

A study of fossil birds from Langebaanweg: Paleoenvironmental and biogeographical indications

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Introduction

The early Pliocene locality of Langebaanweg (ca 5 Ma) constitutes a unique window into the paleoenvironments in southern Africa at a critical period. Global climatic cooling and an increase in seasonality affected environments worldwide. El Niño – La Niña alternances were about to begin (Fedorov et al., 2006), subtropical deserts expanded (Schuster et al., 2006), and some of the earliest human ancestors continued to appear in northern central and eastern Africa (White et al., 1994; Haile-Selassie, 2001; Senut et al., 2001; Brunet et al., 2002). Open environments, in particular C4 grasses, also expanded in Africa and worldwide (Cerling et al., 1997).

State of the art

Studies of some of the abundant fossil birds from this locality have already yielded precious information in terms of their biogeographical history and environmental evolution. For instance, Olson (1983), in his study of marine birds, revealed that the conditions in the southwestern Cape Province in the early Pliocene were much more sub-Antarctic than at present, with a strong Benguela upwelling system.

The marine birds were exceptionally diverse as compared with today, and were comprised of at least four species of penguins (as compared to one today). The pelagic birds are represented by an albatross, a storm petrel, three prions, and a diving petrel, and some of these species bred in the area. In addition, there were other marine birds such as a booby and two marine cormorants.

In terms of the terrestrial birds from the site, many of the fossils and taxa remain unstudied after some preliminary work done initially by P. V. Rich (1980). Langebaanweg is probably the richest fossil bird site in the world older than 2 million years. Of the more than 10,000 specimens which have been preliminarily studied, around 80 species are represented, from a wide spectrum of families and orders, and ranging from tiny passerines to an ostrich slightly larger than the modern species. Because fossil birds are scarce in the Cenozoic of Africa in general, Langebaanweg provides unique insights into the history of many groups. For some of the groups Langebaanweg represents their only appearance in the fossil record older than the Pleistocene. Such birds include the secretive buttonquails (Turnicidae), small birds with habits reminiscent of quails, but which are unrelated; hamerkops (Scopidae), small heron-like birds, limited to sub-saharan Africa, which use their own shadows to help them fish; or painted snipes (Rostratulidae), beautiful colourful waders of the Old World tropics (Olson, 1984, 1994; Olson and Eller, 1989). The most abundant birds in the site are gamefowl (francolins).

Many of the species of Langebaanweg, when studied in detail, appear to represent lineages that are extinct. For instance, the three or four penguin species, a storm petrel, prion, diving petrel, grebe, bald-ibis (Olson, 1985), hamerkop, stork (Haarhoff, 1988), painted snipe, a kingfisher (Olson, 1994), and a mousebird (Rich and Haarhoff, 1985). Others are now absent from southern Africa, but lived there 5 million years ago, for example, the albatross, the petrels and prions, the booby (e.g. Olson, 1983), and small lovebirds (Stidham, 2006). Passerines are numerous in Langebaanweg, whereas they have an extremely poor older fossil record in Africa.

Project description

The high number of bird fossils and bird taxa represented allows for the reconstruction of the composition of a large part of the non-passerine avifauna at 5 Ma in this region of southern Africa. Within the framework of the postdoctorate, I propose to complete the study of some families which will yield the most significant output in terms of zoogeographical and palaeoenvironmental information. Similar investigations made by myself on birds from localities of the same period in diverse African regions have yielded numerous original indications (e.g. Louchart 2003; Louchart et al., 2005, 2008).

The object of the study will be the fossils in the Anatidae, Gruidae, Otididae, Pteroclididae, Piciformes (including the Indicatoridae) and the Struthionidae (the latter in collaboration with A. Elzanowski, Anusuya Chinsamy-Turan, and Julie Carrier), as well as some unidentified or misidentified taxa, and also the Falconidae, Burhinidae, Coraciidae and Apodidae.

The Indicatoridae are birds which indicate bee colonies to animals and people, and benefit in return from beeswax being made accessible. The fossils from Langebaanweg constitute the only fossil record for this very particular family worldwide. The other families to be studied are scarce in the fossil record in general. They live today in very specific environments, which makes them very useful indicators of the landscape 5 million years ago. For example, sandgrouse live today in arid to semi-arid, open habitats. Bustards and thick-knees need very open vegetation, with few trees. By contrast, birds like some parrots, mousebirds and honeyguides need woodlands or forests. Other birds need open water (ducks, grebes), or swamps (abundant shorebirds such as plovers or snipes).

The ostrich fossils will considerably aid in understanding the evolution of this group, as well as relationships between the eggshells and skeletal remains found elsewhere in southern Africa.

The study of these bird families is likely to reveal particularly important aspects of the paleoenvironment of the locality. The diversity of birds at Langebaanweg reveals some profound changes have occurred since 5 million years in the southwestern Cape Province, in terms of environment, and ultimately of climate. The project proposed will provide new, vital information for the locality and the region as a whole.

