, and Signature Rock) are meeting the standards for rangeland health. The House Rock, Coyote, Soap Creek, Badger Creek, and Ferry Swale Allotments are making significant progress towards meeting the standards.
  - Special Status Plants: *Sclerocactus sileri* (Siler fishhook cactus) and *Asclepias welshii* (Welsh’s milkweed)
    - *Primary Investigator:* BLM
    - *Background and Purpose:* Inventory and monitor special status plant species listed above. Welsh’s milkweed is a threatened species under the Endangered Species Act and has been monitored since 1989. Siler fishhook cactus is a BLM sensitive species and has been monitored since 1999.
    - *Findings and Status:* Overall, the population trend of Welsh’s milkweed is down from 1990 population levels. Indications are that ongoing drought conditions are responsible for lower populations. The population trend of Siler fishhook cactus is

stable. Volunteers found 30 additional populations of the fishhook cactus in during the Flora of VCNM project (see Section 2.1) (unpublished data).

- Remote, unspoiled landscape with limited travel corridors
  - Recreation Impact Monitoring
    - *Primary Investigator:* Northern Arizona University in partnership with BLM.
    - *Background and Purpose:* A recreation inventory, monitoring, and assessment program, to assess user impacts to natural resources, cultural resources, and recreational settings, based on Limits of Acceptable Change (McCool, 1998), has been in place since 1995. The Paria Special Management Area (which includes Coyote Buttes North and South, and Paria Canyon) and White Pocket area are the focal areas for this research on VCNM. The purpose of the research is to determine recreation created impacts, use patterns, and trends. These data are used to adaptively implement management actions and prescriptions to mitigate or shift impacts from sensitive areas.
    - *Findings and Status:* Overall, impact to monument resources due to recreation is minimal (unpublished data).
  - Recreation Experience Baseline Study
    - *Primary Investigator:* Colorado Mesa University, cooperation with Grand Staircase-Escalante National Monument, Kanab Field Office, and VCNM.
    - *Background and Purpose:* This is a social science research project focused on establishing the recreation experience baseline for Conservation Lands in southern Utah and northern Arizona. The study will consider the areas accessed by Highway 89 and House Rock Valley Road. Focus groups will be conducted to generate needed data to inform management decisions regarding pertinent and pressing recreation management questions. It will also test the effectiveness of current recreation management practices as they impact the articulated desired outcome preferences of the participants.
    - *Findings and Status:* The study will begin in the fall of 2015.
  - Wilderness Character Baseline Report
    - *Primary Investigator:* BLM
    - *Background and Purpose:* The Wilderness Act of 1964 directs managers to preserve wilderness character. BLM uses the Measuring Attributes of Wilderness Character BLM Implementation Guide (BLM, 2012) to establish baseline data and monitor changes to wilderness character over time. The Implementation Guide is based off the “Keeping It Wild” interagency guide (Landres, et al., 2008).
    - *Findings and Status:* The baseline report for the Paria Canyon-Vermilion Cliffs Wilderness is expected to be finalized in September 2014.
- The Paria River and widely scattered ephemeral water sources and springs:
  - *Primary Investigator:* Grand Canyon Trust in partnership with BLM.

- *Background and Purpose:* In 2008, Grand Canyon Trust, BLM, and the Arizona Water Protection Fund started the Paria Canyon Riparian Restoration project. The focus of the project was to remove invasive species, *Tamarix ramosissima* (tamarisk) and *Elaeagnus angustifolia* (Russian olive) from the Paria River riparian area to improve riparian functionality and enhance the area's wilderness characteristics.
- *Findings and Status:* In 2013, Grand Canyon Trust began monitoring treated areas to determine their effectiveness and to adapt future restoration and management efforts along the Paria River. Monitoring will continue in 2014 with a report expected by the end of the year. Findings from monitoring efforts could be used to inform land managers of effective methods to treat invasive species in remote riparian areas such as Paria Canyon.

### 2.3. Landscape Scale Assessments

Though many landscape scale assessments are coarse and limited in utility when focused on a specific land management unit, they can give perspective on a unit's place in the larger context of a broad-based condition or threat. The following is a snapshot of conclusions that can be drawn about VCNM from specific landscape scale assessments.

