BIOLOGICAL ASSESSMENT

Fiscal Year 2007 Prescribed Fire Plan
Mammoth Cave National Park, Kentucky

INTRODUCTION

The purpose of this Biological Assessment (BA) is to evaluate the effects on federal threatened, endangered, proposed, and candidate species related to implementation of the Annual Prescribed Fire Work Plan developed for 2007.

Mammoth Cave National Park completed a Fire Management Plan in December 2001 for the purpose of managing fire, including prescribed fire, within Mammoth Cave National Park. The approved plan meets policy and other requirements and includes a five-year prescribed fire schedule for the years 2002-2006, which was amended to include the prescribed fire work plan for 2007. An annual prescribed fire plan is developed to define the work that will be done within the next year.

In June 2001, Mammoth Cave National Park initiated informal consultation with the U.S. Fish and Wildlife Service concerning the proposed Fire Management Plan. Consultation was completed in October 2001. The Environmental Assessment was completed following consultation and a Finding of No Significant Impact (FONSI) was signed on December 5, 2001. The Fire Management Plan was also approved on December 5, 2001, and includes a five-year implementation plan for 2002-2006 (amended to include 2007). The park agreed during the consultation process to develop annual work plans and submit them to the U.S. Fish and Wildlife Service under Section 7 of the Endangered Species Act, as amended.

The annual work plan for 2006 was only partially completed. Two burns were not completed at Prescribed Fire Area (PFA) N9A (Big Woods, 1,540 acres) and PFA S11A, B, & C (Dennison Ferry, 790 acres). Accordingly, the Five-Year Prescribed Fire Plan for Fiscal Years 2002-2006 has been amended in an effort to complete the identified work elements of the plan by the end of 2007. The Annual Work Plan for FY 2007 has been adjusted to include the PFA's that were not burned in FY 2006, i.e., PFA N9A Big Woods, (1,540 acres) and PFA S11A, B, & C Dennison Ferry, (790 acres). The Work Plan for FY 2007 also includes the addition and expansion of PFA S7C (Chaumont South, 17 acres) and S7D (Chaumont North, 31 acres) to 85 acres. Chaumont North and South should be considered as a single unit with the FY 2007 scheduled PFA N9A, Big Woods of 1,540 acres and S11A, B, & C, Dennison Ferry of 790 acres. The FY 2007 Work Plan goal in terms of acres amounts to 2,415 acres. Maps of the planned prescribed fire areas are attached.

The total area included in the 2006 Annual Work Plan was 2,443 acres. In FY 2006 we were able to burn PFA Floating Mill Hollow.

The acreage included in each PFA has been increased from the original published targets to improve firefighter safety and to reduce the impact of fire line construction. The principal modifications include the expansion of Dennison Ferry PFA, S11A, S11B, and S11C and Chaumont PFA S7C and S7D. The original Dennison Ferry areas would have required extensive construction of mid-slope fire lines. The original Chaumont areas were expanded to more efficiently utilize natural and man-made barriers and decrease the amount of mid-slope fire line construction. The Big Woods PFA (N9A) was expanded to utilize natural and man-made barriers. Mid-slope fire lines involve much more disturbance to install because they must be wider to account for fire behavior on ridge sides.

The park is located in portions of Barren, Edmonson, and Hart Counties in Kentucky. The U.S. Fish and Wildlife Service identified the species that should be considered by letter dated October 24, 2001.[1] A number of other species that were considered in the Biological Assessment for the Fire Management Plan are not considered in this document because they are not known to be present within the park. Further, during preparation of this 2007 Biological Assessment for the Annual Prescribed Fire Plan for 2007, the situation was reviewed with the conclusion that there was no new or additional information, which was not previously considered, that would indicate those species are present within Mammoth Cave National Park. The following list identifies the species considered in this BA.

Listed Endangered Species

Indiana Bat	*Myotis sodalis*[2]
Gray Bat	*Myotis grisescens*
Kentucky Cave Shrimp	*Palaemonias ganteri*[2]
Rough Pigtoe Pearly Mussel	*Pleurobema plenum*
Clubshell	*Pleurobema clava*
Ring Pink	*Obovaria retusa*
Fanshell	*Cyprogenia stegaria*
Northern Riffleshell	*Epioblasma torulosa rangiana*
Pink Mucket	*Lampsilis abrupta*

Listed Threatened Species

Bald Eagle	*Haliaeetus leucocephalus*

Proposed Species

none

Candidate Species

Surprising Cave Beetle	*Pseudanopthalmus inexpectatus*

[1] Barclay, Lee A. Field Supervisor, U.S. Fish and Wildlife Service, Kentucky/Tennessee Field Office. Letter to Ronald R. Switzer, Superintendent, Mammoth Cave National Park. October 24, 2001.

[2] Critical habitat has been established within the park for these species.

DESCRIPTION OF THE PROPOSED ACTION

The Prescribed Fire Areas included in the fiscal year 2007 plan are Big Woods (N9A), Dennison Ferry Complex (S11A, S11B, and S11C), and Chaumont Complex (S7C and S7D). The three Dennison Ferry units will be combined into one unit. Similarly, the two Chaumont units will be combined into one unit.

Fire Management Objectives

In addition to promoting natural conditions and processes, prescribed fires would meet the following identified objectives. Additional site specific objectives will be identified for each prescribed fire area.

- Assist in the control of invasive and exotic plants such as *Rosa multiflora* (multifolora rose,) and *Lonicera japonica* (Japanese honeysuckle).
- Maintain and enhance diversity of park ecotone (transitional areas) and barren communities.
- Enhance and maintain populations of plant species that require fire and/or open habitat as a component of their life cycle and reproduction.
- Maintain and enhance Eggert's sunflower habitat and population densities. Even though this species was de-listed as threatened in 2005, enhancing the population is favorable.
- Maintain and enhance bat foraging habitat, with an emphasis on Indiana and Gray bats.
- Reduce forest ecosystem fuel loading and reduce the frequency and intensity of wild fires.
- Enhance small mammal, insect, and amphibian populations and diversity by maintaining a diverse botanical community.

The prescribed fires in FY 2007 are expected to take place between February 1, 2007, and the April 30, 2007. Minimum impact suppression tactics will be used to establish control lines before the ignition of prescribed fires. Existing natural and manmade barriers will be used whenever possible to control the spread of fire. In the absence of existing barriers, fire lines will be established with leaf blowers, fire rakes, and other tools. In some cases, wet lines may also be used. To reduce fire intensity adjacent to the fire line, the area inside the perimeter of the fire areas will be burned out to create a wider line without the impacts associated with construction of a wider fire line. Rehabilitation of fire lines will take place as soon as possible and no later than ten days following burn. If a prescribed fire escapes, it will be treated as a wildland fire and suppressed using additional tactics as approved in the Fire Management Plan. The range of those tactics and fire line rehabilitation actions are described below.

Suppression Tactics

Suppression tactics that minimize impacts to park resources will continue to be used when suppressing fires in the park, including:

- The approval of the Superintendent will be obtained for off-road use of vehicles, the use of plows, and other mechanized equipment. When mechanized equipment is used for line construction, a technical advisor from the Division of Science and Resource Management will be assigned, if possible, to clear the route ahead of the piece of equipment. It is

important to note that plows and other mechanized equipment have not been used in the park in the last 30 years, but it is a tactical option that may be required in extreme circumstances.

