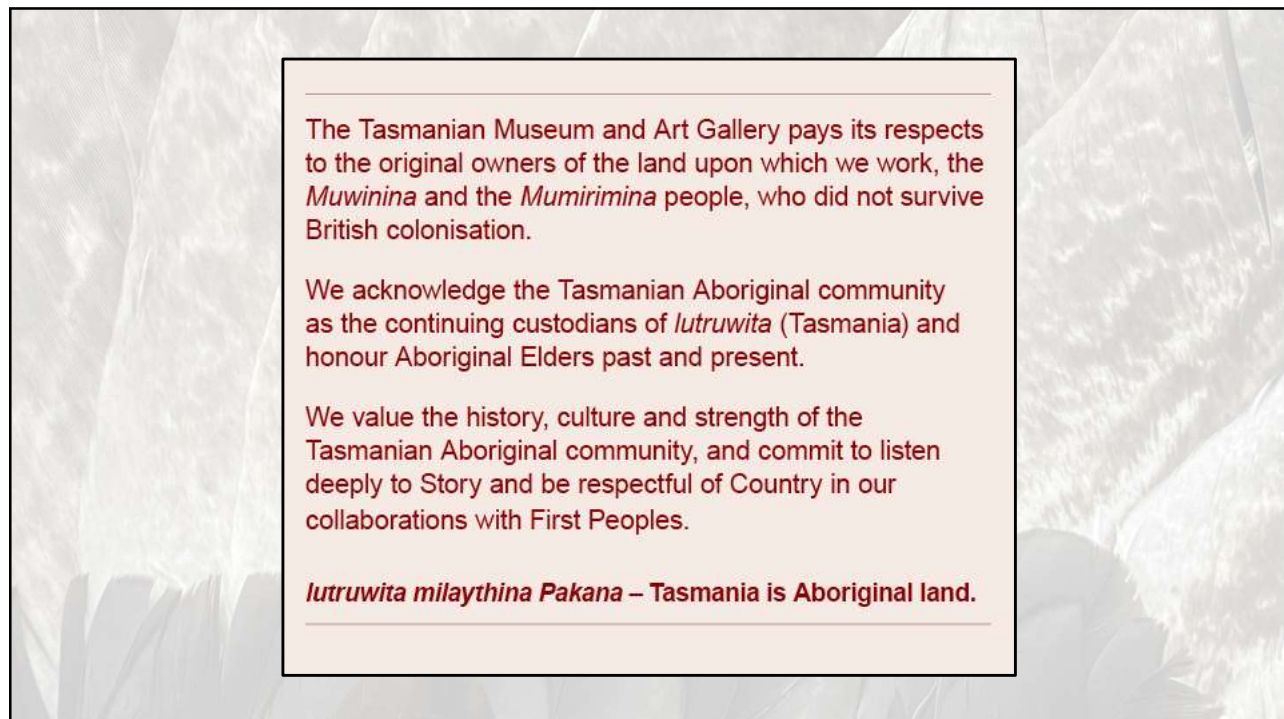


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2

About Me

Evolutionary Biologist

I study animal behaviour and anatomy to help explain how life on Earth evolved.

- PhD from Monash University where I studied feeding behaviour in seals and sea lions
- Postdoctoral research with Museums Victoria studying the evolution of filter feeding in baleen whales.
- Now I am the Curator of Vertebrate Zoology and Palaeontology at TMAG



3

Tasmanian Museum and Art Gallery

TMAG houses the state collection of Tasmanian wildlife specimens

- Record of what species live in Tasmania and its territories (e.g. sub-Antarctic islands)
- Essential for ongoing research and conservation

4

Natural Sciences Collections at TMAG

Basic collection statistics:

