

Ancient Plants and Animals Walk 2022

This walk was developed by Joanne Smith, as a Themed Rostered Walk, for the public, in July 2021. Glenys Bishop, Pam Cooke and Kay Saunders assisted. It has been reviewed, with minor amendments, for use as a Themed Rostered walk in July 2022.

The walk aims to show visitors

- the type of plant material eaten by dinosaurs and, much later, megafauna.

By end of walk we want visitors to understand;

- the impact of geological change on Australia's plants and animals; and
- the ancient lineage of many of Australia's plants

Suggestions

- The Themed Walk is run when the megafauna are on display in the gardens, but the walk can be run at any time. (The walk route does not visit or rely on the megafauna displays.)
- Take copies of the megafauna pamphlet to distribute to visitors at the end of the walk.
- Gather a handful of *Podocarpus elatus* 'fruit' beforehand.

Alternatives for Motorised Wheelchairs and Scooters

For Stop 2 do not turn into Brittle Gum lawn but proceed up bitumen and do Stop 2 from Main Path.

Continue on Main Path and do *P.elatus* (Stop 4), *A.cunninghamii* (Stop 5), *Arthrotaxis* (Stop 3) the *M.communis* (Stop 7), in distance.

Skip Stop 6 altogether.

Turn left just before *B.aemula* toward Rock Garden. At edge of Rock Garden is *Leptospermum variabile* and near it examples of *allocasuarina*, *baekea* and other leptospermum representative of the open forests of the Pleistocene. Do change of time zone here.

Enter Rock Garden and take lower wooden bridge (its wider) then up to the upper bridge to do Stop 9, then Stop 10.

Take Main path out of Rock Garden then bitumen to Red Centre.

