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South Africa suffers a second loss of the blue antelope (*Hippotragus leucophaeus*) as DNA analysis confirms that the sole specimen held in South African collections is sable (*H. niger*) material

The blue antelope, *Hippotragus leucophaeus* (Pallas, 1766), is the only African large mammal to suffer global extinction in historical times, around 1799/1800.[1] This species, endemic to a single habitat type in the eastern lowlands of South Africa's Cape Floristic Region, went extinct before any formal scientific studies could be made of living animals.[2] As a consequence, our information regarding the blue antelope is limited to frustratingly few anecdotal accounts from early naturalists[3], archaeological/fossil material[4,5] and a handful of museum specimens, mostly scattered in collections around Europe. To date, only one such museum specimen has been recognised as remaining in South Africa.[6] This is indeed a sad reflection of not only the loss of the species for our country, but also the fact that virtually all available specimens were taken out of the country. It is ironic that servicing the demand for specimens for foreign collections[7] may have contributed to the final death knell for the species[2]. Fortunately, modern museum ethics have evolved beyond such a cavalier approach to building collections, with internationally developed and agreed-upon standards of ethical practice now being applied.[8]

The opportunity for scientific study of the blue antelope has now become even more dire, as shown by a recently published genetic analysis of available material.[9] Hempel and colleagues[9] were able to physically sample 10 of the documented 16 blue antelope specimens (these vary from whole skin mounts to skull fragments) held in various museums. They subjected these samples to genetic analysis, which yielded a complete mitochondrial genome for the species, and phylogenetic analysis to confirm the species identity of the specimens. These analyses showed that only four of the ten sampled items could be confirmed as representing the blue antelope. The six remaining specimens tested comprised material from congeners, either sable (*H. niger*) or roan (*H. equinus*) antelope. Thus, there are far fewer blue antelope specimens available for study than we thought. Among the victims of this genetic validation of samples is the sole specimen attributed to this species held in a South African collection. This specimen (SAM ZM 40759), a frontlet with horns (Figure 1) acquired by Iziko Museums (Cape Town) as recently as 1989[6], is now genetically classified as a sable antelope[9].

On a positive side, Hempel and colleagues[9] were able to test predictions[2,10] that the historically recorded blue antelope population was genetically depauperate. The mitochondrial sequences available from the four confirmed specimens do indeed show low genetic diversity, comparable to that of other large mammals that have undergone major population declines, such as the European bison, *Bison bonasus*.[9]

