AMBOSELI TRUST FOR ELEPHANTS

Annual Research Report 2018

MISSION STATEMENT FOR ATE SCIENCE AND RESEARCH: *ATE is a trailblazing project and the longest continuous elephant research programme in the world. We contribute to knowledge of large mammal socioecology, provide a basis for public understanding and concern for elephants and their ecosystems, and communicate information enhancing conservation in the Amboseli ecosystem and for regional and global elephant populations.*

Introduction

In a unique, continuous effort for over 46 years, the Amboseli Elephant Research Project (AERP) has worked alongside our partners in the ecosystem: the Kenya Wildlife Service, the Group Ranches, the communities, the Big Life Foundation and other NGOs. AERP supports them with science and knowledge about elephants, their habitats and lives. Our annual report aims to provide background information for all our ecosystem partners on the health and status of the Amboseli elephant population derived from long-term monitoring of individual elephants over their lifespan. We thank all our partners, collaborators and donors for their sustained interest in our research results and for protecting the elephants and ecosystem of the Amboseli Basin.

I. Long-Term Monitoring

(a) Background environmental context

Since 1972, based on individual recognition and re-sightings of known individuals, we have followed the life histories of 3428 elephants, of which 1749 (800 males and 949 females) were alive at the end of 2018. Our results can be used to predict population structures and dynamics under a variety of negative conditions – ivory poaching, trophy hunting, or hostile interactions with humans. These pressures represent significant threats to elephants across Africa, and result in local population extinctions across Africa, further fragmenting elephant populations. AERP's contribution to understanding population dynamics results from the relatively undisturbed, well protected nature of the intensively monitored Amboseli population.

Long-term studies are increasingly important for modelling the future of animal populations, given uncertain and fluctuating climate regimes. While still a brief study in some contexts, such as an elephant's potential lifespan of longer than 75 years, the duration of our study allows us to model ecological and landscape responses to any changes over a period of increasingly unpredictable climate dynamics.

Even given the erratic nature of the impacts of global climate change, 2018 was a year of unexpectedly high rainfall in the Amboseli Basin, leading to flooding, flamingos and abundant forage for grazers such as elephants. This unexpected abundance, following two years of average rainfall but long dry seasons, resulted in many females in oestrus, much mating, and, we anticipate, many calves born over the next two years. This also pushed a significant increase in male-male competition, as so many males came into musth.

Total rainfall within an annual rain-year (Oct-Sept) has not changed significantly over the duration of the study. Slightly greater variation is seen in the short rain months of December and January in the period after the 1980s, which is when NASA data suggestion that there was an acceleration in the rate of change in climatic responses to atmospheric CO^2.

