# WHC Nomination Documentation

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SITE NAME ("TITLE") Mammoth Cave National Park

DATE OF INSCRIPTION ("SUBJECT") 30/10/1981

STATE PARTY ("AUTHOR") UNITED STATES OF AMERICA

CRITERIA ("KEY WORDS") N (i)(iii)(iv)

DECISION OF THE WORLD HERITAGE COMMITTEE:
The Committee made no statement.

BRIEF DESCRIPTION:
Mammoth Cave National Park, located in the state of Kentucky, contains the largest network of natural caves and underground passageways in the world, characteristic examples of limestone formations. The park and its underground network shelter a varied flora and fauna, including a number of endangered species.

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1.b. State, province or region: Counties of Barren, Edmonson, and Hart in the State of Kentucky

1.d Exact location: Long. 86°00’00» – 86°17’30» W ; Lat. 37°07’30» – 37°17’30» N

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# MAMMOTH CAVE NATIONAL PARK

## WORLD HERITAGE LIST NOMINATION

By

THE UNITED STATES OF AMERICA

1980

WORLD HERITAGE NOMINATION
MAMMOTH CAVE NATIONAL PARK
UNITED STATES OF AMERICA

## 1. SPECIFIC LOCATION

### a) Country

United States of America.

### b) State, Province or Region

Mammoth Cave National Park is located in the counties of Barren, Edmonson, and Hart in the State of Kentucky.

### c) Name of Property

In 1905, members of the Kentucky Congressional Delegation recommended to the Secretary of the Interior that a national park be created in the Mammoth Cave region. On May 25, 1926, Congress of the United States authorized the establishment of Mammoth Cave National Park, and on July 1, 1941, the area was declared a national park.

### d) Exact Location on Map and Indication of Geographical Co-ordinates

Mammoth Cave National Park's boundary is irregular and contains over 52,000 acres of land. The boundary lies approximately between 86°00'00" west longtitude and 86°17'30" west longtitude and 37°07'30" north latitude and 37°17'30" north latitude.

## 2. JURIDICAL DATA

### a) Owner

United States Government, Department of the Interior, National Park Service.

### b) Legal Status

The May 25, 1926 Act (44 Stat. 635) authorizing Mammoth Cave National Park stipulated the park could contain up to a maximum of 70,618 acres and that only donated lands conveyed in fee simple could be accepted by the Secretary of the Interior. By July 1, 1941, the minimum amount of land, as required by the Act, had been deeded to the United States and the area was established as a National Park consisting of 45,310 acres. Today, the park contains 52,454.22 acres.

With the exception of six parcels of land totaling 9.2 acres, all lands within the boundary of Mammoth Cave National Park are in public ownership. Location of the private tracts makes any type of development unlikely. However, to preclude any chance of adverse impacts, purchase of these tracts by the National Park Service is contemplated.

The Secretary of the Interior is empowered to make rules and regulations for the proper management and care of the park and for the protection of the property therein.

### Accessibility to General Public

Major population centers are within a day's travel and their cities are interconnected by an interstate highway system. The park is within a few miles of Interstate 65. In 1973, park travel reached an all time high of 1.9 million visitors. Of these, 675,000 (or36%) went on cave tours.

### c) Responsible Administration

The United States Department of the Interior, National Park Service, is responsible for the administration of Mammoth Cave National Park. The address is: U. S. Department of the Interior, 18th & C Street, N.W., Washington, D. C. 20240.

A Superintendent is responsible for on-site administration. Included on his staff are managers and specialists skilled in the fields of administration, resource management, interpretation, maintenance, and visitor protection. A professional geologist studies the hydrogeological and environmental relationships at Mammoth Cave.

3. IDENTIFICATION

a) Description and Inventory

CULTURAL HERITAGE:

Pre-Columbian Indians of four cultural periods occupied the park and its environs. These peoples - Mississippian, Woodland, Archaic, and Paleo-Indian - hunted in the area that is now the park and lived in cave entrances, beneath rock shelters, and near riverbanks. The early Woodland culture period is one of special archeological importance because it exhibits the first evidence of organized horticulture in North America. Evidence indicates the Woodland peoples practiced primitive agriculture on river floodplains and were some of the first explorers and miners in Mammoth Cave. They penetrated as far as three miles into the cave passages where they chipped gypsum and mirabilite from the walls. The stable atmosphere in the caves has preserved perishable items that are non-existent elsewhere. Several mummies have been found and numerous human feces have been analyzed to determine the diet of these ancient people. Sandals, bags made of twine, reed torches, campfire sites, smoke smudges on walls and ceilings, and prints of bare feet preserved in mud are among the evidences of Indian use and activity beneath the surface.

Modern man, who discovered Mammoth Cave around 1798, continued to follow the steps of the earlier explorers and miners. In the early 1800's, someone noted that the dirt on the floor of the cave was rich in nitrate, a substance used in the manufacture of gunpowder. With the advent of the War of 1812, exploitation of Mammoth Cave began. The rich "peter dirt" was mined and the nitrate was leached from it. Cave visitors today can see some of the relics of this period including leaching vats and wood pipes. This industry began in 1809 and flourished for nearly a decade, ending after the close of the war.

Visitors hearing of the immensity of the cave began to come and public tours guided by Negro slaves started in 1816. The guides explored and discovered many passages and in time, Mammoth Cave was extolled as the seventh natural wonder of the world. The cave is considered to be the second oldest tourist attraction in the United States.

In 1842, Dr. John Croghan, seeking a cure for tuberculosis, established an unsuccessful treatment center within the Mammoth Cave system. Two of the six patients' huts, erected in the cave, remain today.

Floyd Collins, an intrepid cave explorer, became entrapped in Sand Cave and caused one of the most widely publicized events of modern times. He died on February 16, 1925, before he could be rescued. A casket in Crystal Cave contains his remains.

Prior to the establishment of the park, about 45 percent of the land was cultivated or grazed. Tobacco and corn were principal crops. Farmlands were connected to one another and to the market by primitive wagon roads. Several private ferries crossed the Green River. Most of the farms were situated on river terraces and on ridge tops. Slopes of valleys and bluffs, too steep for cultivation, remained in forest and were utilized. Today, except for space used for park purposes, the former cultivated lands have returned, or are returning, to forest.

