Transforming the next generation through citizen science in Kenya; The Kids Twiga Tally

In 1984, E.O. Wilson wrote about biophilia, the notion that humans have an instinctive bond with other living systems and vice versa. It explains why nature tourism is such a rapidly growing global business, and why millions of people around the world raised a huge public outcry after the killing of Cecil the lion in Zimbabwe and Satao the elephant in Kenya. This notion also suggests that the loss of wildlife species and the degradation of valuable ecosystems could be reversed if we re-establish the direct connections between people and nature that are largely missing in the modern, urbanized world. This is vital in Africa where wildlife species and wild areas are under massive threat from all sides as the continent enters a period of rapid industrial development.

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Prof. Dan Rubenstein is a behavioral ecologist who studies how environmental variation and individual differences shape social behavior, social structure, sex roles and the dynamics of populations.

Prof. Dan Rubenstien and children from Brookhouse International, Kibera Girls School, Mpala Academy and St Christopher School who participated in the Kids Twiga Tally.

Kenya has a proud tradition of citizen involvement in wildlife conservation. Wildlife Clubs have played a key role in developing a culture of conservation among young people. However, their reach and impact have been unable to keep up with the growth in schools and most children in Kenya today are growing up with very little understanding of nature. To save the country's spectacular wildlife heritage it is essential to re-connect young people and nature and make wildlife conservation the concern of every student.

One of the best ways of arousing children's interest in an issue or problem is to involve them in finding the solution. This was the thinking behind an event organized by the NGO WildlifeDirect, the Mpala Conservation Center, the Laikipia Wildlife Forum, scientists from Princetown and Colombia Universities, and researchers involved in developing the Image Based Ecological Identification System (IBEIS).

We invited school children aged from 10 to 13 to help us count reticulated giraffe in the rangelands of Laikipia County. The high plains of Laikipia harbour a wealth of wildlife, which has thrived in part due to innovative management approaches developed by private landholders that combine cattle ranching and wildlife conservation. Giraffes are endemic to Africa and the reticulated giraffe is only found in northern Kenya and southern Ethiopia today. We only have crude estimates

of the giraffe population numbers: these suggest there are about 140,000 giraffes in total across Africa, of which about 25% are reticulated giraffe.

We wanted to give young children the opportunity to contribute meaningfully to science. This idea had been mooted by children themselves just months earlier. On 4 July 2015, WildlifeDirect and the Kenya Wildlife Service (KWS) and Brookhouse School hosted a one-day workshop at the school in which 350 young people were invited to discuss 'How we together can create a generation of wildlife warriors in Kenya'. Hundreds of suggestions were made, but one that popped out was to make trips to wildlife areas an opportunity to "do something meaningful".

It resonated with us because earlier in the year we had invited the public to join us in a two-day photographic survey of zebras in Nairobi National Park. Typically, visitors to the park take zebras for granted, as an element of the landscape, and concentrate on searching for more 'prized' animals such as lions and rhinos. After a few hours, the 80 participants had become extremely passionate about zebras and spoke excitedly about watching them feed, groom, play and even mate.

The survey made use of IBEIS, a new digital technology that allows identification of individual

TOP: Dino Martins introduces children to cocktail ants that occupy domatia on whistling thorn trees.

BELOW: Dino Martins and Dan Rubenstein demonstrating the power of a male reticulated giraffe by looking at it's skull.

animals in a herd of thousands animals that— superficially—all look the same. IBEIS can read zebra stripes like a bar code and distinguish individuals from each other to create a database of individual animals in the population. It can also read the markings on many other species, including giraffe. In addition to its wide range of ecological applications, IBEIS offers new opportunities for ordinary citizens, equipped with nothing more than a camera, to contribute to science.

Making use of this new technology, citizen science has the potential transform the way we

TOP: Students from different schools and Princeton/Columbia Universities at the Mpala Research Centre.

BELOW: Marion of the Mpala Academy focuses on photographing a giraffe.

count animals and understand their population dynamics, by providing data on abundance and numbers of males, females and young in near real-time. Such data has huge potential for planning conservation, working with communities, and improving understanding of animal behaviour in our rapidly changing world.

Following the success of the zebra count in NNP, further counts were organized in other parts of the country during 2015 and 2016. At these events we noticed that children often commandeered their parent's cameras and this alerted us to the potential of IBEIS as a classroom tool. We thought this could be a powerful way to get children hooked on nature.

On 7 March children from 8 primary schools from a range of backgrounds arrived at the Mpala Research Center for the Kids Twiga Tally (*twiga* means giraffe in Kiswahili). Some were pupils at high-end elite schools, while others came from urban slums and rural pastoralist communities. They had volunteered to take part in the count because of their interest in topics such as technology and photography, or simply attracted by the prospect of the adventure of an overnight trip.

