If these teeth could talk: What was really on the menus of our ancestors?

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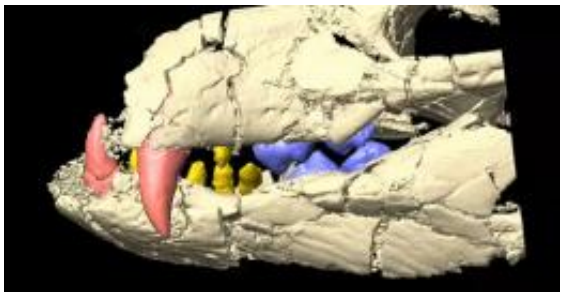

The discovery by an international team of researchers of a relatively lanky, cat-sized animal with mammal-like teeth and a land-based lifestyle supports a growing consensus that crocodiles were once far more diverse than they are today, dominating ecological niches in the Southern Hemisphere during the Cretaceous Period that were filled in the Northern Hemisphere by early mammals. Credit: Patrick M. O'Connor, Ohio University

For human ancestors, eating could be hard work.

"Our ancestors were large creatures. With very low quality foods, without cooked foods, it's very likely that they would have spent a great deal more of their day eating than we do," says Peter Ungar, distinguished professor and chairman of anthropology at the University of Arkansas in Fayetteville.

Ungar's work, understanding ancient diets, is a combination of anthropology, biology, engineering, and dentistry. A tour of his lab reveals tens of thousands of dental casts, representing animals from dinosaurs to modern humans.

"There are gorillas up there; chimpanzees over there. Modern humans, reptiles, antelope, lemurs," he says, while pulling out drawers and boxes filled with casts.

With support from the National Science Foundation (NSF), Ungar is using technology designed to look at the surface textures of the teeth of both ancient and living species.

His work is providing direct evidence of what these animals and early humans actually ate; not just what they were capable of eating.

"Typically, I will work with engineers, surface metrologists, people who study patterns of wear to develop technology for this 3-D imaging of the teeth," explains Ungar.

Ungar and his colleagues have developed new software to look at surface textures using tools from the study of fractal geometry.

Traditionally, anthropologists thought human ancestors ate really tough stuff, like nuts, leaves and stems, because of the size and shape of their jaws and teeth. One example is Paranthropus boisei, known as "Nutcracker Man."

"Paranthropus boisei has these very big, thick molar teeth with thickened enamel--very flat teeth, whereas the modern human has much smaller teeth, and somewhat thinner enamel," says Ungar. "Some of these species have monstrously large teeth, they basically scream 'nutcracker.' These things are basically hammers and anvils for cracking nuts and other hard objects."

But while the body parts show these human ancestors could eat hard objects, the patterns of wear on their teeth show something completely different.

"When we look at the microscopic wear on those teeth, it's actually quite rare that we see the heavy pitting of a hard object eater. More often, they are sort of light, wispy scratches like you would find in a soft fruit feeder," says Ungar.

For a contemporary example of what animals can eat versus what they do eat, Ungar says, just watch

a gorilla.

"Gorillas have tall, sharp, cresty teeth. They are well suited to tough low quality vegetation. But if you go to a zoo, and give a gorilla a choice of fruit or a leaf, every single time, they will take the fruit. It's because they prefer the fruits. Those specialized adaptations are there for the times that those fruits are unavailable. So they will occasionally fall back on leaves. But that won't be their preferred food," says Ungar.

A lot of work takes place before the surfaces of these teeth can be analyzed. "My colleagues and I have traveled around the world, mostly in Ethiopia, Kenya, Tanzania, South Africa and we have used dental impression material, the same material your dentist uses," explains Ungar.

Often the casts are made using museum fossils. But for comparison, they also need to look at the teeth of living animals. That field work can be a challenge. "It takes a year to get an entire cycle of fruiting in a rainforest. I spent more than a year in Sumatra, studying orangutans and gibbons and monkeys, in order to look at how their teeth relate to what they eat. The rainforest is beautiful, but filled with leeches. And 14 hour days get awfully long!"

Technology has really made a difference in Ungar's research. He is now able to see a scratch on a tooth that's about a thousandth of the width of a human hair. And before the white light scanning confocal profiler, (a microscope that creates a 3-dimensional cloud of points of a surface), Ungar was using scanning electron microscopes, with only a two dimensional capability. "When I first started working on this, we took Polaroid pictures, we blew them up to 8 inches by 10 inches and we measured with rulers and protractors," he recalls.

Ungar says that understanding how human ancestors ate can help us understand their diet, their behavior, even their migration. Other scientists have closed in on a development that dramatically changed what and how our ancestors lived and ate: cooking!

"Three-quarters of a million years and after, we get good evidence of cooking," notes Ungar. "Before then, the record is fuzzy."

According to Ungar his research, teaching and outreach goes far beyond determining what was on ancient menus. "What kid doesn't love dinosaurs? What kid doesn't love fossils? A lot of kids love this kind of stuff and it's a hook. It's a hook that exposes them to the scientific method. It's a hook that exposes them to an approach to understanding the world around them," he explains.

"With our students, when we can pull them into the lab, they get exposed to new technologies; new approaches to asking questions and those have all kinds of ramifications. This sort of application of the science to questions that are not necessarily related to fossils or human ancestors, I think has ramifications that go well beyond understanding the evolution of human diet."

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