coevolution involves reciprocal genetic change in interacting species. Humans or our ancestors have clearly shaped honeyguide adaptations, but whether honeyguides have in return shaped our own genetic adaptations is intriguing but hard to test. However, honeyguides and humans may be coevolving culturally if, as they cooperate, each species reinforces the cultural traditions of the other.

What is the future of honeyguide–human cooperation? Hotspots of thriving honeyguide–human cooperation still exist, for example in Mozambique's Niassa Special Reserve and Tanzania's Lake Eyasi region. But in much of Africa, humans and honeyguides now only rarely interact, presumably because honeyguides have learnt that people rarely respond. In many places, people are less interested in honey-hunting because they have access to man-made beehives or sugar, or alternatively still wish to hunt for honey but have been excluded from protected areas. Honeyguide–human cooperation is a remarkable form of culturally dependent biodiversity that is likely to dwindle further, unless we can support human participation in this ancient partnership. Doing so takes collaboration with the communities involved, including safeguarding wildernesses in which people are permitted to harvest wild bees' nests.

Where can I find out more?

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Quick guide

Secretary birds

Steven J. Portugal

What's a secretary bird? Secretary birds (*Sagittarius serpentarius*, Figure 1) are birds of prey, characterised by their eagle-like body and long legs. Secretary birds can reach heights of 1.5 metres, with a wingspan up to 2.1 metres, and are found throughout Africa where grasslands and savannah are present, and thick forest absent. Secretary birds are particularly renowned for their hunting strategy of walking through grasslands, targeting snakes, rodents and other small animals, with their prey being killed through direct forceful kicks to the head. From a phylogenetic perspective, secretary birds have proved somewhat problematic and fluid. Once thought to be more closely related to storks and bustards due to their similar morphology, recent molecular analyses suggest that their closest relatives are potentially ospreys (*Pandion haliaeetus*). Based on general behaviour and anatomy, secretary birds have often been considered analogous to the seriemas (Cariamidae) of South America, although molecular analyses oppose this view. Humans have a surprisingly rich and long relationship with secretary birds, including historically being used by farmers to combat pests, and being present on ancient Egyptian artifacts dating back to 3,200 BC.

Why is it called a secretary bird? The etymology of the secretary bird's name is surprisingly contentious, with a number of possible interpretations offered. Arnout Vosmaer described secretary birds in 1769, suggesting that the species was called '*sagittarius*' by Dutch settlers because its gait was thought to resemble an archer. The species was first formally described pictorially in 1779 by John Frederick Miller, based on a specimen from the Cape of Good Hope. Noting the similarities in claws and bills with birds of prey, he placed the species in the *Falco* genus. A few years later, in 1783, French naturalist Johann Hermann purportedly created a separate genus, giving the name *Sagittarius*, Latin for 'archer', similar to the origins of Vosmaer's descriptions. The species name '*serpentarius*', from the Latin '*serpens*', meaning 'serpent' or 'snake', was used to reflect the bird's diet. As for the unusual common name 'secretary bird', a rationale was offered by Georges-Louis Leclerc, who in 1780 wrote that the name 'secretary' (or 'secretaire') was chosen based on the bird's facial features, with the long-quill-like feathers that sit at the top of the bird's neck looking like a quill pen resting behind the ear of an ancient scribe. In 1995, Alan C. Kemp offered an alternative explanation, suggesting that the name is derived from

Figure 1. The secretary bird. (Photograph by Janet Marshall.)

the Arabic ‘saqr at-tair’, meaning ‘falcon of the hunt’ or ‘hunter bird’, which found its way into the French language.

What makes secretary birds different from other raptors? Apart from the obvious physical characteristics that make secretary birds so distinct from other birds of prey, the method by which they dispatch their prey — their penchant for kicking prey to death — is what really separates them from the raptor crowd. In 1990, Major B. Baden-Powell noted “*as one sees him stalking along with stately gait across the veld in South Africa, he reminds one rather of a very large pied pheasant, but with longer legs and an eagle-like head*”, highlighting their largely terrestrial lifestyle. Strutting through vegetation has become synonymous with the secretary bird’s hunting strategy, and their kicking abilities became the stuff of myth and legend. Anecdotes abound describing secretary birds crushing the skulls of cheetah cubs, and breaking the hands of humans. However, until 2016, none of the purported capabilities of the kick strike of secretary birds had actually been measured. I and my colleagues worked with a captive secretary bird, Madeleine, who was trained to kick a rubber snake (Figure 2). Strike force impulse and contact duration were measured using a portable force plate and synchronized high-speed video by placing the rubber snake over the force plate. To our surprise, Madeleine could transfer five times his own weight in 15 milliseconds, considerably less time than it takes to blink your eye. A single kick delivered an impressive 195 newtons of force. It is likely that this rapid delivery of force is required, due to the venomous nature of the snakes they frequently prey on. Any mistakes or a misplacement of the foot during a kick-strike could be deadly.

What threats are secretary birds facing? Sadly, secretary birds have suffered dramatic declines in the last 10 years. The species is highly nomadic, meaning they regularly need to cross human-modified environments to locate new foraging and breeding grounds. Recent surveys have demonstrated that at least 50% of secretary bird sightings in South Africa were recorded in transformed environments, suggesting that, in some areas at least, secretary birds have been able to adapt to changes in their available habitat. However, in other countries, habitat loss, loss of habitat connectivity, urbanisation and encroaching agriculture have resulted in a significant reduction in secretary bird populations, to the extent that, in 2016, secretary birds were listed as vulnerable by the IUCN, before being declared endangered in 2020. Human disturbance has recently been identified as a primary suspect for breeding failures, and broad-scale campaigns in multiple countries within southern Africa are encouraging people to not approach the nests of secretary birds.

Figure 2. The secretary bird kick.
Madeleine the secretary bird (3.96 kg, 69.2 cm hip height), kept at the Hawk Conservancy Trust (Hants), was trained to aggressively strike a rubber snake for public exhibition displays (photo: Jason Shallcross). In the wild, such kicks are used to dispatch prey items, such as snakes, reptiles, amphibians and small birds.

What is left to learn from secretary birds? Despite their charismatic demeanour and familiarity, we know surprisingly little about secretary birds, in particular how and where they move. Satellite tracking studies would greatly assist in the conservation of this species, and allow conservation efforts to be targeted at specific regions of importance. Similarly, while their remarkable kick-strike forces have been measured, we know little about the neurophysiological basis of these impressive feats. For example, the rapid impact time of the foot-to-snake contact precludes the involvement of proprioceptive feedback control, meaning the birds are likely using visual targeting and additional mechanisms within strike events to ensure efficient contact between their foot and prey. Developing our understanding of how they achieve this, coupled with the kick-strike forces they produce, may have possible applications in the fields of robotics, prosthetics and biomimetics.

Where can I find out more?

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