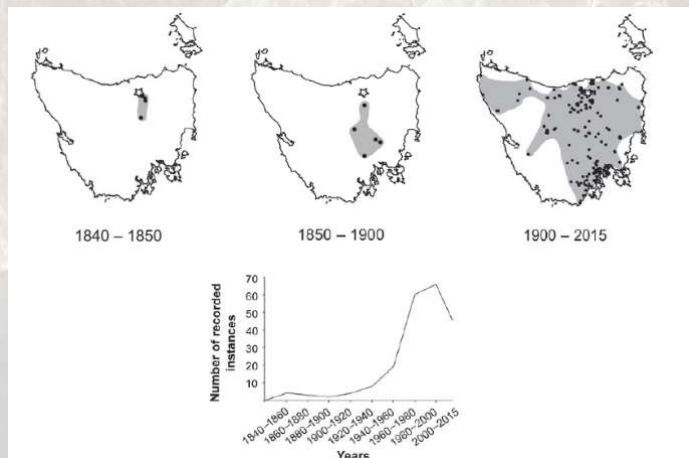
- **Invertebrate Zoology:** 182,000+ specimens
- **Vertebrate Zoology:** 24,000+
- **Geology and Palaeontology:** 20,000+



5

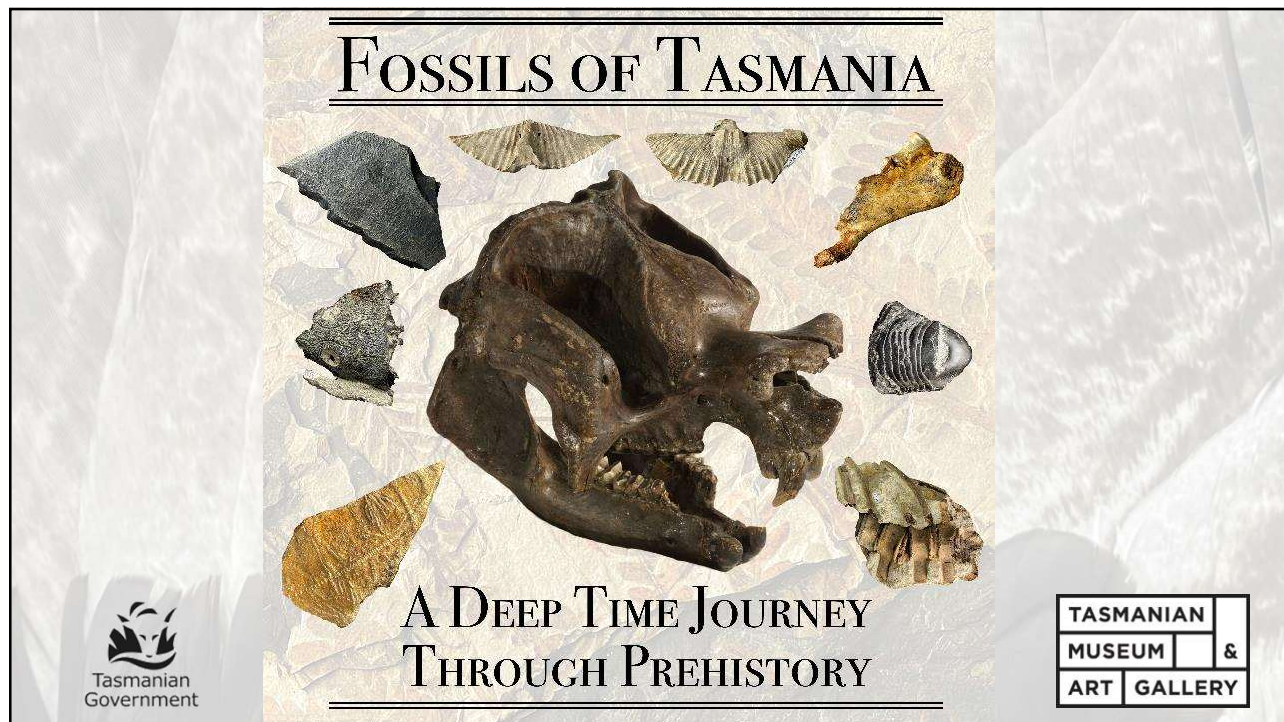
Time travel at the museum

Ongoing collection enables us to use museum specimens to tracking species through time.



Campbell et al. 2018. When is a native species invasive? Incursion of a novel predatory marsupial detected using molecular and historical data. DOI: 10.1111/ddi.12717

6



7

What is a fossil?

Essentially any preserved evidence of past life on Earth.