- *Rapid Ecological Assessments (REA):* Climate change and other widespread environmental influences are affecting BLM-managed land throughout the West. To improve the understanding of the existing condition of these landscapes, and how conditions may be altered by ongoing environmental changes and land use demands, the BLM has begun conducting REAs. VCNM is within the Colorado Plateau REA; the report for this REA was completed in 2012.<sup>2</sup> One critical attribute of this REA was terrestrial intactness, a scientifically-defensible attribute that can be determined by existing geospatial datasets and reasonably tracked through time (Bryce, et al., 2012). According to the REA, VCNM has high terrestrial intactness because of its relative low number of threatened and endangered species, threats, disturbances, and conservation elements (i.e., resources of conversation concern within the ecoregion).
- *HabiMap/CHAT:* The Arizona Game and Fish Department developed HabiMap Arizona to make information contained within the State Wildlife Action Plan available in an accessible and interactive format. Much of that data is compiled into a single model of wildlife conservation potential or the Species and Habitat Conservation Guide model. VCNM is rated from low to moderate wildlife habitat value in this model (Arizona Game and Fish Department, 2013). HabiMap provides data to Western Governors' Association's Wildlife Council's Crucial Habitat Assessment Tool (CHAT). CHAT combines west-wide state wildlife habitat data into a common framework to create an aggregate crucial habitat GIS layer. Wildlife habitat in VCNM ranks in the "least crucial" habitat category (Western Goveners' Association, 2014).

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<sup>2</sup> [http://www.blm.gov/wo/st/en/prog/more/Landscape\\_Approach/reas/coloplateau.html](http://www.blm.gov/wo/st/en/prog/more/Landscape_Approach/reas/coloplateau.html)

### 3. Management decisions and science needs

#### 3.1. Scientific Needs

- In general, research will:
  - Inform land management decisions in VCNM;
  - Be designed around clearly articulated research/management questions;
  - Be responsive to the National Conservation Lands 15-year Strategy, Arizona BLM's National Conservation Lands Strategy, the BLM and National Conservation Lands Science Strategies, and VCNM's Science Plan and RMP.
- Management decisions VCNM expects to make in the next 5-10 years will generally be related to the following issues:
  - Livestock grazing management;
  - Updates to route designations (i.e. travel management);
  - Invasive species control;
  - Riparian area management;
  - Adjustments to recreation management (e.g., Paria Business Plan, special recreation permit management, etc.);
  - Management and protection of wilderness characteristics; and
  - Other decisions related to the protection, conservation, and interpretation of monument objects as needed (e.g., projects to improve habitat of wildlife species, protect archaeological and historical resources, interpreting geologic resources, etc.).
- As the management questions in VCNM continue to evolve, so do the science needs. Thus, the scientific needs will remain fluid and opportunities for research should remain open and inclusive.
- Science needs can be met with either primary research or by synthesizing existing research, and will be connected to the baseline and existing information identified in Section 2.

3.2. Specific on-going and future science needs for VCNM are addressed in two tables. Table 1 identifies the scientific research from Section 2 that is on-going in VCNM. Table 2 identifies potential future research. In general, scientific investigations are related to the protection, conservation, and interpretation of monument objects.

3.3. Science needs are categorized as high, medium, or low<sup>3</sup> priorities. Science needs are prioritized to reflect the following:

- Level of threats and impacts to the integrity monument objects;
- Need for interpretation of monument objects;
- Goals and objectives identified in the VCNM RMP;
- Management and resource issues identified by BLM resource specialists, managers, partners, and the general public; and,
- Science that can be applied on a landscape level versus localized research.

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<sup>3</sup> These are pragmatic decisions (i.e., low priority science needs are still important).

