Conservation - Community - Research

Mpala Memos

news from Mpala

Top Story

Painting the Savanna

Staline Kibet

Painting and enumerating trees under a blazing, equatorial sun is not easy work, but our team of twelve has been doing just that since August. You might well wonder why on earth we are doing this. By knowing how many, what kind and what size of trees cover the savanna—and keeping track of those trees over time—we can better understand the ecosystem, guide its sustainable use, and monitor the impacts of climate change. The Mpala Long-term Monitoring Plot is the newest addition to the Smithsonian Institution Global Earth Observatory (SIGEO). SIGEO is a vast network spanning 21 countries where over 4.5 million trees are monitored in large-scale research plots.

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Staline tagging the first tree.
Photo by Margaret Kinnaird.

Research

Using Traditional Plants as Natural Pesticides

Preparing Datura stramonium.
Photo by Lydia Wheeler.

Lydia Wheeler

Can traditional Kenyan medicinal plants be used to combat plant parasitic nematodes? Dwelling inside soil everywhere are a multitude of tiny worm-like creatures called nematodes. While you can't see them with your naked eye, they are responsible for fueling ecosystems and increasing productivity. However, the nematodes I focus on have significant negative effects on agriculture (primarily fruit and vegetable crops such as bananas and tomatoes). By siphoning off nutrients essential to the plant, these nematodes often cause plants to have yellow leaves, smaller root systems, and decreased growth rates.

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Mpala Memories, Part X: Schwarzenberg II

Truman Young and Margaret Kinnaird

Below is the second installment extracted from Adolph Schwarzenberg's 1946 essay, "A Kenya farmer looks at his colony". Schwarzenberg and his wife Hilda (1890-1950) owned Mpala Farm and lived there from 1933 to 1950. After selling their property to Sam Small, they returned to their homeland in Austria. Although the Schwarzenbergs no longer have land in Kenya, descendents of the family own and manage properties in other parts of Africa, including Zimbabwe.

"Mpala has grown since its early days under the efficient management of Mr. Max Benies, a refugee from Bohemia. It is now a farm of 7,500 acres with about 700 head of cattle. Surrounding the farm are electric fences to keep out the smaller animals—monkeys, gazelles, and antelopes—intent on foraging and destroying crops. But it takes more than an electric fence to keep out a hippopotamus; one time a hippo and family broke through the fence and trampled over everything in their path. Animals are also pests when it comes to fruit trees—orange, mango, and papaya; grass monkeys [vervets] and baboons climb them and eat the fruit. The chief insect pest, not only of Kenya and Mpala, but of the greater part of Africa, is the locust. These are hatched by the billions in Abyssinia ...and then fly across East Africa.

Dairy farming has become a profitable venture, and butter from Mpala had been tinned at a rate of up to 1,500 cans a month and sold to the British armed forces. Kenya butter has been famous in England as well. About two years ago, we branched out successfully into hog raising. Besides the maize and lucern we originally grew, we now cultivate potatoes and Madagascar butter beans. Our crops extend over large areas not restricted to the river front. In addition, interesting experiments were being carried on in "soilless" agriculture, and striking results have been achieved by using certain mosses and chemicals. The lawns in front of the houses are always green; flowers bloom throughout the year; and good grass is available in all seasons. Around and near the homesteads it has been possible to cultivate such tropical and subtropical trees and shrubs as Schinus molle, Jacaranda mimosaefolia, Spathodea nilotica, Erythrina tomentosa, Sterculea acerifolia, Acrocarpus fraxinifolia, Olea chrysophylla, *different kinds of eucalyptus, and various species of* Bougainvillea, Thunbergia, Bignonia, Nerium, Plumeria acutifolia, Poinsettia, *and so forth.*

The Ranch House in the 1940's.
Photo provided by Truman Young.

Mpala is indeed an up-and-coming farm in a country where one does not escape from the realities of the world, but where one is able to combat nature, not man, and build for the future."

