Using footprints to identify and monitor giant pandas in the wild

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New software measures the unique footprints of giant pandas, enabling conservationists to identify and monitor pandas in the wild. Credit: Binbin Li, Duke Kunshan University

Footprints left by giant pandas in the wild can be used to identify the individual panda that made them and determine its sex, a new Duke University-led study by an international team of conservation scientists shows.

The new approach uses an interactive software tool called the Footprint Identification Technique (FIT) to "read" and analyze digital images of footprints, which are submitted electronically to a global database for matching.

Field tests show that the technique accurately identified individual animals and their sex more than 90 percent of the time.

This accuracy, combined with the system's ease of use in the field—a smartphone and a ruler are all you need to collect and submit images—makes it particularly well suited for studying a species as elusive as the giant panda, said Binbin Li, assistant professor of environmental sciences at Duke Kunshan University, who led the study.

"Giant pandas live in remote and hard-to-reach areas and their population density is so low that actual sightings of pandas themselves are not common. What we do see a lot of are footprints and fecal droppings," said Li, who holds a secondary faculty appointment at Duke University's Nicholas School of the Environment.

Identifying individual animals based on a DNA analysis of their fecal droppings provides accurate results, she said, but is costly and requires very fresh samples and sophisticated laboratory equipment. Trying to identify a panda using estimates of its bite size—based on the average length of bamboo fragments found in its droppings—is less technical but not very precise since many pandas in the same geographic area may have similar bites.

Footprints, on the other hand, are unique to each individual animal, somewhat like fingerprints in humans.

"Each species has a unique characteristic foot structure and the panda, in particular, has a beautifully complex foot that makes it a perfect candidate for monitoring with FIT," said Zoe Jewell, principal research associate at JMP Software and an adjunct faculty member at Duke's Nicholas School.

The software is based on a customized statistical model that uses cross-validated discriminant analysis and clustering methodology to "read" a panda's footprint and identify its distinguishing features. Based on these data, the program can identify the animal's sex and pinpoint if its prints are already in the FIT dataset or new to it, said Sky Alibhai, who is also a principal research associate at JMP Software and an adjunct faculty member at Duke's Nicholas School.

The new technique may prove especially useful for monitoring the reintroduction of captive pandas back into the wild, said Zhang Hemin, director of the China Conservation and Research Centre for the Giant Panda, where the field tests were conducted. New filtering and categorizing capabilities being developed with SAS, a data analytics company based in Cary, NC, will allow the system to quickly and efficiently process increasing volumes of digital data as reintroduced and wild populations increase, Jewell added.

Because it's easy to use and requires minimal training, the system will also encourage greater participation by citizen scientists, who can submit images using a public interface called Conservation FIT that Jewell and Alibhai launched earlier this year through WildTrack, a nonprofit conservation organization they lead.

The researchers published their peer-reviewed paper Dec. 20 in the

journal *Biological Conservation*.

"Giant pandas are hard to count—they are shy and live in remote mountains. Yet we must know how many there are if we are to prevent their extinction. The footprint technique is a major breakthrough in our ability to count them," said Stuart L. Pimm, Doris Duke Professor of Conservation Ecology at Duke's Nicholas School, who was not an author of the new study but has worked with its authors on past research.

FIT software is an add-on to JMP software from SAS and can be customized for use on a wide range of different species and in different terrains.

So far it has been developed for use on 15 species in addition to giant pandas, and work is under way to expand the list to include three species of endangered big cats: jaguars in the Americas, snow leopards in Asia, and cheetahs in Africa and the Middle East.

More information: Binbin V. Li et al, Using footprints to identify and sex giant pandas, *Biological Conservation* (2017). DOI: 10.1016/j.biocon.2017.11.029

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