

Science AMA Series: I'm Siobhán Cooke, paleontologist, professor and adventurer looking for fossil clues to inform how we preserve the future. AMA!

HopkinsMedicineAMA¹and/ScienceAMAs¹

¹Affiliation not available

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Abstract

Hi Reddit, my name is Siobhán Cooke, and I'm an anatomy professor and paleontologist at the Johns Hopkins University School of Medicine. My research (mostly) focuses on two things: 1) The evolution and eventual extinction of the native mammals of the Caribbean region including monkeys, giant sloths, rodents, and tiny (and not so tiny) shrews. Recently, my colleagues and I published a paper demonstrating that humans likely played a role in the extinction of many of these animals just 6000 years ago. (<http://www.annualreviews.org/doi/10.1146/annurev-ecolsys-110316-022754>). 2) Teeth and jaws! Often all paleontologists find in the fossil record are teeth, and so we use a variety of modeling methods to get as much information out of them as possible. Some of this information is even applicable to understanding how our own teeth and jaws function. I also spend much of my time during the late summer and early fall teaching human anatomy to our medical students. Ever wonder what it is like to try to recover fossils from caves? Why do paleontologists care about teeth so much? And what does any of this have to do with teaching a gross anatomy to medical students? I look forward to having you Ask Me Anything on December 11th, 1 PM ET.

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HOPKINSMEDICINE_AMA [R/SCIENCE](#)

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This is my question for you: If you could bring back any extinct animal that you have researched which one would it be and why?

Also thank you for taking the time to do this AMA.

[wilkins1952](#)

Everyone always wants to bring back extinct animals and I understand the impulse, but I'd rather see any money that would go into re-introducing extinct animals to modern conservation efforts. We are facing the 6th mass extinction, and there are lots of animals that are almost walking ghosts. Genetic diversity is declining, habitat is disappearing. All of our efforts should be going into preserving what is still able to be saved. I understand the impulse to want to bring things back, but I am a bit of a realist toward our limited grant resources.

However, it is definitely fun to think about what extinct animals would have been like. If I were to choose, I would like to see the ground sloths as they are so different from anything living today. It would be interesting to know their feeding behaviors and how they might have modified their environments.

A few questions!

- What can modeling tell you about teeth?
- How does this information relate to human teeth?
- Are teeth really that helpful as a fossil or has science done its best to work backward from teeth



because there are so many left over?

[scienceaccount103040](#)

Briefly, modeling how dentition processes food items, we can understand what food that animal may have eaten.

For human dentition, dental modeling has been used to understand different dietary transitions through evolutionary time. Our very early human ancestors, Australopithecus, had relatively large teeth for their body size compared to what we see at a later date in human evolution. The dental morphology as well as isotopic data indicate that they were eating a largely vegetarian diet of fruits and leaves. Larger teeth are more resistant to wear that would have been caused by these food types.

Once the earliest members of our own genus, Homo, evolve we start to see a decrease in overall tooth size. This probably signals a transition to foods that were easier to process (e.g., meat). When Homo sapiens come on the scene, we get lots of extra-oral food processing like cooking which further decreases selective pressure to maintain a large set of chompers.

For your last question the answer is: Yes. They are both helpful and what is there. No paleontologist is going to turn down finding more than just the teeth, but beggars can't be choosers.

What are the dangers of fossil hunting in long forgotten caves?

[adenovato](#)

There are the possibilities of things like rock collapses & cave collapses. Often the air isn't great either. You have to be careful that there is adequate airflow and adequate oxygen before you go in. A lot of caves I work in smell like a musty basement and if it is occupied by living bats - bat poop. You have to be careful in caves with a lot of bats because they can carry all kinds of viruses and bacteria. In caves with bats, we wear masks to protect ourselves.

Most of the caves I work in are sinkholes. It's a big open room that you can repel into. In my work, the majority of the fossils are in the cave mouth, where most of the animals would fall in. I did some training with colleagues on climbing, rappelling and cave safety. Most of the caves we are working in are not dangerous, but you should always take precautions to minimize risks. (Don't go into caves without training and experienced mentors, guides, etc.!)

So about those giant sloths... what were they like? What do we know from their bones?

[sciencereader3455](#)

They ranged in size from about 2kg to probably over 100kg in the caribbean. In the mainland, there was megatherium -the largest sloth ever - who could weigh around 4,000kg - about the weight of a hippopotamus - and stood around 6 meters tall. These ancient sloths would have walked on all fours and some of them could have been hindlimb dominant. These ones would have spent a lot of time reaching up unto trees & could have walked mainly on its hind limbs similar to a modern pangolin. Interestingly, there are preserved trackways of large sloths in South America that researchers have used to reconstruct their locomotion.