Can include:

- Hard skeletons, teeth, or shells from animals.
- Impressions of skin, scales or feathers.
- Preserved plant material like bark, leaves or wood.
- Tracks and traces (e.g. footprints or burrows)
- Sedimentary structures and biochemical traces

8

How are fossils preserved?

Many fossils – but not all – are “petrified” or turned to rock.

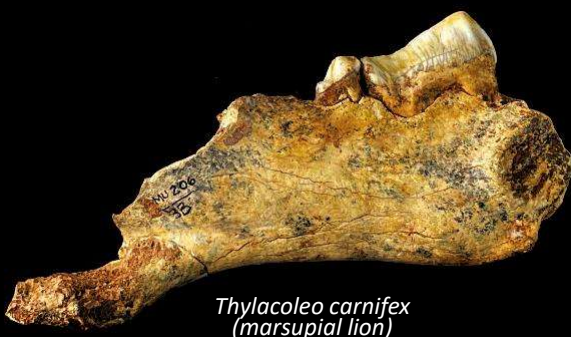


Visit the T MAG fossil display in the “Earth and Life” gallery

9

How are fossils preserved?

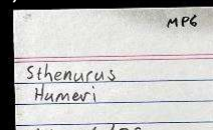
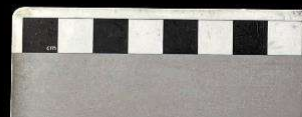
Old bones – Some fossils remain relatively unchanged despite long periods of burial. Sometimes called sub-fossils (e.g. cave bones).



Thylacoleo carnifex
(marsupial lion)



Simosthenurus occidentalis
(short-faced kangaroo)



10

How are fossils preserved?

Permineralisation – where water-born minerals are transported into a buried life-form, before crystallising within it to take up its shape. The animal or plant is literally turned into rock.



Bothriceps australis (ancient salamander-like amphibian)



Petrified wood

11

How are fossils preserved?

Natural moulds and casts – where a buried fossil (e.g. a shell) dissolves, leaving a hollow in the rock around it (i.e. a natural mould). This can sometimes be filled with a new material forming a natural cast in the shape of the original animal.



Natural moulds of Permian age bryozoans and brachiopod shells



Exposed internal cast from bivalve shell, Fossil Bluff

12

How are fossils preserved?

Concretions – hard cement-like rock that often forms around shells or bones that are buried in soft sediments like sand or mud before it lithifies.



13

How are fossils preserved?

Carbonised or coal fossils – plant remains can be cooked by the heat and pressure underground until all that remains is a carbonised impression.



14

How are fossils preserved?

Tracks and traces – Structures animals make in soft sediment (e.g. footprints or burrows) preserved in rock to become “ichnofossils”.



15

How are fossils preserved?

Biosedimentary structures – Microscopic organisms like algae can form structures like slimy mats or stromatolites that can be preserved as layered structures in rock.



16

Fossils of Tasmania

Uncovering ancient environments using discoveries from the fossil record!

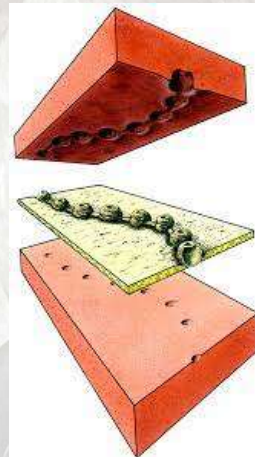
17

First Life

- Approximately 1 billion years ago Tasmania was home to some of the first multicellular organisms.
- “String of bead” fossils known as *Horodyskia* found in Northwestern Tasmania.
- Possibly an early form of colonial brown algae? Research continues...



