

MPALA MEMOS

WELCOME TO THE NEW MPALA MEMOS! WE HOPE YOU ENJOY THE NEW LAYOUT - CLICK ON THE TITLES BELOW TO READ THE FULL ARTICLE!

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- CHRISTINE PESSI, DARAJA ACADEMY
- CAROLINE STONE, PRINCETON UNIVERSITY
- EMILY CHEPYATICH, DARAJA ACADEMY
- EVERLYNE PURKICH, DARAJA ACADEMY

MPALA UPDATES

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INVESTIGATING THE IMPACTS OF WATER AVAILABILITY ON AGRICULTURAL SYSTEMS NEAR MOUNT KENYA



Drew Gower

Mt Kenya, with a peak elevation of 5,200 masl., towers over the surrounding landscape of savannas and low hills, which gradually becomes desert to the North and West. Because of its prominence, the mountain creates a steep gradient in precipitation of more than 1,000 mm/yr. from the base to the upper slopes. This extraordinary endowment of water resources has allowed the local population to turn the region into an agricultural oasis producing specialized crops such as coffee, tea and cut flowers.

using gasoline pumps to provide irrigation for their crops. This migration, occurring farther and farther into the savanna, creates a tight coupling, and sometimes tension, between the more established water users closer to Mount Kenya and the subsistence farmers downstream.

The effects of climate change threaten to exacerbate these tensions by lowering rainfall in the savanna and increasing the rate of snowmelt on the mountain's summit.

MARY PIRORIS

DARAJA ACADEMY

I am from Laikipia County, and am a form four graduate from Daraja Academy. Daraja Academy started a transition program with Mpala that allows me to work with the Mpala Primary School. The school has inspired me very much; I now know that my ideal career is teaching. I hope to join a teaching college very soon. The program has created a bright future for me and allowed me to share my skills with the community. [Photo by Stefanie Siller]



THE EFFECTS OF CLIMATE CHANGE THREATEN TO EXACERBATE THESE TENSIONS ...

These changes will only make farmers more dependent on highly intermittent river flows, creating a need for increased regional cooperation. Recently, water users along neighboring stretches of the rivers have formed Water Users' Associations (WUAs) to coordinate withdrawals and respond to conflicts. Although a step in the right direction, the WUAs are spatially disjointed and have very little ability to enforce water use limits.

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In contrast, the savannas surrounding Mount Kenya have primarily been used for grazing. As the region's population has grown, rangeland degradation has forced many pastoralists to turn to agriculture. In search of reliable water sources, these herders-turned-farmers have begun to move into the river valleys emanating from the mountain,



*The Likii River.
Photo by Drew Gower.*

INVESTIGATING THE IMPACTS OF WATER AVAILABILITY ON AGRICULTURAL SYSTEMS NEAR MOUNT KENYA



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*Map of Laikipia.
Image created by Drew Gower.*

Our team, which includes researchers from Indiana University, Princeton University, Cornell University, Oberlin College, Dartmouth College and the University of Colorado, has come together to better understand the challenges facing water users in the Laikipia region. The objectives of this project are to estimate the availability of agricultural water for communities in upstream and downstream areas, to evaluate the effectiveness of WRUAs in coordinating water usage among communities and to better understand the effects of water availability on household income and food security.

This summer, our field team plans to address the first objective through two separate activities. First, we have organized, in collaboration with the local WRUA, an abstraction survey of the Likii River to catalogue the volume and distribution of water withdrawals for irrigation and household use. Second, our field team will collect hydrological data in the form of river discharge and precipitation records, groundwater levels and pumping test results.

By combining these results, we hope to build a more comprehensive picture of the current and historical impacts of agriculture on water availability in the region.

