

Mara ecosystem connectivity

Information on elephant population status and movements for spatial planning and conservation in Narok County



Statement by the contributors

We, the authors of this document and our institutions of affiliation, support the conservation of elephants and biodiversity in Kenya. It is our conviction that a holistic, well considered spatial plan for Narok County that ensures habitat connectivity and protects elephant movements through the establishment of important corridors will provide a way to conserve elephants and other wildlife for posterity. Such a plan will simultaneously facilitate human development in a way that will minimise wildlife conflict.

Vision 2030 identifies securing of wildlife dispersal areas and migratory routes/corridors and pathways as significant ingredients of sustainable eco-tourism. Likewise, it is our conviction that the protection of wildlife habitat and corridors can help to secure Kenya's natural resources and with them her national interests related to tourism, biodiversity, sustainable use of resources and community livelihoods.

We are concerned at the rate at which wildlife routes in the Mara ecosystem are being blocked and habitat connectivity is disappearing. This will have serious ramifications on biodiversity and threaten the flow of revenue from the world-renowned Maasai Mara National Reserve. The broader implications for Narok County are likely to be significant and clearly of detriment to human well-being.

In this document we lay out what we currently know about the status and movements of elephants within and beyond the Maasai Mara National Reserve and the Conservancies, and we make recommendations for changes in policy as well as for the protection of corridors and key habitats to preserve biodiversity and reduce human-elephant conflict. We recognise that government will be fundamental to the former and that much more detailed mapping and planning work will need to be done to accomplish the recommendations that relate to spatial planning (see **Recommendations** pp 24 -26). Our institutions of affiliation stand ready to support and assist the Narok County and its spatial planners in this process.

Contributors

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Acronyms

| | |
|-------|---|
| ACC | African Conservation Centre |
| CITES | Convention on International Trade in Endangered Species |
| DICE | Durrell Institute for Conservation and Ecology |
| EV | ElephantVoices |
| HEC | Human Elephant Conflict |
| IFAW | International Fund for Animal Welfare |
| KWS | Kenya Wildlife Service |
| MDG | Millennium Development Goal |
| MEP | Mara Elephant Project |
| MIKE | Monitoring the Illegal Killing of Elephants |
| MMNR | Maasai Mara National Reserve |
| MMWCA | Maasai Mara Wildlife Conservancies Association |
| MNC | Mara North Conservancy |
| OOO | Olare Orok Conservancy |
| SFS | School for Field Studies |
| STE | Save The Elephants |
| WWF | World Wide Fund for Nature |

Summary

This document has been prepared at the invitation of the Narok County Government Department of Lands, Urban Development and Physical Planning and the County Assembly Committee on Natural Resources at a stakeholders forum on spatial plan development and resource mobilisation held in Narok on 16 - 17 October 2014.

Kenya's development blueprints - Vision 2030, the Constitution of Kenya (2010) and the Millennium Development Goals (MDG) - recognise the importance of sustainable use of natural resources, reduction of biodiversity loss, and maintenance of ecosystem processes. Vision 2030 identifies securing of wildlife dispersal areas and migratory routes/corridors and pathways as significant ingredients of sustainable eco-tourism. Biodiversity and ecosystem conservation contribute immensely to Kenya's national economy with close to 80% of tourism earnings attributed to wildlife. Like many counties with wildlife, Narok County has, for decades, been a beneficiary of high tourism earnings attributed to wildlife and culture. These economic benefits should not, however, be taken for granted.

Wildlife and their habitats continue to decline in Narok County. This deterioration is primarily attributed to competing land uses and escalating anthropogenic activities that are not compatible with conservation. All wildlife and, notably, wide ranging and large bodied species, such as elephants, are negatively affected. Within the next few years the trend, if not halted, has the potential to have disastrous consequences for tourism and associated economic benefits.