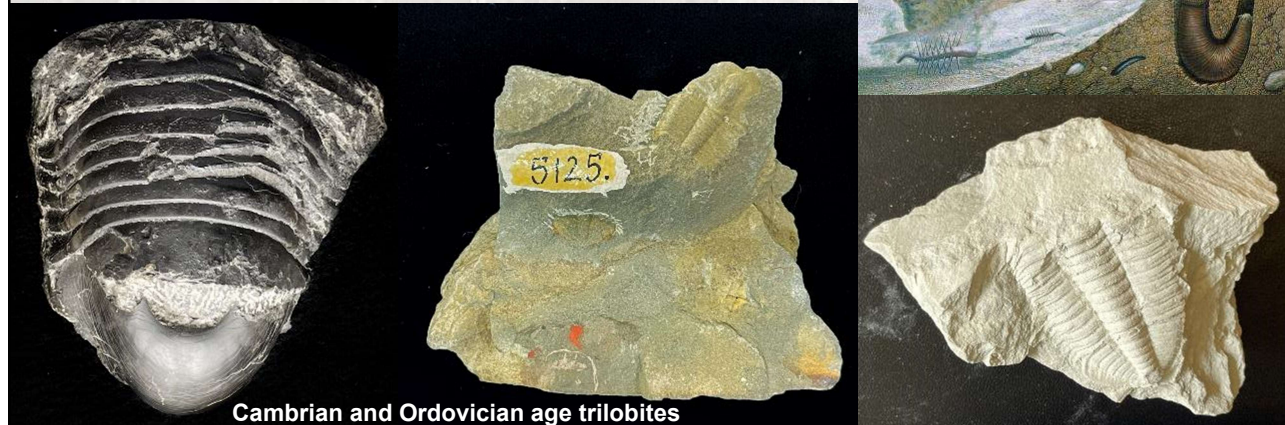
Horodyskia williamsii



18

Cambrian Explosion!

- Everything changed around 540 million years ago...
- Evolution of first shelled animals – Animals with teeth!
- Arms race between predator and prey that continues to this day!



Cambrian and Ordovician age trilobites

19

Hobart's Ancient Seas

- 250 million years ago Hobart was underwater!
- Layers of mud and sand stone rock preserve the creatures that lived in the deep sea at a time when we were much closer to the South Pole.
- Abundant fossils from Brachiopods (lamp shells), Bryozoans (lace corals), bivalves, and crinoids.
- Best place to see these fossils locally is Fossil Cover at Blackmans Bay.



Living Brachiopod

Brachiopod shell

Bryozoan

Living bryozoan (lace coral)

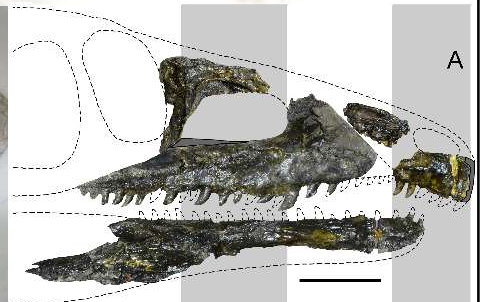
20

Terrors of the Triassic

- 250 million years ago Dinosaurs hadn't really got going yet...
- Ancient Hobart was home to a diverse wetland fauna of fish, amphibians, reptiles and some relics from the previous era!



Replica *Tasmaniosaurus triassicus* model



21



AND GARDENS

- 180 Million Years Ago
- Jurassic Period Tasmania was covered in cool temperate forest.
- No vertebrate animal fossils thus far discovered!



Petrified fern trunk
Osmundacaulis nerii
Lune River, Tasmania

22



23



24

Fossil Bluff Sandstone

- Ancient beach sands preserve 23 million year old shells!
- Tunnelled and blasted with 1 ton of gunpowder in 1880s.
- Full of Shells - Corals, bryozoans, bivalves, gastropods, sea urchin spines – and vertebrate animals!
- Fossil fish, whale skeletons and some of Australia's first marsupials.



25

Australia's First Marsupials

- Skeleton of large possum-like marsupial.
- Found eroding out of a boulder at Fossil Bluff (Wynyard) in mid-1800s.
- For a long time was Australia's oldest marsupial fossil!



