AMBOSELI TRUST
FOR ELEPHANTS

Amboseli Trust for Elephants

Annual Research Report 2020

In memory of "Tim" (M234), born in 1969, died 2-2020

MISSION STATEMENT FOR ATE SCIENCE AND RESEARCH: *The Amboseli Elephant Research Project is the world's longest continuous elephant research programme. ATE contributes trailblazing knowledge of large mammal socioecology, provides a basis for public understanding and concern for elephants and their ecosystems, and communicates information enhancing conservation in the Amboseli ecosystem and for regional and global elephant populations.*

Introduction

Our annual report for 2020 is presented in the context of restrictions on lives and livelihoods due to the global coronavirus pandemic. In this report, we provide background information for all our ecosystem partners on the health and status of the Amboseli elephant population, derived from our long-term monitoring of individual elephants over their lifespan, which carried on due to huge efforts on the part of our field team to keep everyone safe. In this year, we would especially like to thank our ecosystem partners, the Kenya Wildlife Service, the Group Ranches and Community Conservancies, Amboseli Ecosystem Trust and Big Life Foundation, who have all suffered grave financial restrictions and personal losses resulting from the pandemic. We also thank our collaborators and donors for their sustained interest in our research results and for their support in protecting the elephants and ecosystem of the Amboseli Basin.

Despite losing to natural causes one of the Iconic and large tusked Amboseli males ("Tim") at the age of 51 years, several positive and exciting events occurred in 2020. Two sets of twins were born, along with 229 other calves. In collaboration with KWS and with logistical help from Save the Elephants, we completed the collaring of eight young male elephants who will now be monitored as they disperse from their families and establish their bull areas. These young males and their families are among the 3750+ elephants whose life histories we have tracked. At the end of 2020, there were 1880+ (males, females) alive in the known population. While this is still a small population by comparison to other areas of Kenya and elsewhere in Africa, our contribution to understanding elephant population dynamics derives from our knowledge of individuals in this intensively monitored population.

I. Long-Term Monitoring

A) Environmental dynamics

The rainfall year 2019-2020 was very wet with over 800 mm of rain, most of which fell in Nov and Dec of 2019, leading to abundant grass growth for the start of 2020. The 95% Confidence Intervals shown on Figure 1 suggest that there is most variance in the peak months of rainfall. No marked pattern of higher or lower rainfall across time can be easily detected in these records (Figure 2), but the variation in monthly rainfall does appear to be increasing and compared to our early records, rainfall appears to be slightly higher.

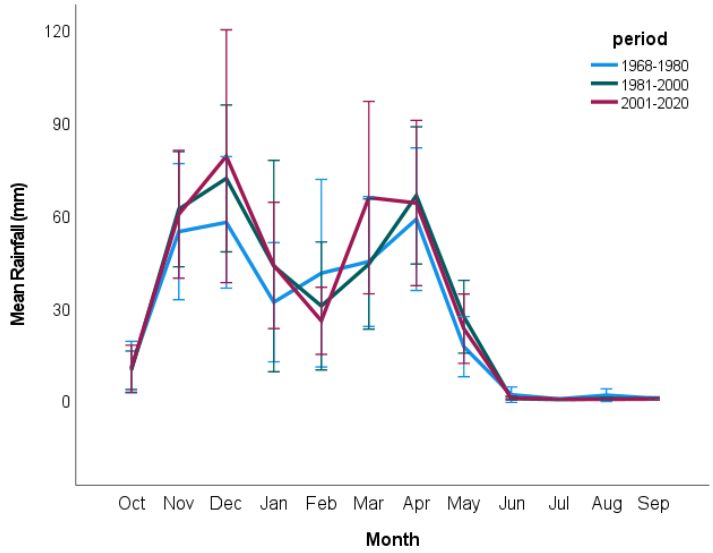


Figure 1. *Mean monthly rainfall (mm) from 53 years of ATE records within the National Park.*

These trends are important for understanding how climate change will affect the Amboseli elephant population, since higher but more variable rainfall may make elephant movements and overlap between livestock and elephants more difficult to predict and manage.

