One Small Step for Man

WERE THE FIRST HUMANS WALKERS OR TREE CLIMBERS? AN ANTHROPOLOGIST PUTS THE CLUES TOGETHER.

BY CYNTHIA K. BUCCINI

ANTHROPOLOGIST JEREMY DESILVA, holding the right foot of a human (top) and of a chimpanzee (bottom), filmed wild chimpanzees in western Uganda to learn more about how upright walking evolved.

AS THE SUN rises over Kibale National Park in western Uganda, wild chimpanzees stir, call to one another, and charge off in search of their morning meal.

For two weeks over two summers, one of those chimp communities was stalked, paparazzo-like, by BU anthropologist Jeremy DeSilva, who sprinted after them, filming as they climbed trees to collect leaves, figs, and other fruit. DeSilva was trying to answer a question that's been nagging anthropologists for decades: when early humans hit the ground walking more than four million years ago, were they still expert tree climbers?

"Upright walking is such a unique way of moving," says DeSilva, a College of Arts & Sciences assistant professor of anthropology. "If you look across the animal world, locomotion is so diverse: things fly, things swim. Moving on two legs is odd. No other primate does it. I'm interested in the question of how it happened, why it evolved."

DeSilva thought a key to answering this question might be found in the bone structure of the ankles of chimpanzees, our closest living relatives, and in the foot and ankle fossils of *Australopithecus*, a distant ancestor that lived two million to four million years ago.

"Many people regarded *Australopithecus* as something like this: they were climbing trees, living and sleeping in trees, and then they'd come down to the ground and walk on two legs," he says. "Maybe they didn't walk on two legs quite as well as we do it today, because *Australopithecus* was still a tree climber."

But mounting evidence suggests it was not. For one thing, DeSilva explains, *Australopithecus* lacked the kind of big

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grasping toe found in most tree climbers. And fossils of its back, pelvis, knees, and ankles pointed to a creature that was good at walking on two legs on the ground and not so good at climbing.

DeSilva didn't set out to resolve the dispute; he just wanted a better understanding of the genus. As a functional morphologist, he studies the bone shapes of our oldest ancestors, compares them to modern chimps, gorillas, or humans, and tries to draw conclusions about how those early animals moved. "My initial inquiry was to find out how tree climbers, in this case chimpanzees, actually climb trees, so that we can find the skeletal signatures of climbing in a more accurate way," he says. "I happened to focus on the foot and ankle."

During those two summers in Uganda, in 2006 and 2007, DeSilva recorded 166 climbs by the wild chimpanzees. Back home, he pored over 100 hours of footage, frame by frame, on his computer, zeroing in on how the chimps flexed and turned, or inverted, their ankles as they climbed.

The idea, he says, was to look at how close the chimps are to the tree. "If you're far away, the force that's pulling you down is a function of your weight — which is not something chimps can do something about — and the distance you are from the tree," he says. "It's also known as leverage. If a chimp is far away from a tree, there's a lot of leverage, which means the chimp could easily fall. You're less likely to fall off the tree if you're closer to it."

WEB EXTRA
Watch a video about Jeremy DeSilva's work at bu.edu/bostonia.

Chimpanzees, it turns out, get very close. DeSilva's video footage and his measurements of ankle flexion show that the primates can flex their ankles to a remarkable degree, so much so that the chimp's shin presses against its foot while climbing.

That movement, DeSilva found, is reflected in the shape of the shin bone, where it connects to the ankle. "In a chimpanzee flexing like that, you would expect the ankle joint would be enlarged in that area, and it is," he says. "I looked at hundreds of shin bones and foot bones of chimpanzees and humans, and this difference was dramatic."

The last step was to look at the fossils. If *Australopithecus* walked on two legs, the shin bone should look like a human's, he reasoned; if it climbed trees, it should look more like a chimp's. And if it was doing both, the shape of the bone might be somewhere in between.

He found that every *Australopithecus* fossil looked strikingly like that of a modern human. "It suggested to me one of two things: either they're not climbing at all, or rarely," he says, "or maybe they're climbing occasionally, but they're doing it in a way that's different from the way a chimpanzee does it today."

Another possibility was that *Australopithecus* was capable of flexing at the midfoot, the way modern monkeys do. Once again, the fossil evidence suggested otherwise: *Australopithecus*, like humans, had stiff feet. "You need to have a stiff foot for propulsion," DeSilva says. "You can't walk on two legs efficiently and have floppy feet. You're not going to have a good push-off."

He published his findings in the *Proceedings of the National Academy of Sciences*, in 2009, and in the *American Journal of Physical Anthropology*, in 2010.

"I'm running out of options to explain how these things climbed," he says of *Australopithecus*. "I'm getting to the realization that they didn't very much at all."

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He believes he will gain greater insight into how *Australopithecus* moved during his next project. The National Museum of Ethiopia has invited him to study the foot bones of a three-year-old female *Australopithecus* who lived 3.3 million years ago. An Ethiopian scientist affiliated with the museum unearthed the partial skeleton, including much of the foot, in that country between 2000 and 2004. It is the most complete fossil foot of an *Australopithecus* known.

DeSilva wants to know: did she have a grasping toe, and was she climbing trees with it and grasping onto her mother? Was the ankle positioned in a way that allowed the creature to flex and turn, and was the foot stiff or did it have an arch? "That's a big argument," he says, "whether the arch was developed yet or if the foot was stiff and the arch came later."

He's already begun his study of the child's foot. "I don't want to jump the gun," he says, "but from what I saw initially, this little girl was already walking around on two legs." As for the tree-climbing abilities? "We'll see."

The bones may shed light on some broader questions as well. "Did upright walking happen very gradually?" DeSilva wonders. "Is this something we've been learning to do for a long time, or is it something our ancestors mastered a while back and we've retained? I think what the fossils show is that upright walking is a pretty ancient thing. And our *Australopithecus* ancestors — when I'm walking from here to there, I can thank them."