During Schwarzenberg's time, Laikipia ranches were partitioned into smaller lots by colonial authorities, but over the years they consolidated into larger holdings that were more economically viable. Today's Mpala is comprised of several parcels: two that made up the 7,500 acres

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Dr. Don Scavia

Laura Budd

The Mpala Research Trust welcomes to its board Dr. Don Scavia, of the University of Michigan. Mpala and the University of Michigan formalized their partnership this year, and Don now serves as Michigan's representative on Mpala's Research Trust board. Don's long career has focused on water and aquatic ecosystems, so perhaps last year's record rains are an honorary welcome for Mpala's newest trustee.

Don enjoying one of his favorite pastimes, kayaking. Photo provided by Don Scavia.

Don's career is filled with impressive achievements, but there are two of which he's particularly proud. While working for NOAA (National Oceanic and Atmospheric Administration), he created a coastal ocean and Great Lakes grant program that was the first of its kind to provide multi-million dollar grants for large-scale, long-term research that can deliver better information to decision-makers. Don also helped create computer models that incorporate land use, land cover, and climate change to predict the size of aquatic dead zones (areas so low in oxygen they cannot support fish and other aquatic life) in both coastal regions and the Great Lakes.

Dr. Don Scavia.

As a professor of Natural Resources and Environment and of Civil and Environmental Engineering, Don continues to study how humans influence marine and freshwater ecosystems. Don also serves as Director of Michigan's Graham Sustainability Institute and as Special Counsel to the University of Michigan President for Sustainability. In these roles Don promotes multidisciplinary research and education that support sustainability within Michigan and across the globe.

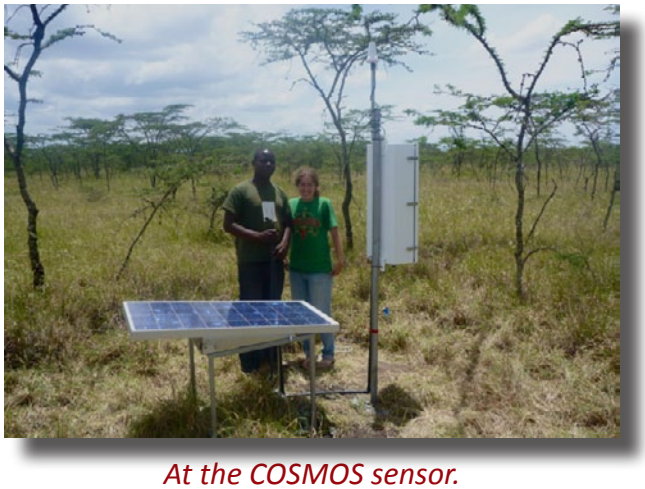
Don first visited Mpala in 2009 in search of a new location to hold undergraduate field courses. His impression then and now is that Mpala's "creative integration of wildlife conservation and active grazing, in the context of social and environmental sustainability, is a terrific place for U-M students and faculty to engage." Michigan now offers field courses for undergraduates and supports masters' projects at Mpala. Don expects that in exchange for education and research opportunities, Michigan can "bring students and researchers to Mpala who can help create a more sustainable enterprise in terms of two key issues—water and energy." Additionally, Don believes that ideas and solutions developed through this partnership can be shared with local communities facing similar challenges.

COSMOS: Measuring Soil Water at the Landscape Level

Trenton Franz

Water retained in soils tells important stories of how rainfall, soil, and vegetation interact. By measuring these interactions we can understand how water moves across the landscape and answer questions about how well the landscape is functioning as a whole. For example, if our goal is sustainable grazing intensification, measuring water availability can help evaluate the impact of different grazing practices on the ecosystem water balance. A critical question might be, "What are the tradeoffs between livestock breaking up soil crust and vegetation loss due to grazing?" By measuring how much rainwater infiltrates into the soil versus runs off the landscape, we can answer such questions.

