



Biological Assessment

Fiscal Year 2009 Prescribed Fire Plan



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Mammoth Cave National Park, Kentucky

INTRODUCTION

The primary purpose of this Biological Assessment (BA) is to evaluate the effects on federal threatened, endangered, proposed, and candidate species related to implementation of projects entered in the National Fire Plan Operations & Reporting System. A secondary purpose for this BA is to address questions of general ecological integrity as they arise.

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 2009.

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 2009). 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 following prescribed fire areas will be treated: PFA N3, Eagle Prairie, (67 acres), PFA N4A, N5F, Temple Hill (1,876 acres), and PFA S4A, B, C, & D, Jim Lee (1,749 acres), for a total of 3,692 acres. Maps of the planned prescribed fire areas are attached.

With the exception of Eagle Prairie, PFA land area was increased from the original targets to optimize firefighter safety. The Temple Hill site utilizes both natural barriers to fire, such as Green and Nolin Rivers, plus existing manmade barriers such as roads and trails. The Jim Lee site is bounded entirely by roads, which make excellent fire lines.

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. Bald Eagles were de-listed as federally threatened or endangered by the

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.

USFWS in June, 2007². During preparation of this 2009 Biological Assessment, no new information indicating presence of these species in Mammoth Cave National Park was encountered. The following list identifies the species considered in this BA.

Listed Endangered Species

Indiana Bat	<i>Myotis sodalis</i>
Gray Bat	<i>Myotis grisescens</i>
Kentucky Cave Shrimp	<i>Palaemonias ganteri</i>
Rough Pigtoe Pearly Mussel	<i>Pleurobema plenum</i>
Clubshell	<i>Pleurobema clava</i>
Ring Pink	<i>Obovaria retusa</i>
Fanshell	<i>Cyprogenia stegaria</i>
Northern Riffleshell	<i>Epioblasma torulosa rangiana</i>
Pink Mucket	<i>Lampsilis abrupta</i>
Purple Catspaw Pearly Mussel	<i>Epioblasma obliquata obliquata</i>

Proposed Species

none

Candidate Species

Surprising Cave Beetle	<i>Pseudanopthalmus inexpectatus</i>
Sheepnose Mussel	<i>Plethobasus cyphus</i>
Spectaclecase Mussel	<i>Cumberlandia monodonta</i>

DESCRIPTION OF THE PROPOSED ACTION

Fire Management Objectives

- Restore fire as an ecological process in fire-adapted vegetation communities such as oak-hickory forest-savanna, barrens, and cedar-oak glades at appropriate frequencies and seasons.
- Minimize damage to vegetation not adapted to fire such as mesic slope/floodplain forests.
- Assist in the control of invasive and exotic plants that are susceptible to fire.
- Reduce fuel loading to reduce the frequency and severity of wildfires.

The prescribed fires in FY 2009 are expected to take place after receiving concurrence with this biological assessment from the USFWS and April 30, 2009. 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. The area inside the perimeter of the fire areas will be burned out to create a wider line without the impacts associated with hand construction of a wider fire line. Rehabilitation of fire lines will take place as soon as possible and no later than

² US Fish and Wildlife Service 2007. Ecological Services Information Sheet.
<http://www.fws.gov/midwest/eagle/>

ten days following burn being declared out. 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. 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 effects 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.

Several years ago, prescribed fires in the park which occurred in areas along the Green and Nolin rivers 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 endangered mussel species considered in this document. However, further assessments of the 50 meter requirement indicated that construction of these buffers areas was 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. 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 ridge tops or slopes with fire adapted vegetation and allowing the fire to move toward mesic slope/floodplain vegetation communities as it will on its own. Fires backing down slope 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 cliff.

Fire Effects Monitoring

Effects on vegetation will be monitored by regional (Natchez Trace Fire Effect Monitoring, Great Smoky Mountains NP) NPS Fire Effects monitoring staff, who will utilize NPS FMH protocols. 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 fire effects monitoring database software approved by the NPS. A copy of completed fire effects reports will be provided to the Division

of Science and Resources Management. For each prescribed fire area, a Monitoring Type Description Sheet (FMH-4) will be completed. This sheet is kept on file with the regional fire ecologist.

