DNA and Databases Help Untangle the Web of the Illegal Wildlife Trade

Two new data-driven approaches help identify key hotspots for poaching and trafficking

A customs officer in Thailand examines specimens from a three ton ivory seizure, estimated to be worth $6 million. (Photo: CHAIWAT SUBPRASOM/Reuters/Corbis)

By **Rachel Nuwer**

Every 15 minutes, an elephant is killed for its tusks—a trend that, if allowed to continue, will condemn African elephants to extinction in the wild within our lifetimes. Rhinos are faring no better. Last year, 1,215 were poached for their horns in South Africa alone, bringing down the global population of white and black rhinos to about 25,000. As few as 3,200 tigers live in the wild, but 200 are killed each year for their fur and body parts.

Despite these mind-numbing statistics, the illegal wildlife trade continues to flourish—it is now ranked as the world's fourth largest contraband network, worth an estimated $20 billion per year. Pledges to combat the trade, issued by nations around the world, have yet to make a dent in the massive numbers of animals that are poached each day.

Corruption, along with lack of funds, resources and political will, are all implicated in the tragedy. But sparse data also plays a role. Now, two papers attempt to fill in the knowledge gaps by using data-driven approaches. Reporting today in *Sciencexpress*, researchers identified major elephant poaching hotspots by genetically analyzing ivory seizures to pinpoint their geographic origin. And earlier this week, a team described a new method in *Proceedings of the National Academy of Sciences* that breaks down the complex network of countries involved in the trade. Their work reveals that removing just 12 of those nations from the network would alleviate the vast majority of poaching of elephants, rhinos and tigers.

"Figuring out how to stop the killing is what we really need now," says Sam Wasser, director of the Center for Conservation Biology at the University of Washington in Seattle, and lead researcher behind the ivory analysis. Rather than simply tracking where ivory seizures took place, Wasser and his colleagues wanted to identify the source of those illegal products. Stemming the flow of ivory by cutting off poaching, he believes, would be the most efficient method of disrupting the trade.

To identify poaching hotspots, he and his colleagues turned to tusks recovered from 28 major elephant ivory seizures over the past 19 years. All of the seizures weighed more than half a ton and were valued at a minimum of one million dollars. Such shipments constitute around 70 percent of all ivory seizures and, compared to smaller ones, are more likely to be overseen by highly organized major crime syndicates. "Poaching is going on all over Africa—there's no question—but it's daunting to think of it that way," Wasser says. "We're trying to identify where the major thrust of the poaching is coming from—the poaching that is really driving transnational crime."

To trace the ivory's origins, the researchers first created a massive genetic database using full genotype sequences of 1,500 individual elephants from all over Africa. They identified 16 DNA fragments that consistently varied with geography, which allowed them to pinpoint a particular elephant's origin to a minimum resolution of 185 miles.

The group then performed genetic analysis on ivory samples that countries have sent them, representing up to 60 percent of large seizures in recent years. Regardless of whether a shipment was seized in Sri Lanka, Hong Kong or Kenya, the team found that most ivory intercepted since 2006 originates from two key geographic areas: either Tanzania and northern Mozambique, or the West Africa nexus where Gabon, Congo-Brazzaville, Cameroon and Central African Republic converge.

The fact that the poaching hot spots have remained stable over nearly a decade indicates that the poachers are loath to change locations. That is significant, Wasser says, because it might mean that cutting off the killing "won't have a whack-a-mole effect," with new hot spots popping up as soon as one is shut down.

"The hope is that, by showing that the lion's share of major poaching is going on in these two areas, it will make it very difficult for these continues to continue to deny the extent of their responsibility," Wasser says. "I also hope that it causes the international community to really pool together to work with these counties to help them solve this problem."

While choking off the supply of ivory is an essential first step, stemming the flow of illegal goods—not only ivory, but of many other animal parts—is also necessary. "I think there's a preconceived notion of where the trade is coming from," says Nikkita Patel, a veterinarian and epidemiologist who recently graduated from the University of Pennsylvania School of Veterinary Medicine.