To address the second and third objectives, our team will also visit 26 community water projects in 5 different WRUAs. During these visits we will carry out a series of interviews at the project manager and household levels to better understand how the communities manage water distribution and how members use this water to maximize their agricultural production. Additionally, we plan to map the distribution network in each community and measure flow rates at pipes leading to selected households, allowing us to estimate the amount of water received by individual members as well as that water lost to leakage.

Our team plans to return to Kenya next summer to continue these activities. In the meantime, we will share the preliminary results with the executive committees of each water project as well as the water project members. We hope that it will then be useful in managing future water use and in troubleshooting problems in the systems themselves. ■

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*A local shamba (farm).
Photo by Drew Gower.*

TESTING DARWIN'S THEORY OF BIOTIC AND ABIOTIC INTERACTIONS IN HIBISCUS PLANTS



Allison Louthan



Hibiscus plant species.
Photo by Allison Louthan.

My work at Mpala is testing an idea first proposed by Charles Darwin more than a century ago. Darwin knew that factors like water and temperature (a.k.a. abiotic stressors) as well as predation, competition, and herbivory (a.k.a. biotic interactions), were important for determining the geographic range of a species. While most of his contemporaries assumed abiotic stress was the most important driver of species' range limits, Darwin speculated that abiotic and biotic factors vary systemically in importance across stress gradients. He suggested that abiotic factors were most important in determining the limits of a population's range only in the most stressful places, whereas biotic interactions were more important

in unstressful areas. In other words, plant populations' performance or density should be negatively influenced where the climate is severe or unsuitable. Conversely, where the climate is less severe or more suitable, density or abundance should be limited by one or all of the biotic factors mentioned above.

I am using an understory Hibiscus plant species as a model organism to examine Darwin's hypothesis. I am comparing population performance inside and outside of the UHURU exclosures, the large exclosures arrayed across the North-South aridity gradient on the red soil. The presence and absence of mammals inside and outside the exclosures and their position along this declining rainfall gradient allows me to examine the relative importance of large mammalian herbivory and abiotic stress (aridity) on plant populations' performance and abundance. I am also studying the relative importance of neighbors and pollinators across this aridity gradient.

MY WORK AT MPALA IS TESTING AN IDEA FIRST PROPOSED BY CHARLES DARWIN MORE THAN A CENTURY AGO

So far, my work suggests that some biotic interactions do vary systematically in importance across abiotic stress gradients, exerting stronger effects in wetter, presumably less stressful areas, as Darwin predicted. For example, consistent with Darwin's hypothesis, herbivores limit plant populations more strongly in wetter areas, with weaker effects in more arid areas. However, other types of interactions do not show support for Darwin's hypothesis.

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TESTING DARWIN'S THEORY OF BIOTIC AND ABIOTIC INTERACTIONS IN HIBISCUS PLANTS



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For example, Darwin's hypothesis suggests that neighbors should be more important in mesic areas and less important in arid areas.

However, my results show that the strength of, neighbors' effects depends only on herbivore presence: in the presence of herbivores, neighbors improve plant performance regardless of rainfall level, likely because neighbors offer physical protection from herbivores. Conversely, neighbors exert weak competitive effects, regardless of



Alison resurveys marked and mapped Hibiscus meyeri plants for multiple years, measuring survival, growth and reproduction across the aridity gradient at Mpala. Unfortunately, many plants live underneath acacia trees, which makes measuring them difficult.
Photo by Allison Louthan.

rainfall level, in the absence of herbivores. Thus, when and where biotic interactions affect populations most strongly depends on the interaction in question.

One of the most fundamental applications of my work at Mpala, which I am beginning to explore, is how best to predict shifts in species' ranges with climate change. There is some evidence that including biotic interactions in species distribution models can sometimes improve predictions; however, we do not yet know where we can accurately predict shifts in distribution using abiotic variables alone (such as temperature and

precipitation) vs. where we need to identify and quantify biotic interactions in order to accurately predict future distributions.

