MONITORING ENDANGERED SPECIES

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WITHOUT FURTHER ENDANGERING THEM:

Indigenous wisdom combined with cutting-edge technology

by **Zoe Jewell and Sky Alibhai**

It had been an average day at work: an 18-mile hike in desiccating 100-degree heat, navigating by VHF radio transmitter through scorched woodlands and around rocky outcrops favored by deadly black mamba snakes. Our quarry had evaded us, and, exhausted, we were about to call it a day.

Just then the wind changed. The red dust rose in a huge cloud, momentarily suffocating us. And she was right in front of us: An agitated mother black rhinoceros with a newborn calf hugging her side. She snorted furiously. Less than a heartbeat later, she put down her enormous head and charged.

A rhino's one-ton bulk belies a fantastic agility, turning radius and speed. We blundered behind a tree—the standard bush emergency exit—and registered only a thundering grey flash as she and her calf blurred past us, deep into the Mopane woodland. It was one of many close calls. (Image 1)

This particular rhino was a survivor. It was the early 1990's, and South and East Africa's black rhinos were being poached for their horns at unprecedented rates. Field stations around the country were filled with rhino skulls, each with a bullet hole and jagged craters in the nasal and frontal bones where desperately poor locals had hacked the horns off with a machete. (Image 2) They were paid by middlemen who profited by shipping the horns to the Far East for use in traditional medicine.

We had been asked by the Zimbabwean Department of National Parks and Wildlife Management to help assess the extent of this problem and perhaps contribute to a national conservation strategy for Zimbabwe's rhinos. Zoe had recently graduated from Cambridge University, U.K., and was beginning a veterinary career. Sky had a tenured position lecturing in zoology at the University of London. We'd been running a project on small mammal population dynamics in eastern Zimbabwe, and had the monitoring expertise and a willingness to stay on and help address this challenge. What did we have to lose?

Our first posting was the remote and beautiful Sengwa Wildlife Research Institute in northwest Zimbabwe, accessed by a bumpy grass airstrip covered in rabbit dugouts. The field station was a low cluster of British Colonial buildings perched on a majestic plateau in the middle of nowhere. The officer in charge had a collection of poorly contained venomous snakes. Our first season was spent walking transects to count signs of rhino. We were often called back to base because National Parks employed a shoot-to-kill policy for poachers, and both sides were armed with Russian AK-47s.

Desperate measures were required, and, at huge cost, the parks department decided to launch a new conservation strategy to radio-collar and de-horn each black rhino in Zimbabwe. Four Intensive Protection Zones were set up for black rhino protection, and we were deployed to the Sinamatella, in Hwange National Park. We stayed 10 years, collecting data on births, deaths, collaring episodes, immobilizations and distribution of each animal in this 580-square-mile area. We had wonderful help from tireless Earthwatch volunteers, students and colleagues. In the end, we had gathered an unprecedented database on black rhino demographics. Over the following year, we carefully examined these data to see how the conservation strategy was working.

The results were truly alarming. Not only were radio collars failing at an unacceptable rate, but female black rhino fertility was being compromised. Females immobilized more often (for repeated collar re-fitting) had fewer calves. The conservation strategy was not just ineffective, it was actually counterproductive.

So we published…*and* were damned! Nobody wanted to hear that the new strategy wasn't working. We were hauled up to defend ourselves in front of the Zimbabwean Department of National Parks and ostracized from the rhinoceros monitoring community. Since then, many other researchers have published on the negative impacts of invasive monitoring techniques, although this scholarship is rarely discussed in the scientific press.

Meanwhile, we began to look for a better solution to keeping track of these animals without disturbing or immobilizing them. Paradoxically, one answer had been staring us in the face all along: footprints.