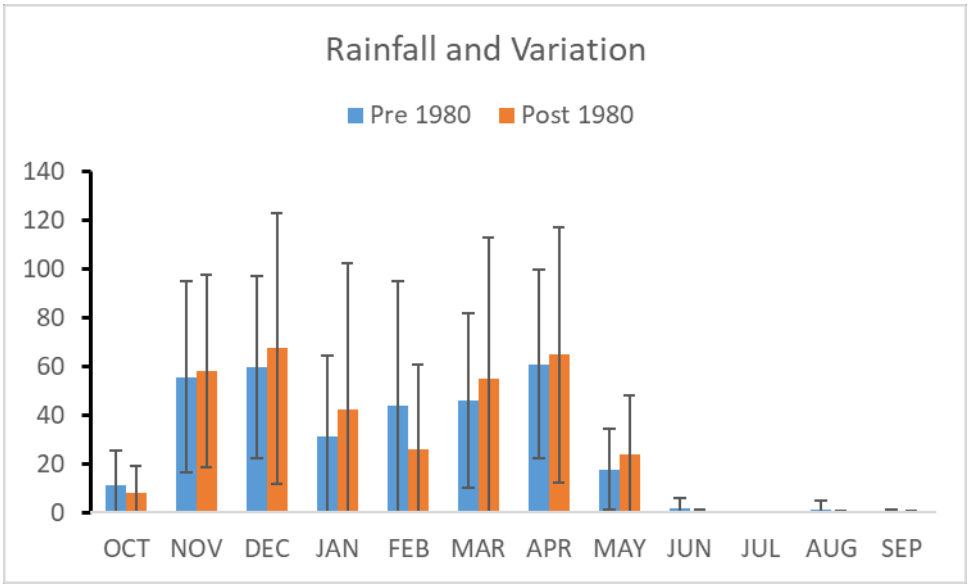


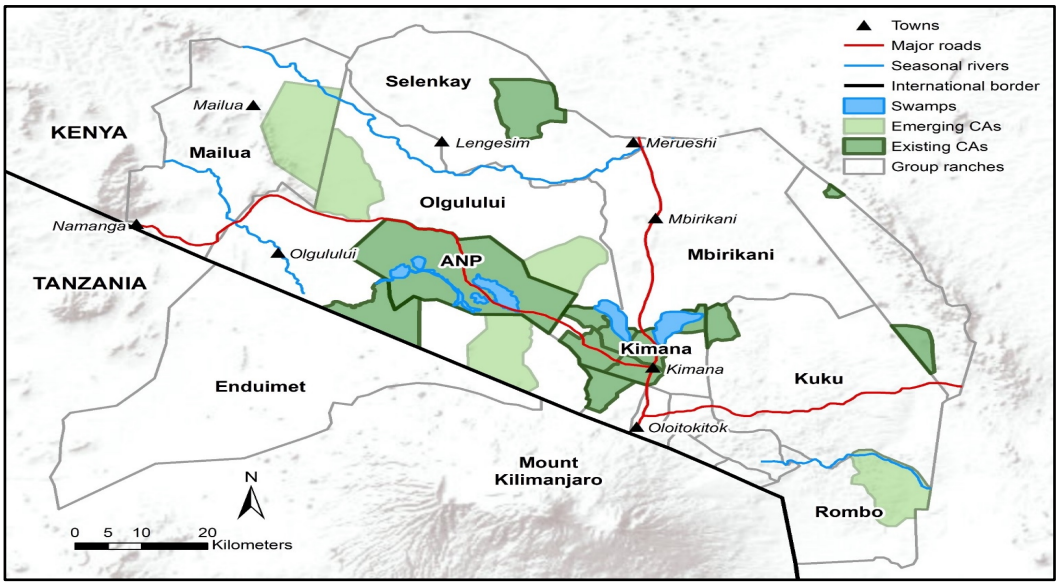
Figure 1: Mean monthly rainfall (mm) and the Standard Deviation of rainfall for the period before 1980 and that after 1980 (NASA defined point for shift in the rate of climate change).

