IUCN Conservation Outlook Assessment 2017 **(archived)**
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Please note: this is an archived Conservation Outlook Assessment for Messel Pit Fossil Site. To access the most up-to-date Conservation Outlook Assessment for this site, please visit https://www.worldheritageoutlook.iucn.org.

Messel Pit Fossil Site

SITE INFORMATION

Country:
Germany
Inscribed in: 1995
Criteria:
(viii)

Site description:

Messel Pit is the richest site in the world for understanding the living environment of the Eocene, between 57 million and 36 million years ago. In particular, it provides unique information about the early stages of the evolution of mammals and includes exceptionally well-preserved mammal fossils, ranging from fully articulated skeletons to the contents of stomachs of animals of this period. © UNESCO

SUMMARY

2017 Conservation Outlook

Good

The conservation outlook for the Messel Pit Fossil Site is good in the long term. The World Heritage values of the site are well preserved and stable thanks to the adequate and improving system of protection and management. The current and potential threats are very low and are all included in the current management plan, which is in place since 2009. The threats are well identified and the risks for the site are adequately estimated and addressed.

Current state and trend of VALUES

Good
Trend: Improving

The site’s World Heritage values are associated with the fossil record of a unique Middle Eocene environment, including various communities of aquatic, terrestrial and aerial organisms. Recovered fossils are well preserved and stored in public institutions and the state of the site itself improved over the last five years, with the creation of a buffer zone and the measures concerning the stabilisation of the western slopes. Significant scientific results have improved our knowledge about the middle Eocene environment. Our knowledge is greater now than five years ago regarding taxa such as turtles, fishes, squamates and especially invertebrates. Advances in the history of primates and carnivores have contributed to the importance of the site for the studying the evolution of mammals. Recent works highlight our knowledge of the trophic structure of this Eocene Ecosystem and provide advances in the scope of taphonomic studies.

Overall THREATS

Very Low Threat

The only current threat is from landslides of the slopes of the pit. Current management system (with a network of inclinometers) is present to follow and

measure any increase of slope landslides. Few potential threats (impact of growing tourism and of scientific activities) can only have a very low impact because they are well identified and the management system already proposed measures to make these threats very unlikely.

Overall PROTECTION and MANAGEMENT

Highly Effective

The current protection and management of the site can be considered as highly effective. The management system that is now in place supports the protection of the site’s outstanding universal value, contributes to building of local and regional networks to communicate on the site, facilitates promotion and access to the site for visitors and educates them to improve understanding of the site’s values (with, especially, the Visitor Information Centre). The international exposure is mainly achieved through the scientific publications and should be enhanced in offering services in more languages (website, guided tours) to larger audience.

FULL ASSESSMENT

Description of values

Values

World Heritage values

► **Record of the Middle Eocene environment**
Criterion:(viii)

Single best site which contributes to the understanding of the middle part of the Eocene. Very strong contribution to explain paleofauna, paleoflora and paleoenvironment of the Eocene (IUCN, 1995), and unique record of a complex, tropical to subtropical ecosystem (with habitats extensively reconstructable in a wide variety of biotopes) from the early Tertiary (UNESCO, 1995; SoOUV, 2013; Dunne et al. 2014).

► **Quality of preservation**
Criterion:(viii)

Particularly high quality of preservation, with complete skeletons with contours of soft part, stomach content, hairs, feathers in the case of vertebrates, conserved pigment, colouring and stomach content in the case of insects, leaves, blossoms, fruits, branches, pollen in the case of flora, bacteria (Franzen et al., 2009; IUCN, 1995; UNESCO, 1995)

► **Richness and diversity of fossils**
Criterion:(viii)

Very rich site, containing fossils of many hundreds of species of insects, plants, also species of lake and marsh ecosystems such as birds, amphibians, reptiles and fishes and land ecosystems species such as mammals

(marsupials, bats) (IUCN, 1995; SoOUV, 2013).

