KIRTLANDIA
The Cleveland Museum of Natural History

December 2007 *Number 56:173–176*

PRELIMINARY ASSESSMENT OF THE LATE MIOCENE AVIFAUNA FROM LEMUDONG'O, KENYA

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ABSTRACT

The small collection of avian skeletal remains, including those of an eagle, an owl, and possibly a pheasant, from Lemudong'o provides additional information about terrestrial late Miocene avifaunas in east Africa. Large phasianids are known elsewhere in the Miocene of Africa, but pheasants are naturally absent today from the continent. The presence of two predatory bird species at the locality also is important because they may have acted as bone accumulators for part of the mammalian fauna occurring at the fossil site.

Introduction

Although Miocene avifaunas and fossil specimens are known from across Africa, relatively few of these collections have been described in detail. These faunas include the predominantly aquatic avifauna of the Beglia Formation (Rich, 1972) and Lothagam (Harris and Leakey, 2003), and terrestrial faunas from Morocco (Brunet, 1971) and Arrisdrift, Namibia (Mourer-Chauviré, 2003), in addition to other material (Rich, 1974). Current research in Chad, Libya, and Ethiopia has produced a diversity of avian taxa (Louchart et al., personal communication, 2006). The Lemudong'o avifauna, as with the mammalian fauna, of the African late Miocene has faunal components (apparently including some extant species) present in Africa today, as well as species and clades that no longer occur naturally in Africa. Miocene African bird clades that are now extinct in Africa include large-bodied ostriches that laid aepyornithoid and *Diamantornis* eggs (Senut et al., 1998; Stidham, 2004; Harrison and Msuya, 2005), swans (Louchart, Vignaud, et al., "New swan," 2005), and Idiornithidae (Mourer-Chauviré, 2003). Miocene faunas from Namibia and Morocco appear to include galliforms not present in Africa today (but known in Eurasia), including several phasianids possibly referable to *Phasianus*, *Gallus*, and *Palaeortyx* (Mourer-Chauviré, 2003). With this sparse Miocene record and faunal change, Lemudong'o adds to the puzzle of the history and biogeography of the African avifauna, even though it comprises relatively few bird bones.

Lemudong'o is a set of fossil localities in the Southern Rift Valley in Kenya that are somewhat older than 6 Ma (Ambrose et al., 2003, p. 739; Deino and Ambrose, 2007). That radiometric age determination appears to place Lemudong'o and its avifauna within the *Struthio karingarabensis* ostrich-eggshell biozone (Senut et al., 1998; Stidham, 2004; Harrison and Msuya, 2005). Fossils from Locality 1, where most vertebrate fossils have been collected, were deposited under mostly fluvial and lacustrine settings (Ambrose et al., 2003, p. 739; Ambrose, Nyami, et al., 2007). The Lemudong'o fauna includes a diverse assemblage of mammals and reptiles (Ambrose et al., 2003; Ambrose, Bell, et al., 2007). However, the bird skeletal remains include mostly pedal phalanges and long-bone shaft fragments. Only four bone fragments are identifiable to a taxonomic group within Aves at this time. These specimens appear to be fragments of a species of pheasant, an owl, and an eagle. All measurements were made from casts.

Abbreviations

FMNH = Field Museum of Natural History, Chicago, Illinois; MVZ = Museum of Vertebrate Zoology, University of California, Berkeley, California; KNM-NK = Kenya National Museum (Narok District), Nairobi, Kenya.

Systematic Paleontology

Order GALLIFORMES (Temminck, 1820)
Family PHASIANIDAE Vigors, 1825
Genus cf. *PHASIANUS* Linnaeus, 1758

Referred material

KNM-NK 36940 and KNM-NK 41255, proximal right-scapula fragments.

Description

KNM-NK 36940 is the anterior end of a right scapula that has a maximum dorsoventral width through the glenoid of 11.2 mm. The glenoid and acromion are preserved, but the scapular shaft is broken obliquely from the posterior end of the glenoid extending dorsoposteriorly. KNM-NK 41255 is the anterior approximately one-third of a right scapula with a maximum dorsoventral width through the glenoid of 11.1 mm. The tip of the acromion is

missing. The shaft is broken just posterior to the anteroposteriorly elongate tubercle on the ventral side of the scapular blade. KNM-NK 41255 is slightly smaller than KNM-NK 36940.