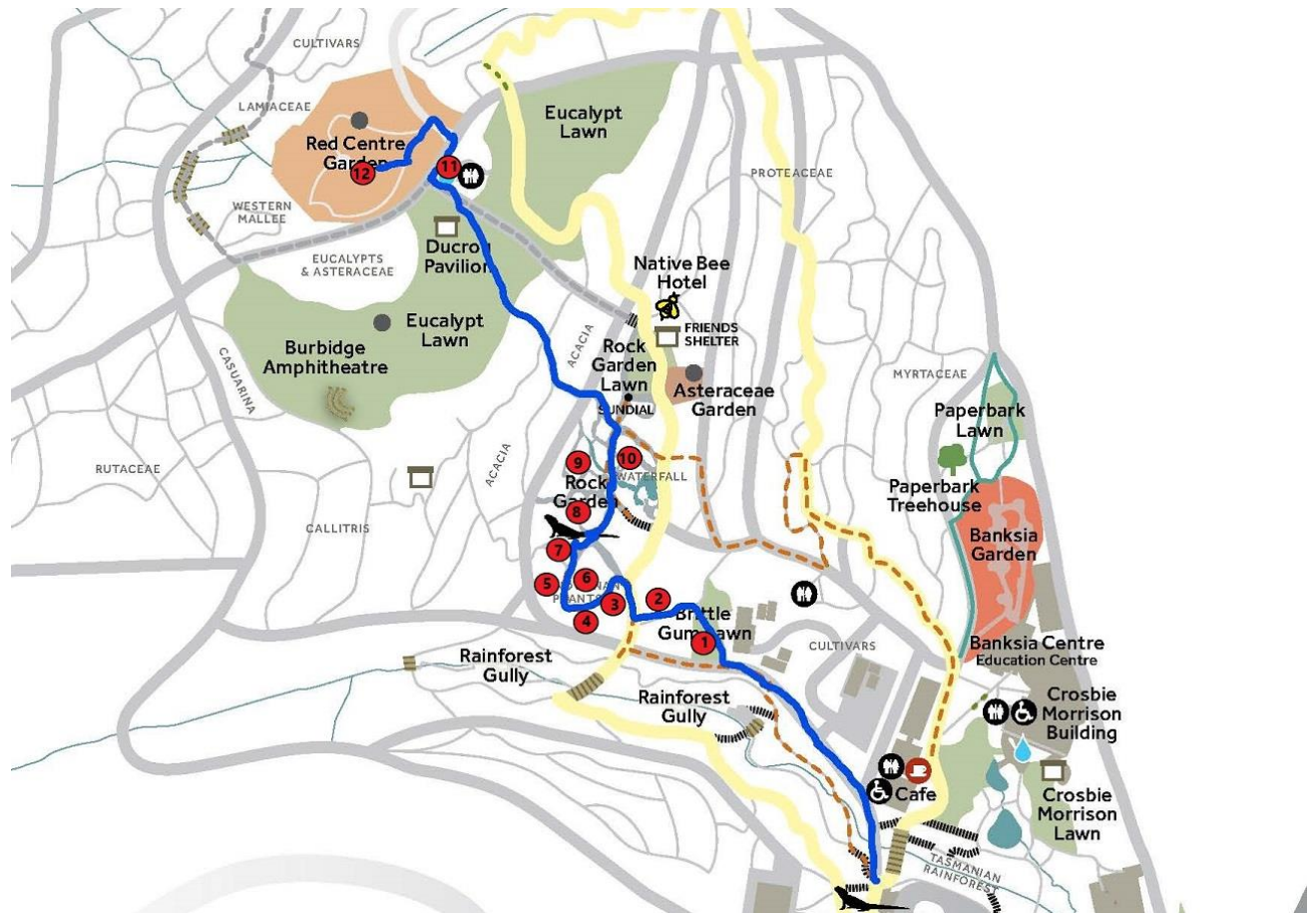
Alternative for Backup Guide

Send first group to the Brittle Gum lawn for Stop 1. Second group would follow the same route slightly behind.

Plant List

Stop	Plant
2	<i>Phyllocladus trichomanoides</i> (Celery Top Pine, NZ)
	<i>Wollemia nobilis</i> (Wollemi Pine)
3	<i>Athrotaxis x laxifolia</i>
	<i>Callitris baileyi</i> (Bailey's Cypress Pine)
4	<i>Lagarastrobos franklinii</i> (Huon Pine)
	<i>Podocarpus elatus</i> (Plum Pine)
5	<i>Araucaria cunninghamii</i> (Hoop Pine)
6	<i>Microcachrys tetragona</i> (Strawberry Pine)
	<i>Prumnopitys ladei</i> (Mt Spurgeon Pine)
7	<i>Macrozamia communis</i> (Burrawang)
8	<i>Melaleuca/Callistemon polandii</i> (Golden Tipped Bottlebrush)
	<i>Leptospermum laevigatum</i> (Coastal Tea Tree)
	<u>Scooter alternative</u> <i>Leptospermum variable</i>
9	<i>Chenopod nitrariaceum</i> (Nitre Goosefoot)
	<i>Rhagodia eremaea</i> (Tall Saltbush)
	<i>Rhagodia baccata</i> (Berry Saltbush)
10	<i>Hakea obtusa</i>
11	<i>Syzygium sp.</i> (Lilly pilly)
	<i>Livistona mariae subsp rigida</i> (Red Cabbage Palm)
12	<i>Atriplex vesicaria</i> (Bladder Salt Bush)
	<i>Maireana sedifolia</i> (Bluebush/Pearl Bluebush)

Map



Stop 1 On the bitumen road opposite service area behind café and looking to the rainforest where we can see a great variety of plants.

250 MYA all land in a single land mass – Pangaea. Hot, dry, no ice caps. The climate was quite stable. With no barriers to the spread of plants, vegetation was quite uniform across the Earth.

- Dinosaurs emerged. They were a group of reptiles and with their non-porous skin, had less water loss and did well in the hot/dry climate.

200 MYA, there were massive earthquakes and eruptions and land mass broke in two – Laurasia and Gondwana.

- Seas cooled the land temperature and rain fell on more of the land. Lush vegetation became common. The Jurassic period - age of conifers, seed-ferns and dinosaurs.

Today, great variety in plants. Scientists use features of plants to classify them into around 240 families. They can be divided into flowering and non-flowering plants.

- In the Jurassic, the vegetation was dominated by a small number of very successful families - they were plants that did not produce a flower and did produce a seed – the gymnosperms.

Enter Gondwana section, past the stump. Enter between S109 and S110.

Stop 2 *Phyllocladus trichomanoides* (celery top pine) *Wollemia nobilis* (Wollemi Pine)

Phyllocladus is a small (five species) genus in the family Podocarpaceae. Leaves are sparse, scale-like with most photosynthesis performed in leaf-like shoots – phylloclades.