Particulate matter concentrations, ozone levels, and visibility conditions will be reported for the days of the prescribed fire. These data will be reported from the Mammoth Cave National Park air quality monitoring station located on the south boundary and the Kentucky Division for Air Quality monitoring station located near Oakland, Warren County, Kentucky. Other regional air quality monitoring data will be reviewed in addition to the Mammoth Cave National Park and Oakland, Kentucky stations for compliance with existing National Ambient Air Quality Standards (NAAQS). If local or near-by regional ozone (O₃) and/or particulate matter (PM_{2.5}) levels have reached 85% of the NAAQS (8-hour ozone concentration \geq 72.25 parts per billion and/or 24-hour PM_{2.5} concentration \geq 29.75 micrograms per cubic meter) then the prescribed burn will be postponed. The 15% margin of safety below the NAAQS will maintain Mammoth Cave National Park compliance with conformity requirements specified in section 176, paragraph (c) of the Clean Air Act, as amended in 1977 and 1990. The direction of the smoke plume will be visually monitored and reported as described in the FMP.

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.

General Description of Vegetation in Mammoth Cave National Park

Vegetation in the park has been classified into seven categories and mapped based upon individual sorting of 200 Landsat satellite spectral data channels using the habitat map as a guide (Olson et.al.2000). This vegetation classification is condensed in order to facilitate designation of fuel types for fire management. The attached project maps are excerpts from this vegetation map, and the seven vegetation types are summarized in Table 1.

In subxeric deciduous forest, chestnut oak and chinkapin oak sort very distinctly with sandstone and limestone substrates respectively, whereas blackjack and post oaks are less selective. With periodic fire, these forest stands may have been a more open woodland or savanna in the past. Much of the relatively level plateau fragments, (locally called ridges) which will someday support oak-hickory forest and savanna, were in agricultural use prior to park establishment. Exceptions to this generality are the Big Woods and Collie Ridge north of Green River, and much of the Mammoth Cave Estate on Jim Lee and Mammoth Cave Ridges. Within these mesic upland oak-hickory forests, the chemical and hydrological influence of relatively thin limestone units (currently classified as calcareous subxeric habitat) interbedded with sandstone on the ridges is muted in comparison with the thick limestone beneath karst valleys. This is due to weathered sandstone residuum on top of the limestone, and the limited degree of karst development possible. Karst usually leads to drier surface conditions due to subsurface drainage, but (paradoxically) upland swamps perched on sandstone may have originated as sinkholes in these thinner units such as the Haney limestone. Unfortunately, these upland swamps with stands of pin oak, sweetgum, and red maple are too small to be mapped at the 30 meter resolution of Landsat imagery.

Mesic hollow forests are most prominent in ravines directly connected with the Green and Nolin River Valleys, but outliers exist in karst valleys in the bottoms of large sinkholes. In addition to beech and maple, black cherry, and black walnut can be locally prevalent. In exceptionally moist hollows mostly found in the northwest extremity of the park, relict stands of hemlock and yellow birch are found. These also are too small to map at 30 meters resolution. Floodplain forests are characterized by sycamore, silver maple, and river birch on river banks, and box elder slightly further from the water. Mesic hollows are relatively undisturbed due to the lack of flat ground, which cannot be said for the once heavily farmed floodplain. Being superbly adapted to the highly disturbance-prone gravel bar habitat, sycamore trees are also found wherever significant disturbance has occurred, such as along roads.

Mixed deciduous/coniferous (and vice versa) forests in the park are overwhelmingly successional after pre-park pasture and row crop use. These old fields are generally located in acid mesic habitats (with some interbedded limestones as discussed above) on relatively level uplands, in calcareous subxeric habitat found in karst valleys, and on floodplain alluvium. On xeric sandstone habitat types, especially on cliff margins, nearly pure stands of Virginia pine occur as a narrow band only tens of meters wide. Outside of this band, chestnut oak takes over, also as a nearly pure stand. Xeric limestone sites are found on moderately steep slopes to cliffs, which generally face south to south west. Eastern red cedar along with chinkapin oak characterize what are termed cedar-oak glades. Conditions are so dry here during some times of the year, that native prickly pear cactus are found in some cedar-oak glades in the park. In these hillside glades, cedars are not successional in contrast to the profoundly disturbed old fields. To illustrate the difference between cedars in old fields and those in glades, consider that the largest cedars growing on the driest sites are probably the oldest living things the park. Looking parkwide, when we hear the term "old growth forest", we immediately think of the Big Woods, but our cedar-oak glades are almost certainly old growth too. The successional trajectory for old field forests is reasonably clear on the uplands (oak-hickory forest/savanna), and the floodplain (sycamore-boxelder), but in the karst valleys pre-settlement vegetation types are not known. Shingle oak is largely restricted to karst valleys, which is an edge species, so this may indicate forest openings prior to settlement and farming.