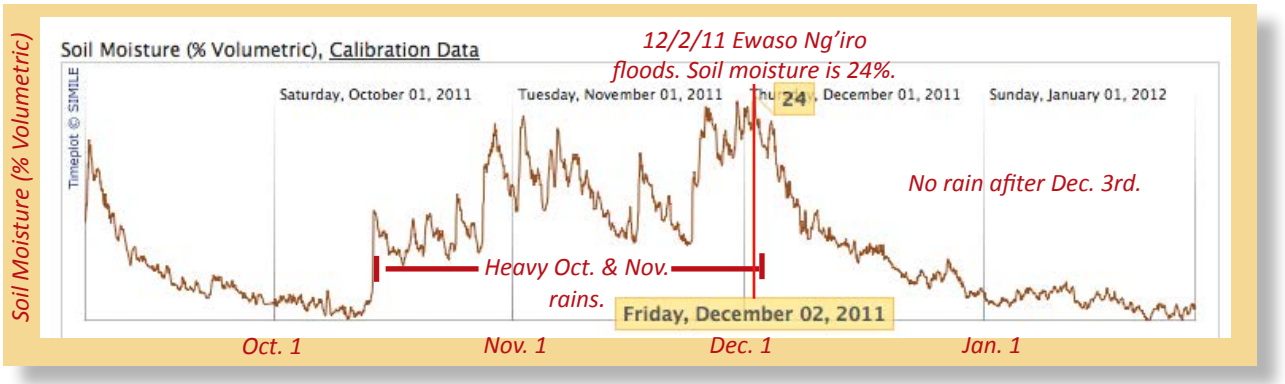
With recent technological advances we are now able to measure changes in soil water at the landscape level. Princeton University and the University of Arizona teamed up last September and installed two cosmic-ray sensors on Mpala. The sensors were developed for the NSF funded COSMOS project (COsmic-ray Soil Moisture Observing System). The sensor works by counting the number of neutrons that pass through a helium gas chamber inside the instrument box, which is mounted above the soil surface. Cosmic rays (yes, cosmic rays! Pieces of atoms that originate in outer space!) bombard and break apart molecules in our atmosphere and in the ground,



At the COSMOS sensor. Photo by Keir Soderberg.

creating a cloud of ambient neutrons zinging around in the air. The density of neutrons is affected by the amount of hydrogen nearby, because hydrogen atoms, are by far the largest absorber of ambient neutrons. Because soil water has a lot of hydrogen atoms the number of neutrons counted over an hour can tell us how much water is in the soil.

Using a satellite antenna, the data are transmitted each hour and made freely available in real-time at http://cosmos.hwr.arizona.edu/Probes/probemap.php (pan over to Kenya and click on balloons). With continued support, we hope to expand the existing network of sensors across Mpala and Kenya. For more information about the project check out http://cosmos.hwr.arizona.edu/ or contact Trenton Franz at tfranz@email.arizona.edu.



Soil moisture data (available online) for the past several months.

Looking for something to do on a sunny afternoon? Find the Dancing Jewel

Dino Martins

Have you ever spotted a Dancing Jewel at Mpala? The Dancing Jewel (*Platycypha caligata*) is arguably one of the most gorgeous of African insects. The male dragonfly is named for the incandescent dance that he performs when courting, which consists of rising and hovering in a sun-spot. Here he waves his turquoise-blue abdomen about while flashing his red-and-white legs in a whirr of glowing color. His thorax is strikingly marked with orange, bronze and yellow stripes against a jet-black 'vest'.

Rivers and streams that flow fast with clean, oxygen-rich water are the best place to look for this species. They disappear from disturbed or polluted waters very quickly. With the rivers and streams of Mpala flowing freely this year, it has been a great year for dragonflies and damselflies. They typically choose quiet areas with emergent vegetation for perching on.

Watching for the Dancing Jewel, and other damselflies and dragonflies, can be a very satisfying and fun experience as they are both colorful and beautiful and engage in a wide range of interesting behaviors including hunting prey, courting and mini-territorial chases. Spend a few moments looking at them when you are next at Mpala—you won't be disappointed!

