Australian Fossil Mammal Sites (Riversleigh / Naracoorte)

2020 Conservation Outlook Assessment

SITE INFORMATION

Country: Australia
Inscribed in: 1994
Criteria: (viii) (ix)

Riversleigh and Naracoorte, situated in the north and south respectively of eastern Australia, are among the world’s 10 greatest fossil sites. They are a superb illustration of the key stages of evolution of Australia’s unique fauna. © UNESCO

SUMMARY

2020 Conservation Outlook

Finalised on 02 Dec 2020

GOOD

The current state of World Heritage values continues to be good. While a number of threats and other issues affecting this World Heritage site exist they are all minor and do not impact upon its Outstanding Universal Value. Accordingly, the conservation outlook remains good but there is concern regarding the sustainability of funding and consequent effects on attaining and managing future research for Naracoorte and Riversleigh. The unique aspect of the Australian Fossil Mammal Sites is that its value lies in knowledge and understanding, a value which should be constantly pursued and enhanced. The addition of sustainable research funding as a key performance indicator would be beneficial as well as adequate funding for curation and digitisation of existing collections to ensure greater public and research access. Such indicators should reflect current and sustainable funding models that contribute to education, protection and management.
FULL ASSESSMENT

Description of values

Values

World Heritage values

► Extensive deposits of vertebrate fossils

The Australian Fossil Mammal Sites (Riversleigh/Naracoorte) contain extensive vertebrate fossil deposits which have, and will continue to provide a significant contribution to the understanding of the history and origins of the contemporary Australian fauna. Riversleigh has yielded exceptional, and in many cases unique, mammal assemblages spanning the period from Late Oligocene to present (approximately 25 million years ago to today). The study of these fossil assemblages has documented changes in habitat from humid, lowland rainforest to dry forests, woodlands and grasslands. These assemblages provide the first fossil evidence of many distinctive groups of living mammals such as the marsupial moles and feather-tailed possums. Naracoorte assemblages date from the mid-Pleistocene to present (530,000 years ago to today), a period characterised by great climatic variability (World Heritage Committee, 2012). Sedimentary profiles associated with several of these fossil sites are exceptionally detailed, providing the potential for substantially-insightful palaeoecological research. These deposits have also accumulated across the time-period that humans first arrived in Australia (IUCN Consultation, 2020).

► Evidence of evolutionary change

Naracoorte and Riversleigh provide complementary evidence for key stages in the evolution of the fauna of one of the world's most time-isolated continents. The history of some modern mammals can be traced through the lineages identified in the fossil deposits, contributing to a better understanding of the conservation status of living mammals and their communities. Both component sites are rich in a diverse range of vertebrates including mammals, as well as plants and invertebrates (World Heritage Committee, 2012). At Riversleigh there are more than 250 fossil assemblages which differ in their faunas. The earliest faunas at Riversleigh are dominated by rainforest specialists, which also suggests a rainforest origin for the majority of mammal groups that today occupy arid Australia. By collectively examining these assemblages it suggests broad scale evolutionary changes over time, and is interpreted as being due to habitat changing from humid lowland rainforest to dry eucalypt forests and woodlands from the Oligocene to the Miocene through the drying out of the Australian continent as it moved northwards. The vertebrate species present at Riversleigh and Naracoorte record these changing faunas, and at Naracoorte they include superbly preserved examples of the Australian ice age megafauna (giant, now extinct mammals, birds and reptiles), such as the enigmatic extinct marsupial lion (Thylacoleo carnifex). This site also hosts essentially modern species including marsupials such as the Tasmanian devil (Sarcophilus harrisii), Tasmanian tiger (Thylacinus cynocephalus), wallabies and possums; placental mammals including mice and bats; and snakes, lizards, frogs and turtles (World Heritage Committee, 2012).

Other important biodiversity values

► Breeding habitat for the critically endangered Southern bent-wing bat

Within the Naracoorte component is a population of the Southern bent-wing bat (Miniopterus orianae bassanii), listed as ‘Critically Endangered’ under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). Bent-wing bats occupy relatively discrete geographical ranges within Australia. The Naracoorte population of bent-wing bats has a range that covers south-eastern South Australia and south-western Victoria. In south-eastern South Australia, one cave within the Naracoorte...
component (Bat Cave) has been chosen as the maternity site and used for the birth and rearing of each generation of young (Department for Environment and Heritage, 2001; State Party of Australia, 2003).

Endangered regional ecosystems and threatened species

The Riversleigh area supports significant natural values that include endangered regional ecosystems and threatened species. Freshwater systems that sustain life in an arid landscape, providing localised habitat for listed species of concern, including the vulnerable purple-crowned fairy wren (Malurus coronatus), the nationally endangered Gulf snapping turtle (Elseya lавarackorum) - first described as a fossil from Riversleigh’s fossil deposits, and the geographically limited rock ringtail possum (Petropseudes dahli).

Mixed shrubby woodlands on rocky limestone and lancewood communities, characterised by Kimberley Bauhinia (Lysiphyllum cunninghamii) and Brachychiton spp provides habitat for spectacled hare-wallabies (Lagorchestes conspicillatus), endemic purple-necked rock-wallabies (Petrogale purpureicollis), and in cave systems and sink holes, a high diversity of bats including the vulnerable orange horseshoe bats (Rhinonicteris aurantius).

Open woodlands and grasslands communities that are structurally complex and dominate the landscape provide important habitat for a range of declining species, particularly the nationally endangered Carpentarian grasswren (Amytornis dorotheae), the Gouldian finch (Erythrura gouldiae), and the nationally vulnerable Painted honeyeater (Grantiella picta).