To determine whether we can improve the accuracy of species distribution models by incorporating biotic interactions, I am currently assembling data from museums to construct predictions of changes in geographic distributions for three Hibiscus species that occur at Mpala. Accurate predictions of changes in species' geographic distributions are critical to developing effective conservation tactics that will protect and maintain biodiversity because we can use these predictions to prioritize land for conservation, rangeland, or farmland. ■

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MAX SILVER

PRINCETON UNIVERSITY

This summer at Mpala, I am conducting field work for my undergraduate senior thesis. The primary purpose of my study is to better understand the social network and group dynamics of the fluid and non-hierarchical Grevy's zebra compared to the multitiered plains zebra. I collect my data by driving fixed routes within Mpala every day searching for both plains and Grevy's zebras. I hope to use my findings to illuminate why the plains zebra has flourished while the Grevy's zebra has become endangered, and ultimately to help conserve the endangered Grevy's zebra. I use this information to create social networks for each species by determining each individual's associates during each sighting. [Photo by Max Silver]



WHAT DO MOSQUITOES CARRY?



David Tchouassi

“Mosquitoes are my best friends!” While most individuals try to avoid mosquitoes at any cost, David Tchouassi, a post-doctoral research fellow at icipe, has dedicated his studies to the pesky insect. His ultimate goal is to understand the effect of biodiversity change on arboviral disease ecology.

Mpala offers a unique context for his research due to the direct interface between wildlife and livestock. David is working with Dr. Vanessa Enzenwa in the KLEE plots to capture mosquitoes within the different enclosure treatments. He is looking at how mosquito abundance and species diversity vary across the various KLEE plots, as well as variations in the viruses the mosquitoes carry. Analysis of mosquitoes that are freshly blood fed will also provide information on the specific host(s) that they feed on.

Discovering which viruses are most common in different

areas is particularly important for both wildlife and human populations. Arboviruses are viruses transmitted by arthropods such as mosquitoes, sand-flies, biting midges and ticks, and usually circulate among animal populations but can accidentally spread to humans. Examples of diseases caused by

these viruses include dengue, yellow fever, west Nile, and rift valley fever. Mild forms of these diseases usually present with fevers, weakness and muscle pain which can easily be misdiagnosed as malaria. Understanding where these different viruses circulate is therefore crucial.

Environmental conditions such as rainfall heavily impact the success of mosquito trappings in the field. It has been quite dry in the field and as a result he has been recording very low mosquito captures in the plots during this period.

David set up his traps around the research centre as he was curious why he was not capturing many mosquitoes in the field. In one of these traps, he caught two mosquitoes, one of which was an Anopheles species. However, he needs to confirm the identity of this anopheline mosquito using microscopy to ascertain if it is one of the known malaria vectors in Kenya.

Though only a few weeks in, David is already starting to unravel a pattern in mosquito number and diversity variation between plots, so stay tuned for further findings! ■

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*A carbon dioxide-baited CDC light trap used for mosquito trapping.
Photo by David Tchouassi.*

CHRISTINE PESSI (TINA)

DARAJA ACADEMY

I just finished high school last year at Daraja Academy. I am from Dol-Dol. At Mpala, I have an internship with the environment conservation clubs, NKCC (Northern Kenya Conservation Clubs). After my internship, I hope to attend university in September. I love Mpala, it's a nice place to be! [Photo by Stefanie Siller]



FLORAL FORAGERS: THE HAWKMOTH POLLINATORS OF MPALA



Dino Martins

Hawkmoths are just one family of insects in Laikipia that often go unnoticed, but are just as important to the ecosystem as large mammals. As hawkmoths are faithful visitors to flowers, they pollinate many different species of plants. In fact, 4 % of Kenya's flora is pollinated by hawkmoths (this works out to over 250 species of plants!).



*Verdant Hawkmoth visiting some Pentanisia flowers.
Photo by Dino Martins.*

As many of us make your way back to camp at dusk after a long days' work, the hawkmoths of Mpala are just waking up and heading out to feed from flowers. You often glimpse them swirling by in the headlights of a car as many of the plants they feed on grow on roadside verges.

