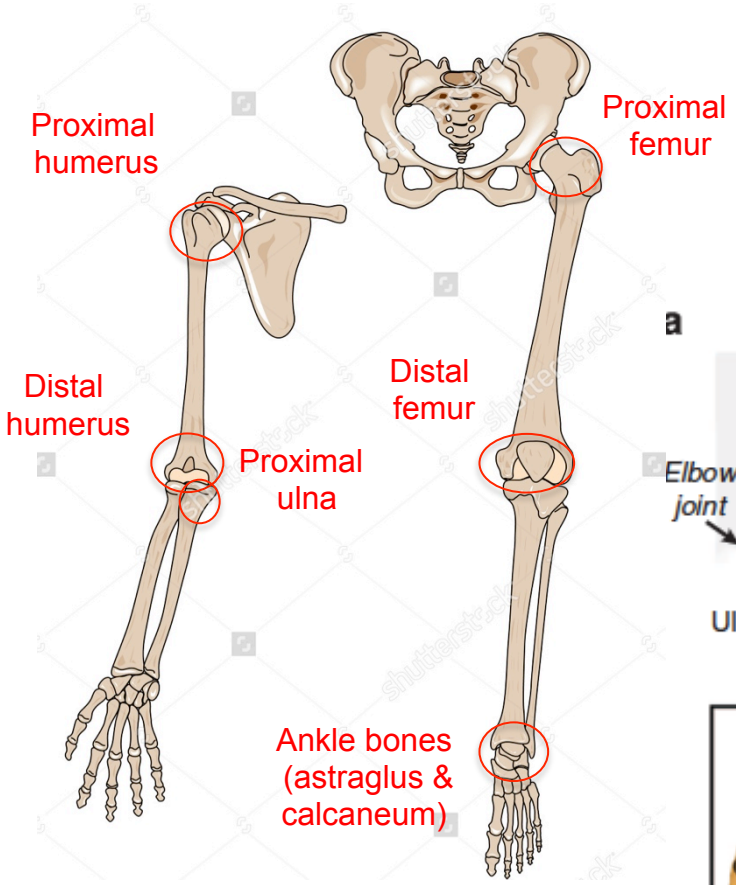
HOW THE ANATOMY OF THE DISTAL (LOWER) HUMERUS JOINT RELATES TO LOCOMOTION & SUBSTRATE USE IN MAMMALS

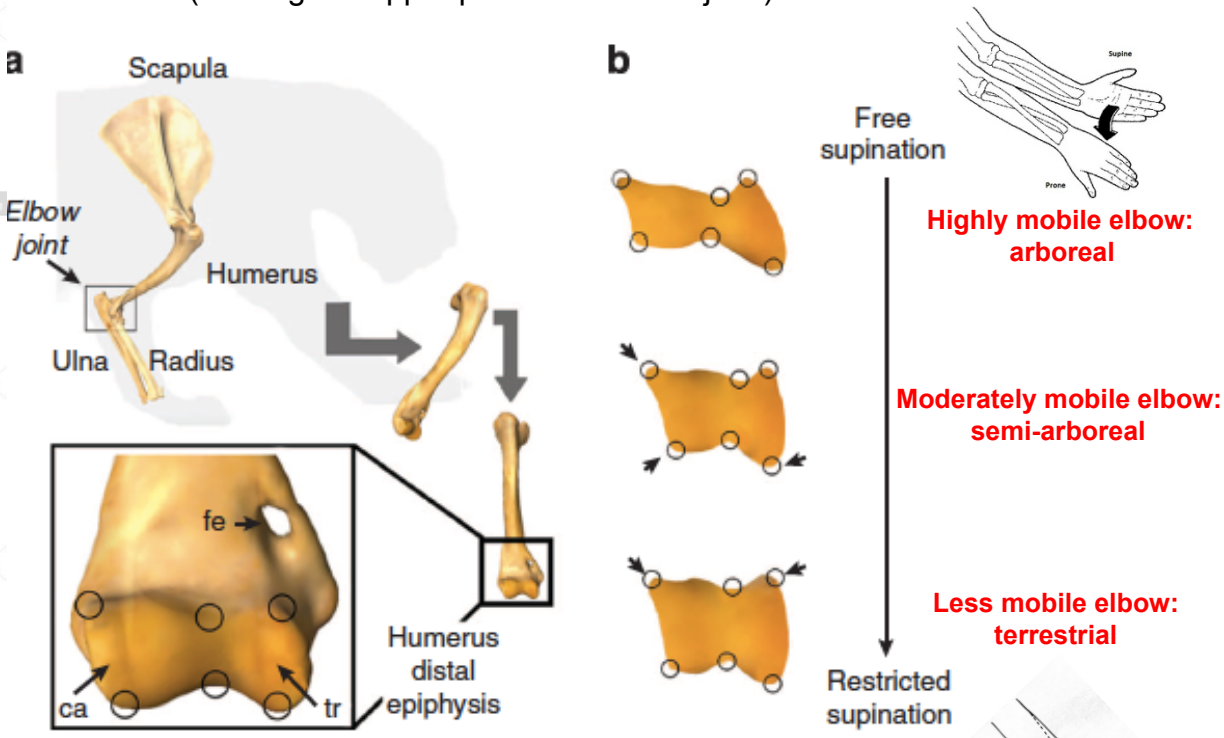
These were the joints subjected to statistical analysis