To uncover key countries involved in the trade, Patel and her colleagues repurposed a technique developed to analyze drug trafficking and terrorist networks. They researchers seeded the model with information about 108 tiger-related seizures, 232 elephant-related ones and 165 rhino-related ones, all intercepted between 2010 and 2013. The information was taken from a new database called the HealthMap Wildlife Trade, which crawls the web for wildlife trade-related information issued by official trade-monitoring sources, news stories, blog posts and discussion boards. The model's algorithms then tested different combinations of countries to identify which strands, if removed, would create the most fragmented outcome.
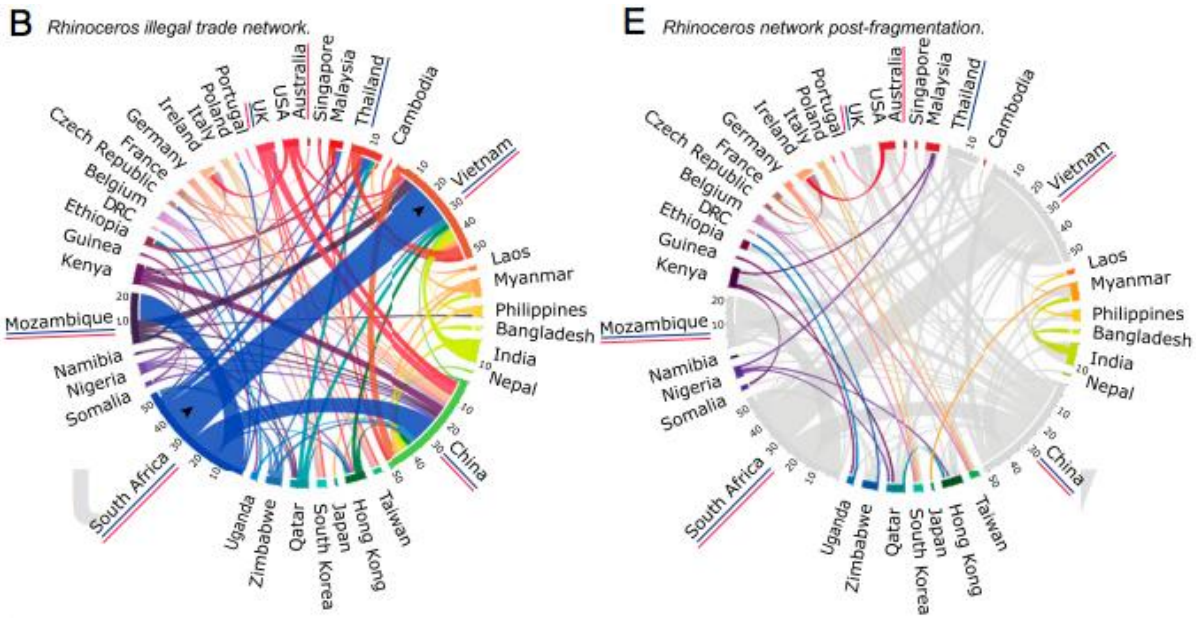
An example of the network visualizations the researchers produced, this one for rhinos.

The image on the left shows the countries involved in the trade. The image on the right shows the fragmented network after the six biggest players are removed. (PNAS)

According to the results, if just 12 countries were completely removed from the trade, 89.5 percent of pressure on elephants, 92 percent of pressure on rhinos and 98 percent of pressure on tigers would be alleviated. Removing China, not surprisingly, created the biggest dent, followed by other key importers and exporters like Vietnam, South Africa and Kenya. But the researchers also found that some transit countries—the U.K. and the U.S., for example—turned up as well.

This method is particularly useful because of the speed with which it can provide an analysis, but it would be strengthened by relying on a more trustworthy source of data, says Richard Thomas, global communications coordinator at the wildlife trade monitoring network TRAFFIC, who was not involved in either study. "As the authors do acknowledge, there's great variability in media coverage, and crucially, there is always concern over the accuracy of such reports," he says.

However, he adds, "the more detailed the profile built up of those involved in orchestrating large-scale ivory trafficking, the sooner they can be brought to book and punished as serious wildlife criminals." And ensuring that happens in time to save

animals requires action. All the data in the world will not stop poaching from occurring if the findings are not translated into on-the-ground measures, the researchers caution.

"This is really where international coordination becomes pivotal," Wasser says. "Everyone wants to solve the problem themselves, but the time has come to get together and have a big Kumbaya moment and really fix this whole thing."