Number 19, 2022
ISSN 2076-5764

# GEO-PAL UGANDA


Uganda Museum, Kampala

# Geo-Pal Uganda

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**ISSN 2076-5746**

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Uganda Museum, P.O. Box 5718, Kampala

# Fossil dog foot from Moroto II, late Pleistocene, Uganda

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**To cite the article : Pickford, M. 2022. Fossil dog foot from Moroto II, late Pleistocene, Uganda. *Geo-Pal Uganda*, 19: 1-4.**

## ABSTRACT

Moroto II is a fossiliferous locality in Karamoja, Uganda, best known for having yielded mammalian fossils, including hominoids, of basal Middle Miocene age. It is less well known for the late Pleistocene fossils that occur in the superficial sediments of the area. In 2019, the locality yielded associated elements of a medium-sized mammal foot which evidently belongs to Canidae (dogs), the first fossil representative of this family of carnivores reported from Uganda.

**Key Words**.- Canidae, Mammalia, Pleistocene, Karamoja, Fossil

## INTRODUCTION

In 2019, during a visit to Moroto II, Karamoja District, Uganda, by a team from the Uganda Museum, an articulated partial foot of a medium-sized mammal was found in a block of indurated calcified sediment close to the screening dump (« vertebra » site – B in Fig. 3 of Pickford, 2021). The specimen comprises a block of sandy to pebbly, yellow-brown calcareous sediment in which there are two metapodials lacking their distal extremities, a fragment of distal metapodial and two complete phalanges. One of the pebbles in the nodule is a piece of basalt similar to specimens of the lava flows that cap the Moroto II Miocene sediments. This evidence indicates that the fossils in the block are younger than the lava flow.

The aim of this paper is to put on record the discovery of the Moroto II fossil foot, and to establish its affinities.

## GEOLOGICAL CONTEXT

MOR II 12'19 is a partial left foot skeleton of a medium-sized mammal, in a nodule of calcified yellow-brown, coarse sand which contains a basalt pebble. The bones are pale yellowish-brown to cream coloured (Fig. 1).

The specimen was collected close to the screening dump left by Bishop's excavations during the late 1950's to early 1960's (Allbrook & Bishop, 1963; Bishop & Whyte, 1962), specifically, the screening dump where the Moroto hominoid vertebrae are considered to have been found (Pickford, 2021).

Moroto II is best known for the basal Middle Miocene fossils that have been collected there. These fossils occur in fluvial deposits that accumulated in shallow valleys eroded into the Basement Complex (gneisses) of the Karamoja Plains. The sediments are capped by basalt lava flows from Moroto Volcano (Allbrook & Bishop, 1963; Bishop & Whyte, 1962).

Unconformably overlying the Miocene lavas and sediments at Moroto II, are thin lenses and sheets of « alluvium » and transient sediment in the gullies draining Kogole Hill. These younger deposits have yielded several species of extant molluscs and mammals (see list in Pickford, 2021). The presence of stone tools indicates that *Homo* was present in the area at least from the Late Pleistocene, although no fossils attributable to humans have been found.

## METHOD OF PREPARATION

The nodule containing the foot bones was bathed in a 4% solution of acetic acid for a few minutes to clean off the thin layer of calcified dust that coated the bones, after which the bones were consolidated with a dilute solution of super-glue dissolved in acetone. The bones were left in their original positions in the block of sediment (Fig. 2).

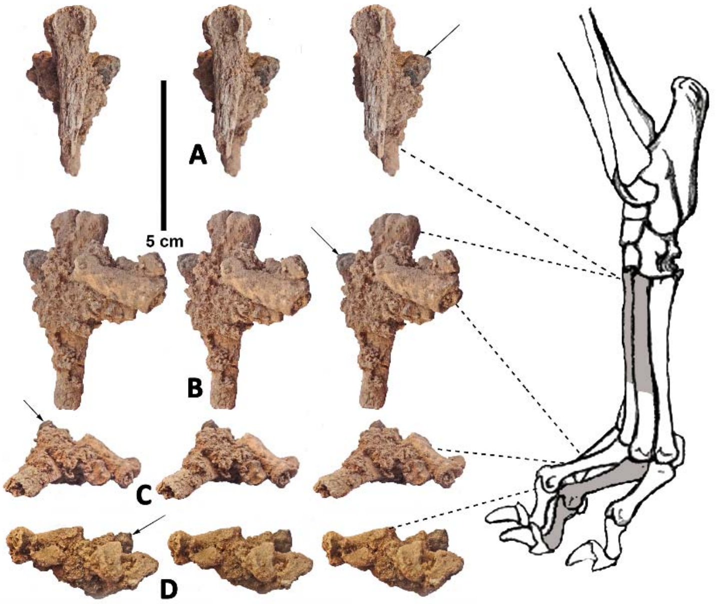


**Figure 1**. MOR II 12'19, partial left hind foot skeleton in a nodule of calcified sediment prior to cleaning. A) stereo medial views, B) stereo dorsal views, C) stereo distal views, D) stereo proximal views. On the right is the hind foot skeleton of a dog showing the positions of the fossils in the foot (dotted lines). Note the basalt pebble (arrows).