VEGETATION	HABITAT TYPE	TYPICAL SPECIES
1. Subxeric Deciduous Forest/Savanna	Acid Subxeric Calcareous SubXeric	Chestnut Oak Post Oak Chinquapin Oak Blackjack Oak Post Oak
2. Mesic Upland Deciduous	Acid Mesic Calcareous Subxeric	White Oak Pignut Hickory Black Oak Tulip Poplar

3. Mesic Hollow/Floodplain Deciduous Forest	Calcareous Mesic Acid Mesic Alluvium	Sugar Maple Beech Box Elder Sycamore
4/5. Mixed Deciduous/Coniferous Mixed Coniferous/Deciduous Forest	Acid Mesic Calcareous Subxeric Alluvium	Red Maple Tulip Poplar Dogwood Sweetgum Cedar/pine
6. Coniferous Forest	Acid Xeric to Mesic Calcareous Xeric to Subxeric	Virginia Pine Eastern Red Cedar
7. Prairie/Open Area	Calcareous Subxeric Acid Mesic	Native Grasses and Forbs Mown Grass

Table 1. Vegetation types, habitat types and typical species found in each community type.

Coniferous forests in the park, like the mixed stands previously discussed, are overwhelmingly successional after pre-park agriculture. Stands in karst valleys are dominated by eastern red cedar, and those on sandstone uplands are mostly Virginia pine, but considerable mixing occurs. Whether the stands are cedar or pine, indications of ecological succession are visible on the map. Commonly on the uplands around a nucleus of coniferous forest, a zone of coniferous/deciduous forest is found, which is followed by a zone of deciduous/coniferous vegetation, transitional to oak-hickory forest. All elements are not present in each case, but forest succession is clearly documented. In the big karst valleys, the current successional trajectory is less clear. In the absence of fire, the karst valleys could easily become a subxeric oak-hickory forest with mesic hollow species in the sink bottoms. Prairie in the park is limited to small areas each less than 100 acres and none can be considered actual remnants from presettlement times. Even so, these areas are rich in prairie grasses and forbs such as big bluestem, Indian grass, goldenrod, and tall coreopsis. They serve as refuges for species marginalized by conversion of former prairie on the sinkhole plain to agriculture, and by fire suppression within and beyond park boundaries (Seymour 1997). Other open areas in the park are largely mown roadsides, cemeteries, and lawns around developments maintained in fescue.

Vegetation Descriptions of Proposed Prescribed Fire Areas

Eagle Prairie, N3

The Eagle Prairie prescribed fire area consists of 67 acres that were planted in tall grasses and native forbs as a prairie restoration project in 2005. The site historically contains known populations of the exotic and invasive Johnson grass, *Sorghum halepense*, and possible domestic blackberry (*Rubus*) species. Populations of these species are still present inside or in close proximity to the unit. The elevation ranges from about 700- 800 feet. A vegetation map of this planned prescribed fire area is attached.

PARAMETER	RANGE	PREFERRED
Dates:	January – April	
Temperature:	40-90° F	75° F
Relative Humidity	25-70%	35%
Mid-Flame Windspeed	0-6 mph	4 mph
Wind Direction	All	North
1-hour fuel moisture	5-9%	5%
10-hour fuel moisture	6-30%	
KBDI's ³	<500	
Total length of fire line	1.5 miles	
Acres planned	67 acres	

Table 2. Preliminary Burn Prescription for Eagle Prairie (PFA N3).