▶ **Early evolution of mammals**
Criterion:(viii)

Documenting an early stage of the evolution of mammals (44 species are known in Messel), when many basic steps in diversifications were being achieved. Messel documents a time when mammals became firmly established in all the principal land ecosystems, and when they also re-invaded the seas (whales) and took to the air (bats). (IUCN, 1995; SoOUV, 2013)

Assessment information

Threats

Current Threats

Low Threat

The only current threat is from landslides of the slopes of the pit. Current monitoring system (with water drainage and a network of inclinometers) is present to follow and measure any increase of landslide-risks at the slopes A landslide of the slope of the pit may directly impact the integrity of parts of the site.
This current threat may hinder future research excavations in certain parts but it will have a very low or no impact on the World Heritage values of the site which base on its content in fossils. Thousands of fossils are already in public institutions and adequately curated, which is a guarantee of conservation of the site’s values.

▶ **Avalanches/ Landslides**
Low Threat
Inside site, extent of threat not known

Climate change, and in particular heavy rain falls can affect the site. Current

forecasts indicate a possible increase of climatic events such as heavy rainfalls (UNESCO, 2006; Messel Pit Management Plan, 2009). Such event may have major consequences on the integrity of the site through landslides of the slopes in the pit, but the risk is judged as low.
An active system of measurements has been installed since the 1990ies to monitor the stability of the slopes (network of inclinometers, Messel Pit WH Management Plan, 2009: see map p. 49; Schaal & Rabenstein, 2012)Additionally, continuous water drainage takes place to stabilize the slopes (Messel Pit Management Plan, 2009). Research has been undertaken to propose measures when an increase in slides occurs (UNESCO, 2006). For stabilisation of the western slope of the pit, a slope-protection retaining structure consisting of 99 bored piles was built in the winter 2009/2010 (Dürrwang et al. 2011). This will very effectively secure this slope in the future which is important for the access of both visitors and scientific teams to the Messel pit.

Potential Threats

Very Low Threat

Few potential threats (impact of growing tourism and of scientific activities) can only have a very low impact because they are well identified and the management system already proposed measures to make these threats very unlikely. Another threat (potential landslides) is climate-dependent and not possible to control. The current forecasts indicate a possible increase of climatic events such as heavy rainfalls that may result in landslides. The current management measures include a network of inclinometers and additional measures are proposed not only to prevent but also to control landslides and to eventually protect the integrity of the most valuable areas of the site.

► Tourism/ visitors/ recreation

Very Low Threat
Inside site, scattered(5-15%)

With the growing number of visitors (currently about 40.000 annually, up to 100,000 annually), tourism pressure will also increase in the future and could possibly have a negative impact on the site. However this risk is a very low threat for two reasons: first the only way to descend into the pit is by guided

tours; second, the number of visitors descending into the pit will be strictly controlled and will only moderately increase, with a maximum number of about 50 participants for each of the currently eight guided tours that may take place simultaneously (400 people is the maximum number of visitors at a time) (Messel Pit WH Management Plan, 2009); second, most of the tourists will visit the Visitor Information Centre, which is not located into the site but in its vicinity, and then will have no direct impact on the integrity of site.

► Other Activities

Very Low Threat
Inside site, localised(<5%)

Scientific excavations take place every year from Spring to Autumn. The excavations are undertaken by permanent teams and volunteers which are mostly students.
Such frequency of excavations may have a negative impact on the integrity of the oil shale deposit. But the risk is very low due to protective and active measures undertaken by the Senckenberg Research Institute, which is responsible for the scientific activities led in the pit. The scientific excavations are strictly controlled and minimum requirements are necessary to have a granted access to the fossil-bearing oil shale sediments (Messel Pit Management Plan, 2009; Wedmann & Schaal, 2010, 2011).
It is also worth noting that the annual excavations, use very little oil-shale and the volume of fossil-bearing oil shale sediments is still massive and far from being depleted.