In this document, we contribute information about the status of elephants in the Mara ecosystem, their movement patterns and habitat use for consideration in the county's spatial planning process. We lay emphasis on the need for urgent intervention to secure critical routes and habitats for long-term survival of elephants and to prevent escalating human elephant conflict and declining biodiversity. By drawing on data from long term monitoring by various non-governmental conservation organisations (NGOs) as well as by Kenya Wildlife Service (KWS), the report characterises the spatial extent of elephants, their status, movements, distribution and mortality.

The 2014 (Mduma et al. 2014) aerial count revealed a marked decline to 1,448 elephants in the Mara ecosystem, the lowest number and distribution for many years. This drop has been attributed to the southerly movement of elephants into Serengeti National Park, though the illegal killing of close to 400 elephants between 2011-2015 was a contributing factor and land transformation cannot be ruled out. Despite the clear attrition, individual identification study indicates that well over 2,500 elephants use the ecosystem and that they are increasingly dependent on private land due, in part, to overgrazing of the northern Maasai Mara National Reserve (MMNR) by livestock. Further, the MMNR cannot meet the needs of male elephants who require dense browse, currently found on private land, to meet their high growth rates and large bodies.

Elephants can shape the structure and function of natural ecosystems and require large diverse areas to survive. Their habitat requirements make them particularly vulnerable to land-use practices of people. As human settlements expand, elephants are being contracted into ever-smaller spaces causing knock-on effects that can be seen across the ecosystem, including human-elephant conflict. The report highlights important habitats that have been interfered with or lost through land subdivision, settlement and fencing, and maps the current extent of human settlement (**Figure 1a**) in the Mara ecosystem. Based on the satellite tracking of 27 elephants, it illustrates elephant movement across the ecosystem (**Figure 1b**). The report draws attention to critical routes used by elephants and proposes a landscape connectivity framework for sustained elephant movement (**Figure 1c** and detailed in **Table 2**).

We strongly recommend a spatial plan that considers a Landscape Species Approach. Such an approach will incorporate protection of the elephant routes, promotion of MMNR and conservancies and protection of the remaining forests, watercourses and other key habitats. Moreover, such a plan will help to mitigate human elephant conflict and reduce illegal killing of elephants.

Given the grim and urgent situation facing elephants and wildlife in general, we suggest that Narok County Government consider five priority actions. The purpose would be to create a viable platform for the sustained connectivity, biodiversity and conservation of the Mara ecosystem for the long-term benefit of wildlife and the people of Narok County.

- i. Halt development in all critical conservation and migratory areas and establish protected corridors (as identified in Figure 1c and described in Table 2), to sustain biodiversity and prevent escalating human-elephant conflict. Use legal and economic instruments in consultation with local communities and landowners to this end.
- ii. Suspend further sub-division of land and issuance of title deeds until the ongoing spatial planning process is completed and approved.
- iii. Halt destruction by loggers, charcoal burners and settlement of the Mau Forest Complex and of the Forests of Naimina Enkiyio, Nyakweri, Mugor and Laila to protect crucial water towers, biodiversity and dry season grazing lands and to prevent escalating human-elephant conflict. Securing the Mau Forest is vital for the survival of the Mara River and the entire ecosystem.
- iv. Manage the grazing of livestock in the MMNR and conservancies sustainably and such that elephants and other wildlife are not negatively impacted.
- v. Ensure the equitable and transparent sharing of benefits from the MMNR to improve livelihoods and mitigate human wildlife conflict among those communities in the Mara hosting wildlife.

We offer additional policy recommendations under *Sustaining Conservancies and Improved Wildlife Conservation and Management* and recommendations for the spatial planning process under *Spatial planning for ecosystem connectivity and human elephant conflict mitigation* (see pp. 24-26).

Figure 1 (a) Boundaries of relevant land entities (National Reserve, current/proposed conservancies/conservation areas, relevant (ex) group ranches) and centres, and the current extent of human settlement, hilltop bush lands and key forests. Note: property boundaries are in flux and difficult to mark accurately. Forest edges are being eroded and are marked according to how they appeared on Google Earth when the report was prepared.