## DESCRIPTION

The proximal articular facet of the Mt III has a slightly convex lateral edge and a more convex medial edge. The facet is taller than broad, narrowing towards its plantar extremity. The proximal articular facet of the Mt IV has an almost straight medial edge, and a concave lateral margin. It has a waist in its centre, and its plantar base is narrower than the dorsal edge.

The diaphyses of the Mt III and Mt IV are remarkably straight in their preserved parts. The distal extremities of both metatarsals are missing.

The 1st phalanx is longer than the 2nd one and its proximal facet for the corresponding metatarsal is concave with a broad plantar groove which accepts the plantar keel of the corresponding distal metatarsal. The proximal facet is visible in dorsal view. In the 2nd phalanx the proximal articulation is hidden in dorsal view by the proximo-dorsal process which articulates with the dorsal part of the 1st phalanx when the bone is in a fully extended position.

The distal articular facet of the 1st phalanx has a more deeply concave profile than that of the 2nd phalanx. The tendinal pits either side of the distal articulation of the first phalanx are deeper and greater in diameter than those in the 2nd phalanx. The distal epiphysis curves slightly downwards in the 1st phalanx, whereas that of the 2nd phalanx rises dorsally.

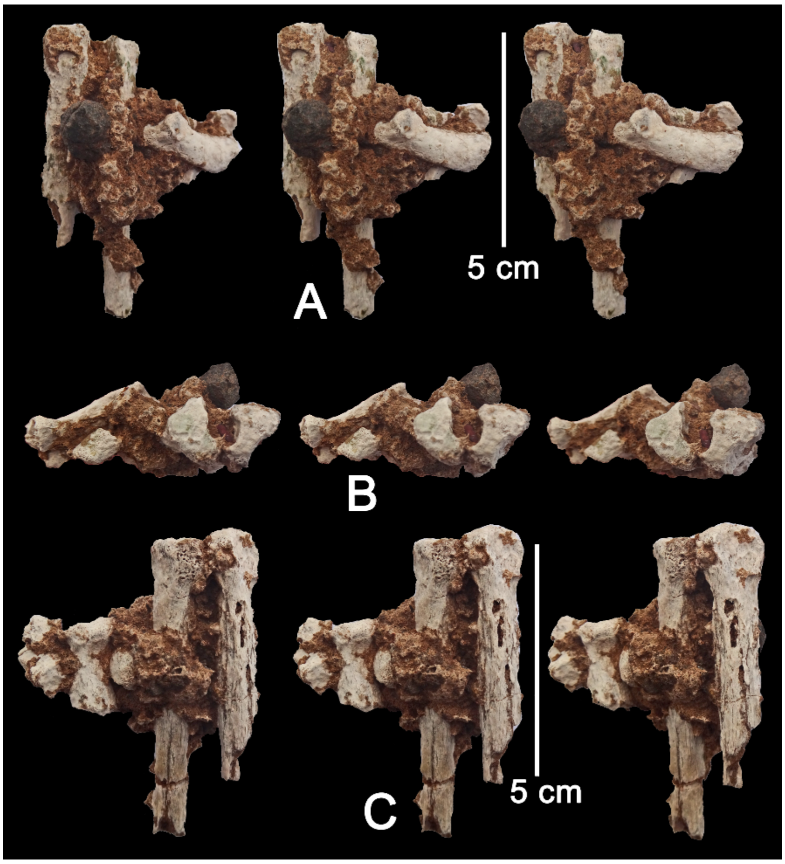


**Figure 2**. MOR II 12'19, partial left foot skeleton after preliminary cleaning in 4% acetic acid to remove calcified dust and inorganic matter from the exposed bones. A) Stereo dorsal views of metatarsals and oblique view of the first phalanx. B) Stereo proximal views of metatarsals and plantar view of the first phalanx (partly obscured by matrix), C) Stereo plantar views of metatarsals and dorsal views of the second phalanx. Note the black basalt pebble visible in A) and B).

## COMPARISONS

The Moroto II foot bones were compared with corresponding skeletal parts of a variety of medium-sized mammals. The closest match is with foot skeletons of Canidae. Detailed comparisons were made with feet of a wolf (*Canis lupus*), a wild hunting dog (*Lycaon pictus*) and a large domestic dog (*Canis lupus familiaris*).