Historical and classified structures total 95. To date, more than 50 archeological sites have been identified which represent only the beginning of the archeological survey in the park. Among the sites are the extensive investigations conducted in Salts Cave and Mammoth Cave which have produced important archeological finds.

NATURAL HERITAGE:

Mammoth Cave National Park contains the most extensive cavern system and some of the finest examples of karst topography in the world. On the surface, fascinating landscapes, luxuriant vegetation, abundant animal life, and evidence of ancient culture exist. Beneath the surface, over 200 miles of interconnecting cave passages have been explored and mapped. Cave explorers and geologists predict discoveries will extend the cave system to more than 500 miles. Nearly every type of cave formation is displayed within the park. The caverns contain minerals such as travertine, gypsum, and mirabilite and a number of underground streams of which Echo and Roaring Rivers are best known. Of equal importance are the 300 kinds of animals and plants found within the cave system.

The major cave system is beneath the Mammoth Cave Plateau. This plateau is an erosional remnant consisting of three northwest trending ridges - Joppa, Mammoth Cave, and Flint - separated by solutional valleys - Woolsey, Doyel, and Houchins - 200 to 300 feet deep, formed when cave ceilings collapsed and subsided along the beds of ancient underground streams. Ridges are capped by impermeable sandstone and shale beds totaling about 100 feet thick, which have protected the caves in the limestone beneath. In cross section, the limestone is honeycombed with passages that began as the underground continuation of north-flowing

tributaries of the Green River that were once on top of the Big Clifty sandstone. These tributaries drained a large sinkhole-covered area called the Pennyroyal Plateau. In time, the erosion-resistant sandstone was breached and the water table dropped as the Green River cut its bed lower. Concurrently, water from the Pennyroyal found its way underground and flowed through the solution passages it formed in the limestone. Some of these passages are up to 100 feet wide and high and are several miles long. These very long horizontal passages, elliptical or canyon-like in cross section, are best known to visitors. A spectacular example is Main Cave (in Mammoth Cave) which is 3 miles long, averaging 60 feet wide and 40 feet high. Throughout the caves, passages join and diverge on at least five different levels. Among the distinctive features of the cave are the vertical shafts, called domes or pits, which resemble the interior of a silo. They occur in many sizes, up to 40 feet or more in diameter and 130 feet in height.

Beneath the surface of the park are several trunk conduits that carry water to the Green River from the Sinkhole Plain. The Sinkhole Plain, also part of the ancient Pennyroyal Plateau, is outside of park lands. Approximately 80 square miles of the Sinkhole Plain drain into the Mammoth Cave system and eventually into Green River.

The Green River, a major tributary of the Ohio, bisects the park from east to west for 26 miles. The river ranges in width from 50 to 300 feet and is subject to 50-foot flood crests. By an act of the Kentucky Legislature, the section of the river within the park was designated as a "Wild River". Some of the most outstanding riverscapes in the state exist here. A total of 107 species of fish have been collected from river waters. In addition to the abundant fish population, the river hosts a wide range of fresh water mussels, several of which are on the official list of endangered species. The river is now 400 feet below its former level on the Mammoth Cave Plateau.

From Turnhole Bend eastward, no surface streams enter the Green River from the south. Instead, tributaries from the south enter the Green in the form of several large springs along its bank or in its bed. These springs are at the mouths of the underground conduits that pass through the limestone and carry water from as far away as the Sinkhole Plain. Turnhole Spring is the largest and most spectacular resurgence in the park. Pike Spring, and the outlets of River Styx and Echo River, which drain Mammoth Cave, are quite sizeable also. Former underground rivers, now dry, are the cave passages that visitors use today. In Mammoth Cave, the passages are developed on five different levels that correlate with stages in the lowering of the riverbed.

In all, some 200 kinds of animals are known in the cave passages of the park, including two species of "blindfish". Some live in total darkness, high humidity, and 54 degrees constant temperature; others may leave the cave for varying lengths of time and return to it. For many animals, the only source of nutrients is washed into the cave by water. About one-third of the animals have been isolated from other cave systems for over a million years. Many species are found only in the central Kentucky karst area. Once extirpated, they could never be replaced. The Indiana bat (Myotis sodalis), an endangered species, utilizes certain caves in the park.

Of special concern is the Kentucky cave shrimp (Palaemonias ganteri), a freshwater species that is colorless and eyeless. It depends on annual flooding of relatively quiet pools in autumn when water levels are lowest, microorganisms are present, and the majority of the young hatch. According to the Office of Endangered Species and International Activities of the Fish and Wildlife Service (FWS), the shrimp is known in only two pool systems, both in Mammoth Cave National Park - Roaring River in Mammoth Cave and near Golden Triangle in Crystal Cave - where there are only small populations, though it was once abundant along tourist trails in the Echo River passage. Because of its uncertain status, the FWS consideres this species as a candidate for the official list of endangered species.

Water of the proper quality and quantity is basic to perpetuation of the animal and plant life in the caves and to the geologic development of the cave passages. Despite 50 inches of annual rainfall, there are few surface streams because the water disappears quickly underground through sinkholes, swallow holes, cracks, and fissures.

The many sinkholes, lack of surface streams, rock-capped ridges, valleys, forests, overgrown fields, varied wildlife and a wealth of wildflowers present a unique and everlasting picture to park visitors. Living on the surface of the Mammoth Cave Plateau are communities of plants and animals that include 84 kinds of trees, 28 varieties of shrubs and vines, 29 types of ferns, and 209 wildflowers. The cedar karren and savannas of the solution valleys are picturesque and of interest to scientists. There are 41 kinds of mammals, 203 species of birds, 18 kinds of reptiles, and 15 species of amphibians. Invertebrates are numerous.

Various watersheds, self-contained within the park that occur north of the Green River, have been identified in the park's General Management Plan as "basin ecosystems". These are rare and their study would be valuable to the

International Biological Program. One of them adjoins Big Woods, a tract of about 300 acres which is reported to be one of the best remaining examples of a virgin white oak/black oak/tulip tree forest in eastern North America.