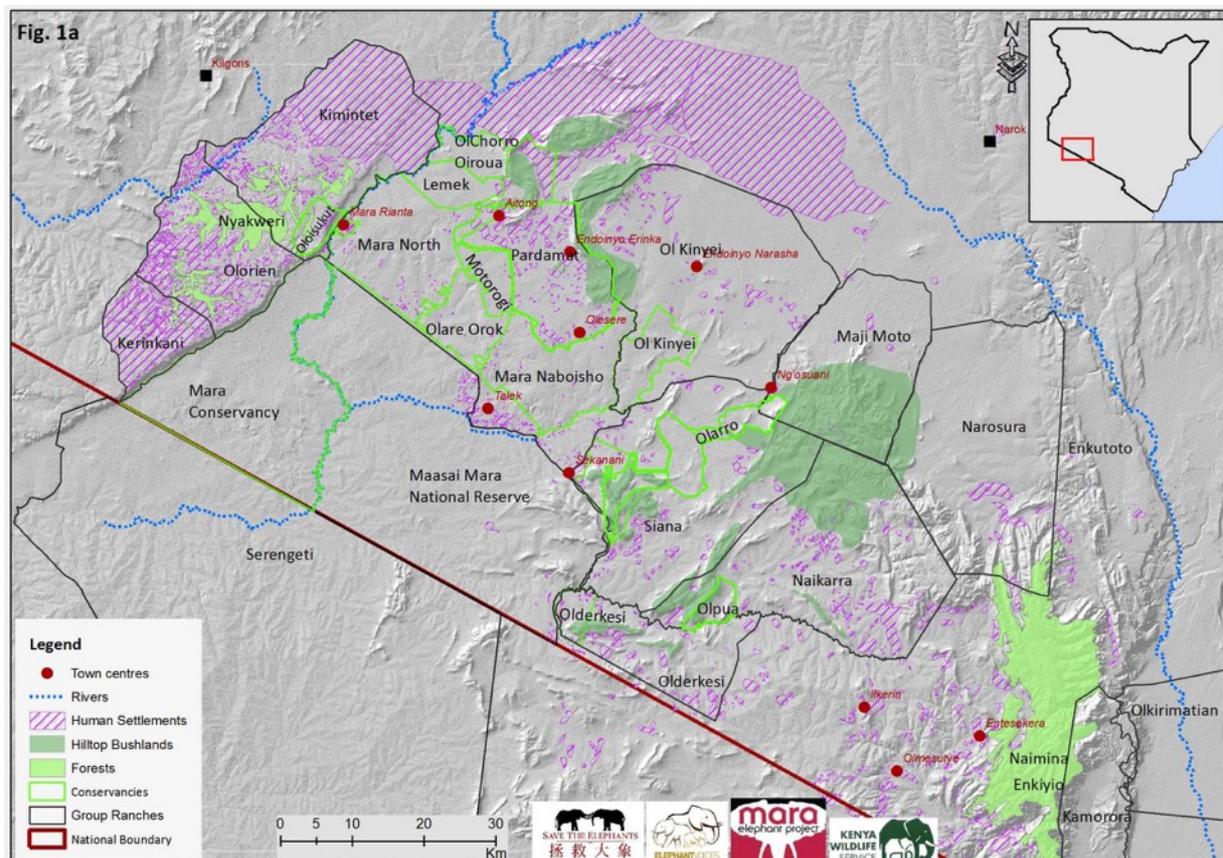