Specific Objectives

1. Maintain woody species percent cover at <25% as measured 2 years postburn.
2. Increase herbaceous diversity to include 20% native forbs as measured 2 years after the second fire.
3. Cause no net gain in percent cover of exotic plants as measured one year and five years post burn.

Special Considerations

Fire may promote the growth of Johnson grass, so particular attention should be given to this species in post fire assessments.

(See www.fs.fed.us/database/feis/plants/gaminoid/sohal/all.html)

Temple Hill, N4A, N5F

The Temple Hill prescribed fire area consists of 1,876 acres with an elevation range from about 440-850 feet. The area supports a wide range of regionally typical forest forbs that benefit from fire such as false foxglove, and species that may not benefit such as ginseng, and goldenseal. The burn unit also contains exotic and invasive plant species including ailanthus, royal paulownia, and garlic mustard, which may tend to increase after fire. A vegetation map (Olson et.al.2000) of this planned prescribed fire area is attached, and the following is a GIS-based community type breakdown based upon the map. In the Temple Hill unit, there are 552 acres of Xeric/Subxeric Forest/Woodland and 469 acres of Mesic Forest/Woodland for a total of about 1,021 acres. This acreage is fire-adapted oak-hickory, and it covers about 54% of the Temple Hill unit. This is where fire should be applied, whether is on ridge tops or on slopes. There are 19 acres of coniferous forest, 233 acres of mixed coniferous/deciduous forest, and 76 acres of mixed deciduous/coniferous forest. These vegetation classes are old fields and total 328 acres, which accounts for about 17% of the Temple Hill unit. There are 493 acres of mesic slope/floodplain forest, which account for roughly 26% of the Temple Hill unit. Together, the

old fields and moist habitat vegetation account for about 43% of the unit, and should not have fire applied directly. Fire can spread into these areas from fire adapted vegetation as it will on its own.

Specific Objectives

1. Reduce density of encroaching mesic species such as beech and red maple in chestnut oak forest.
2. Assist in the control of invasive and exotic plants that are susceptible to fire.
3. Reduce fuel loading to reduce the frequency and severity of wildfires.

PARAMETER	RANGE	PREFERRED
Dates:	January – April	
Temperature:	40 - 90° F	75°
Relative Humidity	25-70%	35%
Mid-Flame Windspeed	0-6 mph	4
Wind Direction	West - South	South
1-hour fuel moisture	5-9%	5%
10-hour fuel moisture	6-30%	
KBDI's	<500	
Total length of fire line	7.0 miles	
Acres planned	1,876 acres	

Table 3. Preliminary Burn Prescription for Temple Hill (PFA N4A, N5F).

Special Considerations

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. As well, any known Butternut trees in the unit will be prepped with a 30 foot fire ring and excluded from burning.

Whereas it is known that exotic plant species are in the burn unit, complete information on populations is lacking, and so the effects of fire on these areas will not be known. In the temple Hill unit, ailanthus and royal paulownia are known to be along the road, especially near old home sites. On the Green river floodplain, garlic mustard is abundant and there is a patch of ailanthus, but because fire will not be applied in these areas, it should not be a factor.

Jim Lee Ridge, 54A, B, C, & D)

This unit includes a mix of mostly dry upland habitats underlain by both sandstone and cap rock limestone, which also includes an upland swamp. Slopes support both sandstone and limestone based plant communities, including rich coves on shaded aspects. An arson fire in 1995 burned 116 acres within this unit. Jim Lee consists of 1,749 acres of mixed forest of both calcareous and acidic xeric soils with extensive areas of exposed limestone outcrops and glade communities. Elevation ranges from about 475 to 810 feet. This unit contains a significant cedar-oak glade on the southern flank of Jim Lee Ridge. The glades support coneflowers, *Lobelias*, blazing star and native grasses. A vegetation map (Olson et.al.2000) of this planned prescribed fire area is attached, and the following is a GIS-based community type breakdown based upon the vegetation map (Olson et.al.2000). In the Jim Lee unit there are 58 acres of Xeric/Subxeric Forest/Woodland and 627 acres of Mesic Forest/Woodland for a total of about 685 acres. This acreage is fire-adapted oak-hickory, and it covers about 40% of the Jim Lee unit. This is where fire should be applied, whether is on ridge tops (plateau fragments) or on slopes. There are 191 acres of coniferous forest, 347 acres of mixed coniferous/deciduous forest, and 147 acres of mixed deciduous/coniferous forest. This is mostly old fields, and totals 685 acres, but the mixed coniferous/deciduous forest would include about 40 acres of cedar oak glade that is found on the south slopes of Jim Lee Ridge. So, about 40% of the Jim Lee unit is old fields except for about .02% in the cedar oak glades. The glades are probably maintained primarily by dry site conditions with infrequent fire. There were 342 acres of mesic slope/floodplain forest, which account for roughly 20% of the Jim Lee unit. Together, the old fields, cedar oak glades and moist habitat vegetation account for about 60% of the unit, and should not have fire applied directly. Fire can spread into these areas from fire adapted vegetation as it will on its own.