On arrival we held an initial briefing session where we encouraged the children to talk about their interests and talk about giraffes. We didn't tell the children anything about giraffes. Instead, we invited them to write their questions down on a whiteboard and try to work out the answers for themselves. Just five of the students said they were interested in science and only a handful of questions were asked. However the children did display some knowledge of conservation issues: They predicted that there would be more giraffe on protected conservancies than in the poorly managed, degraded landscapes of collectively-owned group ranches.

The next day we trained the 70 school children in using GPS-enabled cameras. Then we split them

TOP: Students from Kibera School for Girls practice matching photos, so as to better understand how the IBEIS software works.

BELOW: Children spotting wildlife from the Laikipia Wildlife Forum bus.

up into mixed groups before letting them loose in the company of undergraduate students from Princeton and Columbia Universities. Each vehicle had 2 or 3 cameras and the job of the children on board was take photos of giraffes.

Spotting giraffe is not as easy as you might think, but the children had incredible eyesight. They directed drivers to giraffes they spotted in the distance and, since we were on private land, vehicles could go off road to get closer. While looking for giraffe the children also saw elephants, leopard, wild dogs, impalas, kudu, plains and Grevy's zebra and many other species.

Some children watched hippos; others examined whistling thorn acacias, where they discovered that what looked like fruit pods were in fact ant homes, full of young larvae, not seeds. They were fascinated to learn that the tiny but fierce biting cocktail ants were tolerated by the trees because they attacked browsing animals, including giraffe.

At the end of the day our combined efforts had produced over 1300 photographs of giraffes, as well as photos of many other species. The children gathered at the research center and played a game of manually pairing photos of giraffes on just 8 cards. It took the winning team 15 minutes to figure out the pairs. Then we showed them how the computer running IBEIS could do it much more quickly. The exercise left the children in awe and a flood of questions followed. By the end of the day the children knew what giraffes ate, how long they lived, how much they weighed and who their predators were. All 70 children said they wanted to be scientists, and most said they did not want to go home or that they wanted to come back again. They said they loved the day out. They enjoyed seeing all the animals, talking to scientists, and meeting and interacting with children from other schools.

Undergraduate students and the Mpala Research Center science team repeated the count on Day 2 to allow for the sight–resight analysis.

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This uses the identification of individuals animals made possible by IBEIS to estimate population numbers. Imagine that 100 individual giraffe are seen on Day 1 and 100 giraffe are seen on Day 2. The population can be estimated from the proportion of repeated sightings. If only half of the zebras seen on Day 1 are resighted on Day 2, then the total population is 200, twice the number seen on Day 1. This method is a much more accurate way of estimating population numbers of animals than total count methods. Our survey found 30 individuals on Day 1 of which only 8% overlapped on Day 2, giving us a total population of 376 on the conservancies. This compared with a population of 80 on the group ranches, estimated by the same method.

The Kids Twiga Tally did not just tell us how many giraffes are on the landscape. Further analysis of the data will enable us to assess whether the sex ratios and age structure of the giraffes on the conservancies and group ranches differ. Although one might expect to find more females and young animals on the group ranches where predators are less common, poorer food quality on the ranches may make it more difficult for giraffes to raise young. The detailed information collected by the survey will help us understand the relative importance of these factors and how they interact. The results will be presented to the KWS management in coming weeks.

Counting the giraffe of Laikipia could be done multiple ways. We could have hired a student to go out and count the giraffe. It would have taken much longer and, like so much research in Kenya, only a few people would have been engaged and informed. The Kids Twiga Tally showed how doing real science is a powerful magnet for engaging children's minds. Moreover, thousands of people joined the Tally vicariously via social media (on Twitter and Facebook), which attracted interest from the media as well as other schools that have expressed an interest in participating in future activities.

It looks like this could be a winner. And it's not just zebra and giraffe that will benefit. Any uniquely patterned animal can be counted using IBEIS, which will be available to anyone in the world from June. One of the most exciting possibilities is the use of IBEIS for elephant identification. This could provide vital information for education and management; for example, for communities concerned about problem elephants. It could enhance the tourism experience by giving visitors access to information (such as name, age and family relations) about the individual elephants they see.

We hope the Kids Twiga Tally will be just the start of something much bigger, unleashing the power of children to change the future of Kenya. The Mpala Research Center already sponsors conservation clubs and the Laikipia Wildlife Forum has recently initiated a program called Wild Classrooms for Laikipia children, in which local conservation clubs visit conservancies and conduct citizen science projects. WildlifeDirect is exploring ways to scale this up to a national level, by developing a system that enables schools nationwide to use parks and wilderness areas as outdoor classrooms for any subject. Our hope is that citizen science using software like IBEIS will transform public attitudes, leading people to demand cleaner cities and less polluting industries, and more consideration of environmental issues in planning and policy making.●

About IBEIS
The Image Based Ecological Identification System (IBEIS) software has been developed by a team of faculty members, students and engineers at Princeton University, Rensselaer Polytechnic Institute, the University of Illinois-Chicago, and Wild Me. It uses the HotSpotter software for individual animal identification and the Wildbook ecological information management system. To find out more go to **IBEIS.org.**