Questions/Comments about Insects?
insects.eanhs@gmail.com

Dragonfly & Damselfly Facts

- Together they form the Insect order Odonata (Which means 'toothed jaw').
- They are ancient insects, having been on the planet for over 300 million years. Some fossil species whirred above the dinosaurs with wingspans approaching a meter from tip to tip!
- They are voracious predators both as adults and larvae—I've watched one gobble up 40 mosquitoes in under 30 minutes! The dragonfly and damselfly nymphs also feed on mosquito larvae in the water (and anything else they can catch).
- Dragonflies and damselflies are good indicators of water quality as they disappear from polluted or mismanaged rivers, streams and wetlands.

A Dancing Jewel.
Photo by Dino Martins.

Can Widlife and Cattle Benefit from One Another?

Dan Rubenstein

If you ask most American or Kenyan ranchers about wildlife many will bemoan the fact that wildlife eat precious vegetation that could be used to sustain their livestock. But is wildlife the nemesis that it is cracked up to be? In an experiment using Mpala cattle and donkeys, Wilfred Odadi and I along with Meha Jain of Columbia University and Sipke Van Wieren and Herbert Prins of Wagenigen University in the Netherlands, showed that contrary to popular belief, zebras may actually benefit the growth of cattle.

To measure the extent to which competition or facilitation between cattle and zebra operates in semi-arid landscapes like Mpala, we created six experimental cattle herds with donkeys as surrogates for zebras, 4 solely comprised of cattle or donkeys and 2 consisting of 60% cattle and 40% donkeys. We observed what individual animals ate, weighed them at regular intervals to measure growth rate and assessed overall health through intestinal parasite levels in dung.

Weighing one of the donkeys. Photo by Dan Rubenstein.

There are good reasons to think that zebras might be actually helping cattle grow. First, even though cattle and zebras both eat grass, they process food in different ways. Both ferment vegetation in order to extract extra energy from the non-digestible parts of plants. Cattle ferment food in a digestive organ, located before the stomach, whereas zebras—as well as donkeys and horses, their close evolutionary relatives—do so in an organ, located after the stomach. Because of the different locations of fermentation chambers, ruminants must eat higher quality food than equivalently sized zebra, donkeys and horses. Conversely, because fermentation takes place after digestion in zebras, donkeys and horses, they have to eat almost twice as much food as equivalently sized ruminants in order to compensate for decreased digestive efficiency. Therefore, these two different types of grazers often move to different places where foods match their specific dietary needs.

Second, because the foraging of each species alters the rangeland for the other, the changes could enhance—rather than diminish—each other's foraging. Observations over 50 years ago in the Serengeti revealed that zebras often leave grazing areas shared with wildebeest and move to habitats with more food available. Zebras subsist on the abundant but coarse vegetation they encounter and increased the availability of the hidden, higher quality vegetation. Fortunately for the wildebeest, when forced to leave the previous grazing area, they arrive to habitats transformed by zebra that can better sustain them. Although intuitively pleasing as a way of fostering co-existence, the idea of a grazing succession has never been demonstrated experimentally.

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Courses & Student Groups

• This January, 19 biology and computer science graduate students from Princeton University, the Univeristy of Illinois, and the University of Nairobi participated in a course in Tropical and Computational Ecology. Together the students used computer programs to more efficiently answer a variety of ecological questions.

• Also in January, 27 undergraduate students from Cornell University participated in a three-week Behavioral Ecology and Conservation field course. The course was led by Professor Irby Lovette of Cornell University.