- Gondwanan rock sediments identified in 1872 in a geological survey in an area of India where the people were called the Gonds. Promoted the concept of super southern continent.
- This plant is a type of conifer - a Podocarp. A type of those that existed with the dinosaurs.
- Tasmania is famous for celery top pines. But this is an NZ species! (Aust. species is *Phyllocladus aspleniifolius*)

This section contains plants from Chile, South Africa, Malaysia and NZ that are all closely related to plants found only in Aus. Called “Gondwanan” – because they demonstrate the existence of a great southern supercontinent. Beside the *Phyllocladus trichomanoides* is *Podocarpus polystachyus* a Podocarp found in Brunei, Indonesia, Malaysia, Papua New Guinea, the Philippines, Singapore, and Thailand. Opposite the Wollemi group are *Podocarpus salignus*, from Chile.

Another family of conifers dominant at the time of dinosaurs - the Araucariceae. *Wollemia* is a single species genus in the family Araucariaceae. (The other genera are *Araucaria* and *Agathis*. There is an *Agathis robusta* immediately opposite.)

- There were many species in this family, in dense numbers on every land mass. The gemstone jet is petrified *Araucaria*. Sometime after Pangea broke in two, species in the north began to die out. Today there are 41 existing species - all are in southern hemisphere.
- *Wollemi* considered the most ancient. It is the most rare. Known to scientists through fossils. In 1994 was found to still be existing.
- Grows to about 40 meters. It drops branches, not leaves, and has no leaf stalk (petiole). The leaves are different lengths – changing with the time of the season when made. An easy feature to recognise in fossils.
- It has two types of branching. One grows upright and forms either a stem or another trunk. One grows sideways from an upright branch and has the leaves on it. Results in a heavily branched canopy with a multi-trunked tree. Large old plants may have many trunks of different ages. Ability to reproduce itself this way may have helped it survive in its environment. Incidentally, if you propagate a plant from one of the sideways branches, the new plant grows sideways.
- The male and female cones are found at tips of the branches. The tree relies on wind for pollination.

Walk along main path toward Rock Garden - turn left into the conifer garden, opposite the sticky hop sign.

Stop 3 *Athrotaxis x laxifolia*

Athrotaxis is a very small genus (of 2 or 3 species depending on opinion) in the family Cupressaceae. (NB sign has the former family name.) Found only in Tasmania. These trees are thought to be possibly a hybrid of *Athrotaxis cupressoides* (Pencil pine) and *Athrotaxis selaginoides* (King Billy Pine).

- The tree grows to 15 meters, at 12 mm per year, living to 1300 years. It is very poorly adapted to fire. Populations continue to withdraw to wet areas. Male cones (at tips of twigs) and female cones, further back into the branches, can be seen.
- The atmosphere of Jurassic was high CO₂. How do we know? *Brachyphyllum* – are a group of **extinct** conifers with an extensive fossil record. *Athrotaxis* is identified as the Nearest Living Equivalent (NLE). Scientists have used differences between the fossils and the living plant as an indicator of the atmosphere. (Lower density of stomata on Jurassic plants indicating higher CO₂.) (Reduced numbers of stomata can also occur in dry climates, but this would not have applied in the Jurassic!)
- Just beside it is *Callitris baileyi* (Bailey's Cypress Pine). *Callitris* is a genus also in the Cupressaceae family. It has 16 species – 13 in Aus. This tree is a member of the same family as the *Athrotaxis*. While an ancient lineage, this is a much more modern genus. Earliest fossils of existing *callitris* were found in Tasmania and date to just 35 million years ago. So, not eaten by dinosaurs but much later was eaten by something also very large.

- Today scientists have used the variations in the cypress family, studying the changing features and the DNA of different family members worldwide to help plot how the environment changed.

A few metres on

Stop 4 *Lagarastrobos franklinii* (Huon pine) and *Podocarpus elatus* (Plum pine) on left. There is also a large *Podocarpus totara* (NZ) behind it.

Select some pods of the *Podocarpus elatus* beforehand.

- *Lagarastrobos* is a single species genus in the Podocarpaceae family. It is a Podocarp type of conifer and found today only in Tasmania. It is also very slow growing and very long lived (individuals to 2500 years old) .
- *Podocarpus Elatus* is a member of Podocarpus genus – the largest genus in the family Podocarpaceae with more than 90 species spread across the southern hemisphere, though some are found in Japan and southern China.
- What is a podocarp? It is a type of conifer. Examine the hard seed. It has modified scales and is technically a type of cone. The stalk is fleshy and resembles a fruit.
- Podocarps appeared in the fossil record about the same time as the dinosaurs in the southern part of Pangaea. Fossils show that they did not spread into the northern part of the continent before the two parts broke apart. So, a southern hemisphere family. Dinosaurs on what is now Australia were eating these types of plants.