Tussock grasslands are critical protected remnant habitat for the northern nail-tail wallaby (Onychogalea unguifera) and many grass finch populations (IUCN Consultation, 2020).

Naracoorte Caves National Park (including the World Heritage component) also contains substantial habitat for and populations of the nationally-endangered bell-flower hyacinth orchid (Dipodium campanulatum) and South-eastern red-tailed black cockatoo (Calyptorhynchus banksii graptogyne), and nationally-vulnerable Yarra pygmy perch (Nannoperca obscura) (all listed in the EPBC Act). Also present are locally-endangered satin flycatcher (Myiagra cyanoleuca) and yellow-footed antechinus (Antechinus flavipes) (both listed in the South Australian National Parks and Wildlife Act 1972). The key habitat feature of the park that most of these species rely on is the substantial stands of Brown Stringybark (Eucalyptus baxteri) (IUCN Consultation, 2019).

Assessment information

Threats

Current Threats

Threats such as site damage and fossil theft are considered to be very low due to the nature and difficulties of public access, remoteness and relatively low numbers of visitation (at Riversleigh) and controlled public access (at Naracoorte). Research activity at Riversleigh is monitored through Scientific Permit conditions. Provided there is committed ongoing additional funding support into the future, the threat level remains very low. Further concerns about compliance with research practices should be addressed by rigorous monitoring by management authorities. At Naracoorte, access to the site is by permit and/or supervision. Illegal access is a low threat - Naracoorte’s fossil sites are underground and in the main are secure from impact from natural events.

Fire/ Fire Suppression

Wildfires occur at Boodjamulla (Lawn Hill) National Park, which includes Riversleigh, and may have an impact on extant biota but this does not impact upon the World Heritage values of the area to any great extent. The approved Fire Strategy (internal management document) aims to minimise risk of large scale conflagrations (State Party of Australia, 2003) and protect those areas that are sensitive to fire. Managing fire, maximises the long-term resilience of vegetation communities and reduces potential
threats to site’s Outstanding Universal Value (OUV) (erosion of the limestone terrain). For Naracoorte the South Australia Fire Management Plan (2010-2020) facilitates practical reduction of fire impact for the Naracoorte section. Fire hazard reduction activities should be planned to eliminate risk of damage to surface karst and natural cave processes.

**Tourism/ visitors/ recreation**

*Illegal access and fossil theft*

Illegal access is a low threat at both components. At Naracoorte, caves are locked and/or fenced to prevent illegal entry and fenced caves are not lit after-hours which inhibits illegal access (IUCN Consultation, 2017). Cave tours are always supervised by a trained DEW guide, and provide a low-risk way of enabling recreational and educational use of the site. Cave access for purposes other than guided tours (with the exception of Wet Cave) is by special permit only, and specific conditions are outlined in permits if they are approved. Both access methods effectively regulate cave entry, with numbers on tours limited, and special permits not commonly issued and carefully scrutinised. Installation of external monitoring would be prudent to protect the most significant caves. There is anecdotal evidence of small-scale disturbance at Riversleigh but it is not clear that it is an ongoing threat. The responsible management authority ensures visitors were well informed that removal of material is not permitted (State Party of Australia, 2003). Illegal access to Riversleigh is difficult to control but is not considered a significant threat to the OUV. The majority of fossils sit within the hard limestone terrain and are generally difficult to remove and access. Anecdotal fossil theft has been noted once but is considered a low threat due to access being restricted to D Site (the only publicly accessible site at Riversleigh). Site damage or fossil theft is now included in QPWS Health Checks that are part of monitoring under the Queensland Parks and Wildlife Service’s (QPWS) Values-Based Management Framework (VBMF) - a separate methodology to park management plans for all national parks in Queensland (IUCN Consultation, 2020). At Riversleigh, signage is being updated to better reflect fossil protection (IUCN Consultation, 2019).

**Other**

*A lack of structure and funding for ongoing research*

Both the Naracoorte Caves Management Plan and the Riversleigh Management Strategy acknowledge the significance of ongoing research to fully realise the World Heritage values of the site. Both acknowledge the need to ensure research is sustainable and details appropriate controls and permitting procedures in the form of conditions. Importantly, the management plans acknowledge the need for structured research.

The Naracoorte plan includes a requirement for a ‘research program coordinating committee’ which was formed several years ago and the Riversleigh strategy includes the requirement to ‘develop and implement a five-year Research Plan’. Research at Riversleigh is regulated by the Queensland Department of Environment and Science (DES) via the (Qld) Nature Conservation Act 1992 and permit applications are evaluated in coordination with the Queensland Museum (the States statutory custodian of the excavated fossils). Permittees are required to refer the proposed action to the Department of Agriculture, Water and the Environment for assessment and approval under the Environment Protection and Biodiversity Conservation Act 1999. The referral considers the proposed activity's impact on the World Heritage Value. In accordance with the Australian World Heritage management principles, DEW developed The Naracoorte Caves Scientific Research Opportunities and Guidelines with input from the Naracoorte Caves Interagency-Community Reference Group (IRG). DEW also sought expert advice from other stakeholders with a particular interest in the Naracoorte Caves including researchers, recreational cavers and community organisations. The Australian Government approved funding of $500,000 ($100,000 per year) for the Naracoorte Caves IRG and Executive Officer for 2018-2023. The committee's operations are becoming limited, partly because the non-indexed amount provided by the Australian Government is lower than needed to meet the objectives on its own, and partly because of the withdrawal of additional funding to support the committee previously provided by the South Australian government (IUCN Consultation, 2019). Engaging effectively with First Nations Peoples involves consultation. Working with the community is seen as a critical element for the future management of the World Heritage Area, although the funding to do this is not currently in place. In addition, there is inadequate funding to curate and manage the incorporation of existing collections in the Queensland...
Museum, estimated at 40,000 items extracted from the Riversleigh component of the site to date (IUCN Consultation, 2020).