2011: The Year in Review

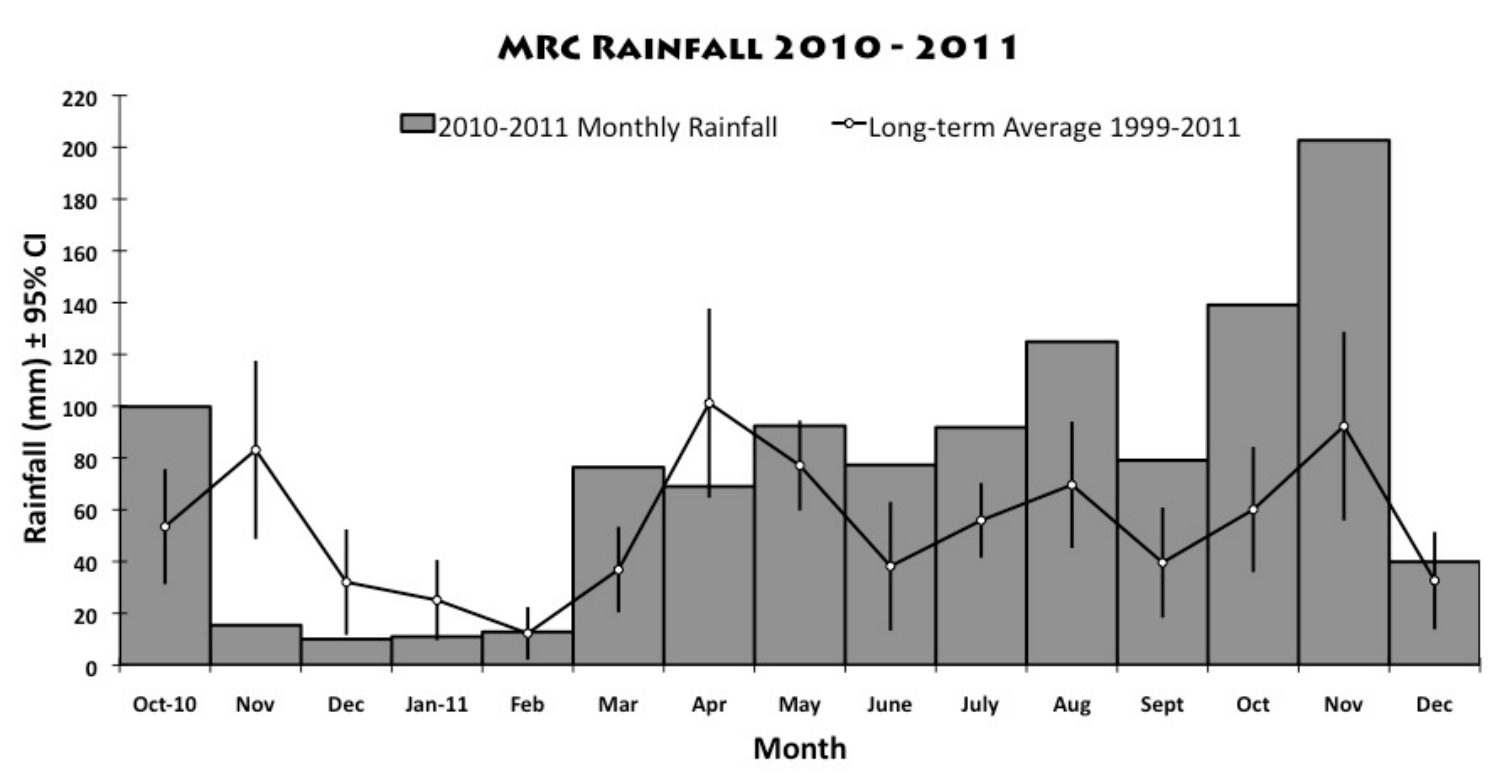
2011 was Mpala's busiest year to date with a record 13,084 bed nights at the research center and campsite—12% more than in 2010. We hosted over 100 independent researchers from over 35 different institutions and organizations from around the world, and 148 students in groups from the University of Nairobi, McGill University, Cornell University, Leeds University, Columbia University, University of Illinois, University of Michigan, Princeton University, and the Institut de Biodiversitat Tropical (Spain).

Events

On December 2, 2011, after a month of heavy rain, the Ewaso Ng'iro rose to record heights. Mpala received over 1,000 mm of rain in 2011, the highest annual rainfall of this century.

The Ewaso Ng'iro River on December 2, 2011.
Photos by Laura Budd.

The Ewaso Ng'iro River on January 5, 2012.
Photos by Laura Budd.