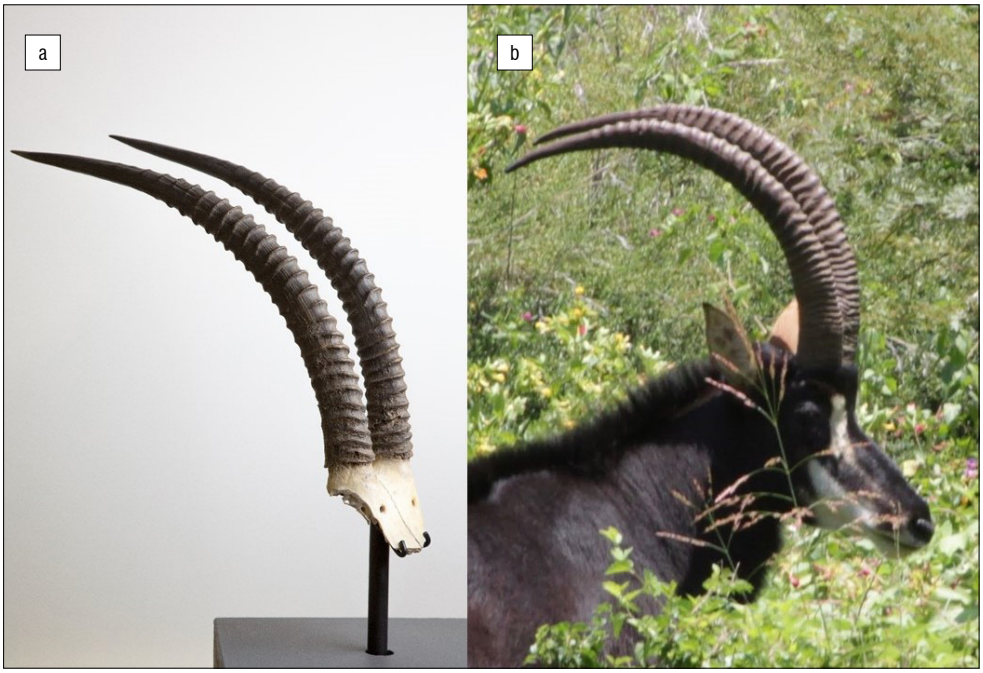

Figure 1: Images of (a) the Iziko Museum specimen (SAM ZM 40759) previously identified as a blue antelope and now shown to be a sable antelope (photo: Iziko Museums of South Africa/Nigel Pamplin) and (b) an adult sable antelope (photo: E. Le Roux), illustrating the annulated and back-swept horns characteristic of the hippotragine antelopes.

While not causally linked to the observed extinction, and based on a small sample, such low genetic diversity may reflect the predicted small population size and lack of metapopulation processes in the historical population[2], and suggests an inability to respond to changing environmental pressures[9]. This analysis highlights the deeper and enduring value of properly curated and accessible museum collections[11]; while we have lost the species, the study of museum specimens allows a (admittedly narrow) window of insight into the biology and ecology of such species. We therefore have a responsibility to protect and better resource our museums in the face of increasing societal neglect of these institutions and their collections.[11]

Of the six specimens that Hempel et al.[9] did not sample, two have already been suggested to be *H. niger* or *H. equinus*[9], leaving only four unvalidated specimens. Given that two of these are recognisable whole mounts, including the lectotype (held by the Rijksmuseum van Natuurlijke Historie, Leiden), there remains two specimens (comprising skeletal material) of untested identity. Whatever the outcome of further testing of these specimens, it appears that the global holding of blue antelope in natural history collections is likely to be no more than eight specimens. Clearly, there is much value in testing all the remaining specimens to confirm their genetic identity, and to add to our understanding of the genetic diversity of the blue antelope at the time its extinction was drawing near.

An interesting side note to Hempel et al.'s[9] study is the degree of confusion and lack of detail in the recorded provenance for the purported blue antelope specimens. Over the years, various authors[6,12], in grappling with the challenge of advancing our understanding of the blue antelope, have highlighted this confusion around the provenance of the available specimens. This situation is possibly best illustrated by the fact that the mounted specimen in the Muséum national d'Histoire naturelle (Paris) has been attributed to three different collectors. Only recently was Glenn[13] able to clear up this confusion and decisively show that this specimen was collected by Levaillant, presumably representing the blue antelope shot 'in early 1782 in the Soetmelks River Valley, between the current Genadendal and Riviersonderend'[13]. Hence, the legacy of the blue antelope is also marked by the poor quality of the records of the few specimens that are available to science.

The paucity of historically collected blue antelope specimens highlights the urgency to assess the validity of the available fossil material[4,5], which is similarly at risk of misidentification. This assessment could apply ancient DNA techniques that would not only assist in the validation of the fossil material, but would also extend our understanding of the genetic diversity of the blue antelope and possible hybridisation with the closely related and sometimes sympatric roan antelope, and explore patterns in genetic diversity over time.

The fact that all of the known blue antelope specimens available for scientific study are held in collections outside South Africa highlights the loss of biodiversity and intellectual property for South Africa during colonial times. As shown by Rookmaaker[7], much of the early interest in zoology in South Africa was driven by collectors motivated by the prospects of selling specimens to wealthy European individuals and institutions. South Africa now has strong legislation to manage the export and possible loss of biodiversity assets (*National Environmental Management Biodiversity Act No. 10 of 2004*). There is a clear need to maintain and enforce the regulations within this legislation, as also recently argued for live specimens of iconic species like rhinos.[14] Unfortunately, as the blue antelope saga shows, this legislation was clearly 250 years too late. This 'loss' of the South African specimen may, however, be an incentive for South Africa to initiate a conversation with the relevant institutions regarding the return of these exported blue antelope specimens.

Competing interests

There are no competing interests to declare.

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