**Other Activities**

*(Impacts of research activities)*

Threats to the integrity of fossil sites through excavation and removal of fossil material for analysis are very low.

The analysis of the fossil record is fundamental to understanding the site’s Outstanding Universal Value. The excavation of fossil material for scientific purposes from the Riversleigh component of the site is undertaken under scientific permit, issued by QPWS, and with sensitivity to the concerns from the Waanyi Aboriginal People’s - the First Nations Peoples of the lower Gulf region (IUCN Consultation, 2017). At Naracoorte Caves, the removal of fossil material for research is by permit only, with the DEW already having an established state-wide scientific permit framework and personnel to oversee it. Permit applications are also submitted to the Research Sub-Group of the Naracoorte IRG for expert advice to the DEW. On-ground DEW staff check research activities in caves, to ensure they comply with permit conditions (IUCN Consultation, 2019).

**Potential Threats**

Careful attention needs to be given to balance commercial demands with conservation of the site as pressure for infrastructure development comes with higher rates of visitation. Potential threat from climate change to the site's values exists, but is considered very low.

*Tourism/ visitors/ recreation*

*(Increased visitation)*

The Queensland Government Department of Environment and Science (DES), is cognisant of the need for additional monitoring. QPWS has developed a plan to redevelop signage and visitor facilities at Riversleigh to significantly improve site interpretation. Once implemented these facilities should mitigate against impacts of potential future increases in visitor numbers. Improved interpretation, community awareness and close cooperation between commercial tour operators, neighbouring landholders and QPWS park rangers can help to mitigate against inappropriate visitor activities (IUCN Consultation, 2019). At Naracoorte, access to the caves is regulated, and security measures are enhanced as needed. All caves are locked between tours and after hours, and doors are designed with deadlocks and hinges that cannot be removed. A large fence was built in 2018 around the entrance to Victoria Fossil Cave, encompassing an area not previously protected, and the gate is locked after hours. Many other fences around the cave entrances have also been updated. Part of Wet Cave is accessible to visitors without guided supervision (but subject to an entry ticket) during DEW staff hours, and is regularly monitored (IUCN Consultation, 2019). Pressures for more visitor infrastructure to meet demand must be carefully weighed against conservation goals for the site. Development should be monitored for environmental impact.

*Temperature extremes*

*(Climate Change)*

At Naracoorte, higher temperatures and altered humidity in caves could exacerbate the proliferation of cave microbiota, and there is potential that this could increase surface degradation of the fossils. Drought can also pose a risk to cave structures, as changes in hydrology can lead to increased speleothem degradation. Drying of the cave vadose flows can also affect cave biota such as bats and invertebrates. Extreme weather events may mean increasing frequency and intensity of floods, and excess water can run into caves and cut through fossil beds, leading to the loss of temporal fossil series. However, it will be important to maintain natural flows into the caves and not exacerbate the potential impacts with changes to the land surface via development. Current research into lampenflora diversity and management at the site is underway (IUCN Consultation, 2019). At Riversleigh, increased erosion on the limestone terrain, represents the main potential impact of
climate change (the limestone terrain contains the fossil deposits). Although the likelihood and impact may be determined as low, extreme weather events such as harsher/hotter fire weather (affecting vegetation communities that may protect the limestone terrain from rainfall), increased storm activity, higher category cyclones, and larger and longer-lasting rainfall events leading to greater erosion, may have potential impacts on the OUV of the site (IUCN Consultation, 2020).

**Diseases/pathogens**
*(Risk of introduction of the fungus causing the white-nose syndrome in bats)*

The risk and potential impact of white-nose syndrome on the bats is something of great current concern, as identified in the recent review of the South Australian Regional Action Plan for the Southern Bent-wing Bat. While white-nose syndrome is not known to occur in Australia, a risk assessment has concluded that it is “almost certain” to be introduced in the next 10 years, and the Southern bent-wing would be the species most impacted. White-nose syndrome is caused by a fungus and has decimated populations of bats in North America. It is typically transmitted from bat-to-bat and by international tourists, and the fungus can stay dormant in caves for several years before it is detected in bat populations. As a site specialising in cave tourism, Naracoorte Caves management staff from the Department for Environment and Water and advisors are actively participating in threat mitigation discussions and recovery plan review processes, and advocate for border-interception measures in Australia, similar to other already-implemented biosecurity practices at a national level (IUCN Consultation, 2019).

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**Overall assessment of threats**

Threats such as site damage and fossil theft are considered to be very low due to the nature of public access, remoteness and relatively low numbers of visitation (at Riversleigh) and controlled public access (at Naracoorte). Research activity at Riversleigh is monitored through Scientific Permit conditions. Provided there is committed ongoing additional funding support into the future, the threat level remains very low. At Naracoorte, access to the site is by permit and/or supervision. Illegal access is a low threat - Naracoorte’s fossil sites are underground and are secure from impact from natural events. Illegal access to Riversleigh is much more difficult to control and has led to allegations of theft of unique and irreplaceable materials. Potential threat posed by climate change is currently considered very low. Overall, the threat to the World Heritage values of the site is very low.

