Giant Sequoia National Monument

Specialist Report

Signature: _____

Date: _____

GEOLOGIC RESOURCES REPORT

Introduction

The Giant Sequoia National Monument (Monument) has many geologic features and landforms that include caves, hot springs, soda springs, domes, spires and glacial moraines. Paleontological features may also be present within the Monument. The Clinton proclamation specifically identifies limestone caverns and other geologic features, including granite domes, spires, geothermal produced hot springs and soda springs, and the mix of glacial and river-carved gorges. The Clinton proclamation further identifies paleontological resources in meadow sediments, and other sources that have recorded ecological changes such as fire regimes, volcanism, vegetation, and climate.

The Clinton proclamation describes caves and other special geologic resources as follows:

> The monument is dominated by granitic rocks, most noticeable as domes and spires in areas such as the Needles. The magnificent Kern Canyon forms the eastern boundary of the monument's southern unit…Particularly in the northern unit of the monument, limestone outcrops, remnants of an ancient seabed, are noted for their caves (2000, p. 24096).

This document describes geologic features within the Monument as defined by the Clinton Proclamation and assesses potential indirect and cumulative affects to these geologic features from the alternatives proposed. This assessment is intended to be used in the draft EIS describing the effects of the proposed action and alternative proposals to manage the Monument.

Current Management Direction

Current management direction for caves and other geologic features allows for open access to these sites by the public, with the exception of Boyden Cave and Church Cave. Boyden Cave is currently managed as a commercially developed cave under a special use permit and allows the public to view the cave along a designated route on a fee basis. Current management of Church Cave allows for limited access into the cave by authorized leaders and pre-approved parties. Each trip has to be approved with an access permit and allows access on pre-approved routes. Monitoring of Church Cave has occurred over the years to determine if the cave is being used in compliance with the permit.

Open access is allowed to other caves and other geologic features, including granite domes, spires, geothermal produced hot springs and soda springs, and the glacial and river-carved gorges. Management of paleontological resources has not been identified in the past, as paleontological resources have not been identified or inventoried to manage, even on a limited basis.

Description of Proposal

The Clinton proclamation notes that geological features, as well as paleontological resources, are some of the objects of interest for which the Monument was established. These features will be emphasized by designating the Windy Gulch Geologic Special Interest Area. The Proclamation withdraws all Monument lands from "locating, 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" (Clinton 2000, page 24097). The following are desired conditions, strategies, objectives, standard and guidelines for the managing the proposed Windy Gulch Geologic Special Interest Area and other geologic objects of interest within the Monument.

Desired Conditions

Geological Resources

Geological features are protected while providing for public use and enjoyment of these resources.

Paleontological Resources

Paleontological resources retain the components providing the fossil record.

Strategies

Geological Resources

1. Identify areas where domes, spires, soda springs, and hot springs are located and can be used by recreationists, while protecting and preserving these sites.

2. Enhance opportunities for interpretation and education, including brochures and signs, of geological resources (cave ecosystems, domes, and spires).

3. Keep Church Cave and Boyden Cave open for public use under an appropriate permit system.

4. Identify and minimize potential geologic hazards including flood hazards, landslide hazards, and naturally-occurring asbestos (NOA) hazards within the Monument.

Paleontological Resources

1. Retain areas of significant sedimentation and meadow vegetation deposits.

2. During cave inventories, conduct paleontological evaluations of any fossilized material found.

3. Determine whether any paleontological areas need to be proposed for designation as stated in Forest Service Manual Section 2370.

Objectives

Geological Resources

1. In 5 years, complete an inventory of the known caves within the Monument to assess geologic features and their hydrologic characteristics, safety hazards, biological, archaeological, and paleontological resources, to make a determination of significance. Use this information to develop site-specific standards and guidelines for cave management.

2. On an annual basis, evaluate the condition of Church Cave and Boyden Cave, ensuring gates are secured and cave features are protected.

3. In 5 years, develop a cave management plans, as appropriate, for caves within the Monument.

Paleontological Resources

1. Within 5 years, conduct a survey to identify the location and type of paleontological resources in the Monument, focusing on areas most likely to contain these resources. Use survey data to evaluate risk factors to these resources.