The two metapodials correspond to metatarsals III and IV of the left side. It is not possible to be precise about the side or rays to which the first and second phalanges belong, but the fact that they were fossilised close to the left metatarsals suggests that they are likely to be from the left foot. Their robusticity also suggests that the two phalanges are from the main weight-bearing part of the foot skeleton (rays III and IV) and are unlikely to be displaced manual phalanges which are more slender in build than pedal phalanges.

**Table 1.** Metric comparison (in mm) of the canid foot bones from Moroto II with specimens of extant *Canis lupus* and *Lycaon pictus* (MNHN - Muséum National d'Histoire Naturelle, Paris).

| **Measurement** | **MNHN CG 2018-2666** ***Canis lupus*** | **MNHN CG 1998-147** ***Lycaon pictus*** | **MOR II 12'19** ***Canis* sp.** |
|---|---|---|---|
| Mt III height of proximal articular facet | 21.0 | 15.0 | 12.1 |
| Mt III breadth of proximal articular facet | 13.7 | 10.0 | 8.2 |
| Mt IV height of proximal articular facet | 18.6 | 14.3 | 12.1 |
| Mt IV breadth of proximal articular facet | 9.9 | 7.4 | 9.5 |
| 1st phalanx length | 36.7 | 31.3 | 29.0 |
| 2nd phalanx length | 21.0 | 20.0 | 19.4 |

Metric comparisons of the elements in the Moroto II foot skeleton (Table 1) with those of other canids indicate that it was appreciably smaller than a wolf (*Canis lupus*) and slightly smaller than a wild hunting dog (*Lycaon pictus*). The length-to-breadth proportions of the 1st and 2nd phalanges from Moroto II are closer to those of the wolf than to those of the wild hunting dog, which possesses relatively longer, more slender phalanges than the wolf. The Moroto II foot thus has a greater resemblance to feet of true dogs than to those of wild hunting dogs. The Moroto specimen is accordingly attributed to the genus *Canis*, but due to the limited amount of information that it yields, it is left in open nomenclature at the species level. It might represent a large domestic dog but there is no direct evidence of this possibility.

## DISCUSSION

The Moroto II foot skeleton is evidently that of a digitigrade mammal. The length of the metatarsals cannot be measured, but the straightness of the diaphyses and the preserved length indicate that the foot belongs to a cursorial mammal. The phalanges also give the impression of a digitigrade cursorial mammal, with the main weight-bearing skeletal parts being the rays III and IV of the foot. The proximal articulation of the 1st phalanx is oriented such that the corresponding metatarsal transmits the body weight at an angle of ca 45° onto the 1st phalanx, while the 2nd phalanx is gently convex on its plantar side such as to spread the weight over a relatively large area. The slightly dorsal orientation of the distal articular facet of the 2nd phalanx indicates that the base of the 3rd phalanx was oriented anteriorly and slightly upwards, as in extant dogs, such that the claws would seldom have been in contact with the ground.

## CONCLUSIONS

Comparisons with the skeletons of a diversity of mammals reveals that the Moroto II foot represents a canid that was appreciably smaller than a wolf (*Canis lupus*) and marginally smaller than a wild hunting dog (*Lycaon pictus*).

The morphology of the metatarals and the phalanges indicates that the Moroto II foot likely represents a large dog (*Canis* sp.) but the specimen is not complete enough to identify at the species level, nor is it possible to determine whether it was a domestic dog or not.

It is noted that there is a wide scatter of Late Stone Age tools at Moroto II, as well as grind stones and pestels of Neolithic to sub-recent aspect. Neither the foot skeleton nor the stone tools were *in situ*, so it is not possible to demonstrate whether the stone tools and bones were contemporaneous or not.

The Moroto II dog foot yields the earliest known evidence of the presence of true dogs in Uganda.


## ACKNOWLEDGEMENTS

Thanks to the Commissioner of the Uganda Museum (Mrs R. Mwanja) and the Curator of Palaeontology (Ms S. Musalizi) for providing access to the fossils in their care. Research permits were issued by the Uganda National Council for Science and Technology. The help of the staff of the Uganda Museum (C. Ssebunyungo) and of villagers from Rupa, Karamoja, is gratefully acknowledged, as is the collaboration of the French members of the Uganda Palaeontology Expedition (B. Senut, D. Gommery, L. Ségalen, J. Schnyder).


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**Published by the Uganda Museum**
**Kira Road,**
**P.O. Box 5718,**
**Kampala,**
**Uganda**