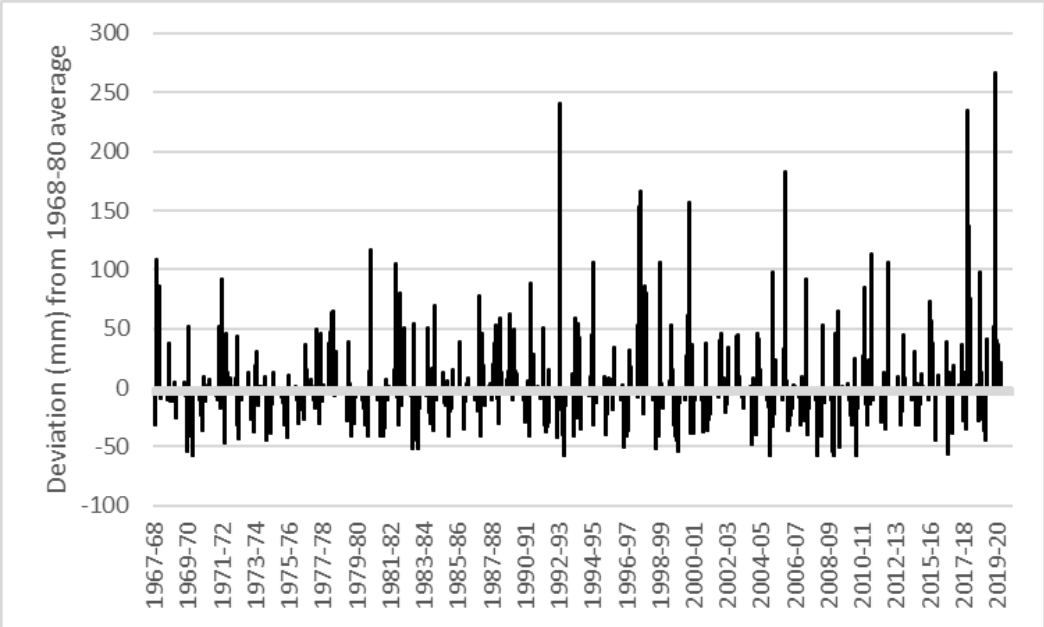


Figure 2: *Deviation from monthly mean rainfall (1968-80 average) within rainfall years over time (ATE long-term rainfall data).*

B) Elephant ranging and grouping

Rainfall represents both food availability for elephants, and an ability to disperse more widely over the ecosystem without needing to return to central swamps for water. We illustrate the ability of females to disperse with the wet and dry season maps showing seasonal density of elephant use of the central areas.

A: **Wet season (Nov-Dec)** **B: Dry season (Aug-Sept)**

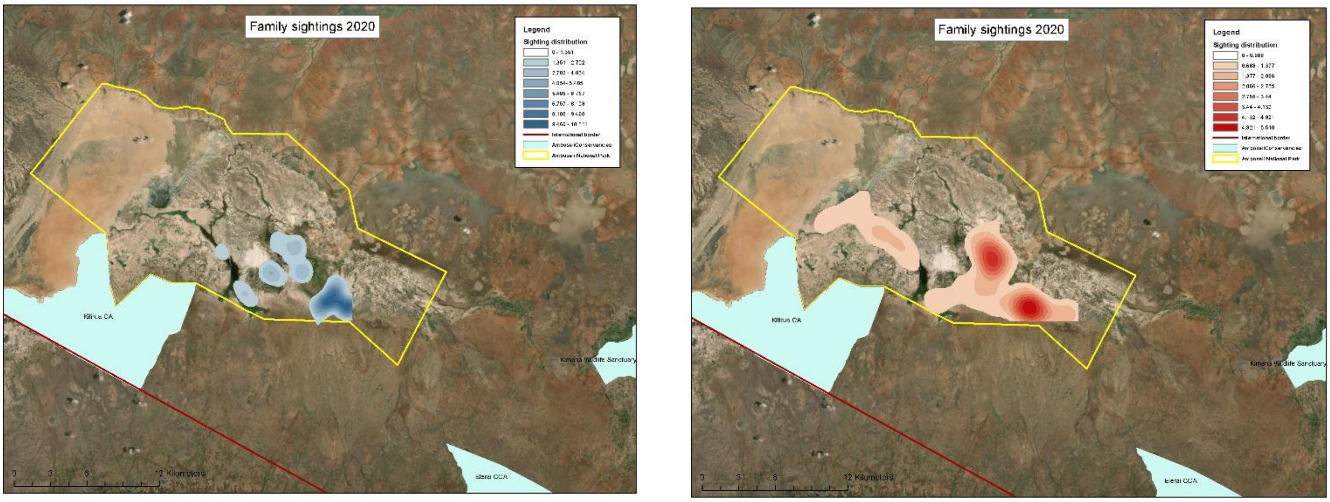


Figure 3: *Kernel densities of female sightings within the protected area, comparing wet and dry seasons. Fewer females with greater localisation were seen in the park in the Wet while more females used a greater area of the park in the Dry.*

We have now, based on collared females from 2010-14 and the newly young collared males, been able to describe more about how elephants are using the entire 8000 km^2 greater Amboseli ecosystem. Females and males both travel deep into the West Kilimanjaro area (WK Game Management Area). Around 12 families, totalling over ~300 animals, use western and southern areas of Kitirua Conservancy and WKGMA. A further 6+ families, or ~190+ elephants, use the area to the east of the park, including Kimana Sanctuary, Kuku, and as shown by one young male, venture as far as Tsavo West. Eselenkei now hosts 4 families more or less permanently (~100+ elephants), and 3-4 families (~45 elephants) use Mailua to the north west. All of these areas also contain independent males, many of whom are resident in these dispersal areas and return to the central basin seasonally, while others, such as the younger males roam across the entire ecosystem.

C) Elephant population dynamics

At the end of 2020, 1,887 elephants were alive and known as part of the Amboseli population monitored over the long-term. This total represents 582 females over the age of 9 years (minimum age at first reproduction) and 295 males over the age of 15 (independence from the mother's family). The number of deaths was very low with only 7 deaths of calves born in 2020 and only 6 deaths of adults (3 females, 3 males). Of these deaths only one, that of an elderly female near Eselenkei, was directly attributed to human-elephant hostility. It remains vital to continue to work with our ecosystem Partners (KWS, Big Life Foundation, the Maasai group ranches) to minimise dangerous contacts between people and elephants and to have clear mechanisms to solve any problems of hostile interactions.

