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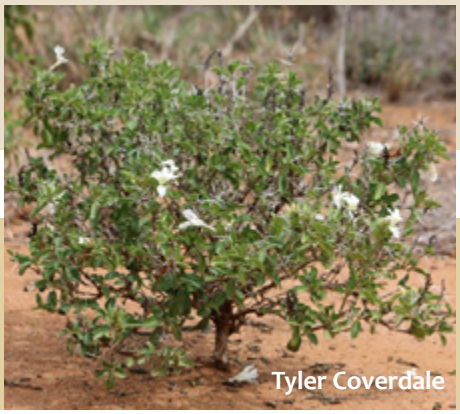
DECEMBER 2016


Tyler Coverdale

From Our Director's Desk

Dr. Dino Martins reflects on his first year as Director, and on the way ahead for Mpala Research Centre. read more

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Outreach at Mpala and Mpala at a Glance

Read about Field Methods in Mammalogy and the Laikipia Rabies Vaccination Campaign, and catch up on other events and happenings at our research centre.

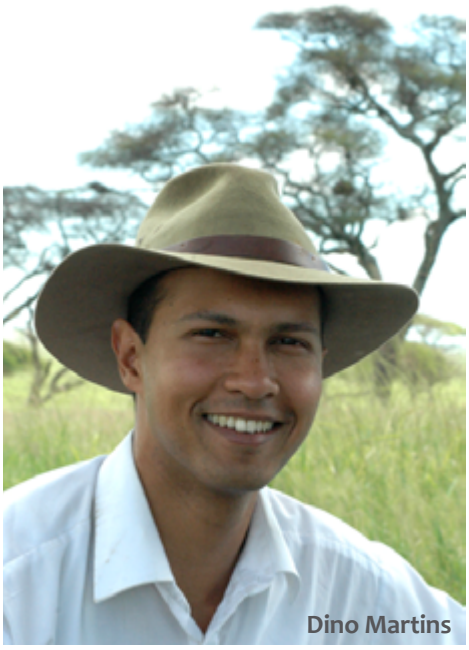
read more

From Our Director's Desk

Dino J. Martins

Dear scientists, students, friends and the wider Mpala community,

After several months of dry weather at Mpala, the rains have started again and are being welcomed by the wildlife, cattle and communities that live here. It has been a challenging year for both Laikipia and Mpala, but I am pleased to report that we have weathered these challenges. The Mpala family remains strong and the centre continues to serve as a hub for exciting research and discovery. A larger number of students and scientists made use of Mpala this past year than in 2015, and the number of university groups visiting doubled. I am especially pleased that Uganda's Makerere University, one of the oldest and leading universities in the region, came to Mpala where their students got to experience the wonder of being immersed in our living laboratory.


Dino Martins

Around the world people continue to share in the joy and drama of the natural world through the 'MpalaLive!' portal. We now have >14 million unique viewers, and tens of thousands access the educational materials on our website. We're scaling up some of our educational and outreach programs, and will be sharing more on this with you soon.

One of our most successful projects this year has been the continued Laikipia Rabies Vaccination Campaign (LRVC), with over 4500 dogs and cats vaccinated in our neighboring communities. This effort supports the health of humans, livestock and wildlife, particularly that of endangered species such as the African Wild Dog and Cheetah. LRVC 2016 brought together a large number of partners and is now serving as a model for vaccination campaigns both nationally and globally.

We also held two incredibly successful citizen science events, the Great Grevy's Zebra Rally and the Kids Twiga Tally (see www.mpala.org for links), and will be doing more on this front in the coming year.

I am especially proud to announce our fellowship program for Kenyan/East African students, which will be launched shortly. This program has been made possible by our generous donors, the support we have received from Princeton University and the Smithsonian Institution, and our partnership with the Kenya Wildlife Service, National Museums of Kenya and local universities.

I look forward to a year of exciting new research ideas, continuing long-term projects and productive collaborations. For all your support and enthusiasm: Asante!

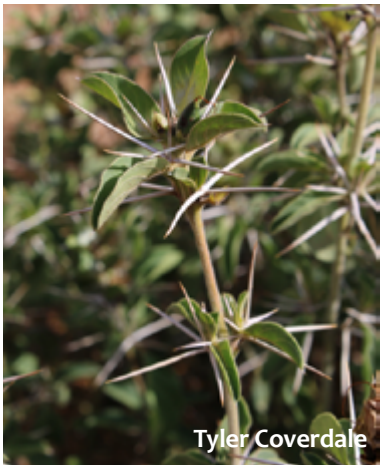
Kind regards,

Dino J. Martins

Executive Director, Mpala Research Centre

Spiny Questions

Tyler Coverdale

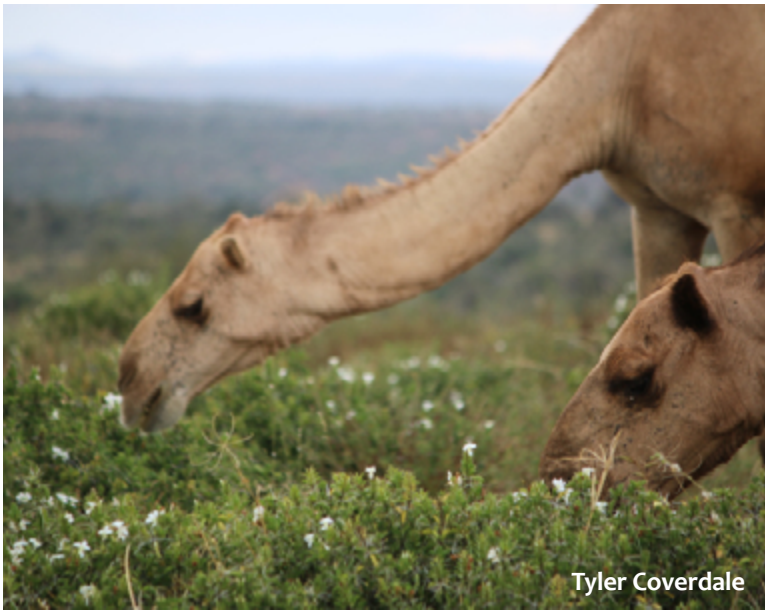


The defensive spines of Barleria racemosa, a common shrub at Mpala.

If you've spent any time walking or driving around Mpala, you've probably experienced plant defenses firsthand: the hiss after an *Opuntia* punctures your tire or the distinctive ripping sound of a shirt worn carelessly close to an acacia tree. Plants evolved these physical defenses in response to the diverse suite of herbivores that call Mpala and other savannas home. They rely on these defenses to persist despite intense herbivory by wildlife and livestock. In an evolutionary arms race that has culminated in the prickly landscape we see today, herbivores drove plants to develop increasingly effective defenses and, in response, developed behavioral and morphological adaptations that allow them to feed on well-defended plants. Far from being passive participants in these interactions with herbivores, savanna plants actively increase or decrease their investment in defenses according to their own complex perception of herbivory risk. For example, if you enclose *Acacia drepanolobium* in herbivore-free plots, as Dr. Truman Young has done in the Kenya Long-term Exclosure Experiment (KLEE) for more than two decades, they produce shorter spines than neighbors growing just outside the exclosures. In contrast, *Acacia etbaica* growing in the risky environment of an impala-filled glade produce more spines than those growing in denser stands of trees, where the risk of herbivory is lower. An increase in defense investment in response to herbivory is known as an induced defense: given a reliable signal that herbivory is likely to be high in the future, many plants can increase their investment in defensive spines and thorns to protect against future losses to herbivores. In the absence of such cues, such as in the KLEE experiment, plants reduce their investment in defenses. But how do plants "know" if they're likely to be eaten in the future?

Caught on camera trap: an elephant uprooting an entire B. spinisepela.