Fossils are generally distributed throughout the rocks of Mississippian Age in the park. The fossils include brachiopods, crinoids, and corals. Important paleontological finds from the cave include recent bone discoveries of the mammoth, the long-nosed and flat-headed peccary, and the great short-faced bear.

b) Maps and/or Plans

Maps and plans of Mammoth Cave National Park pertinent to its protection and operation include:

1. Map - U. S. Geological Survey map of Mammoth Cave National Park and Vicinity, Kentucky (N3705-W8557 .5/12.5x20), Scale 1:24,000. Edition 1966. Including partial culture revision 1972.

2. Master Plan, Mammoth Cave National Park. U. S. Department of the Interior, National Park Service, approved September 8, 1977.

3. Final Environmental Statement, Mammoth Cave National Park, U. S. Department of the Interior, National Park Service, Document Number FES 76-27.

c) Photographic Documentation

Photographs showing the significance of the Mammoth Cave Region are attached.

d) History

Subsequent information on Cultural and Natural Property has been discussed elsewhere in this report.

e) Bibliography

A list of source material used in preparation or documentation of this nomination is attached.

## 4. STATE OF PRESERVATION/CONSERVATION

### a) Diagnosis

Visits to the world-renowned cave have been occurring for more than a century and a half. People have come on foot, on horseback, in stagecoaches, by railroad, on packet boats, in buses, and in automobiles. Over the years, caves were commercialized as they were discovered and facilities to accommodate visitors occurred. Damage to some irreplaceable cave resources did occur, especially during the early periods of cave use. Full protection of resources became a reality after the area was established as a National Park. Today, the majority of development is near the Historic Entrance and likewise, so are the visitors and the traffic congestion. The Master Plan proposes that essential visitor facilities be relocated from the Historic Entrance to a peripheral staging area. This will assure future protection of the irreplaceable and unique resources of the cave system. However, development of areas adjacent to the park, if not regulated, will have profound effects on the cave system. Lands adjacent to the park, which have relied for years on agriculture, are now turning to light industry as well as tourism for the major income sources. Of major environmental concern is the Sinkhole Plain to the south and east of the park. Precipitation that falls on this extensive area collects in underground streams, flows through natural conduits in limestone beneath the park, and finally discharges into the Green River. Even minor changes in quality or quantity of water could adversely affect the unique aquatic life in underground streams and alter natural cave development.

### b) Agent Responsible for Preservation/Conservation

The United States Government is responsible for Mammoth Cave National Park and it is administered through the U. S. Department of the Interior by the National Park Service.

### c) History of Preservation/Conservation

The movement to protect the area began in 1905 when members of the Kentucky Congressional Delegation suggested National Park status for Mammoth Cave to the Secretary of the Interior. On April 18, 1926, the Appalachian National Park Commission recommended National Park status for Mammoth Cave. One of their reasons was because the limestone caverns contained "beautiful and wonderful formations," the "great underground labyrinth" of passageways "of remarkable geological and recreational interest perhaps unparalled elsewhere," and the "thousands of curious sinkholes of varying sizes through which much of the drainage is carried

to underground streams, there being few surface brooks or creeks." Another reason cited was because of the rugged topography and "areas of apparently original forests which, though comparatively small in extent, are of prime value from an ecological and scientific standpoint, and should be preserved for all time in its virgin state for study and enjoyment."

Pursuant to the recommendation of the Commission, Congress authorized on May 25, 1926 (44 Stat. 635), the establishment of Mammoth Cave National Park which utlimately offered protection to the fragile, priceless, and irreplaceable cave system. Subsequent events concerning preservation of the area have been discussed elsewhere in this report.

d) Means for Preservation/Conservation

The National Park Service is charged by Congress (Act of May 25, 1926, 44 Stat. 635) with the responsibility to manage, develop, interpret, and preserve Mammoth Cave National Park.

e) Management Plans

The Master Plan for Mammoth Cave National Park, approved on September 8, 1977, provides for the management and preservation of park resources, expanded enjoyment of the resources and a mutually advantageous role for the park within the region.

The Environmental Protection Agency is currently preparing an Environmental Impact Statement on proposed wastewater facilities (201 Plan) for Mammoth Cave National Park and several local communities. In August 1979, a draft alternative evaluation task report was prepared. The Citizen Review Committee recommended development of a system that would provide maximum protection for the cave system and for the region. Decision is pending.

5. JUSTIFICATION FOR INCLUSION ON THE WORLD HERITAGE LIST

Mammoth Cave National Park is a world heritage in that it is a unique natural feature with a broad range of universal values recognized throughout the world. It is unique because its beauty is spectacular - yet subtle, its life simple - yet complex, and its world small - yet unknown and mysterious. Men from throughout the world have been fascinated by its mysteries and have explored its passages, studied its life, and lived in its world.

b) For Natural Property

(i) Stages of the Earth's Evolutionary History

The oldest rock deposits of the region are over 300 million years in age and today are covered by limestone and capped with layers of sandstone, shale, and additional limestone. Waters, now known as the Green River, are believed to have flowed along its present course for nearly 100 million years. During the last 10 to 20 million years, the river has been entrenching itself through the sandstone and into the limestone. Underground tributaries developed as the water worked its way under the capped layer and into the limestone. As the river and its erosional processes cut deeper into the bedrock, the surrounding water table was lowered, thus passages that were once water filled dried up. Today this huge and complex network of cave passages provides park visitors with a clear and most complete record of the geomorphic and climatic changes of any readily accessible continental feature in the world.. In these passages are recorded the history of development of the layers of rock and is one of the few places in the world where man can literally walk through time in an environment not familiar to him.

(ii) On-Going Geological Process and (iii) Superlative Examples of Natural Features

Even before Mammoth Cave obtained National Park status, it was world renowned for its size and vast network of passages. Extremely large horizontal passages, ranging in width and height up to 100 feet, make up mile after mile of the system. Connected to the lengthy horizontal passages are hundreds of vertical shafts often extending over 25 feet in width and over 100 feet in height.

Approximately 80 square miles are within the Mammoth Cave watershed. Here exist the most extensive networks of cave passages on earth. No other cave system can provide such a natural laboratory.

By the end of 1980, 225 miles of cave passages will have been surveyed. New passages with unique formations are continually being found. With over 200 catalogued unexplored leads, many more miles of cave will be added to the system. Perhaps the greatest discoveries at Mammoth Cave are yet to come. Only time will uncover the remaining mysteries of the longest known cave in the world.