- ❑ Minimum use of retardant. Any use of retardant will be reviewed by an assigned technical advisor and approved by the Superintendent.
- ❑ The use of minimum impact suppression tactics also includes increasing the size of fire areas to take advantage of existing manmade and natural barriers.
- ❑ Leaf blowers and wet-lines will be used when possible.
- ❑ Cold-trail the fire edge when practical.
- ❑ Branches and other debris from line construction will be scattered in accordance with guidelines contained in the Fire Line Handbook (PMS 410-1).
- ❑ Use mop-up kits and other low pressure nozzle settings to prevent erosion.
- ❑ Felling of trees will be minimal. Lower branches on living trees will be pruned to remove ladder fuels as opposed to felling the tree. Snags near the fire line will be removed only if they present a hazard to firefighters or constitute a threat to fire line integrity.
- ❑ Water bars will be placed on steep slopes.

Fire Line Rehabilitation

All rehabilitation actions will be in accordance with National Park Service policy. After a fire is declared out, all flagging, litter, and trash associated with the suppression operations will be removed. Fire lines will be rehabilitated and erosion control devices installed as necessary. Stumps will be flush cut and covered with soil. Brush will be scattered and, on slopes, boles of fallen trees will be placed parallel to the hill to serve as erosion control devices. Plow furrows will be rehabilitated by rolling the material back into the furrow. Public-use trails will be inspected and measures will be taken to ensure public safety.

The severity of the burn and the resulting impacts may dictate the need to seed or plant native plant species. Although the likelihood of the need is considered low, if it is deemed necessary to do so, a rehabilitation plan will be prepared and approved in accordance with National Park Service policy before action is taken.

Special Restrictions related to protection of Federal Threatened and Endangered Species

Prescribed fires are limited to the period between November 15 and April 30 each year to avoid direct affects on Indiana bats roosting in trees as well as their fall swarming activity.

Prescribed fires will not be conducted during times when the ambient atmospheric conditions are such that smoke could be drawn into caves. Indiana bats and gray bats hibernate in caves, and gray bats also use caves as their maternity and bachelor roost sites.

Indiana bats roost in trees during warmer seasons with a preference for trees with loose bark. Personnel from the Mammoth Cave National Park Division of Science and Resources Management (S&RM) will survey the fire line of the proposed prescribed fire area prior to the burn and concurrent with construction of the fire line to identify any such habitat trees. S&RM staff will mark and label such trees with flagging tape. Any roost trees in the interior burn area

that are known Indiana bat roosts will be excluded from prescribed fire areas by flagging and establishing a fire line around the base of each tree to be excluded prior to ignition. Where the proposed perimeter fire line is constructed by hand, it will be constructed at least two tree-lengths away from any identified habitat tree. If such trees are adjacent to a fixed part of the fire line such as the road, a trail, or the river, they will have fire line constructed around the base. During the prescribed burn or during site preparation, if standing dead snags are located at any location and are determined to jeopardize firefighter safety, then they may be removed.

For the past several years, prescribed fires in the park which have occurred in areas along the Green and Nolin rivers have included the digging of handline 50 meters from the river edge to provide a buffer strip with a minimum width of 50 meters between any prescribed fire area and the respective rivers. These buffers were established to protect habitat for the seven endangered mussel species considered in this document. However, further assessments of the 50 meter requirement indicate that construction of these buffers areas is not essential; the riversides are generally areas of a perpetually moist nature and comparatively lush vegetation, and are fairly inhospitable to the spread of fire. Furthermore, populations of river cane (*Arundinaria gigantea)* in the park, which are frequently within the 50 meter buffers, are known to benefit by the effects of fire. Consultations in 2005 with the park's aquatic biologist indicate that there are no known negative impacts to mussel populations associated with minor changes to water chemistry which result from this type of comparatively small, low-intensity burns. Forest fires have occurred periodically in proximity of the river naturally throughout time. In fact, more concern has been suggested as to the effects of increased siltation caused by disturbance from installing handlines in proximity of the river than to any effects from the actual burn. Rather than constructing physical fire line along the 50 meter barrier, the prescribed fires in this plan will follow a policy of physically igniting the fire on the ridgetops and allowing the main fire to travel downslope. Fires backing downslope toward the river will be monitored to ensure that they are creeping and burning at lower intensities, if at all. These backing fires are expected to be of minimal intensity. Where high cliffs are present immediately at river-edge, ignition will be at the top of the bank or cliff. Steep terrain along the river valley will generally dictate that all ignitions take place at least 50 meters from the edge of the river.

Fire Effects Monitoring

A post burn report will be prepared for each prescribed fire area describing and quantifying a number of parameters associated with the burn conditions, weather conditions, and related effects of each prescribed fire. This Fire Effects Monitoring will be completed in conformance with the National Park Service Fire Monitoring Handbook (FMH). All records and reports will be maintained in the most recent version of FMH software.[3] A hard copy of all field sheets will be given to S&RM as well as an electronic version of species encountered during monitoring.

In order to determine the effects of a variety of management prescriptions at Mammoth Cave National Park, including prescribed fire, monitoring will be conducted throughout the park (at sites that will be burned, as well as, comparable control sites). This will include monitoring communities such as birds, reptiles, amphibians, small mammals, invertebrates, and plants.

[3] National Park Service. Fire Monitoring Handbook. 2001.

Monitoring will be conducted through a variety of avenues including regular duties of the NPS resources management staff, approved projects through various universities, and through regional (Natchez Trace, Great Smoky Mountains NP) NPS Fire Effects monitoring staff, who will utilize NPS FMH protocols. For each prescribed fire area, a Monitoring Type Description Sheet (FMH-4) will be completed.

Particle matter concentrations, ozone levels, and visibility will be reported for the days of the prescribed fire. This information will come from the state's real-time monitor in place at Oakland, Kentucky, and from Mammoth Cave National Park monitors just south of the park. If the measures exceed the acceptable levels as reported in the State Implementation Plan, then the burn will be postponed. The direction of the smoke plume will be visually monitored as described in the FMP. Within each fire crew, one or two of the firefighters will wear a carbon monoxide monitor to determine the level of exposure sustained while working the fire.

In FY 2001, the park signed an Interagency Agreement with the U.S. Geological Survey's Biological Research Division to monitor mussel populations within the 16km free-flowing zone of the Green River that flows through the park. In 2001, Dr. Jim Layzer established eight sites for collecting quantitative data on the mussel assemblages of the Green River within the park, and the current proposal will involve a maximum of five sites. At each site, quadrant samples will be collected annually by hand. All mussels collected will be identified and measured to the nearest millimeter before being returned to the river.

Mammoth Cave National Park monitors cave fish, crayfish, and the Kentucky Cave Shrimp through a Cooperative Agreement with the University of Louisville. Under this Agreement, Dr. Bill Pearson, with assistance from the park, will quantitatively survey populations of the Kentucky Cave Shrimp within habitat designated as critical habitat for the species. This monitoring will occur in a systematic manner so those sites designated as critical habitat are monitored every other year and census data are recorded every other year.

Waters of Mammoth Cave National Park were previously sampled monthly in areas which have been burned by prescribed fire, up until September 2005. Samples were taken at fixed watershed integrator sites – cave streams, springs, and rivers at the downstream end of the watersheds – in order to capture water quality signatures from specific watersheds. Twenty-eight parameters were measured, including various nutrients (nitrate, nitrite, potassium and phosphorous). Non-purgeable total organic carbon was also measured. During the course of 2005, there was no detectable change in these nutrient values from previous non-burn years. There was an excessive growth of algae within the spring run of Echo River Spring observed on April 10, 2005. No abnormal nutrient values were associated with the observation. A tract of land within the Echo River Spring groundwater basin was burned approximately two weeks prior to sampling.

Eggert's sunflower, (*Helianthus eggertii,)* a previously listed species, was delisted in September 2005, and is known to be present within the proposed 2007 burn area. This species will continue to be observed, although not targeted for specific action.