(b) Landscape changes

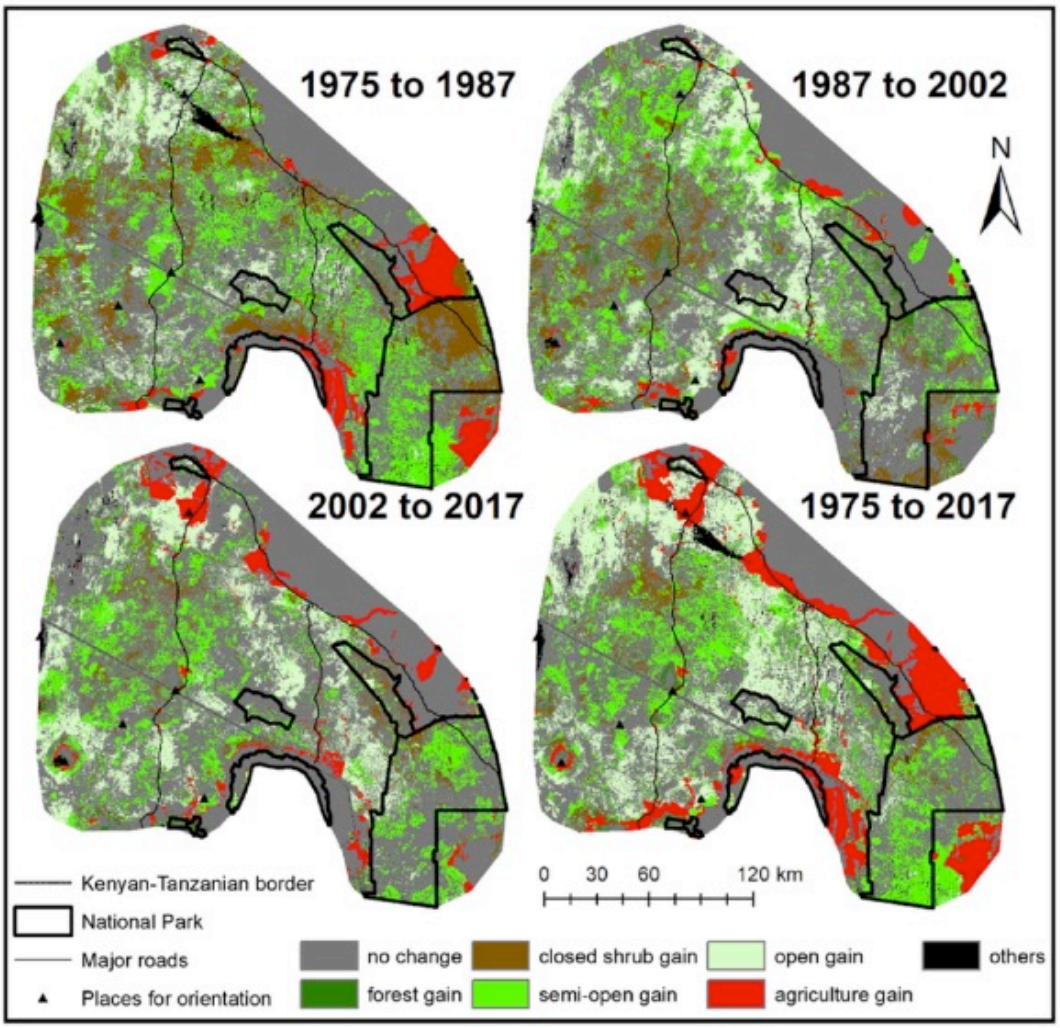
AERP has been monitoring vegetation and habitats over the duration of the study as well as rainfall. Two significant features were analysed during this last research year. The first of these was the overall change in habitat types, with a shift to greater expanses of swamp within the central study area, covering the mosaic of National Park and conservancies, while there was a loss of woodlands in the extended surrounding area. Woodland loss can be attributed to a number of factors, of which grazing pressure from livestock and exploitation for charcoal may be the most influential. These trends are important for elephants and other wildlife species which disperse from the protected area in search of grazing and browse.

Figure 2: Landscape level changes from 1975-2017 over the region including Amboseli National Park in the dark outline (A: Area for habitats; B: Figure 4, from Schüßler et al. 2018, *Landscape Ecology*)

(A)



(B)



Elephant movements respond to rainfall, subsequent vegetation availability, and water, with a number of families dispersing far from the central basin while others remain and concentrate on the swamps. Decisions about where and when to move between the protected area and further away in community lands to the north and across the border into Tanzania can be shown to depend on when and where there is food and water (Figure 3, From Boult et al., 2018, *African Journal of Ecology*). However, despite the widespread use of NDVI to model elephant movements, our analyses show that these ecological decisions are only part of the picture. Elephants also make decisions based on the social component of their movements, aggregating in large social groups, seeking mates or avoiding competition. Although elephants may be sexually segregated at the landscape scale, within the central study area, males and females use the habitats in very similar proportions (Figure 4).