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**Protection and management**

**Assessing Protection and Management**

**Management system**

A number of framework documents guide the management of the component sites of this serial World Heritage site. DES is currently in the process of generating a separate and contributing methodology to park management plans for all national parks in Queensland through the development of QPWS’s Values-Based Management Framework (VBMF) (Queensland Government, 2019). The VBMF for Boodjamulla National Park, within which the Riversleigh component is located, is currently in draft and is an adaptive approach to meeting park planning and management accountabilities. The VBMF for Boodjamulla National Park incorporates a strong emphasis on managing threats to key values, including World Heritage, maintaining environmental integrity, promoting healthy ecosystems and undertaking active management of pests, weeds, fire and visitation (IUCN Consultation, 2020). The Boodjamulla (Lawn Hill) National Park and Resource Reserves Management Statement (QPWS,
The Australian Fossil Mammal Sites (AFMS) Framework is currently in draft and will coordinate management across both Riversleigh and Naracoorte. The AFMS Framework will complement existing legislative structures and other regimes to address Australia's international responsibilities under the Convention Concerning the Protection of the World Cultural and Natural Heritage (the World Heritage Convention) and will describe how the existing management and governance arrangements provide for the long-term collaboration, protection, conservation, presentation and transmission of the values of the AFMS World Heritage site.

The AFMS Framework will provide overarching guidance for management of AFMS, while more detailed management objectives and strategies for Riversleigh and Naracoorte are provided in the site-specific Strategic Management Plans prepared by the Queensland and South Australian State government agencies (IUCN Consultation, 2020).

The signatories to the Framework will work cooperatively to share information and develop appropriate strategies for the benefit of the AFMS. Respective State governments will continue to undertake regulatory and day-to-day management, but with a greater level of coordination and consistency. Cooperative opportunities include the development of promotional and interpretative material, research and information exchange, and sharing of expertise and resources to protect, conserve, present and transmit values.

Cross collaboration through regular Coordinating Committee meetings (Executive officers and Management representatives from both QLD and SA) and World Heritage Advisory Committee meetings, where appropriate (IUCN Consultation, 2020).

**Effectiveness of management system**

Mostly Effective

There is a suite of legislation in place that provides suitable support for protection and management. There are regular site inspections, flood control measures (for Naracoorte) and a prescribed burning programme designed to mitigate any negative effects associated with wildfires. Management of both components of this serial site appears effective. The QPWS Boodjamulla (Lawn Hill) National Park and Resource Reserves Management Statement 2013 provides management effectiveness evaluation. Management effectiveness will also be reported on in Queensland's State of the Parks Reporting (2023 and onwards). While there is no single management plan for the entire World Heritage site, consultations are ongoing on finalising a draft AFMS Framework. Once finalised this Framework will complement existing legislative structures and other regimes to address Australia's international responsibilities under the World Heritage Convention (IUCN Consultation, 2020). Such a strategic framework for the entire site would further strengthen its management.

**Boundaries**

Mostly Effective

The boundaries of the Naracoorte Caves National Park do not match those of the caves in which the fossil deposits occur, although the entrances to the caves are protected. Since the World Heritage inscription, the boundaries of the National Park have been expanded and cover most known caves within the park, and also now include many other caves that were not part of the park at the time of inscription. Some of these ‘new’ caves are of very high scientific value, containing further extensive fossil deposits. The World Heritage site now only represents a sub-section about half the size of the total National Park area.

The Riversleigh component (approximately 10,000ha) sits within the boundary of Boodjamulla (Lawn Hill) National Park (approximately 380,000ha). Access to the only publicly available site is across the
neighbouring pastoral lease (held by the Lawn Hill Riversleigh Pastoral Holding Company (LHRPHC)), as is access to the remainder of the World Heritage site (utilised by QPWS and scientific permit holders). QPWS negotiate access through informal agreement with the LHRPHC as required. The boundary, while adequate for the protection of values, is not entirely adequate for security of long-term public and scientific researcher access and presentation of the values (IUCN Consultation, 2019).

Integration into regional and national planning systems

Highly Effective


The South Australia Heritage Act, 1993 provides for the conservation of places of heritage value and the Development Act 1993 provides for planning and regulating development, the management of land, and the design and construction of buildings.

The Boodjamulla (Lawn Hill) National Park, in which the Riversleigh component is located, has a Management Strategy in place. The Riversleigh Management Strategy (Queensland Government and Environment Australia, 1993) (subsequently renamed the Riversleigh Strategic Management Plan – RSMP) is currently under review (IUCN Consultation, 2019).

Relationships with local people

Highly Effective

The Queensland Department of Environment and Science (DES) recognises that First Nations Peoples have rights and interests in Country listed for World Heritage values. Two Waanyi representative positions are held on the Riversleigh World Heritage Advisory Committee (RWHAC). These representatives are nominated by the Waanyi Native Title Aboriginal Corporation (Registered Native Title Body Corporate) that represents the Waanyi peoples. The RWHAC assist in meeting the obligations under the World Heritage Convention and the Commonwealth EPBC Act 1999 and provide advice to the management agencies and the Queensland and Australian Government Ministers responsible for World Heritage. DES is working to incorporate First Nations priorities and perspectives in decision-making and operations through The Gurra Gurra Framework 2020-2026 (The Framework), a ‘whole of department framework that prioritises co-management of business with First Nations partners, including the business of World Heritage’ (Queensland Government, 2020).

The RWHAC also includes representation from the scientific community (palaeontology, archaeology, geology, speleology, geochronology, hydrology, zoology, botany), Queensland Museum, commercial tourism and the Queensland government tourism body Tourism and Events Queensland, Local Councils, local landholder representatives, and Queensland and Australian governments.