Remarks

The two specimens are from two individuals and the slight difference in size between them is probably within the range of sexual size dimorphism present in galliforms. There is no evidence to support these two specimens as representing two species. Based on their size and ordinal identification, these scapulae were originally identified as members of Numidinae (Hlusko et al., 2002, p. 66A). However, careful comparisons with extant skeletal material have changed that identification. Both of the fossil scapulae are larger than comparative elements in *Acryllium vulturinum* (MVZ 155192), *Numida meleagris* (MVZ 124694), and *Guttera plumifera* (FMNH 313049). The fossils also have a ventral tip of the glenoid that is much more pointed than in the Numidinae. The lateral groove separating the acromion from the glenoid (an extension of the triosseal canal) is wider in the fossils than in the Numidinae. The fossils lack the lip on the dorsal edge of the glenoid present in extant guineafowl. The elongate tuber on the ventral surface of the scapular blade is relatively closer to the posterior edge of the glenoid in KNM-NK 41255 than in *Guttera plumifera* and *Numida meleagris*. The tuber is a similar size and in a similar position in the fossil and *Acryllium vulturinum*. Comparisons with *Phasianus* indicate very similar morphology between the fossil specimens and extant pheasant species. For example, *Phasianus colchicus* (MVZ 84651) has the same pointed ventral aspect of the glenoid, the wide groove between the glenoid and acromion, and an acromion that is widest (projecting laterally) dorsally and narrows ventrally in anterior view that are present in the fossils. The fossils lack the pneumatic foramen present in *Pavo*. At present, the morphology appears to support placement within the Phasianidae and possibly within *Phasianus* rather than with Numidinae or other extant African galliform clades (''*Francolinus*''). The identification of fossil pheasants in Kenya may not be unique in Africa (see below).

Order Falconiformes Sharpe, 1874
Family Accipitridae Vieillot, 1816

Referred material

KNM-NK 41004, a proximal right carpometacarpus.

Description

KNM-NK 41004 is broken just distal to the point where the major and minor metacarpals separate distally. The proximal face of the extensor process is damaged. The flexor process is broken. The maximum proximal-distal length of the trochlea is 14.9 mm and the dorsoventral depth through the proximal end of the trochlea is 9.2 mm.

Remarks

Overall the fossil's morphology is generally similar to *Pandion* and other falconiforms except that it is larger and differs in details of the morphology. Comparisons with *Pandion*, *Sagittarius*, *Accipiter*, *Buteo*, *Aquila*, and *Circus* appear to reject allocation to those genera. The distal end of the carpal trochlea with large ridges at the distal end is similar to *Haliaeetus*. The specimen is also similar in size to *Haliaeetus* and *Aquila*. With these comparisons, it appears that the fossil should be allocated to the Accipitridae (not Pandionidae or Sagittariidae), and is probably from a large eagle (i.e., not a hawk) and possibly from a fish eagle. Refinement of the identification of this specimen will require further work.

Order Strigiformes Wagler, 1830
Family cf. Strigidae Vigors, 1825

Referred material

KNM-NK 41489, a distal right ulna.

Description

KNM-NK 41489 is broken a little proximal to the end of the intercondylar sulcus. The carpal tuber is damaged just above its base. A small chip is missing from the distal edge of the intercondylar sulcus. The distal width (with carpal tuber broken) is 5.8 mm, and the depth through the dorsal rim of the intercondylar sulcus is 7.5 mm.

Remarks

KNM-NK 41489 was compared to nearly every order of neognathous bird. Several characters present in the fossil appear to allocate it with owls: the presence of a lateral trochlear ridge that extends much further proximal relative to the medial ridge (almost two times greater in length than the medial ridge); the proximal end of the lateral trochlear ridge is displaced medially and is nearly centered (mediolaterally) on the ventral face of the ulna; the lateral ridge of the trochlea is larger (extending further ventrally) than the medial ridge, but the medial ridge extends further distally and is the distal tip of the ulna; and in distal view, the dorsal margin of the ulna forms a rounded point laterally, and medially this dorsal margin is concave adjacent to where the carpal tuber was. The combination of those characters is consistent with the identification of the fossil as an owl. An area, proximal to the base of the carpal tuber (anterior surface), that is slightly concave and that is bounded dorsally by a slight ridge separating the concave area from an adjacent relatively flat area on the dorsal surface, appears to be present among owls only in the Family Strigidae. It is absent in *Tyto alba* and *Phodilus*. The fossil is approximately the size of *Asio flammeus*, *Strix fulvescens*, and *Strix woodfordi* (Ambrose et al., 2003, p. 741), is smaller than *Bubo africanus*, and is much larger than *Glaucidium* and *Aegolius*.