With the increase in overall population size, and in the number of reproductive age females, there has been an increase in family unit size to an average of 24 (Table 1).

Table 1: *Changes in Family Unit size and composition over time*.

Date	1976	2002	2020
Number of known families	52	55	65
Range of family sizes	2-23	2-52	2-76
Mean family size	7.2	19.3	24.3
Number of adult females	Range 1-9 Mean = 2.35	Range 1-19 Mean = 7.1	Range 1-35 Mean = 10.9

A small number of births (22) in 2019 was followed by a burst of 233 calves in 2020. This baby boom was the result of 370 females available to give birth in 2020 as their previous calves had reached 3-4 years of age.

Examining conceptions by rainfall year shows clear trends for peaks after years of reduced frequencies, either because there were few females available for conception or because it had been dry in that year. The 2020 birth peak was due to the large number of conceptions in the 22 months prior, which followed on from the low rainfall in 2017.

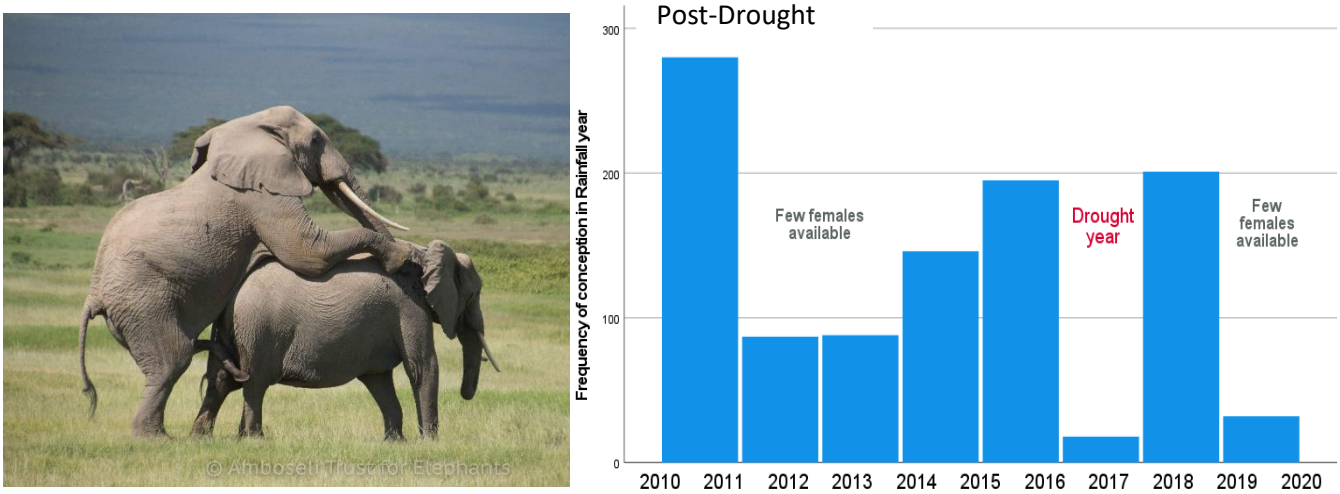


Figure 4: *Conceptions within rainfall years since the end of the 2009 drought.*

Are females in the population reproducing at an unexpectedly high rate? The clear answer is no, from two lines of evidence; the rate of calf production and age-classes giving birth. Firstly, females are not accelerating the rate at which they produce calves. We show here (Figure 5) the interbirth intervals – the time between successive births. Were these intervals consistently shortening, then we would expect that the reproductive rate of the females had increased, but we see no consistent changes over time. There are some differences between experienced and less experienced mothers, with longer intervals for the less experienced mothers (i.e. those giving birth to their second calf).

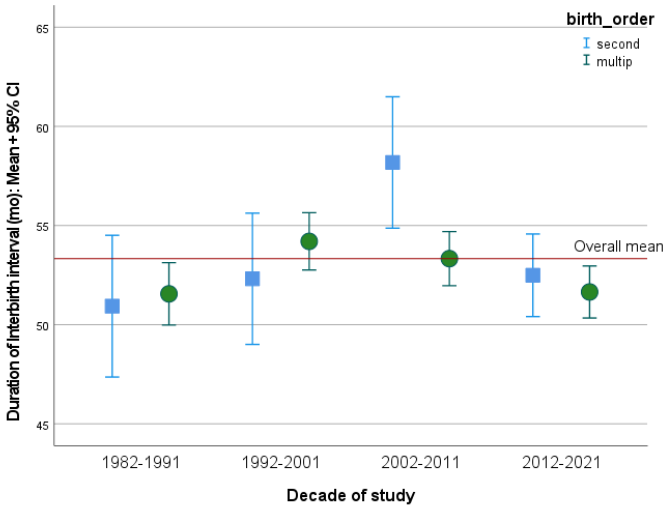


Figure 5: *The interval in months between successive births, comparing inexperienced females with experienced females within the decades of the study (Decade 1 was excluded due to small sample sizes of known intervals).*

Since the population has become younger over time with successful births and good survival, we might expect that the rate of reproduction would be biased by these younger age distributions of mothers. In fact, we again find no marked decadal differences in the rate of reproduction within each age class of mother; we do however clearly illustrate the slow decline in the rate of reproduction with age (reproductive senescence).

