

Mammoth Cave National Park

2020 Conservation Outlook Assessment

SITE INFORMATION

Country: United States of America (USA)

Inscribed in: 1981

Criteria: (vii) (viii) (x)



Mammoth Cave National Park, located in the state of Kentucky, has the world's largest network of natural caves and underground passageways, which are characteristic examples of limestone formations. The park and its underground network of more than 560 surveyed km of passageways are home to a varied flora and fauna, including a number of endangered species. © UNESCO

SUMMARY

2020 Conservation Outlook

Finalised on 02 Dec 2020

GOOD WITH SOME CONCERNS

Overall, the conservation outlook for the Mammoth Cave National Park World Heritage site is good with some concerns. The park has especially benefited by the removal of Lock and Dam 6 in 2017, which previously flooded portions of the cave system unnaturally. The current condition of the World Heritage values is generally stable, whilst there remain existential threats to the values of the site, the protection and management standards are very high and intervention measures are mostly effective in combatting these threats. There are concerns that levels of air and water pollution are increasing and impacting detrimentally on the biological values of the site as well as damage to the karst formations of the site by visitors. Of particular concern is the significant reduction of bat populations from the deadly white-nose fungal disease recently introduced into the site, which may prove extremely difficult to overcome.

FULL ASSESSMENT

Description of values

Values

World Heritage values

► **Superlative examples of natural features in limestone karst terrain.**

Criterion:(vii)

The longest cave system in the world, with huge chambers, vertical shafts, stalagmites and stalactites, splendid forms of beautiful gypsum flowers, delicate gypsum needles, rare mirabilite flowers and other natural features that are all superlative examples of their type. No other known cave system in the world offers a greater variety of sulfate minerals. (State Party of the USA, 1980; 2006; IUCN, 1981; World Heritage Committee, 2018).

► **The world's largest network of natural limestone caves and underground passages.**

Criterion:(viii)

The 100 million-year old karst landscape presents nearly every type of cave formation known. Its huge and complex network of cave passages provides a clear, complete and accessible record of the world's geomorphic and climatic changes. The land surface has all of the classic features of a karst drainage system - a vast recharge area, complex network of underground conduits, sink holes, cracks, fissures, and underground rivers and springs. (State Party of the USA, 1980; 2006; IUCN, 1981; World Heritage Committee, 2018).

► **The richest known cave biota.**

Criterion:(x)

The property has the greatest diversity of known cave biota numbering over 130 species, of which 14 species of troglobites (animals adapted to living entirely in caves) and troglophiles (animals preferring to live in caves) are endemic. (State Party of the USA, 1980; 2006; IUCN, 1981; World Heritage Committee, 2018).

Other important biodiversity values

► **Diverse vegetation and abundant wildlife.**

Terrestrial vertebrates include 43 species of mammals, 207 birds, 37 reptiles and 27 amphibians. The temperate deciduous oak-hickory forest community includes 84 tree varieties, 28 shrubs and vines, 29 types of ferns, 209 wildflowers, 67 species of algae, 27 species of fungi and 7 species of bryophyte. (State Party of the USA, 1980; 2006; IUCN, 1981; World Heritage Committee, 2018).

Assessment information

Threats

Current Threats

High Threat

The threats to the site are diverse and of varying degrees of severity, so overall remain high. Low levels of threat come from damage by visitors and ecosystem modification, especially suppression of wildfires and flooding of natural underground water systems due to storm water drainage from surrounding residential and industrial areas. The most serious threats are from neighboring coal-fired power plants that cause air and groundwater pollution, and from the incidence of the deadly white-nose fungal disease affecting the

bat population.

► Fire & Fire Management

Very Low Threat

(Fires)

Inside site, extent of threat not known
Outside site

Wildfires are imprinted on patterns of vegetation development. Most fires are from arson, careless smoking and campfires, but there are some lightning fires. The authorities include fire suppression among fire management measures. Prescribed fires are considered unlikely to affect nationally protected species or critical habitats in the World Heritage site (NPS, 2001; NPS, 2009; Olsen et al., 2005). Storm water drainage wells in neighboring areas are causing sinkhole flooding and ground collapse (May et al., 2005). Fire also has impacts on recharge which in turn can impact on speleothems (IUCN Consultation, 2020).

► Commercial & Industrial Areas

Low Threat

(Residential and commercial development)

Outside site

Both new and existing industrial development in the groundwater recharge basin, outside park boundaries, has the potential to impact water quality and cave biota (IUCN Consultation, 2020).