Affected Environment

The Monument is located in the Sierra Nevada Geomorphic Province and includes two areas. The northern area of the Monument is located along the Kings Canyon, which has the distinction of being considered deeper than the Grand Canyon. The southern area of the Monument is located along the Kern Canyon, where the Kern Canyon Fault is exposed on the east side of the canyon walls. The Little Kern River and the Great Western Divide are located northeast of the junction of the Monument boundary and the Kern Canyon. This area offers spectacular views of the Little Kern Plateau, Little Kern Volcanic Field, and the Needles. These areas offer unique areas for geologic interpretation.

The geology within the Monument consists of four major geologic groups: (1) Mesozoic granitic rocks, (2) late Paleozoic-Mesozoic Kings River Metamorphic Roof Pendants, 3) Tertiary Volcanic Deposits and (4) Quaternary glacial deposits and recent alluvial and colluvial deposits. Mesozoic granitic rocks are the dominant rocks types within the Monument boundary and consist of several plutons that are approximately 100 million years old (Moore and Nokleberg 1992). The metamorphic rocks are known as the Kings Terrain and the most extensive of these areas is the Lower Kings River roof pendants and the Kaweah River and Tule River roof pendants (Nokleberg 1983). The Lower Kings River Roof Pendant includes the Boyden Cave roof pendant and it is located in the south end of the Monument in the Windy Gulch area. Several caves including Boyden Cave and Church Cave are located in marbles of the Boyden cave roof pendant. Tertiary volcanic rocks are located throughout the Monument with the most extensive outcrops located in the north end of the monument: near Hume Lake; Indian Creek; on both sides of the McKenzie Ridge; and between Pyles Camp and Capital Rock. Quaternary glacial deposits are located in the north end of the monument in Windy Gulch Grove, Evans Grove and Kennedy Grove. The glacial deposits are mostly in the form of ground moraines and lateral moraines.

Caves

The Monument contains several caves that are located primarily in kings terrain metamorphic roof pendants. The kings terrain consists of Triassic and Jurassic metamorphosed sedimentary rocks and sparse intermediate to silicic metavolcanic rocks. The dominant rock types in the kings terrain are phyllite, quartzite, schist, marble, gneiss and metavolcanic rocks (Matthews and Burnett 1965, Nokleberg 1983). The marble is a metamorphosed limestone that is conducive to the formation of caves, and carbonate endemic flora and fauna may be present. Caves are found where stream channels cross the marble outcrop. This marble dissolves in Sierra Nevada waters and, if a marble outcrop is subjected to stream flow, a cave can result.

The location of fifteen caves is known. These include Boyden Cave, Church Cave, and several named and unnamed caves (USDA Forest Service 2004). Most of the known caves are located in the Hume Lake Historic Area Windy Gulch Area. There are possibly as many as 100 caves located in the Monument (Despaine, personal communication). No caves have gone through the process of being evaluated as “significant” under the Federal Cave Resource Protection Act of 1988.

Boyden Cave is a commercially developed cave that is operated under a special use permit. The operators of the cave offer a 40-minute walking tour between April and November. Approximately 35,000 people visit the cave each year. A survey of Boyden Cave is nearly completed, with 0.63 miles of mapped cave features. This cave contains outstanding karst features including stalagtites, stalagmites, and flow sheets.

As of 1997, the Southern California Grotto had surveyed up to 3.45 miles of the cave, and there are still many openings to explore and survey. The passages of Boyden Cave come within 400 feet of Church Cave. Current management of Church Cave allows for limited access into the cave by authorized leaders and pre-approved parties. Each trip has to be approved with an access permit. Church Cave is available to a limited list of authorized leaders to lead parties into the cave. Each trip has to be approved with an access permit.

Access to Bear Cave and Windy Cave has been blocked to protect the features in these caves. Forest Service and National Park Service personnel know of several other caves, but their locations have not been formally documented. A cave survey has not yet been completed.