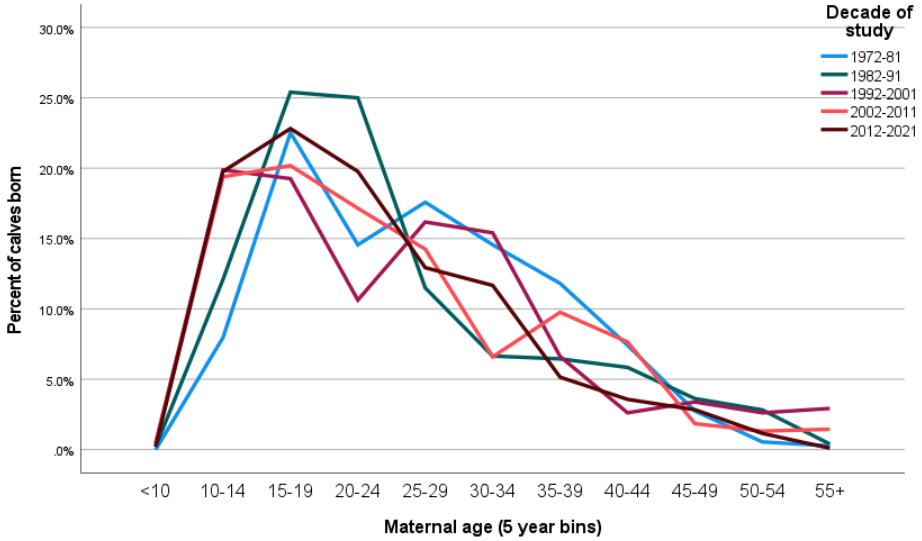


Figure 6: *Rate of reproduction (expressed as percentage of calves born) to mothers of each age over the 5 decades of the study.*

It is clear from these figures that the Amboseli population is showing sustained reproductive performance, but no marked increase in overall rates of reproduction. The important features underlying the increase in the Amboseli elephant population between 1972 and 2020 are twofold. First, in environmentally good years with high rainfall and food availability, almost all females

without a current calf <24 months of age are able to reproduce. Second and most importantly, the key feature leading to the increasing size of the population over time is the high survival of these elephants, both of the calves and the adults. Since the Amboseli elephants are largely protected from spearing, poaching, and poisoning, we are able to gain insights into whether elephant populations can sustain themselves naturally even in the face of future environmental variability and uncertainty.

Another major reproductive feature of considerable interest was the birth of three sets of twins over the past several years. Twins are unusual in any population, although a high proportion (2.5 per hundred) was seen in the central Tarangire TZ population when these elephants were recovering from a drought period. This high proportion was suggested to have resulted from a release of competition for food due to the previous drought die-off. However, even well-fed zoo populations only twin at 1.4%, which compares with the Queen Elizabeth National Park elephant population in Uganda in the 1970s at 1.35 per hundred. We hope to collaborate with the new KWS genetics lab to assess the relatedness between the twins (possibly monozygotic for one set, known dizygotic for the other two sets) and possible paternity. This will be an exciting collaboration for 2021 and beyond (see below).

Pazia with her new twins and older son

II) Collaborations and Dissemination

a) Overview of ongoing research

Despite the pandemic restrictions due to Sars-CoV-2 on the National Park, our monitoring team (Katito Sayialel, Norah Njiraini, along with Cynthia Moss) have been able to continue to locate and observe elephants across the ecosystem. Our long-term population monitoring, documenting family dynamics, independent males, and building our dataset on lifetime reproductive success for individuals has fortunately been able to carry on throughout the last year (2020). We are now approaching the 50th year of the project, which makes the years 2021 to 2022 exciting prospects to come.

We are currently developing collaborations with KWS scientists to gain insight into the genetics of the Amboseli families and in particular the twins. We are also working with Professor Moses Okello and Nairobi university colleagues to implement and support an MSc study by Peter Kimani on how elephant diets can be assessed from environmental DNA (e-DNA) extracted from dung. This collaborative study should be able to chart how elephants move and exploit the different vegetation types in the ecosystem as well as pressures on vegetation from drought, grazing and wildlife in this region.

In further collaboration with KWS, our study on how young male elephants use social and ranging strategies to buffer against anthropogenic risks, has now finally deployed all eight collars on young males who have recently dispersed from their families. The ATE collaring project is managed by ATE's Senior Research Scientist, Dr Vicki Fishlock. The males have travelled widely over the ecosystem (Figure 7), although they have all been present at times in the central core of the protected area. These males show both the range across which elephants travel, and the variety of strategies they use to move across varying risk gradients within the landscape. We are tracking companion choices for all males in this cohort, to determine who these young males learn new social and ecological strategies from. By mapping these choices onto previous social experience, examining our records of who their families associated with while they were growing up, we can gain insights into how males expand their range and companion choices as they become independent, and more likely to test the human-elephant interface. Mapping work is managed by our GIS and media expert, Tal Manor.