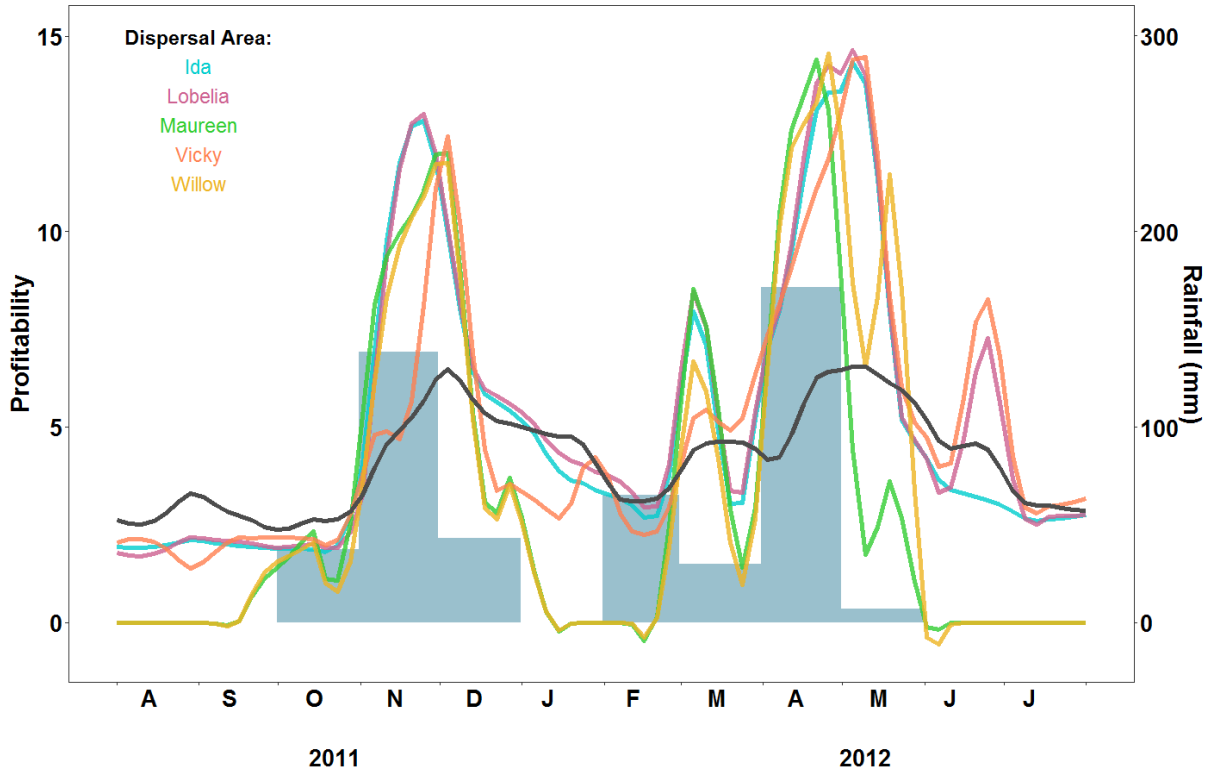


Figure 3: Association between total habitat profitability (lines: black = swamp edge within protected area, coloured = elephant dispersal areas), the product of the quantity and quality of vegetation and water availability, with monthly rainfall (bar: blue) during satellite collaring period. From Boult et al., 2018