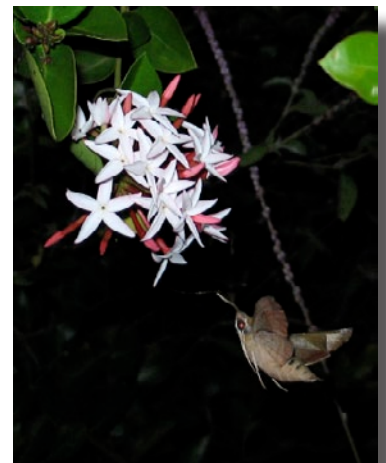
There are some 12 species of hawkmoths, also known as sphinx moths (Sphingidae, Lepidoptera) on Mpala, which is typical for the drier parts of Laikipia. Among the more common ones are the large Convolvulus Hawkmoth, the Comma Hawkmoth, the Lined Sphinx and the Verdant Sphinx.

They are gregarious feeders and visit a wide range of flowers including species of Jasminium, Datura, Pentanisia and Maerua. They feed from flowers with their long tongues (proboscis) that they keep coiled up when not in use. Many plants are pollinated exclusively by hawkmoths in Laikipia including the lovely Conostomium, with long, narrow brilliant white flowers (you can find this

remarkable wildflower growing among the rocks just above the research centre between the staff quarters and the airstrip).

In the Mukogodo forest and the riverine forests near Nanyuki, it is hawkmoths that pollinate the Comet Orchids, with their long tapered spurs that are filled with nectar. Hawkmoths are specialised pollinators that have co-evolved with a range of flowering plants in East Africa and the tropics at large.

What is amazing in terms of co-evolution between hawkmoths and flowers is the close match of the lengths of the hawkmoths' tongues and the tubes/spurs of the plants that they pollinate. One interesting discovery is that while hawkmoths are often exclusive pollinators of some of the longest tubed plants, they remain generalist and opportunistic foragers that visit a wide range of plant species. This asymmetry in the co-evolution between hawkmoths and flowers is interesting and suggests that interactions between plants and their pollinators is complex with many details remaining to be understood in East Africa.



Comma Hawkmoth visiting Carissa spinarum.

Please spend a few minutes during your sundowners appreciating the hawkmoths at Mpala – you won't be disappointed! ■

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Send any insect-related questions or observations to the Insect Committee of Nature Kenya: insects.eanhs@gmail.com

STUDENTS FROM INTERNATIONAL AND KENYAN UNIVERSITIES CONDUCT RESEARCH AT MPALA DURING THE SUMMER - BETWEEN JUNE AND AUGUST OF 2013 OVER 90 STUDENTS HAVE STUDIED AT MPALA!



CAROLINE STONE

PRINCETON UNIVERSITY

The big headed ant, *Pheidole megacephala*, is listed as one of the world's 100 worst invasive species. It has been present at the research center (in and around the dining hall and bandas) for a while, but has just recently spread to the surrounding bush. Using sardine bates, I have mapped the invasive front as the ants spread on the red cotton into UHURU South and up the river road, but have not yet reached the black cotton. They have totally wiped out the acacia ant communities in their territory, as well as most of the ground ants. Because of their dominance in the insect world, I am interested if they offer their host plants protection from insect herbivory. I am monitoring insect herbivory damage on solanum plants with BHA at the base, as well as plants where the ants have been experimentally removed.

[Photo by Morgan Pecora-Saipre]



A view from MuKenya. Photo by Matt Snider.