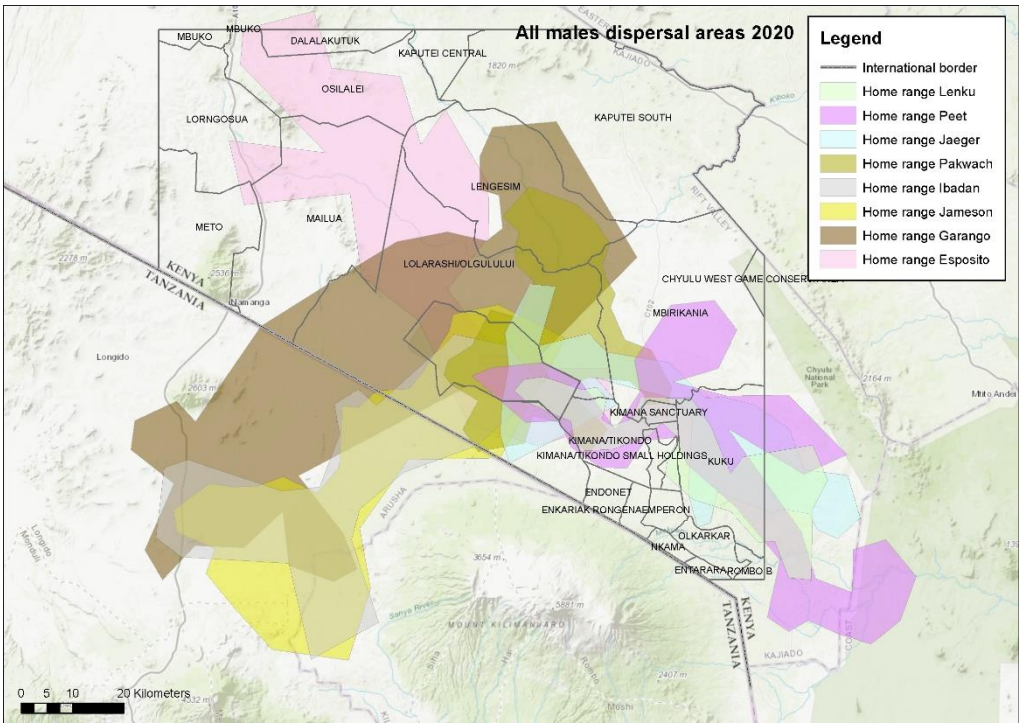
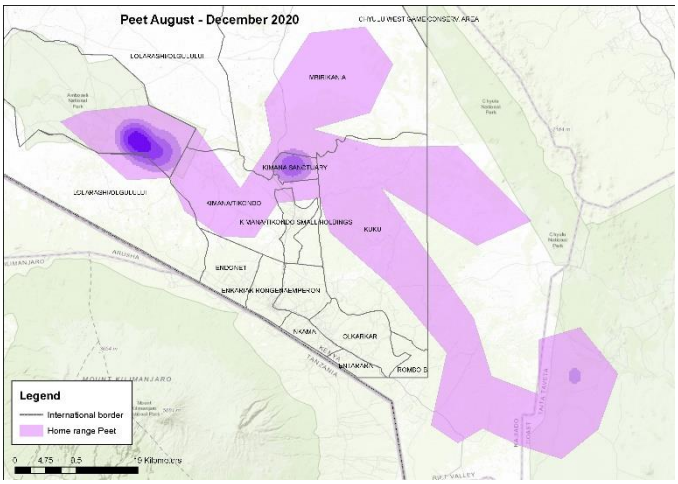
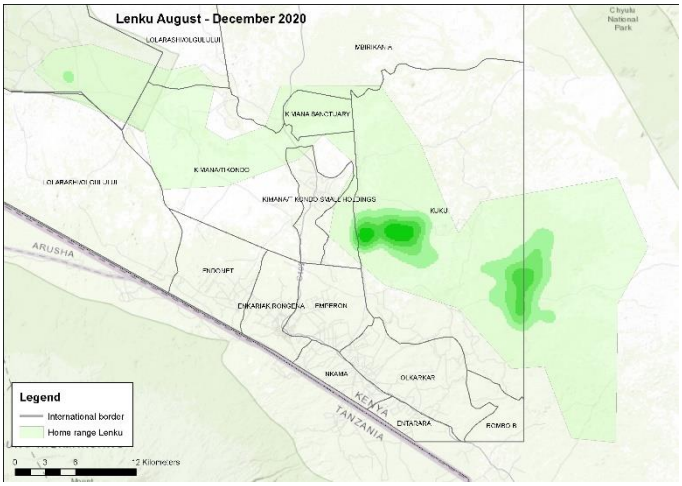


Figure 7. *Map of all eight young male home ranges in 2020. Note the extensive areas used in Tanzania and to the Northwest.*