**Table 1 - On-Going Research**

Monument Object/Issue	Research Topic/Question Description	Priority Level (High, Medium, Low)	Related Management Decision
<b>Issues identified in the Kane and Two Mile Applied Research Plan</b>	<i>See Kane and Two Mile Applied Research Plan</i>	High	Livestock grazing management; invasive species control
<b>Wildlife</b>	<i>California condor:</i> Continue research to help establish a self-sustaining population, including studies related to condor movement; behavior; foraging ecology; and toxicology (specifically, lead poisoning and effectiveness of lead reduction programs in Arizona and Utah).	High	
	<i>Northern leopard frog:</i> Monitor the growth and development of embryos/larvae and juvenile frogs at Soap Creek Tank #2, as well as monitoring the survival and reproductive success of the population.	Medium	
	Raptor, bat, and songbird surveys/counts for inventory and monitoring	Medium	
	<i>Mexican spotted owl:</i> Continue surveys in Paria Canyon and Buckskin Gulch	Medium	Recreation management
<b>Archaeology</b>	Archaeological research at West Bench Pueblo and other sites.	Medium	Recreation management; travel management
<b>Geology</b>	Refine models on how soft sediment deformation occurs in Navajo Sandstone. For example, establish a relationship between deformation features, early Jurassic climate, deformation dynamics, and ancient reptilian behaviors.	Low	
<b>Vegetation</b>	Continue long term vegetation trend studies to study impacts from resource uses such as livestock grazing.	High	Livestock grazing management
	Continue support of NRCS efforts to write new and refine existing ecological site descriptions.	High	Livestock grazing management

	Continue inventory and monitoring of special status plant species ( <i>Sclerocactus sileri</i> and <i>Asclepias welshii</i> ).	High	Livestock grazing management; recreation management.
<b>Remote, unspoiled landscape with limited travel corridors</b>	Support assistance agreement for recreation and wilderness impact monitoring, with special attention to travel and the Coyote Buttes-Paria Canyon Special Management Area.	High	Recreation management; travel management; wilderness characteristic management.
	Complete Wilderness Character Baseline Report in September 2014. Continue monitoring wilderness character every 5 years to detect any changes.	High	Wilderness characteristic management.
	Continue support of Colorado Mesa University's Recreation Experience Baseline Study. Study is expected to be complete in 2015.	High	Recreation management; wilderness characteristic management
<b>Paria River</b>	Continue effectiveness monitoring of treatment of tamarisk and Russian olive along the Paria River.	High	Invasive species control; riparian area management

**Table 2 - Future Potential Research**

Monument Object/Issue	Research Topic/Question Description	Priority Level (High, Medium, Low)	Related Management Decision
<b>Wildlife</b>	Research into understanding wildlife connectivity and movement between VCNM and other landscapes.	Medium	Livestock grazing management; recreation management; travel management
	Nest research and monitoring for peregrine falcons and golden eagles.	Low	
	Identify and inventory locations of pinyon jay nesting colonies.	Low	
	Investigations into locations of any burrowing owl or ferruginous hawk sightings or nest sites.	Low	
	Investigate and refine habitat models for Houserock Valley chisel-toothed kangaroo rat ( <i>Dipodomys microps leucotis</i> ) (O'Farrell, 1997).	Low	
	Small mammal studies in the Paria/Buckskin corridor to assess prey base for Mexican spotted owl.	Low	
<b>Archaeology</b>	<p>Surveys, recording, and site preservation and monitoring, will be critical to future project implementation, especially when ground disturbing activities are planned. High priority areas for future inventories include:</p> <ul style="list-style-type: none"> <li>• Coyote Buttes (intense ongoing recreation impacts)</li> <li>• White Pockets (intense ongoing recreation impacts)</li> <li>• Designated motorized routes and routes to be closed</li> <li>• Paria Plateau (ongoing recreation and vandalism)</li> <li>• House Rock Valley (ongoing recreation and vandalism)</li> <li>• Paria Canyon (ongoing recreation impacts in a narrow canyon)</li> </ul>	High	Recreation management; wilderness characteristic management; travel management
	Conduct soil surveys and testing research to help identify agricultural potential and possible actual use of VCNM by archaeological and	Medium	