The geologic process that accounted for the longest known cave is also responsible for creating the premiere model karst system on earth. All of the features of a karst drainage system including a vast recharge area, a complex network of underground conduits, and springs that discharge water from the recharge area and the conduits exist within the Mammoth Cave region.

Surface water collects in the numerous sinkholes on the Sinkhole Plain and flows horizontally underground toward the Green River where it eventually reappears in springs along the river. Water from the perched aquifer atop the Mammoth Cave Plateau flows downward and forms deep vertical shafts that link with the water-filled conduits which drain from the Sinkhole Plain.

The extensive network of conduits and unique underground features have been preserved because of the impermeable caprock. The karst area is constantly undergoing changes and even the overlying caprock is showing signs of gradual erosion. As the Green River continues to cut deeper and deeper, more major conduits will be formed and passageways now traversed by rivers will be left high and dry. Sinkholes will be more numerous in future years and the dissolving action that began several million years ago will continue to become more complex with time.

(iii) Unique and Rare Formations

Within the cave system, splendid forms of beautiful gypsum flowers, delicate gypsum needles, and rare mirabilite flowers decorate many of its

passages. The reason for the rich abundance of sulfate minerals and other rare minerals is not fully understood. What is certain is their extreme fragility. Even the slightest air movement and temperature change caused by man's passage may be detrimental to them. Even how to study some of these unique and rare phenomena presents problems. No other known cave system in the world offers a greater variety of sulfate minerals. In fact, some may exist nowhere else.

(iv) Ecosystems in which Concentrations of Plants and Animals of Universal Interest and Significance are Found

Nowhere on earth does any cave system offer a richer variety of organisms. In fact, few cave systems can match the intensive biological studies that have occurred at Mammoth Cave.

In 1825, the famed French naturalist, Constantine Rafinesque, visited the area and wrote about its bats and salamanders. The world's first known blind cave fish (Amblyopsis spelaea) was discovered in 1842. Other blind cave animals, including a crayfish, beetle, spider, and harvestman, were collected as early as 1842-1844 by a German physician, Dr. Theodor Tellkampf. Today studies and investigations of the cave's unique and fragile fauna are continuing. Mammoth Cave has the most diverse ecosystem in the world.

Of the 200-odd species of fauna, 22 percent are troglobites, 36 percent are troglophiles, 22 percent are trogloxenes, and 20 percent are accidentals. Other organisms include 67 species of algae, 27 species of fungi, and 7 species of twilight-zone bryophytes. Twelve species of troglobites or trolophiles are found only in Mammoth Cave National Park and its immediate vicinity. The extensive large cave system with five cave levels provides ample food and habitat and accounts for the variety of underground life. The geological setting also contributes to its species richness in that the cave system is old enough to have stable communities with fauna from three karst regions within an area large enough for speciation to have occurred. Nowhere else do two blind fish - the Amblyopsis spelaea and the Typhlichthys subterraneus - and their spring-cave dwelling relative - the Chologaster agassizi - co-exist. The first two species are classic examples used to document the phenomenon of regressive evolution of visual systems. Their fragile habitat

could easily be destroyed and their species erased forever by one careless act of man. Their survival is highly dependent upon the normal flow of water into their habitat and upon the absence of water-borne pollutants.

Habitats Where Populations of Rare or Endangered Species of Animals Still Survive

It is clear the rare fauna of Mammoth Cave is of universal importance. Animal species considered rare and found only in the Mammoth Cave area include:

| | |
|---|---|
| Two pseudoscorpions | - *Kleptochthonius hageni* |
| | *K. cerberus* |
| Spider | - *Anthrobia monmouthia* |
| Millipede | - *Antriadesmus fragilis* |
| Three beetles | - *Pseudoanophthalmus audax* |
| | *P. inexpecatus* |
| | *Vatrisodes henroti* |
| Booklouse | - *Dorypteryx hageni* |
| Springtail | - *Arrhopalithes altus* |
| Snail | - *Helicodiscus punctatellus* |
| Ostracod | - *Sagittocythere stygia* |
| Shrimp | - *Paleomonias ganteri* |

Essentially, the same ecosystems exist today as existed since prehistoric times. One species, a colorless, eyeless, freshwater shrimp (*Paleomonias ganteri*), is being proposed for endangered species status. It is believed the limited suitable micro-habitat used by this species has been reduced by unnatural flooding and/or pollution. The shrimp, being at the end of the food chain, is of special concern to park managers as it is considered an indicator species for an entire ecosystem. What action man takes to assure its survival will be carefully monitored by the scientific community. For many, the true significance of Mammoth Cave rests with its fascinating and unique animal life. Indeed, the large populations of rare animals found at Mammoth Cave have made it world renowned.

Signed 

Full name David F. Hales

Title Deputy Assistant Secretary for Fish and Wildlife and Parks

Date December 2, 1980

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WORLD HERITAGE NOMINATION

IUCN TECHNICAL REVIEW

1. IDENTIFICATION NUMBER AND NAME 150 Mammoth Cave National Park

2. LOCATION: Barren, Edmonson, and Hart Counties, State of Kentucky, United States of America; 86°10'W, 37°10'N.

3. NOMINATED BY: National Park Service, Department of the Interior, Government of the United States of America

4. DOCUMENTATION:

(i) Nomination (with maps and photos)
(ii) Supplementary documentation (IUCN)

a) Consultation, Dr. M.E. Tuttle, Smithsonian Tropical Research Institute (chiropteran specialist)

b) Consultation, Dr. Arrigo A. Cigna, President, Union Internationale de Spéléologie

5. BACKGROUND AND SUMMARY

Mammoth Cave National Park includes by far the longest cave system in the world, with known passages extending some 306 kilometres and perhaps an equal length of as yet undiscovered passages. It is of geological importance due to the 100 million years of cave-forming action by the Green River and its tributaries; nearly every type of cave formation is known within the site, and the geological processes involved in cave formation are continuing. The long passages with huge chambers, vertical shafts, stalagmites and stalactites, typsum "flowers" and "needles", and other natural features of the cave system are all superlative examples of their types. The flora and fauna of the cave is the richest caverniculous wildlife known, numbering some 300 species, of which 12 species are rare and endemic to the cave system. Outside the cave, the karst topography is superb, with fascinating landscapes, luxurient vegetation, and abundant wildlife; all of the features of a karst drainage system -- vast recharge area, complex network of underground conduits, sink holes, cracks, fissures, and surface and underground springs -- are found within the site. Mammoth Cave has been important in the development of human culture, with four distinct cultural periods described: Paleo-Indian, Archaic, Woodland, Mississippian. The early Woodland period is particularly important because it marked the independent development of horticulture in the Western Hemisphere.