Specific Objectives

1. Reduce density of encroaching mesic species such as beech and red maple in oak-hickory forest.
2. Assist in the control of invasive and exotic plants that are susceptible to fire.
3. Reduce fuel loading to reduce the frequency and severity of wildfires.
4. Maintain cedar-oak glade community structure and composition.

Special Considerations

Several mussel species are known to be present in the Green River downstream from the prescribed fire unit and one mussel breeding bed has been identified at Turnhole Bend area. While the activity level of the mussel species is low during the cool months of the proposed fire season, it is not known how sediment from fire sites could affect this group of species. Drainage into Green River from the burn unit would be via underground streams emerging at Echo River Spring rather than directly into the river.

Significant portions of habitat for the endangered Kentucky cave shrimp lie beneath the Jim Lee prescribed fire area. This includes Roaring River in Mammoth Cave, which is designated as critical habitat in the recovery plan for this species. The potential effects of fire on this species are not known; however, fire has occurred on the landscape as a natural process and via native American set fire for the past 4,000 years with no apparent negative effects.

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.

The unit contains several plots of American chestnut saplings which have been planted as part of a restoration project in the past several years. These plots should be prepped and excluded from burning. This unit also contains three high-density ginseng plots near the public access cave entrances which have been part of an intensive monitoring project for several years. These areas should also be excluded from burning. Any known Butternut trees in the unit will be prepped with a 30 foot fire ring and excluded from burning. Roads will be used as fire lines on all sides of the prescribed fire area. Hand line will only be constructed to contain spots or unplanned ignitions, to protect specific natural or cultural resources.

Whereas it is known that exotic plant species are in the burn unit, specific information on populations is lacking, and so the effects of fire on these areas will not be known. In the Jim Lee unit, ailanthus and royal paulownia trees are known to be along the road to Carmichael entrance, with another stand of ailanthus on route 70 near where the motor nature trail joins. In the moist coves near the north end of the motor nature trail, garlic mustard is abundant, but because fire will not be applied in these areas, it should not be a factor.

PARAMETER	RANGE	PREFERRED
Dates:	January - April	
Temperature:	40-90° F	75° F
Relative Humidity	25-70%	35%
Mid-Flame Windspeed	0-6 mph	4 mph
Wind Direction	All	North
1-hour fuel moisture	5-9%	5%
10-hour fuel moisture	6-30%	
KBDI's	<500	
Total length of fire line	7.0 Miles	
Acres planned	1749 acres	

Table 4. Preliminary Burn Prescription for Jim Lee (PFA S4 A, B, C, & D).



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.⁴ 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 2009 plan. This plan calls for prescribed fires to be limited to the period of time that Indiana bats would likely be hibernating in some caves (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 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 insignificant.

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

Proposed Finding: The prescribed fires proposed in the FY 2009 Prescribed Fire Plan are not likely to adversely affect 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

⁴ See Clawson, Richard L. "Report on the Status of Priority 1 Indiana Bat Hibernacula, 1989," 1989.

biennial censuses conducted by the U.S. Fish and Wildlife Service.⁵ 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 2009 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 insignificant.

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

Proposed Finding: The prescribed fires proposed in the FY 2009 Prescribed Fire Plan are not likely to adversely effect the Gray bat.