	historic cultures. These studies would build knowledge related to archaeological site distribution and historical climate change.		
<b>Historic Resources</b>	Document on the ground sites and encourage field survey, recording, preservation, oral histories, monitoring, archival data mining, and ethnography.	Medium	
<b>Geology</b>	Formal inventory and monitoring of paleontological resources.	Low	
	Research into the possibility of Navajo sandstone once being an ancient carbon dioxide reservoir. Findings could give insights into techniques for subsurface carbon sequestration (Loope et al. 2010; Weber et al. 2011).	Medium	
<b>Remote, unspoiled landscape with limited travel corridors</b>	Through recreation monitoring, establish and further refine Limits of Acceptable Change for general recreation use and Special Recreation Permits.	Medium	Recreation management; travel management; wilderness characteristic management.

#### 4. Meeting Science Needs

4.1. An effective internal organization is necessary to strategically identify and address science in VCNM. Due to the VCNM's limited staff, the Monument Manager will serve as the unit's science coordinator, collaborating with appropriate BLM staff in the Arizona Strip District and science partners. The roles of the science coordinator in relation to scientific inquiries on VCNM are:<sup>4</sup>

- 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 Appendix 3.
- Coordinating these inquiries with the Arizona Strip District Wildlife Program Lead, who has collateral duties to process research permits for the district. This collateral duty position will work with resource specialists on VCNM and Arizona Strip Field Office 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. The Wildlife Program Lead will also prepare the research permit for signature by the Arizona Strip Field Manager. Contact information for these employees is listed in Appendix 2.
- Coordinating internal/external scientific inquiries with the Arizona Strip Field Manager.
- Coordinating the inquiry process with the applicant and other scientific partner, if necessary.
- 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 VCNM is pertinent to the protection of monument objects and future management decisions.

- Existing Scientific Partnerships with VCNM:
  - Friends of The Cliffs (VCNM's friends group)
  - Kane and Two Mile Ranches Research and Stewardship Partnership

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<sup>4</sup> The process of obtaining and authorizing scientific inquiries is outlined in Section 5.2.

- Other government agencies:
  - US Forest Service
  - US Fish and Wildlife Service
  - US Geological Survey
  - Arizona Game and Fish Department
  - Natural Resource Conservation Service
- Not for profit organizations:
  - The Peregrine Fund
  - Grand Canyon Trust
- Institutions for higher learning:
  - Dixie State University
  - Northern Arizona University
  - Montana State University
  - University of Utah
  - University of Arizona
- Other partnerships that may be developed to further VCNM’s science needs include, but are not limited to: adjacent BLM administrative units (Grand Staircase-Escalante National Monument, Kanab Field Office, etc.); other adjacent federal land management agencies (Glen Canyon National Recreation Area, Grand Canyon National Park, etc.); universities such as Southern Utah University and Brigham Young University; local government agencies such as Coconino County and Kane County; etc.
- Outreach to existing and potential partners and collaborators will be critical in soliciting help to meet the science needs of VCNM. Methods of outreach to VCNM partners will include posting this Science Plan on VCNM’s website, mailing the plan to existing and potential science partners, issuing a press release when the Science Plan is completed, using social media to promote the plan, etc.

## **5. Science Protocols**

### **5.1. General Science Guidelines**

- Scientific inquiries will comply with current and relevant agency laws and regulations.
- Scientific inquiries will not detrimentally impact the long term health or sustainability of monument objects or other resources of VCNM.

- Scientists initiating research projects within VCNM must be aware of existing data within the BLM and should incorporate these data into projects whenever possible.
- Proposed research within the Paria Canyon-Vermilion Cliffs Wilderness should comply with appropriate laws and regulations including the Wilderness Act of 1964 and BLM wilderness policy (Manual 6340).
  - The “Research and Scientific Activities Toolbox” will be used to guide what types of scientific activities are appropriate in wilderness<sup>5</sup>.
- VCNM, when applicable, will encourage internal and external science inquiries to adopt the BLM’s Assessment, Inventory, and Monitoring (AIM) Strategy (Toevs, Taylor, Spurrier, MacKinnon, & Bobo, 2011).
- Proposed research will follow guidelines in the Department of the Interior’s “Integrity of Scientific and Scholarly Activities” policy establish in Departmental Manual Part 305 Chapter 3.<sup>6</sup>
- External scientific projects must apply for and receive a research permit from the Arizona Strip Field Manager in order to proceed (see section 5.2).