The First Nations Peoples of the Naracoorte area are the Potaruwutij to the North, Jardwadjali to the East, Boandik to the South and Meintangk to the West. Naracoorte Caves feature in Dreaming tracks, and some of the wildlife species that inhabit the caves are culturally significant.

The South Australian Department for Environment and Water recognises First Nations Peoples’ connection to country, strength and resilience, and the importance of engaging Traditional Custodians in the care and management of natural resources and heritage. A Traditional Custodian representative nominated by the South East Aboriginal Focus Group sits on the Naracoorte Caves Interagency-Community Reference Group (IRG).

Naracoorte has also been able to gain the support of the local community. A strong ‘Friends of Naracoorte Caves’ group, an active consultative committee and supportive local businesses along with an understanding of the role the community has had in the development of Naracoorte Caves NP over 160 years contributes to a positive partnership between the park and community. Local government at Naracoorte have also recently enhanced connections with the community, through a prospectus and plan for the local business community titled Caves Connections, and by financially supporting scientific research at the site. Other local business associations have also contributed funds for research and events.

Legal framework

Highly Effective

Naracoorte and Riversleigh both have significant strengths in regard to existing legislation, according to the interests of various stakeholders and as a result of on-going scientific interest. The Riversleigh
component is protected under the Queensland Nature Conservation Act (1992) and managed according to the Riversleigh Management Strategy. The Naracoorte component falls under the jurisdiction of the Naracoorte Caves National Park Management Plan (2001). The Riversleigh fossil deposits are largely situated within the boundary of the Boodjamulla (Lawn Hill) National Park, but also extend outside the World Heritage site in both the national park and on neighbouring properties. The Naracoorte fossil deposits are situated within the Naracoorte Caves National Park. Both components of the World Heritage site are protected under the relevant parks legislation of the States in which they are situated. In May 2017, the South Australian Heritage Council confirmed the Naracoorte Caves Complex as a State Heritage Place in the South Australian Heritage Register (Government of South Australia, 2017). This formal recognition as an important part of South Australia’s rich non-Aboriginal heritage adds another layer of protection as State Heritage Places are protected under the Heritage Places Act 1993 and the Development Act 1993. The World Heritage values of the Australian Fossil Mammal Sites are also protected as a matter of national environmental significance under the Australian Government’s Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). Any new development proposal in the World Heritage site will be subject to assessment and approval under the EPBC Act if an action is considered likely to have significant impacts on World Heritage values. Importantly, this Act also aims to protect World Heritage site from impacts that originate outside their boundaries. It thus forms an additional layer of protection designed to protect values of World Heritage sites from external impacts (State Party of Australia, 2003).

Law enforcement

Highly Effective

Enforcement of the relevant laws and regulations is highly effective. All research activity (especially involving excavations and removal of materials) is carried out at the sites in accordance with existing procedures. No breaches of optimal conservation practice have been observed (IUCN Consultation, 2019).

Implementation of Committee decisions and recommendations

Data Deficient

There have been no Committee decisions regarding this World Heritage site in recent years.

Sustainable use

Highly Effective

Use of both components is limited mainly to research, education and tourism which pose little to no threat to the site’s values. The SA DEW Scientific Permits Team with input from the IRG Research Subgroup, regional team and park management review all scientific research permit applications for work at Naracoorte Caves to determine the likely impacts of the research on World Heritage Values. In particular, DEW Permits Team assess the methods and always seek to minimise impacts of research from a conservation and aesthetic viewpoint if the area is in the public view. DEW and researchers developed a ‘Researchers Protocol’ for Naracoorte covering all aspects of fossil extraction including minimum information that has to be recorded and procedures that are to be followed when conducting research. Tourism is addressed by implementing rigid policies which only allow access to areas designated as show cave or adventure cave under the Management Plan except where visitors are under the direct supervision of a park employee (State Party of Australia, 2003; Queensland Government and Environment Australia, 1993). Use by the public of Riversleigh’s resources is considered sustainable. Public access to the fossil sites is controlled along a public access walking track, in a remote area with low visitation (IUCN Consultation, 2019).

Sustainable finance

Some Concern

In Queensland and South Australia, day-to-day management activities in World Heritage sites are funded by the State Governments, while the Australian Government funds those additional activities necessary to meet World Heritage obligations and to address and respond effectively to the expectations of Traditional owners. The World Heritage site remains dependent upon regional funding to undertake any programmes, which are specifically targeted on the World Heritage values. Primary
funding for research at Riversleigh has depended on successful application by the researchers for competitive grant funding from the Australian Research Council, support that has been achieved since 1978, but funding from this source is not guaranteed into the future. Faced with growing competition for finite resources funding from other State and National funding bodies has been focused on protecting Australia’s existing biota rather than on understanding the nature of and conservation relevance of extinct biota, despite the fact that the fossil record in the World Heritage site at Naracoorte and Riversleigh contain critical information important for the development of more effective long-term conservation programs for endangered living species such as the Mountain pygmy-possum (Burramys parvus). Hence better funding for understanding the far longer, pre-modern history and potential environmental resilience of modern lineages should be better supported than it is at present (IUCN Consultation, 2017). In September 2017, the Australian Government announced funding of AUD $145,000 per annum for five years from July 2018 to provide the continuation of the World Heritage Executive Officer and Advisory Committee for Riversleigh. However, this funding has remained the same for more than 10 years, despite increasing costs in operation. The Naracoorte component receives a non-indexed $100,000 per annum from the Australian Government for the Naracoorte Interagency-Community Reference Group (Advisory Committee) and World Heritage Executive Officer. This amount has become insufficient to continue the Executive Officer in a full-time capacity (IUCN Consultation, 2019).