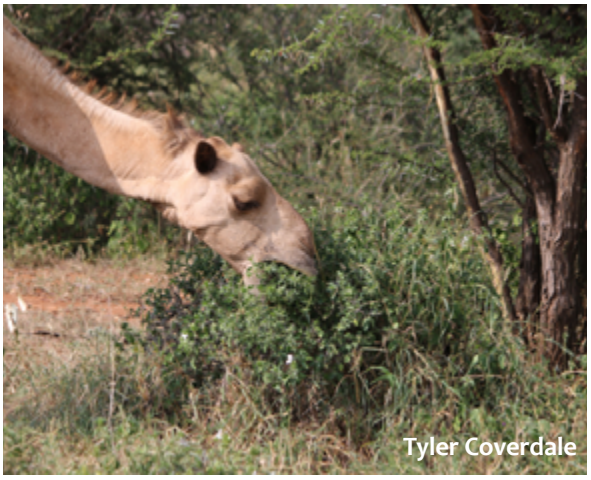
One of the most reliable cues that plants use to determine their future herbivory risk is whether they are being eaten at present. Plants escaping herbivory now may well avoid it in the future, while those that are browsed often this year are likely to be browsed again next year. This is true of plants within Mpala's many herbivore exclosures and experimental glades, but variation in herbivore pressure can occur over much smaller scales. For my dissertation, I am studying how neighboring plants affect herbivore risk and, in turn, how consistent differences in herbivore damage affect the speed and magnitude of induced defenses.



Camels eating Barleria, which extends as far as the eye can see.

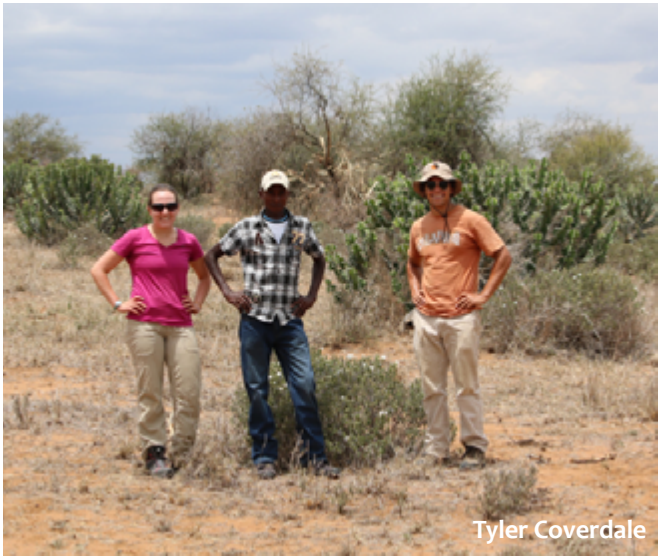
Many plants, including the understory species that live beneath the canopies of well-defended Acacia trees at Mpala, experience reduced herbivory by virtue of living in close proximity to neighbors. We call this an associational defense. Such relationships are easily observed: peer under the tangled, spiny branches of an elephant-damaged Acacia and you'll see a variety of unbrowsed, palatable plants that persist here and virtually nowhere else. While studying this pattern in 2013, I noticed another striking difference between plants growing beneath Acacia and those growing in the open: not only are there typically more plants under Acacia canopies than outside them, but the individuals that grow beneath trees appear to invest much less in their own defense. They seem to be relying on the defenses of the Acacia rather than producing their own spines and thorns. Surprisingly, despite being more poorly defended than individuals of the same species growing in the open, they are often less browsed by herbivores. To determine how plants growing among neighbors know that they don't need as many defenses, and how these same poorly-defended individuals remain relatively unbrowsed despite appearing nearly defenseless, I began performing experiments with three species of Barleria, a common, spiny sub-shrub found throughout Mpala.

First, I set out to determine how well neighbors defend Barleria against herbivores. With a saw and clippers, I removed overlying tree branches and understory neighbors from Barleria growing under tree canopies and tracked their fate for one year. Plants in my unmanipulated treatment, in which both the tree and surrounding understory neighbors were left in place, experienced no change in herbivory damage and grew considerably over twelve months. In contrast, removing either understory or overstory neighbors, or both, significantly increased herbivore damage and reduced plant growth. As expected, growing among well-defended neighbors appeared to reduce herbivory on Barleria. But what about their own defenses?



Camel with a mouthful of B. racemes.

With the help of several Princeton Environmental Initiative interns (and not a few band-aids), I removed all the spines from dozens of plants to determine how effective they were against the elephants, impala, and dik dik that were eating Barleria. I included several plants within the UHURU exclosure plots to serve as herbivore-free controls, so that we would know if the process of removing spines alone affected the plants. When I returned a month later to see if the newly defenseless plants outside the plots had been eaten, I was shocked: every plant had a full complement of spines. I walked from plant to plant, hoping that we had somehow forgotten to remove the spines of just a few individuals, but each plant was covered in thousands of sharp, white spines. Going into the UHURU plots, I was met by another surprise: the plants inside didn't have any spines at all! I had no idea how to explain this bizarre pattern. Were my memories of the days spent removing spines outside the plots all in my head?



Princeton undergraduates Katie Grabowski and Ben Culver and field assistant Adan Ibrahim (pictured above) were instrumental in setting up the early Barleria experiments.

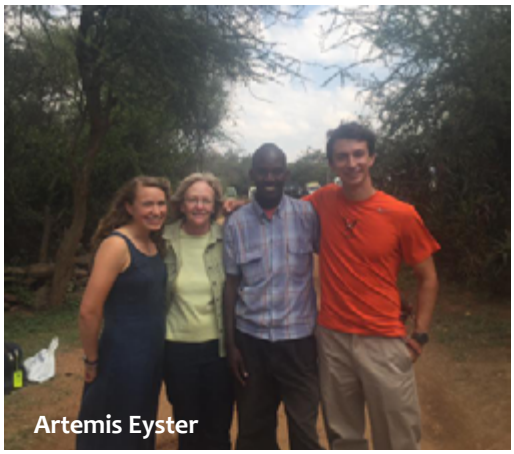
Two years and several experiments later, I finally have the explanation I was looking for that day. The plants growing outside the exclosure plots had experienced consistent browsing for their entire lives. When I clipped their spines they responded to the insult as they always have, by replacing the missing spines in anticipation of being browsed again in the near future. That's why they looked as if we'd never removed a single spine. In contrast, those plants growing in the relative safety of the exclosure plots had never been browsed, so the same experimental treatment elicited almost no response. They'd had years of information that suggested that they were unlikely to be browsed again, and our one day of spine clipping wasn't enough to overwrite that memory.

It turns out that it doesn't take a long-term exclosure plot to produce these types of differences; plants growing beneath tree canopies, which reduce herbivory pressure almost as effectively as an electrified fence, also don't respond when we clip their spines or leaves. They are naïve, like the plants within exclosures, having never been exposed to the cues that would cause them to produce an induced response. I suspect that they find our experimental clipping to be only a minor hassle – one bad day among thousands of herbivore-free ones, and certainly no reason to spend their limited resources on making more spines. But when we clip the leaves of Barleria growing in the open, doing our best to mimic the damage caused by herds of impala or territorial dik dik, we seem to be confirming what the plants already know: that they're in a vulnerable spot and must produce even more spines to survive. Moving forward, I hope to understand the genetic and epigenetic differences that allow plants of the same species to respond so differently to real and experimental browsing, and how living with and without neighbors affects the lifetime fitness of Barleria and other plants. In the meantime, I continue to be amazed that Mpala's herbivores are up to the task of thriving in a landscape where every bite they take today means another spine tomorrow. •

Conservation Club Diaries

Artemis Eyster

"Karibuni," greets John Maina, a teacher at the Mpala Academy Conservation Club. "Karibuni means a big welcome," he explains to us as we walk to his office. After many chairs are crammed into one room to accommodate our numbers, we sit. We are many: Nancy Rubenstein (Northern Kenya Conservation Clubs' kind supervisor and facilitator); Laura Bidner (scientist, lover of monkeys, excited to be doing community outreach); Henry Ogibly (geoscientist by study, natural leader, loves public speaking, likes to joke around with the kids and teach them new words); and me, Artemis Eyster (birdwatcher, Kiswahili student, always ready with my journal to draw a new animal or plant). Henry and I will be teaching the Conservation Clubs at different schools each day, for the next eight weeks. We listen to what the club had been working on, and hear about the displays and performances they have been preparing for Community Conservation Day, scheduled midway through our stay at Mpala Research Centre.