Every day, on our walks through the bush, we were accompanied by an expert tracker, usually a member of the Ndebele tribe. These men had, like many indigenous peoples living amongst wildlife, grown up tracking. Their senses were finely tuned. They could spot a rhino footprint from the back of a Land Rover travelling at 25 miles per hour along a bumpy dirt road. They could hear the chirp of an oxpecker on the back of a rhinoceros a kilometer away. They could smell rhino urine on bushes. They knew which trees rhino liked to lie under

during the heat of the day. They could tell exactly where a rhino had gone by the shrubs it browsed, and even knew the order in which it had browsed them. We'd ask the scout, "Where do you think the rhino is?" He'd laugh and point to the ground.

Above all, they could identify individual rhinos from their footprints. (Image 3)

This made us think about morphometrics. Feet, and therefore footprints, vary by species, of course, but like fingerprints, they also vary by individual. But it's complicated, because each footprint an animal lays down has a unique character and structure determined by surface, wind direction, gait, pace and light direction. Then of course each animal has four feet to consider. All this had to be taken into account if we were to stand a chance of identifying individuals from their footprints.

Before the dawn of digital technology, we spent a summer inhaling dust and waiting to be trampled to death as we kneeled over footprints, tracing them on acetate. Then Agfa came to our rescue and donated four first-generation digital cameras. We were back on track! We discovered JMP data visualization software from SAS Institute and were able to customize it with the help of the software's developers. Working from our digital photos, this wonderfully flexible tool enables us to identify footprints at the species, individual and age-class levels, using a statistical model that provides levels of accuracy greater than 90 percent. In this way, we've been able to mesh cutting-edge computational analytics with some of the wisdom gleaned from millennia of human experience.

Two years ago we came in from the conservation wilderness. We had learned of the wonderful work that Stuart Pimm's group is doing at the Nicholas School to reverse the catastrophic loss of biodiversity. Stuart invited us to visit his research family. His group looks at global and landscape scale species conservation issues. We help fill in the detail of those pieces for the big picture. In 2014–15, we're offering a course on non-invasive monitoring techniques, using JMP software and supported by Duke's Africa Initiative. It will also feature a field course in Namibia where students can learn from San bushmen, at an Academy for Ancient Skills. To the best of our knowledge this combination will be a world-first.

WildTrack, which we founded in 2004, is a 501(c)3 organization dedicated to developing and applying better monitoring tools for endangered species. We have partner projects and collaborators all over the world, with studies of Amur tigers (Image 4) and giant pandas in China, mountain lions in Texas, black rhinos and cheetahs in Namibia and tapirs in Brazil. In the Research Triangle of North Carolina, we're collaborating with North Carolina State University on the development of automated image segmentation for FIT (Footprint Identification Technique), talking with Duke medical doctors about the possible use of FIT for identifying premature babies, and working with colleagues from the Museum of Natural Sciences in Raleigh to adapt FIT software for quantifying herbivory in rainforest canopies. Of course, we continue our software development and enhancement with JMP at SAS, which is located nearby in Cary.

We're also investigating new tools for our non-invasive toolbox, such as using trace DNA from footprints and deploying drones to find trails of Amur tigers in northeast China.

Biodiversity is a resource worth an estimated $40 trillion a year, and monitoring biodiversity is now arguably the biggest global challenge we face. Our joint 50 years of experience in conservation monitoring has convinced us that good ethics in conservation promote better scientific outcomes. If the techniques we use harm a species we study, then our data simply can't provide reliable information on numbers and distribution. Non-invasive approaches are not only more cost-effective and humane, but can also engage and revive the amazing traditional ecological skills of local people before they, like the species they share space with, are lost forever.

Sky Alibhai, a wildlife biologist, and Zoe Jewell, a veterinarian, are visiting research scientists at JMP software, a division of SAS Institute, in Cary, N.C., and at the Nicholas School of the Environment. They founded WildTrack in 2004 in response to interest in the research community in non-invasive techniques for monitoring wildlife.

FOR MORE

www.wildtrack.org
WildTrack working with Amur tigers in China: youtube/Qy6U91gzMjg

All Image courtesy Zoe Jewell and Sky Alibhai