The park will continue to cooperate with the U.S. Fish and Wildlife Service and the Kentucky Department of Fish and Wildlife Resources to conduct hibernacula inventories of Indiana and gray bat populations. Inventories are conducted every other year. In 2003, the park cooperated with the U.S. Fish and Wildlife Service and the U.S. Forest Service in a study to determine habitats within the park used by Indiana bats as maternity sites.

Dennison Ferry (S11A, B, & C)

Dennison Ferry prescribed fire area consists of 790 acres oak-hickory forest with dense thickets of mature eastern red cedar and shallow soil outcroppings of limestone cedar glade species. There are also large pockets of Virginia pine along the upland ridges. Several small drainage coves and sinks are within the burn unit and support sycamores, maples, and beeches as well as native cane. Prescribed fire in this area may allow for increased understory species diversity by reducing fuels loading as well as by thinning thickets of cedars. By expanding the eastern boundary of the burn unit to the MACA boundary line, the prescribed fire effort will reduce hazardous fuels at the wild land urban interface/public-private lands interface through cooperation with adjacent landowners, and by reducing fuels around a high-use visitor recreation area. The site supports white oaks, hickories, northern red oak, black oak, Virginia pine, Carolina buckthorns, hornbeams, coral berries, phlox, trilliums, toothworts, little bluestem, blazing star, sunflowers, goldenrods, and ground cedar, as well as the non-natives lespedeza, nepal grass, and Japanese honeysuckle.

Specific Objectives

The use of prescribed fire at this site would benefit the glades by reducing the ground litter, increasing the forbes, reducing the density of the woody species along the edge of the glades and increasing the light reaching the glades. The woods are rich with herbaceous species and fire would reduce the understory of sapling red maples and help to maintain open woodland for a diverse array of understory wild flowers.

Table 1. Preliminary Burn Prescription for Dennison Ferry (S11A, B & C).

PARAMETER	RANGE	PREFERRED
Dates:	November 15 – April 30	February
Temperature:	35-85° F	70° F
Relative Humidity	25-60%	40%
Mid-Flame Windspeed	0-10 mph	3-4 mph
Wind Direction	West –Southwest	Southwest
1-hour fuel moisture	6-12%	10%
10-hour fuel moisture	7-30%	
100-hour fuel moisture	7-30%	
KBDI's[4]	<400	
Total length of fire line	27,773 feet	

[4] Keech-Byram Drought Index

[5] Personal communication with MACA SRM ecologists Rick Olson and Kurt Helf with Michele Webber, park botanist, August 2005.

PARAMETER	RANGE	PREFERRED
Acres planned	790	

Special Considerations

There are numerous mussel breeding beds in the Green River adjacent to and down river from the prescribed fire unit. While the activity level of the mussel species is low during the fire season, it is not known how sediment from fire sites could affect this group of species.

A permanent station for Monitoring Avian Populations and Survivability (MAPS) has been established along the flood plain of the Green River in the spring of 2004. The station extends from the Dennison Ferry canoe launch north approximately 1,500 along the river and extends from the river's edge east upslope approximately 1,000 feet. A habit structure analysis is performed when establishing a MAPS station and if there are structural changes in the vegetation due to a prescribed fire, the structure analysis should be reassessed. Considering this plan will ignite the burns either on the ridgetops or at least 50 meters inland from the river, any fire traveling through the MAPS area is expected to be of low intensity and comparatively low impact.

Big Woods (N9A)

The Big Woods prescribed burn unit encompasses 1,540 acres and harbors several distinct vegetation communities. Differences in primary vegetation components between communities are based on landscape position and the associated differences in soils and moisture. The five basic communities in the Big Woods unit are as follows: 1) Flat Upland, 2) Upland Slope, 3) Ravine, 4) River Slope, and 5) Riparian (Braun 2001). The Flat Upland community is xeric with poor soils. Common overstory species in these areas are dry-site species such as hickory, southern red oak, post oak, black oak, and blackjack oak with scattered Virginia pine. The Upland Slope communities are typically more mesic than the Flat Upland and are characterized by white oak, southern red oak, and tulip poplar. The Ravine sections of the unit are located on slopes and bottoms of the deeply incised valleys. The largest example of this community in the burn unit is located in Wilson Cave Hollow and is characterized by an abundance of American beech, sugar maple, and tulip poplar. Unlike both the Flat Upland and Upland Slope communities, Ravine sections are more shaded, wetter, and less adapted to fire. The River Slope sections of the burn unit occupy the east and southeast facing slopes that extend from the upland areas to the riparian zone. The areas changes considerably from the higher elevation, drier sites to the lower elevation, wetter sites which are richer limestone-derived soils. Higher elevation River Slope sites typically have a greater proportion of oak and hickory, while the more mesic areas below are beech/maple dominated and tend to have more herbaceous diversity. The Riparian section bounds the eastern edge of the burn unit and abuts the Green River. These

floodplain sites have deep, alluvial soils; common overstory species include American sycamore, silver maple, walnut, green ash, and American elm. Riparian areas remain moist most of the year making naturally occurring fire uncommon.

The old growth portion of the burn unit encompasses approximately 300 acres in both the Flat Upland and Upland Slope sections of the Big Woods unit. The larger trees are on the relatively mesic slopes where white oaks and southern red oak are commonly over 3 feet dbh with some tulip poplar over 4 feet dbh. Forest structure in this part of the unit has many qualities indicative of an old growth forest including: 1) uneven-age canopy structure, 2) large diameter coarse woody debris, 3) large standing snags, and 4) numerous canopy gaps. This site is one of the larger tracts of old growth forest in Kentucky and is designated a Natural Heritage site by the Kentucky State Nature Preserves Commission.

Special Considerations

Known plant species of special interest in the Big Woods burn unit are the American chestnut, butternut, and Eggert's sunflower. The Big Woods harbors more American chestnut per unit area than any location in the park. Generically, evidence suggests American chestnuts benefit from fire over the long term, but the effects of initiation of prescribed fire after long intervals without fire disturbance are unknown. Due to the rarity of the American chestnut caused by the pathenogenic chestnut blight, a 30 ft. diameter fuel-free zone will be established around the seven tree-sized American chestnuts in the Big Woods unit. Butternut, also devastated by a pathogen, does not usually occupy areas where fire would have naturally occurred, but a 30 ft. diameter fuel-free zone will be established around the two known butternut trees in case of abnormally intense fire behavior or unintentional ignition. Eggert's sunflower has recently been removed from the endangered species list, but it is still a rare plant that should be managed. Populations of Eggert's sunflower occur along Little Jordan Road (the western boundary of the burn unit) and would benefit from fire. Wilson Cave is within the burn unit and both the Indiana bat and Little Brown Bat are known to populate this cave. The Indiana bat is listed as a T& E species, and prescribed fires will not be conducted during times when the ambient atmospheric conditions are such that smoke could be drawn into caves.

Specific Objectives

The use of prescribed fire at this site would greatly benefit the forest by reducing the surface litter and increasing the forbs. The woods here are rich with herbaceous species, and fire would reduce the surface debris to help maintain open woodland for a diverse array of understory wild flowers. The patchy nature of woodland burns during the winter produces a variety of light regimes as the canopy develops in the spring and summer, and allows for the development of a multitude of microsites.

Table 2. Preliminary Burn Prescription for Big Woods N9A).

PARAMETER	RANGE	PREFERRED
Dates:	November 15 – April 30	
Temperature:	35-85° F	70º
Relative Humidity	25-60%	40%
Mid-Flame Windspeed	0-10 mph	3-4
Wind Direction	Any	Southwest
1-hour fuel moisture	6-12%	
10-hour fuel moisture	7-30%	
100-hour fuel moisture	7-30%	
KBDI's	<400	
Total length of fire line	12,144 feet	
Acres planned	186	

Chaumont South and North (S7C & S7D)

In 2007, the two prescribed fire areas (S7C and S7D) at Chaumont will be treated as one unit. They are established as separate areas so they can be treated as separate units in the future. There is a population of Eggert's sunflower in S7C. These prescribed fire areas are located near the south boundary of the park.