► Pathogens

High Threat

(White-nose fungal disease)

Inside site, widespread(15-50%)

Other invasive species names

Outside site

White-nose fungus (*Pseudogymnoascus destructans*)

In 2013, the White-nose fungal disease resulted in a major die-off of bats native to the park, including all seven species, three of which were already listed as endangered. This has resulted in shifts in foraging assemblages (Thalken et al., 2018) which may have further ecological consequences. A response plan includes access restrictions, decontamination requirements for all activities, surveillance and monitoring, and outreach and education (NPS, 2010; NPS, 2011) for which additional funding has been made available recently (IUCN Consultation, 2020).

► Oil & Gas exploration/development

High Threat

(Groundwater infiltration of contaminants)

Inside site, widespread(15-50%)

Outside site

There is existing and potential future groundwater contamination from human and animal waste production, agricultural land runoff and urban storm water discharge, because the majority of groundwater recharge area for Mammoth Cave lies beyond park boundaries. In addition, three major transportation corridors traverse the cave's recharge basin, so that any spills or other release of contaminants is quickly washed into the karst aquifer.

► Air Pollution

Low Threat

(Pollution)

Inside site, widespread(15-50%)

Outside site

The location of the World Heritage site is downwind of many sources of air pollution, including power plants, urban areas, and industry in Kentucky and Tennessee (NPS, 2019c). The park authorities are addressing air pollution at the site and as a result, had seen some improvements in air quality in recent years, but the implications of any national air pollution policy changes will need to be closely observed. Several coal-fired plants in the vicinity have been taken out of service in recent years, but the area already contained 40 operating power plants. Plants produce huge quantities of carbon dioxide, sulfur dioxide, nitrogen and mercury. Some bats have up to 10x the mercury level considered safe for people, ozone pollution is considerably above levels known to harm plant life, and particulate matter causing hazy skies reduces vision for scenic viewing.

► Storms/Flooding

Low Threat

(Severe weather)

Inside site, widespread(15-50%)

Outside site

Severe storms result in flooding, causing damage to trails, campsites and roads, and requiring emergency funding (May et al., 2005; NPS, 2003; NPS, 2006). Increasingly severe storms result in flooding, both at the surface and subsurface levels, which may also have impacts on stygobites from increased sediment (IUCN Consultation, 2020). However, most of the Mammoth Cave passages are relict and hence not impacted (IUCN Consultation, 2020).

► **Recreational Activities**

Low Threat

(Damage by visitors)

Inside site, extent of threat not known

Damage by tourists such as graffiti, vandalism, and removal of cave formations continues to be a threat to the limestone karst features in the caves (NPS, 2019a).

► **Invasive Non-Native/ Alien Species**

Low Threat

(Lamp flora establishment)

Inside site, localised(<5%)

Lamp flora which would not otherwise occur in the caves has established itself in many damp areas of the cave that are electrically lit (NPS, 2019a), posing a threat to the cave biota and potentially carrying impacts on the evolution and formation of the natural cave features (IUCN Consultation, 2020).

Potential Threats

Low Threat

Pollution from neighboring industrial developments, and its possible impact on natural values of the site, is of major future concern to stygobiota.

► **Commercial & Industrial Areas**

Low Threat

(Neighbouring industrial developments)

Inside site, scattered(5-15%)

Outside site

Pollution, especially of groundwater, from neighboring commercial, residential, and industrial developments, and their possible impact on natural values of the site, are of major future concern, particularly to stygobites (IUCN Consultation, 2020).

Overall assessment of threats

High Threat

The threats to the site are diverse and of varying degrees of severity, so overall remain high. Low level threats come from ecosystem modification, especially suppression of wildfires, damage to the caves by visitors and flooding of natural underground water systems due to storm water drainage from surrounding residential and industrial areas. More serious threats come from neighboring coal-fired power plants that cause air and groundwater pollution, where impacts will be largely felt by stygobites and there may be some smaller impacts on the dissolution process. However, the vast majority of the cave system is relict and lies beneath a caprock so is mostly unaffected by such pollution. The incidence of the deadly white-nose fungal disease affecting the bat population is of high concern. The most significant potential threat is from increased air and water pollution due to ongoing development in surrounding areas outside the park.

Protection and management

Assessing Protection and Management



Highly Effective

The management system is well formulated through an excellent Foundation Document, and a new 2019 Cave and Karst Management Plan along with several subsidiary plans such as a business plan, water resources plan, fire management plan, trail management plan etc. (NPS, 2003; NPS, 2006; NPS, 2007;

NPS, 2011; NPS, 2019a; 2019b; State Party of the USA, 1980). Additional funding has also been received in recent years for a variety of management activities related to White-nose Syndrome in bats.