Continue along this path to the bend

Stop 5 *Araucaria cunninghamii* (hoop pine)

Araucaria is one of three genera in the *Araucariaceae* family. (The others are *Wollemia* and *Agathis*)

- Another representative of those trees dominant in Gondwana at the time of the dinosaurs.
- What is a dinosaur? Laid eggs, legs went straight down from their body (e.g. like a horse) not splayed (like a crocodile). Lived in the Jurassic. Had huge jaw muscles attached to the top of the skull and two holes at top of the skull that gave space for the huge jaw muscles to fully contract. Huge, majority were herbivores.
- Sauropods, a group of plant eating dinosaurs, would have consumed between 200 and 900 kg of foliage per day. They included the biggest animals to have ever lived. They had an extremely long neck which meant they could access large amount of foliage without moving. This conserved energy. But they had no teeth to chew food and no cheeks to keep the foliage in their mouths.
- How were they able to take in huge amounts of material? They had relatively small peg like teeth. Moved through foliage like a rake taking in branchlets and swallowing whole. They did have a huge hind gut for processing tough plant material.

- Consider how Wollemi pine, that we saw earlier, lost branchlet rather than individual leaves, making it easier for animals like this to take in the foliage.

A few paces on right

Stop 6 and *Prumnopitys ladei* (tall tree on right) and *Microcachrys tetragona* (small plant on ground).

Gondwana continued to break apart into different land masses with seas and vast areas of water forming between land masses. This was not a smooth separation. Land masses bumped and separated and bumped again. Rivers, lakes and seas rose and fell. This impacted the climate dramatically. There was a greater variety of conditions and the rate of change was increasing. Instead of relatively uniform conditions, regions of specific conditions developed.

Two examples of podocarps demonstrate this.

Prumnopitys is a genus of 9 species, in the Podocarp family, occurring in Aus. to South America.

- The *Prumnopitys ladei* (Mt Spurgeon Black Pine) is a rainforest tree. The Genus was widespread across Gondwana but there are only 9 species still existing. Most in South America and New Zealand. This one found only on two mountains in the Atherton Tablelands, North Queensland.

Microcachrys is a single species genus in the *Podocarpaceae* .

- *Microcachrys tetragona* (Strawberry Pine) is a dwarf conifer that grows in cold, wet places. Another podocarp. Fossils show that at the end of the Jurassic, there were many species of *Microcachrys*, widespread across Gondwana.
- Today, only one species, restricted to western Tasmania. This plant is often used by scientists to demonstrate highly dynamic and changing Southern Hemisphere vegetation after the breakup of Gondwana. Of interest, this species is often used for landscaping in cold wet areas, e.g. in Oregon, USA.

Continue on this path to the Burrawang Information sign

Stop 7 *Macrozamia communis* (Burrawang) and cycad sp.

The *macrozamia* genus is one of 8 in the family of cycads *Zamiaceae*. It is the most common in NSW and the most southerly growing cycad species.

- A large order of plants widespread across all land masses at the time of the dinosaurs were the Cycadales. Generally, they had stout cylindrical woody trunk with a crown of radiating leaves. Sometimes the trunk was fully under the ground, in others it may be several meters tall. Each plant was either male or female and typically long lived.
- Although the cycad lineage is ancient, most existing species have evolved in the last 12 million years, though the foliage of existing species is considered little changed from that of the Jurassic. They can be found in poor light, full light, wet, dry, acid, alkaline, sandy or rich soil environments. This is evidence of their once broad range.

- There are relatively few dinosaur fossils in Australia, possibly because conditions for creating fossils were less common. Titanosaur fossils have been found in Nth Qld – Diamantina and Winton. Fossils of araucaria and podocarp were found with them. Fossil bones in Qld, remaining plants in Tasmania. At the time of the dinosaurs, what we now know as far Nth Qld was positioned about where Tasmania is today.
- A dinosaur found predominantly on what is now Australia was Muttaburrasaurus. It was an ornithomimid (“bird feet”) dinosaur and had a rounded snout. About 8 metres in length and around 2.8 tons. It had very powerful jaws and a system of shearing teeth with no chewing action. (Think a pair of pruning shears.) It is considered an adaptation to eating really tough vegetation, such as cycads. A herd animal, the collective noun is ‘burra’.