Chaumont was privately owned until the primary portion of this tract (116.45 acres) was donated to the park in 1992. It was part of a farm until the late 1960's when it was developed as a theme park intended to represent an 1890's village. Following acquisition of the property, all of the buildings and their foundations have been removed. The previous mowing practices resulted in a number of barrens species being able to persist at this site. Woody species began invading the site as soon as mowing stopped. Invading eastern red cedar have been reduced by mechanical removal The two prescribed fire sites combined constitute 85 acres and are located in the lower portion of a karst valley typical of the area. The property lines fall in the middle of the ridge slopes. If permission can be gained from adjoining landowners and from the Commonwealth of Kentucky, the burn areas will be expanded to include some private property in order to avoid construction of mid-slope fire control lines.

The areas are best described as disturbed old farm fields that are in early stages of succession. The periphery of the old fields and some sinkhole areas possess mesic slope forests and mixed deciduous and coniferous forest. Many barrens species were noted including coneflowers, compass plant, blazing star and several native grass species. The pond has at least five species of

sedges as well as rushes and royal fern along its edges. The nonnative clovers, grasses and vines are dense in the open areas and prescribed fire would release the natives from the competition. *Helianthus eggertii* (Eggert's sunflower) grows along the edge of the open area and is threatened by encroachment from both the woods and the thickets of dense blackberries and Korean lespedeza.

There are no surface streams in the prescribed fire areas. Drainage is sheet flow that disappears in the bottom of the karst valley via numerous sinkholes. The site is underlain entirely with limestone formations, St. Genevieve (50%) and Girkin (50%). The slopes range from 10-23 degrees. Drainage from this area does enter groundwater basins known to provide habitat for the Kentucky cave shrimp.

The closest known Indiana bat or gray bat hibernaculum is 1.27 miles west of this location. The Green River, which provides habitat for seven endangered mussel species is 4.74 miles away.

There are several sinkhole pits within the limits of the prescribed fire area, but there are no cave entrances. There is a small cave, that was shown to the public for commercial gain until 1992, a short distance outside the prescribed fire area to the east. This cave is not used by endangered bat species.

There are no cemeteries or other identified cultural resources present within the prescribed fire areas.

Table 3. Preliminary Burn Prescription for Prescribed Fire Areas S7C and S7D, Chaumont South and Chaumont North, respectively.

PARAMETER	RANGE	PREFERRED
Dates:	January through April	March through April
Temperature:	35-85° F	70° F
Relative Humidity	30-60%	40%
Mid-Flame Windspeed	0-6 mph	2-3 mph
Wind Direction	Any	Southwest
1-hour fuel moisture	6-12%	10%
10-hour fuel moisture	7-30%	
100-hour fuel moisture	7-30%	
KBDI's	<400	
Total length of fire line	5,280 feet	
Acres planned	53	

Specific Objectives

Prescribed fire at Chaumont should enhance the restoration of barrens habitat, which is fire dependent. Prescribed fire should have beneficial effects for the Eggert's sunflower population. The invasion of old farm fields by trees should be reduced or temporarily halted. Dead and down fuel load should be reduced. The effects of previous human use of the area should be somewhat mitigated through removal of non-fire tolerant non-native species. In general, the objective for this area is to increase herbaceous species diversity, encourage the release of native barren species from competition, reduce the encroachment of exotics and woody species and mitigate the damage incurred through previous human use.

Chaumont consists of 84 acres of open barrens habitat surrounded by mixed forest. An increase of native species at this site was observed after a past prescribed fire.

Special Considerations

Fire line construction in some areas of this site may require removal of cedar trees adjacent to the fire lines to reduce the intensity of the flames. Location of the fire line should be adjusted where possible to avoid the presence of cedar trees.

Burning this area when the winds are from the north should be avoided because of the presence of private property to the south near the prescribed fire area.

EFFECTS OF THE PROPOSED MANAGEMENT ACTION ON EACH THREATENED AND ENDANGERED SPECIES EVALUATED

Following is a description of the expected effects that the proposed action is likely to have related to each federal threatened, endangered, proposed, and candidate species located within the park. Where the direct, indirect, and cumulative effects are similar for all three prescribed fire areas they are discussed without specific reference to each area. In cases where there are differences, references are made to the specific area. A proposed finding is also listed for each species, e.g., no effect, not likely to adversely effect, etc.

Indiana Bat

Mammoth Cave National Park provides important year-round habitat for the Indiana bat. Several caves within the park are hibernacula. The number of bats that use the priority hibernacula within the park is monitored biannually by the U.S. Fish and Wildlife Service.[6] When not hibernating, female Indiana bats roost in trees under loose bark. There is a preference for standing dead trees and species that have loose bark, but Indiana bats may roost in any tree greater than six inches in diameter (they have occasionally been seen in smaller trees). The cave hibernacula are gated to prevent human disturbance during hibernation. The park has modified its hazard tree management program to avoid, to the extent possible, adverse effects on Indiana bats.

Direct Effects: There are no direct effects associated with the prescribed fire areas anticipated in the FY 2007 plan. Wilson Cave, a known underground roost site, is located in the prescribed fire area, possible direct effects on this population are expected to be negligible. This plan calls for prescribed fires to be limited to the period of time that Indiana bats would likely be hibernating (i.e., November 15 through April 30). During that period, prescribed fires would not be ignited when the ambient atmospheric conditions would make it possible for smoke to be drawn into caves.

Indirect Effects: Some potential roost trees (snags) may be consumed by prescribed fire; however, the number of available snags would likely be increased as a result of prescribed fire. Known roost trees along the fire line or standing snags that are potential roosting sites for

[6] See Clawson, Richard L. "Report on the Status of Priority 1 Indiana Bat Hibernacula, 1989," 1989.

Indiana bats will be flagged and excluded from the prescribed fire area along the fire line by routing the lines at least two tree-lengths from the tree and establishing lines around their bases. Some snags may be removed near the fire line if it is determined that they cannot be reasonably excluded and leaving them would jeopardize firefighter safety. To the extent that implementation of a prescribed fire program would enhance natural processes and biological diversity, the planned fires may have some positive effects. Considering that wildfires have burned in this ecosystem for centuries as a natural process. The effects, if any, are expected to be negligible.

Cumulative Effects: No cumulative effects related to Indiana bats are anticipated.

Proposed Finding: The FY 2007 Prescribed Fire Plan is not likely to adversely effect the Indiana bat.

Gray Bat

Some populations of Gray bats (1,400 in 2003 and 900 in 2005) have been found within Mammoth Cave National Park hibernating along with Indiana bats and other species during biennial censuses conducted by the U.S. Fish and Wildlife Service.[7] A major Gray bat hibernaculum is located near the park. Gray bats normally hibernate in caves and use caves for their summer roosts as well.

Direct Effects: As with Indiana bats, no direct effects on Gray bats associated with the prescribed fire areas included in the FY 2007 plan are anticipated. Dixon Cave, which houses both Indiana and Gray bats year-round in underground roosts, is not in the burn area, but will be considered. Prescribed fires are limited to the period of time that Gray bats would likely be hibernating (i.e., November 15 through April 30). During that time prescribed fires would not be ignited near cave entrances when atmospheric conditions would make it possible for smoke to be drawn into caves. The seasonal limitations imposed to protect Indiana bats roosting in trees would also protect Gray bat maternity colonies roosting within caves.

Indirect Effects: To the extent that implementation of a prescribed fire program would enhance natural processes and biological diversity, the planned fires may have some positive effects. Considering that wildfires have burned in this ecosystem for centuries as a natural process, the indirect effects, if any, are expected to be negligible.

