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The Postcranial Functional Anatomy of the Endemic Rats from Liang Bua, Flores, Indonesia

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Introduction

Liang Bua, an Indonesian site on the island of Flores, is best known as the type locality of the endemic hominin, *Homo floresiensis*. Excavations at Liang Bua have recovered an overwhelming amount of vertebrate remains, including more than 200,000 fragments identified to the Muridae family (i.e., rats).



- Previous research by Guy Musser (1981) suggests the presence of at least six genera represented on the island (*Papagomys*, *Spelaeomys*, *Hooijeromys*, *Komodomys*, *Paulamys*, and *Rattus*) indicative of small, medium, large, huge and giant body sizes
- Current and previous excavations at Liang Bua indicate the presence of at least six rat species through dental remains.
- Variation in dental and cranial morphology between *Papagomys* and *Spelaeomys* suggests ecological differences among taxa of similar body sizes

- Behavior and habitat is essentially unknown for all of these extinct, native taxa, and even some that are still living on Flores (e.g., *Papagomys armandvillei*)
- Here, for the first time we analyze the functional anatomy of recovered calcanei (n=372) and humeri (n=1474) to interpret body size variation, identify species, and behavior.

BACKGROUND

Small (*R. exulans*)



Giant (*P. armandvillei*)



Table 1. Liang Bua Murids

Species	Size class	Weight (g)	Known	Habitat
<i>Papagomys armandvillei</i>	Giant	~1,200	Modern & Fossil	Forest (Terrestrial)
<i>Papagomys theodorverhoeveni</i>	Huge	unknown	Fossil	Forest (Terrestrial)?
<i>Spelaeomys florensis</i>	Huge	unknown	Fossil	Arboreal?
<i>Hooijeromys nusateggara</i>	Large	unknown	Fossil	Grasslands?
<i>Paulamys naso</i>	Medium	~120	Modern	Terrestrial
<i>Komodomys rintjanus</i>	Medium	~142	Modern & Fossil	Grasslands
<i>Rattus exulans</i> / <i>Rattus hainaldi</i>	Small	~70	Modern & Fossil	Various

MEASUREMENTS

HUMERUS

Maximum Length*
ML Head Diameter
AP Head Diameter
ML Midshaft Diameter
AP Midshaft Diameter
Length of Medial Condyle

ML Distal Width
AP Distal Depth*
AP Capitulum Thickness
Anterior Articular Breadth*
Posterior Articular Breadth**
Minimum Articular Thickness

CALCANEUS

Maximum Length**
Maximum Breadth
Heel Length*
Shelf Length*
Midpoint-to-Heel Length

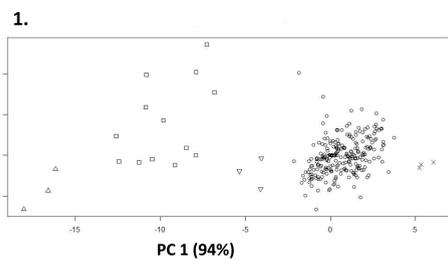
Midpoint-to-Cuboid Length
Mid Heel Breadth
Mid Heel Height
Posterior Heel Breadth
Posterior Heel Height



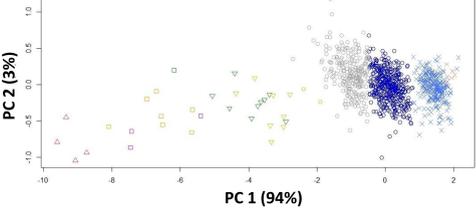
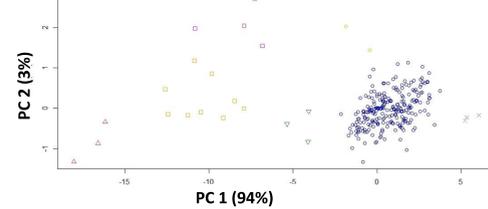
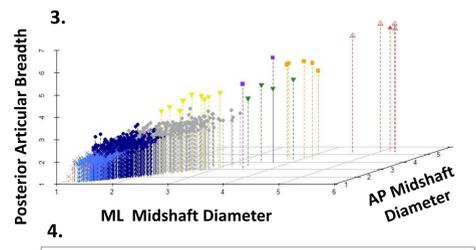
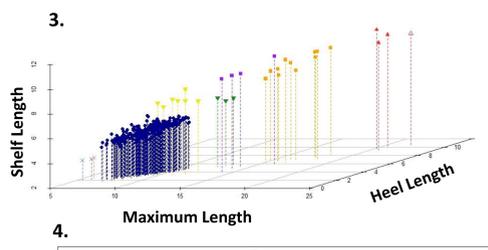
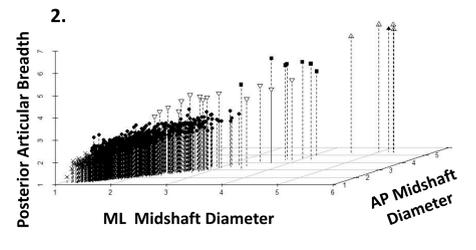
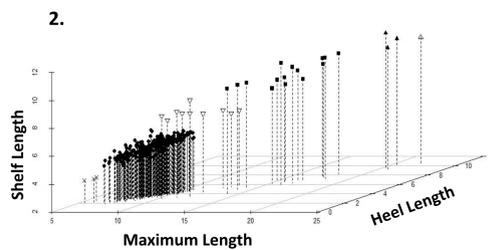
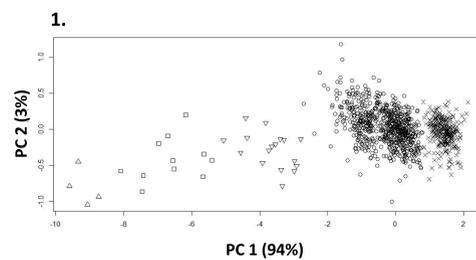
Matt Tocheri and Vens measure *P. armandvillei*
Photo credit: Liang Bua Team