Protection and management

Assessing Protection and Management

► Relationships with local people

Highly Effective

The local population is included in decision making (Messel Pit Management Plan, 2009).

► Legal framework

Highly Effective

The legal framework is effective in maintaining its values (Messel Pit Management Plan, 2009: see 3.2).
There is no land tenure issue since the sole land owner of the Messel Pit Fossil Site is the State of Hesse (through the Hessian Ministry of Sciences and Arts, one of the key partners in the management of the site; Messel Pit WH Management Plan, 2009).
The legal framework is effectively enforced (perimeter fence, buffer zone, surveillance by foot patrols). (Messel Pit WH Management Plan, 2009)

► Enforcement

Highly Effective

The site comprises a perimeter fence accessible only by authorised personnel. This fencing-off is very effective. Perimeter is kept under surveillance by foot patrols to prevent trespassing (Messel Pit Management Plan, 2009). Researcher access to excavation requires an agreement.

► Integration into regional and national planning systems

Highly Effective

The integration into regional and national planning systems is highly effective through an effective networks of communication and cooperation (Messel Pit Management Plan, 2009). A number of stakeholders can be identified, all being involved in the management of the site: Hessian Ministry of Science and Arts, the Senckenberg Society for Nature Research and Messel Pit World Heritage Non-Profit Limited and the municipality of Messel (Messel Management Plan, 2009).

► Management system

Highly Effective

The site has a management plan (Messel Pit Management Plan, 2009) which identifies values, management objectives, future management outcomes and threats (e.g., tourism pressure, climate change, natural disasters).
On behalf of the state of Hesse who is the landowner, the Messel pit fossil

site is operated and scientific diggings are managed by the Senckenberg Society for Nature Research, and the public relations of the site is managed by the Messel Pit World Heritage non-profit company, especially including the visitor information centre and guided tours through the pit. This is regulated via contracts of the respective society/company directly with the state of Hesse (Messel Management Plan, 2009).
The governance framework is clear and the role of every partner is clearly explained and detailed so that there is no ambiguity.
The governance and decision-making is open to scrutiny. Information is clearly presented in the Messel Pit Management Plan (2009). The plan should be updated to ensure the permanence of the management system, particularly after the opening of the visitor information centre in 2010.

► Management effectiveness

Highly Effective

The management system, already considered as highly effective at the time of inscription (UNESCO, 2006) greatly improved the effective protection and management and strengthened the integrity of the site (SoOUV, 2013).

► Implementation of Committee decisions and recommendations

Highly Effective

Not Applicable

► Boundaries

Highly Effective

The boundaries of the site are effective to the management and protection of its values (Messel Pit WH Management Plan, 2009) with a highly effective fence and including a buffer zone (22.5 ha) that both enhance site protection (IUCN, 2010).

► Sustainable finance

Some Concern

There is no available estimate of the level of financial resources required to ensure the effective management of the site, but financial resources seem adequate to maintain the site’s values. The existing sources of funding come

from the Hessian State (227,500 euros annually to the benefit of Messel Pit) and German Federal State and Hessian State (7,553,250 euros each to the benefit of the Senckenberg). (Messel Pit WH Management Plan, 2009)
The resources are adequate to maintain site's values in supporting the cost of protection and management operations such as operation of the pit and waste water treatment, security measures and slope reinforcement, etc. (Messel Pit WH Management Plan, 2009).
The visitor information Centre opened in 2010. Its operation should be covered mainly by entrance fees and guide tours. However, there is no recent information available on the sustainability of this funding sources in the long-term (IUCN Consultation, 2017).