Cumulative Effects: No cumulative effects related to Gray bats are anticipated.

Proposed Finding: The prescribed fires proposed in the FY 2007 Prescribed Fire Plan are not likely to adversely effect the Gray bat.

Kentucky Cave Shrimp

[7] Clawson, 3.

The Kentucky cave shrimp is endemic to the Mammoth Cave National Park region.[8] The known distribution includes nine distinct groundwater basins in the area. Three of the basins are located mostly within the park. Two of the basins are located entirely outside the park. Most of the basins have a substantial input of water from areas outside the park. The shrimp has very specific habitat requirements which are characteristic of the base level streams of the Mammoth Cave area. Food is scarce and population densities are low. Events that significantly effect the quality of water in a given groundwater basin will have an impact on the species. The Dennison Ferry sites are within a groundwater basin that is known habitat for the Kentucky cave shrimp. Sediment would not likely back-up underground to influence the shrimps' specific habitat, but it does likely filter through the limestone substrate into the underground waters below. What the impact of this would have on the Kentucky cave shrimp is unknown.

Direct Effects: Sediments and/or nutrients can be carried by storm water into the base level waters inhabited by the Kentucky cave shrimp. This occurs generally along ridge sides through shaft drain complexes. In some cases, runoff appears within the cave only a few minutes following the onset of heavy rainfall. Dilution by mixing with untainted waters at the base level, combined with a relatively short duration, is expected to localize any effects that might occur. Since the total area to be burned within a year's time is not large in comparison to the total drainage area of the cave system, the effects, if any, are expected to be negligible.

Indirect Effects: It is suspected that soils within the park are abnormally acidic at least in part due to acid precipitation and dry deposition. Buffering of acidic soils is one of the beneficial effects of fire. It is unknown how this situation may affect the Kentucky cave shrimp. Considering that wildfires have burned in this ecosystem for centuries as a natural process, the indirect effects, if any, are expected to be negligible.

Cumulative Effects: To the extent that prescribed fire promotes natural processes and conditions, there is potential for positive benefits for the shrimp over a period of years.

Proposed Finding: The prescribed fires proposed in the FY 2007 Prescribed Fire Plan are not likely to adversely affect the Kentucky cave shrimp.

Potential Effects: Within the park's Strategic Plan for 2007-2011, the long term performance goal titled "Threatened and Endangered Species Improved" states: "By September 30, 2011, eight of Mammoth Cave National Park's listed species in the park are making progress toward recovery". This goal relates specifically to the Kentucky Cave Shrimp (Palaemonias ganteri), which is listed as endangered. Shrimp are monitored as part of four base level aquatic communities in the Mammoth Cave System, and an Index of Biotic Integrity (IBI) is calculated based upon eleven metrics (see appendix). IBI scores from the mid 90s and early 2000s indicate generally stable to improving condition of the base level communities where shrimp live as shown in table. An analysis of the shrimp data indicates a stable to improving population status. This data analysis indicates that the MACA prescribed fire program has had no adverse impacts

[8] U.S. Fish and Wildlife Service. Recovery Plan for Kentucky Cave Shrimp (*Palaemonias ganteri Hay*). Atlanta, Georgia, 1988, 1.

on the Kentucky Cave shrimp populations up until 2003. (Effects of burns on shrimp from 2004 and 2005 have not yet been assessed.)

Table 4. IBI values and shrimp counts (in red) at four sites in MCNP, 1993-2005. Note that the shrimp census numbers are much more variable than the IBI values.
Table courtesy of Dr. Bill Pearson, University of Louisville.

	1993	1994	1995	2001	2003-2005
Mystic River	41 (8)	41 (33)	49 (233)	47 (41)	47 (46)
Roaring River	*NS	39 (32)	46 (34)	NS	48 (21)
Echo/Styx River	41.5 (0)	35 (6)	37 (2)	NS	46 (7)
Golden Triangle	NS	29 (25)	39 (45)	27 (5)	41 (14)

*Not Sampled

Endangered Mussels

There are six mussel species found within the park that are listed as endangered species. Because they are found in the same general areas and because the potential effects on each species as a result of the proposed action are similar if not identical, the discussion of effects is combined. The effects discussion follows a brief summary of each species. The presence or absence of individual mussel species has been established by several surveys over a period of years.[9] The most recent work has been conducted by Dr. Jim Layzer of Tennessee Tech University. Dr. Layzer provided information concerning the status of individual species in the Green River.[10]

Rough Pig-toe Pearly Mussel

The Rough Pig-Roe Pearly Mussel is found in the free-flowing reaches of the Green River within the park above Cave Island. This species is endangered because of loss, alteration, and degradation of habitat. This species is also threatened by the impending invasion of zebra mussels. The fish hosts for this mussel's parasitic larvae are thought to include rose-fin shiners and bluegills.

[9] See Cicerello, Ronald R., and Richard R. Hannan. "Survey of the Freshwater Unionids (Mussels) (Bivalvia: Margaritiferidae and Unionidae) in the Green River in Mammoth Cave National Park, Kentucky." Kentucky State Nature Preserves Commission. January, 1990.
See also Isom, Billy G. "Mussels of the Green River, Kentucky." Trans. Kentucky Academy of Science. 35(1-2), June 1974.

[10] Personal communication between Mark DePoy, Mammoth Cave National Park, Chief of the Science and Resource Management Division, and Dr. Layzer.

Clubshell

The Clubshell currently occurs in 12 streams including the Green River. The current distribution represents a range reduction greater than 95 percent. This mussel occurs in small rivers and streams in clean sweep sand and gravel. The reduction in range can be attributed to impoundment, channelization, loss of riparian habitat, pollution, and the impacts of silt from poor land uses. This species is also threatened by the impending invasion of zebra mussels.

Ring Pink

The Ring Pink Mussel is a large river species that inhabits relatively shallow water (2 feet deep) with gravel and sandy substrates. Only five populations remain of what was once a widely distributed species. The likely cause of the loss of many of the historic populations is impoundment of the river. Impoundments have seriously limited the availability of the species' preferred riverine gravel and sand habitat. The viability of the five remaining populations is questionable. This species is also threatened by the impending invasion of zebra mussels.

Northern Riffleshell

The Northern Riffleshell occurs in a wide variety of streams, large and small, preferring runs with bottoms composed of firmly packed sand and fine to coarse gravel. The range of this species has been reduced to less than 5% of its former distribution. The reduction in range can be attributed to several factors including impoundment, channelization, loss of riparian habitat, the impacts of silt from poor land use practices, and pollution. This species is also threatened by the impending invasion of the zebra mussel.

Fanshell

The Fanshell mussel occurs in medium to large rivers, and has been reported primarily from relatively deep water with moderate currents and gravelly substrate. The population in the Green River is thought to be the best of the three remaining reproducing populations. The reduction in range can be attributed to several factors including impoundment, dredging, and water pollution. This species is also threatened by the impending invasion of the zebra mussel.

Pink Mucket

This species is found both upstream and downstream from the park, and is believed to be present in the park. The species is threatened by several factors including impoundment, dredging, and water pollution. This species is also threatened by the impending invasion of the zebra mussel.

Direct Effects: The Dennison Ferry burn unit and parts of the Big Woods unit are near the Green River floodplain. Because ignition near the river is to be on the ridgetops as opposed to along the banks of the Green River, ash or storm water runoff would not be likely to directly impact the river habitat of these species. Ignition will take place at the breakover point of ridge slopes above the floodplains, or at the top of cliffs and steep areas, where the fire should creep slowly

back toward the river, if at all. It is expected that the flat and mesic conditions in the floodplains will not carry the prescribed fires through these areas in most cases, and where fire does occur will be a zone of very low fire intensity.