EMILY CHEPYATICH

DARAJA ACADEMY

I was born in Kacheliba, a place near the border of Kenya-Uganda. I studied in Daraja Academy of Kenya, and got good grades to take me to the next level of education. I want to be a Researcher in Education. At my internship in Mpala Research Centre, I work with the Grevy Zebra team. It has been one of the most amazing things I have ever done in my life. I gratefully appreciate everybody in Mpala who has made my internship a success. [Photo by Stefanie Siller]

SPECIAL THANKS TO... FRIENDS OF MPALA



Donor support allows Mpala to focus on our core goals of education, outreach and wildlife conservation and every donation, no matter the amount, is important to us. We offer our heartfelt thanks to all our Friends of Mpala listed below who generously contributed to our 2012 annual fundraising drive.

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- Mpala says goodbye and good luck to Enock Odera! After 3 years of at Mpala as the elephant monitoring project coordinator, Enock will start his master's degree in September at the University of Nairobi studying Biology of Conservation - he received a STRI/Levinson Fellowship to complete his master's. We welcome Sandy Oduor who recently graduated from Moi University with a BSc in Wildlife Management and the incoming coordinator.
- Dr. Ryan Sensenig taught a field biology course for 10 students from Goshen College in June.

Events

- On Saturday July 6th, Mpala hosted Discovery Day! 15 researchers gave short, 5-minute popular talks about their research to over 100 students, researchers and community members.
- The Mpala Girls Empowerment Project hosted a Mpala Mentorship Day on June 1st for 16 Daraja students - students went into the field with six researchers to explore and learn about their experiments.
- On June 28th Shivani Bhalla of Ewaso Lions presented on her research and career in conservation to students at Daraja Academy as part of the Women in Leadership Outreach Lecture Series of the Mpala Girls Empowerment Project.
- Kimanjo Secondary School hosted Mpala's 5th annual Community Conservation Day on July 20th. Look for the article in the next memos!



*Enock takes a closer look to identify the individuals.
Photo by Enock Odera.*

- We also say goodbye to Morgan Pecora-Saipe, the outgoing Princeton in Africa Fellow, and welcome incoming fellow Stefanie Siller!

Courses & Student Groups

- 5 Kenyan and 15 Princeton undergraduate students are visiting Mpala for a five week class titled 'Documentary Filmmaking in Kenya: The Art of Science Storytelling.' The students are creating films based on research and programs at Mpala - keep an eye out to catch their films!
- Dr. Todd Palmer and Wayne Sentman led a 4 week field biology and conservation course for 19 undergraduate students from the University of Florida in May.



A glimpse of Community Conservation Day: students from Naiperere Primary School performed a dance and song to encourage community members to conserve their environment. Photo by Morgan Pecora-Saipe

EVERLYNE PURKICH

DARAJA ACADEMY

I studied at Daraja Academy of Kenya. I come from Kacheliba in the border of Kenya-Uganda. At Mpala, I work with the UHURU Project. I like playing and watching football and having fun with my friends during my leisure times. In the future, I would like to be a teacher and environmentalist. [Photo by Stefanie Siller].



This list is comprised of the publications related to Mpala Research Centre released within the first half of this year:

Bergstrom, B.J. 2013. Would East African savanna rodents inhibit woody encroachment? Evidence from stable isotopes and microhistological analysis of feces. *Journal of Mammalogy* 94: 436-447.

Crall, J.P., C.V. Stewart, T.Y. Berger-Wolf, D.I. Rubenstein, and S.R. Sundaresan. 2012. HotSpotter - Pattern Species Instance Recognition. *IEEE Workshop on Applications of Computer Vision*, January, 2013.

Chandler, M., D.P. Bebber, S. Castro, M.D. Lowman, P. Muoria, N. Oguge, and D. I Rubenstein. 2012. International citizen science: making the local global. *Frontiers in Ecology and the Environment* 10: 328-331.

Dixit, A., S. Levin, and D. I Rubenstein. 2012. Reciprocal insurance among Kenyan pastoralists. *DARPA. Theoretical Ecology* 6(2): 173-187. DOI: 10.1007/s12080-012-0169-x.