Mpala History

Mpala Memories, Part X: Schwarzenberg II

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mentioned by Schwarzenberg plus two parcels to the north and one in the south. The southern parcel was purchased from J. Fairhall by George Small in 1992. This last addition is where the Mpala Research Centre stands today. Although vervets and baboons continue to snatch the odd papaya from the few remaining ranch-house fruit trees, there are no longer butter beans or potatoes to tempt monkeys or hippos. Large-scale irrigated crop production on the banks of the Ewaso Ng'iro River is no longer sustainable, in part due to burgeoning upstream and downstream human populations, all of whom rely on the river as their lifeline. Today, Mpala focuses on beef production while providing safe haven for Kenya's diverse wildlife and a stimulating landscape for researchers and students from around the world.

The Ranch House today.
Photo by Laura Budd.

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Painting the Savanna

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The first SIGEO plot was established in 1980 on Barro Colorado Island, Panama. The Panama plot has helped answer numerous questions about how forests are structured, how fast they grow and why there are so many kinds of trees in the tropics. Over the years, the SIGEO program has expanded from the wet to the dry tropics and into temperate areas. With the establishment of the Mpala Plot, the SIGEO program is making its first foray into savanna ecosystems.

The acacias fight back.
Photo by Staline Kibet.

The Mpala plot is unique in other ways. At 150 ha, it is the largest SIGEO plot (most are 50 ha or less), and it is floristically simple (we've only identified seven tree species in our first five months whereas other SIGEO plots can hold up to 450 species). Like other SIGEO projects, our team is comprised of national researchers (in our case, partners from the National Museums of Kenya) and local community members trained as research assistants.

"SIGEO is a vast network spanning 21 countries where over 4.5 million trees are monitored in large-scale research plots."

As the only savanna plot in the SIGEO network, we are experiencing unique challenges. Savanna work is a thorny business—the acacias, in cahoots with their ant protectors, put up a spirited fight to keep us away. Many of the trees have multiple stems (the record being 75), each of which must be measured, painted, and tagged. And, of course, we must always keep a watchful eye for elephants, buffalo, and other wildlife.

"So far, we have covered approximately 18 ha, mapping, counting and painting 16,411 trees."

So far, we have covered approximately 18 ha, mapping, counting and painting 16,411 trees. We plan to check on our plants five years down the line to find out which have died and how (uprooted by elephants?), which have grown and by how much, and to measure new trees. Our hope is that Mpala's plot will help us unravel the ecological intricacies that maintain our savanna ecosystems, and by comparing our results with those from other plots around the globe, better understand why the natural world is so diverse.

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Using traditional Plants as Natural Pesticides

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In fact, these nematodes cause over 157 billion US dollars in economic loss and 5-12% loss of total crop yield worldwide every year. Poisons used to control nematodes (e.g., carbofuran and methyl bromide) are harmful to the surrounding environment, contaminating water sources, depleting the ozone layer, and leaving residual toxins. Also, these chemicals are expensive and difficult to obtain. So the race is on to find natural and cheaper alternatives to synthetic poisons. What better starting point than traditional knowledge?

Measuring root ball growth. Photo by Lydia Wheeler.

Based on conversations with local residents of Jua Kali about home remedies and observations about which plants animals and insects tend to avoid, I selected four plants on which to focus: *Aloe arborescens, Datura stramonium, Solanum incanum*, and *Capiscum annuum* (chili peppers). I chopped and ground the plants, then soaked the parts for 72 hours or boiled them in soapy water to form a sprayable solution. I then strained the seeds from the solution, retaining only plant material for application. My experimental fields were in Jua Kali, where I divided, randomized and applied treatments of 10kg solution/ha or 20 kg solution/ha roughly every ten days after maize and tomatoes were planted.

My results showed that these natural plant solutions resulted in significant improvement in the growth and yield of the crops and a significant decrease in the number of parasitic nematodes. This indicates that traditional plant knowledge may be key to creating effective, natural pesticides that are less harmful to the environment.

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Can Widlife and Cattle Benefit from One Another?