Kentucky Cave Shrimp

The Kentucky cave shrimp is endemic to the Mammoth Cave National Park region (U.S. Fish and Wildlife Service 1988). The known distribution includes nine groundwater basins in the area. Three of the basins are located mostly within the park, and 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 affect the quality or flow pattern of water in a given groundwater basin will have an impact on the species. The Jim Lee unit is substantially within Echo River Spring groundwater basin. This includes Roaring River, which is designated as critical habitat for the Kentucky cave shrimp. Post burn, sediment is unlikely to impact shrimp habitat for the simple reason that only the surface leaf layer is consumed by flames and the duff layer remains intact. The potential impact of fire upon cave life in general is not known, but it is fair to say that Native Americans burned frequently and broadly in the Mammoth Cave area for thousands of years. In terms of cave life, Mammoth Cave is known as a biodiversity hot spot, so if fire in the past had detrimental consequences then it is not apparent.

⁵ Clawson, 3.

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 insignificant.

Indirect Effects: It is suspected that soils within the park are abnormally acidic at least in part due to acid precipitation. 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 throughout time as a natural process, the indirect effects, if any, are expected to be insignificant.

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. From 1993 to 2005, shrimp were monitored in four stream reaches within base level aquatic communities in the Mammoth Cave System. An Index of Biotic Integrity (IBI) was calculated based upon eleven metrics (see appendix). IBI scores from the mid 90s and early 2000s indicated 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 up to 2005. Monitoring efforts are currently under review to determine the future set of monitoring parameters.

Table 5. 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					

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 2009 Prescribed Fire Plan may affect, but are not likely to adversely affect the Kentucky cave shrimp.

Endangered Mussels

There are seven 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.⁶ 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.⁷

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. This species is also threatened by the impending invasion of zebra mussels.

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, including a population in the Green River 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.

⁶ 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.

⁷ Personal communication between Mark DePoy, Mammoth Cave National Park, Chief of the Science and Resource Management Division, and Dr. Layzer.

Northern Riffleshell

The Northern Riffleshell occurs in a wide variety of streams, large and small, including the Green River. It 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 in the Green River 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.

Purple Catspaw Pearly Mussel

The Purple Catspaw Pearly mussel inhabits large to medium river system in sand and gravel substrates in runs and riffles. This species is thought to be reproducing in only one population. Three extant populations are thought to exist; one in the Green River in Kentucky. The reduction in range can be attributed to several factors including impoundment, dredging, water level fluctuations and water pollution. This species is also threatened by the impending invasion of the zebra mussel.

Direct Effects: The Temple Hill unit adjoins the Green River and Nolin floodplains. Because ignition is to be on the ridge tops or slopes as opposed to along the banks of the rivers, ash or storm water runoff would not likely impact habitat of these species significantly. Ignition will take place on slopes above the floodplains with fire adapted vegetation, 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.

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

Proposed Finding: The prescribed fires proposed in the FY 2009 Prescribed Fire Plan are not likely to adversely affect the endangered mussel species.

Surprising Cave Beetle

This species is one of 255 species in the genus *Pseudanophthalmus*. 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 three of the listed caves. Little is known of its specific food requirements. No photosynthesis takes place within the dark zone of a cave. Therefore, all organisms that are adapted to life within a cave are dependent upon energy from the surface. This energy can be in the form of cave cricket guano, bat guano, wood rat latrines, leaf litter, woody debris, and small bits of organic matter that falls or is washed into the cave. The habitat used by *P. inexpectatus* has been described as wet, rotting wood in humid, protected microhabitats with slow airflow. However, we now recognize that humans imported the woody material into these areas, so the natural habitat did not necessarily consist of wet, rotting wood. Recent collections of the species have occurred in habitats typical of the interior portions of the Mammoth Cave system (i.e., mineral soils and rock and their mixtures). 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 1996.⁸ The species was located in Surprising Cave in 2003 by park employee Steve Thomas. The three prescribed fire units included in the FY 2009 do not lie directly over the locations reported for the surprising cave beetle.

Direct Effects: No direct effects are expected.

Indirect Effects: No indirect effects are expected.

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

Proposed Finding: Implementation of the FY 2009 Prescribed Fire Plan is not likely to adversely affect the surprising cave beetle.