The ankle bones, which show excellent correlation with locomotor habits within smaller mammalian taxonomic groupings (e.g., primates, carnivores) did not prove useful for correlations across the range of living placental and marsupial mammals.

The other joints all showed reasonably good correlation with locomotion habit/substrate use (i.e., arboreal, semi-arboreal or terrestrial).

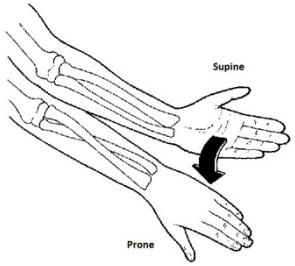
The fossil samples mainly comprised the proximal ulna and the distal humerus. This presentation shows the correlations of the distal humerus (forming the upper part of the elbow joint) with locomotor habit.

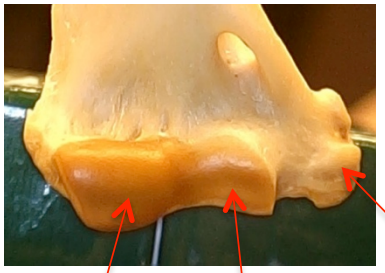


From Figueirido, Martín-Serra & Janis. *Palaeobiology* 2016.
(the circles indicate the points taken for digitisation)

Humerus anatomy

Pronounced pronation and supination of forelimb:
Large area for insertion of
flexor muscles (median epicondyle)





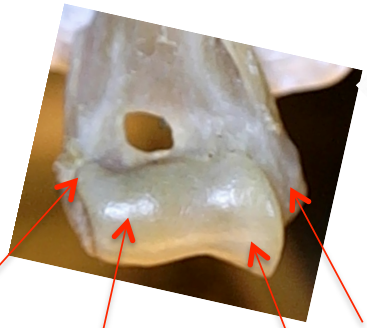
Large median epicondyle

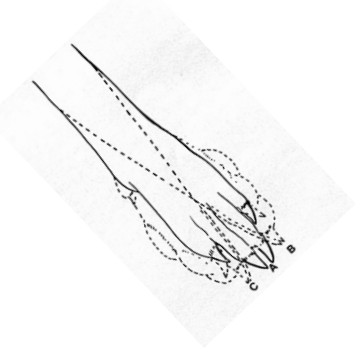
Long, rectangular capitulum
(articulation for radius)

Oblong, shallow trochlea
(articulation for ulna)

Although the size of the median epicondyle is highly informative, it was not included in the statistical analyses as it is often missing in fossils

Restricted pronation and supination of forelimb:
Small area for insertion of
flexor muscles (median epicondyle)