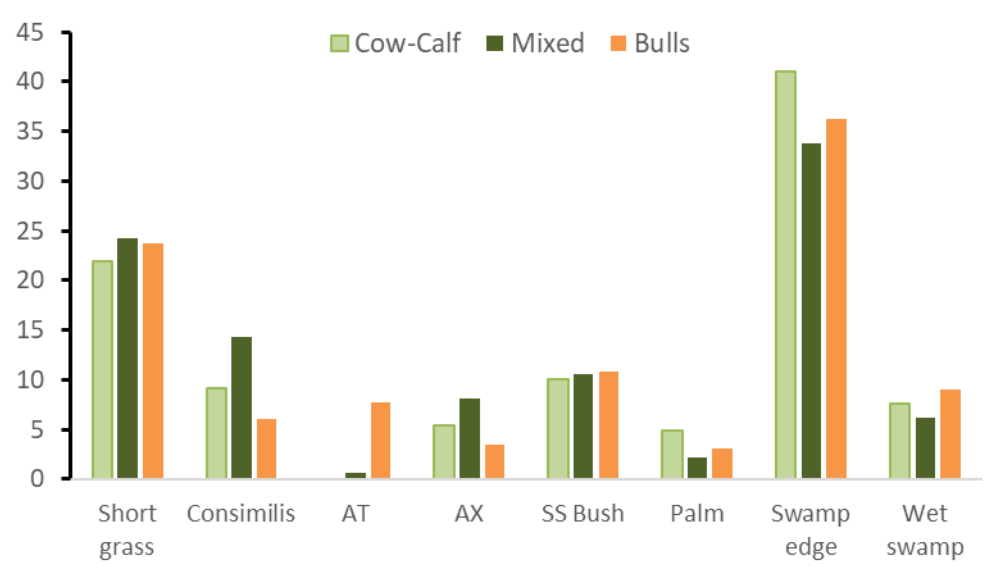


Figure 4: Habitat occupancy (percentage of sightings) for 2018 by group type (Cow-Calf group n = 407, Mixed sex group n = 322, Bull group n = 232) showing little difference in occupancy by sex. AT = *Acacia tortilis* woodland, AX = *A. xanthophloea* woodland, SSbush = *Suaeda-Salvadora* bush, Palm = *Phoenix reclinata* woodland)

(C) Elephant population dynamics

There were 45 deaths recorded in the rainfall year of 2018. In the first months (October, November and December 2017) of rainfall year 2018, there were 38 deaths due to the late onset of the short rains and increased grazing competition with livestock, reducing the food available to elephants and other wildlife in the ecosystem at large. It is worth noting that very few Amboseli elephants have died as a result of human-elephant hostility in 2018, despite these tough ecological conditions that push elephants and livestock into close proximity. The ecosystem partners of Kenya Wildlife Service, the local communities, and Big Life Foundation appear to be managing most hostile interactions between people and elephants very effectively.

There were 113 births in the 2018 rainfall year. The population now has 519 females over the age of nine years (youngest age of first reproduction). Currently most of these females (68.6%) are already caring for a calf under the age of four years (average interbirth interval). This high proportion of females with calves suggests that there will be relatively few births in the coming year, since so many females have a dependent infant.

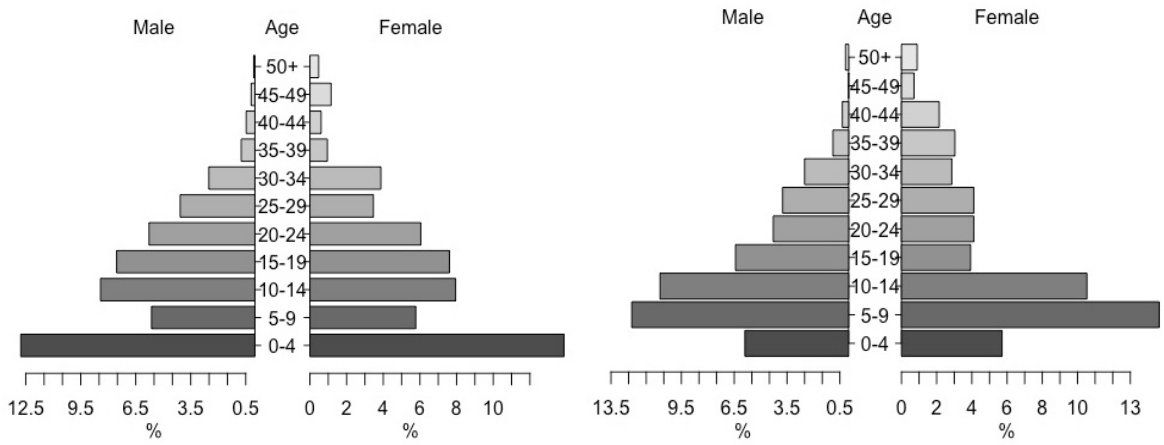


Figure 5: The age-sex population profile in 2018 (left) compared with early in the study in 1975 (right).

