World Heritage Sites

Protected Areas and World Heritage

AUSTRALIAN FOSSIL MAMMAL SITES
AUSTRALIA

These two sites are outstanding for the extreme diversity and the quality of preservation of their fossils which represent major stages of the earth's evolutionary history and of ongoing ecological and biological evolution. They both possess many samples of the species living in a time of great change in the development of Australia's mammal fauna, and have profoundly altered our understanding of these.

COUNTRY
Australia

NAME
Australian Fossil Mammal Sites

NATURAL WORLD HERITAGE SERIAL SITE
1994: Inscribed on the World Heritage List under Natural Criteria viii and ix.

STATEMENT OF OUTSTANDING UNIVERSAL VALUE [pending]

IUCN MANAGEMENT CATEGORY
Unassigned

BIOGEOGRAPHICAL PROVINCES
Riversleigh: Northern Grasslands (6.12.10);
Naracoorte: Eastern Grasslands and Savannas (6.13.11).

GEOGRAPHICAL LOCATION
The two sites are in the states of Queensland and South Australia respectively, separated by 2,000 km. Riversleigh is in northwestern Queensland in the Gregory River basin 200 km south of the Gulf of Carpentaria. It is part of the Boodjamulla (Lawn Hill) National Park at 18°59'-19°08'S x 138°34'-138°43'E. Naracoorte Caves are in south-eastern South Australia, 11 km south-southeast of Naracoorte township and approximately 320 km south-east of Adelaide at 37°S by 140°48'E.

DATES AND HISTORY OF ESTABLISHMENT
1917: Naracoorte Caves gazetted;

1972: The Naracoorte Caves Conservation Park was proclaimed under the South Australia National Parks and Wildlife Act;

1984: Riversleigh was gazetted as part of the Lawn Hill National Park under the Queensland National Park and Wildlife Act of 1975;

1992: The Riversleigh deposits included in Lawn Hill National Park extension;

2001: The Naracoorte Caves proclaimed a National Park.

LAND TENURE
Riversleigh is owned by the State of Queensland and is managed by the Queensland Parks and Wildlife Service; Naracoorte is owned by the State of South Australia and is managed by the the South Australian Department of Environment and Heritage.

AREA
10,305 ha. Comprised of Riversleigh: 10,000 ha and Naracoorte: 305 ha.

ALTITUDE
Riversleigh: approximately 200m; Naracoorte: approximately 50m.

PHYSICAL FEATURES
Riversleigh has been a cattle station in the semi-arid grassland watershed of the upper Gregory River which drains to the Gulf of Carpentaria. The fossil fields are found over a 40-60 square kilometre area and were laid down over three different periods in time. The Tertiary deposits occur as inliers encased in hard rough light-coloured limestone formed in lime-rich freshwater pools 10-21 million years ago. They lie within eroded areas of extensive, darker, flat-lying Cambrian Thorntonia limestone some 530 million years old which in turn overlie less common remnants of much older Proterozoic limestone. Another time period is represented at Rackhams Roost where the bones of carnivorous bats and the creatures they caught and ate 3.5 million years ago were found in the remnants of an ancient cave high above the Gregory River. The fossil bat record is the richest in the world. A third, recent, time period is preserved in old river terraces where the remains of animals that lived and died in and along the Gregory River some 50,000 years ago have been found (Mount Isa Centre, 2001). The Cenozoic sediments can be classed in four groups: late Oligocene to early and middle Miocene alluvial and lacustrine deposits; Oligo-Miocene karst and fissure fills; Pliocene cave sediments; and Quaternary fluvial and cave sediments.

The 26 caves at Naracoorte are located in a flat coastal plain punctuated by a series of low stranded coastal dune ridges parallel to the present coastline which were formed by a series of marine transgressions and regressions. The region's geology consists of sediment-covered karst, now exposed in outcrops and cliffs. The caves of the Park are formed in a ridge of Oligo-Miocene Gambier limestone capped by the Naracoorte East Dune. In the Late Pleistocene the caves were open to the surface which led to the accumulation of bones in their entrances and dolines and allowed sediments to seep over and cover them. The most significant of these accumulations are those in Victoria Fossil Cave. Other caves have striking stalagmite and stalagtite formations. The natural history of this southeastern region, including its geography, hydrology, ecosystems and flora and fauna has been described in detail in Tyler *et al*. (1983).