Wynyardia bassiana (ancient possum)



26

Hobart's Ancient Rainforest

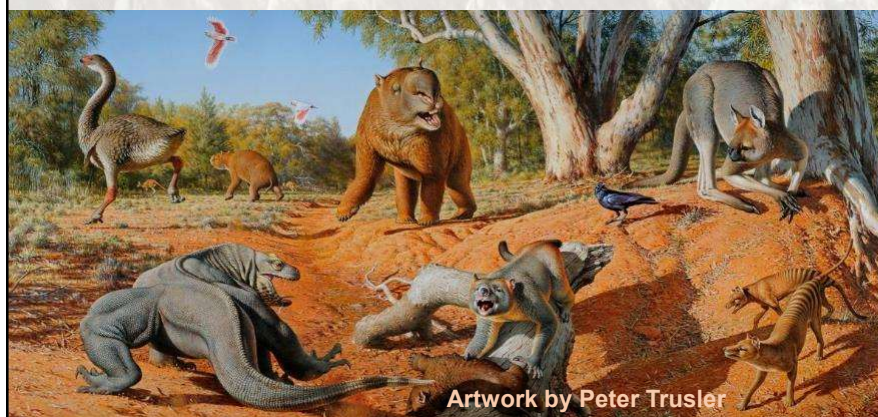
- 23 Million years ago Hobart was home to a temperate rainforest environment.
- Mammal fossils sent to Richard Owen in 1867 (re-identified by Noel Kemp and Richard Tedford in 1998)
- Quarry underneath the old Geilston Bay High School sports oval and among the rocks at the beach adjacent to Taroona High School.



27

Megafauna Mayhem!

- During the late Pleistocene Australia hosted a range of large megafauna species, including giant marsupials, birds and reptiles!
- Most went extinct towards end of Pleistocene between 80 and 40 thousand years ago.



Artwork by Peter Trusler



28

Research at TMAG

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Tasmania's
Swamp Monster
*Zygomaturus
trilobus*!

30

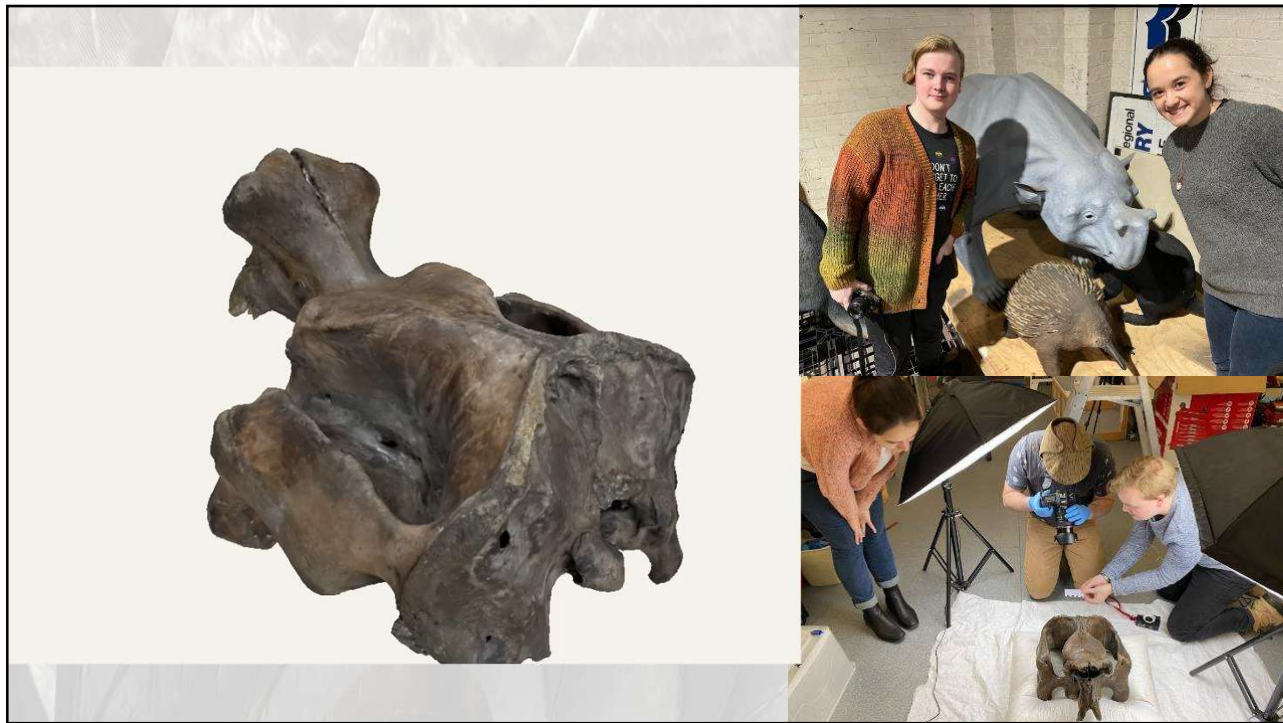
CT Scanning at North Hobart Veterinary Hospital:



31

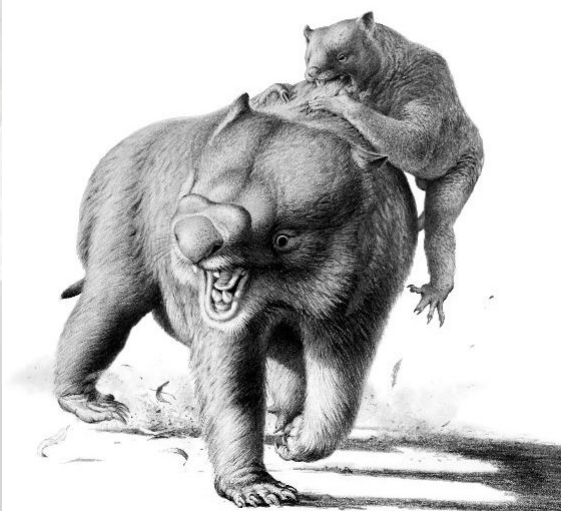


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***Thylacoleo* VS. *Zygomaturus*!**

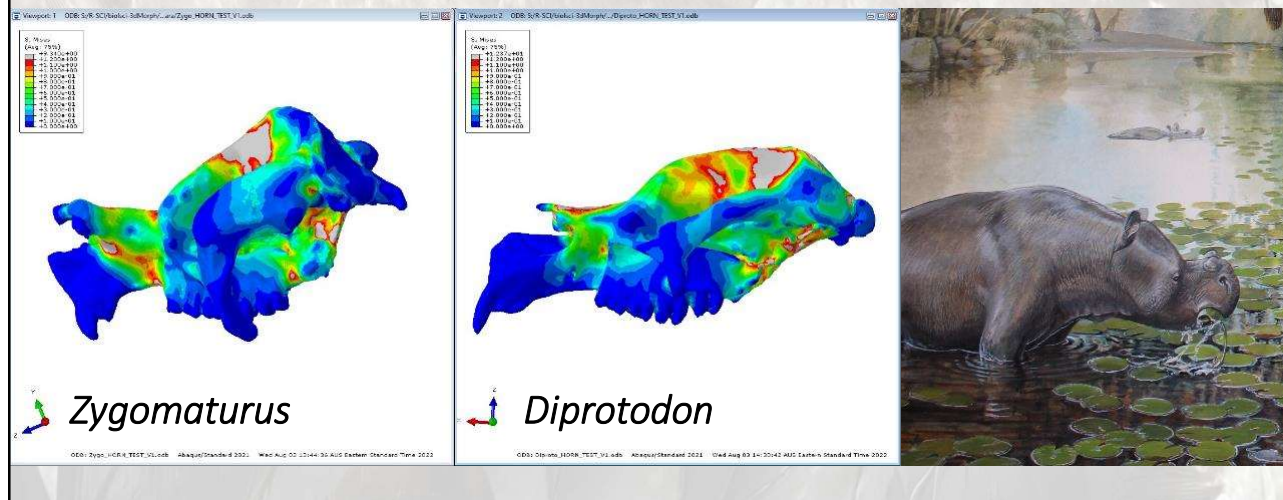


Artistic reconstruction by Peter Trusler

34

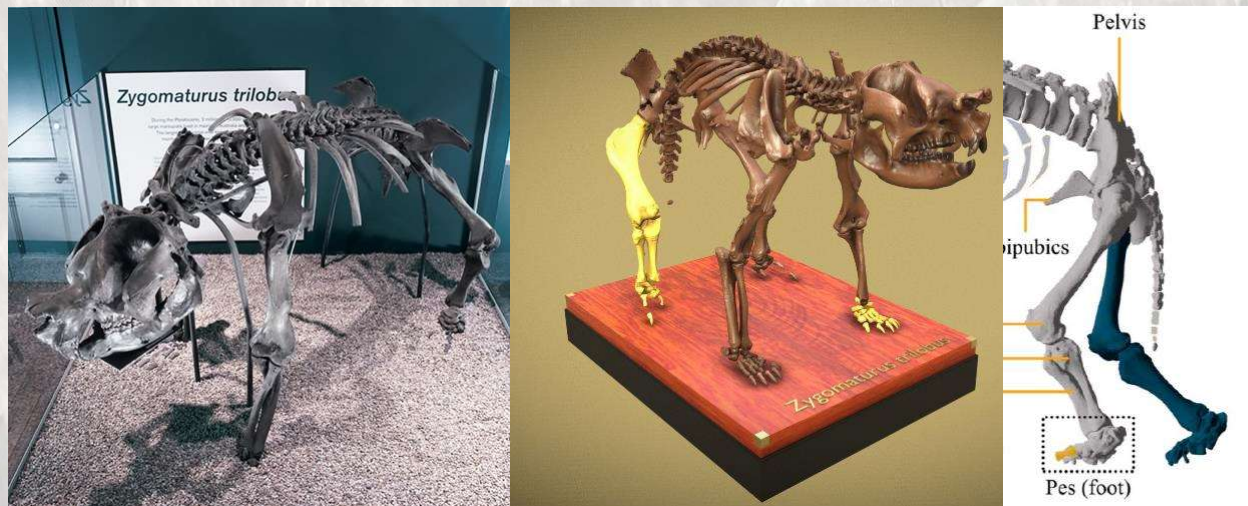
Did *Zygomaturus* have a horn?