#### 5.2. Authorization and tracking process

- Proposals, including those from the Research and Stewardship Partnership, will be submitted to the VCNM Monument Manager (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 to determine the scientific validity and integrity of the proposal, and potential impacts to resource and resource uses.

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<sup>5</sup> See <http://www.wilderness.net/science>

<sup>6</sup> See <http://elips.doi.gov/elips/0/doc/3045/Page1.aspx>

- The Monument Manager will brief the Arizona Strip Field Manager. In coordination with the Monument Manager, the Field Manager will determine whether the proposal:
  - Is consistent with this Science Plan;
  - Meets VCNM's scientific mission;
  - Conforms with VCNM's RMP;
  - Is consistent with the Paria Canyon-Vermilion Cliffs Wilderness Management Plan (BLM, 1986), if applicable; and,
  - Is consistent with other current and relevant agency laws and regulations.
  - In addition, for proposals from the Research and Stewardship Partnership, the Field 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 Field Manager will provide written notification and justification to the applicant of the decision as soon as practical.
- If the proposal is accepted:
  - The Field Manager will determine what, if any, NEPA analysis is required to carry out inquiry. If a Categorical Exclusion or Environmental Assessment is needed, the Field Manager will assign an Interdisciplinary 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).
  - The Arizona Strip District Wildlife Program Lead will prepare a research permit for the applicant to be approved by the Field Manager.
  - The research permit will be sent to the applicant for review and signature. The permit will be returned to the Field Manager for final signature and approval.
  - Reporting for all scientific investigations will require:
    - Annual progress reports filed with the Monument Manager.
    - A final report that includes an executive summary, research background and results; results' relevancy to VCNM 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 Field Manager.

## **6. Organization and Communications of Completed Science**

### **6.1. Internal Communications**

- 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 Arizona Strip District. The Monument Manager should strive to organize periodic presentations of scientific results to District staff.

### **6.2. 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.

### **6.3. Communication of Scientific Results to the Public**

- The Monument Manager, in coordination with the Arizona Strip District Public Affairs Officer, will strive to make information on science projects within VCNM accessible to the general public. This includes posting updates on VCNM'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 tumblr; brown bag lunch presentations; leading field tours; participating in community outreach events, etc.

## **7. Integrating Science into Management**

7.1. Direct communication between scientists, Monument Manager, Arizona Strip Field Manager, and the Arizona Strip District Manager will be encouraged. It is the responsibility of the Monument Manager to ensure that scientific findings are communicated to the Field 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 VCNM.

7.2. The Kane and Two Ranches Applied Research Plan outlines mechanisms for integrating science and research into management (page 47). Those mechanisms and approaches are incorporated by reference into this plan.

7.3. Integrating scientific findings into management decisions should not end scientific inquiry into a specific topic. In fact, using science in the decision making process should provide an opportunity to identify future science needs to adaptively manage for certain objectives. For example, scientific inquiries into recreation impacts on natural resources and social settings in Coyote Buttes and Paria Canyon could yield information that could change the number of people allowed into the permit area (currently 20 people/day are allowed).

#### **8. Science Plan Review and Approval**

This plan will be used as the basis for conducting science in VCNM. “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 VCNM and BLM.

Kevin Wright  
Monument Manager  
Vermilion Cliffs National Monument

Matt Preston  
NLCS Science Coordinator  
Washington Office

Lorraine M. Christian  
Field Office Manager  
Arizona Strip Field Office

Nikki Moore  
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## Appendix 1

### **Proclamation 7374—Vermilion Cliffs National Monument**

*November 9, 2000*

*By the President of the United States of America*

#### ***A Proclamation***

Amid the sandstone slickrock, brilliant cliffs, and rolling sandy plateaus of the Vermilion Cliffs National Monument lie outstanding objects of scientific and historic interest. Despite its arid climate and rugged isolation, the monument contains a wide variety of biological objects and has a long and rich human history. Full of natural splendor and a sense of solitude, this area remains remote and unspoiled, qualities that are essential to the protection of the scientific and historic objects it contains.