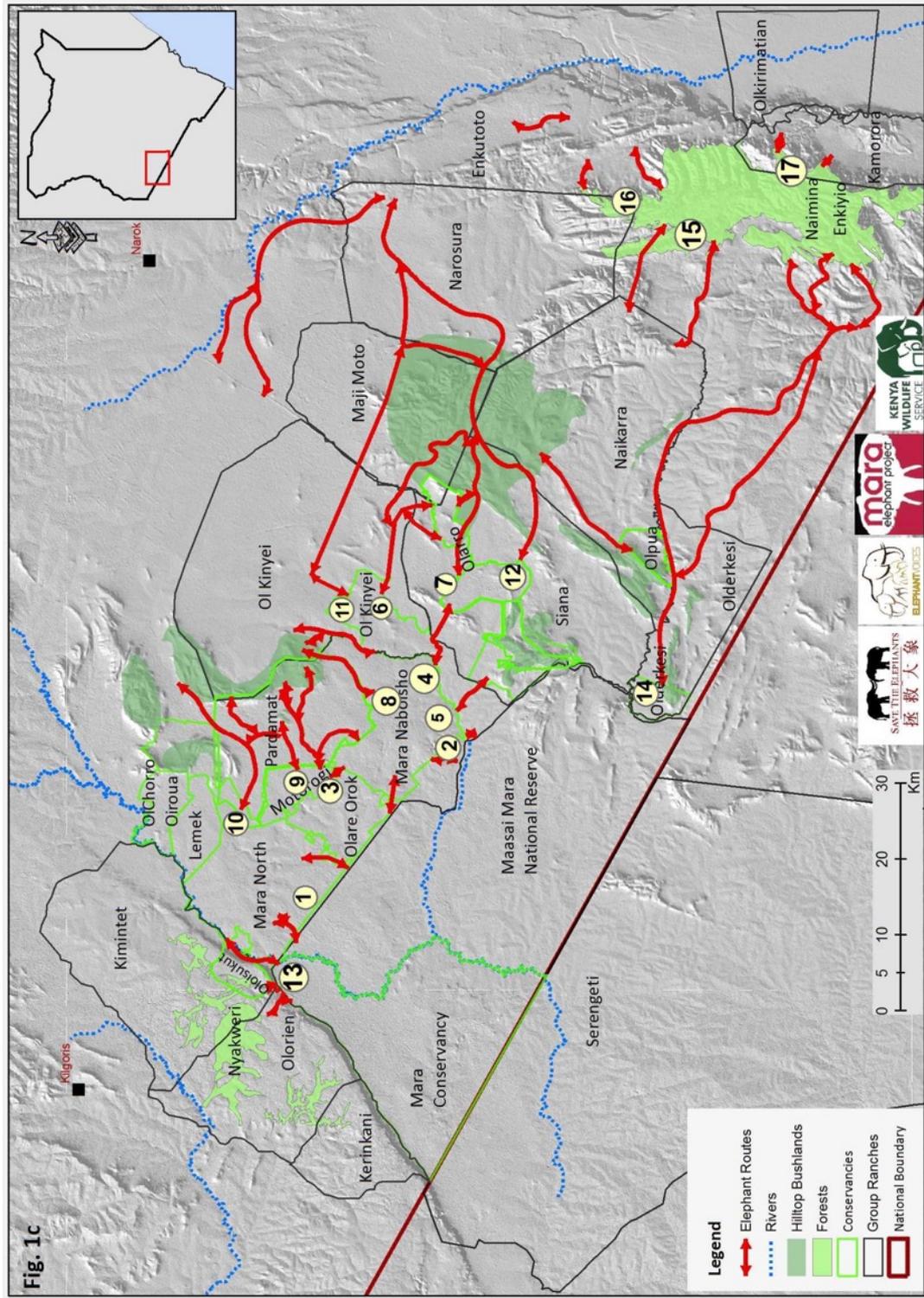