6. INTEGRITY

The site includes the entire cave system, thus meeting criteria 21 (ii) and (iii). However, the site does not include the entire river catchment of waters flowing through the site, so future disturbance beyond the control of the Responsible Authority is possible, particularly to the south and east of the Park where light industry is replacing agriculture. The Environmental Protection Agency is preparing a study on proposed wastewater facilities for the site and surrounding local communities and small sewage treatment plants for surrounding communities have been funded in part by the National Park Service. Tourism also threatens the site, and some bat colonies have already been disturbed. The Master Plan for the National Park recognizes this danger

and has recommended steps to remove tourist facilities from fragile areas. Much of the cave system is not accessible to the public, and 1980 tourism was 25% less than in 1973; a tourism development plan provides for staging areas outside the cave drainage.

## 7. COMPARISON WITH OTHER AREAS

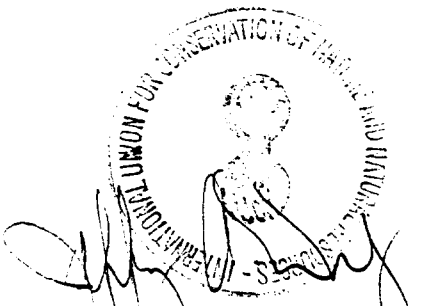
Mammoth Cave system is well over twice as long as the next-largest cave system (Hölloch in Switzerland, 135 km). According to Dr. Arrigo A. Cigna, President of the Union Internationale de Spélélogie, "No other cave system in the world can be compared with it".

## 8. EVALUATION

The limestone caverns of Mammoth Cave contain a natural spectacle of world interest. The site illustrates a number of stages of the Earth's evolutionary history, contains on-going geological processes, has superlative examples of natural features, and contains unique wildlife. It is protected by the US National Park Service, which has been charged by Congress to manage, develop, interpret and preserve the site. The possible dangers to the integrity of the site have been considered and steps are being taken to limit their influence.

## 9. RECOMMENDATION

The Mammoth Cave National Park meets the criteria of the Convention and should be placed on the World Heritage List.



International Union for Conservation of Nature and Natural Resources

July 1981 (rev)

NAME Mammoth Cave National Park

MANAGEMENT CATEGORY II (National Park)

World Heritage Site (Criteria: i, ii, iii, iv)

BIOGEOGRAPHICAL PROVINCE 1.9.7 (Chihuahuan)

LEGAL PROTECTION No information

DATE ESTABLISHED 1 July 1941. Accepted as a World Heritage Site in 1981.

GEOGRAPHICAL LOCATION Situated in Barren, Edmonson and Hart Counties, Kentucky. 37°07'30"-17'30"N, 86°00'00"-17'30"W.

ALTITUDE No information

AREA 21,191ha

LAND TENURE Public ownership except 6 parcels of private land totalling 3.7ha.

PHYSICAL FEATURES The Park contains the longest cave system in the world, with known passages extending some 306km and perhaps an equal length of undiscovered passages. It was formed over 100 million years ago by the Green River and its tributaries and the geological process is continuing. Most types of cave formation are found here and features include the long passages with huge chambers, vertical shafts, stalagmites and stalactites and gypsum "flowers" and "needles". Outside the cave there is superb karst topography with all the features of a karst drainage system - a vast recharge area, complex network of underground conduits, sinkholes, cracks, fissures, and surface and underground springs. Fossils are distributed throughout the rocks of the Mississippian age and include brachiopods, crinoids and corals. Mean annual precipitation is 1,270mm.

VEGETATION Luxuriant vegetation outside the cave system and a rich cave flora. Communities on the surface of the plateau include 84 tree varieties, 28 varieties of shrubs and vines, 29 types of ferns, 209 wildflowers, 67 species of algae, 27 species of fungi and 7 species of bryophytes. The Big Woods basin ecosystem (120ha) is reputed to be one of the best remaining examples of a virgin white oak/black oak Quercus velutina/tulip tree Liriodendron tulipifera forest in eastern North America and the cedar Cedrus sp. karren and savannas of the solution valleys are also of scientific interest.

NOTEWORTHY FAUNA The richest caverniculous wildlife known, including species endemic to the cave system occur in the Park. There are 41 species of mammals, 203 species of birds, 18 varieties of reptiles, 15 species of amphibians and numerous invertebrates. Bat colonies include the Indiana bat Myotis sodalis (V). Of special concern is the Kentucky cave shrimp Palaemonias ganteri, a freshwater species of uncertain status. The geological setting has contributed to the species richness of the area with the cave system being old enough to have stable communities of fauna from three karst regions within an area large enough for speciation to have occurred. Nowhere else do the blind fish Amblyopsis spelaea and Typhlichthus subterraneus and their spring-cave dwelling relative Chologaster agassizi co-exist. Animal

species considered threatened and found only in the Mammoth Cave area include Kleptochthonius hageni, K. cerberus, Anthrobia monmouthia, Antriadesmus fragilis, Pseudoanophthalmus audax, P. inexpecatus, Vatrisoides henroti, Dorypteryx hageni, Arrhopalithes altus, Helicodiscus punctatellus, Sagittocythere stygia and Paleomonias ganteri.

CULTURAL HERITAGE The Park contains evidence of 4 pre-Columbian Indian cultures: Mississippian, Woodland, Archaic and Paleo-Indian. The early Woodland culture period is of special archaeological importance because it shows the first evidence of organized horticulture in North America with primitive agriculture on river floodplains and was the period of the first exploration and mining in Mammoth Cave. Several mummies, sandals, campfire sites, bare foot prints have been found preserved in the stabilizing cave atmosphere.