Capitular tail
(restricts rotation of radius)

Small median epicondyle

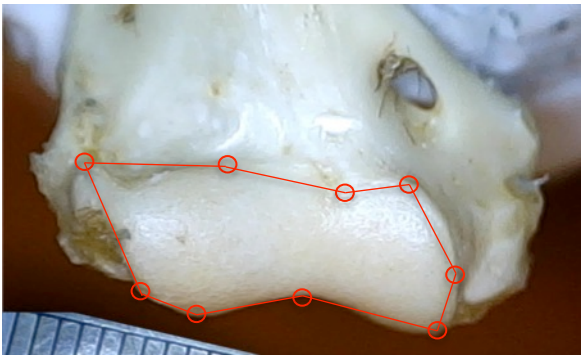
Short, square capitulum
(articulation for radius)

Fan-shaped, deep trochlea
(articulation for ulna)

***Potos* (kinkajou)**
Arboreal

***Viverricula* (Indian civet)**
Terrestrial

Quantification of the anatomy of the distal humerus articular surface

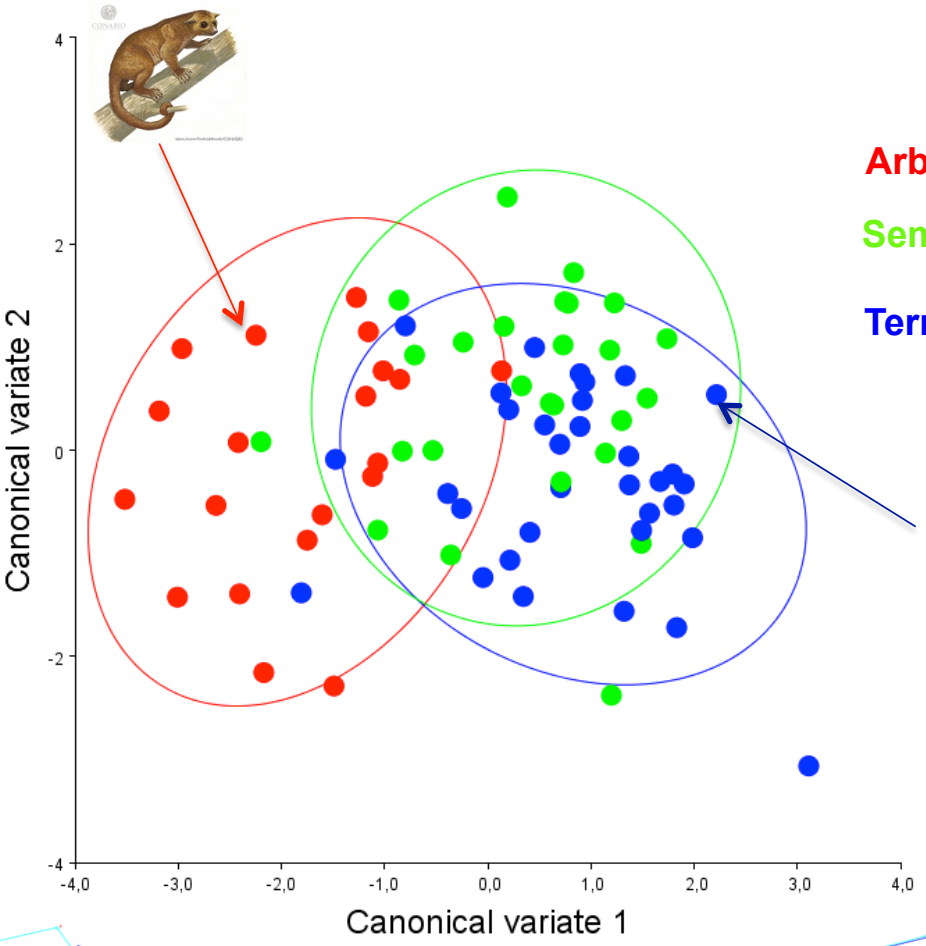


Landmarks taken for two-dimensional geometric morphometrics

Arboreal forms are statistically different from both semi-arboreal and terrestrial ones, but semi-arboreal cannot be distinguished from terrestrial

