

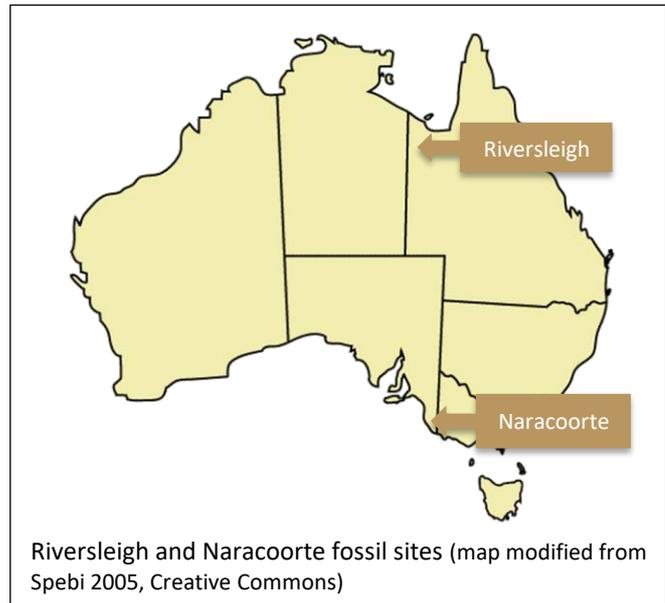


Introduction

The World Heritage listed Riversleigh and Naracoorte fossils sites record millions of years of Australia's biodiversity and changing climate. Riversleigh has rich fossil sites from the Oligocene to Miocene (10 – 30 Ma) with less diverse Pliocene and Pleistocene sites. Naracoorte contains fossils from the past 530,000 years.

Riversleigh

The >200 individual fossil sites at Riversleigh document the change from the humid, lowland rainforests of the Oligocene, to the dry eucalypt forests and woodlands of the Miocene, and dry grasslands of the Pleistocene. The high number of specimens at one location has provided an unprecedented record of climate at one locality.



The main indicators of Riversleigh climate are based on the diversity and adaptations of local faunas (groups of animals found at the same fossil site and layer) and palaeocommunities (groupings of local faunas that are not statistically different). There are approximately 100 local faunas at Riversleigh, with mammalian species the best studied.

The older Riversleigh local faunas are interpreted as representing rainforest because of:

- High species diversity indicating a rich, finely divided resource base,
- Complex feeding guilds involving up to six similar species of small mammals,
- High number of species of leaf-eaters in single local faunas,
- Presence of animals only known from modern rainforest communities, and
- Absence of grazing mammals, indicating a closed forest canopy.

Drying of the continent and a change to warmer conditions is indicated as species diversity drops and grazers (mainly kangaroos) increase. Changes in bat species reflect a similar change in Europe associated with drying climate in the late Tertiary.

Palaeocommunity analysis uses statistical analysis to determine which local faunas should be grouped together as similar communities. Using this analysis, Myer et al. found three major groups that are consistent with previous interpretations of the Riversleigh area. Two of the palaeocommunities occur on either side of a major climate warming event in the Miocene (Miocene Carbon Isotope Excursion). This is interpreted to mean that climate caused changes in the animal communities observed at Riversleigh. Community analysis highlights differences, but examination of individual species is required to interpret the climate differences.

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Present arid environment of Riversleigh
(J Fitzgerald 2011, Creative Commons)

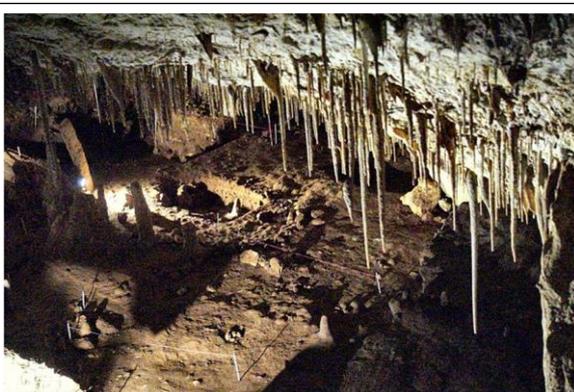


Papua New Guinea rainforest contains many distant relatives of Riversleigh's early faunas
(W Margotomo 2012, Creative Commons)

Naracoorte

Naracoorte Caves host fossil evidence of climate change through owl pellets and a series of pitfall fossils (where animals fell into a cave and their remains were covered by sand and other sediments). The fossils span times of climate change and the arrival of humans in Australia, allowing scientists to examine the effect of these events on ecosystems. Past climate is determined by changing isotope ratios in cave formations (speleothems), sediment isotope analysis and fossils. Only the latter is considered here.

Analysis of Cathedral Cave fauna over a glacial-interglacial cycle indicates that most changes were in the abundance of individuals within a species rather than changes in the overall diversity (e.g. number of species). The changes in abundance are interpreted to reflect climate-driven changes in local vegetation. Many modern species are present in the fossil deposit. The abundance of modern species is used to indicate the type of vegetation such as woodland, heathland or grassland. Species abundances indicate that the environment went through a warm, dry period during the interglacial period. This finding is supported by speleothem records.



Fossil excavation at Victoria Fossil Cave, Naracoorte
(KTW Photography 2017, Creative Commons)

A separate study of small mammal communities in Wet and Blanch Caves during the last glacial cycle (50 – 10 ka BP) also shows changes in abundance, but stable diversity of species in the early glacial and last glacial maximum. However, the abundance and diversity decreased after the glacial maximum as the climate became warmer and drier. Scientists have interpreted this to indicate a specific temperature threshold that caused a community shift. Pollen data from the same deposits indicates a vegetation change to more woody plants as climate dried.

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Questions

1. How do palaeontologists use animal fossils to determine climate? _____

2. Both Riversleigh and Naracoorte have a high abundance of fossils. What analyses require a large sample size? _____

3. How do scientists use information about modern ecosystems to make inferences about those in the past? _____

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