

Thylacine DNA: *life after death*

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Tasmanian Museum & Art Gallery (TMAG)


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Stiftung/Foundation


THE UNIVERSITY OF
MELBOURNE


Australian Association
of von Humboldt Fellows

Global perspectives, Local Knowledge

Tasmania: A conservation success story

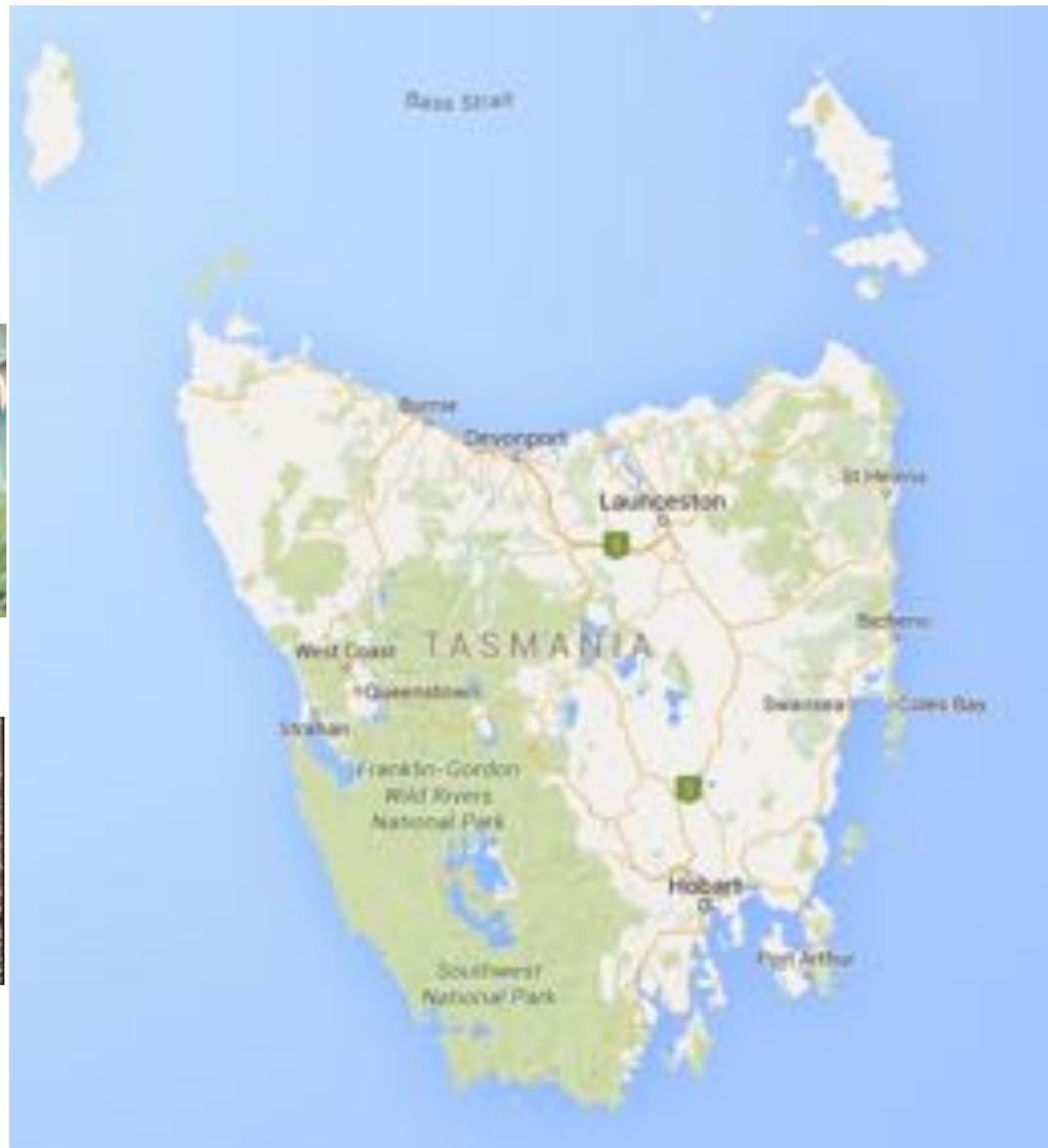
Tasmanian devil



Bandicoot



Eastern Quoll



Tiger Quoll

But, what a specimen it was !

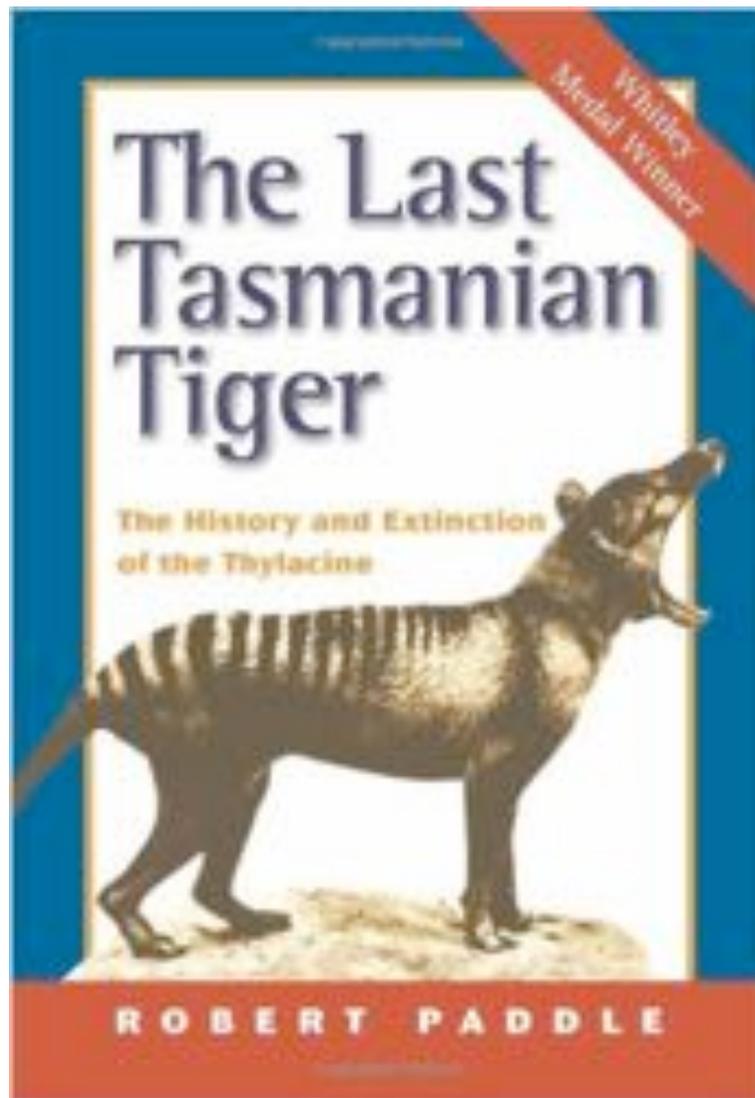


Tasmanian Museum & Art Gallery (TMAG)

Bounty motion passed - 1887



Wikipedia



Paddle (2000)

Hermann Klaatsch (1863-1916)