The monument is a geological treasure. Its centerpiece is the majestic Paria Plateau, a grand terrace lying between two great geologic structures, the East Kaibab and the Echo Cliffs monoclines. The Vermilion Cliffs, which lie along the southern edge of the Paria Plateau, rise 3,000 feet in a spectacular escarpment capped with sandstone underlain by multicolored, actively eroding, dissected layers of shale and sandstone. The stunning Paria River Canyon winds along the east side of the plateau to the Colorado River. Erosion of the sedimentary rocks in this 2,500 foot deep canyon has produced a variety of geologic objects and associated landscape features such as amphitheaters, arches, and massive sandstone walls.

In the northwest portion of the monument lies Coyote Buttes, a geologically spectacular area where crossbeds of the Navajo Sandstone exhibit colorful banding in surreal hues of yellow, orange, pink, and red caused by the precipitation of manganese, iron, and other oxides. Thin veins or fins of calcite cut across the sandstone, adding another dimension to the landscape.

Humans have explored and lived on the plateau and surrounding canyons for thousands of years, since the earliest known hunters and gatherers crossed the area 12,000 or more years ago. Some of the earliest rock art in the Southwest can be found in the monument. High densities of Ancestral Puebloan sites can also be found, including remnants of large and small villages, some with intact standing walls, fieldhouses, trails, granaries, burials, and camps.

The monument was a crossroad for many historic expeditions. In 1776, the Dominguez-Escalante expedition of Spanish explorers traversed the monument in search of a safe crossing of the Colorado River. After a first attempt at crossing the Colorado near the mouth of the Paria River failed, the explorers traveled up the Paria Canyon in the monument until finding a steep hillside they could negotiate with horses. This took them out of the Paria Canyon to the east and up into the Ferry Swale area, after which they achieved their goal at the Crossing of the Fathers east of the monument. Antonio Armijo's 1829 Mexican trading expedition followed the Dominguez route on the way from Santa Fe to Los Angeles.

Later, Mormon exploring parties led by Jacob Hamblin crossed south of the Vermilion Cliffs on missionary expeditions to the Hopi villages. Mormon pioneer John D. Lee established Lee's Ferry on the Colorado River just south of the monument in 1871. This paved the way for homesteads in the monument, still visible in remnants of historic ranch structures and associated objects that tell the stories of early settlement. The route taken by the Mormon explorers along the base of the Paria Plateau would later become known as the Old Arizona Road or Honeymoon Trail. After the temple

in St. George, Utah was completed in 1877, the Honeymoon Trail was used by Mormon couples who had already been married by civil authorities in the Arizona settlements, but also made the arduous trip to St. George to have their marriages solemnized in the temple. The settlement of the monument area by Mormon pioneers overlapped with another historic exploration by John Wesley Powell, who passed through the monument during his scientific surveys of 1871.

The monument contains outstanding biological objects that have been preserved by remoteness and limited travel corridors. The monument's vegetation is a unique combination of cold desert flora and warm desert grassland, and includes one threatened species, Welsh's milkweed. This unusual plant, known only in Utah and Arizona, colonizes and stabilizes shifting sand dunes, but is crowded out once other vegetation encroaches.

Despite sporadic rainfall and widely scattered ephemeral water sources, the monument supports a variety of wildlife species. At least twenty species of raptors have been documented in the monument, as well as a variety of reptiles and amphibians. California condors have been reintroduced into the monument in an effort to establish another wild population of this highly endangered species. Desert bighorn sheep, pronghorn antelope, mountain lion, and other mammals roam the canyons and plateaus. The Paria River supports sensitive native fish, including the flannelmouth sucker and the speckled dace.

Section 2 of the Act of June 8, 1906 (34 Stat. 225, 16 U.S.C. 431) authorizes the President, in his discretion, to declare by public proclamation historic landmarks, historic and prehistoric structures, and other objects of historic or scientific interest that are situated upon the lands owned or controlled by the Government of the United States to be national monuments, and to reserve as a part thereof parcels of land, the limits of which in all cases shall be confined to the smallest area compatible with the proper care and management of the objects to be protected.