Donihue, C.M., L.M. Porensky, J. Foufopoulus, C. Riginos, and R.M. Pringle. 2013. Glade cascades: indirect legacy effects of pastoralism enhance the abundance and spatial structuring of arboreal fauna. *Ecology* 94: 827-837.

Goheen, J.R., T.M. Palmer, G.K. Charles, K.M. Helfen, S.N. Kinyua, J.E. Maclean, H.S. Young and R.M. Pringle. 2012. Piecewise disassembly of a large-herbivore community across a rainfall gradient: The UHURU experiment. *PLoS One* 8 (2): e55192.

Isbell, L.A., J.M. Rothman, P.J. Young and K. Rudolf. 2013. Nutritional benefits of *Crematogaster mimosae* ants and *Acacia drepanolobium* gum for patas monkeys and vervets in Laikipia, Kenya. *American Journal of Physical Anthropology* 150: 286-300.

Martins, D.J. and S.D. Johnson. 2013. Interactions between hawkmoths and flowering plants in East Africa: polyphagy and evolutionary specialization in an ecological context. *Biological Journal of the Linnean Society*. DOI: 10.1111/bij.12107

Palmer, T.M. and A.K. Brody. 2012. Enough is enough: The effects of symbiotic ant abundance on herbivory, growth and reproduction in an African acacia. *Ecology* 94: 683-691.

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Pilowsky, J.A. and D.R. Rubenstein. 2013. Social context and the lack of sexual dimorphism in song in an avian cooperative breeder. *Animal Behaviour* 85: 709-714.

Porensky, L.M. and T.P. Young. 2013. Edge-effects interactions in fragmented and patchy landscapes. *Conservation Biology* 27 (3): 509-519.



*Dr. Todd Palmer teaching Daraja students at Mpala Mentorship Day.
Photo by Todd Palmer.*

Porensky, L.M., S.F. Bucher, K.E. Veblen, A.C. Treydte, and T.P. Young. 2013. Megaherbivores and cattle alter edge effects around nutrient hotspots in an East African savanna. *Journal of Arid Environments* 96: 55-63.

Rubin, B.E., R.M. Anderson, D. Kennedy, T.M. Palmer, and M.L. Stanton. 2013. Polygyny in the nest-site limited acacia-ant *Crematogaster mimosae*. *Insectes Sociaux* 60: 231-241.

Schumer, M., R. Birger, C. Tantipathananandh, J. Aurisano, M. Maggioni, and P. Mwangi. 2013. Infestation by a common parasite is correlated with ant symbiont identity in a plant-ant mutualism. *Biotropica* 45:276-279.

Soderberg, K., S. P. Good, M. O'Connor, L. Wang, K. Ryan, and K. K. Caylor. 2013. Using atmospheric trajectories to model the isotopic composition of rainfall in central Kenya. *Ecosphere* 4(3): 33. <http://dx.doi.org/10.1890/ES12-00160.1>

Soderberg, K., S.P. Good, L. Wang, and K. K. Caylor. 2012. Stable isotopes of water vapor in the Vadose Zone: A review of measurement and modeling techniques. *Vadose Zone Journal* 11 (3): DOI: 10.2136/vzj2011.0165.