from Erckenbrecht, 2010

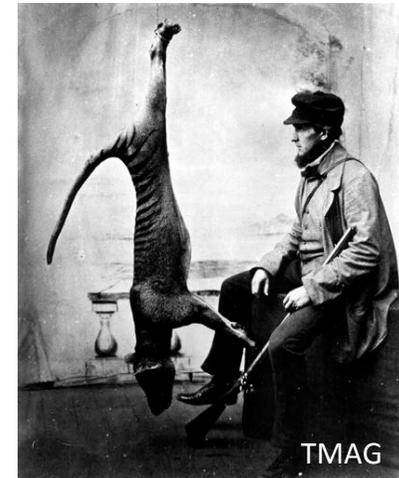
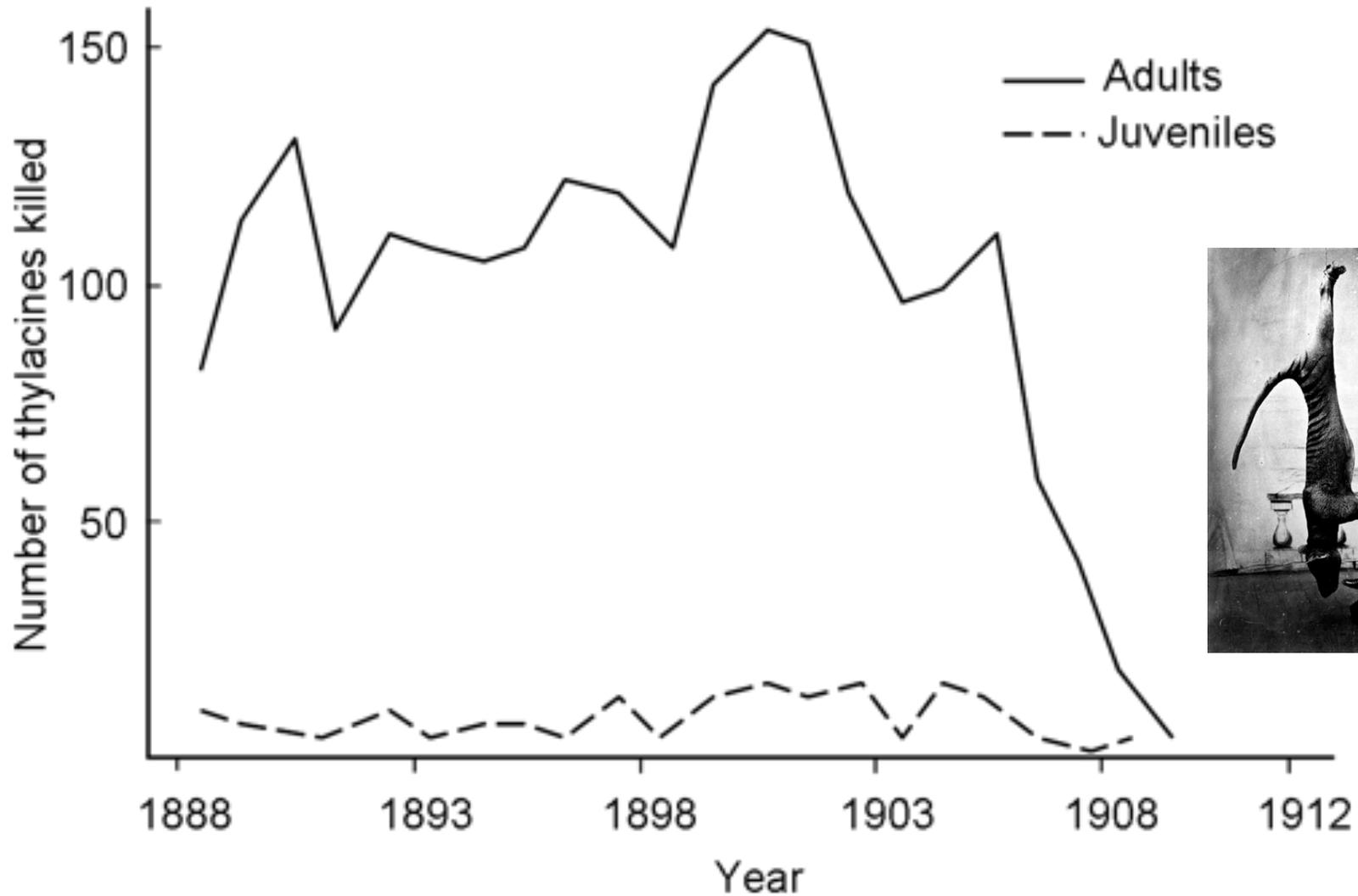
Tasmania's animals "were being totally exterminated, with no understanding and with no pity, the hard-hearted and ignorant colonists shooting everything on sight"

Theodore Thomson Flynn (1883-1968)



Sourced from <http://www.utas.edu.au>

Population collapse



Data adapted from Guiler, 1985

Global demand for specimens



International Thylacine Specimen Database

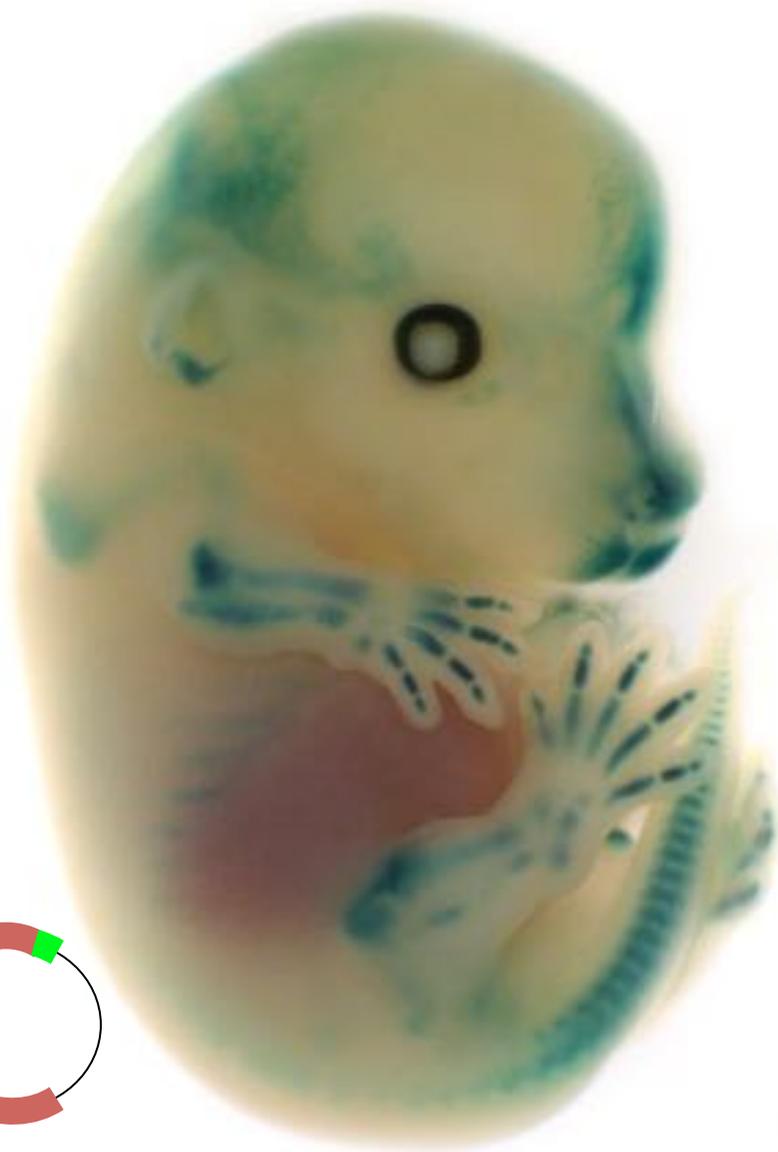
754 specimens in museums and private collections around the world

>60% overseas (UK, Europe, North America)