Change of Time Period

Approximately 66 MYA Earth was hit by a comet, or an asteroid, and its impact caused the mass extinction of three quarters of the plants and animals. Few animals over 25 kilograms survived (exceptions are turtles and crocodiles.) The small avian dinosaurs survived to become birds. Small mammals survived and over the next 43 million years diversified into many different forms.

NOW MOVING TO THE MOST RECENT 2.5 MILLION YEARS

From the Burrawang Information sign, take the path slightly uphill past the seat and turn right into a narrow indistinct path. Follow this down towards a lilly pilly covered in fruit.

Stop 8 *Melaleuca polandii* (Golden-tipped bottlebrush) on the right, beside lilly pilly and *Leptospermum laevigatum* (coastal tea tree) on the left.

Melaleuca/Callistemon and Leptospermum represent two genera of Myrtaceae typical of sclerophyll forest that dominated large areas of Australia. (Eucalypts were present but they were not the dominant species we see today)

- The 2.5 million to about 10,000 years ago are known as known as the Pleistocene. It is a period with cycles of glacial and interglacial periods impacting temperature, rainfall and sea levels. Cycles could be 50,000 to 100,000 years.
- It was during a period of glaciation that many creatures across the world, grew larger - collectively called megafauna. Increased body size offered advantages in changing conditions – body temperature regulation, larger home range, bigger hind gut for tough vegetation.
- One of the biggest was Diprotodon optatum. It was the largest marsupial to have lived. It was about 4 metres long and about 2800 kgs– a bit smaller than a rhinoceros. Compare with a small 4WD vehicle. Widespread thru open plains and woodlands which dominated Australia.
- It was a bulk feeder of coarse vegetation. It had broad molars for grinding, large muzzle for large mouthfuls. Its fossils have been found with fossilised Callitris seeds. Gut contents of a fossil had leaves and stems of sclerophyll shrubs such as these.

- Diprotodon optatum also had large lower incisor teeth that, in some specimens show a pattern of wear on the outer surfaces suggesting that they were frequently pushed into the ground. Leptospermum laevigatum often has a wide system of surface or sub-surface roots. Today considered a beneficial feature for soil/sand dune stabilization.
- Diprotodon optatum occurred across the country in a broad range of environments. In dryer areas it was eating shrubs and grasses. Termed by one scientist as “an ecologically flexible species” i.e. it ate whatever it came across.

Enter Rock Garden, on high side path to small bridge. Look up towards Black Mountain tower, above eye level, in section 15g, to a group of three chenopods, from left to right:

Stop 9 *Chenopodium nitrariaceum* (nitre goosefoot) (the tallest), *Rhagodia baccata* (Berry Saltbush) (growing over the rock, probably with red berries) and *Rhagodia eremaea* (Tall Saltbush) and then reeds, grasses around bridge.

Three members of the subfamily *Chenopodioideae* - chenopods

- Chenopods occur across the world. Many species in semi-arid Aus.
- Chenopods, along with some grasses use a method of photosynthesis that is different to most other trees and plants. It is a method that is more efficient in dry, hot conditions. Known as C4. Using isotope analysis of remains, scientists can tell whether an animal’s diet was predominantly C4 or other types of plants.
- Remains of Diprotodons have shown that they ate a lot of Chenopods.
- During glacial cycles, water was stored in ice. Sea level much lower. Continent ringed by wide shallow seas. Inland Aus. became drier. Southern Aus. was quite wet with snow melt.
- *Zygomaturus trilobus* was another member of the Diprotodon family. It lived on the coastal edge inhabiting wooded habitats, creeks and swamps. Weigh only 500s kgs, possibly partly aquatic – like a hippo. Bottom incisors pointing forward with big jowl – like bucket of stem shovel.
- It is believed to have eaten reeds and sedges by shovelling them up in clumps with its lower incisor teeth.

Cross the bridge and turn right

Stop 10 *Hakea obtusa* on left (Alternatively, if this one stops flowering, there is one on the main path over near the Friends Shelter.)