Most storm water runoff within the park quickly moves underground. The only surface streams south of Green River within the park are springs along edges of ridges. These springs are relatively short and sink into the underlying limestone after passing over the Big Clifty Sandstone (30-50 feet in thickness) that caps the ridge tops. The water then reemerges from the caves through large springs. North of the Green River there are some small creeks that run varying distances down the deep hollows before sinking to reemerge through large springs that feed into Green River.

Because of the underground drainage, the limited, low intensity fire in riparian areas as well as the distance from the river, the prescribed fire areas are not likely to contribute elevated sediment levels into the river. The relatively limited area, the short duration of each fire, ignition points away from the riverbank, and site rehabilitation following prescribed fires greatly mitigate the possibility of any direct effects on these species. The effects, if any, are expected to be negligible.

Indirect Effects: No indirect effects are expected.

Cumulative Effects: The primary potential for cumulative effects lies with the possible future expansion of the use of prescribed fire. A significant increase in the acreage burned annually would only be proposed in the future if adequate research and documentation indicates it could be done without prohibitive adverse effects.

Proposed Finding: The prescribed fires proposed in the FY 2007 Prescribed Fire Plan are not likely to adversely affect the endangered mussel species.

Bald Eagle

The Bald Eagle is becoming more common throughout Kentucky. Bald eagles are known to reside year-round at Land Between the Lakes in western Kentucky. Sporadic sightings of bald eagles have occurred within the park, even during spring and summer months. The park participates in the annual January bald eagle census. Sightings during the census have become more frequent in recent years. No nesting sites have been identified within the park. Nesting has been reported, but not confirmed at both Nolin Lake and Barren River Lake, which are near the park and offer larger amounts of suitable habitat. Reports of winter sightings have been recorded in the vicinity of First Creek Lake north of the Green River, and along the length of the Green and Nolin Rivers in the park. The prescribed fire areas for 2007 are located on the both sides of the Green River. Any bald eagles in the park are expected to migrate north by no later than early March.

Direct Effects: Due to the distance of the prescribed fire sites from winter sighting locations at First Creek Lake and Nolin Rivers, no direct effects are expected in relation to those sites. There is a possibility of temporarily disturbing any bald eagles which might be present along the Green

River at the time of the burns, although that effect should be of short duration and with negligible consequences.

Indirect Effects: To the extent that implementation of a prescribed fire program would enhance biological diversity and natural processes, the prescribed fires may have some positive effects. The effects, if any, are expected to be negligible.

Cumulative Effects: Implementing the prescribed fire plan for fiscal year 2007 would have no cumulative effect on the bald eagle.

Proposed Finding: The prescribed fires proposed in the 2007 prescribed fire plan are not likely to adversely affect the bald eagle.

Surprising Cave Beetle

This species is one of 255 species in the genus *Psuedanopthalmus*. It is cave dependent and has not been found outside four caves listed below, with the possible exception of a recent discovery in one additional cave in the park. In February, April, and May 2003, the surprising cave beetle was located in all four listed caves. Little is known of its specific food requirements. It is thought to be dependent on slowly decaying discarded wood in both Mammoth Cave and White Cave. The extent to which it may be dependent on bat guano, wood rat, or cave cricket communities is unknown. The surprising cave beetle was described from the following four locations within Mammoth Cave National Park, i.e., the Historic section of Mammoth Cave 1959, White Cave 1995, and Great Onyx Cave 1996.[12] The species was located in Surprising Cave in 2003 by park employee Steve Thomas.

The three prescribed fire units included in the FY 2007 plan are more than a mile from the locations reported for the surprising cave beetle.

Direct Effects: Direct effects related to the surprising cave beetle, if any, are expected to be negligible.

Indirect Effects: No indirect effects are expected.

[12] See U.S. Fish and Wildlife Service. "Nine Cave Beetles – Pseudanophthalmus spp. 2001 Candidate Notice of Review." Internet. http://es.southeast.fws.gov./pdf/pcb.pdf. September 5, 2001.

See also Barr, Thomas C., Jr. "Cave Beetle Status Survey and Prelisting Recovery Project." Prepared for the U.S. Fish and Wildlife Service and the Kentucky Department of Fish and Wildlife Resources, August 21, 1996.

See also Barr, Thomas C., Jr. "New Cave Beetles (*Carabidae, trechind*) from Tennessee and Kentucky." Journal of the Tennessee Academy of Science. 34-1, January 1959.

Cumulative Effects: There are no cumulative effects expected related to this species.

Proposed Finding: Implementation of the FY 2007 Prescribed Fire Plan is not likely to adversely affect the surprising cave beetle.

Eggert's Sunflower

Eggert's sunflower is a perennial, fire dependent herb that grows in Alabama, Kentucky, and Tennessee. The species was delisted as threatened in spring of 2005, but is still a species of management concern. Several populations are present within the park along roadsides or the edge of old fields. The U.S. Fish and Wildlife Service has requested Mammoth Cave National Park to undertake prescribed burns to enhance the habitat for this species. Previous experience with prescribed fire and Eggert's sunflower has documented the benefits of fire to the species.[13] As an interim measure, the park conducted canopy thinning to benefit those populations within the park. The Chaumont unit supports a small population of Eggert's. The Big Woods unit supports small populations of Eggert's along the roads.

Direct Effects: This species is located in two of the Prescribed Fire Areas (N9A, S7C). Prescribed fire in this area is expected to improve the habitat and increase the number of plants present.

Indirect Effects: Over a period of time, the prescribed fire program at Mammoth Cave National Park will increase the amount of suitable habitat for this species. The direct effects are expected to be minor.

Cumulative Effects: The prescribed fire areas with populations of Eggert's sunflower would be burned repeatedly on a schedule determined to have the greatest benefit. That is expected to be every two to three years.

Proposed Finding: Implementation of the 2007 Prescribed Fire Plan is likely to have a beneficial effect for Eggert's sunflower.

Table 5. Summary of the conclusions reached concerning the likely effects of implementation of the preferred alternative identified in the draft Fire Management Plan for the park. Each cell is an intersection between a species and one of the statements listed above. True statements are indicated by insertion of an "X." Blank cells indicate false statements. Shading indicates statements, which are "not applicable" to the species.

DETERMINATION OF EFFECT AND RATIONALE SUMMARY

[13] U.S. Fish and Wildlife Service. "Recovery Plan for *Helianthus eggertii* (Eggert's Sunflower)." Final Plan ed. Atlanta, Georgia. December, 1999, 13-15.
See also Jones, Ronald L. "The Status of Helianthus Eggertii Small in the Southeastern United States [Draft]." Mammoth Cave National Park files. 14-15.

Rationale (See Table 5.)

A. Species not present in Mammoth Cave National Park
B. Species not present in Prescribed Fire Areas
C. Suitable habitat for species not present in Prescribed Fire Areas
D. Suitable habitat for species not present near Prescribed Fire Areas
E. Proposed prescribed fire program would have no negative affect on species if it were located within Prescribed Fire Areas
F. Proposed prescribed fire program will not have a direct effect on the species
G. Proposed prescribed fire program will not have an indirect affect on the species
H. Proposed prescribed fire program will not have a direct affect on habitat for the species
I. Proposed prescribed fire program will not have an indirect affect on habitat for the species
J. Proposed prescribed fire program would nave no negative affect on the potential for the prescribed fire area to support the species if it is introduced
K. Proposed prescribed fire program may provide or improve habitat for the species
L. Proposed prescribed fire program may maintain or improve habitat for a possible introduction of the species
M. Any potential effects are mitigated by avoidance strategy

Table 5. Summary of the conclusions reached concerning the likely effects of implementation of the preferred alternative identified in the draft Fire Management Plan for the park. Each cell is an intersection between a species and one of the statements listed above. True statements are indicated by insertion of an "X." Blank cells indicate false statements. Shading indicates statements, which are "not applicable" to the species.