► Staff training and development

Mostly Effective

The staff numbers is adequate. The Senckenberg Institution provides 6 scientific researchers, 1 preparator and 3 technical assistants (http://www.senckenberg.de). For access and promotion, the Messel Pit World Heritage Non-Profit Limited provided 6 full-time positions, 2 seasonal positions (7 months) and 1 short-term position. For the operation of the Visitor Centre, a minimum of 8-10 full-time positions for the service counter (including guided tours) are estimated. (Messel Pit WH non-profit limited, 2009; http://www.grube-messel.de/de/ueber-uns/mitarbeiter.html).
The staff receives in-house and external training for promotion, interpretation and visitor management.
The Senckenberg Institute keeps a satellite research station in Messel for scientific work and operation (Messel Pit WH non-profit limited, 2009).
The equipment and infrastructure are well maintained to guarantee the management plan. The new Visitor Information Centre offer a top quality service in the context of the management of visitors.

► Sustainable use

Highly Effective

Only parts of the geological formation of oil shale containing the fossils are accessible on the surface. Most of it lies deep underground. The volume of fossil-bearing oil shale sediments is still massive and far from being depleted (Messel Pit WH non-profit limited, 2009).

Scientific excavations are limited and are under the responsibility of the Senckenberg Institution and are strictly controlled by mining regulations of the Federal Mining Law. The research permits are valid for a one year excavation period.
Resource use at present does not represent a threat to the conservation of the site.

► Education and interpretation programs

Mostly Effective

There are several education, interpretation or awareness programmes that enhance the understanding of values of the site: Messel Pit World Heritage non-profit company manages the Visitor Information Centre; a website (http://www.grube-messel.de), although it is only available in German (an English version should be available shortly); flyers (see, e.g., Messel Pit WH non-profit limited, 2013); Working meetings concerning new scientific findings on the Messel Pit are organised by Senckenberg and take place annually (Wedmann & Schaal 2013) less frequent are large international scientific conferences (e.g., Lehmann and Schaal, 2011).

► Tourism and visitation management

Mostly Effective

Promotion of the Messel Pit Site is managed by the Messel Pit World Heritage non-profit company. It is supported by various networks: the Global Geoparks Network, several key partners involved in the conservation and administration of the site which include local and regional institutions such as the Senckenberg Society for Nature research, Hessisches Landesmuseum Darmstadt, the Messel Museum of Fossils and Local History and the Geopark Bergstrasse-Odenwald Association.
The Messel Pit World Heritage non-profit company also manages the Visitor Information Centre which offers temporary and permanent exhibitions of fossils, exhibits on the history of the site, volcanism, climate, evolution, landscape, as well as guided tours. In addition a wide range of communication activities concerning the site are now in place (SoOUV, 2013).
Several equipments such as the viewing platform and the Visitor Information Centre have no impact on the conservation of the site. The number of visitors

actually descending into Messel Pit is moderate and under strict control. Its impact on the integrity of the site is very low, especially because the only mean to visit the site if through guided tours. Each guided tour is limited to a maximum of 50 participants; currently 8 guided tours can take place simultaneously, meaning a maximum of 400 people is present at a time (Messel Pit Management Plan, 2009).
The tourism is therefore managed to support protected area objectives and the integrity of the site.

► Monitoring

Mostly Effective

Threats to the site’s values are constantly being monitored and management plans and decisions are adapted. For example, the stability of the slope is constantly monitored with a network of 30 inclinometers. Groundwater and rainwater are pumped away to stabilize the slopes (Messel Pit Management Plan, 2009).
The scientific values of the site are adequately and constantly monitored by the Senckenberg Institution, especially through annual excavations (Messel Pit Management Plan, 2009).

► Research

Highly Effective

The management system of the site includes a specific research programme, notably through risk assessment, studies related to the values of the site, condition surveys, archaeological surveys, visitor management. In addition, the management system takes into account the result of studies and research programmes at the decision-making stage (Periodic reporting, 2006). Scientific research is represented mainly by the Senckenberg Society for Nature research and Hessen State Museum, Darmstadt. Many research papers in international scientific journals have been published.

Overall assessment of protection and management

Highly Effective

The current protection and management of the site can be considered as highly effective. The management system that is now in place supports the

protection of the site's outstanding universal value, contributes to building of local and regional networks to communicate on the site, facilitates promotion and access to the site for visitors and educates them to improve understanding of the site's values (with, especially, the Visitor Information Centre). The international exposure is mainly achieved through the scientific publications and should be enhanced in offering services in more languages (website, guided tours) to larger audience.