(From left) Artemis, Nancy, Jackson Miliko and Henry: part of the Northern Kenya Conservation Clubs team this summer.

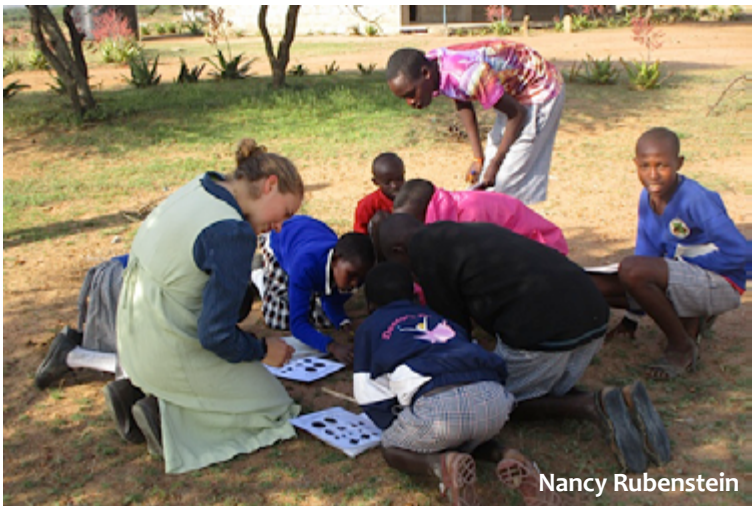
Children peer at us through classroom windows, around doorways, around the corners of the school buildings. After I greet them, "Habari ya leo?" (How is your day?), the students become friendlier and begin to swarm around Henry and me. They ask me questions and Henry teaches them how to give a "thumbs up". There seem to be too many to ever possibly know their names.

***

Today is Tuesday: time for me to go to Olgirgiri Primary School. "They are ready," Raphael, their club teacher, informs us. After dropping Henry off at Shiloh Naibor Primary, Jackson, our driver, takes Nancy and me to Olgirgiri. "Driver" isn't the word for Jackson Miliko. An incredibly bright young man and father of two, he is appreciated and respected by all of us. Having attended Ewaso Primary School and living just outside the town of Il Motiok, he is well-connected and well-liked by the communities we work in. He is more than competent, always smiling after every challenging river and sandy lugga crossing.

Artemis greeting her students, as they strike a pose for the camera.

I look out at the tin-roofed buildings of Olgirgiri. It is an especially daunting school because the club is so big. I had counted 67 students in the club during a previous week. A large number to teach. Noticing my concern, Nancy had agreed to teach half of the class inside while I would teach the other half outside in the shamba (garden). Olgirgiri's conservation club has constructed two goat-proof tree gardens. While the soil around the schools is normally bare dirt, inside the garden there is lush grass growing to sit on and healthy young trees.



Conservation Club students enjoy an outdoor lesson with Artemis.

"Leo sisi tutaongea kuhusu acacia na ants." Today we will chat about acacia and ants. I try to speak in as much Kiswahili as I can. After I give the class some background, we leave the garden and look at Whistling Thorn trees (*Acacia drepanolobium*) to understand the story of the mutualism between ants and acacia. We tap the trees' domatia (swollen thorns, often occupied by ants) with pencils, and the ants run out along the thorns. The children asked me if I knew that one can eat domatia. They teach me how to find the young domatia and eat them when they are green, before the ants move in. The club members draw the ants and the domatia. We go back into the garden to piece together the story. I have some questions prepared: What were the ants doing? What likes to eat acacia? "We do!" they respond. After we arrive at the conclusion that domatia, although sweet, are not fruits, we discuss symbiosis and mutualism. We leave the shamba, each of us wiser than before. I feel alive and full of domatia, learning, and smiles. I am invigorated. I could not wish to be anywhere else.

***

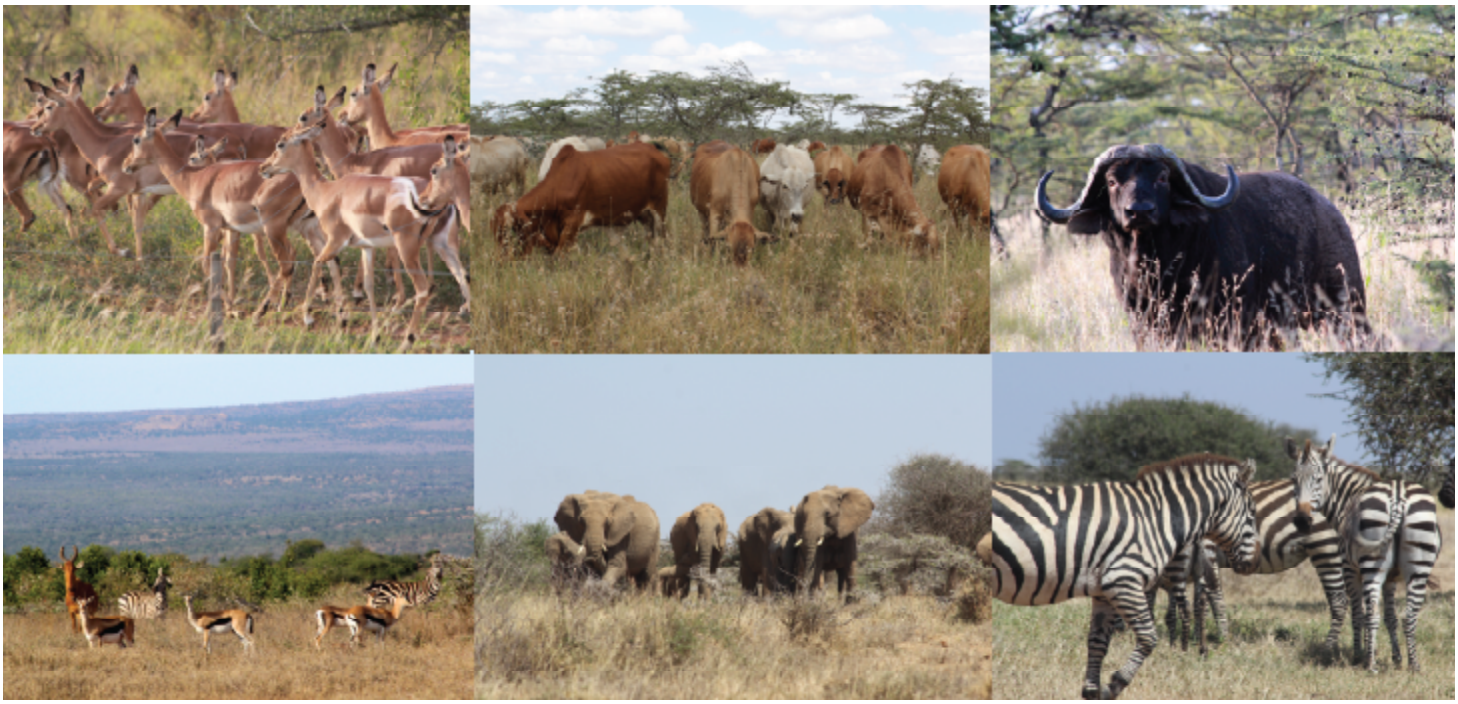
Time passes and it is the Friday before I have to return home to the USA. I walk to Mpala Academy through the village at the Ranch House for my last lesson. I shake the teachers' hands. The students, now my friends, call to me, though they are still supposed to be in class. Spending much of my free time at the Mpala Research Centre staff village playing with the children, I have come to know many of them. Before club starts, as Vincent shakes my hand, I see Ceceline making a silly face at me and hear Elvina saying my name. In class, I read a story I had written – of native ants, which protect the acacia, being overrun by the invasive big-headed ants – and illustrate with chalk on the board. Three key concepts – mutualism, invasive species and biodiversity – are taught through the experience of acting out this tragic story. It ends in mass chaos, with most of the actors coming to a catastrophic demise. The children love it. "What can we learn from the native ants?" I asked. "Not to cut down trees," replies a student. "Sawa ndio, lakini watu wanakaa katika miti?" (Okay, yes, but do people live in trees?) I ask. "What else can we learn from the ants?" I asked again. "Protect your environment. Protect the Earth," replies another student.