We recently developed a model of how female elephants move and manage their energy requirements in order to survive and successful reproduce (Boult et al., 2018b). This is a model of individual energy budgets based on physiological ecology, with parameters specifying energy allocation between the vital life processes of maintenance, growth and reproduction. Each individual has her own energy budget and lives in an environment for which food availability is known from ground-truthed remotely-sensed measurements. Emergent population dynamics are compared to observed rates of reproduction and mortality. Our aim is to develop a mechanistic model with good predictive qualities that can serve to forecast future population dynamics in response to climate change and alternative management scenarios. This kind of model allows us to predict where elephants might range over the basin, and more crucially to try to model population responses to declines in food or water availability with further conversion from wildlife grazing habitats to agriculture, development infrastructure, and human settlements.

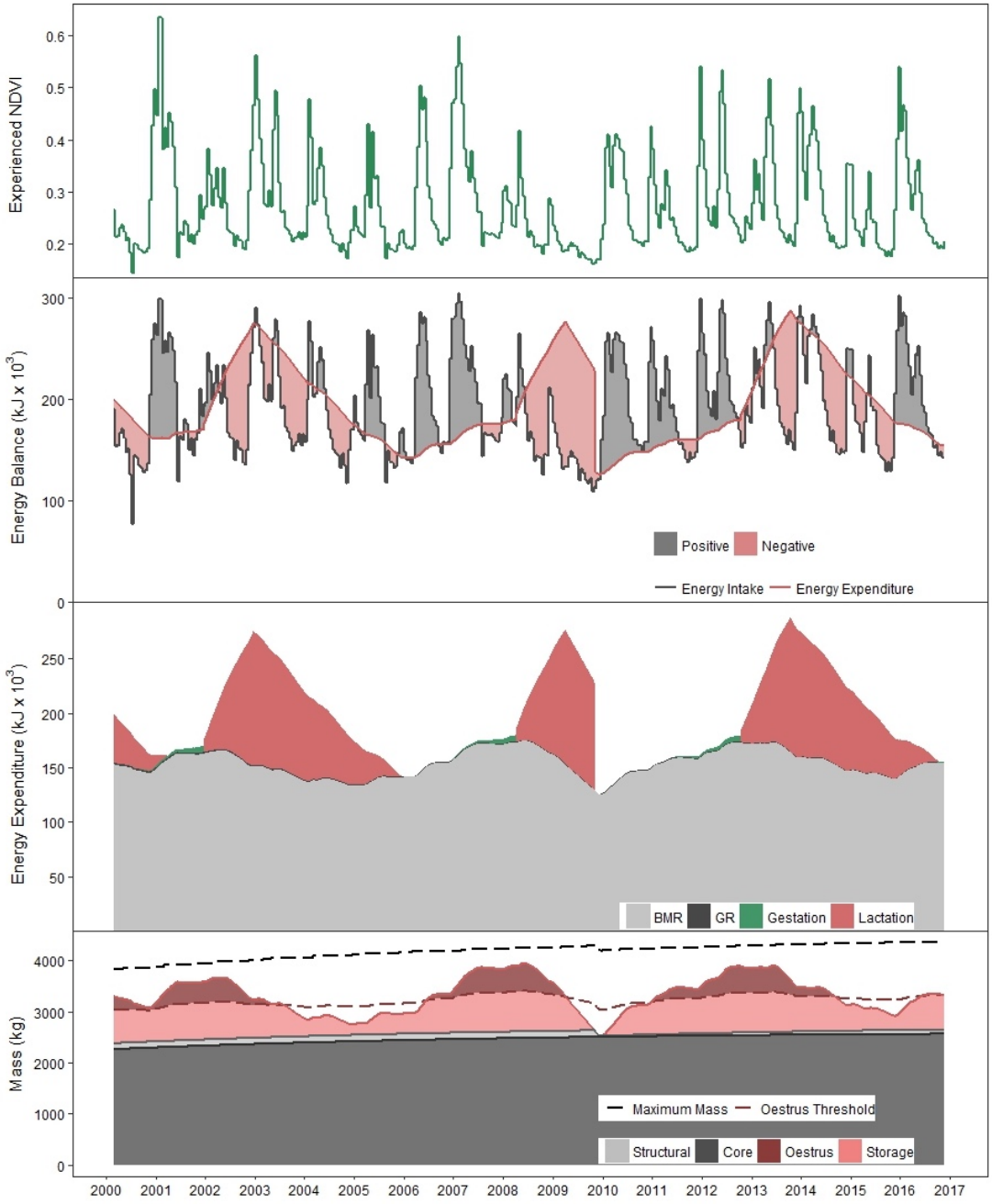


Figure 6: From Boult et al. 2018b, *Ecological Modelling*, *387*, 187-195. Energy balance and resulting body composition of a "typical" adult female elephant, Ilka, throughout the model period 2000-2016. The top plot shows the NDVI experienced by Ilka. NDVI is used here as a proxy for food availability, peaking during the biannual wet seasons and declining as the dry seasons progress. The energy balance plot compares energy expenditure with energy assimilated (red and grey lines, respectively). The resulting energy balance indicates whether energy intake was greater or less than energy expenditure (grey and red shading, respectively), and broadly coincides with peaks and troughs in NDVI. The energy expenditure plot further breaks down expenditure into BMR, gestation, growth and lactation. Lactation is energetically costly and results in a period of net negative energy balance. Due to the fluctuating energy balance, body composition changes: storage tissues increase when the balance is positive but are depleted during times of negative balance. Structural tissues may be depleted during starvation, as seen here in 2009-2010.

II. Collaborations and Dissemination