**Whereas** it appears that it would be in the public interest to reserve such lands as a national monument to be known as the Vermilion Cliffs National Monument:

**Now, Therefore, I, William J. Clinton**, President of the United States of America, by the authority vested in me by section 2 of the Act of June 8, 1906 (34 Stat. 225, 16 U.S.C. 431), do proclaim that there are hereby set apart and reserved as the Vermilion Cliffs National Monument, for the purpose of protecting the objects identified above, all lands and interests in lands owned or controlled by the United States within the boundaries of the area described on the map entitled "Vermilion Cliffs National Monument" attached to and forming a part of this proclamation.

The Federal land and interests in land reserved consist of approximately 293,000 acres, which is the smallest area compatible with the proper care and management of the objects to be protected.

All Federal lands and interests in lands within the boundaries of this monument are hereby appropriated and withdrawn from all forms of entry, location, selection, sale, or leasing or other disposition under the public land laws, including but not limited to withdrawal from location, entry, and patent under the mining laws, and from disposition under all laws relating to mineral and geothermal leasing, other than by exchange that furthers the protective purposes of the monument. For the purpose of protecting the objects identified above, the Secretary shall prohibit all motorized and mechanized vehicle use off road, except for emergency or authorized administrative purposes.

Lands and interests in lands within the proposed monument not owned by the United States shall be

reserved as a part of the monument upon acquisition of title thereto by the United States.

The Secretary of the Interior shall manage the monument through the Bureau of Land Management, pursuant to applicable legal authorities, to implement the purposes of this proclamation.

The Secretary of the Interior shall prepare a transportation plan that addresses the actions, including road closures or travel restrictions, necessary to protect the objects identified in this proclamation.

The establishment of this monument is subject to valid existing rights.

Nothing in this proclamation shall be deemed to enlarge or diminish the jurisdiction of the State of Arizona with respect to fish and wildlife management.

This proclamation does not reserve water as a matter of Federal law.

Nothing in this reservation shall be construed as a relinquishment or reduction of any water use or rights reserved or appropriated by the United States on or before the date of this proclamation. The Secretary shall work with appropriate State authorities to ensure that any water resources needed for monument purposes are available. Laws, regulations, and policies followed by the Bureau of Land Management in issuing and administering grazing permits or leases on all lands under its jurisdiction shall continue to apply with regard to the lands in the monument.

Nothing in this proclamation shall be deemed to revoke any existing withdrawal, reservation, or appropriation; however, the national monument shall be the dominant reservation. Warning is hereby given to all unauthorized persons not to appropriate, injure, destroy, or remove any feature of this monument and not to locate or settle upon any of the lands thereof.

**In Witness Whereof**, I have hereunto set my hand this ninth day of November, in the year of our Lord two thousand, and of the Independence of the United States of America the two hundred and twenty-fifth.

**William J. Clinton**

[Filed with the Office of the Federal Register,  
8:46 a.m., November 13, 2000]

NOTE: This proclamation was published in the *Federal Register* on November 15. This item was not received in time for publication in the appropriate issue.

## Appendix 2: Contact Information

	Name	Title	Phone	Address	Email
<b>Science Coordinator</b>	Kevin Wright	Monument Manager (VCNM)	435-688-3241	345 E Riverside Dr. St. George, UT 84790	<a href="mailto:kjwright@blm.gov">kjwright@blm.gov</a>
<b>Arizona Strip District Research Coordinator</b>	Jeff Young	Arizona Strip District Wildlife Biologist	435-688-3373	345 E Riverside Dr. St. George, UT 84790	<a href="mailto:j8young@blm.gov">j8young@blm.gov</a>
<b>Authorized Officer</b>	Lorraine Christian	Arizona Strip Field Office Manager	435-688-3323	345 E Riverside Dr. St. Georg, UT 84790	<a href="mailto:lmchrist@blm.gov">lmchrist@blm.gov</a>