***

I didn't have to say goodbye that day. After the weekend of packing and playing with children, I walk up to the village just after sunrise. I hug the students, my friends, before they board their bus. "Tutaonana tena," I tell them. We will meet again. •

Zebra = Cow? Effects of Different Herbivores on Plant Growth

Grace Charles



Mpala is home to a variety of herbivores, both wild and domestic. Pictured above are (clockwise from above left) impala; Boran cattle; African buffalo; gazelles, hartebeest and plains zebra; elephants; and plains zebra. The area provides opportunities for researchers to study interactions among humans, their domestic herds and wildlife in an area where they coexist. Pictures by Grace Charles.

Which mammals did you see the last time you drove around Mpala? Elephants? Gazelles? Giraffes? How about cattle? In addition to being home to a diverse array of wildlife, Mpala also manages a number of domestic herbivore species including cattle. This arrangement mirrors rangelands worldwide, where wildlife and livestock often graze side-by-side. However, there is surprisingly little research globally that explores how different herbivore communities influence and alter ecosystems. Does a savanna with only cattle look the same as a savanna with only wildlife? What about a savanna where cattle and wildlife graze together?

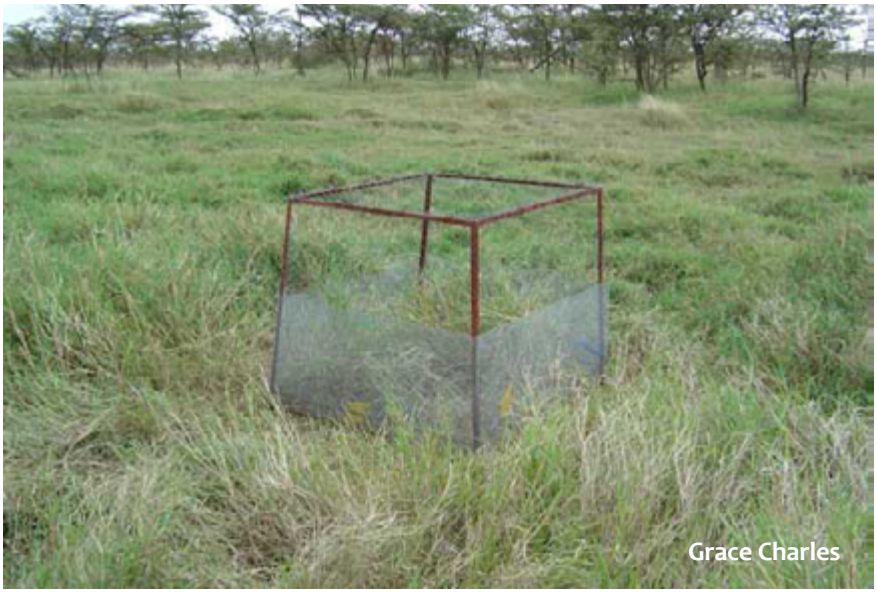
Understanding the role of herbivore identity is becoming increasingly relevant in a world where wildlife species are being partially or completely replaced with domestic species such as cattle. Since 1994, the Kenya Long-term Exclosure Experiment (KLEE) has experimentally manipulated the presence of three different groups of herbivores – mesoherbivores, megaherbivores, and cattle – to better understand the consequences of changing herbivore communities. I am conducting research within these plots to explore how different herbivores influence critical ecosystem functions and services.

One recent project I have been working on asks how different herbivores affect plant productivity. It's a simple, but surprisingly unexplored question. You might expect that because herbivores eat plants, they would reduce plant production. In fact, it's difficult to predict even the most fundamental effects of herbivores on productivity. Some studies from similar savanna ecosystems have reported that herbivores boost productivity, while others have reported the opposite. To add to this puzzle, even herbivores with largely similar diets could affect productivity in different ways because of differences in how or when they eat plants.

My colleagues and I collected data within KLEE to measure the effects of different herbivores on productivity. We measured plant productivity in two ways. First, we used productivity cages to quantify how much plants grew over a given time period. We repeated our measurements multiple times over a period of two years to capture plant productivity in both rainy and dry seasons. Second, we used a series of satellite images to quantify the 'greenness' of the experimental plots in three separate years.

One big surprise from our measurements? Plants grew fastest in plots with cattle. We think this is related to grazing pressure; plots with the highest levels of grazing pressure also tended to have to highest rates of plant productivity. Many of the plants in this ecosystem have evolved under intense grazing pressure and are perhaps well-equipped to compensate for defoliation.

In contrast, we found that plots where all herbivores had been excluded had plant production rates close to zero. This could be the result of plant self-shading, a process where dead uneaten plant matter shades out new plant growth.



The productivity cages Grace and her colleagues used to measure how much plants grew over time.

Finally, we found that wildlife, but not cattle, affected variation in productivity patterns across both space and time. Productivity patterns were more homogeneous when wildlife was present.

Our study highlights the fact that replacing wildlife with cattle may have unintended consequences for how ecosystems look and function. Understanding the influence of different herbivore species will hopefully help us better protect and conserve ecosystems. Stay tuned as we continue to study the impacts of livestock and wildlife, separately and together, on savanna ecosystems. •

Tiny Ants May Pose a Big Threat for Diversity in Laikipia

Patrick Milligan

If you ask locals, they all have a story about a small, shiny ant that steals their cooking oil and sugar. When the seasonal rains come, they retreat into their underground nests, but they strike with full force during the dry months. The "big-headed ants" (*Pheidole megacephala*, which literally means "big head") don't bite or sting humans, but it's hard to ignore the innocuous little insects picking over every unattended scrap of food.

Big-headed ants are a new resident in Laikipia. They are an invasive species, introduced in the last 2 decades to Mpala Research Centre, and to our neighbors at Ol Pejeta Conservancy, Ol Jogi Conservancy, El Karama Ranch, and beyond. When we build a house, dig a well, or drop a few crumbs on the ground during teatime, the ants aren't far behind. They make the most of any nest or food that we (unwittingly) provide, and are exceedingly good colonists.

I might use similar words to describe heroic explorers, but these ants may be problematic for diversity and conservation in Laikipia. Big-headed ants are notorious killers of insects in other ecosystems, especially native ants, and can seriously alter the diversity of the local insect community. What do these ants mean for our beloved Laikipia landscape?

My research seeks to answer some small part of this question. My 'working relationship' with big-headed ants began in 2014: as a research assistant to Dr. Todd Palmer, I spearheaded an experiment in invaded and pristine areas of the Mpala conservation grounds, testing the influence of big-headed ants on native dung beetles and termites. Dung beetles and termites might live in lowly holes and eat nature's refuse, but we can't ignore their importance: these little critters are crucial parts of the natural recycling of dead and discarded materials. I can try to make this project sound fancy, but it involved a lot of cow dung. As in, "multiple-trips-in-a-LandCruiser-with-an-extended-bed" *lot* of dung.