Something is missing



Thylacine Col2A1 functional gene rescue in mice

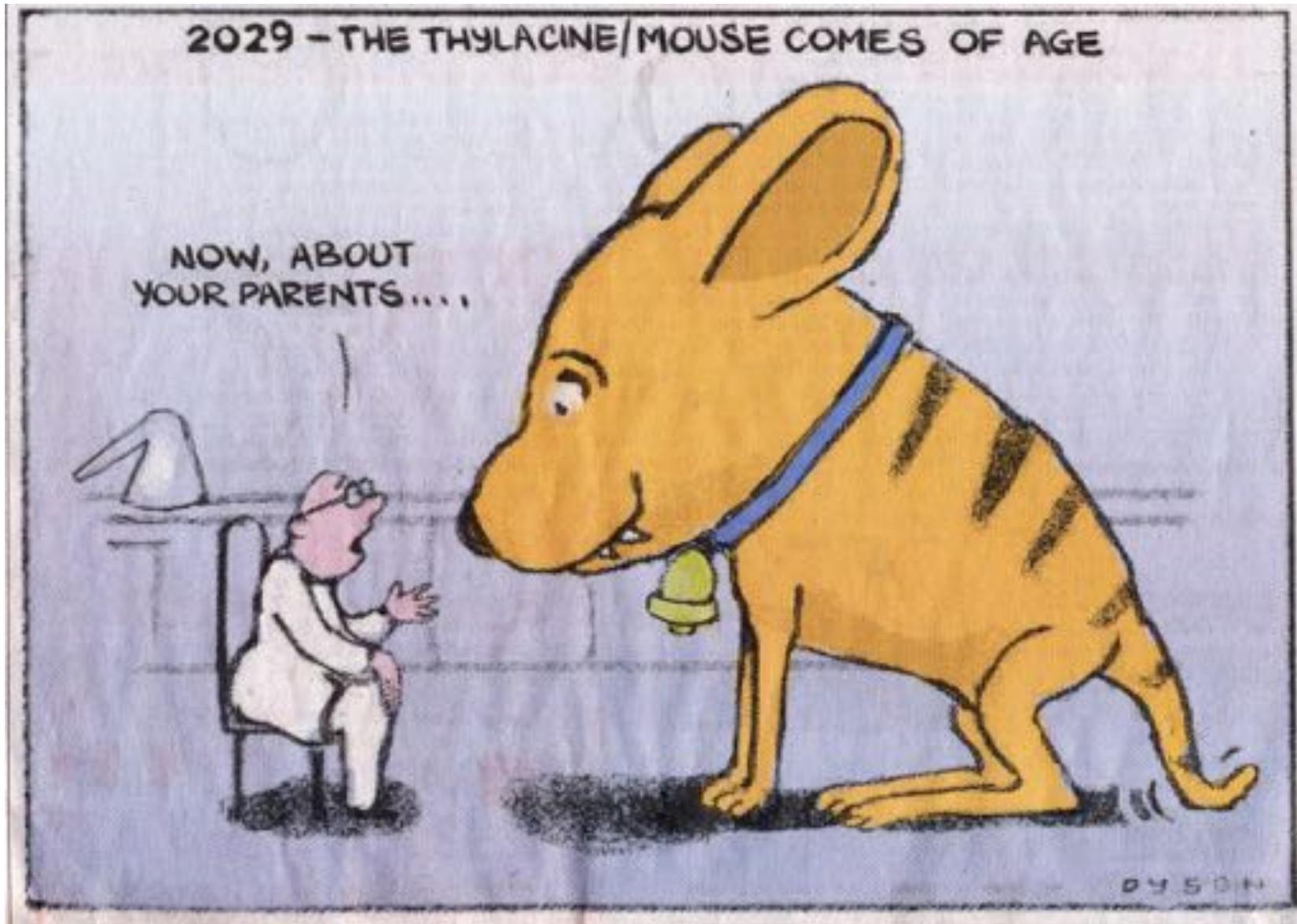


lacZ stained transgenic

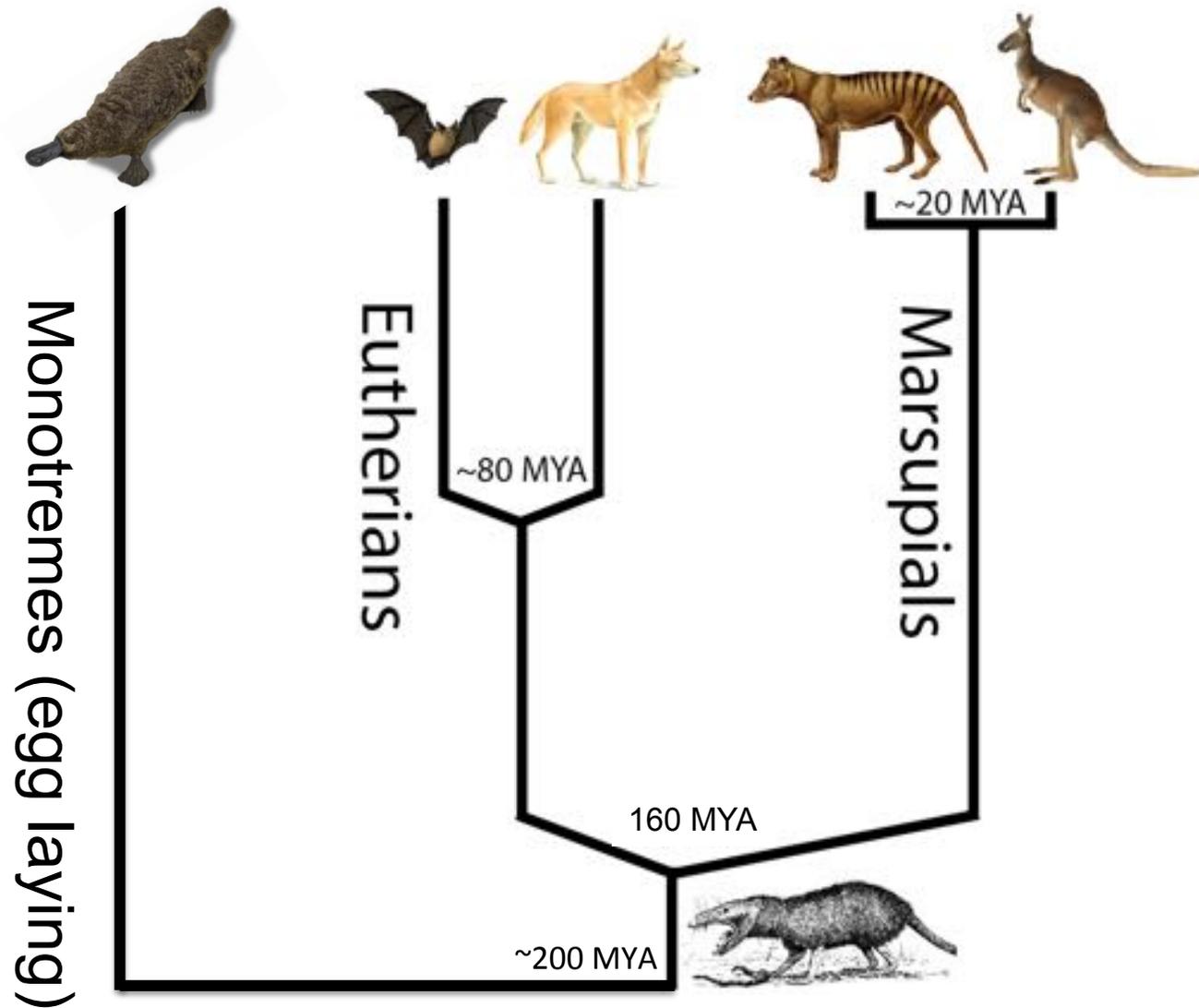


lacZ stained control

Science and science fiction



The Marsupial Advantage



Bininda-Emonds et al *Nature* (2007), Luo et al *Nature* (2011)

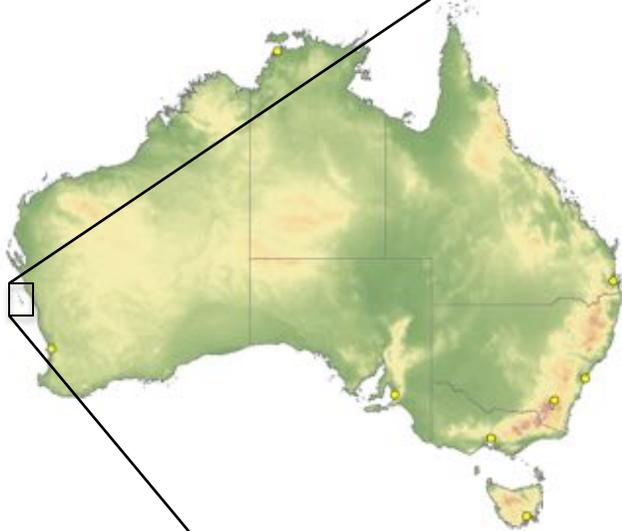
Discovery of marsupials by Europeans

- Vincente Pinzon (1501): North American opossum

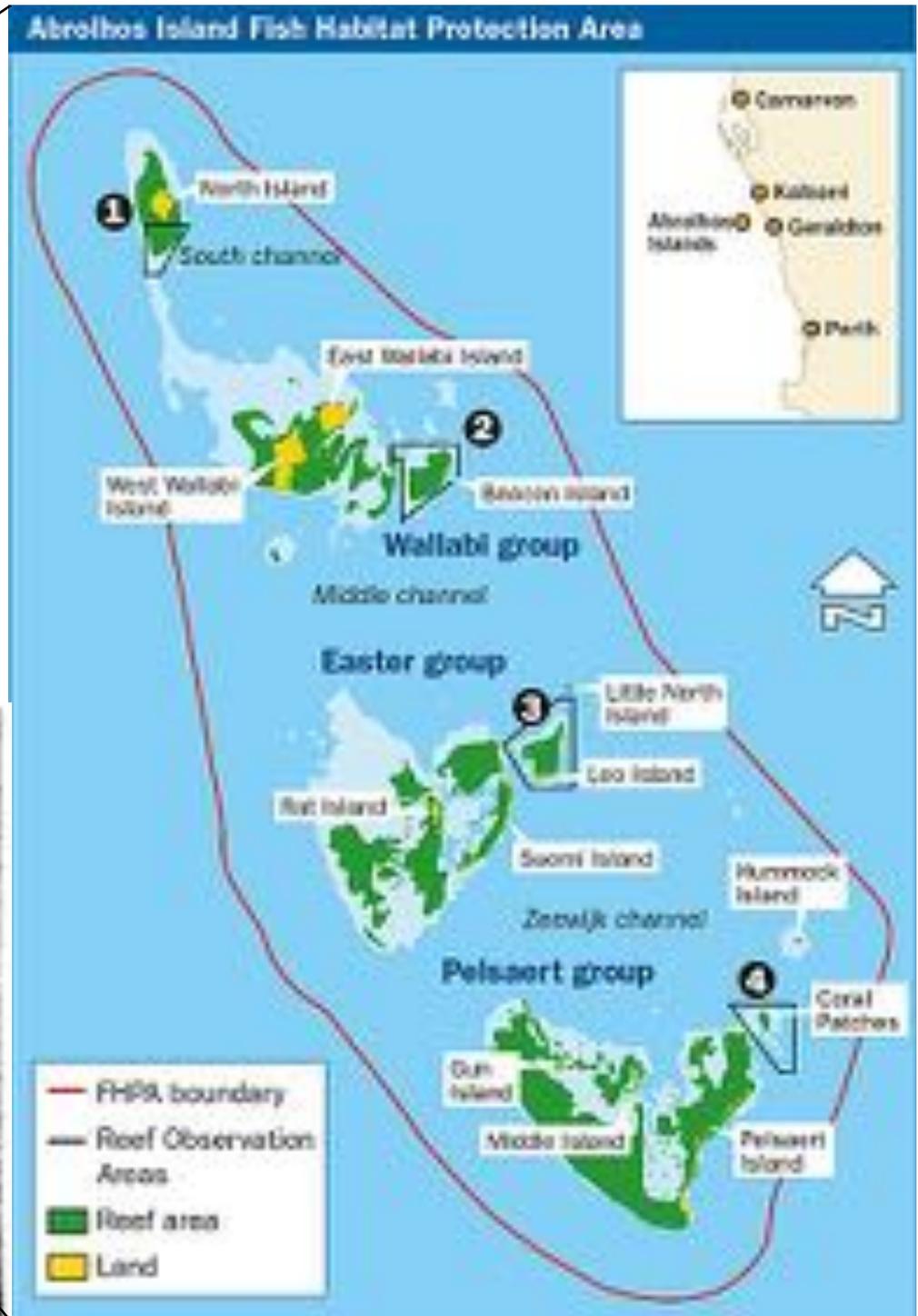
- Portuguese officer (1536-1540): Cuscus, Indonesia
- “On their belly they have a pocket like an intermediate balcony; as soon as they give birth to a young one they grow it inside there at a nipple until it does not need nursing any more”