Aves indeterminate

Referred material

KNM-NK 40898A, an ungual phalanx; KNM-NK 40898B, a humeral shaft fragment; KNM-NK 41244, the proximal end of a radius; KNM-NK 41476A, the proximal end of an ungual phalanx; KNM-NK 41476B, an ungual phalanx; and KNM-NK 44801, a pedal phalanx missing the distal end.

Description

KNM-NK 40898A is 11.6 mm long. The proximal diameter of KNM-NK 41244 is 3.8 mm. KNM-NK 41476B is 8.7 mm long. KNM-NK 44801 has a maximum preserved length of 23.2 mm, a proximal width of 8.2 mm, and a proximal depth of 8.9 mm.

Remarks

These bones and fragments lack distinctive morphology for them to be identified at this time beyond Aves. The one possible

exception to this is KNM-NK 44801. With further comparison it might be identified as a falconiform and possibly accipitrid. It has distinctive, flattened, medial and lateral surfaces that are absent in owls, falcons, *Buteo*, and *Aquila*. The other specimens are all from taxa smaller than the pheasant, eagle, and owl described above and indicate additional taxa of birds at Lemudong'o. The small size of these elements could indicate their allocation to Passeriformes, Piciformes, or Coraciiformes, but the ungual phalanges lack any distinctive morphology to identify them to a lower taxonomic level at this time.

Discussion

Lemudong'o preserves one of the few late Miocene avifaunas of Africa. The Lemudong'o avifauna is roughly equivalent in age to that of the Upper Member of the Nawata Formation (McDougall and Feibel, 2003) and its taxa *Struthio* cf. *karingarabensis*, *Pelecanus*, *Anhinga* cf. *rufa*, *Leptoptilos* cf. *crumeniferus*, a heron, a duck, a rail, and a bustard (Harris and Leakey, 2003; Harrison and Msuya, 2005). Lemudong'o is intermediate in age between the Miocene avifaunas from Chad and Ethiopia (Louchart et al., personal communication, 2006). The dominance of terrestrial (rather than aquatic) bird taxa at Lemudong'o is similar to Arrisdrift, Namibia (Mourer-Chauviré, 2003) and Beni Mellal, Morocco (Brunet, 1971). In general, these terrestrial avifaunas have specimens similar to Eurasian taxa. Other Miocene African (aquatic) avifaunas can appear to be very similar (at the generic level) to those present in Africa today, but also exhibit Eurasian links (Louchart et al., personal communication, 2006). These avifaunas with genera present in Africa today include: Rusinga Island, Kenya with a flamingo (*Phoenicopterus aethiopicus*) (Harrison and Walker, 1976), a stork (*Ciconia minor*), a goshawk (*Accipiter* cf. *tachiro*), and a francolin (Harrison, 1980); Beglia Formation, Tunisia with an ostrich, a cormorant (*Phalacrocorax* cf. *littoralis*), an anhinga (*Anhinga* cf. *pannonica*), a whalehead stork, and a marabou stork (*Leptoptilos richae*) (Rich, 1972; Louchart, Vignaud, et al., "Extinct stork," 2005); Toros Menalla area, Chad with anhingas (*Anhinga* cf. *melanogaster* and *Anhinga* cf. *pannonica*), a heron (*Ardea* sp.), a stork (*Ephippiorhynchus* sp.) and a finfoot (*Helopais* cf. *personata*) (Louchart et al., personal communication, 2006); Adu Asa Formation, Ethiopia with a grebe (*Podiceps* sp.), cormorants (*Phalacrocorax* cf. *carbo* and *Phalacrocorax* sp.), anhinga (*Anhinga* cf. *melanogaster*), a heron (*Ardea* sp.), and spur-winged goose (*Plectropterus* sp.) (Louchart et al., personal communication, 2006); and Maboko Island with a stork (*Ciconia* sp.) and a bustard (cf. *Chlamydotis undulatus*) (Harrison, 1980). These aquatic-dominated avifaunas contain members of families, genera, and in some cases specimens identical to species present in Africa today. However, swans (Louchart, Vignaud, et al., "New swan," 2005) and the finfoot *Helopais* cf. *personata* (Louchart, Mourer-Chauviré, et al., 2005) are extinct in Africa today. This parallels the avifaunas that have a larger proportion of terrestrial birds that also contain species in clades that presently do not occur in Africa. These include the occurrence of *Gallus* at Beni Mellal (Brunet, 1971) and possibly Arrisdrift, and the records of other phasianids similar to *Palaeortyx* and *Phasianus* at Arrisdrift (Mourer-Chauviré, 2003). The terrestrial birds of the African Miocene, in particular the galliforms, differ significantly from those found in present day Africa, as demonstrated by the presence of taxa similar to Miocene African specimens in Eurasia (*Phasianus*, *Gallus*, and *Palaeortyx*). In addition, the fossils of *Pavo* in the early Pliocene of Africa (Louchart, 2003; Pickford et al., 2004) add to the distinctiveness of the late Neogene African avifauna and indicate significant changes in avifaunal make-up since the end of the Miocene in Africa. In an unpublished manuscript, Louchart et al. (personal communication, 2006) discuss the biogeographic links among the birds of North and East Africa with Europe and the Oriental Region of Asia. The Lemudong'o phasianids at present appear to support this biogeographic affiliation. The links between Africa and Eurasia are present in aquatic and terrestrial avian taxa distributed across the Pelecaniformes, Galliformes, Ciconiiformes, and Gruiformes. The potential presence of Eurasian taxa in avifaunas in Morocco, East Africa, and Namibia appear to indicate that avifaunal changes potentially would have been pan-African, and not just regional extinctions or emigrations.

