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Embargoed: Not for Release Until 2:00 pm U.S. Eastern Time Thursday, 28 November 2024

Fossil Footprints Offer Direct Evidence for Two Extinct Human Relatives Living, Interacting Together

Research raises questions about role of competition in human evolution

PITTSBURGH (November 28, 2024) Kevin Hatala, Ph.D., associate professor of Biology at Chatham University in Pittsburgh Pa., is the primary author of a new study published in *Science* that provides the first direct evidence of two different fossil human relatives, *Homo erectus* and *Paranthropus boisei*, occupying the same immediate landscape and likely interacting with each other. While skeletal fossils have long provided the primary evidence for studying human evolution, new data from fossil footprints are revealing fascinating details about the evolution of human anatomy and locomotion, and giving further clues about ancient human behaviors and environments. Hatala is part of an international team of researchers from the US, Kenya, and UK.

Members of the research team excavating the ancient footprint site near Lake Turkana in northern Kenya, in July 2022. (Photo credit: Neil Roach)

"Fossil footprints are exciting because they provide vivid snapshots that bring our fossil relatives to life - with these kinds of data, we can see how living individuals, millions of years ago, were moving around their environments and potentially interacting with each other, or even with other animals," says Hatala. "That's something that we can't really get from bones or stone tools. The insights they give us, and the questions they raise, can be rather unique. For example, until now we have struggled to find the necessary data to know whether and how ancient human species may have coexisted and interacted during the early Pleistocene."

For much of our evolutionary history, multiple fossil human species are believed to have coexisted within the same geographical regions and time periods. This has driven numerous hypotheses about the importance of niche partitioning and competition between species in human evolution. However, the resolution of the paleontological record has often been insufficient to determine whether fossil human species actually lived together on the same landscapes at the same times.

In this paper, the authors present a newly discovered ~1.5-million-year-old fossil footprint site in northern Kenya, which records two different kinds of ancient human footprints, reflecting different patterns of anatomy and locomotion. Hatala and co-authors were able to distinguish the two different kinds of footprints using new methods that they recently developed for 3D analysis. "In biological anthropology, we're always interested in finding new ways to extract behavior from the fossil record, and this is a great example," said Rebecca Ferrell, a program director at the U.S. National Science Foundation who helped fund this portion of the research. "The team used cutting-edge 3-D imaging technologies to create an entirely new way to look at footprints, which helps us understand human evolution and the roles of cooperation and competition in shaping our evolutionary journey."

This is the first direct evidence showing that *Homo erectus* and *Paranthropus boisei*, two ancient human species known from this region at this time, occupied the same lake margin environment and likely interacted with each other. "Despite these two hominins diverging considerably in their anatomy, behavior and land use, they are both clearly drawn to these important lakeshore environments," says co-author Neil Roach, of Harvard University. "It raises new questions like did this overlap increase competition between them for the same resources? Were they there for different purposes?"

Two of the 1.5-million-year-old footprints preserved at the site. The research team attributes the one on the left to Paranthropus boisei, a member of an extinct side branch of human relatives, and the one on the right to Homo erectus, which could be a direct ancestor to us. (Photo credit: Kevin Hatala)

The fossil footprints were found in 2021, when Louise Leakey, Cyprian Nyete, and other co-authors from the Turkana Basin Institute were excavating skeletal fossils from overlying sediments. Richard Loki was a member of that excavation team who recognized the first hominin footprint. Leakey then coordinated a team, led by Hatala, Roach, and Nyete, that excavated the footprint surface in July of 2022.

The research team also expanded its analyses to other fossil footprint sites known from the surrounding area and they found more evidence that these two species occur together, at sites spanning up to 200,000 years. This combination of data suggests low to neutral competition between these two species, which may have enabled their long-term coexistence during the early Pleistocene. Later, environmental shifts could have impacted resource availability, increasing competition and potentially driving the behavioral adaptations that have come to define our genus.

Resolving these kinds of questions may be possible in the future. “Documenting the strata revealed that are many more trackway surfaces that could be excavated nearby,” says Kay Behrensmeyer, a co-author from the Smithsonian’s National Museum of Natural History who studied the paleoenvironmental context of the trackways. “These might hold more clues that could address questions about how different hominin species interacted, what they were doing wading in the shallow water, and why this behavioral pattern recurred over 200,000 years.”

Geological trench at the footprint site that revealed multiple stratigraphic levels for future research. Members of the excavation team, from left to right: Apolo Alkoro Longaye, Hilary Sale, Ben Sila, Losogo Nyakitala, and David Kipkebut, who excavated the trench in 2023. Photo included with permission of all who are pictured. (Photo credit: Kay Behrensmeyer)

During this time and place in human evolution - about 1.5 million years ago in the Turkana Basin of Kenya - it has long been hypothesized that these fossil human species coexisted together. *Homo erectus*, a possible direct ancestor of ours, persisted for more than one million years after this. The other, *Paranthropus boisei*, went extinct within the next few hundred thousand years.

“Perhaps changes to climate influenced resource availability and that led to the extinction of *Paranthropus* and the persistence of *Homo*,” Hatala adds. “This is a hypothesis that will require further testing, and we're hopeful that by combining fossil footprints with other kinds of paleontological and archeological data, we might be able to build a better understanding of how factors like competition and niche partitioning played a role in our evolutionary history.”

The research was supported by the National Geographic Society, U.S. National Science Foundation, the Turkana Basin Institute and UK Research and Innovation.

More information, including a copy of the paper, can be found online at the *Science* press package at https://www.eurekalert.org/press.

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