Shipwreck of the Batavia (1629)



The Voyage of the Batavia
(Australian Maritime Series 2)



First description of Australian marsupials

“We found in these islands large numbers of a species of cats, which are very strange creatures. It has two hind-legs and it walks on these only. Its tail is very long; if it eats, it sits on its hind legs, and clutches its food with its forepaws.”

-Francisco Paelsart, Commander of the Batavia, 1629

Tammar wallaby (*Macropus eugenii*)



Marsupial reproduction

“Their manner of generation or procreation is exceedingly strange. Below the belly the female carries a pouch and we have found that the young ones grow up in this pouch until they are able to walk...”

-Francisco Paelsart, Commander of the Batavia, 1629

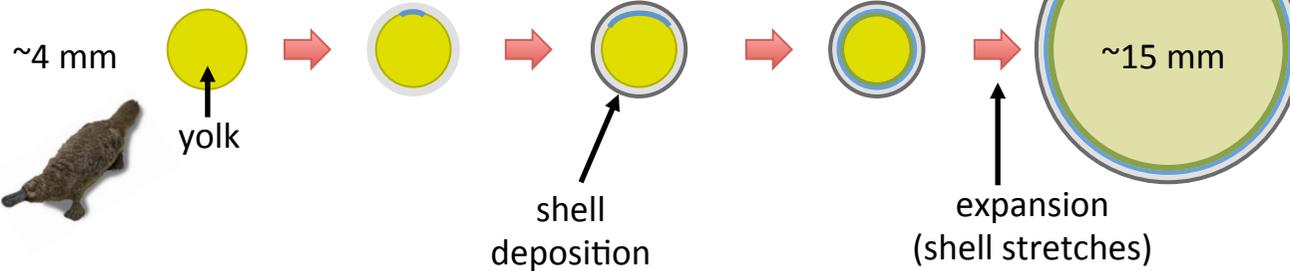


Photo: G. Shaw

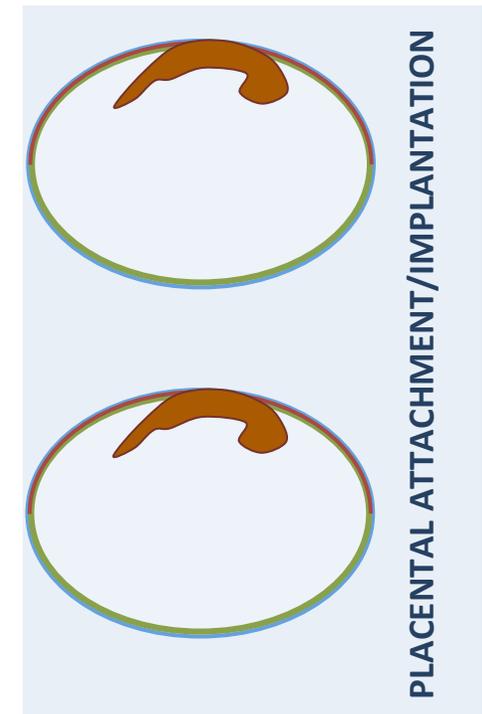
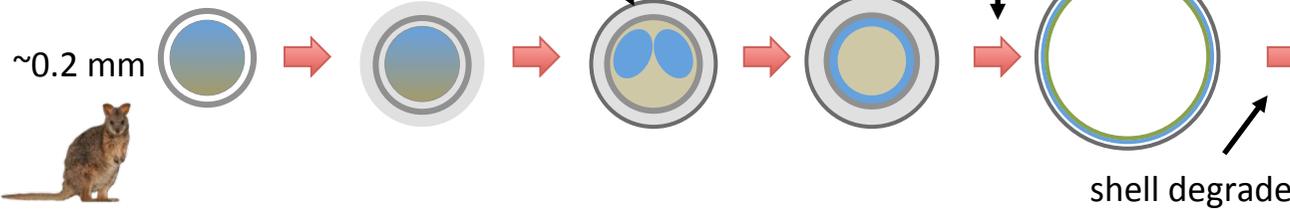
Embryonic/fetal development



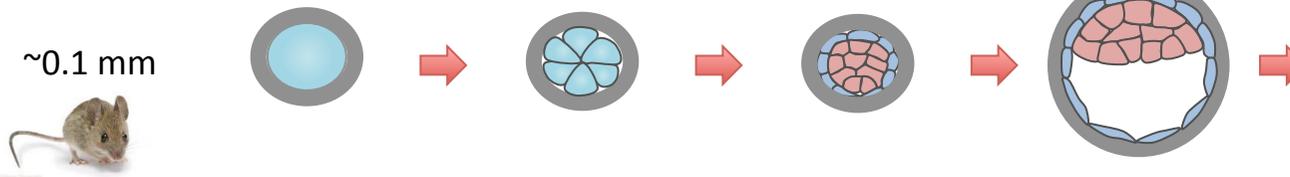
monotremes



marsupials



eutherians



Wallabies practice climbing before birth



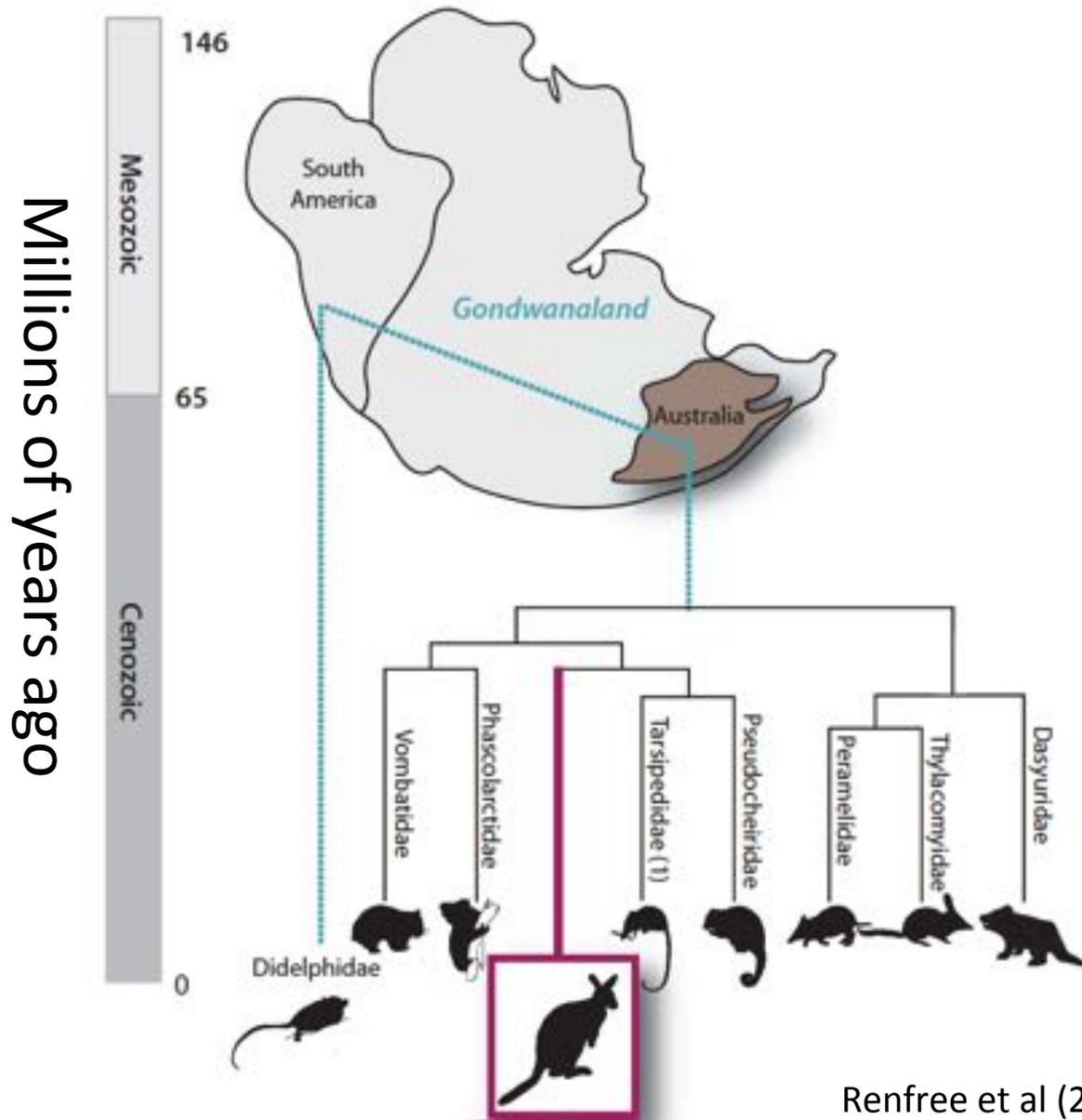
Drews et al (2013) *Scientific Reports*

Thylacine reproduction?