Most of them were probably quite shaggy and paleontologists have found bunches of sloth fur in caves in North & South America. They would have had a slow metabolism similar to sloths today, but the giant ground sloths probably wouldn't have been as slow and cryptic as modern sloths.

The two-toed and three-toed sloths that are alive today are actually not very closely related to each other. They are only the remnants of the once very diverse sloth lineage. They're on distant branches of the sloth of the phylogenetic tree. The ground sloths filled in the middle of the tree.

They all would have been herbivores. Even though their teeth were simple pegs for the most part, they had shearing crests on them that allowed them to breakdown vegetation for digestion. Some

researchers have even looked at the microwear (or tiny scratches) left on teeth to get an idea of what they might have consumed in the past. You can see images of their teeth here:http://animaldiversity.org/collections/contributors/anatomical_images/family_pages/xenarthra/megalonychidae/

Why do paleontologists care about teeth so much? :)

[sciencereader3455](#)

Teeth are hard (enamel is the hardest substance in the body), so they preserve very well in the fossil record, and they are often very distinctive of and unique to the species.

First, teeth also reflect the diet of an animal. Since changes in diet often lie at the root of evolutionary changes and transitions, dentition can give a researcher a window into change through time. So, if you have the diet, you can tell a lot about an organism's ecological niche.

Second, you can extract stable isotope data from teeth. For example, oxygen stable isotopes can provide information about climate, carbon can shed light on if the organism was consuming C4 or C3 vegetation (i.e. grasses vs other types of plants such as oak trees), and nitrogen isotopes can tell you about trophic level.

Third, sometimes fossils (or really subfossils - bits of bones that still contain some organic material) contain DNA. And many researchers are now using ancient DNA to better understand the relationships between extinct animals and their living relatives.

What are the unique challenges (or benefits) to hunting for fossils in caves? Are they easier to find? Harder? More rare or interesting finds compared to other sites?

Thank you!

[kiri-kin-tha](#)

On Hispaniola where I do most of my work, there are many regions with a karstic landscape where cave are very likely to form. Many of these caves are sinkhole (think of a big room in the ground with a small skylight through which you must enter). Ancient animals just fell in and became trapped. Often this type of site is extremely rich with fossil material. If you have one animal fall in each year for 10,000 years you're in good shape! Typically we go in, check for fossils and if a cave has them we spend some time excavating there.

Hello Prof. Cooke! Thank you for your AMA.

Are there many similarities in modern-day Caribbean mammals (reintroduced, perhaps?) to those who went extinct?

[StonedPhysicist](#)

There are a few rodents that are still alive and are probably very similar to the ones that went extinct. Plagiodontia - that is related to many of the extinct forms (<http://www.arkive.org/cuiviers-hutia/plagiodontia-aedium/photos.html>). But the primates are extinct & very different to what exists today on the mainland. The ground sloths are, of course extinct. There is a surviving animal called Selenodon (<http://www.arkive.org/hispaniolan-solenodon/solenodon-paradoxus/>), that are similar to some of the extinct shrews. About 50% of the Caribbean endemic bats are still alive and are fairly similar to their extinct relatives.

What does this have to do with teaching medical students (really)?

[scienceaccount103040](#)

Paleontologists are often trained in anatomy because we reconstruct anatomy of extinct animals, which is key for understanding the anatomy of the human species. Many of the faculty members in the Center for Functional Anatomy and Evolution department (<http://www.hopkinsmedicine.org/fae/>) are functional anatomists with a paleontological component to their research. During the summer and fall, we bring our anatomical knowledge into the classroom to help train the next generation of doctors at Johns Hopkins University School of Medicine. In the lab, it is really exciting to be able to talk with students about how the evolutionary history of our own anatomy can affect health today.

While most of our teaching is to medical students we also run a summer anatomy institute for undergraduate students where cadaveric dissection is a component - just like in a medical school gross anatomy class. Link here: <http://esgweb1.nts.jhu.edu/fae/anatomyinstitute/>

What would be the most enigmatic or surprising fossil that you've come across?

[Xenoprimatology](#)

Well, each fossil my colleagues and I find can be exciting if it preserves new anatomy that we haven't been able to see and study before. However, there have been a few finds that were exceptional. For example, we found the most complete skeleton of the extinct monkey *Antillothrix bernensis* in an underwater cave in 2009. Previously, this animal was only known from a very small bit of upper jaw. The new fossils allowed us to show that the monkey had portions of its anatomy that were very similar to ancient monkeys from the Miocene (~15 million years ago) of mainland South America. This indicated that its ancestors likely entered the islands early on. In addition to these portions of the anatomy that tie *Antillothrix* to early monkeys, there are some really unique features that show that once on the island, it evolved in its own way. For example, *Antillothrix* was very stout - meaning that it had limbs that were short and squat relative to the animals living on the mainland. This may have meant that it moved slowly as a tree-dwelling quadruped.