How do you measure the effect of ant invasion on dung breakdown? One dung pile at a time…

Pat wasn't allowed in the dining room because of "flies", according to lab-mate Travis Guy.

Sometimes you just have to suck it up and do the work: the project revealed large losses in insect diversity after big-headed ant invasion, and opened the door to new research ideas. If these ants can disrupt an entire insect community, how will they affect other crucial parts of this savanna?

Native acacia ants (Crematogaster nigriceps) scurry over the domatia on a whistling-thorn acacia. These ants proactively defend the trees against herbivores. By disrupting this protective mutualism, invasions of big-headed ants could lead to reductions in savanna tree cover (Riginos et al., 2015).

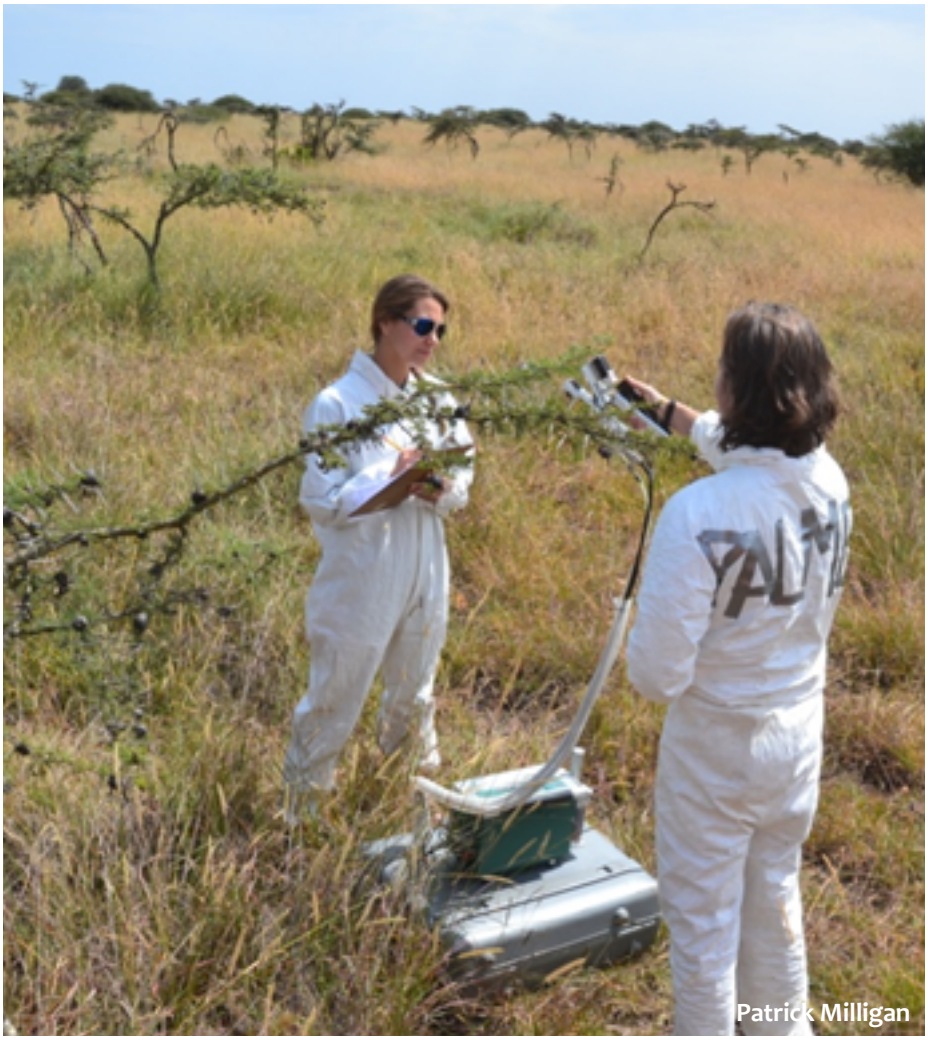
My current research project focuses on another iconic part of the Laikipia landscape: a natural partnership between the whistling-thorn acacia and 4 native ants. These native ants receive sugar-rich nectar and shelter, and in return protect the whistling-thorn acacia from hungry elephants. This ant-plant combo can cover massive swathes of the "black-cotton" savanna, and supports many key savanna processes. But it is not impervious to the spread of big-headed ants.

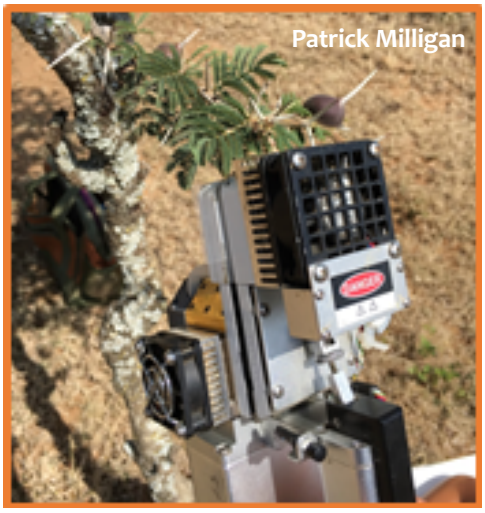
When big-headed ants invade, they kill the beneficial ants and leave entire tree communities unprotected. Acacias have a few backup plans for dealing with herbivores, such as thorns or chemicals in leaves to disrupt digestion. Branches and leaves that are eaten can regrow, chock-full of new chloroplasts — the parts of a leaf cell that turn light, water and carbon dioxide into sugar — as the trees do their best to bounce back. All of these responses require an investment, and the question now arises: Without their ant defenders, can the acacias still make it in their harsh environment? Are the costs of defense too great in a landscape full of elephants, giraffe, and other massive herbivores?

I returned to Mpala in May 2016 to tackle this problem with new tools to answer a complicated question. First up, the LiCor LI-6400: this complicated machine can control humidity, temperature, light, and other conditions in a tiny leaf-sized chamber, and can measure the photosynthesis going on inside of the new leaves growing on invaded acacias. And it all fits in a backpack. University of Florida undergraduate Gabby Mizell accompanied me into the field, making sure that our measurements were stable, that we didn't fall into any aardvark holes, and didn't complain once about the pre-dawn wakeup times. Some people can't cut it in the bush — Gabby handled it like she was born in the savanna.

Our other tools are lower-tech. A new mealworm/beetle farm provides a constant supply of test subjects to study the aggression of big-headed ants. Tubs of sticky insect glue — a natural pest deterrant for gardeners — help us to keep the invaders off of some acacia trees. We use shovels, plastic cups and some soapy water to make hundreds of low-cost ant traps, which we use to survey landscape-scale changes in invasive ant numbers. These are just a few tools for a biologist at Mpala, though many more can be carried in the bed of our trusty LandCruiser.

We tinker with nature in small ways: remove some ants here, water some trees there, add water and fertilizer at times, wait for changes to occur, and measure those changes. The big-headed ant could mean big trouble for Laikipia, which has become my nyumba mbili ("second home") in the last few years. My PhD work aims to understand this invasion at multiple levels: how it affects important insects, plants, and the crucial parts that make an entire ecosystem work. More news to come… •


Patrick Milligan


Patrick Milligan

Is it stable yet? Gabby and Pat clamp the LiCor sensor head onto a whistling-thorn acacia, growing strong in an area still untouched by the invasive big-headed ant.