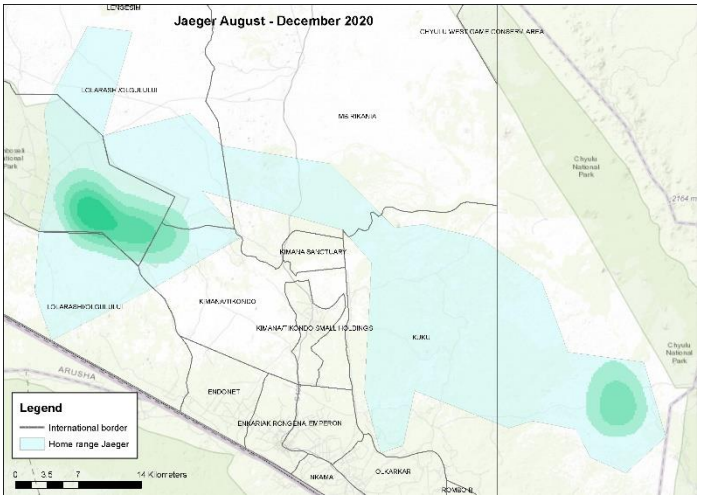
The importance of corridors and connectivity between Amboseli and Tsavo West are illustrated in detail by the home ranges of each of the eight young males.

Peet (PA, eastern family) and Lenku's (TC, eastern family) home ranges (below) show the greatest eastern movement. Peet was associating with his family and with other young Amboseli males, so his is one of the first confirmed demonstrations of how the Amboseli and Tsavo populations connect and exchange members and possibly genes. Lenku also uses the Eastern areas of his natal family, but focusses on Kuku and had not ventured into Tsavo by the end of 2020.

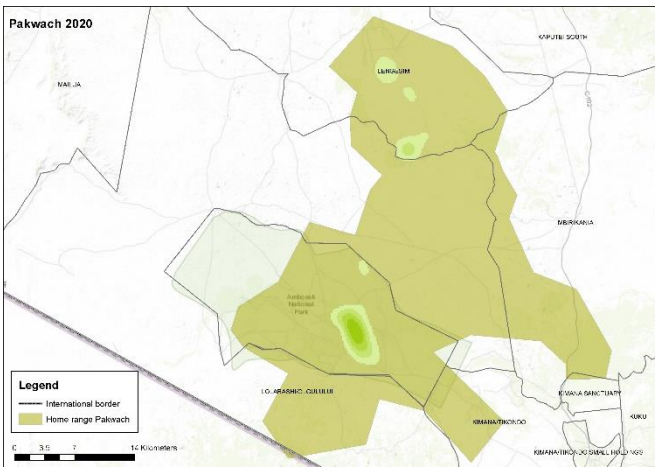


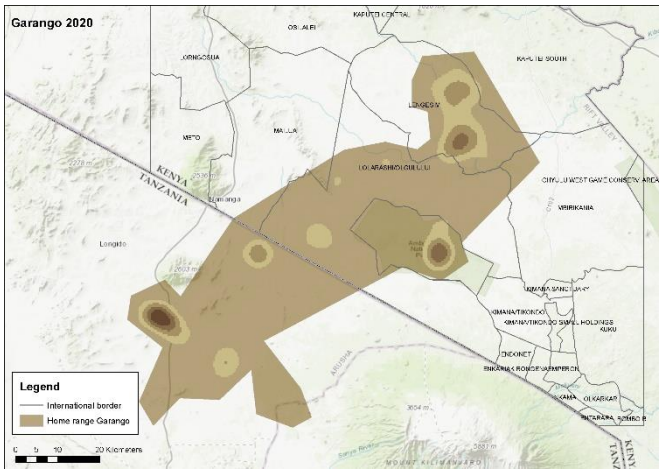


Jaeger's (JB, Eastern family) range is similar to that of Peet, with more concentration on areas near Chyulu, and he has not yet been observed to travel to Tsavo.