ZONING No information

CONSERVATION MANAGEMENT The Master Plan for the National Park (1977) has recommended steps to remove tourist facilities from fragile areas.

DISTURBANCES OR DEFICIENCIES Damage to some irreplacable cave resources occurred during the early periods of cave use, and it is proposed that further damage be avoided by the relocation of essential visitor services from the Historic entrance to a peripheral area. The area adjacent to the Park is now turning from agriculture to light industry. Of major environmental concern is the Sinkhole Plain to the south and east of the Park. Precipitation falling on this extensive area collects in underground streams and is finally discharged into the Green River. Any changes in quality or quantity of water would adversely affect the unique aquatic life of the underground streams and alter natural cave development. Tourism is disturbing the cave system and particularly the bats, however, only limited access to the cave system is available to the public on organised cave tours. Tourism was 25% less in 1980 than in 1973 (1.9 million). The scattered distribution of the few small private tracts makes development in the Park unlikely.

SCIENTIFIC RESEARCH A professional geologist is studying the hydrogeological and environmental relationships at Mammoth Cave. In 1981 the Envrionmental Agency was studying the environmental impact of the proposed wastewater system.

SPECIAL SCIENTIFIC FACILITIES No information

PRINCIPAL REFERENCE MATERIAL No information

STAFF Superintendant for on-site administration assisted by managers and specialists skilled in administration, resource management, maintenance and visitor protection.

BUDGET No information

LOCAL PARK OR RESERVE ADMINISTRATION U.S. Department of the Interior, 18th and C Street, N.W., Washington D.C. 20240, U.S.A.

DATE July 1981.

UNITED STATES OF AMERICA - Kentucky

**NAME** Mammoth Cave Area Biosphere Reserve

**IUCN MANAGEMENT CATEGORY** II (National Park)
X (World Heritage Site: Criteria i, ii, iii, iv)
IX (Biosphere Reserve)

**BIOGEOGRAPHICAL PROVINCE** 1.05.05 (Eastern Forest)

**GEOGRAPHICAL LOCATION** Situated in Barren, Edmonson and Hart counties, South Central Kentucky near Park City, which lies within the transition area. 37º07'-37º17'N, 86º00'-86º17'W

**DATE AND HISTORY OF ESTABLISHMENT** The area was declared a national park on 1 July 1941, under enabling legislation of US Congress (44 Statute 635) of 25 May 1926. Kentucky ceded exclusive jurisdiction over park lands by an act of legislature approved on 22 March 1930 and this was accepted by the Secretary of the Interior on 1 May 1944 by authority of the act of 5 June 1942 (56 Statute 317). Exclusive jurisdiction over the remainder of the land was accepted on 1 May 1965. Certain roads through the park are legally open to the public under Deed No.262 of 18 June 1945. Part of the area is endorsed by the Barren River Area Development District resolution of 24 October 1988. Big Woods Old-growth Forest is designated a state natural area by the state of Kentucky. Green River is designated a wild and scenic river and Green River and Mammoth Cave subsurface streams are designated outstanding resource waters by this state. Accepted as a World Heritage site in 1981 and as a biosphere reserve in 1990.

**AREA** National park 21,191ha; the area included in the biosphere reserve is 21,217ha, comprising a core area of 20,917ha and buffer zones of 300ha; an additional transition zone covers 62,160ha.

**LAND TENURE** The national park (core area) is federally owned

**ALTITUDE** 180-231m

**PHYSICAL FEATURES** The park is situated in an area known as the Mammoth Cave Plateau and contains an internationally important karst area. The core area is a dissected plateau known as the Chester Upland, formed of sandstone-capped ridges separated by karstified valleys containing sinkholes. It also contains the longest cave system in the world, with known passages extending for over 532km. Most types of limestone cave formation are found here, including long passages with huge chambers, vertical shafts, stalagmites, stalactites and gypsum 'flowers' and

'needles'. On the surface there is a superb karst topography with largely subsurface drainage, sinkholes, cracks, fissures and springs. Groundwater flows from the extensive recharge areas on the plateaux to the southwest through the park's cave system to springs that discharge into the Green River. The erosion by the Green River and its tributaries which formed this system began over 25 million years ago and these rivers are now meandering and deeply incised. The limestone rocks of Upper Mississippian age are highly soluble and include contain fossils throughout, including brachiopods, crinoids and corals. The main series in which the cave systems and karst landscape have developed are the St Louis, St Genevieve and Paoli limestones of the Meramecian. The Chester Upland is capped by sandstones of the Upper Mississippian-Lower Pennsylvania periods. Structural dip in the north-west is about 5m/km. The major soil types are those developed from limestone residuum and are either alfisols or ultisols. To the east, south and west of the park (included in the transition zone) is the Pennyroyal Plateau which is separated from the Chester Upland by an escarpment.

**CLIMATE** Conditions are humid temperate. Mean annual precipitation is 1118mm at an altitude of 205m and practically all of it is in the form of rain as temperatures are generally above freezing during the day. Mean annual temperature is 13.6ºC with a summer mean of 26.6ºC and a winter mean of 1.7ºC.

**VEGETATION** There is a luxuriant surface vegetation, including 84 tree species, 28 shrubs and vines, 29 species of fern, 209 flower species, 67 species of algae, 27 species of fungi and seven species of mosses. An inventory of the flora is included in the biosphere reserve nomination. Big Woods is reputed to be one of the largest and best remaining examples of the ancient forest of eastern North America that once covered Kentucky. This is temperate deciduous oak-hickory forest dominated by oaks including Quercus alba, Q. velutina, Q. prinus and hickories including Carya glabra and C. tomentosa with some beech Fagus sp., maples Acer spp. polpar Liriodendron sp., ash Fraxinus sp. and cedar Juniperus virginiana.