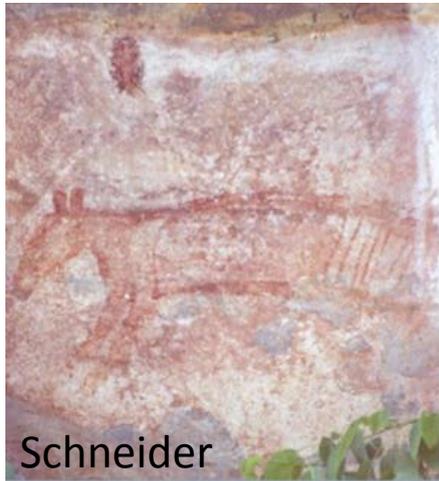


Wikipedia

Marsupial diversity

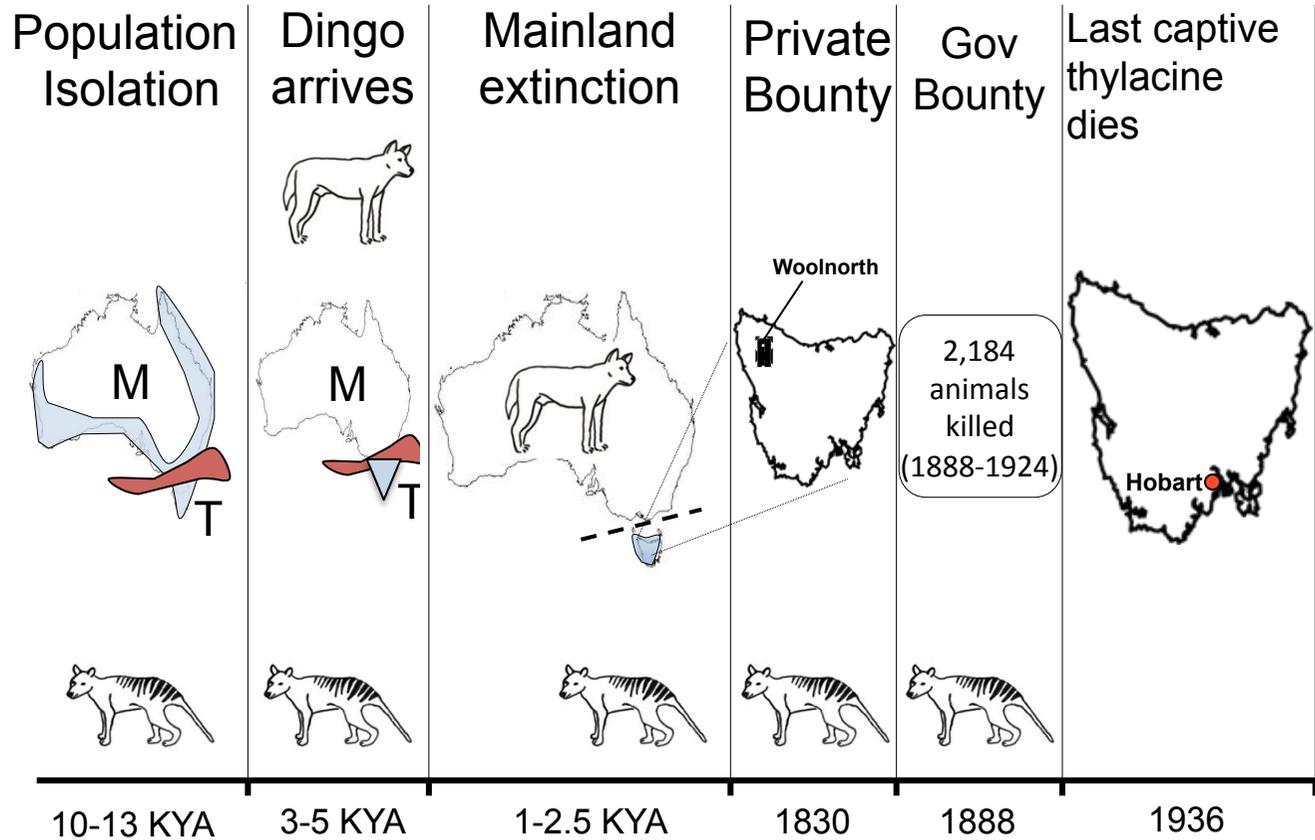


Prehistoric isolation of the thylacine

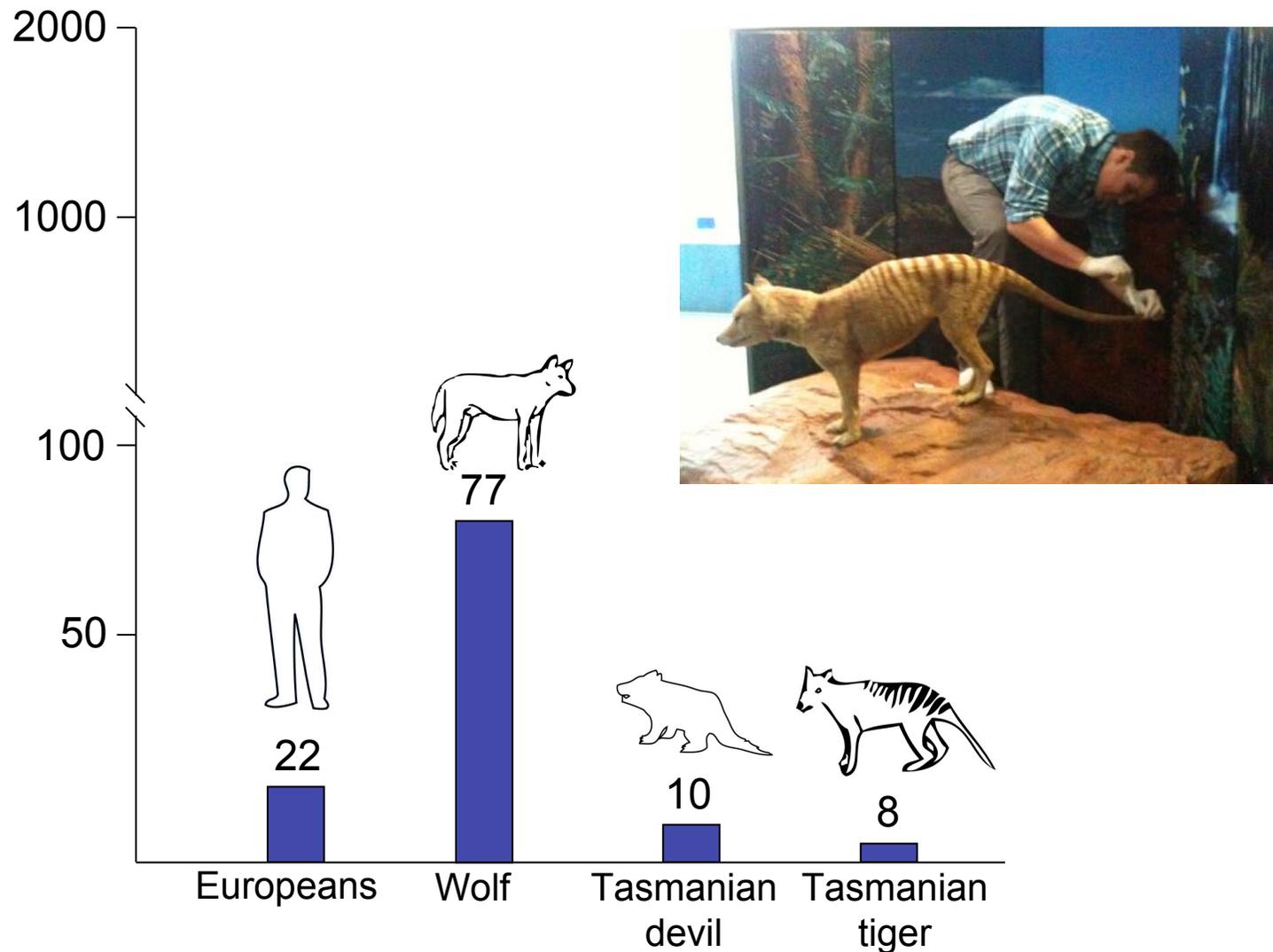


Schneider

Thylacine rock art:
Kakadu



Limited Genetic Diversity Preceded Extinction



Menzies et al (2011) *PLoS ONE*; Pask and Menzies (2013)