a) Overview of ongoing research

Our vital and active monitoring team (Katito Sayialel, Norah Njiraini, and Moses Saruni) has been locating and observing elephants across the ecosystem. They continue our long-term population monitoring, documenting family dynamics, independent males, and building our dataset on lifetime reproductive success for individuals.

As we show above, our current theme is to link individual ranging, and social and reproductive strategies to elephant population dynamics at a landscape scale. Behavioural patterns confer resilience and flexibility on elephant populations and are important for Amboseli, for Kenya and for elephant populations across Africa that face myriad threats from changes to their landscapes due to human activities. We are currently working on developing further collaborations with Kenyan students who will examine the changing vegetation and pressures on vegetation in this region.

ATE's Senior Research Scientist, Dr Vicki Fishlock, aims to launch our new large-scale study in early 2019 on how young male elephants use social and ranging strategies to buffer against anthropogenic risks, by deploying collars on young males who have recently dispersed from their families. This will allow us to assess: (i) dispersal areas, responses to risk and survival in adolescent males during a poorly understood phase of their life history; and (ii) social strategies of males as they range over the wider ecosystem.

b) Dissemination

As we illustrate above, our recent research findings have been successfully published in a number of peer reviewed journals. We aim to continue to disseminate our findings widely so that unique knowledge from these individuals will continue to act as a baseline for understanding elephant responses to landscape and climate change as well as enabling comparative models of population dynamics across Africa.

Recent scientific publications by the ATE team and allied researchers:

Bates, L. A. (2018). Elephants–Studying Cognition in the African Savannah. *Field and Laboratory Methods in Animal Cognition: A Comparative Guide*, 177.

Boult, V. L., Sibly, R. M., Quaife, T., Fishlock, V., Moss, C., & Lee, P. C. (2018). Modelling large herbivore movement decisions: Beyond food availability as a predictor of ranging patterns. *African Journal of Ecology*.