	Rationale*												
Species Common Name	A	B	C	D	E	F	G	H	I	J	K	L	M
NOT LIKELY TO ADVERSELY AFFECT													
Listed Endangered Species:													
Indiana Bat						X	X				X		X
Gray Bat						X	X				X		X
Kentucky Cave Shrimp		X	X	X		X		X					
Rough Pigtoe Pearly Mussel		X	X	X		X	X	X	X				X
Clubshell		X	X	X		X	X	X	X				X
Ring Pink		X	X	X		X	X	X	X				X
Fanshell		X	X	X		X	X	X	X				X
Northern Riffleshell		X	X	X		X	X	X	X				X
Tuberculed-blossom Pearly Mussel		X	X	X		X	X	X	X				X
Purple Cat's Paw Pearly Mussel		X	X	X		X	X	X	X				X
Listed Threatened Species:													
Bald Eagle					X		X	X	X		X		
Candidate Species:													
Surprising Cave Beetle		X	X	X		X	X	X	X				
LIKELY TO HAVE BENEFICIAL EFFECTS													
Previously Listed Threatened Species:													
Eggert's sunflower, (delisted, 2005)													

SUMMARY OF MITIGATING ACTIONS AND CONDITIONS

As previously discussed, Mammoth Cave National Park intends to implement a prescribed fire strategy that avoids the potential for adverse effects on federally protected species. Based on current knowledge of the protected species, the park has proposed a plan that includes appropriate limitations to avoid adverse impacts. These mitigating actions along with other circumstances or conditions that diminish the potential for unintended consequences are listed below.

- Prescribed fires are limited to the period of time that Indiana bats and Gray bats would likely be hibernating (i.e., November 15 through April 30). During that time prescribed fires will not be ignited when the ambient atmospheric conditions would allow smoke to enter caves.
- Where the proposed perimeter fire line is constructed by hand, it will be constructed at least two tree-lengths away from any known Indiana bat habitat tree, or potential habitat trees that have been identified. If such trees are adjacent to a fixed part of the fire line such as the road, a trail, or the river, they will have fire line constructed around the bases, so long as their remaining in place does not jeopardize firefighter safety.
- Mechanical lines will not be used in prescribed fire operations. Mechanical lines will be a last resort to control wildland fires in the most extreme conditions. Leaf blowers will be used to the extent possible to minimize soil disturbance.
- Fire lines for prescribed fires will not be placed in edge situations. Instead they will be located in open hardwoods and to the extent possible existing features such as roads and trails will be used as fire lines.
- Fire lines will be rehabilitated as soon as possible to minimize the potential for erosion.
- The underground drainage makes it very unlikely that sediment, if any, related to prescribe fires, will be carried by storm water runoff into either the Green or Nolin Rivers.
- Research and monitoring activities will determine the actual effects of the prescribed fires and future burns will be adjusted accordingly.
- Consultation with the U.S. Fish and Wildlife Service as required by Section 7 of the Endangered Species Act will be initiated if new species are listed or critical habitat is designated that might be affected by the proposed actions. Consultation will be initiated if new information reveals that implementation may affect listed species in a manner or to an extent not previously considered, or the selected alternative is modified to include new activities.

SUMMARY CONCLUSION

Considering the mitigating actions and conditions established for prescribed fires within Mammoth Cave National Park, prescribed fires within the designated Prescribed Fire Areas are "not likely to adversely affect" federally protected species or critical habitat within or near Mammoth Cave National Park.

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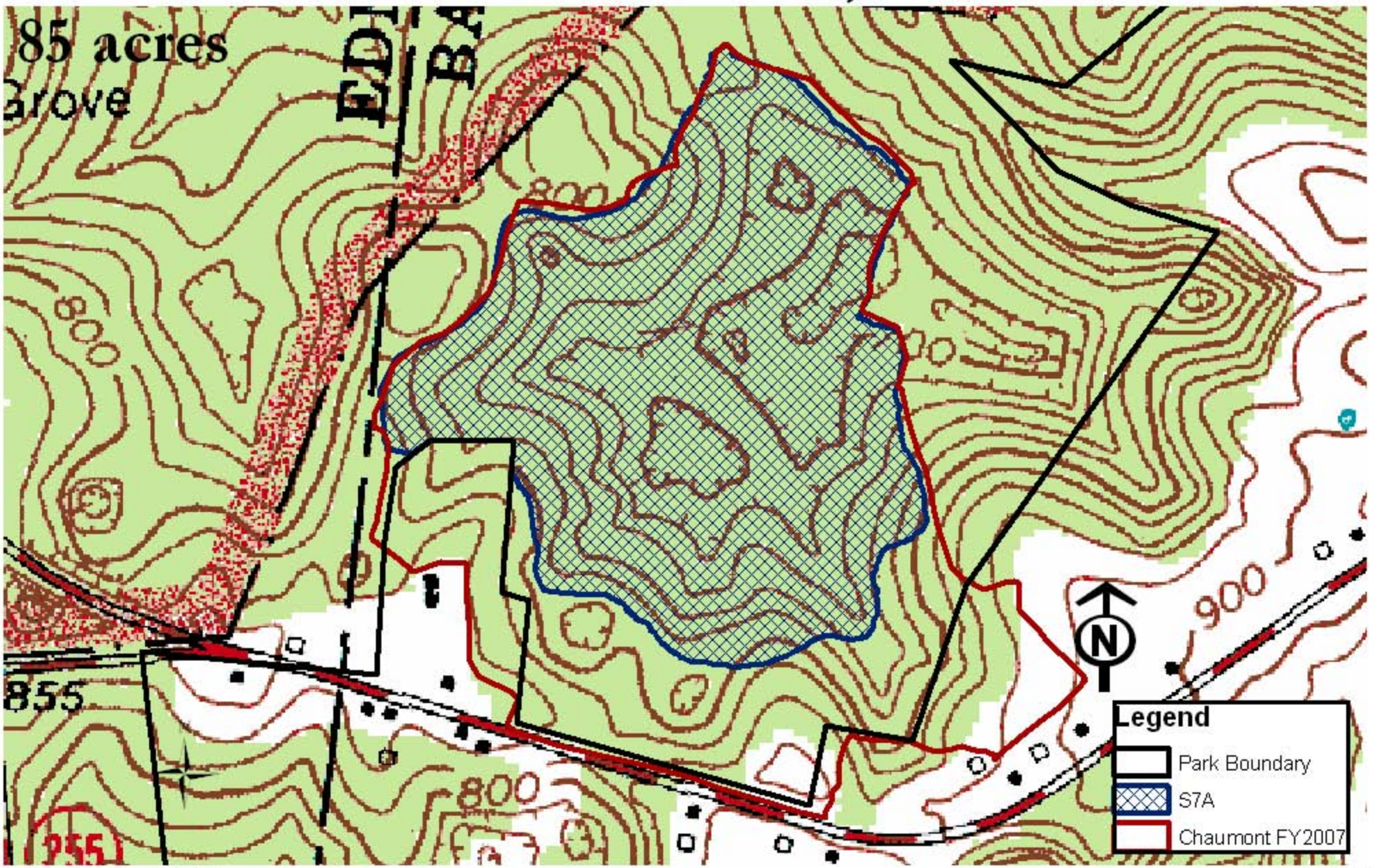
Mammoth Cave National Park
Mammoth Cave, Kentucky