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If competition were occurring, then growth rates would be higher and parasite levels lower in herds of only cattle or only donkeys. If facilitation were occurring, the outcomes would be reversed: mixed herds would show higher individual growth rates and lower parasite loads.

The outcomes were striking: facilitation, not competition, occurred between cattle and donkeys. Cattle and donkeys in mixed herds grew faster than in corresponding pure herds. Moreover, parasite levels were reduced in mixed herds. In part these outcomes occurred because donkeys removed the tough forage, which in turn increased the availability of easily digestible grass that cattle prefer. By a different mechanism, cattle enhanced donkey growth. The presence of cattle grazing alongside donkeys dramatically lowered donkey parasite levels so that the health and overall growth rate of donkeys increased.

The fact that donkeys, our surrogate zebras, increase cattle growth suggests that wildlife can be beneficial to ranchers, allowing for healthier, faster growing cattle. In turn, grazing cattle alongside wildlife may make for healthier wildlife populations.

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Mpala Publications 2011

This list is comprised of the publications related to Mpala Research Centre released within the second half of the year (Please see the July 2011 edition of the Mpala Memos for the first half of the year):

Didier, K.A., A. Cotterill, I. Douglas-Hamilton, L. Frank, N.J. Georgiadis, M. Graham, F. Ihwagi, J. King, D. Maller-et-King, D. Rubenstein, D. Wilkie & R. Woodroffe. 2011. Landscape-scale conservation planning of the Ewaso Nyiro: a model for land-use planning in Kenya? Smithsonian Contributions to Zoology (Conserving Wildlife in African Landscapes: Kenya's Ewaso Ecosystem, N. Georgiadis, ed.) 632:105-123.

Frank, L. Living with Lions: Lessons from Laikipia. 2011. Smithsonian Contributions to Zoology (Conserving Wildlife in African Landscapes: Kenya's Ewaso Ecosystem, N. Georgiadis, ed.) 632:73-84.

Frank, L.G., Cotterill, A., Dolrenry, S. Hazzah, L. 2011. The role of carbofuran in the decline of lions and other carnivores in Kenya. In Carbofuran and Wildlife Poisoning: Global Perspectives and Forensic Approaches. Ed. by N. Richards. John Wiley & Sons Ltd., Chichester, pp.70-74.

Franz, T. E., J. Nolan, J. M. Nordbotten, K. K. Caylor, and L. D. Slater. 2011. Quantifying transient soil moisture dynamics using multipoint direct-current resistivity in homogeneous sand. Vadose Zone Journal. 10:286–298.

Georgiadis, N.J. 2011. Introduction: Conserving wildlife in Kenya's Ewaso landscape. Smithsonian Contributions to Zoology (Conserving Wildlife in African Landscapes: Kenya's Ewaso Ecosystem, N. Georgiadis, ed.) 632:1-10.

Georgiadis, N.J., J.G.N. Olwero, Osundwa and G. Aike. 2011. Reassessing aerial sample surveys for wildlife monitoring, conservation, and management. Smithsonian Contributions to Zoology (Conserving Wildlife in African Landscapes: Kenya's Ewaso Ecosystem, N. Georgiadis, ed.) 632:31-42.

Gitahi, N. & K.H. Fitzgerald. 2011. Conserving wildlife on private land: the legal framework for landownership and new tools for conservation. Smithsonian Contributions to Zoology (Conserving Wildlife in African Landscapes: Kenya's Ewaso Ecosystem, N. Georgiadis, ed.) 632:95-104.

Kingdon, J., B. Agwanda, M. Kinnaird, T. O'Brien, C. Holland, T. Gheysens, M. Boulet-Audet, and F. Vollrath. 2011. A poisonous surprise under the coat of the African crested rat. Proceedings of the Royal Society B published online before print August 3, 2011, doi:10.1098/rspb.2011.1169

Lahiri, M., C. Tantipathananandh, R. Warungu, D. I. Rubenstein & T. Y. Berger-Wolf. 2011. Biometric Animal Databases from Field Photographs: Identification of Individual Zebra in the Wild. Proceedings of the ACM International Conference on Multimedia Retrieval (ICMR 2011), Trento, Italy.