**Staff capacity, training, and development**  
Some Concern

Staff levels are sufficient to meet minimum day-to-day management requirements. Current Naracoorte staff do not have substantive training in fossil conservation, cave conservation and water management techniques, and rely on external advisors to assist in these areas. However, staff are trained to be vigilant observers in all related areas and are encouraged to report any changes (IUCN Consultation, 2019). There is currently strong support from researchers to assist and advise on management of values and train staff, highlighting the importance for management authorities to continually engage with the scientific community. Continued training of site interpreters in the methods and findings of current World Heritage-centred research is important to maintain quality communication of the World Heritage values, and some staff feel this training is too limited at present (IUCN Consultation, 2019). No staff are provided by State or National bodies responsible for World Heritage management to assist with research or site interpretation at Riversleigh.

**Education and interpretation programs**  
Mostly Effective

Riversleigh has some developed education in the form of web material and Riversleigh centric on-line educational resources, a brochure and fossil kits that enable some select and non-significant fossils to be used as a resource off-site (supervised by trained staff). Savanna Guides based out of Adel’s Grove conduct guided walking tours of the site. The Riversleigh Fossil Discovery Centre (operated by the Mount Isa City Council) in Mount Isa (260 km from Riversleigh) and Naracoorte Caves Wonambi Visitor Centre and interpretive displays contribute significantly to the transmission of the site’s OUV. The Riversleigh Fossil Discovery Centre undertook a 2.2 million dollar re-development and opened in June 2020 ($1.23 million through the Queensland Government’s Outback Tourism Infrastructure fund) and provides an excellent interpretation of Riversleigh’s World Heritage values and the ongoing research activities. The RWHAC’s expertise and the expertise of the University of New South Wales researchers were utilised to support interpretive content in the newly-refurbished Centre (IUCN Consultation, 2019). Naracoorte’s Wonambi Visitor Centre, on site at the Caves, also houses interpretive displays providing important context to the values of the World Heritage site. Special exhibitions and displays are an ongoing part of site presentation, and the visitor interpretive centre hosts a sophisticated series of animatronic displays set within recreated habitats. However, many of the interactive components and interpretive panels have been damaged and are degraded. Low-level funds needed to restore the display area are being sourced in a staggered manner over the long-term, but a more substantive funding source is needed to avoid major disrepair, which could render the display static, or force it to be converted to a different space (IUCN Consultation, 2019). Naracoorte has a range of informative interpretive signage that conveys information on the importance of the site. Findings from new research
will ideally be incorporated into these displays on an ongoing basis. Close consultation with researchers will ensure the accuracy and integrity of interpretative material.

**Tourism and visitation management**

Mostly Effective

The Riversleigh Management Strategy recognizes that visitors play a significant part in ensuring that the World Heritage site is an integral component in the life of the community. Furthermore, tourism provides important social and economic benefits to the region and opportunities for indigenous employment (IUCN Consultation, 2020).

The Naracoorte Caves National Park is promoted as a prime visitor attraction and plays a substantial role in regional tourism. Modification of the caves to facilitate the interpretation of fossil deposits revolutionised the visitor experience as has the site’s interpretative centre which is focused specifically on the World Heritage values. Cave tours give visitors an appreciation of the processes which formed the caves and their contents, with particular focus on the fossil deposits, the aesthetics of caves and the biology and cultural history of the caves and the region in which they occur.

It would be beneficial to further promote the sites by additional profiling in order to build upon and enhance scientific and tourism interest. Special events help to reach a wide audience through media promotion, such as the World Heritage Festival, and can offer insight for people both familiar and unfamiliar to the site.

**Monitoring**

Some Concern

Both components of the World Heritage site have management documents, which acknowledge the need to establish and maintain monitoring programs. Monitoring of research at Riversleigh is done through DEW and EPBC Act permitting and reporting, and via the regular assessments carried out by the research scientists themselves. Monitoring is now also included in Queensland’s State of the Parks Reporting. Currently conditions and threats are reported on in Queensland’s State of Environment Reporting which is published approximately every two years (IUCN Consultation, 2017). At Naracoorte, monitoring activities include inspections of caves on a set regular schedule to assess stability of limestone walls and ceilings. Ongoing observations are conducted on tours and glass indicators are used to detect rock movement. Visual monitoring of fossil sites occurs in show-caves daily and in other caves during stability inspections, and the bats are monitored by infrared cameras installed in the cave (IUCN Consultation, 2019). An opportunity exists to collaborate with researchers to develop a sustained monitoring program to keep track of the conservation status of natural values. A structured, scientific monitoring program that is delivered collaboratively with scientists, staff and volunteers would provide baseline data for conservation planning (IUCN Consultation, 2020).

**Research**

Mostly Effective

There has been a considerable amount of literature published as outputs of research for AFMS - research is the cornerstone of the site’s World Heritage values. Both the Naracoorte Management Plan and the Riversleigh Management Strategy (RSMP) acknowledge the significance of ongoing research to fully realize the World Heritage values of the site. Both acknowledge the need to ensure that research is sustainable and detail appropriate controls and permitting procedures.

The Naracoorte Management Plan includes a requirement to ‘develop and implement a five-year Research Plan’ and the RSMP includes the requirement to ‘develop and implement a Research Plan. There are currently some large-scale high-level fossil-related projects underway involving multiple universities with multiple funding partners. The majority of research on Riversleigh fossils has been undertaken by the University of New South Wales (UNSW) who collaborate with over 100 research colleagues, and have discovered more than 40,000 fossils to date (IUCN Consultation, 2020).