CLIMATE
Riversleigh has a semi-arid climate of dry winters and warm summers with monsoonal rains. Figures from Mount Isa, 220 km directly southeast are: a 386mm annual rainfall and an average temperature range between 25°C in July to 38°C in January. Anciently, Riversleigh had a warm humid climate which the fossil remains show to have grown cooler and drier over millennia. Naracoorte has a cool-temperate moist climate with long mild dry summers and maximum rainfall in winter. Annual rainfall is 386mm and the average temperature range is between 23.3°C in January to 14.3°C in July.

VEGETATION
Modern: The Riversleigh deposits underlie northern semi-arid grassland with occasional trees. Naracoorte is in cool eastern grassland country with sparse eucalyptus woodland, 600 ha of remnant stringybark scrub and open savanna hosting a wide variety of animals and birds.

Ancient: In the Tertiary period the two sites appear to represent quite distinct paleohabitats. Riversleigh's Oligo-Miocene assemblages 15 to 25 million years old have been interpreted by Archer *et al.* (1989, 1991) to represent rainforest communities. The loss of family- and generic-level diversity in

mammals between the early and middle Miocene suggest a first response to a change in climatic conditions or botanical biodiversity in the region. Gradual declines in rainforest plant species characterise the middle to late Miocene of other areas of Australia, although arid conditions are unknown from the continent prior to the Plio-Pleistocene (Martin, 1993). However, the abundance of granivorous rodents and the occurrence of marsupial genera such as species of *Planigale* and *Sminthhopsis* that dominate dry habitats in modern Australia suggest that if rainforest was present, it was confined to refugia. Palaeohabitats for the Pleistocene and early Holocene of the Riversleigh region are as yet unclear. Ancient Naracoorte was a sandy coastal plain, periodically under the sea until quite recent times.

FAUNA

The two sites were nominated for their importance as fossil sites, charting the development of Australia's mammalian fauna; the following information therefore relates primarily to the fossil fauna. Both sites separately provide evidence of key stages in the evolution of the fauna of the world's most isolated continent. Though there are other important Australian fossil mammal sites (Rich *et al*., 1991), Riversleigh and Naracoorte are outstanding for the extreme diversity and the quality of preservation of their fossils. They also provide links that unify the biotas of the past with those of today in the World Heritage sites of the Wet Tropics of Queensland, Central Eastern Rainforest Reserves and Kakadu National Park.

Riversleigh: The discovery of the fossils here has profoundly altered the understanding of Australia's mid-Cenozoic (Oligo-Miocene) vertebrate diversity of 15 to 25 million years ago. The beds are one of the world's richest mammal records for the period, providing exceptional examples of middle to late Tertiary mammal assemblages in a continent whose mammalian evolutionary history has been the most isolated and most distinctive in the world, and linking it to the predominantly modern assemblages of the later Pliocene and Pleistocene epochs.

The recently extinct marsupial thylacine or Tasmanian tiger *Thylacinus cynocephalus* was the largest living mammalian carnivore in Australia. Before Riversleigh's fossil record began to unfold, there was only one Tertiary species known. But several thylacines have been identified from its Oligo-Miocene faunas (Muirhead & Archer, 1990; Muirhead, 1993). A 15 million-year-old complete skull and nearly complete dentition of the monotreme *Obdurodon dicksoni* has already provided a great deal of new information about this highly distinctive group of mammals (Archer *et al*., 1992, 1993). This record has been used to demonstrate the potential conservation value of understanding the prehistory of a group (Archer,1991a, Archer *et al*., 1992) although in this case understanding was obtained too late to be of value in avoiding the extinction of the thylacine in the 1930s. Similarly, the mammal lineages in what were probably Riversleigh's rainforest and non-rainforest habitats anticipate open-forest lineages, such as those that occur in Kakadu National Park today. These lineages adapted to loss of the lowland rainforests sometime between the late Miocene and early Pliocene. The potential value of these connections is considered by Archer *et al*. (1991, 1992).

Other ancestral marsupial forms found at Riversleigh include carnivorous kangaroos, marsupial lions, koala, wombat, bandicoot, moles and possums. These ancient mammal assemblages are biotically more diverse, some having 64 mammal species, than any other Tertiary or modern Australian examples. Arboreal forms such as possums and koalas are proportionately abundant, with up to twelve species of obligate folivores in some deposits. Also discovered are the remains of giant pythons, birds, fish and even insects. Placental mammals are represented by more than 35 bat species and the Riversleigh fossil bat record is the richest in the world.