► **Highly Effective**

The management system is implemented well through sufficiently resourced staff, guided by a comprehensive set of management plans (NPS, 2003; NPS, 2006; NPS, 2007; NPS, 2011; 2019a; 2019b; State Party of the USA, 1980). In FY 2020, the park received funding to begin the preparation of a Resource Stewardship Strategy (RSS). The RSS will evaluate the major components of the park's fundamental resources that must be protected into the future, including a comprehensive strategic plan for achieving and maintaining targets in conserving these resources over time (IUCN Consultation, 2020).

► **Some Concern**

The boundaries of the World Heritage site are well defined. However, most current and potential threats to the values of the site arise outside park boundaries, and largely beyond NPS control.

► **Mostly Effective**

Park land use is well co-ordinated with other State land and resource uses (IUCN, 1981; State Party of the USA, 1980). Whilst there are some concerns regarding industrial development outside the site, the development priorities are completed in accordance with applicable laws. In addition, a number of designations are currently being sought by the park management authorities, including National Water Trail and Dark Sky Park designations (Barren River Area Development District, 2019; IUCN Consultation, 2020).

► **Highly Effective**

Stakeholder and local community support for the park is excellent. Park management is supported by a number of organisations representing a wide range of stakeholders including NGOs such as Friends of Mammoth Cave National Park (IUCN, 1981; NPS, 2009a; State Party of the USA, 1980; Friends of Mammoth Cave National Park, 2019), research organisations such as the Cave Research Foundation, National Speleological Society as well as local, state and federal institutions (IUCN Consultation, 2020).

► **Highly Effective**

The World Heritage site is Federal and publically owned land subject to Federal and State protection laws (State Party of the USA, 1980; IUCN, 1981).

► **Mostly Effective**

Protection of park resources is largely provided by the park's ranger staff, but supplemented by reciprocal enforcement agreements with local agencies.

► **Highly Effective**

There have been no requests to the State Party from the World Heritage Committee in recent years. The committee adopted a retrospective statement of outstanding universal value for the site based on improvements to the site's integrity following significant measures that have been taken since Mammoth Cave National Park was inscribed in 1981 (World Heritage Committee, 2018).

► **Data Deficient**

According to the Statement of OUV for the World Heritage site, a portion of the site has development (roads, visitor facilities, park operational and administrative infrastructure), but most of the area remains undeveloped in a natural zone.

► **Some Concern**

The 2014 Foundation Document reports that historical levels of funding were reduced by 30% in recent years. The park geologist, hydrologist, anthropologist and botanist positions have been left vacant in the past, there is currently no information whether these have been subsequently filled. Some needed

research is supplemented with a master cooperative agreement with a nearby university. However, in 2020, the park received funding to begin the preparation of a Resource Stewardship Strategy (RSS) (IUCN Consultation, 2020) which will identify key issues in the management, which may address this issue.



Mostly Effective

The staff are highly professional and well trained, with staff resources reportedly mostly effective (IUCN, 1981; State Party of the USA, 1980). The absence of key personnel, including a park geologist and hydrologist, has been a concern and it is not clear whether this has been resolved.



Mostly Effective

The site has an excellent visitor centre and learning centre (NPS, 2003; NPS, 2010). A portion of the educational programs from the former learning center remain in effect. However, the Learning Center program was curtailed in 2017 because of a lack of funding. Although, in 2018, new sections of the Echo River Spring Trail were rehabilitated and made fully accessible and interpretive exhibits about cave geology and hydrology were opened. Further rehabilitation is also being made to walking path, stairs, handrails, seating and resource issues along approximately two miles of trail across The Grand Avenue, Wild Cave and Wondering Woods Cave (NPS, 2020).



Highly Effective

The annual number of tourists visiting the site is approximately 550,000, with 80% taking a guided cave tour. In 2019, a Trail Management Data Collection research program was initiated in advance of the preparation of a Comprehensive Trail Management Plan update (IUCN Consultation, 2020). In 2019, rehabilitation of two miles of Cave Trail along the Grand Avenue Route began. This project will improve visitor services and also enhance resource protection (IUCN Consultation, 2020).



Highly Effective

Comprehensive monitoring program for ecological indicators, water and air quality, cave environment, fire and visitor use, among others (May et al., 2005; NPS, 2006; NPS, 2007; NPS, 2009; NPS, 2011; 2019a; 2019b; Watson, 2005). Ongoing monitoring is being carried out following the removal of lock and dam #6 following initial ecological assessments of the affected waterways (Compton et al., 2017).