National Park Service
U.S. Department of the Interior

Chaumont Prescribed Fire Project



Produced by Fire Management

January, 2007

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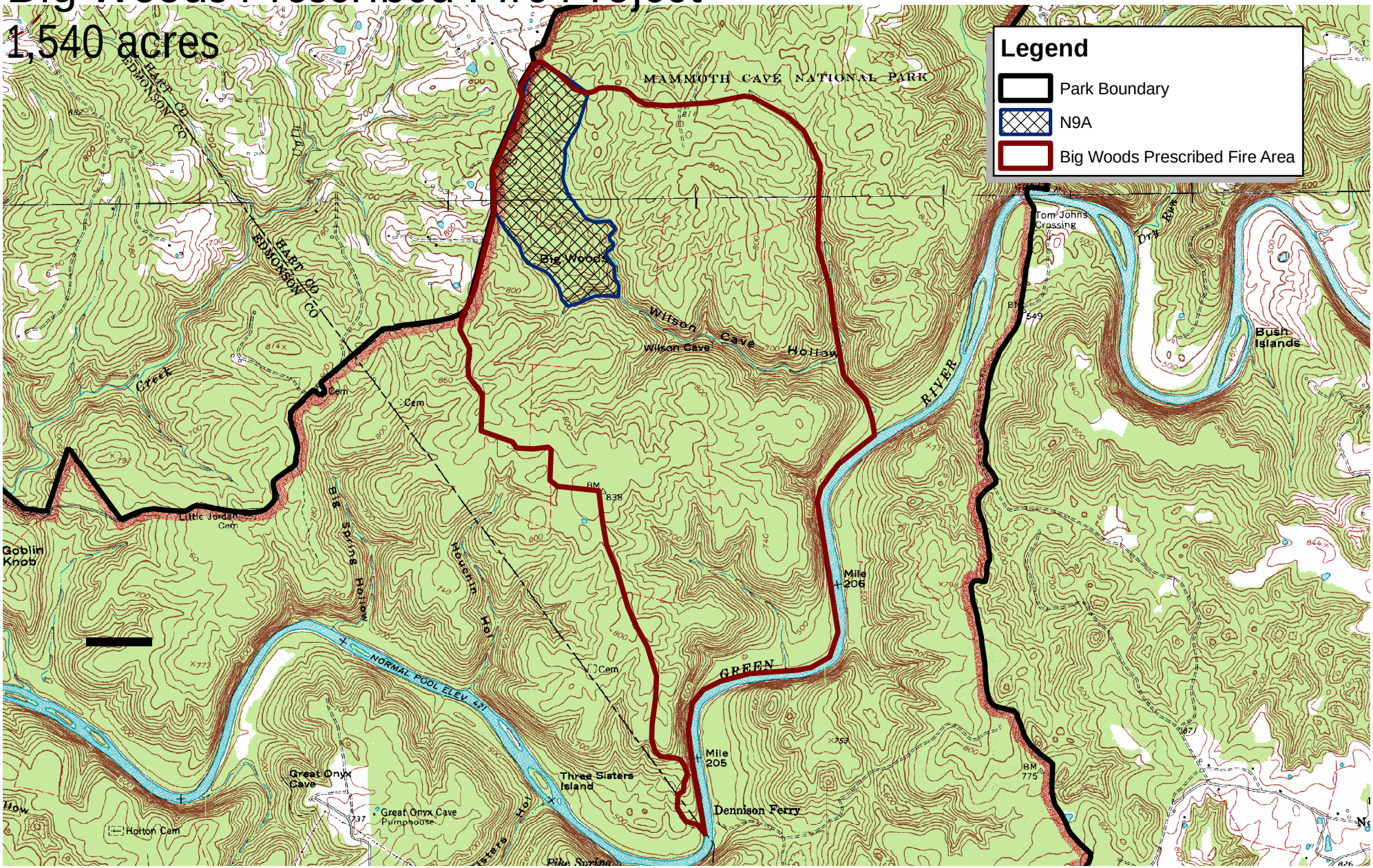
0.2
Miles

Mammoth Cave National Park
Mammoth Cave, Kentucky

National Park Service
U.S. Department of the Interior

Big Woods Prescribed Fire Project

1,540 acres



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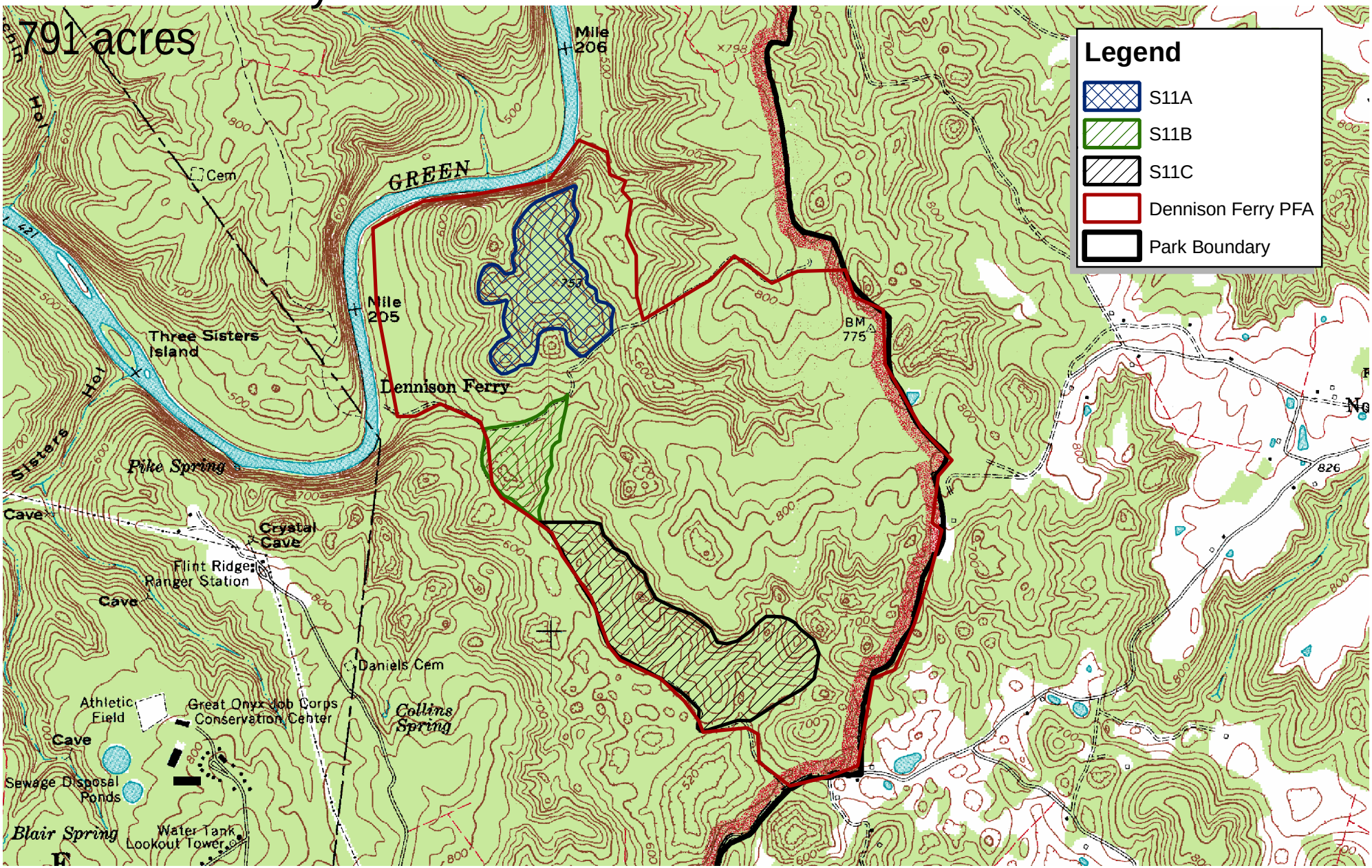
October, 2005

Dennison Ferry Prescribed Fire Area



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October, 2005

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