Some caves in the Monument are unique in that they contain paleontological information from the last 50,000 years. These caves contain information on the prehistory of the giant sequoias that is important to understand the paleoecology of this species. Some of these caves were used by prehistoric people as attested to by petroglyphs near cave openings.

Caves are prime habitat for some wildlife species, including forest sensitive species such as the Townsend's big-eared bat, spotted bat, and pallid bat. Other bats use caves for hibernation and breeding and include the little brown myotis, Yuma myotis, California myotis, and big brown bat. Other rare and endemic species found in caves include spiders, other invertebrate species, tight coin snails, packrats, and cave-dwelling salamanders.

Caves offer good opportunities for recreation and education if their resources can be protected. Boyden Cave is a good example of a recreational cave where cave ecology can be studied by the general public.

Monitoring of caves has been minimal and has included assessments to determine direct visitor impacts to Boyden and Church Cave. The results of this monitoring has found damage to gates, discarding of bagged human waste left in passages, and some damage to speleothemes in Church Cave.

Domes and Spires

Several domes and spires are located on the Monument. These domes and spires are landforms that have developed from speroidal weathering and exfoliation of layers of rock along sheet joints, similar to layers of an onion. Spires have developed in a similar way, except spires have formed from rocks falling and collapsing along vertical joints. This process has resulted in domes and spires. Domes and spires are located throughout the Monument. These domes and spires are popular rock climbing areas and are spectacular geologic features. The most popular domes and spires are located in the southern portion of the Monument, including the Needles, Buck Rock, Dome Rock,Chimney Rock, Sentinel Peak, and Elephant Knob. There are a many domes and spires in the Monument, too numerous to list here.

Soda and Hot Springs

Several soda springs and hot springs are located within the Monument. There are approximately 65 springs included in the Monument GIS Database. Some of these springs may be influenced by geothermal activity and may be hot or warm. Spring inventory data has not been conducted to make this determination. There are five soda springs associated with tufa deposits, located in the Middle Fork Tule River and South Fork Tule River.

Paleontological Resources

Paleontological resources have not been identified or inventoried within the Monument, other than invertebrate fossils, such as crinoids, fusulinid, and ammonites, found within metamorphic rocks in the Monument. These fossils have been used to date the age of the metamorphic rocks. There have been no inventoried fossils in meadow sediments or caves within the Monument.

Environmental Effects

Direct Effects

There are no direct effects because the alternat5ives are establishing programmatic direction and they are not proposing any site-specific projects.

Indirect Effects

The environmental effects to caves from activities that are proposed in the alternatives vary depending on the emphasis of the alternative. All of the alternatives will include some form of vegetation management, prescribed burning, managed wildfire, and recreation. These activities could affect air quality, groundwater geochemistry and sediment levels in caves. In addition, cave resources that include cave fauna and flora, paleontological, and archaeological resources, and speleogens and speleothems could be affected. Other geologic objects of interest could also be affected by the proposed activities.

Caves

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Vegetation Management

Vegetation management includes thinning out and/or removal of vegetation with mechanical equipment. The result of this treatment is disturbance to soil in the form of reduced soil porosity (soil compaction) and decreased ground cover. During rainfall and snow melt events, erosion could accelerate and sediment delivery rates could increase. Increased sediment rates in areas that drain into caves could result in additional sediment deposits over and beyond the normal range of distribution of sediment deposition in cave systems. Cave systems could become inundated with sediment and cave resources could be damaged. Habitat for cave flora

and fauna could be changed and result in lower populations (for more information, see the wildlife environmental effects of the draft EIS).

Managed Wildfire and Prescribed Burning

Prescribed burning includes burning activity-created fuels (slash generated from mechanical treatment of vegetation) and natural fuels (standing and down vegetation) that are in a condition that will burn from prescribed fires and managed wildfires. Managed wildfires and prescribed fires are designed to meet resource objectives that include reducing fuels and protecting resources that could get damaged from fire. Fire prescriptions are such that fire creeps down hills and up slope and consumes dead and live vegetation, and soil duff and litter. Most areas with low burn intensity will have at least 50 percent ground cover and damage to soil is relatively minor. During the initial prescribed burn, some small areas with heavy fuels will flare up and result in moderate to high burn intensities. These small pockets could result in low ground cover and damaged soils. Prescribed fire will be allowed to creep down into stream side management zones where the fire will mostly consume ground vegetation or go out because of cooler, moister conditions. Some caves are located in stream side management zones and in watersheds where prescribed burning will probably occur. Maintenance of fuels through secondary prescribed burning will have fewer moderate to high burn intensities.