Naracoorte: The cool caves at Naracoorte contrast strongly with dry Riversleigh. There are fossils here spanning several ice ages that record a distinctive fauna ancestral to modern species alongside the doomed giants of a world about to be devastated by climatic change. Since the fossils also record the impacts of humankind on Australia's mammals from at least 350,000 years before the present, covering the probable time of the arrival of humans in Australia, they are valuable for analysing the relationships between humans and their environment. In addition, recent geological research suggests that deposits

of Pliocene and even Miocene age could be found at the site, thus providing closer links with the fossils of Riversleigh.

The Pleistocene vertebrate deposits of Victoria Fossil Cave are considered to be in both volume and diversity, Australia's largest and best preserved (Wells *et al.*, 1984), and one of the richest fossil deposits in the world (Wells, 1975). From the 3 to 4 metre deep Fossil Bed, in a series of deposits, tens of thousands of specimens representing 99 vertebrate species have been recovered, ranging in size from very small frogs to buffalo-sized marsupials. These include superbly preserved examples of the Australian Ice Age megafauna and a host of essentially modern species such as the Tasmanian devil, thylacine, mountain lion, wallabies, possums, bettongs, mice, bats, giant malleefowl, parrots, snakes, turtles, lizards and frogs. The fossil material includes complete post-cranial remains, many of them still partially articulated, and skulls so well preserved that even the most delicate bones are still intact. The fossil remains are believed to have steadily accumulated in the karst over thousands of years until sediments seeping into the Cave completely blocked the entrances to the chambers.

CONSERVATION VALUE

The sites, each highly significant on their own, are presented as a serial nomination, because they both possess key samples of the species living in a time of change in the development of Australia's mammal fauna. They are also, which is rarer, outstanding for the extreme diversity and the quality of preservation of their fossils. They provide links through time that unify the biotas of the past with those of today and a basis for documenting evolutionary change in the lineages and communities that may be valuable in the development of future conservation strategies (Archer, Hand & Godthelp, 1992).

CULTURAL HERITAGE

The landscape at Riversleigh, particularly near the rivers, has a large number of visible archaeological traces of Aboriginal occupation and sites of cultural significance to the Waanyi people of Lawn Hill gorge who revere the area as the Rainbow Serpent Country. The Traditional Owners are currently documenting their traditional and contemporary connections with Riversleigh and the surrounding area as part of native title and land claim processes (QPWS, 2004).

LOCAL HUMAN POPULATION

The site at Riversleigh lies on the south-western boundary of the Waanyi Aboriginal clan territory (Oates & Oates, 1970, Oates, 1975, Tindale, 1974). Until recently it was a grazing property. No Aboriginal people currently live within the site, but appropriate involvement is sought in the management of identified cultural sites.

VISITORS AND VISITOR FACILITIES

At Riversleigh, D-Site, the only area open to the public, was one of the first fossil deposits found and gives visitors an opportunity to view fossilised mammals and reptiles in situ. There are approximately 10,000 visitors a year. The Riversleigh Fossil Centre at Mount Isa, 250 km south, provides an extensive insight into the region as it was 25 million years ago and into the process of fossilisation. A Site Interpretation Shelter funded by the Australian Geographic Society provides basic interpretation of the fossils and there is a self-guided trail. No camping is permitted on the site but the Miyamba bush camp is nearby and the Adel campsite and store are 45 km northwest. Access is over long dusty trails, not always open during the wet season, even to 4WD vehicles. There is an airfield at Mount Isa.

At Naracoorte an estimated 800,000 people, about 10% of whom were overseas visitors, took the professionally guided interpretive tours of Victoria Fossil Cave between 1969 and 1994. Since then, with the establishment of the National Park, an area always popular for recreation has seen the numbers of tourists greatly increase. At present visitors number about 80,000 a year. It now has the Wonambi Fossil Centre, signed walking trails, a campground, caravan park, dormitory accommodation for 50, picnic grounds and a café. Visitor access to the ten caves open to the public is carefully controlled to limit damage. There are show caves, a bat cave with infra-red camera observation and a cave for adventure caving. Road access is excellent.

SCIENTIFIC RESEARCH AND FACILITIES

Fossils were first discovered in 1901 but detailed searches started only in the 1960s. D-site at Riversleigh was first worked in 1776-78. Further exploration followed examination of the light-coloured limestone revealed by high-altitude colour photography leading in 1983-5 to the very rich Gag-Site. The history of mammal lineages in modern Australia can be traced through these fossil deposits and, as a consequence, there is a better understanding of the conservation status of living mammals and their communities.