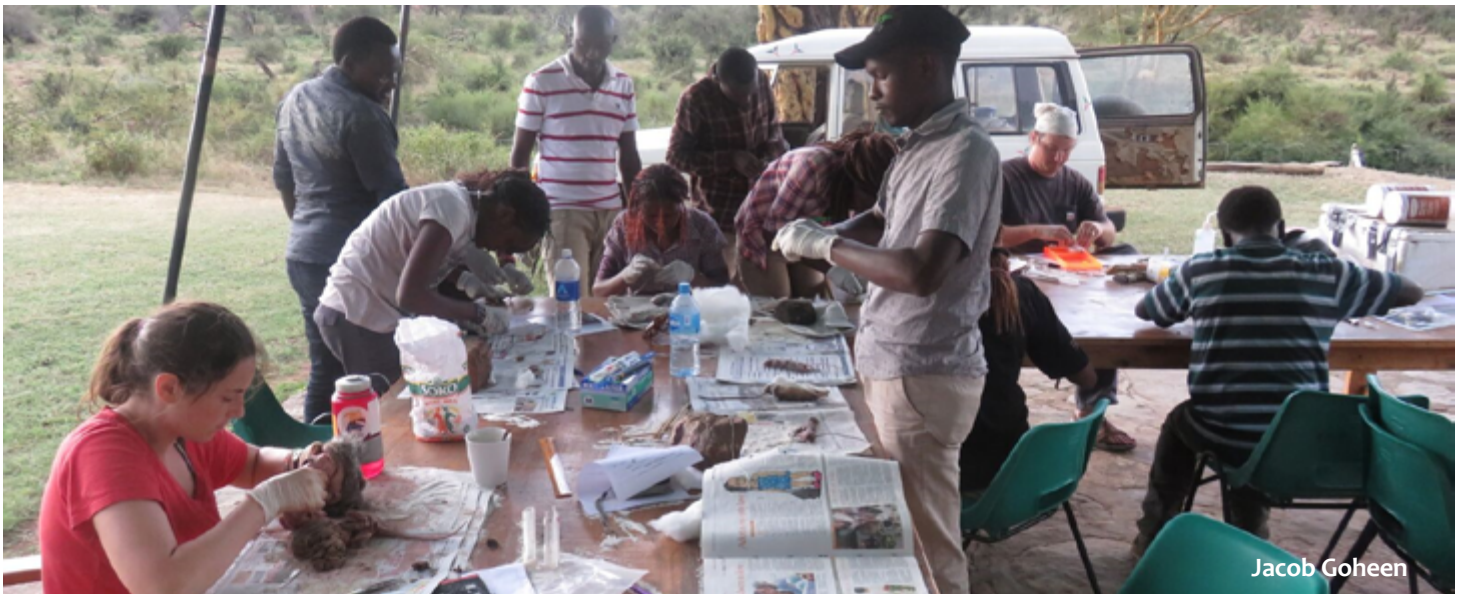
Mpala Mammalogists Train Kenyan Students in Field Methods

Anchal Padukone

For 10 Kenyan ecology students, the week from 15 to 23 August was transformative. These talented young scientists had been selected from over 80 applicants to attend Field Methods in Mammalogy - a course held at Mpala Research Centre and co-led by Dr. Jake Goheen (University of Wyoming), Simon Musila (National Museums of Kenya) and Dr. Adam Ferguson (Smithsonian Institution).

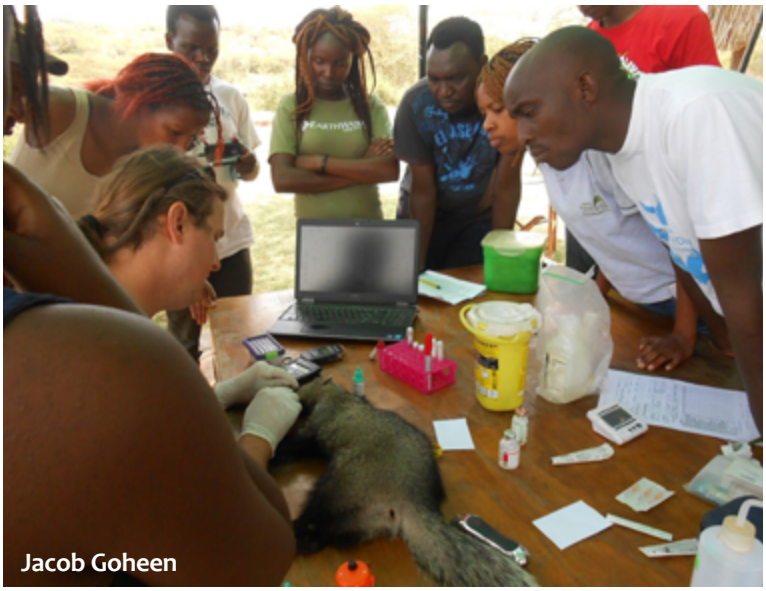
Their fieldwork would start early, often with a pre-dawn foray into the field to check the Sherman traps they had set the previous evening for small mammals. By noon, the students would be analyzing data they had collected or attending one of a series of lectures by seasoned mammalogists. Their training was rigorous and varied. On Friday, they worked painstakingly with an impressive assortment of mammals to prepare specimens for the National Museums of Kenya, making small but valuable contributions to the scientific community in Kenya. Over the weekend, many tried their hand at sampling bats with bat nets for the first time, before listening to a talk by Simon Musila, who studies, among other things, issues affecting human-bat coexistence. On Monday, they travelled down straight line transects across Mpala to record all the dik diks they spotted within a fixed distance from the road, and used this data to estimate the size and density of dik dik populations around Mpala.

Student Noreen Muturo deploys an eartag on a fringe-tailed gerbil.



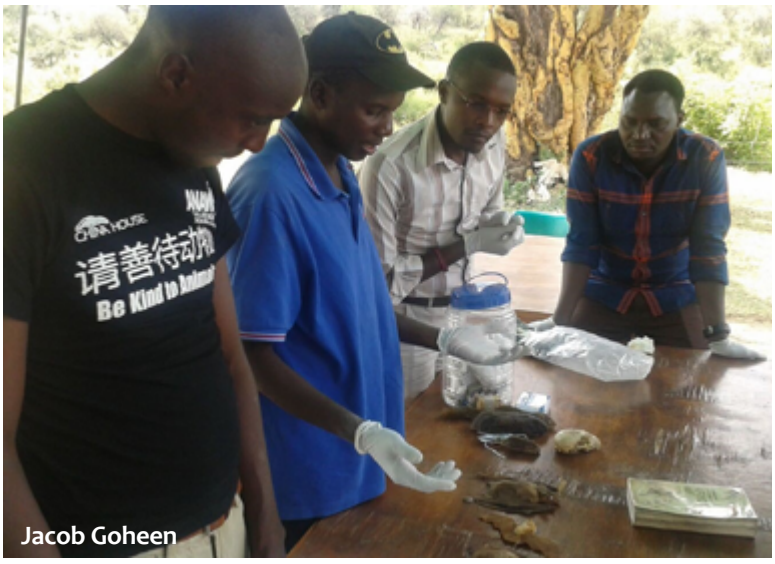
Students and instructors prepare maned rats, northern pouched mice, striped ground squirrels, and other small mammals for the National Museums of Kenya.

From working alongside Kenyan scientists and research assistants, Dr. Goheen had realized that conservation issues in Kenya would benefit from the involvement of more Kenyan biologists, who can speak local languages, unlike western researchers, and build stronger rappports with communities. He and his team founded the course on the belief that motivated Kenyan students deserve the same investment as their western counterparts, even though their home institutions often lack the resources to provide them with research experiences and a similarly rigorous education. With funding from Wyoming Biodiversity Institute, UW Department of Zoology and Physiology and Mpala Research Centre, the instructors and teaching assistants (Rhiannon Jakopak and Brock McMillan) set out to give course attendees learning opportunities that were unavailable to them at their universities. They pushed them to design research questions and field studies that they would carry out, use a variety of statistical software, and trap and handle animals ranging from elephant shrews to jackals. In addition to gaining practical experience and important research skills, the students - most of whom had just completed their undegraduate degrees - also gained an appreciation of the challenges and opportunities faced by Kenyan graduate students and professionals in the field of wildlife management.