**FAUNA** Over 200 species are indigenous to the cave system. On the surface are 41 species of mammals, 203 species of birds, 18 species of reptiles and 15 species of amphibians. A faunal list is included in the biosphere reserve nomination. The age of the geological formations has contributed to species richness in the cave fauna, the cave system being old enough to have communities from three karst regions and covering an area large enough for speciation to have occurred. Nowhere else do blind fish Amblyopsis spelaea (V), Typhlichthus subterraneus and their spring cave-dwelling relative Chologaster agassizi co-exist. Resident animal species listed as federally endangered include freshwater mussels Obovaria retusa (I), Hemistena lata (E), Pleurobema plenum (E) and Lampsilis orbiculata (E), Indiana bat

Myotis sodalis (V), grey bat M. grisescens and Kentucky cave shrimp Plaemonias ganteri. There have been successful reintroduction of wild turkey, beaver and deer.

**CULTURAL HERITAGE** The park contains evidence of four pre-Columbian Indian cultures: Mississippian, Woodland, Archaic and Paleo-Indian. The early Woodland culture period is of special archaeological importance because it shows the first evidence of organised horticulture in North America, with primitive agriculture on river floodplains. These indians used the caves for shelters and chipped gypsum and mirabilite off the walls; more than 150 archaeological sites have been identified within the national park. Saltpetre deposits were discovered on the cave walls and this valuable nitrate was removed and sent to be processed in gunpowder factories between 1809 and 1819. After the 1812-1815 war Mammoth Cave became a national and international tourist attraction. Three churches and fourteen cemeteries still exist in the park and are used by the public.

**LOCAL HUMAN POPULATION** There are no permanent inhabitants in the core area. About 240 people live in the buffer zones with a further 1500 in the transition area, including about 600 in Park City. Population density in the region surrounding the park is low (30 per sq.km) and has remained stable for the past 20 years. Only 25% of the population is considered urban and no significant increase in urbanisation is expected in the near future. Most people are engaged in agriculture, tourism or service industries.

**VISITORS AND VISITOR FACILITIES** Since a peak in 1979 of 1.6 million visitors, numbers remained stable near this level into the 1980s with an increase occurring in recent years to about 2 million per annum. The summer months of June, July and August account for over 60% of the annual total. Park headquarters are located at the historic entrance to Mammoth Cave and there is a visitors' centre here, but this is very small. Guided tours are offered of the underground portion of the park and there are commercial boat trips on Green River. There are 155km of roads within the park and many hiking trails including over 45 miles in the remote section of the park but there are only two small ferries across the Green River so that resources in much of the remoter hilly areas of the park remain untapped. Access is good and it is estimated that a third of all visitors do no more than drive through the park. There are about 110 rooms in a hotel, lodge and various cottages and restaurant and shopping facilities in the buffer zone but a further 2,000 motel rooms and over 7,500 campsite places are located within easy distance of the park.

**SCIENTIFIC RESEARCH AND FACILITIES** Long-term hydrological and ecological research into karst systems is being carried out in the Mammoth Cave area, including the effects of water quality on the cave's biota. In particular, research into groundwater flow-pulse rates and modelling has been applied to the

development of instrumentation packages for monitoring the physical and chemical properties of groundwater. Preliminary discussions of the international applications of this have been initiated. Much research into a variety of aspects has already been carried out. A research facility and laboratory are available to visiting researchers. The US Geological Survey plans to further delineate groundwater basins in the area and the Agricultural Stabilisation and Conservation Service will be studying the effects of agriculture on groundwater in the transition zone. There are cooperative agreements with Western Kentucky University, Eastern Kentucky University, the Cave Research Foundation and the American Cave Conservation Association for research and education or training opportunities.

**CONSERVATION VALUE** The Mammoth Cave area is an internationally important karst area. It contains the longest cave system in the world, with known passages extending for over 532km. Most types of limestone cave formation occur here. Over 200 species of animal are indigenous to the cave system including several endangered species of blind fish, shrimp, bat and freshwater mussel. Surface features are also important and Big Woods, a temperate deciduous oak-hickory dominated forest, is reputed to be one of the largest and best remaining examples of the ancient forest of eastern North America that once covered Kentucky. Archaeological sites in the area show evidence of four pre-Columbian Indian cultures.

**CONSERVATION MANAGEMENT** The core area (Mammoth Cave National Park) is managed by the National Park Service. The transition zone falls within Barren River Development District of which three counties are within the Mammoth Cave system recharge area. The Biosphere Reserve Cooperative Subcommittee of the Natural Resources Council of the Barren River Area Development District will coordinate biosphere reserve functions. The general management plan for the national park (1983) states that the management aims at Mammoth Cave National Park are to perpetuate the integrity and diversity of geological features and life systems associated with the caves and preserve aquatic and terrestrial environments for their aesthetic, recreational, educational and scientific values. Within the core the management plan identifies separate natural zones and historic zones and it classifies caves into six types according to the access approved. A resource management plan has been compiled (Anon., 1988), which includes natural and cultural resource management programmes. The oak-hickory woods of the national park are being allowed to return to their natural state. Some of the oak and poplar forests are currently managed but there are no plantations. As well as public recreation, authorised fishing and hunting is permitted in the core area. Narrow corridors along roads within the core zone have been designated as zones of managed use and concentrate tourist developments, administrative and recreational facilities. A transition zone for the biosphere

reserve has also been designated to the south and east of the core area to curtail groundwater pollution as this is where much of the rainwater which flows through the cave systems of the park falls. Federal, state and local authorities have cooperated to develop a regional sewer system in this area, surrounding Park City, to stop pollutants reaching the groundwater.

**MANAGEMENT CONSTRAINTS** Damage to irreplaceable cave features occurred during the early periods of cave use, including smoke deposits from torches and fires and graffiti. The use of electric lighting for cave tours has also led to the introduction and growth of mosses, fungi and algae in the caves and may eventually spoil the natural beauty of some of the unique formations. At least 130 cave entrances have been identified as needing some level of monitoring for illegal entry. Several cave gates are in need of repair. Oil and gas wells were also drilled in this area and although those inside the park were abandoned when it was established they still pose a threat to human safety and environmental quality as many have been insufficiently plugged. In adjacent areas, oil and gas exploration has increased recently and with this, the risks of spillages into the park's groundwater system including that of injected dyes. About half of the Mammoth Cave system actually lies outside the national park boundaries but management of these areas should be improved by the designation of a transitional zone to the biosphere reserve. Commercial freshwater mussel fishing outside the park has destroyed the natural mussel beds there and illegal operations have expanded into the park, resulting in conviction of the operators.