Convergent forms



Marsupial mole



Eutherian mole



Eutherian mouse



Marsupial mouse



Marsupial glider



Eutherian flying squirrel



Eutherian wolf



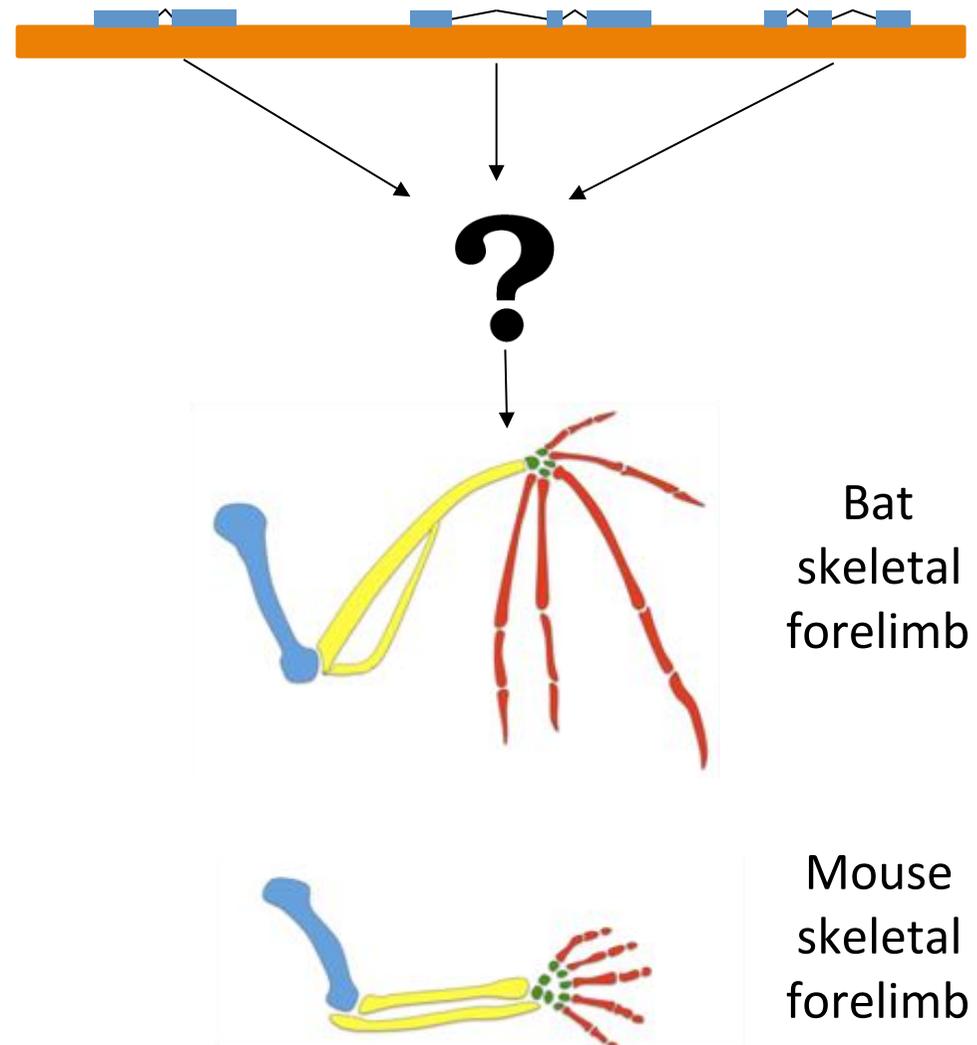
Marsupial wolf

The **most** quintessential example of convergent evolution in mammals

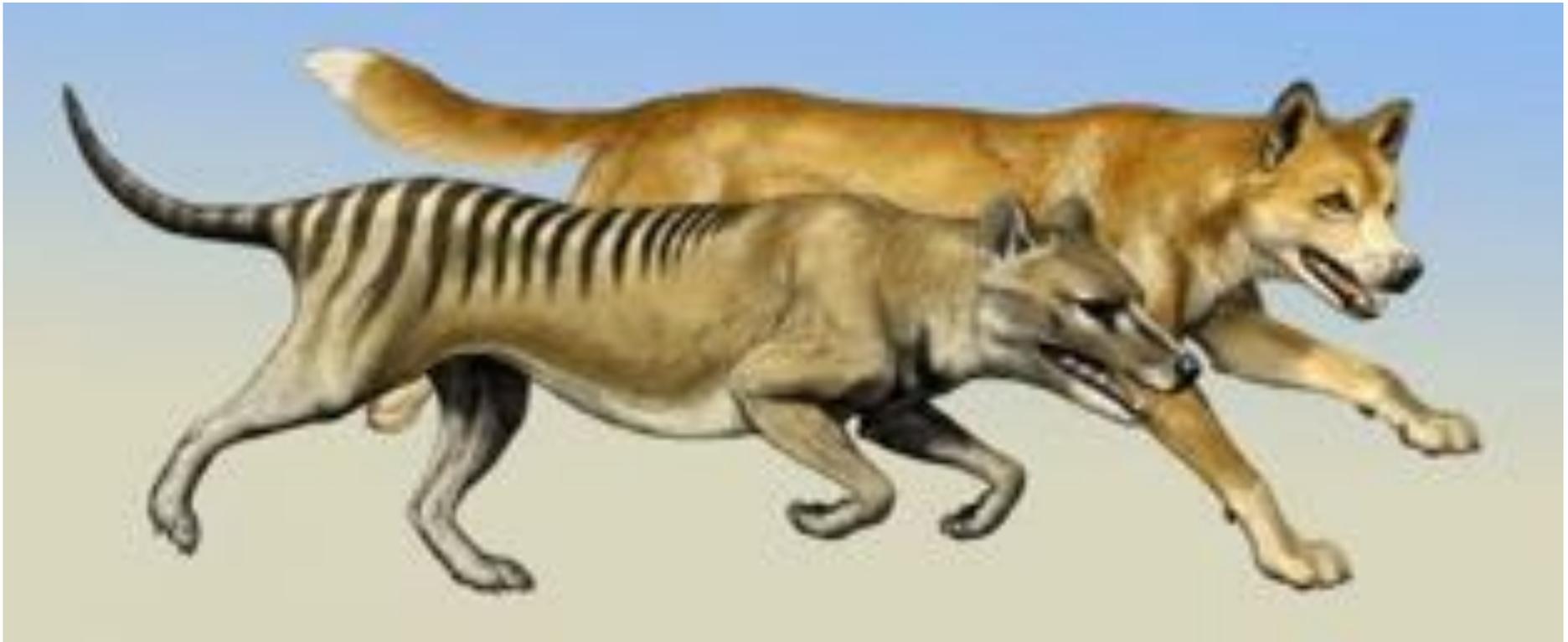


How does convergent evolution occur at the genome level?