This Hakea is from West. Aus. This hakea protects its flowers by having them inside the canopy. *Hakea corymbosa*, nearby, protects its flowers using spikes. Flower is similar to grevilleas – but has a woody fruit.

- An unusual looking megafauna was the *Palorchestes azeal*. Sometimes called ‘marsupial tapir’. About 100 kgs. Short trunk and long prehensile tongue, like giraffe. The tongue and trunk allowed it to access foliage that was difficult to get to. Giraffes today use their tongue to access softer foliage around the spikey vegetation of acacias in Africa.

- Especially long and powerful forearms and very sharp claws, along with good grinding teeth – thought to have stripped trees of bark.
- No mammals eat Hakea today though they are still ‘protecting’ their flowers.

Exit Rock Garden at ‘Birthday Candles’ and enter acacia forest. Cross the Eucalypt Lawn, past the Ducrou Pavilion to the road next to the Red Centre Garden. On the corner near the toilets is.

Stop 11 *Syzygium* covered in fruit.

Syzygium is a genus in the *Myrtaceae* family – a rainforest tree. Interestingly, it is one of the earlier members of this family and still has the soft fruits, whereas later members like the Eucalypts, Callistemons etc have very woody fruits.

- One of the great megafauna families were the Dromornithids. A family that existed for over 23 million years. Large, flightless birds. Possibly largest bird ever. Weighed about 600 kgs, over 3m high. Very long neck, strong, bird like beak. Related to ducks/geese rather than emus.
- The largest was *Dromornis planei* It lived more than 15 MYA in warm, wet forests. Its fossils found in Northern Territory with genera of crocodile and tortoise. It had a higher metabolic rate than the marsupial megafauna so needed a higher energy plant product – expected to be fruit, nuts and seeds.
- Look across to Livistona in Red Centre. Many fruits and nuts of Northern Aus. are left on the tree or fall and rot because the existing Northern Aust. animals don’t eat many of the fruits. It is calculated that *Dromornis planei* may have spread 2 to 4 kgs of fruit seeds 30kms per day. The loss of the animal dispersing the seed will have had a large impact on the plant.

Enter Red Centre, take left path, branch to the right at the Electric Scooters sign and continue to the mozaic.

Stop 12 *Atriplex vesicaria* (Bladder saltbush) several specimens on left and *Maireana sedifolia* (pearl bluebush) where path joins mosaic area.

Aus., two million years ago was home to many, diverse species of kangaroo. They appeared around 5 MYA in dry, open woodlands and as the continent dried their diversity and numbers reached a peak about 2MYA. In the Pleistocene (2 MYA to near present), 55 species of mammals became extinct – over half were types of kangaroo.

- A sub-family -procoptodons - short-faced kangaroos. Very short, deep skull, giving strong bite, but lacked grinding teeth for branches/twigs. Nor did they have strong front incisors for efficient grass cropping. These features tell scientists they were mixed grazer/browser.

- The largest species was *Procoptodon goliah*. Although it was probably only about 2 metres high (a large, modern Red Kangaroo), it was much more heavily built – more than twice as heavy as a large Red. It stood on its hind legs, using its tail as a prop and could raise its long arms above its head. It could feed on the new growth and flowers 3 metres above. On the mounds in the middle of the Garden are *Grevillea juncifolia*, beyond them *Allocasuarina* and *Acacia ammobia* and *Acacia minyura*.

P.goliah also believed to be eat a lot of chenopods, with a preference for saltbush. Two types of Chenopod here, with very different strategies.

- *Atriplex vesicaria* (bladder saltbush) is a Chenopod. Several small poor looking plants on outer side of path. It has shallow, fan like roots spread two metres. Grows rapidly, shuts down when conditions don't suit. Lives about 25 years.
- *Maireana sedifolia* (bluebush, pearl bluebush) a Chenopod. Very deep roots, grows slowly, over 200 years.

This environment may seem poor but these plants both nutrient rich. Both valued today in livestock pastures for their high protein content.

P.goliah believed to have been one of the last megafauna to become extinct. It, some species of Diprotodon and a species of Dromornithid were still living around 30,000 years ago.

- There is physical evidence of overlap with Aboriginal peoples. Potential source for dreamtime stories.

Extinction believed to be due to combination of changing climate and environment with use of fire and hunting by Aboriginal peoples – **but this remains a source of debate.**

END OF WALK. BROCHURES FOR MEGAFUNA TRAIL.