The result of prescribed fire is reduced soil cover and changes to the biogeochemistry of soil and organic matter. During rainfall and snow melt events erosion could accelerate and increased sediment and residual matter from the fire will be transported. Some of this transported residual matter could enter and deposit in cave systems. Sediment could deposit in cave channels and inundate cave resources. In addition, the biogeochemistry of sediment and residue could be changed as a result of fire. This change in the biogeochemical characteristics of sediment and residue and its effect on cave resources is unknown at this time. This is an unknown impact and should be evaluated in the monitoring plan. Soil strategies and best management practices in all alternatives should provide for enough ground cover and protection of the streamside management zone regardless of the alternative that is selected.

Managed wildfire and prescribed fire generates smoke that moves in the direction of prevailing winds. Some caves that have multiple openings have drafts that move air in one direction. There is a possibility that smoke from prescribed fire could move through a cave system and impact cave resources. As fire moves upslope and down slope vegetation near cave entrances could burn. Fire near cave entrances could result in scorching, cracking and failure of the rock surface at the cave entrance. This could result in negative impacts to cave resources including archaeological resources.

Potential impacts from managed wildfire could include widespread, high burn intensity areas that could burn in watersheds where caves are located. The greatest risk of this occurring is in Alternative D, and to a slightly lesser degree in Alternative C. A cave management plan will be developed, regardless of alternative chosen. This plan will provide protection to this resource.

Recreation

Recreation operations with the potential to affect caves include expanding and constructing new campgrounds, extending existing trails, maintaining existing trails and roads, and constructing new trails and roads. Septic systems are used in campground facilities to treat human-generated waste. Depending on the location of these septic systems, ground water that moves through caves could be contaminated. This contaminated groundwater could negatively impact cave resources. Encouraging more people to use trails in the vicinity of caves could result in unauthorized access into caves. This unauthorized access could negatively impact cave resources. Unmanaged access into caves by recreationists could result in damage to caves including:

broken speleothemes, graffiti in cave walls or cave entrances, human waste left in the cave, tarnished or disturbed cave walls and floors from people touching or walking on these surfaces. Over time and with many people accessing these caves, there could be cumulative cave damage. The highest potential for impacts to caves to occur is in Alternatives A, D, and E. These alternatives allow open cave access to all caves except Boyden Cave and Church Cave. Boyden Cave is managed under a special use permit and provides protection to the cave. Church Cave allows access by an access permit only and a minimum of monitoring is conducted. It is unknown if other caves are accessed and if damage is occurring in these caves.

Other Proposed Management Strategies

There are no known indirect or cumulative impacts from the proposed watershed management, soil management, cultural resource management, transportation management, special area management, or management of paleontological resources, to cave resources in any of the alternatives.

Domes and Spires

Wildfire suppression potential impacts from wildfire suppression includes fire retardant drops on domes and spires. At a minimum, this effects the color of the natural rock on the natural geologic feature. Natural weathering of fire retardant could take decades to be removed. Wildfire suppression efforts in past fires on the Sequoia National Forest has resulted in fire retardant drops on existing domes and spires.

Recreation

Potential impacts from recreation activities to domes and spires, include climbing hardware left in rocks where the sport is popular. These popular areas include the Needles, Buck Rock, Dome Rock,Chimney Rock, Sentinel Peak, and Elephant Knob and the many more domes and spires in the Monument that are too numerous to list here. Hardware, including bolts drilled into the rock face and webbing material used to create anchors, provide some level of protection to a rock climber. Drilling or wedging anchors into the rock face has less impact on any feature of the dome or spire.