A wide variety of arable and animal farming occurs in the transition zone and this area is now increasing its light industry. However, solution of the existing pollution problems should provide a basis for increased opportunities to attract sustainable economic development compatible with the karst terrain. Of major environmental concern is the extensive sinkhole plain to the south and east of the Park. Run-off from this area flows via underground streams into the Green River and includes effluent from Park City. There has also been illegal dumping of wastes into sink holes in the transition zone. Any changes in quality or quantity of water would adversely affect the unique aquatic life in the underground streams and alter natural cave development but this problem is now being addressed (see previous section).

**STAFF** The biosphere reserve has a staff of 94. Of these, 20 are involved in administration, control and resource management within the core area and 17 are university educated. There are 12 staff for education and training purposes and three involved in research who have a technical support of up to ten personnel.

**BUDGET** US$ 3,500,000 annually

WCMC/UNESCO Draft World Heritage Database, March 1994

**LOCAL ADDRESSES** Mammoth Cave National Park, Mammoth Cave, Kentucky 42259

**REFERENCES**

Anon. (1983). General management plan, Mammoth Cave National Park, Kentucky. Denver Service Center.

Anon. (1988). Resource Management Plan for Mammoth Cave National Park. Draft.

MAB USA (1990). Mammoth Cave Area biosphere reserve. Biosphere Reserve nomination form.

**DATE** July 1981, revised October 1989 and September 1990

**DOCUMENT** 0359U

PATRIMOINE MONDIAL: CANDIDATURE

EXAMEN TECHNIQUE PAR L'UICN

1. NUMERO D'IDENTIFICATION ET NOM: 150 Parc national des grottes du Mammouth

2. SITUATION GEOGRAPHIQUE: Comtés de Barren, Edmonson, et Hart, Etat du Kentucky, Etats-Unis d'Amérique, 86° 10'0, 37°10'N

3. CANDIDATURE PROPOSEE PAR: Le Service des parcs nationaux, Département de l'Intérieur, gouvernement des Etats-Unis

4. DOCUMENTATION:

(i) Formulaire de candidature (avec carte et photos)
(ii) Documentation complémentaire (UICN)

a) Consultation de M. M.E. Tuttle, Smithsonian Tropical Research Institute (spécialiste des chiroptères)

b) Consultation de M. Arrigo A. Cigna, président de l'Union internationale de spéléologie.

5. PRESENTATION RESUMEE

Le parc national des grottes du Mammouth comporte de loin le plus long réseau de grottes du monde, avec ses passages connus qui s'étendent jusqu'à quelque 306 km, et une longueur peut-être égale de galeries encore à découvrir. Ce réseau revêt une importance géologique du fait de la formation de grottes qui s'y déroule depuis 100 millions d'années sous l'action de la rivière Verte et de ses affluents. Ce site présente pratiquement tous les types de formation de grottes et les processus géologiques impliquant la formation de grottes s'y poursuivent encore. Les longs passages aboutissant à de vastes cavités, les puits verticaux, les stalagmites et les stalactites, les "fleurs" et les "aiguilles" de gypse et les autres caractéristiques naturelles de ces grottes sont tous des exemples du genre particulièrement saisissants. Leur flore et leur faune sont parmi les plus riches qui soient, avec leurs 300 espèces cavernicoles, dont 12 sont rares et endémiques. En dehors de la grotte, la topographie offre un relief karstique magnifique; les paysages sont remarquables, la végétation est luxuriante et la faune abondante. Toutes les caractéristiques d'un système de drainage karstique sont présentes dans ce site - vaste zone d'alimentation, réseau complexe de conduits souterrains, trous, crevasses, fissures, sources de surface et souterraines. Les grottes du Mammouth ont joué un rôle important dans le développement de la culture humaine, quatre periodes culturelles distinctes étant décrites: le paléo-indien, l'archaïque, la culture de la forêt claire et mississippien. Le début de l'ère de la forêt claire est particulièrement importante en ce qu'elle marque le développement indépendant de la culture des jardins dans l'hémisphère occidental.

6. INTEGRITE

Le site inclut tout le réseau de grottes; il répond donc aux critères 21 (ii) et (iii). Toutefois, il n'englobe pas tout le bassin de drainage des eaux du site, de sorte qu'on ne peut éliminer la possibilité d'une perturbation que l'autorité responsable ne serait pas à même de contrôler, surtout au sud et à l'est du parc, là où l'industrie légère remplace l'agriculture. L'Agence de

protection de l'environnement prépare une étude sur une installation de traitement des eaux usées pour le site et les communautés locales, et sur de petites usines de traitement des eaux usées, car les communautés voisines ont été financées en partie par le service des parcs nationaux. Le tourisme est aussi une menace; certaines colonies de chauves-souris ont ainsi été perturbées. Ce risque est reconnu dans le plan directeur établi pour le parc et le retrait des installations facilitant le tourisme a été recommandé pour les régions fragiles. Une bonne partie du réseau de grottes n'est pas accessible au public; en 1980, le tourisme a été 25% inférieur à 1973. Un plan de développement du tourisme prévoit des zones étapes en dehors du système de drainage des grottes.

## 7. COMPARAISON AVEC D'AUTRES REGIONS

Le réseau des grottes du Mammouth est plus de deux fois plus long que le 2$^{e}$ réseau, celui d'Hölloch, en Suisse (135 km). Selon M. Arrigo Cigna, président de l'Union internationale de spéléologie: "nul autre ensemble de grottes ne peut rivaliser avec celui-ci".

## 8. EVALUATION

Les grottes de grès du Mammouth offert un spectacle naturel d'intérêt mondial. Ce site illustre plusieurs étapes de l'histoire de la Terre; des processus géologiques s'y poursuivent. Il offre des exemples remarquables de traits naturels et abrite une faune unique. Il est protégé par le US National Park Service qui a été chargé par le Congrès de gérer, développer, présenter au public et préserver le site. Les risques que pourrait courir son intégrité ont été considérés et des mesures sont prises pour les limiter.

## 9. RECOMMANDATION

Le parc national des grottes du Mammouth répond aux critères de la convention et devrait être inscrit sur la liste des sites du patrimoine mondial.

Union internationale pour la conservation de la nature et de ses ressources

juillet 1981