(This degree of overlap between groups is common in these sorts of studies)

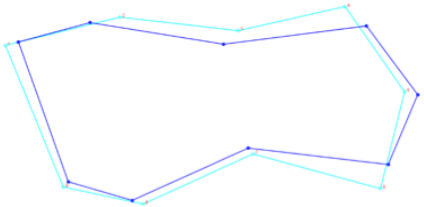
Canonical variates analysis of landmarks



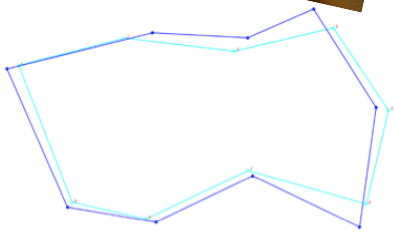
Arboreal (19)

Semi-arboreal (22)

Terrestrial (32)

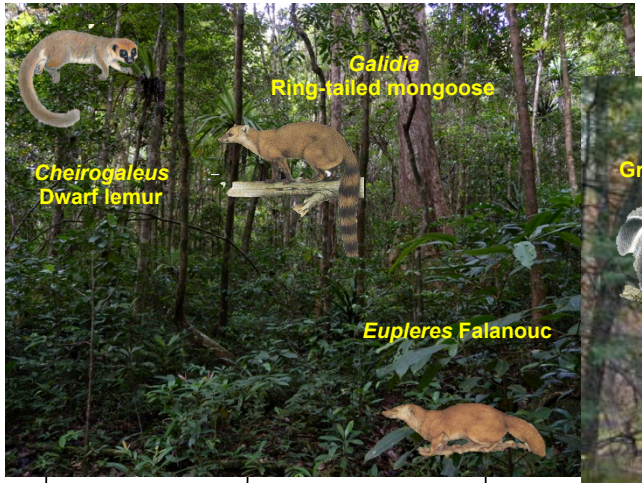


Shape variation along the first axis:
Light blue = average shape
Dark blue = deviation from that shape



A QUALITATIVE ILLUSTRATION OF THE CORRELATION OF HUMERUS ANATOMY AND HABITAT IN LIVING MAMMALS

Madagascan Rainforest

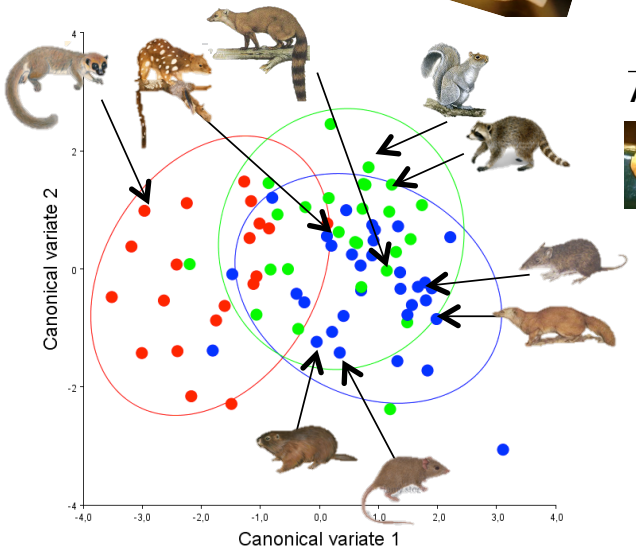




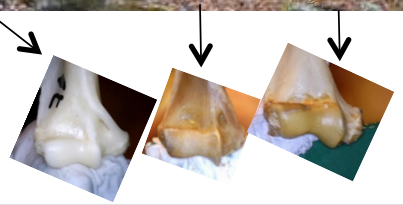
Arboreal (1) **Semi-arboreal (1)** **Terrestrial (1)**


