Forensic tools for catching poachers

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The trade in ivory was largely outlawed in 1989, but poaching continues and remains a serious threat to the African elephant. Seizures of large amounts of ivory, sometimes over a ton, continue to occur. Research by Alfred Roca, an assistant professor at the university, could be the basis for the development of new law enforcement tools.

Roca has found a way to determine where the ivory comes from. With funding from the Division of International Conservation of the U.S. Fish and Wildlife Service, he and his collaborators have sampled elephants at 22 locations in 13 African countries to get sequences of their mitochondrial DNA (mtDNA).

mtDNA is the DNA located in mitochondria, structures within cells that convert the chemical energy from food into a form the cells can use. Most DNA is "nuclear," found in the cell nucleus. What makes mtDNA a good marker for tracing the origin of ivory is first, that it is transmitted only by females and second, the fact that female elephants do not migrate between herds.

Other researchers have found that it is possible to get fragments of mtDNA from ivory and that is possible to amplify those fragments. Roca and his collaborators wanted to match these fragments to elephants from a specific location.

To do this, Nicholas Georgiadis, a researcher who was in Kenya and is now at Washington State, used a rifle to shoot a biopsy dart, which would hit the side of the elephant and scrape a small piece (less than a

centimeter square) of skin from the elephant and fall off.

"It's like a biting insect," said Roca. "The hardest part was finding the dart after it fell off. Georgiadis never had a problem with an elephant unless it was already predisposed to be hostile to humans."

Georgiadis collected 653 samples that Yasuko Ishida, a researcher in Roca's lab, then sequenced and analyzed. She found eight distinct subclades, or subdivisions, of mtDNA – previous research had detected only two to five -- seven of which had limited geographical distribution.

They identified 108 unique mtDNA sequences, which provided fine-scale information about the origin of the ivory. Among the sequences, 72 percent were found in only one locality and 84 percent of them were country-specific. Although many elephants can have the same sequence, 44 percent of the individual elephants carried a sequence detected only at their sampling locality.

Roca and his team combined these results with five earlier trans-national surveys, which allowed them to examine a shorter region of elephant mtDNA in 81 locations in 22 African countries. Among the 101 unique short sequences detected, 62 percent were present in only one country.

More importantly, the phylogeographic signal (the geographic information provided by mtDNA) was different from the signal provided by nuclear DNA markers used in previous studies. Nuclear markers distinguished between forest and savanna elephants; the mtDNA marker indicated a precise location. The best method would be to combine both types of markers.

Roca hopes that the method developed in this research will be used by conservationists to determine the provenance of confiscated ivory. "It is often hard to trace ivory back to where it came from," he said. "A ship

may have left from a certain port in Africa, but that's not necessarily the country where the elephants were poached."

Sequencing the mtDNA can give a good indication of where the ivory is being poached. "Then steps can be taken by that particular country to prevent the poaching from taking place," said Roca.

The research has just been published in *Evolutionary Applications*.

More information: Ishida, Y., N. J. Georgiadis, T. Hondo, and A. L. Roca. "Triangulating the provenance of African elephants using mitochondrial DNA." Evolutionary Applications. Published online onlinelibrary.wiley.com/doi/10 … 71.2012.00286.x/full

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