- Fundamental aspect of genetics / genomics

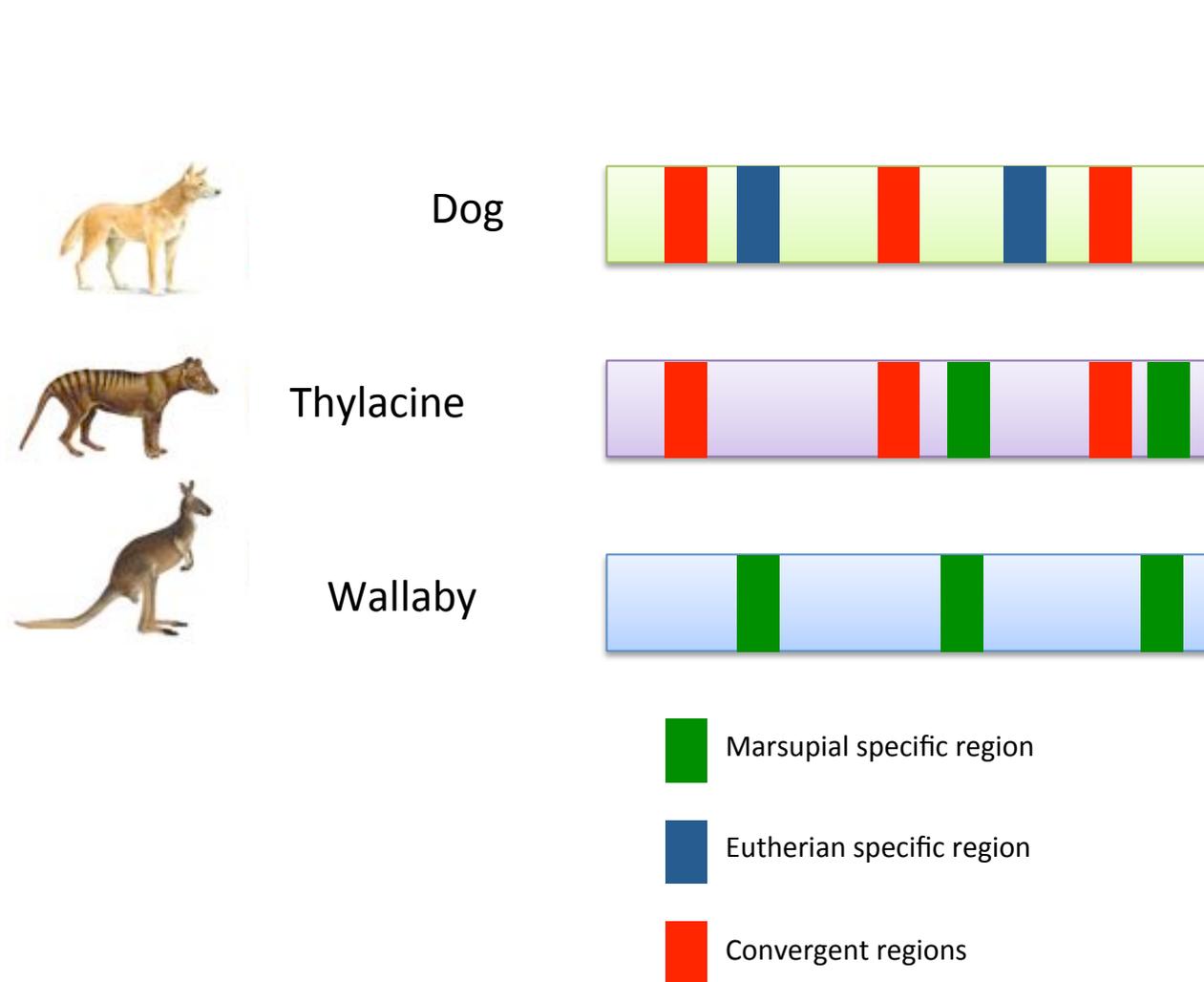


Thylacine genome



Does Thylacine genome = Canine genome ?

Similarities and differences

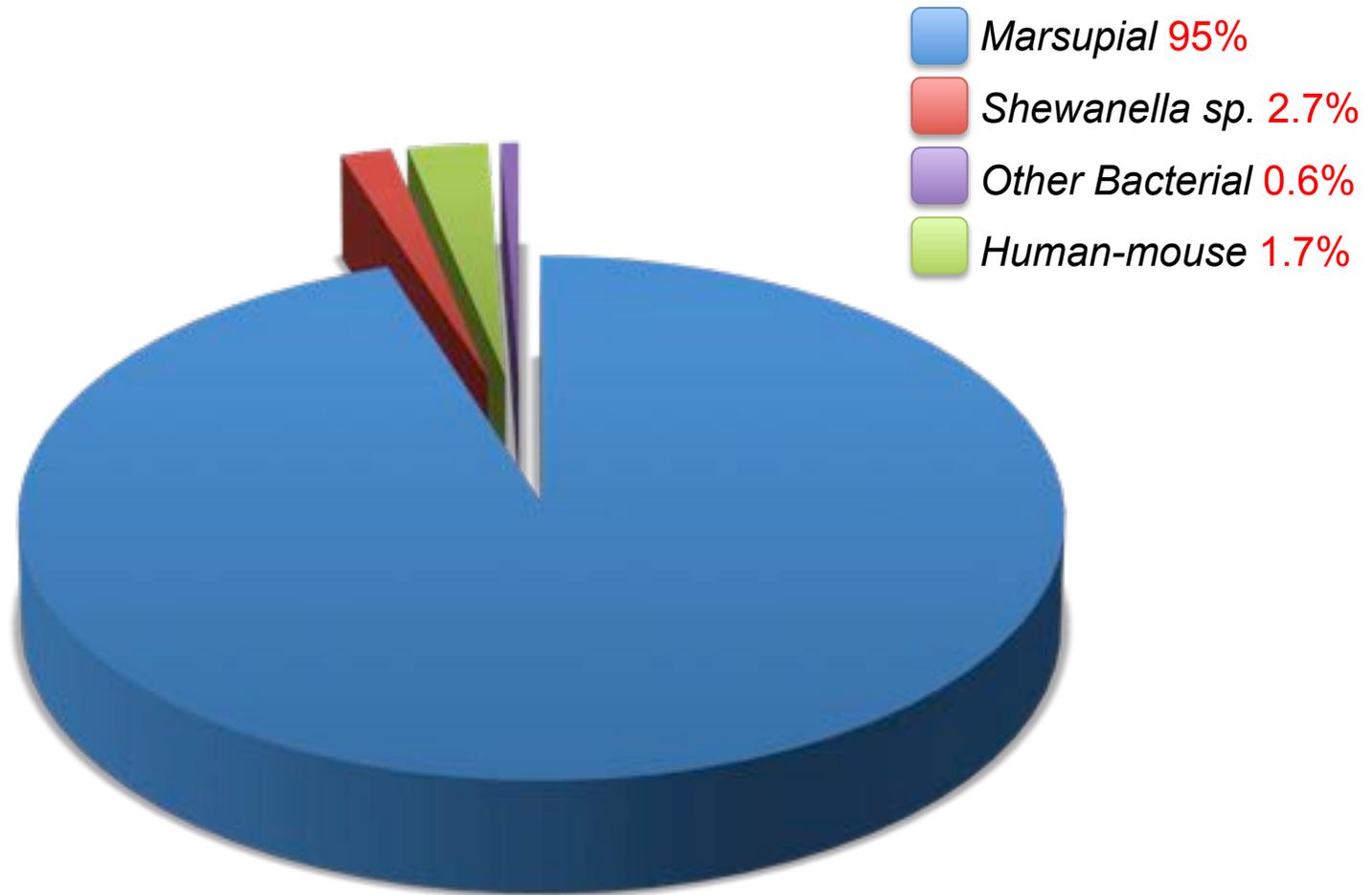


Diamond in the rough



C5757: Museum Victoria, Female pouch young collected in 1909

Is there contamination?