DETERMINATION OF EFFECT AND RATIONALE SUMMARY

Rationale (See Table 6.)

⁸ 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, trechid*) from Tennessee and Kentucky." *Journal of the Tennessee Academy of Science*. 34-1, January 1959.

- A. Species not known to be present in Mammoth Cave National Park
- B. Species not known to be 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

Species Common Name	Rationale*												
	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					
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
Pink Mucket Mussel		X	X	X		X	X	X	X				X
Purple Cat's Paw Pearly Mussel		X	X	X		X	X	X	X				X
Candidate Species:													
Surprising Cave Beetle		X	X	X		X	X	X	X				
Sheepnose Mussel		X	X	X		X	X	X	X				X
Spectral Case Mussel		X	X	X		X	X	X	X				X

Table 6. 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.

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 directly 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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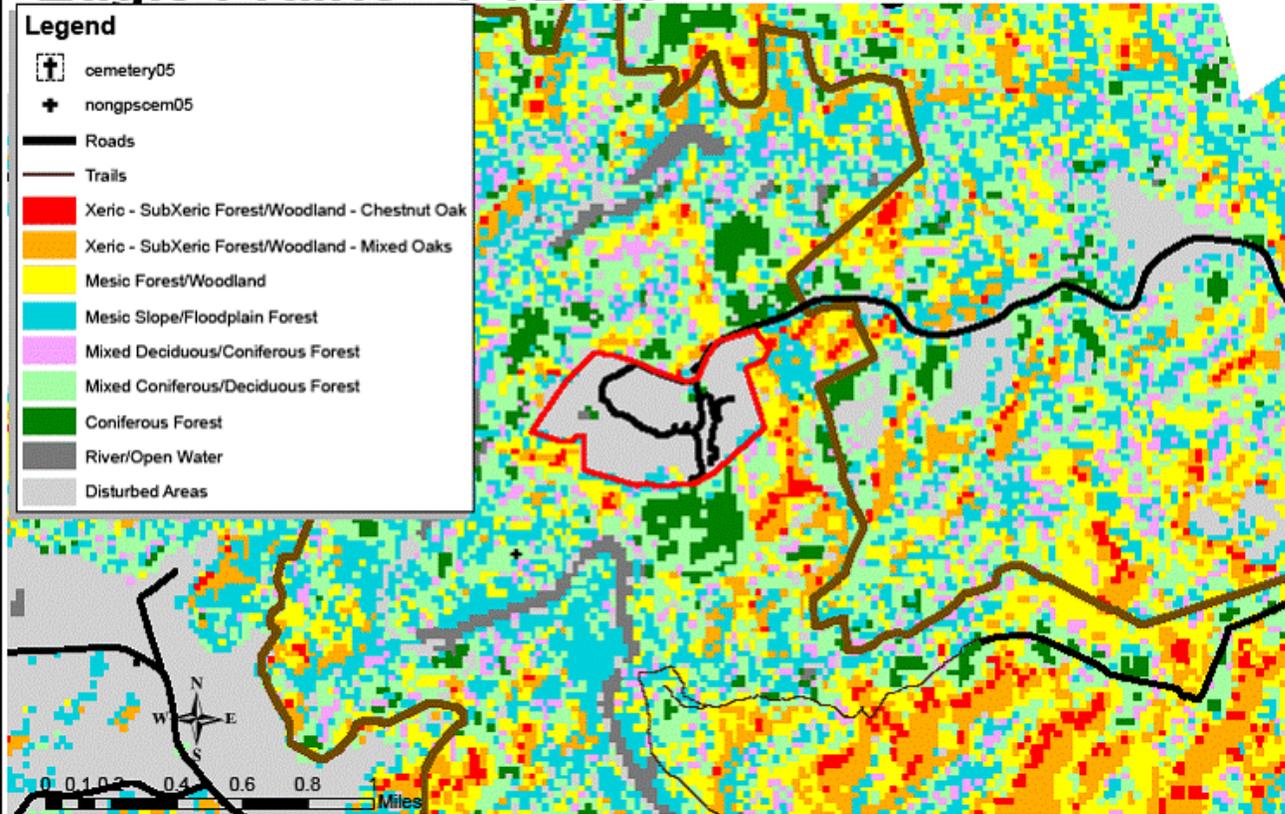
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Eagle Prairie - FY2009