▶ **Assessment of the effectiveness of protection and management in addressing threats outside the site**
Highly Effective

At this time, the protection and management are highly effective in addressing threats outside the site (illegal trespassing, illegal excavations, industrial sites surrounding the site, renaturation of the site and uncontrolled growth of the vegetation). (Messel Pit WH non-profit limited, 2009)

State and trend of values

Assessing the current state and trend of values

World Heritage values

▶ **Record of the Middle Eocene environment**
Good
Trend:Improving

The unique knowledge of the Middle Eocene environment provided by the Messel pit is based on the scientific investigations conducted in and on the Messel oil shale deposits and/or the included sediments. The site is particularly significant in preserving records of various communities of aquatic, terrestrial and aerial organisms, providing a unique record of a complex ecosystem from the early Tertiary. The current state of this value is improving as the site's management and protection system against the few threats (tourism pressure, climatic events) improved during the last five years, with especially the creation of a buffer zone and the measures. Concerning the stabilisation of the western slope, recent significant results also improved our knowledge of the middle Eocene environment (e.g., Lenz

et al., 2011; Wedmann and Richter, 2007, Tütken 2014) ecosystem (Labandeira et al., 2011; Tütken, 2011, Mayr & Wilde, 2017) including food web structure (Dunne et al. 2014, Smith & Scanferla 2016).

► Quality of preservation

Good
Trend:Stable

This value is based on the state of preservation of fossils unearthed from the site during decades. Skeletons are often complete, with the contours of soft parts and stomach contents, and even a fetus for vertebrates (Franzen et al. 2015), conserved colouring and stomach contents for insects (e.g., McNamara et al., 2011). The exceptional preservation of fossils will leads to new findings according to the improve of analytic technics as the recent discovery of pigment remains (Colleary et al. 2015)
Fossils recovered are now adequately curated and stored in public institutions. Thanks to the methodology employed (known as ‘transfer method’; UNESCO, 1995), fossils are permanently preserved. Thanks to this methodology and to the preservation of the fossils in public institution, the value is stable.

► Richness and diversity of fossils

Good
Trend:Improving

Messel is known for its record of a highly diverse flora and fauna. The flora includes one the widest varieties of early Tertiary species of leaved flora with preserved cuticle structures. Within the fauna, invertebrates outnumbered vertebrates with a significant number of insects. The vertebrate fauna included 100 identified species at the time of inscription (UNESCO, 1995). This value is improving, with a greater richness and diversity, with, for example, 132 species of vertebrates (including 45 species of mammals in 31 genera; Morlo et al., 2004) and over 20,000 specimens (Messel Pit Management Plan, 2009) representing 203 species of plants in 75 families (see Lehmann and Schaal, 2011: preface) of which 65 are of flowering plants with preserved fruits and seeds (see Collinson et al., 2011; Collinson et al. 2012). Our knowledge is greater now than five years ago (e. g. Lehmann and Schaal 2012),also regarding other taxa such as turtles (Joyce and Scheyer, 2011), fishes, squamates (Müller et al., 2011) and especially invertebrates

that represent a large part of the fauna found at Messel: approximately 15,000 specimens of insects (60% are beetles) with an improving record regarding water-living insects (Wedmann and Richter, 2007; Ficacek et al 2010; Wedmann et al, 2011) and preserved colouring in moths (McNamara et al., 2011).