**Overall assessment of protection and management**

Mostly Effective

The protection and management of the World Heritage site is mostly effective although there is some concern about the security of funding. The integrity of both components (Naracoorte and Riversleigh) of this serial site is dependent on management plan updates (maintenance of cave monitoring and...
regular inspections (Naracoorte), adaptive management (necessary actions taken if current management practices are found to be ineffective) and continued financial support for on-going site protection, staff training and scientific research. Although there is a cohort of on-site staff dedicated to the interpretation and site security of Naracoorte, at present there are no staff dedicated to on-site protection of the fossil deposits at Riversleigh. Site presentation and interpretation at Naracoorte in the future may be limited by lack of funding support for on-going site protection and the upkeep and maintenance of interpretive facilities. While there is currently no single management plan for the entire World Heritage site which consists of two widely separated component sites, consultations are ongoing on finalising a draft AFMS Framework. This draft Framework will complement existing legislative structures and other regimes to address Australia’s international responsibilities under the World Heritage Convention. The AFMS Framework will specifically describe how the existing management and governance arrangements provide for the long-term protection, conservation, presentation and transmission of the World Heritage values of the site. The Framework will provide overarching guidance for management of the AFMS while detailed management objectives and strategies for Riversleigh and Naracoorte are included in site-specific management plans prepared by the respective State governments.

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

External threats are minimal and adequately addressed by the Environment Protection and Biodiversity Conservation Act 1999. This Act is the statutory instrument for implementing Australia’s obligations under the World Heritage Convention. Importantly, the Act also protects World Heritage sites from impacts even if they originate outside their boundaries (World Heritage Committee, 2012).

State and trend of values

Assessing the current state and trend of values

**World Heritage values**

- **Extensive deposits of vertebrate fossils**

  The extent to which the resource is affected by excavation in Riversleigh is less than 1% Fossil material extracted from Riversleigh by Scientific permit is studied at scientific institutions before it is formally described and named. The material, once registered, becomes the property of the Queensland Government (QG). The Queensland Museum is identified as the QG organisation designated to hold the fossils. The site marking project completed in 2019 provided a framework to ensure that all fossil sites/assemblages in the Riversleigh area have been identified and have georeference data available. This critical step was undertaken to ensure that the research value of collections was not lost due to inadequate or incomplete data collection in the past, prior to implementation of modern GPS systems (IUCN Consultation, 2020).

  Excavations in Naracoorte affect a similar proportion and some intrinsically valuable deposits have not been disturbed. Excavated fossils remain the property of the South Australian Museum. Both components of the World Heritage site implement strict procedures to ensure that disturbance is minimal and that the specimens retrieved are not widely dispersed (State Party of Australia, 2003; Queensland Government and Environment Australia, 1993; Department for Environment and Heritage, 2001). Overall, the integrity of the World Heritage listed fossils is considered sound with condition assessed by routine inspection. At Naracoorte, scientific research, recreational caving, filming and other access is only by approved permit and/or supervision (IUCN Consultation, 2017). At Riversleigh, scientific research is conducted under permit issued by the Queensland Government, QPWS&P.
Evidence of evolutionary change

This value is derived from comprehensive interpretation of the fossil fauna assemblages and continues to be built upon through new research. However, there is always more that can be learned and ongoing research must be encouraged. Continued efforts at engagement with the public, including the Riversleigh Fossil Discovery Centre have occurred and are important. There needs to be greater emphasis placed on digitisation of all ex-situ collections from Riversleigh and Naracoorte to provide access for researchers and the general public alike and to digitally conserve these collections into the future. This requirement is being driven by new research approaches including the 3D imaging and digitisation of fossils that will allow new research projects on these faunas (IUCN Consultation, 2020).

Summary of the Values

Assessment of the current state and trend of World Heritage values

The current state of the AFMS World Heritage values in respect to in situ values is good and stable. The extent to which the fossils are affected by excavation in Riversleigh is less than 1%. Excavations in Naracoorte affect a similar proportion overall and some intrinsically valuable deposits have not been disturbed. Both components of the World Heritage site implement strict procedures to ensure that disturbance is minimal. Management of ex situ collections remains an ongoing challenge and while there is an architecture in place there are many opportunities to improve research and public access to collections.

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

Despite some early concerns for the stability of the critically endangered population of Southern bent-wing bats (Miniopterus orianae bassanii) which breed within the World Heritage site at Naracoorte (State Party of Australia, 2003) more recent research has revealed that the earlier concerns were unfounded. The species status under the Federal EPBC Act is Critically Endangered (Lumsden and Jemison, 2015).

The status of many of the unique/rare/or endangered modern species at Riversleigh is monitored through Health Checks in the QPWS VBMF (IUCN Consultation, 2020). At Naracoorte there is a need for monitoring of cavernicolous invertebrate faunas, several of which are rare and endemic to the site.

Additional information

Benefits

Understanding Benefits

Importance for research

The World Heritage site facilitates research leading to an understanding of palaeoclimates and the possible implications for climate change.

History and tradition,
Sacred natural sites or landscapes,
Cultural identity and sense of belonging

The World Heritage site is of cultural significance to the Waanyi Peoples, the First Nations Peoples of the lower Gulf region and the Potaruwutij, Jardwadjali, Boandik and Meintangk peoples of the Naracoorte.
region. The site is also of historical significance to local communities and the history of palaeontological research in Australia.