Legend

-  cemetery05
-  nongpscem05
-  Roads
-  Trails
-  Xeric - SubXeric Forest/Woodland - Chestnut Oak
-  Xeric - SubXeric Forest/Woodland - Mixed Oaks
-  Mesic Forest/Woodland
-  Mesic Slope/Floodplain Forest
-  Mixed Deciduous/Coniferous Forest
-  Mixed Coniferous/Deciduous Forest
-  Coniferous Forest
-  River/Open Water
-  Disturbed Areas

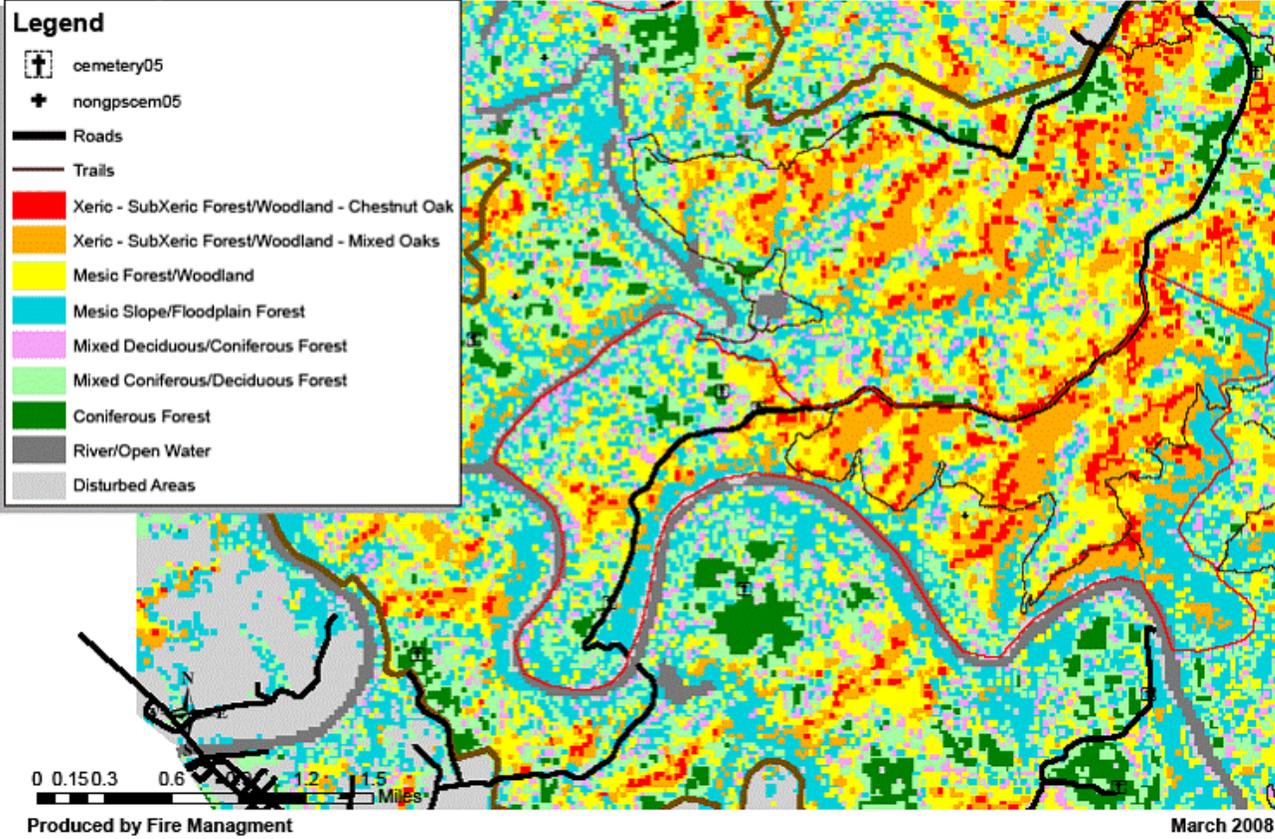


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Temple Hill - FY2009





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