► Early evolution of mammals

Good
Trend:Improving

The Messel Fossil Pit records a uniquely important diversification phase of the evolution of mammals, when they experienced a rapid development and became globally predominant class of animal. The site provides a sharp insight into the early phylogeny of mammals, with 40 species having been identified at the time of site's inscription, a number that increases up to 45 nowadays (see Lehmann and Schaal, 2012; Dunne et al., 2014) belonging to 13 different orders (Rose, 2012). The recent discoveries improved the value of the site, with especially recent advances on the history of primates (Franzen, 2011; Franzen et al., 2009, 2011; Gingerich, 2011; Hurum et al., 2011; Koenigswald et al., 2011), or additional knowledge on the bats (Gunnell et al., 2011; Habersetzer and Schlosser-Sturm, 2011) or carnivors (Morlo et al., 2011).

Summary of the Values

► Assessment of the current state and trend of World Heritage values

Good

Trend: Improving

The site's World Heritage values are associated with the fossil record of a unique Middle Eocene environment, including various communities of aquatic, terrestrial and aerial organisms. Recovered fossils are well preserved and stored in public institutions and the state of the site itself improved over the last five years, with the creation of a buffer zone and the measures concerning the stabilisation of the western slopes. Significant scientific results have improved our knowledge about the middle Eocene environment. Our knowledge is greater now than five years ago regarding taxa such as turtles, fishes, squamates and especially invertebrates.

Advances in the history of primates and carnivores have contributed to the importance of the site for the studying the evolution of mammals. Recent works highlight our knowledge of the trophic structure of this Eocene Ecosystem and provide advances in the scope of taphonomic studies.

Additional information

Benefits

Understanding Benefits

► Outdoor recreation and tourism

The site is already relatively important for tourism. Since 1997, a visitor observation platform with text panels about the history and developments of the site has been on site and open to the public. There are no definite statistics available, but this platform has had 212,000 visitors since 2004. To improve this benefit, one needs a wider regional integration of the Messel Fossil Pit site and maybe an improvement of the relationships/connection with other touristic sites of the Global Geopark Bergstrasse-Odenwald.

► Importance for research, Contribution to education

The site is an important resource for building knowledge and for educating, through the Visitor Information Centre now in place. Unfortunately data are not sufficient to adequately evaluate this benefit. Seven years after its opening, the number of annual visitors is estimated at about 40.000 currently. The Visitor Information Centre welcomes a wide range of visitors and aims at, among other objectives, presenting exhibitions on evolution and geo-diversity, proposing lectures, brochures, internet access, development of a didactic approach for the mediation of the Messel Pit WH Site. Along the year, the WH Messel Pit coordinates and offers a large number of guided tours, offers training of teachers and tours for schools, kindergartens or groups. Data are also missing regarding measures to be taken by stakeholders to better promote and ease public access to the site:

improvement of the signage to the site, extension of access road, visitor facilities.

Summary of benefits

Key benefits of the site include tourism, knowledge building and education. Data are lacking for a pertinent evaluation of the importance of the site for education and building knowledge. The value of the site as a recreation place is real, but difficult to evaluate in detail in the absence of accurate data.

Projects

Compilation of active conservation projects

№	Organization/ individuals	Project duration	Brief description of Active Projects
1	Senckenberg Society for Nature Research		Investigation and reconstruction of the Eocene Lake Messel: excavation and preparation, geology, paleobiology, digital media, X-Ray applications, documentation of Messel and the fossil collection.
2	Senckenberg Society for Nature Research		Research Portal, where scientists can introduce their projects on Messel Pit. The portal is restricted to scientists who have registered with the SGN.

Compilation of potential site needs

№	Site need title	Brief description of potential site needs	Support needed for following years
1	N.A.	Need for translation of the internet website www.grube-messel.de, at this time only available in German. Shall be at least in English, and even in French and other languages.	
2	N.A.	Impact of the tourism after the building of the Visitor Information Centre, in term of conservation/protection of the site and implication for the local community.	

№	Site need title	Brief description of potential site needs	Support needed for following years
3	Senckenberg Gesellschaft für Naturkunde	A list of the animal and plant species which can be found in the area of Messel Fossil Pit area (a future project of the Senckenberg Gesellschaft für Naturkunde).	
4	Visitor Information Centre	Periodic review of activities should be planned for the Visitor Information Centre.	

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