Adam Ferguson demonstrates parasite collection on a white-tailed mongoose.

Students praised the course for offering them new experiences and statistical knowledge that would benefit them in their careers. To Amos Chege, it was the "most informative training" he had attended: he pointed out how much he had learned from the instructors and also from his coursemates. Another student, Cyrus Kavwele, vouched that the training would have "multiplier effects" as he would pass on his newly acquired knowledge to colleagues and future students. To Dr. Goheen himself, this field course was "the most gratifying of the six" in which he has been involved since 2002. •



Amos Chege, Simon Musila, Cyrus Kavwele and Kiprop Johnson work to key out museum skin specimens of bats.

With inputs from Dr. Jake Goheen, Rhiannon Jakopak and Wangechi Kiongo.

Laikipia Rabies Vaccination Campaign: Doubling Goals, Increasing Awareness

Anchal Padukone

Every year, about 2,000 people die of rabies in Kenya. A viral disease that causes acute inflammation of the brain and spinal cord, rabies kills almost 100% of its human victims and up to 86% of rabid dogs. In addition to humans and dogs, other domestic and wild mammals may also succumb to rabies, threatening livelihoods and conservation efforts during outbreaks. In the last 5 years, 3 rabies-induced deaths have been reported in the communities surrounding Mpala Research Centre.

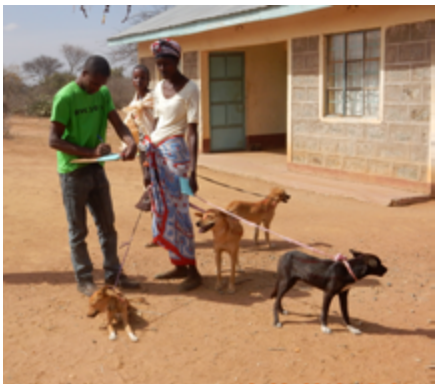
Bites from infected domestic dogs result in about 98% of human rabies cases in developing countries. Intercepting this transmission through mass vaccination of dogs has been effective in reducing rabies incidence around the world.

The Laikipia Rabies Vaccination Campaign (LRVC) started as a localized effort in the communities around Mpala, in which Dedan Ngatia, Karatina University Master's student, had been researching the spatial ecology of domestic dogs. In last year's pilot campaign, 821 dogs and cats were vaccinated across 5 communities.

The 2016 Laikipia Rabies Vaccination Campaign team aimed to expand their coverage to 2000 domestic dogs and cats across 10 communities, still focusing on rural communities that bear the greatest risks, while also targeting a semi-urban centre (Rumuruti).

In total, 4530 domestic dogs and cats were vaccinated against rabies this year.

LRVC 2016 at Il Motiok on September 3. Our dedicated field team included vets, Karatina University student volunteers, Mpala Research Centre staff and researchers, LWF Community Liaison Officers and community organizers from the targeted communities. Kudos to those who joined us for several campaign weekends!



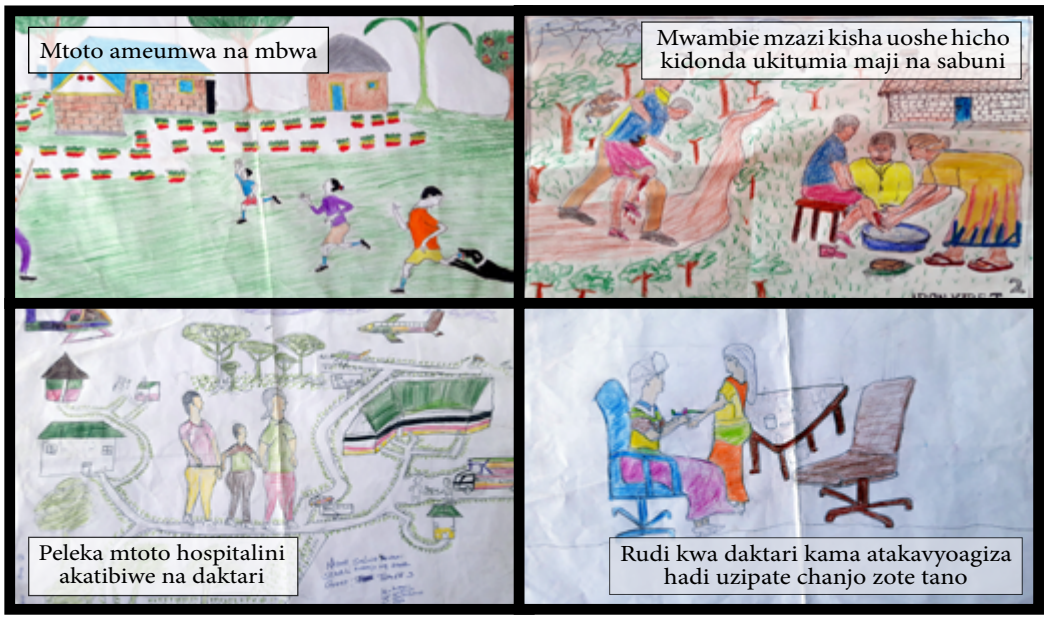
(Left) Karatina university students helped immensely in collecting data, organizing queues and tagging dogs that had been vaccinated. (Right) Our vets demonstrated their love for Laikipia's dogs and cats by sacrificing their weekends and volunteering at LRVC!

This year's significantly scaled-up campaign was coordinated by Mpala researcher Dr. Adam Ferguson, Dedan Ngatia, veterinarian Dr. Dishon Muloi and Mpala Research Centre staff. The team brought on board numerous partners whose support was crucial to the campaign's success, including International Livestock Research Institute (ILRI), the Laikipia County Government, Africa Network for Animal Welfare, Karatina University, University of Liverpool, and the Laikipia Wildlife Forum (LWF).

LRVC 2016 took place over the 5 weekends of September 2016 in the following communities: Dol Dol, Endana, Il Motiok, Il Polei, Koija, Lekiji, Maramoja, Naibor, Ngobit, and Rumuruti.

We thank all our donors and supporters for their valuable contributions to this effort! •

Je wajua utafanya nini ukiumwa na mbwa kichaa?

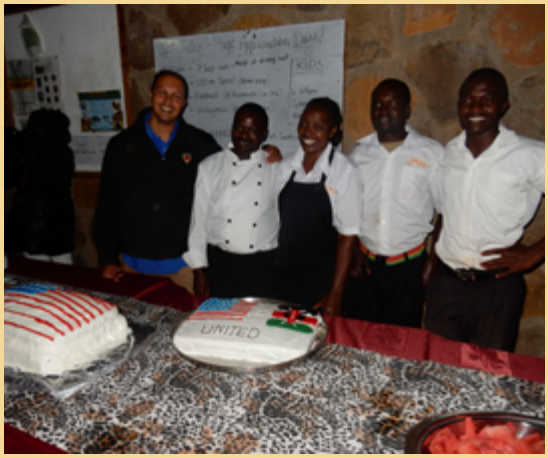


In addition to vaccinating animals, LRVC also aimed to inform Laikipians about the deadly but preventable nature of rabies. Children from the Northern Kenya Conservation Clubs learned about the disease and how to prevent it. They shared this knowledge at Community Conservation Day, and designed panels for a series of outreach posters that were distributed in their communities. This poster aims to raise awareness on how to treat dog bites correctly.

Mpala At A Glance

* The June 2016 Mpala Research Centre and Mpala Wildlife Foundation Board Meeting was held at the centre from **June 25 to 28**.
* Mpala Research Centre hosted 4 interns this year, from the Daraja Academy Transition Program: Caroline Ndanu, Margaret Lokonon, Bilha Akoth and Mary Wanjira. From **June to July 2016**, they worked on a variety of projects, from conducting field research with the Laikipia Zebra Project to assisting with store keeping operations and supply management. All four girls started Bachelor's degree programs at national universities this year.
* Mpala celebrated US Independence Day and Staff Appreciation Day on **July 4**.