**Importance for research**

The site’s core value lies in the knowledge derived from ongoing study of the fossil deposits and modern fauna, and in providing insights to evolutionary trends in response to climate and environmental change. The knowledge gained from research contributes to the global community’s understanding of climate change and species evolution, and the diversity and uniqueness of Australia’s past. The results of the research may provide insights into understanding the environmental resilience and ecological requirements of many groups of Australian animals, including the critically-endangered Southern bent-wing bat and mountain pygmy possum (Burramys). This is already helping to develop innovative strategies (especially in the Burramys Project) to conserve species by translocating them to habitats different than those currently threatened by climate change.

Threat to this benefit is lack of ongoing scientific research.

**Outdoor recreation and tourism, Natural beauty and scenery**

The site provides opportunities for recreation and educational tourism (including palaeotourism) which in turn stimulates local economic activity. It also provides wellbeing and social benefits through its aesthetic and natural values.

**Importance for research, Contribution to education**

The suite of now extinct fauna is of great tourism interest. The educational potential of both component sites is highly significant and is delivered via educational materials and displays which provide accounts of key stages in the evolution of Australian fauna in association with changing climates. Such scientific and educational benefits highlight the importance of the sites and provide economic benefits to the local community that are and may continue to be derived from tourism.

**Tourism-related income, Provision of jobs**

Both components of this serial World Heritage site are important tourism destinations. As an iconic tourism site, Naracoorte is located 12km from a regional centre and generates economic benefits related to tourism. The managing agency (DEW) conducts guided tours and provides educational services whereby visitors are informed of site values and awareness of World Heritage is provided. DEW also engage with the community to facilitate World Heritage-centric events and foster mutually-beneficial relationships with local businesses.

Benefits of tourism involving visitation to Riversleigh, via the Boodjamulla (Lawn Hill) National Park headquarters (50km from Riversleigh) Adel’s Grove (50km from Riversleigh) and the Riversleigh Fossil Discovery Centre in Mount Isa (260km from Riversleigh) also provides significant and growing financial and cultural benefits to those communities as well as regional Australia in general.

**Summary of benefits**

The essential benefits derived from this serial World Heritage site include the knowledge gained from research which contributes to the global community’s understanding of climate change and species evolution, as well as the use of that knowledge to better understand the dynamics and future needs of living endangered species. The conversion of such knowledge to an education focused tourism product is very important for the economic benefit of regional and isolated communities.

**Projects**
### Compilation of active conservation projects

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<tr>
<th>№</th>
<th>Organization</th>
<th>Brief description of Active Projects</th>
<th>Website</th>
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<tbody>
<tr>
<td>1</td>
<td>University of New South Wales (UNSW), Natural History Museum London, Univ. of Queensland, Queensland Museum, Flinders Univ., South Australian Museum, Western Australian Museum, Columbia University, Salford Univ. England, Vandebrook Univ. (USA) etc.</td>
<td>Many different projects (coordinated by UNSW research staff) focused on the long-term changes in biodiversity and environmental adaptation in a wide range of different groups including lungfish, amphibians, reptiles, birds and mammals. All of these projects have important consequences in terms of developing critical understanding about the conservation status of surviving and sometimes endangered species in these groups.</td>
<td><a href="http://www.pangea.unsw.edu.au/people/academic-research/michael-archer">http://www.pangea.unsw.edu.au/people/academic-research/michael-archer</a> <a href="http://www.create.unsw.edu.au/team/marcher/">http://www.create.unsw.edu.au/team/marcher/</a></td>
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<tr>
<td>2</td>
<td>Department for Environment and Water</td>
<td>Documentation and collection of the macrofungi of South Australia</td>
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<td>3</td>
<td>Flinders University</td>
<td>Faunal responses to middle Pleistocene faunal change in southeastern Australia</td>
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<tr>
<td>4</td>
<td>University of Melbourne</td>
<td>Using fire to manage biodiversity in fragmented landscapes</td>
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<tr>
<td>5</td>
<td>University of Adelaide</td>
<td>Naracoorte Caves: a critical window on faunal extinctions and past climates.</td>
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<td>6</td>
<td>Queensland Museum, South Australian Museum</td>
<td>Registration, curation, conservation and digitisation of fossils to ensure increasing and ongoing research and greater public access to Riversleigh collections.</td>
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<td>7</td>
<td>University of New South Wales (UNSW)</td>
<td>Survey of the modern vertebrate biota of Riversleigh since European settlement of this region</td>
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<td>8</td>
<td>University of New South Wales (UNSW) and ANSTO</td>
<td>Research into the hydrological underpinnings of the Riversleigh region and recharge rate for aquifers that support modern ecosystems of this region</td>
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<td>9</td>
<td>University of Melbourne and UNSW</td>
<td>Research into the palaeoclimatic change in the Riversleigh region over the last 25 million years</td>
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<td>10</td>
<td>University of Melbourne and UNSW</td>
<td>Research into the palaeobotanical and palynological history of the Riversleigh region based on pollen and macroplant material from fossil deposits</td>
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<td>11</td>
<td>University of New South Wales (UNSW)</td>
<td>Research into the way in which ecosystems and biodiversity have responded to climate change in the past in order to better anticipate change that is going to impact the Wet Tropics World Heritage rainforest communities in NE Queensland.</td>
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<td>12</td>
<td>UNSW, USydney, UNE, NSW NPWS, NSW DPI, Australian Ecosystems Foundation Inc., Prague Zoo etc.</td>
<td>Implementation of a conservation strategy (the Burramys Project) based on growing understanding about the Riversleigh fossil record to help save the Critically Endangered Mountain Pygmy-possum from extinction.</td>
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# REFERENCES

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<td>5</td>
<td>IUCN Consultation (2020). IUCN World Heritage Confidential Consultation form: Australian Fossil Mammal Sites (Riversleigh/ Naracoorte) (Australia).</td>
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