RESULTS

CALCANEUS



HUMERUS



A: *P. armandvillei* was positively identified through comparisons with known specimens (e.g., MCZ) included in analyses
 B: *P. theodorverhoeveni* was identified as being a slightly smaller version of *P. armandvillei* with similar morphology overall
 C: *Spelaeomys* was identified based on large size but different morphology than *P. armandvillei* (e.g., shorter heel, thinner midshaft)
 D: "*Hooijeromys*" was identified based on similarities with both species of *Papagomys*, but smaller in size
 E: "Unknown" is a group of medium to large-sized calcanei and humeri that exhibit morphology more similar to *Spelaeomys* but smaller in size



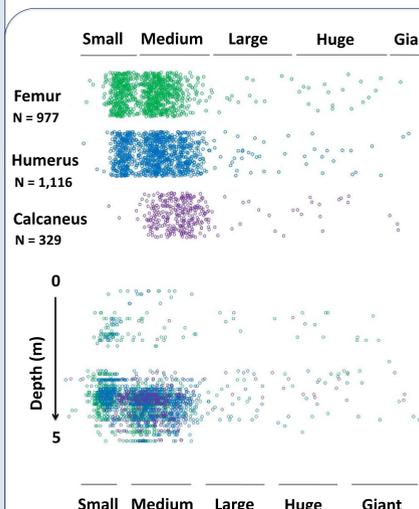
Thomas Sutikna holding a modern *P. armandvillei*
Photo credit: Liang Bua Team



Anterior dentition and lower face of *P. armandvillei*
Photo credit: Liang Bua Team

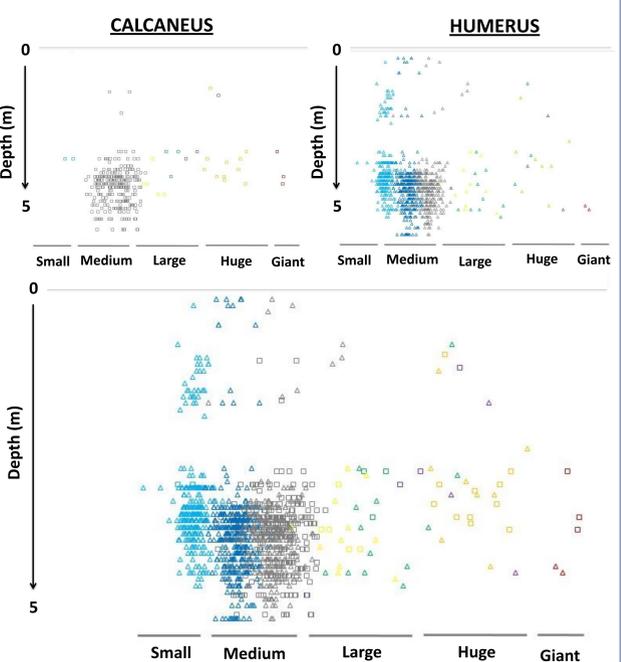


Skulls of *P. armandvillei* (left) and *S. florensis* (middle and right)
Photo credit: Liang Bua Team



- The femur, humerus and calcaneus show a similar size pattern
- There is a high concentration of larger and smaller *Komodomys* below 3 m depth
- Taxa representation appears to change dramatically with the onset of the Holocene

STRATIGRAPHY



DISCUSSION

- The postcranial functional anatomy of the murid calcaneus and humerus suggests a variety of murid species have occupied the available ecological habitats/niches surrounding Liang Bua throughout the late Pleistocene and Holocene
- The calcanei and humeri were assigned to a total of seven endemic murid species (*Papagomys armandvillei*, *Papagomys theodorverhoeveni*, *Spelaeomys florensis*, "*Hooijeromys*", *Komodomys sp.*, *Rattus hainaldi*, and *Rattus exulans*) based on comparisons of size and morphology
- Within the medium-sized clusters, there appears to be two groups suggesting the likelihood of a smaller and larger taxon within the genus *Komodomys*
- P. armandvillei*, *P. theodorverhoeveni*, and "*Hooijeromys*" postcranial morphology suggests these taxa are more adapted for terrestrial behaviors
- Spelaeomys* calcanei and humeri suggests adaptation for either more (1) arboreal or (2) riverside behaviors
- Both elements suggest the presence of a medium to large-sized murid that has yet to be positively identified by dental remains. This "unknown" group appears more functionally similar to *Spelaeomys* and may represent a terrestrial shrew rat referred to by Musser et al. (1986), which was likely specialized for eating a diet comprised mainly of earthworms

References

Musser, G.G., 1981. The giant rat of Flores and its relatives east of Borneo and Bali. *Bulletin of the American Museum of Natural History*, 169(2): 67-176.
 Musser, G.G., Van de Weerd, A., Strasser, E., 1986. *Paulamys*, a replacement name for *Floresomys* Musser, 1981 (Muridae), and new material of that taxon from Flores, Indonesia. *American Museum of Natural History*, number 2850:1-10.

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