AMBOSELI CONSERVATION PROGRAM

ACP Statisticians Take Bayesian Inference Back 1 Million Years at Olorgesailie

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Amboseli Conservation Program (ACP) statisticians this week took Bayesian inference back 1 million years during a field visit to the world-renowned Olorgesailie Prehistoric Site. After about an hour of travel through southern Nairobi and along the partly constructed Magadi Road, our team of ecologists, statisticians and anthropologists arrived at the archaeological site.

The conditions were a sharp contrast to those in Nairobi city. It was hot and dusty, although locals jokingly told us that the area was experiencing “winter”. At other times, temperatures can rise to unbearable levels.

The National Museums of Kenya describes the Olorgesailie Prehistoric Site as a “factory of stone tools”, known for its exceptionally large number of stone tools found there. The site also contains well preserved biological and cultural evidence of human evolution. Heavy falls of alkaline volcanic ash from nearby Mt. Suswa and Mt. Longonot may have contributed to the accumulation of ash in the lake basin, helping to preserve this evidence.

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The ACP team is working on data analysis, modelling and artificial intelligence applications using palaeontological data. The work is being undertaken in collaboration with Dr. Rick Potts, founder and director of the Human Origins Program at the Smithsonian's National Museum of Natural History in Washington, DC.

Dr. Potts' research focuses on Earth's environmental dynamics and the processes that have shaped human evolutionary adaptations.

The collaboration brings together ACP's expertise in ecological statistics, modelling and AI with paleoanthropological research to explore what ancient environmental and fossil records can reveal about human evolution.

Dr. Rick Potts (third from right) guides the visitors through a heap of what are believed to be hand axes used by human ancestors at one of the sites at Olorgesailie.

Rick and his team guided us throughout the tour. Some of his local team members have been involved in excavating and documenting fossils at Olorgesailie for nearly 40 years.

"We are adapted for this. We are always looking at the ground for possible fossils," one of Rick's team members said as we walked along the trails, past the distinctive red soils and ancient sediment layers that preserve evidence of the region's environmental history.