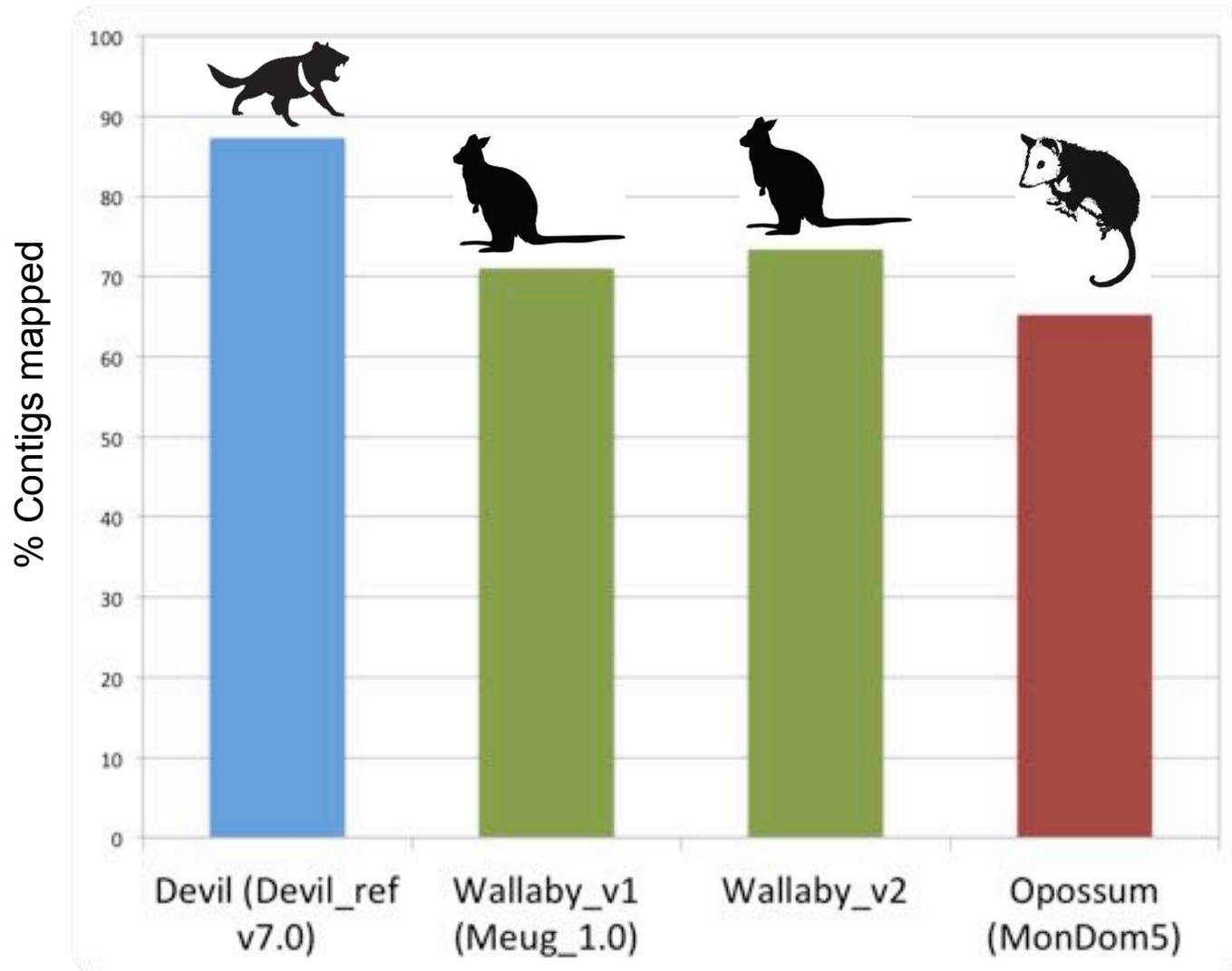
Thylacine Genome 1.0

Assembly Stats

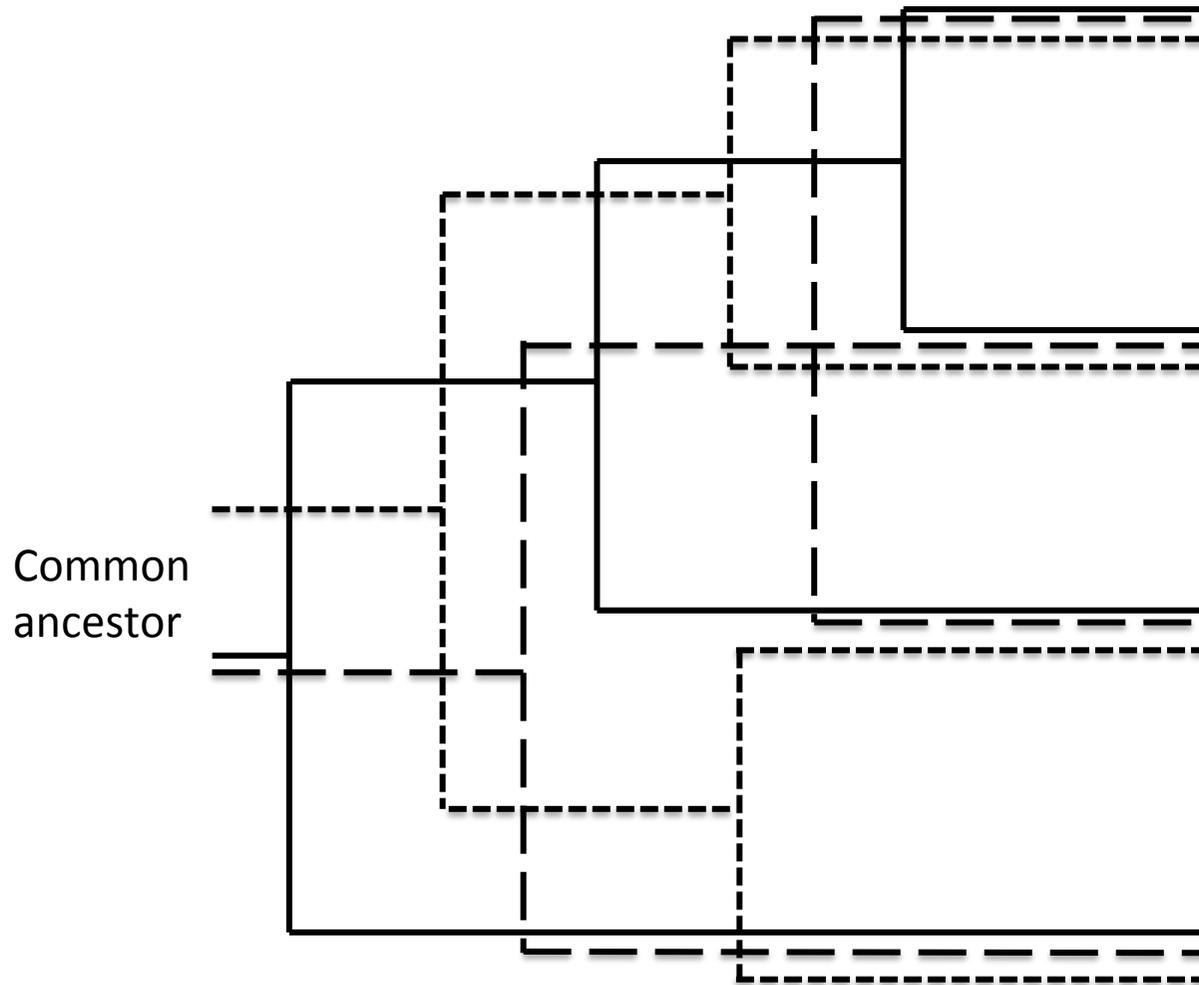
Total Number of Bases	3,016,507,000
Total Number of Contigs	2,065,150
N50 Contig Length	3,500bp
N90 Contig Length	729bp
Longest Contig	39,863
GC%	35.98

~15x coverage after filtering for high quality reads
Further 10x coverage from Proton, 454, SOLiD reads
Damage estimate <0.5% before preCR

Contig Mapping to Marsupial Genomes

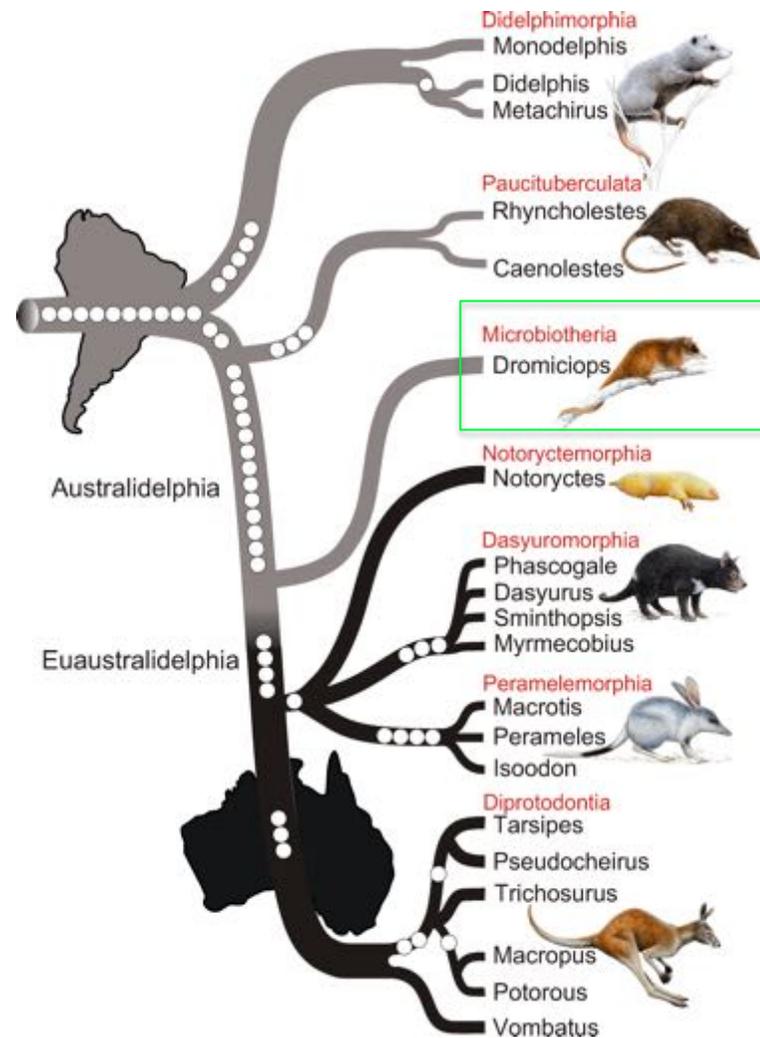
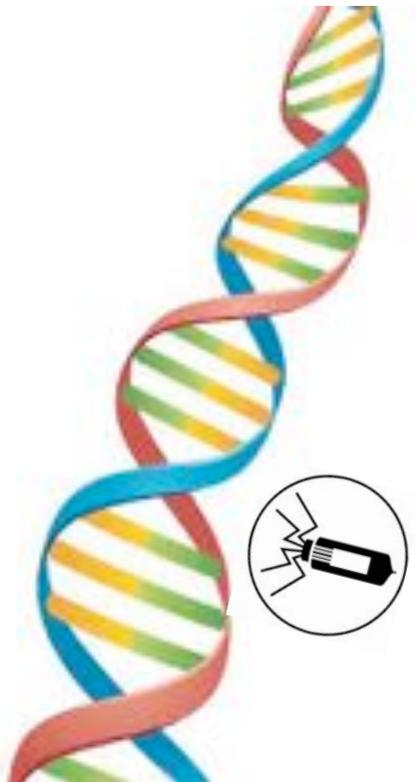


What is a thylacine?



Lowenstein et al (1991), Krejewski et al (1997), Miller et al (2009)

Tracking retroposon insertions



Summary

- Marsupials provide terrific models to understand mammalian evolution
- High quality “ancient” DNA – best extinct genome build to date
- Correct placement of the thylacine phylogenetically
- Opportunity to understand convergent evolution

Acknowledgements