Broad research projects currently focus on the prehistoric mammals of Riversleigh and the mammal diversity in Victoria Fossil Cave. Work is being done on the palaeobiogeographic history of Australia's mammals, on changes in the structure of Australia's Cenozoic terrestrial mammal communities and on a bio-correlative framework for the country's Cenozoic mammal-bearing sediments. One of the opportunities offered by the fossil record is the correlation of events in the Cenozoic history of Australian mammals with those hypothesised on the basis of palaeobotany and marine invertebrates; another is to unite rainforest mammal lineages and communities beginning with the early to middle Miocene Australian lowland rainforest assemblages at Riversleigh, through the southern lowland rainforests of Pliocene south-eastern Australia to the rainforests of contemporary northeastern Queensland and New Guinea. This continuum highlights the significance of modern rainforest refugial mammals now confined to the Wet Tropics of Queensland World Heritage site.

Finds from Riversleigh are analysed at the Pasminco Century Treatment laboratory in Mount Isa, 250 km south, or at the University of New South Wales. Updated lists of publications, technical and popular, relating to Riversleigh are published four times a year in *Riversleigh Notes*, the newsletter of the Riversleigh Society Inc. At Naracoorte the major fossil discoveries date from 1969 on. Flinders University has been the primary research institution for the last 30 years. Research is by permit and closely controlled. Further work at the Naracoorte Caves sites will document a series of snapshots of Pleistocene life in southeast Australia, including details of the climate and vegetation associated with the fauna.

MANAGEMENT

The Riversleigh site is contained within the Riversleigh Management Unit of the Lawn Hill National Park. and is managed by the Queensland Parks and Wildlife Service; Naracoorte is managed by the South East Region of the South Australian Department of Environment and Heritage. Both are within National Parks. The properties are protected principally by the Environmental Protection and Biodiversity Conservation Act of 1999. The Ministerial Council and Steering Committee coordinates the management of the sites through the Australian Fossil Mammal Sites Steering Committee of national and state officials and both the Riversleigh and Naracoorte Community and Scientific Advisory Committees, the former being linked with the Waanyi Ministerial Advisory Committee (QPWS, 2002).

At Riversleigh, owing to the rugged limestone terrain, European activity is restricted to grazing, palaeontological research and education. In 1992 there was an arrangement for cattle grazing to continue under permit for seven years. The impact of this grazing was very minor, as stocking rates were low. The most significant impact on the site's natural condition is the collection under permit of fossil-bearing limestone by palaeontological researchers using dynamite although their impact is minor and restricted to very small areas. Education is a small but significant use. Impacts from visitors can be controlled in the National Park because removal of any material from the Park without a permit is prohibited. Recreation on the proposed Gregory Resources Reserve which abuts the nominated site attracts a small but increasing number of campers and day visitors, but impact from recreation on the nominated site is not considered to be significant. A management plan has been compiled and is reviewed on a 7-year cycle (QDEH, 1994; QPWS, 2002).

At Naracoorte visitor access is carefully controlled to protect the scientific, conservation and aesthetic values of the caves. A management plan for the Caves was adopted in 2001.

MANAGEMENT CONSTRAINTS

The fragility of the exhibits requires strict controls over visitors, but there is also some damage from feral pigs, cattle, fire and alien plant invasions. At Riversleigh, where there is a lack of infrastructure, the absence of on-site staff has allowed vandalism in the past: D-Site has had to be fenced over 10 km. At Naracoorte tours are guided and touring groups are controlled.

STAFF

Riversleigh is patrolled by 7 staff members from Boodjamulla National Park but there is only one fulltime ranger position. In 2005 however, staff accommodation was being completed and two seasonal Cultural rangers and a Project Officer were nominated. At Naracoorte there are 35 fulltime staff with 5 fulltime rangers and 10 seasonal rangers are available from the National Park and educational institutions. A Palaeontologist is funded by the Federal Government (EA/QPWS/WSA, 2003).

BUDGET

Both the local state and Commonwealth governments provide funds towards the management of these properties although Riversleigh is the less well funded. No further information is available at present.

LOCAL ADDRESSES

Riversleigh: Queensland National Parks and Wildlife Service, PO Box 2316, Mt. Isa, QLD 4825.

Naracoorte: South Australia Department for Environment & Heritage, Box 134 Naracoorte, SA 5271,

Department of the Environment, and Heritage, GPO Box 787, Canberra, ACT 2601, Australia.

Websites: www.riversleigh.qld.gov.au/rfc/sitelocation.html
www.naracoortecaves.sa.gov.au/caves/index.html

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DATE

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