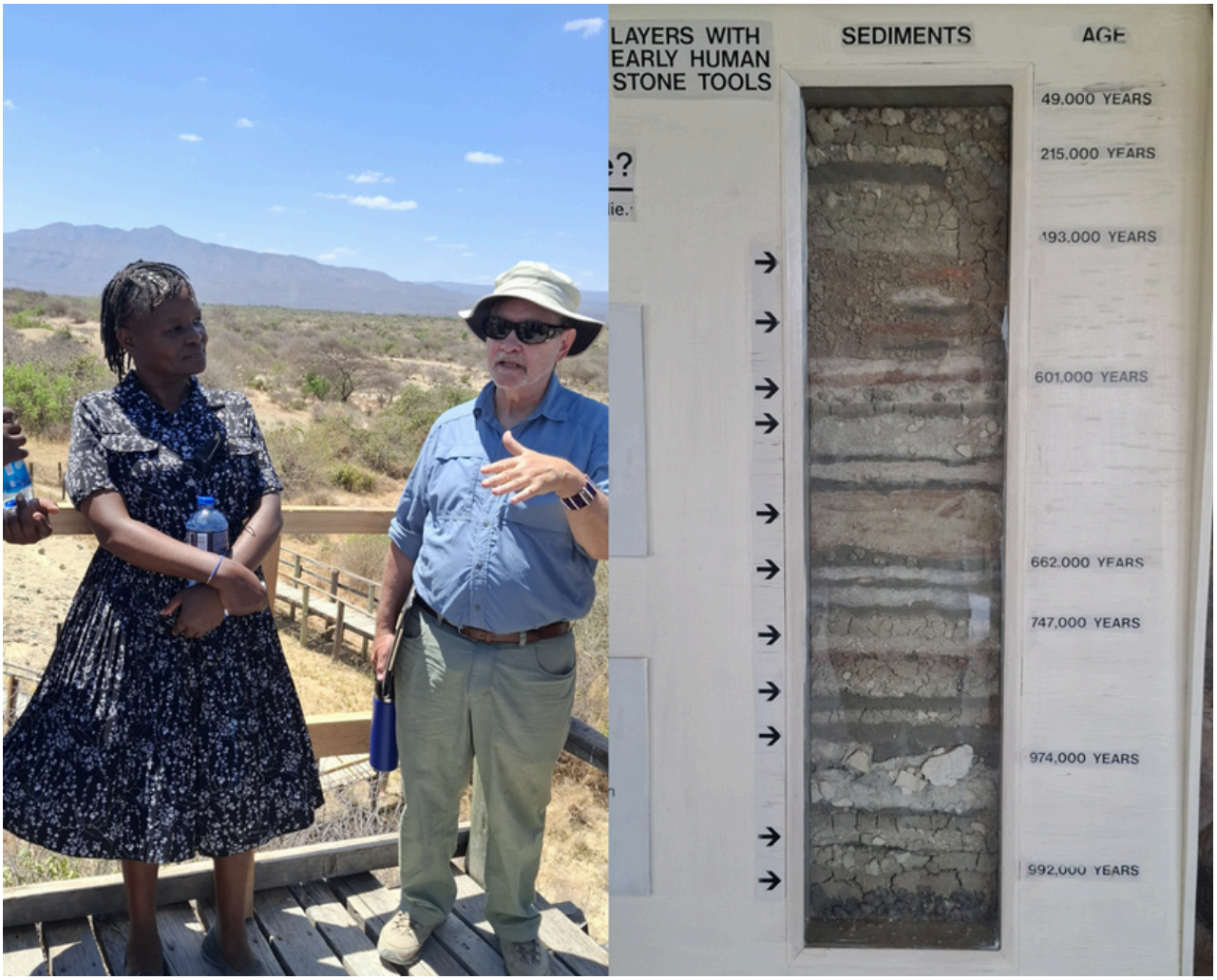
"Watch out, your posture will bend forward from continuously looking down, reversing the evolution gains," one of us quipped.

Back to the Stone Age: Statisticians Mwania and Mose try their hands at stone tools at one of the Olorgesailie sites, believed to date back 1 million years.

A section of the ACP team (from right: Pennina, Mwania and Simon) listens keenly as Dr. Potts explains the site from the observation point. A dust cloud rises in the background, adding to the atmosphere of the ancient landscape.

Over lunch, a discussion led by Dr. David Western turned to how ACP's long-term study of modern fauna could complement the fossil record. This naturally brought the conversation to the concepts of belief and evidence in Bayesian modelling.

Bayesian modelling provides a framework for combining prior knowledge or evidence with new observations to produce updated estimates--the posterior distribution. As new information becomes available, these estimates can be updated, allowing models and our understanding of a system to evolve as the evidence changes.



Left: Winfridah Kemunto, ACP's long-serving Database Manager, follows a discussion on sedimentation and fossil preservation at Olorgesailie, where some records date back 992,000 years. ACP's database contains hierarchical records of modern fauna, derived from aerial and ground counts.

The discussion also explored Bayesian social network analysis of fossil occurrences across archaeological sites in Africa, including the co-occurrence of species and ecological guilds in the fossil record and comparisons with modern fauna databases.

The Bayesian approach accounts for uncertainty in the data. Rather than excluding incomplete observations or repeatedly refitting models, missing values can be incorporated directly into the statistical framework and estimated from other available variables. This could be especially valuable when working with fossil records where attributes such as age may be uncertain or unknown.

Network-based community detection offers another powerful approach, helping researchers move beyond the limitations of conventional computational methods. It allows researchers to analyse relationships and patterns across the broader fossil record, rather than restricting analysis to selected regions or time periods.

Our collaborative interdisciplinary team is working to develop this approach and uncover new insights into our deep human origins.