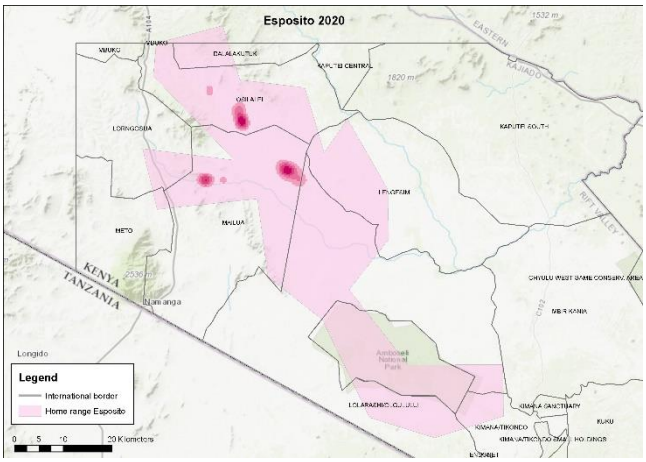


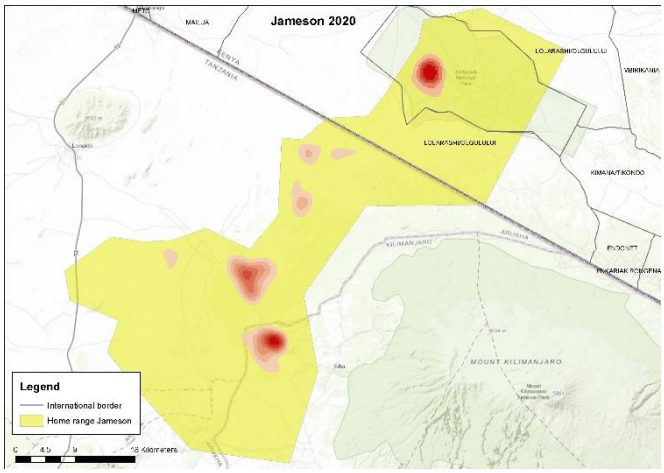
For the males collared in 2019, their ranges are now showing more consistent use of specific areas. Pakwach (in contrast to his younger cousin Peet, also from the Eastern PA family) uses areas north to Lengism and east to Kimana. Garango (from the central GB family) now splits his time between the north (Lengism) and the southwest in Tanzania.

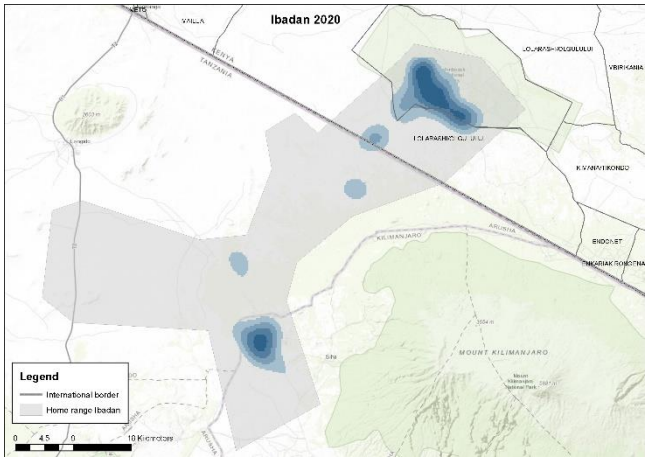




Esposito (a central EA family male) has moved far to the northwest, while Jameson (JA family, southwestern) and Ibadan (IA/IC family, west central) are found using areas far into Tanzania.







Jameson still uses the western areas of the National Park, where his family is often found, while Ibadan also uses the National Park central areas more than most of the other dispering males.

The key features of the movements of these young males are that they regularly cross the international boundary, that they include large amounts of semi- or unprotected areas, and that linkages allowing free movement and unimpeded foraging between habitats and elephant "populations" appear to be vital to the success of the Amboseli elephant males. Their future survival and success are predicated on these movements over 100s of km being sustained.

b) Dissemination

Our research findings have been successfully published in a number of peer-reviewed journals (3 in 2020, 5 in 2019, 5 in 2018). 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 behaviour in general, elephant welfare, communication and cognition, responses to landscapes and climate change as well as enabling comparative models of population dynamics across Africa.

2020

Lee, P. C., & Lindsay, W. K. (2020). A "halfway house" for improving captive welfare. *Animal Sentience*, *5*(28), 14.

Schlossberg, S., Chase, M. J., Gobush, K. S., Wasser, S. K., & Lindsay, K. (2020). State-space models reveal a continuing elephant poaching problem in most of Africa. *Scientific reports*, *10*(1), 1-9.

Webber, C. E., & Lee, P. C. (2020). Play in elephants: Wellbeing, welfare or distraction?. *Animals*, *10*(2), 305.

Wisniewska, M., Puga-Gonzalez, I., Lee, P., Moss, C. J., Russell, G., Garnier, S., & Sueur, C. (2020). Simulated poaching affects connectedness and efficiency in social networks of African savanna elephants. *BioRxiv*.

2019

Brakes, P., Dall, S.R.X., Aplin, L., Bearhop, S., Carroll, E.L., Ciucci, P., Fishlock, V., Ford, J.B., Garland, E.C., Keith, S.A., McGregor, P.K., Mesnick, S.L., Noad, M.J., Nortabartolo di Sciara, G., Robbins, M.M., Simmonds, M.P., Spina, F., Thornton, A., Wade, P.R., Whiting, M.J., Williams, J., Rendell, L., Whitehead, H., Whiten, A. & Rutz, C. (2019). Animal culture matters for conservation. *Science* 10.1126/science.aaw3557

Boult, V. L., Fishlock, V., Quaife, T., Hawkins, E., Moss, C., Lee, P. C., & Sibly, R. M. (2019a). Human-driven habitat conversion is a more immediate threat to Amboseli elephants than climate change. *Conservation Science and Practice*, *1*(9), e87.

Boult, V. L., Sibly, R. M., Quaife, T., Fishlock, V., Moss, C., & Lee, P. C. (2019b). Modelling large herbivore movement decisions: Beyond food availability as a predictor of ranging patterns. *African journal of ecology*, *57*(1), 10-19.

Moss, C. J., Fishlock, V., & Lee, P. C. (2019). Twinning in the Amboseli elephant population. *Pachyderm*, (60), 118-119.

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 especially to KWS and Big Life Foundation who are the principal agencies managing the human-wildlife interface.