Finite Element Analysis (FEA) of stress and strain within the skull

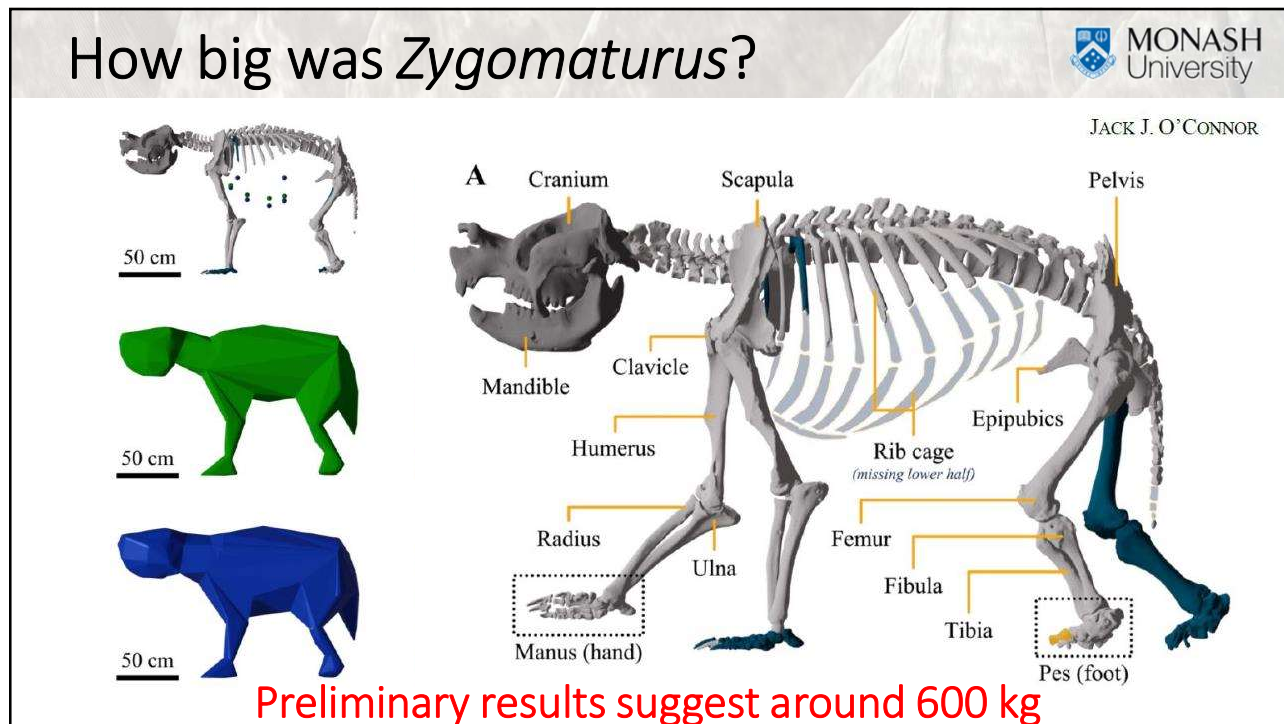


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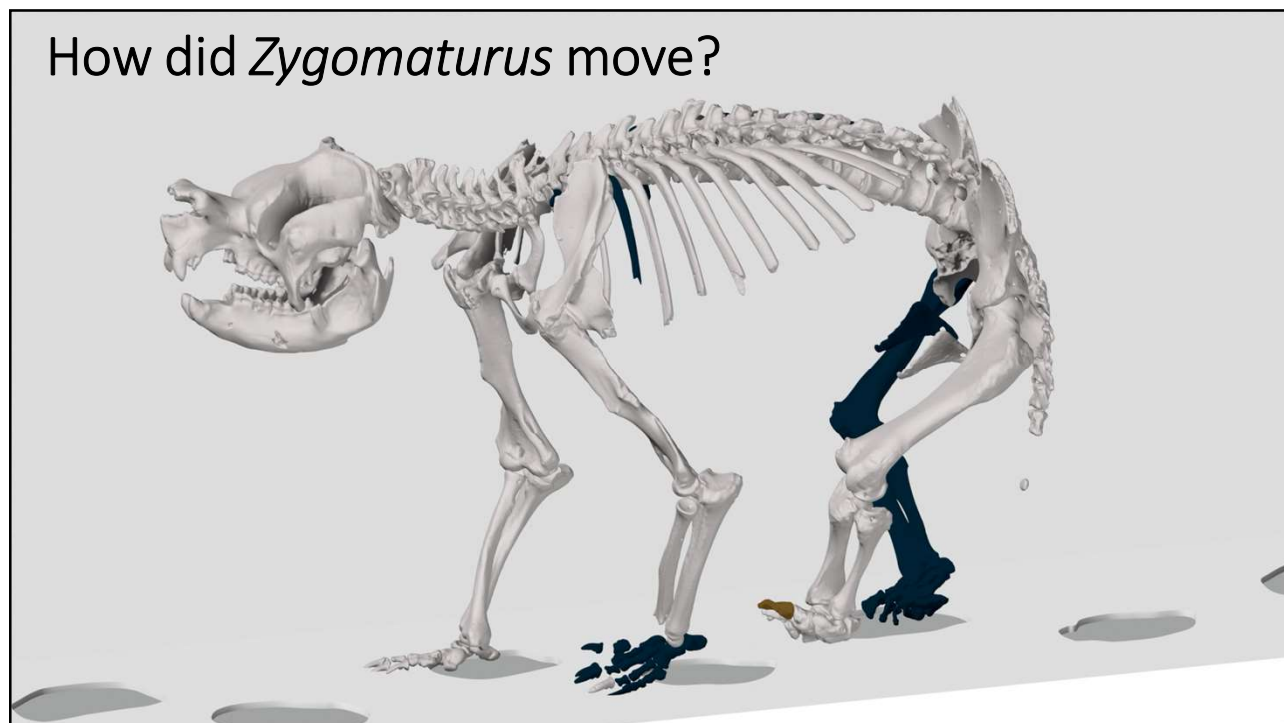
Reconstructing body posture in extinct species



36



37



38

When did Zygomaturus go extinct?

Between 32-36 thousand years based on dating of an articulated skeleton found at the Willandra Lakes in far west New South Wales.

But, it may have survived even later in Tasmania...

Westaway et al. (2017) At least 17,000 years of coexistence: Modern humans and megafauna at the Willandra Lakes, South-Eastern Australia. *Quaternary Science Reviews*. 157: 206-211

39

Any Questions?

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