Other Proposed Management Strategies

There are no known indirect or cumulative impacts from the proposed vegetation management, fuels management, watershed management, soil management, cultural resource management, transportation management, special area management, or management of paleontological resources to domes and spires.

Soda Springs and Hot Springs

Recreation

Potential impacts to soda springs and hot springs could occur from increased recreation activity. This could include open access to these resources by recreationists. Standard and guidelines for watershed management, including aquatic management strategies, riparian conservation objectives, streamside management zones, and best management practices should protect soda springs and hot springs in all the alternatives.

Other Proposed Management Strategies

There are no known indirect or cumulative impacts from the proposed vegetation management, fuels management, watershed management, soil management, cultural resource management, transportation

management, special area management, or management of paleontological resources to soda springs and hot springs.

Paleontological

Potential impacts to paleontological resources within meadow sediments are unlikely to occur from any proposed management strategy. Standard and guidelines for watershed management, including aquatic management strategies, riparian conservation objectives, streamside management zones, and best management practices should protect soda springs and hot springs in all the alternatives.

There are some potential impacts to paleontological resources within caves. The highest potential for potential impacts to paleontological resources within caves is in Alternatives A, D and E. These alternatives allow open cave access to all caves except Boyden Cave and Church Cave. A cave management plan will be developed, regardless of alternative chosen, and will include management of paleontological resources within caves. This plan will provide protection to this resource.

Cumulative Effects

There are no direct and minimal indirect effects to geological resources from the proposed alternatives. A number of standards and guidelines are in place to minimize potential effects on geological resources as well. Therefore, considering the current conditions, reasonably foreseeable actions, and the potential direct and indirect effects of the proposed alternatives, there are few cumulative effects, as described below.

Caves

Continuous access and use of caves could result in degradation of cave resources. Single access of one cave may not result in effects to cave resources, but multiple access of a single cave could result in a cumulative effect to the cave resources. For example, multiple trails in caves could damage wildlife habitat and disturb wildlife. Touching the walls of caves could leave residual matter that over time could have a visual impact. Lint, hair, skin cells, and other residual matter could result in an adverse biological change to the cave. In addition, multiple disturbances within the drainage area of a cave entrance could result in sedimentation of the cave. These disturbances could include wildfire, prescribed fire, fire salvage, and mechanical treatment of vegetation.

There are no known cumulative impacts from the proposed watershed management, soil management, cultural resource management, transportation management, special area management, or management of paleontological resources to cave resources in any of the alternatives. All alternatives provide for the development of a cave management plan.

Domes and Spires

There are no known cumulative impacts from the proposed vegetation management, fuels management, watershed management, soil management, cultural resource management, transportation management, special area management, or management of paleontological resources to domes and spires.

Soda Springs and Hot Springs

There are no known cumulative impacts from the proposed vegetation management, fuels management, watershed management, soil management, cultural resource management, transportation management, special area management, or management of paleontological resources to soda springs and hot springs.

Standards and Guidelines and Monitoring

Effects on geological resources affect the following objects of interest identified in the Proclamation:

- The limestone caverns and other geologic features, including granite domes, spires, geothermally-produced hot springs and soda springs, and glacial and river-carved gorges.

The standards and guidelines for geological resources displayed in Appendix A are designed to protect, identify, and study these objects of interest.

The monitoring plan developed for the Monument, as described in Part 3, Design Criteria, of the Monument Plan, contains implementation, effectiveness, validation, and status and trend monitoring for Caves. Plan monitoring is conducted to evaluate plan implementation and its effectiveness in meeting management strategies and objectives, in particular protecting the objects of interest and restoring ecosystems. Data collected and analyzed inform specialists and managers of any additional effects from management activities and the need for restoration. For example, monitoring will help determine if caves are affected by management activities, if gates are secured, and if cave features are protected (e.g., change in condition of Church and Boyden Caves).

Legal and Regulatory Compliance

The following laws apply to the management of geologic resources:

Cave management is conducted under the Federal Cave Resources Protection Act of 1988 (102 Stat. 4546; 16 U.S.C. 4301 et seq). This act provides that Federal lands be managed to protect and maintain, to the extent practical, significant caves.

