Human, artificial intelligence join forces to pinpoint fossil locations

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The Great Divide Basin, a 4,000-square-mile stretch of rocky desert in Wyoming. Credit: Courtesy of Robert Anemone

In 1991, a team led by Washington University in St. Louis paleoanthropologist Glenn Conroy, PhD, discovered the fossils of the first — and still the only — known pre-human ape ever found south of the equator in Africa after only 30 minutes of searching a limestone cave in Namibia.

Traditionally, fossil-hunters often could only make educated guesses as to where fossils lie. The rest lay with chance — finding the proverbial needle in a haystack.

"I don't want to say it's total luck," says Conroy, professor of physical anthropology in Arts & Sciences, "but it's a combination of hard work, meticulous planning and, well, a good dose of luck."

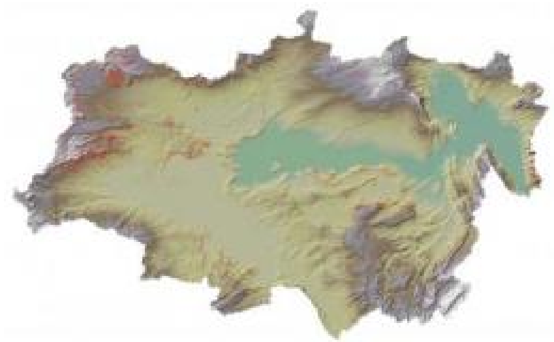
But thanks to a software model used by Conroy and researchers at Western Michigan University, fossil-hunters' reliance on luck when finding fossils may be diminishing.

Using artificial neural networks (ANNs) — computer networks that imitate the workings of the human brain — Conroy and colleagues Robert Anemone, PhD, and Charles Emerson, PhD, developed a computer model that can pinpoint productive fossil sites in the Great Divide Basin, a 4,000-square-mile stretch of rocky desert in Wyoming.

The basin has proved to be a productive area for fossil hunters, yielding 50 million- to 70 million-year-old early mammal fossils.

The software builds on satellite imagery and maps fossil-hunters have used for years to locate the best fossil sites. It just takes the process a step further, Conroy says.

With information gathered from maps and satellite imagery — such as elevation, slope, terrain and many other landscape features — the ANN was "trained" to use details of existing fossiliferous areas to accurately predict the locations of other fossil sites elsewhere in the Great Divide Basin.



This map shows sites (in red) in the Great Divide Basin with a 95 percent probability of containing fossils that also have slopes of greater than 5 percent. Credit: Courtesy of Robert Anemone

Because few sites are 100 percent identical, researchers had to "teach" the ANNs to recognize sites that shared key features in common. With the help of guidance from the scientists, the ANNs use pattern recognition to identify sites that share similar features.

"The beauty and power of neural networks lie in the fact that they are capable of learning," says Conroy, also a professor of anatomy and neurobiology at the School of Medicine. "You just need to give them a rule to deal with things they don't know."

Conroy and colleagues tested the software at the Great Divide Basin last summer. The ANNs correctly identified 79 percent of the area's known fossil sites, and 99 percent of the sites it tagged contained fossils.

Next up, the scientists tested the software on the nearby Bison Basin, also in Wyoming. Despite having been taught to recognize fossil sites at a neighboring location (the Great Divide Basin), the ANNs correctly identified four fossil sites in the Bison Basin.

"That gave us encouragement that a blind test based on a neural network for a different basin still gave us pretty good predictive results," Conroy says.

Next, Conroy is planning to continue to use the software to search for early hominid fossil sites in South Africa.

The scientists hope this new application of existing technology will help increase the efficiency of paleontological fieldwork.

"In the old days, we'd all bring different maps, and start walking," Conroy says. "Now, we're talking about ways to improve one's chances."

Provided by Washington University in St. Louis

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