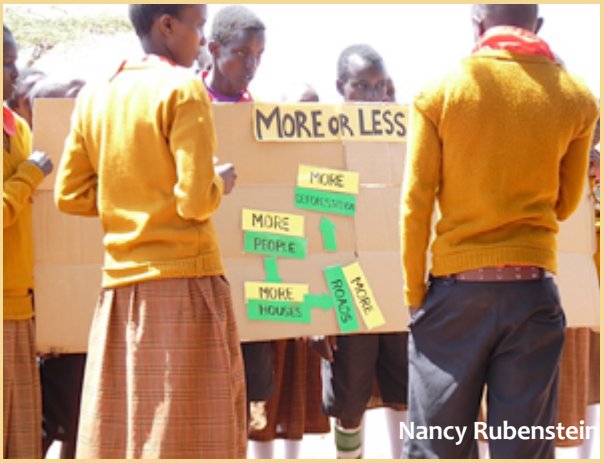
Our Daraja interns at their graduation from the Transition Program.



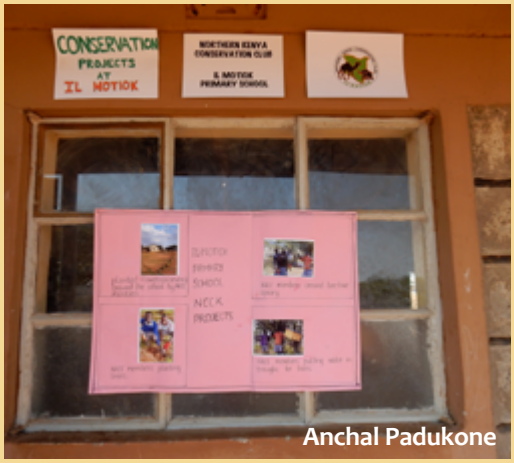
(Left) University of Calgary field school students pose along the hike up MuKenya. (Centre) Dr. Martins and Mpala chefs smile for the camera behind cakes specially baked for July 4. (Right) Students, researchers and staff at Mpala Research Centre enjoy a game of football on Staff Appreciation Day. Other activities included a 7 lap run, 100m sprint, volleyball, and games for children and grandchildren of staff and researchers. Pictures by Danielle Martin.

* 13 students from the University of Calgary visited Mpala as part of a summer palaeontology and geology field school from **July 5 to 8**. They were introduced to the geology, vegetation and wildlife of the area through lectures and field visits with Mpala researchers.
* The 8th Annual Community Conservation Day for the Northern Kenya Conservation Clubs was held on **July 23**. More than 400 students participated in this event, supported by Mpala Research Centre and Mpala Ranch. Community leaders, teachers and scientists from around Laikipia travelled to Kimanjo Secondary School to watch the students share their knowledge though plays, games, songs and poems. The students also demonstrated approaches to conservation that they had adopted in their communities through poster presentations.

Mpala At A Glance



Nancy Rubenstein



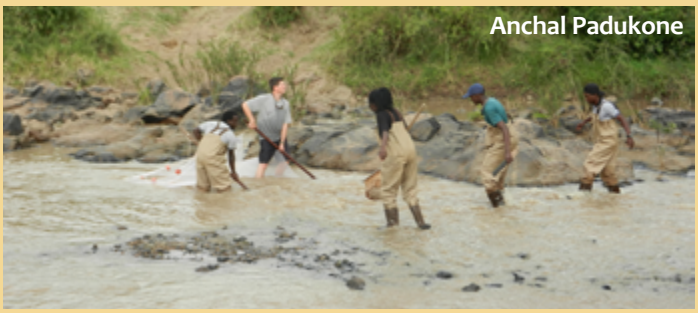
Anchal Padukone

(Left) Conservation Club members play More or Less, a game that encourages them to thinkabout the impact of the growing population on the environment. (Right) Posters at the Conservation Day environmental fair showcase students' conservation projects.

* 20 undergraduates from Makerere University attended a research skills training program hosted by Mpala Research Centre from **July 24 to 29**. The group, which consisted mostly of Wildlife Health and Management students, was led by faculty members, Dr. Joelia Nasaka and Dr. Sente Celsus. The students attended talks and worked on one of four research projects, directed by Dr. Daniel Rubenstein, Dr. Ray Schmidt and Kimani Ndung'u.


Cosmas Nzomo

* On **July 29**, Mpala hosted a meeting between representatives from Naibunga Conservancy, County Government Livestock Department, Northern Rangelands Trust, Mpala Research Centre, FAO and Laikipia Wildlife Forum, among others. The group discussed the effectiveness of different methods of controlling the invasive species, *Opuntia stricta*, from their research and experiences.


Anchal Padukone

(Above) The group from Makerere University, together with Mpala researcher, Daniel Rubenstein. (Below) Makerere students sample fish in the Ewaso Nyiro river with Dr. Ray Schmidt, a previous Smithsonian-Mpala postdoctoral fellow at Mpala.

* This year, Space for Giants hosted three training workshops for magistrates, prosecutors and investigators at Mpala, in collaboration with the Office of the Director of Public Prosecutions, Kenya Wildlife Service, Directorate of Criminal Investigations, and the Judicial Training Institute, among others. The training workshops aimed to build capacity among those involved in prosecuting wildlife crimes and bringing poachers to justice. 78 individuals in total attended one of three workshops, held over the following days: **July 22 to 24**, **August 12 to14**, and **September 30 to October 2**.

Mpala At A Glance

Children on the World Lion and Elephant Day safari ask a Save The Elephants researcher about his work and daily life.

* From **August 12 to 14**, 91 children from Nairobi, Samburu and our own Mpala Academy went on safari in Samburu National Reserve, to celebrate World Lion and Elephant Day. The event was organized by WildlifeDirect, with contributions from several partner organizations, including Mpala Research Centre. During this camping trip, children watched elephants, lions, and other creatures in the wild, listened to the experiences of conservationists, and participated in educational games around a campfire.

* From **August 31 to September 2**,Princeton provost, David S. Lee, visited Mpala Research Centre, together with Pablo Debenedetti (Dean for Research), Paul LaMarche (Vice Provost for Space Programming and Planning) and Anastasia Vrachnos (Vice Provost for International Affairs and Operations). The team met with Princeton faculty and students conducting research at the centre, and learned more about the center's operations and facilities.

* Around 32 members of the Kenya Museum Society visited Mpala from **September 2 to 4**. They enjoyed game drives, wildlife tracking and walks around the conservancy.

(Above) Kimani Ndung'u discusses patterns in vegetation across Mpala with TBI Field School students. (Below) The group from Jomo Kenyatta University of Agriculture and Technology.

* From **September 8 to 25**, 12 students from the Turkana Basin Institute Origins Field School (Fall 2016) were based at Mpala for part of their Ecology module. At Mpala, they studied vegetation ecology, plant-herbivore and plant-insect interactions and predator-prey dynamics.

* On **November 16**, about 45 students from Jomo Kenyatta University of Agriculture and Technology visited Mpala Research Centre as part of a field visit. They attended talks by John Gitonga (UCSB Ecohydrology Lab), Duncan Kimuyu (KLEE), Kimani Ndung'u (Smithsonian Forest-GEO Plot), Charlotte Christensen (Farine Lab, Max Planck Institute of Ornithology) and Jenna Hulke (Young Lab, UCSB), and visited our experimental plots.

* The November 2016 Mpala Research Centre and Mpala Wildlife Foundation Board Meeting was held at Princeton, New Jersey, from **November 19 to 20**.

Mpala Weather Corner