The current absence of aquatic bird taxa at Lemudong'o in spite of its largely fluvial and lacustrine nature is unusual. As noted above, terrestrial Miocene avifaunas are uncommon in Africa. However, the avian sample size is small from Lemudong'o and further fieldwork may yet produce aquatic birds. Even with that potential bias, the presence of an eagle and an owl at Lemudong'o may indicate proximity of the fossil sites to a nest or roost, and it is potentially important for the interpretation of the mammalian faunal assemblage. Both birds were predators and both would have included mammals in their diet. With the large number of small mammals in the fossil deposit, a taphonomic contribution provided by the diurnal and nocturnal carnivorous component of the Lemudong'o avifauna cannot be ruled out. Bone breakage patterns and skeletal element compositions should be examined to determine if they are consistent with modern predatory bird bone accumulations.

Acknowledgments

I would like to express my gratitude to the Office of the President, Kenya, for the authorization to conduct research on Kenyan fossils, the Masai people of the Narok District, and the Divisions of Palaeontology and Casting staff at the National Museums of Kenya. Funding was provided in part by the L.S.B. Leakey Foundation, the University of Illinois Center for African Studies and Research Board, the National Science Foundation grant SBR-BCS-0327208, and the National Science Foundation HOMINID grant Revealing Hominid Origins Initiative BCS-0321893. I wish to thank L. Hlusko for the invitation to work on this avifauna and participate in this volume, for providing casts of the material, and her patience. Portions of this research were completed while I was funded by a postdoctoral fellowship in the Human Evolution Research Center (formerly the Laboratory for Human Evolutionary Studies), University of California, Berkeley. A. Louchart and C. Mourer-Chauviré provided valuable comments on an earlier draft of the manuscript. I also thank A. Louchart, Y. Haile-Selassie, P. Vignaud, A. Likius, and M. Brunet for access to their unpublished manuscript on fossil birds from the late Miocene of Chad and Ethiopia (quoted herein as a personal communication).

References

Ambrose, S. H., L. J. Hlusko, D. Kyule, A. Deino, and M. Williams. 2003. Lemudong'o: a new 6 ma paleontological site near Narok, Kenya Rift Valley. Journal of Human Evolution, 737–742.

Ambrose, S. H., C. J. Bell, R. L. Bernor, J.-R. Boisserie, C. M. Darwent, D. Degusta, A. Deino, N. García, Y. Haile-Selassie, J. J. Head, F. C. Howell, M. D. Kyule, F. K. Manthi, E. M.

Mathu, C. M. Nyamai, H. Saegusa, T. A. Stidham, M. A. J. Williams, and L. J. Hlusko. 2007. The paleoecology and paleogeographic context of Lemudong'o Locality 1, a late Miocene terrestrial fossil site in southern Kenya. Kirtlandia, 56:38–52.

Ambrose, S. H., C. M. Nyamai, E. M. Mathu, and M. A. J. Williams. 2007. Geology, geochemistry, and stratigraphy of the Lemudong'o Formation, Kenya Rift Valley. Kirtlandia, 56:53–64.

Brunet, J. 1971. Oiseaux miocènes de Beni Mellal (Maroc); un complément a leur étude. Notes Mémoires Service Géologique Maroc, 31:109–111.