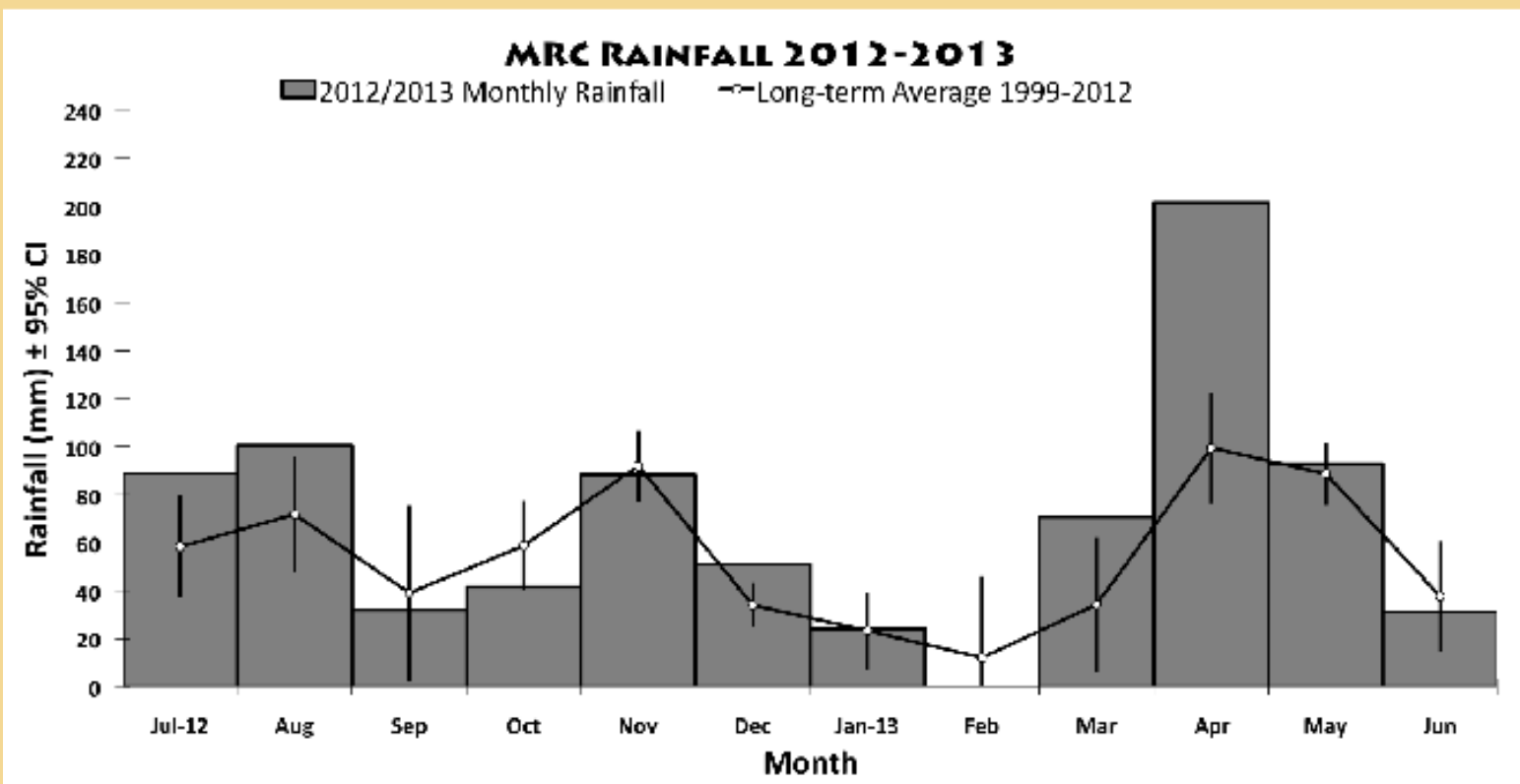
Yusuf, A.A., R.M. Crewe, and C.W.W. Pirk. 2013. An effective method for maintaining the African termite-raiding ant *Pachycondyla analis* in the laboratory. *African Entomology* 21(2): 132-136.

Yusuf, A.A., I. Gordon, R.M. Crewe, and C.W.W. Pirk. 2013. Prey choice and raiding behavior of the Ponerine ant *Pachycondyla analis* (Hymenoptera: Formicidae). *Journal of Natural History*, DOI:10.1080/00222933.2013.791931.

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*Daraja students out with Michael Brown to observe Grevy's zebra on Mpala Mentorship Day.
Photo by Michael Brown.*



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