National Environmental Policy Act of January 1, 1970 (NEPA) (83 Stat. 852 as Amended; 42 U.S.C. 4321, 4331-4335, 4341-4347) (FSM 1950.2). This act directs all agencies of the Federal Government to utilize a systematic interdisciplinary approach which will ensure the integrated use of the natural and social sciences in planning and in decision making which may have an impact on man's environment. Geology is one of the applicable sciences.

Wild and Scenic Rivers Act of October 2, 1968 (82 Stat. 906 as Amended; 16 U.S.C. 1271-1287. This act states that it is the policy of the United States that certain selected rivers of the Nation which, with their immediate environments, possess outstanding scenic, recreation, geologic, fish and wildlife, cultural, or other similar values shall be preserved in free-flowing condition.

Forest and Rangeland Renewable Resources Planning Act of August 17, 1974 (RPA) (88 Stat. 476; 16 U.S.C. 1600-1614) as Amended by National Forest Management Act of October 22, 1976 (90 Stat. 2949; 16 U.S.C. 1609) (FSM 1920 and FSM 2550). This act requires consideration of the geologic environment through the identification of hazardous conditions and the prevention of irreversible damages. The Secretary of Agriculture

is required, in the development and maintenance of land management plans, to use a systematic interdisciplinary approach to achieve integrated consideration of physical, biological, economic, and other sciences.

National Forest Roads and Trails Systems Act of October 13, 1964 (78 Stat. 1089; 16 U.S.C. 532-538) (FSM 7701.1). This act provides for the construction and maintenance of an adequate system of roads and trails to meet the demands for timber, recreation, and other uses. It further provides that protection, development, and management of lands will be under the principles of multiple use and sustained yield of product and services (16 U.S.C. 532). Geologic conditions influence the final selection of route locations.

Organic Administrative Act of June 4, 1897, as Amended (30 Stat. 34, as Supplemented and Amended; 16 U.S.C. 473-478, 482-482(a), 551 (FSM 2501.1). This act authorizes the Secretary of Agriculture to issue rules and regulations for the occupancy and use of the National Forests. This is the basic authority for issuing special use permits for the collection of vertebrate paleontological resources for scientific and educational purposes on National Forest System lands.

Archeological and Historical Conservation Act of 1974 (AHCA) (88 Stat. 174; 16 U.S.C. 469) (FSM 2361.01). This act requires all Federal agencies to notify the Secretary of the Interior when a construction project threatens to irreparably harm or destroy significant scientific, prehistoric, historic, or archeological data. The paleontological resource may have significant scientific and historic value.

Preservation of American Antiquities Act of June 8, 1906 (34 Stat. 225; 16 U.S.C. 431 et seq.) (FSM 2361.01). This act authorizes permits for archeological and paleontological exploration involving excavation, removal, and storage of objects of antiquity or permits necessary for investigative work requiring site disturbance or sampling which results in the collection of such objects.

Vertebrate Paleontological Resources Protection Act of 2002. This act provides for management and protection of paleontological resources on Federal lands using scientific principles and expertise. The act provides for the development of appropriate plans for inventory, monitoring, and the scientific and educational use of paleontological resources, in accordance with applicable agency laws, regulations, and policies. These plans shall emphasize interagency coordination and collaborative efforts where possible with non-Federal partners, the scientific community, and the general public.

Federal Water Pollution Control Act of July 9, 1956, as Amended (33 U.S.C. 1151) (FSM 2501.1); Federal Water Pollution Control Act Amendments of 1972 (86 Stat. 816) (FSM 2501.1), and Clean Water Act of 1977 (91 Stat. 1566; 33 U.S.C. 1251). (FSM 2501.1, 7440.1). These acts are intended to enhance the quality and value of the water resource and to establish a national policy for the prevention, control, and abatement of water pollution. Groundwater information, including that concerning recharge and discharge areas, and information on geologic conditions that affect ground water quality are needed to carry out purposes of these acts.

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Federal Documents:

The Federal Cave Protection Act of 1988

Significant Cave Criteria (43 CFR Part 37.11(c))