

Feature

Following in the footsteps of giants

Tomos Prys-Jones (2009) is studying for his PhD at Northern Arizona University, researching the effect that large wild animals have on the spread of infectious diseases. Here, he explains what this hands-on research involves, the importance of his findings so far and what the next steps are.

INTERVIEW HANNAH SHARPLES

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For as long as I can remember I have loved the natural world and especially the world's biggest animals. As a dinosaur-obsessed child, I remember pestering my mother to speed through the back roads of North Wales to get home in time for BBC's *Walking with Dinosaurs*. This interest persisted through the following decade and from 2009–12 I was fortunate enough to read Natural Sciences (Zoology) at St John's College. During my second year I co-led a field trip to the Peruvian Amazon, and a friendship made during this trip led me to Arizona in 2017, to begin a PhD in Bioinformatics. My doctoral studies have taken me to southern Africa, the Yucatan Peninsula in Mexico and deep into the Grand Canyon, with further field work planned for October in Yellowstone National Park. ▶





I have been lucky enough to go to all these incredible places in order to better understand how large animals influence our environment.

These species are often referred to as 'megafauna' and offer us an array of ecosystem services including seed and nutrient dispersal. African elephants are the largest remaining land mammals, capable of transporting seeds up to 65km from the parent tree and depositing them in their dung. The same is true for nutrients. Whereas humans tend to concentrate nutrients (such as phosphate) in particular areas (eg in agricultural fertilisers), megafauna have the opposite effect. By feeding in one location and defecating in another, these species tend to homogenise the nutrient landscape. It is true that many smaller species also offer these services, but megafauna are disproportionately important as they eat more and travel further.

To understand how loss of megafauna will impact ecosystems, our group is studying a series of human-induced extinctions that occurred 10,000–50,000 years ago. At present we live in a world that is missing approximately 150 species of megaherbivores and megacarnivores. Many of these species would have survived to this day had it not been for overhunting in prehistory by bands of *Homo sapiens*. Woolly mammoths and giant ground sloths are often perceived as coming from a bygone era. However, remnant populations of these iconic species existed until quite recently. Had the ancient Egyptians travelled more widely, they could have found

mammoths on Wrangel Island (in arctic Russia) c 3,700 years ago and giant sloths on the Caribbean islands c 4,200 years ago.

My work focuses on understanding how the extinction of these large animals has influenced the distribution and prevalence of human diseases that originate from wildlife (otherwise known as zoonoses). These include diseases such as Ebola and Zika virus – both of which have recently caused significant human morbidity and mortality. Our models suggest that the removal of large animals from an ecosystem increases the risk of new zoonotic diseases emerging into human populations, and my studies will test why this is.

In June 2017 I travelled to Southern Africa in a team of four to collect faecal samples from wild megafauna and analyse their nutrient and microbial content. With me were Roo, John, Duncs and Scott: Roo was my friend from Peru and research lead for the group; John was the logistics lead, having guided many tours around Southern Africa in the previous two decades; Duncs acted as a research assistant; and Scott was the photographer. We travelled in a roughly 2,000-mile loop between game reserves from South Africa to Namibia before returning to South Africa via Botswana.

Starting near the coast of the Indian Ocean, we travelled west across the country to the red



PHOTOS TAKEN DURING TOMOS' RESEARCH TRIP IN SOUTHERN AFRICA



sands of the Kalahari and the Tswalu reserve. This area is famous for its pangolin population and we were fortunate to come across these amazing scaled creatures. From South Africa we crossed into Namibia via its southern border and travelled up to the Etosha salt pans via the colossal sand dunes at Sossusvlei. As we moved east along the Caprivi strip, we were increasingly surrounded by lush vegetation and eventually entered the altogether wetter environment of Botswana and the Okavango Delta. Leaving John to guide a tourist group in Botswana, we headed back down through South Africa towards Cape Town.



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There were many special moments on this trip, but one of the most memorable was wild camping in Botswana with hyaenas outside our tent. At this point we had not yet seen hyaenas in daylight and four gleaming eyes reflected in our torch light did not seem like a threat. We felt excitement more than fear at the two individuals circling our tent. I did have a slight pang of anxiety when we heard a rather loud sniff 20cm from Duncan's head and remembered there was a goat-skinned drum in the porch of our tent. Only later, when I saw spotted hyaenas in the flesh and heard tales of their interactions with unfortunate campers, did I feel some delayed-onset relief. It is said that their jaws are capable of crushing bones 6cm in diameter. Further into the trip, I saw a female carrying an impala (small antelope) head in its jaws: quite a memorable sight.

Another unforgettable experience occurred during a run that Roo, Duncan and I did along the edge of the Thanda Game Reserve in South Africa. Being the slowest in the group, I had turned back earlier than the other two so that we could meet back at the car at roughly the same time. Nearing the end of the run, I realised that a herd of 40 elephants, at a watering hole on the other side of the reserve's fence, were watching me struggle up the final hill. After beckoning Roo and Duncs to slow down, I waited with them for the elephants to relax. We then stood and watched the group drinking and playing for about 20 minutes.

Since the African trip I have spent a month working in the Mexican forests on the Yucatan Peninsula, helping another member of my lab with her eco-archaeological project. As a possible

means to help identify ancient archaeological sites, we were comparing the light spectra reflected from leaves collected from trees on ancient Maya pyramids – hidden under dense jungle – with those from leaves taken from surrounding forest. It was good to visit an ecosystem so different from the ones that I had experienced in southern Africa, most notably with regard to the lack of large animals. This is a recent difference, however, as an elephant-like mastodon skeleton standing outside one of the National Parks reminded me.

At the time of writing I am planning a trip to Yellowstone National Park to collect further faecal samples from living megafauna in order to better understand how their movement impacts the transmission dynamics of microbes. Ultimately, I hope to understand how the removal of large wild animals increases the risk of disease outbreaks so that I can improve disease surveillance models. With many species of megafauna increasingly under threat from mankind, it is important to characterise the full suite of services that they provide.

Advice for current Johnians?

Use your undergraduate summers for projects you find interesting, rather than feeling obliged to follow your peers into unappealing internships. What seemed like a stand-alone research trip to the Peruvian Amazon during my second year has led to a PhD place and remarkable opportunities.