Highly Effective

Strong research program involving park scientists and domestic and international researchers. Research results are applied to management intervention (MCNP, 2013). New paleontological research in 2020 has unveiled a rare fossilized shark specimen, located inside Mammoth Cave (IUCN Consultation, 2020).

Overall assessment of protection and management

Mostly Effective

Generally, the protection and management of the World Heritage site is of high standard and mostly effective. There is strong legal protection at State and Federal level, the site is under public ownership and the stakeholder support is good. The park has suffered some reduction in terms of staff and finance, but management intervention is guided by a series of comprehensive and widely consulted management plans. Monitoring, research, interpretation and education are exemplary. Of greatest importance for managers is the need to remain vigilant over impacts from urban, industrial and resource development activities outside the site that have the potential to increase above current levels.

► Assessment of the effectiveness of protection and management in addressing threats outside the site

Some Concern

There is good communication and collaboration with outside agencies, especially through NPS participation in the Mammoth Cave Area Biosphere Region Advisory Council, which is a partnership with the surrounding Barren River Area Development District and Western Kentucky University

(IUCN Consultation, 2020), with cross-sectoral engagement in conservation of Mammoth Cave and most development priorities completed in accordance with applicable laws which, while less strenuous than other states, still provide some protection (NPCA, 2013; NPS, 2003; NPS, 2009a; State Party of the USA, 1980; IUCN Consultation, 2020). However, the site continues to face threats from a variety of development that has potential for impacts (i.e. increase in chicken farms), accidental leaks from a variety of sources, antiquated septic systems, etc. As such, continued vigilance in protecting Mammoth Cave with both existing and new development is required to ensure that development outside the site does not negatively impact the sites values.

State and trend of values

Assessing the current state and trend of values

World Heritage values

- **Superlative examples of natural features in limestone karst terrain.**

Low Concern
Trend:Stable

The general state and trend in scenic and aesthetic values are good, but concerns surround human disturbance and vandalism to some karst landforms and the incidence of atmospheric haze from pollution affecting scenic viewing and visitor enjoyment (AP, 2006; May et al., 2005; MCNP, 2013; NPS, 2007; NPS, 2009; State Party of the USA, 2002; NPS, 2019a).

- **The world's largest network of natural limestone caves and underground passages.**

Low Concern
Trend:Stable

The state and trend of the karst geological values can be assessed as generally of low concern. While there are concerns about modification to natural water flows and deterioration in water quality, the park achieved a major goal in 2017 with the removal of Lock and Dam 6 on the Green River, re-establishing natural flow on 10 miles of river in the park and significantly reducing cave flooding. (AP, 2006; May et al., 2005; MCNP, 2013; NPS, 2007; NPS, 2009; State Party of the USA, 2002).

- **The richest known cave biota.**

High Concern
Trend:Deteriorating

Of major concern to management is the recent introduction of the deadly white-nose fungal disease, which has destroyed much the bat population in the World Heritage site (NPS, 2010; NPS, 2011; NPS, 2014).

Summary of the Values

- **Assessment of the current state and trend of World Heritage values**

Low Concern
Trend: Stable

Overall, the current state of World Heritage values in the site is of low concern and the trend is stable. The integrity of the site has improved significantly since inscription due to a number of management interventions. Whilst issues remain around air and water pollution impacts, these are addressed in the comprehensive management plans. Continued die-off of a majority of seven native bats species due to white-nose fungal disease is another concern, which could even eliminate some species, including populations of the three species already listed as endangered.

- **Assessment of the current state and trend of other important biodiversity values**

Low Concern
Trend: Stable

Biodiversity values are generally not seriously threatened. However, some concern remains around White Nose Syndrome in bat species, amongst other low level concerns about the impacts on plant life from air pollution, caused by neighboring coal-fired power stations, and deterioration in water quality from external pollution sources affecting aquatic biota.

Additional information

Benefits

Understanding Benefits

► **Importance for research,
Contribution to education**

The World Heritage site is of great research interest to the international scientific community and through hosting visitors makes a major contribution to geological interpretation and education.

► **Outdoor recreation and tourism**

Mammoth Cave National Park is a major tourist destination, with benefits flowing to local and regional tourist operators and other related commercial enterprises.

► **History and tradition**

Significant archaeological resources and historical sites have been identified, recovered, recorded and/or curated in the site.

Summary of benefits

The Mammoth Cave National Park World Heritage site not only protects a karst landscape of outstanding universal value, it also makes a significant contribution to geological science through research and education, and to cultural protection and promotion, while providing economic benefits from tourism.

Projects

Compilation of active conservation projects

No	Organization	Brief description of Active Projects	Website
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