Kinkajou

Civet

North American Woodland

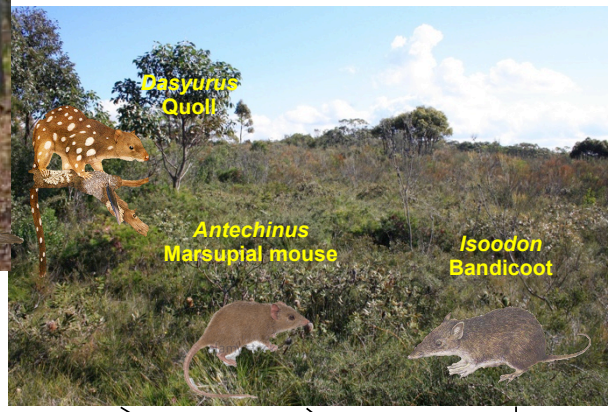


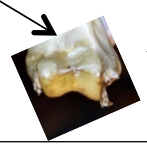
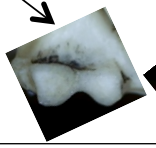
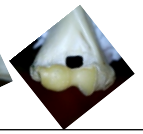
Arboreal (0) **Semi-arboreal (2)** **Terrestrial (1)**


Kinkajou

Civet


Australian Heathland



Arboreal (0) **Semi-arboreal (1)** **Terrestrial (2)**

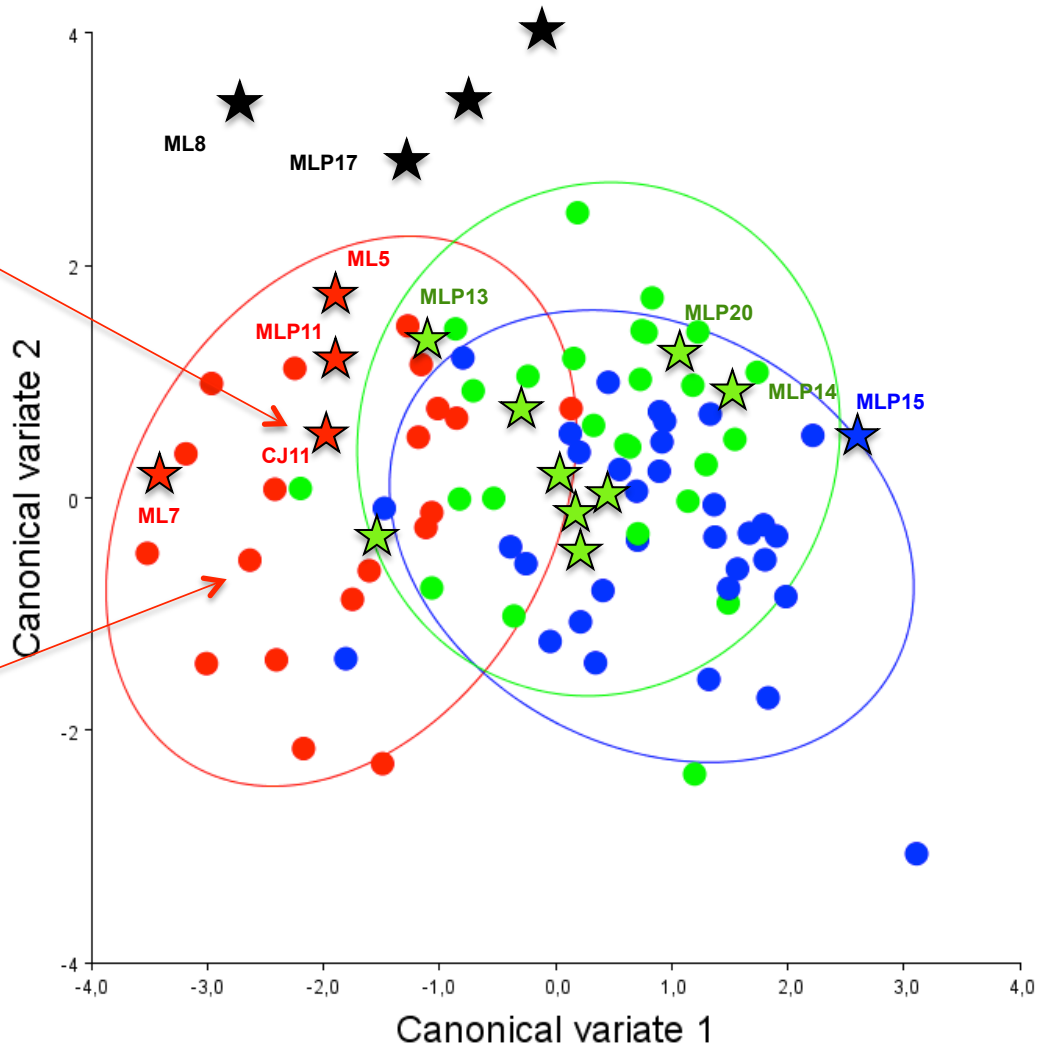

Kinkajou

Civet


The diversity of locomotor types of mammals characterises the habitats they are found in

Adding fossils to the canonical variates analysis

This fossil looks very similar (and is of similar size) to the feather-tailed possum *Acrobates*



Arboreal (19)

Semi-arboreal (22)

Terrestrial (32)

Likely arboreal fossil

Generalized, likely semi-arboreal fossil

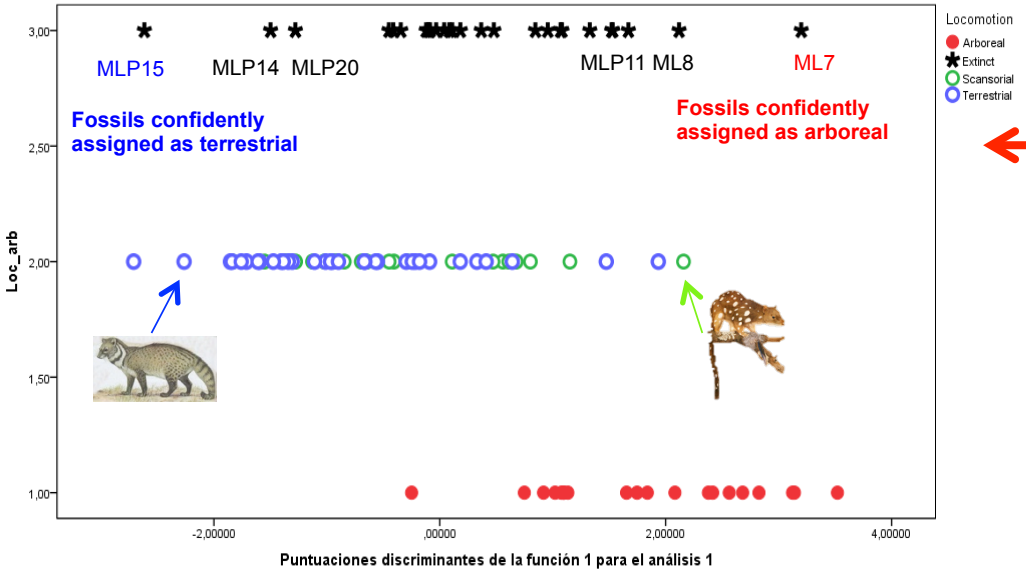
Likely arboreal fossil

Fossil outside range of extant mammals, difficult to determine

Fossils identified here are the same ones identified in the linear discriminant analyses on the following page

Adding fossils with linear discriminant analysis

(rather than comparing all three locomotor groups with each other, this compares one against the other two)



Arboreal forms compared with semi-arboreal + terrestrial forms:

65% of living mammals are correctly reclassified

Terrestrial forms compared with semi-arboreal + arboreal forms:

80% of living mammals are correctly reclassified

Comparing these two results with the canonical variates analysis:

MLP15 can be confidently assigned to terrestrial locomotion
ML7 can be confidently assigned to arboreal locomotion

CJ11, ML8, MLP11, & MLP 13 are possible arboreal forms

MLP14 & MLP20 are possible terrestrial forms

All other fossils are likely semi-arboreal