Lane, P.J. An outline of the later Holocene archaeology and precolonial history of the Ewaso Basin, Kenya. Smithsonian Contributions to Zoology (Conserving Wildlife in African Landscapes: Kenya's Ewaso Ecosystem, N. Georgiadis, ed.) 632:11-30.

Maclean, J.E., J.R. Goheen, T.M. Palmer, & T.P. Young. 2011. Small mammals limit tree population growth in an African savanna. Ecology 92:1626–1636.

Nuñez, C., C. S. Asa & D. I. Rubenstein. 2011. Zebra Reproduction: Plains Zebra (*Equus burchelli*), Mountain Zebra (*Equus zebra*), and Grevy's Zebra (*Equus grevyi*). Pp. 2851-2865. In: Equine Reproduction, 2nd edition. A. O. McKinnon, E. L Squires, W. E. Vaala & D. D. Varner, eds. Wiley-Blackwell, Ames, Iowa.

O'Brien, T.G. & M.F. Kinnaird. 2011. Density estimation of sympatric carnivores using spatially explicit capture—recapture methods and standard trapping grid. Ecological Applications 21(8): 2908-2916.

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Mpala Publications 2011

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Odadi, W.O., A.S. Abdulrazak, M.M. Karachi & T.P. Young. 2011. African wild ungulates compete with, or facilitate, cattle depending on season. Science 333:1753-1755.

Ogada, D.L. and N.C. Gregory. 2011. Northward extension of the known range of the Bush pipit *Anthus caffer blayneyi* in Kenya and preliminary evidence for a northern breeding population. Scopus 31: 11-18.

Ogada, D.L. 2011. A chronicling of long-standing carbofuran use and its menace to wildlife in Kenya: Threats of secondary Furadan poisoning to scavengers, especially vultures, in Kenya. In: N. Richards (Ed), Carbofuran and Wildlife Poisoning: Global Perspectives and Forensic Approaches. John Wiley & Sons Ltd., Chichester, pp. 74-76.

Riginos, C., J.E. Herrick, S.R. Sundaresan, C. Farley, and J. Belnap. 2011. A simple graphical approach to quantitative monitoring of rangelands. Rangelands 133: 6-13.

Roberts, B. 2011. Perinatal behavior of a wild Grevy's zebra (*Equus grevyi*) mare and foal. Journal of Ethology 30:205-209. Doi: 10.1007/s10164-011-0308-7.

Romañach, S.S., P.A. Lindsey and R. Woodroffe. 2011. Attitudes toward predators and options for their conservation in the Ewaso Ecosystem. Smithsonian Contributions to Zoology (Conserving Wildlife in African Landscapes: Kenya's Ewaso Ecosystem, N. Georgiadis, ed.) 632:85-94.

Rubenstein, D. I. 2011. Family equidae (Horses and relatives). Pp. 106-143. In: Handbook of Mammals of the World, Vol. 2, Hoofed Mammals, D. E. Wilson and R. A. Mittermeier, eds. Lynx Edicions, Barcelona, Spain.

Shrestha, B., Reed, J.M., Starks, P.T.B., Kaufman, G.E., Goldstone, J.V., Roelke, M.E., O'Brien, S.J., Koepfli, K. Frank, L.G., Court, M. 2011. Evolution of a major drug metabolizing enzyme defect in the domestic cat and other Felidae: Phylogenetic timing and the role of hypercarnivory. PLoS ONE 6(3): e18046. oi:10.1371/journal.pone.0018046

Sundaresan, S.R., C. Riginos, E.S. Abelson 2011. Management and analysis of camera trap data: alternative approaches (response to Harris et al. 2010). Bulletin of the Ecological Society of America 92:188-195.

Woodroffe R. and C.A. Donnelly. 2011. Risk of contact between endangered African wild dogs *Lycaon pictus* and domestic dogs: opportunities for pathogen transmission. Journal of Applied Ecology 48:1345-1354. DOI: 10.1111/j.1365-2664.2011.02059.x