In collaboration with the Amboseli Ecosystem Trust, the Group Ranches, and the UK Overseas Development Agency, our project "*Co-developing community data skills to address the challenges of adapting pastoralist practices in Amboseli, Southern Kenya*" was completed. The project assessed what group ranch members saw as the key challenges to pastoralism and resilience in the face of climate change. ATE community research officer, Moses Saruni, has been engaged on this project for the past 18 months. Further work on designing governance mechanisms and strategies for monitoring of stocking and grazing regimes are now devolved to group ranch planning committees for implementation as desired by stakeholders.

Moses Saruini and a group ranch interviewee during the ODA project

Incident protocols

Protocols to deal with serious incidents occurring between people and elephants from the Human Wildlife Coexistence Committee have been developed and approved by the community organisations, Amboseli Ecosystem Trust and the Senior Warden and Assistant Director, Southern Region, and are pending approval from KWS Senior Management. These protocols are vital as part of the effort to prevent retaliatory attacks, which result in further injuries and fatalities to humans and wildlife. We continue to work with Big Life and the Olgulului game scouts 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. Our team also participates in ecosystem counts and other monitoring activities as and when requested by KWS.

Economic assessment of the protected area

In late 2018 we began a project in collaboration with the Amboseli Ecosystem Trust (AET) to conduct an ecosystem-wide survey to quantify some of the economic benefits from living with wildlife. We provided logistical and other support while the Big Life Foundation helped fund the report. In recognition of a growing need for human development, understanding the balance between sustaining natural habitats as opposed to converting land for human use requires us to systematically understand the economic value of natural resources. This understanding will enable informed decision making on land-use planning. The survey was an ambitious undertaking, since

Amboseli's wildlife has catalysed many different sectors. NGOs, hotels, camps, and research organizations were all approached to share their financial data for 2017-2018. It took us over a year to get the data from the participants, but by June 2020 we had enough data from participants to provide an overview of how the existence of wildlife benefits the local economy and communities. The results were clear: the presence of wildlife in Amboseli is drawing in substantial investment and employment, with the vast majority of staff coming from local communities. The total annual economic value for 2018 was 1.36 billion Kenya shillings. The report demonstrates the importance of wildlife for the local employment and economy, as well as their contribution to tax revenues for Kenya. We host a copy of the report on our website: https://www.elephanttrust.org/annualreports/Amboseli%20Ecosystem%20Economic%20Impact%20Survey%202018.pdf

Training, sensitisation and filming

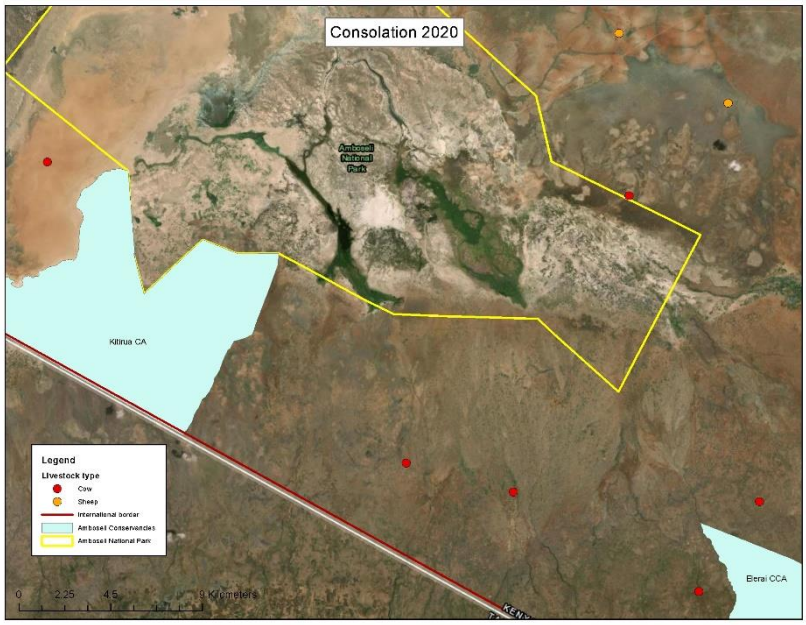
ATE provides training in elephant behaviour, biology, growth, ageing and sexing to our collaborators within the ecosystem and for range country biologists and conservation managers from Africa and Asia. Training events for 2020 were unable to proceed due to the pandemic. We have planned future events with Tanzania Rangers and Big Life Foundation rangers. While we normally also give lectures to and host school groups, this communication work was only available online. We engaged in 14 online and written events with educators and media communicators over the year.

Supporting Government of Kenya authorised filmmakers

- BBC filmmakers for series “Dynasties”
- BBC series “Queens”

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 was called on to support seven events of livestock loss (5 cows, 2 sheep/goats) in 2020. Our programme remains vital to sustaining 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 through funding scholarships for primary, secondary and university students from the Group Ranches surrounding Amboseli National Park.

During 2020, we sponsored 18 students in total. Unfortunately the pandemic closed schools from March 2020 to January – 2021. Our four primary students together with eight secondary students had to stay home for that duration. These students are from the surrounding Maasai communities. However, our three sponsored university students and three students doing their masters were able to do online learning and are continuing well with their studies. ATE's scholarships build capacity and develop livelihoods in many areas of learning and professional training for young community members who share their lives with elephants, and our ecosystem partners.

Cynthia Moss, Director
Phyllis Lee, Director of Science
February 2021