Boult, V. L., Quaife, T., Fishlock, V., Moss, C. J., Lee, P. C., & Sibly, R. M. (2018). Individual-based modelling of elephant population dynamics using remote sensing to estimate food availability. *Ecological Modelling*, *387*, 187-195.

Lee, P. C. (2018). All for One and One for All Box 8.1 Social Cognition and Social Strategies in Wild Elephants and Other Taxa. *Field and Laboratory Methods in Animal Cognition: A Comparative Guide*, 185.

Lindsay, K., Chase, M., Landen, K., & Nowak, K. (2017). The shared nature of Africa's elephants. *Biological Conservation*, *215*, 260-267.

Schüßler, D., Lee, P.C. and Stadtmann, R., 2018. Analyzing land use change to identify migration corridors of African elephants (Loxodonta africana) in the Kenyan-Tanzanian borderlands. *Landscape Ecology*, *33*(12), pp.2121-2136.

Webber, C. E. (2017). A Comparison of Behavioural Development of Elephant Calves in Captivity and in the Wild: Implications for Welfare. PhD Thesis, University of Stirling, UK

Wilkie, R. D., & Douglas-Hamilton, I. (2018). High-resolution tracking technology reveals distinct patterns in nocturnal crop raiding behaviour of an African elephant (Loxodonta africana) in Amboseli, Kenya. *Pachyderm*, (59), 41-48.

III. Activities with Stakeholders and Communities

a) Stakeholder engagement

ATE continues to play an active role as technical advisors to the Amboseli Ecosystem Trust, and to KWS and Big Life Foundation who are the principal agencies managing the human-wildlife interface. ATE, as key members of the Human Wildlife Coexistence Committee, is in the process of developing protocols to deal with serious incidents occurring between people and wildlife in an effort to prevent retaliatory attacks, which spread resources thinly across the ecosystem and result in further injuries and fatalities to humans and wildlife. We also continue to work with Big Life to harmonise elephant mortality data for KWS, to identify elephants that have been treated for injuries or illness and where possible provide follow up information on treatment outcomes to

KWS vet teams. We also participate regularly in ecosystem counts, most recently in the total aerial count for Amboseli-Tsavo in June 2018.

Training, sensitisation and filming

ATE provides training in elephant behaviour, biology, growth, ageing and sexing to our collaborators within the ecosystem and for range country biologists and conservation managers from Africa and Asia. Training events for 2018 were:

- Training the Space for Giants field team (15/11/18-21/11/18); the team will also return for data management training in 2019.

Supporting authorised film-makers

- Citizen TV (Kenya): 1/11/18- 6/11/18

b) Consolation Scheme

Our consolation scheme, which addresses the loss of cattle, sheep-goats, and donkeys as a result of interactions with elephants outside the protected area of Amboseli National Park paid out only three cases of livestock loss in 2018, for a total of 380,500 KES. The number of events was far lower than in 2017 (30), when elephants and livestock were concentrated in areas of scarce forage and water. Our programme remains vital to sustaining some tolerance of elephants among Maasai pastoralists even when they experience livestock losses caused by elephants.

c) Scholarships

ATE fosters livelihood development among young men and women by funding primary, secondary and university students from the Group Ranches surrounding Amboseli National Park.

Left; Student Coordinator Sylvi Nyambura with Everline and Mercy graduating at Kabarak. Above; Norah Njiraini leads prayers Tembea Academy, as Chief Guest and keynote speaker.

During 2018 we sponsored five students in primary and five in secondary schools. We also funded seven university and technical institution students from the Maasai communities; two of our students graduated from Kabarak University with degrees in Education and Mathematics. We sponsored both of these girls throughout their secondary education; Everline Siyalo and Mercy Kotikash plan to continue to graduate school and we will continue to support their studies. In 2019 we will also support further study for one of our previous students who is pursuing a Master's degree in Education. These scholarships again build capacity across many different areas of learning and professional training for members of the Maasai communities who share their lives with the elephants.

Cynthia Moss, Director

Professor Phyllis Lee, Director of Science

February 2019