Deino, A. L., and S. H. Ambrose. 2007. $^{40}Ar/^{39}Ar$ dating of the Lemudong'o late Miocene fossil assemblages, southern Kenya Rift. Kirtlandia, 56:65–71.

Harris, J. M., and M. G. Leakey. 2003. Lothagam birds, p. 161–166. *In* M. G. Leakey and J. M. Harris (eds.), Lothagam: The Dawn of Humanity in Eastern Africa. Columbia University Press, New York.

Harrison, C. J. O. 1980. Fossil birds from Afrotropical Africa in the collection of the British Museum (Natural History). Ostrich, 51:92–98.

Harrison, C. J. O., and C. A. Walker. 1976. Cranial material of Oligocene and Miocene flamingos: with a description of a new species from Africa. Bulletin of the British Museum of Natural History (Geology), 27:305–314.

Harrison, T., and C. P. Msuya. 2005. Fossil struthionid eggshells from Laetoli, Tanzania: taxonomic and biostratigraphic significance. Journal of African Earth Sciences, 41: 303–315.

Hlusko, L. J., S. H. Ambrose, R. Bernor, A. Deino, and T. Stidham. 2002. Lemudong'o, a late Miocene mammalian-dominated locality in southern Kenya. Journal of Vertebrate Paleontology, 22(supplement to 3):65A–66A.

Linnaeus, C. von. 1758. Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis. Tenth edition. Laurentii Salvii, Holmiae, Stockholm. 824 p.

Louchart, A. 2003. A true peafowl in Africa. South African Journal of Science, 99:368–371.

Louchart, A., C. Mourer-Chauviré, P. Vignaud, H. T. MacKaye, and M. Brunet. 2005. A finfoot from the late Miocene of Toros Menalla (Chad, Africa): palaeobiogeographical and palaeoecological implications. Palaeogeography, Palaeoclimatology, Palaeoecology, 222:1–9.

Louchart, A., P. Vignaud, A. Likius, M. Brunet, and T. D. White. 2005. A large extinct marabou stork in African Pliocene hominid sites, and a review of the fossil species of *Leptoptilos*. Acta Palaeontologica Polonica, 50:549–563.

Louchart, A., P. Vignaud, A. Likius, H. T. MacKaye, and M. Brunet. 2005. A new swan (Aves: Anatidae) in Africa, from the latest Miocene of Chad and Libya. Journal of Vertebrate Paleontology, 25:384–392.

McDougall, I., and C. S. Feibel. 2003. Numeric age control for the Miocene-Pliocene succession at Lothagam, a hominoid-bearing sequence in the northern Kenyan rift, p. 43–64. *In* M. G. Leakey and J. M. Harris (eds.), Lothagam: The Dawn of Humanity in Eastern Africa. Columbia University Press, New York.

Mourer-Chauviré, C. 2003. Birds (Aves) from the middle Miocene of Arrisdrift (Namibia): preliminary study with description of two new genera: *Amanuensis* (Accipitriformes, Sagittariidae) and *Namibiavis* (Gruiformes, Idiornithidae). Memoirs of the Geological Survey of Namibia, 19:103–111.

Pickford, M., B. Senut, and C. Mourer-Chauviré. 2004. Early Pliocene Tragulidae and peafowls in the Rift Valley, Kenya: evidence for rainforest in East Africa. Comptes Rendus Paleovol, 3:179–189.

Rich, P. V. 1972. A fossil avifauna from the upper Miocene Belgia Formation of Tunisia. Notes du Service Géologique, Tunisie, 35:29–66.

Rich, P. V. 1974. Significance of the Tertiary avifaunas from Africa (with emphasis on a mid to late Miocene avifauna from Southern Tunisia). Annals of the Geological Survey of Egypt, 4:167–210.

Senut, B., Y. Dauphin, and M. Pickford. 1998. New avian remains from the Neogene of the Sperrgebeit (Namibia): refinement of the avian biostratigraphy of Namib Desert aeolianites. Comptes Rendus Académie des Sciences Paris, Sciences de la terre et des Planètes, 327:639–644.

Stidham, T. A. 2004. Extinct ostrich eggshell (Aves: Struthionidae) from the Pliocene Chiwondo Beds, Malawi: implications for the potential biostratigraphic correlation of African Neogene deposits. Journal of Human Evolution, 46:489–496.

Temminck, C. J. 1820. Manuel d'ornithologie: un tableau systematique des oiseaux qui setrouvent en Europe, Second edition, Volume 1. G. Dutour, Paris. 46 p.