Methods

I will identify the taxa to which the fossils belong using comparative osteology, with the help of the modern collections housed in the Iziko South African Museum, as well as other institutions abroad. Fossil and modern specimens will be measured with a caliper. I will also draw important characters, and photograph some fossils and modern specimens with a digital camera. The data and results will be incorporated in several publications, grouped according to taxa. I plan to complete part of the work in the South African Museum in three sessions of one month, the first being in January-February 2009.

Publications planned

I am planning the following publications to be submitted toward the end of the postdoc, and in the following months:

1-Gruidae, Otididae, Burhinidae and Pteroclididae from Langebaanweg (earliest Pliocene, South Africa): paleoenvironmental implications

2-Large Anatidae from the early Pliocene of Langebaanweg (South Africa): zoogeographical implications

3-The first fossil record of honeyguides (Indicatoridae), and its significance

4-Falconidae, Coraciidae and Apodidae from the early Pliocene of Langebaanweg (South Africa)

5-A publication on fossil ostriches of southern Africa (incl. Langebaanweg), in collaboration with Andrzej Elzanowski (Wroclaw University, Poland)

References

- Brunet, M. et al. (2002) A new hominid from the Upper Miocene of Chad, Central Africa. *Nature* **418**: 145-151.
- Cerling, T. E., J. M. Harris, B. J. MacFadden, M. G. Leakey, J. Quade, V. Eisenmann and J. R. Ehleringer (1997) Global vegetation change through the Miocene/Pliocene boundary. *Nature* **389**: 153-158.
- Fedorov, A. V., P. S. Dekens, M. McCarthy, A. C. Ravelo, P. B. de Menocal, M. Barreiro, R. C. Pacanowski and S. G. Philander (2006) The Pliocene paradox (mechanisms for a permanent El Niño). *Science* **312**:1485–1489.
- Haarhoff, P. J. (1988) A new fossil stork (Aves, Ciconiidae) from the Late Tertiary of Langebaanweg, South Africa. *Annals of the South African Museum* **97**: 297-313.
- Haile-Selassie, Y. (2001) Late Miocene hominids from the Middle Awash, Ethiopia. *Nature* **412**: 178-181.
- 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., Y. Haile-Selassie, P. Vignaud, A. Likius and M. Brunet (2008) Fossil birds from the Late Miocene of Chad and Ethiopia and zoogeographical implications. *Oryctos* **7**: 147-167.
- Olson, S. L. (1983) Fossil seabirds and changing marine environments in the Late Tertiary of South Africa. *South African Journal of Science* **79**: 399-402.
- Olson, S. L. (1984) A hamerkop from the early Pliocene of South Africa (Aves: Scopidae). *Proceedings of the Biological Society of Washington* **97**: 736-740.
- Olson, S. L. (1985) Early Pliocene ibises (Aves, Plataleidae) from South-Western Cape Province, South Africa. *Annals of the South African Museum* **97**: 57-69.
- Olson, S. L. (1994) Early Pliocene grebes, button-quail, and kingfishers from south-western Cape Province, South Africa (Aves: Podicipedidae, Turnicidae, Halcyonidae). *Annals of the South African Museum* **104**: 49-61.
- Olson, S. L. and K. G. Eller (1989) A new species of painted snipe (Charadriiformes: Rostratulidae) from the Early Pliocene at Langebaanweg, Southwestern Cape Province, South Africa. *Ostrich* **60**: 118-121.
- Rich, P. V. (1980) Preliminary report on the fossil avian remains from Late Tertiary sediments at Langebaanweg (Cape Province), South Africa. *South African Journal of Science* **76**: 166-170.
- Rich, P. V. and P. J. Haarhoff (1985) Early Pliocene Coliidae (Aves, Coliiformes) from Langebaanweg, South Africa. *Ostrich* **56**: 20-41.
- Schuster, M., P. Düringer, J. F. Ghienne, P. Vignaud, H. T. Mackaye, A. Likius and M. Brunet (2006) The age of the Sahara Desert. *Science* **311**:821.
- Senut, B., M. Pickford, D. Gommery, P. Mein, K. Cheboi and Y. Coppens (2001) First hominid from the Miocene (Lukeino Formation, Kenya). *Comptes Rendus de l'Académie des Sciences, Sc. Terre Planètes* **332**: 137-144.
- Stidham, T. A. (2006) Parrots (Aves: Psittaciformes) from the Miocene Varswater Formation, West Coast Fossil Park, South Africa. *African Natural History* **2**:198-199.
- White, T. D., G. Suwa, and B. Asfaw (1994) *Australopithecus ramidus*, a new species of early hominid from Aramis, Ethiopia. *Nature* **371**: 306-312.