Figure 1 (c) (following page) Some priority elephant routes that take into consideration data from the satellite elephant collars, elephant signs and local knowledge on vital resources for elephants including forage, water, minerals and security. Details on the numbered routes can be found in **Table 2**. Note: Much more detailed maps are required for the spatial planners. We have mapped the rivers, salt licks, hills etc that are mentioned in Table 2 and can make these available.



Introduction

Over many decades wildlife-based tourism has been a vital source of revenue for Narok County generating on average Kshs 3 billion annually. The County has been able to reap financial rewards of its natural bounty with limited investment in planning, conservation management or infrastructure. Unfortunately, the consequences of neglect are dramatic. Following high increases in human populations and settlement, conflict with wildlife is on the rise and natural resources, including habitat and wildlife, are in rapid decline (Sitati 2003, Kaelo 2008, Ogutu et al. 2009, Thompson et al. 2009). All wildlife and, notably, wide ranging and large bodied species, such as elephants, are negatively affected. The situation continues to make international headlines (e.g. [BBC 2009](#), [BBC, 2010](#), [The Guardian 2013](#), [The Guardian, 2015](#)) and, within the next few years, has the potential to have disastrous consequences for tourism and associated economic benefits.

Conservation efforts have, historically, focused on establishing and managing protected areas, like the Maasai Mara National Reserve. However, most protected areas do not encompass enough land to offer functional protection to landscape species, like elephants.

To successfully conserve these and other wide-ranging species, healthy ecosystems and the ecological processes upon which biodiversity as a whole depends, we must often extend our vision beyond protected areas. This approach requires work at a more ecologically meaningful spatial scale, one that includes the matrix of human-dominated land use that surrounds and connects parks and reserves.

Elephants play a critical role in the Mara ecosystem from biodiversity, tourism and human development perspectives. Furthermore, when habitat for elephants is protected other wildlife species are also secured.

In ecological and conservation terms elephants are considered a **“landscape species”** (Wildlife Conservation Society Resources 2001, Didier *et al.* 2009). This means that they:

- a. Require large, diverse areas;
- b. Have significant impact on the structure and function of natural ecosystems;
- c. Are culturally or economically important and;
- d. Are particularly vulnerable to the land-use and other practices of people.

A **“Landscape Species Approach”** is a wildlife-based concept to planning landscape-scale conservation efforts. It is designed to help planners define:

- a. What a landscape means for the wildlife populations they are trying to conserve over the long term;
- b. What habitats need to be conserved and how those habitats should to be arranged and connected;
- c. What threats will affect those habitats and where will they occur, and;
- d. Where the work should be prioritised considering the needs of people and the threats of wildlife to them, and, likewise, the needs of wildlife and threats of people to them, as well as the availability of resources (time, money, people, expertise).

Over the past decade or so the Narok County group ranches and other communal lands have been undergoing a process of land subdivision and adjudication. Currently, all of the group ranches and communal land located in the Mara ecosystem east of the Siria Escarpment have been subdivided except Olderikesi, Narosura and Loita. The two former are already into the early stages of land adjudication. The current conservancies (and those in process) to the north, east and, to some extent, west of the Maasai Mara National Reserve (MMNR; **Figure 1**) have been formed by the leasing and amalgamation of individual land parcels carved out of the ex-group ranches of Koiyaki, Kimintet, Ol Kinyei, Maji Moto, Siana, Olderikesi, Lemek and Olchorro Oirowua. While this may be financially viable in areas of high tourism revenue, a different model is necessary in outlying yet ecologically critical areas (e.g. Pardamats, Loita Hills, Naimina Enkiyio Forest).

Coughenour et al. (2000) reported that the human population around the Maasai Mara was growing at 7% per annum, almost three times the national rate of 2.5%. Since then subdivision of land has taken place across much of the Mara landscape resulting in continued rapid human population growth, through natality as well as immigration, and exploding settlement and fencing. Rising wealth from land lease payments (Crystal Courtney, *pers. comm.*) and access to pasture for livestock in the conservancies and MMNR has led to a marked increase in livestock numbers.

Land use modification, human and livestock population increases, and changing settlement patterns form the context of the current and future elephant picture. High numbers of cattle in the MMNR and in the conservancies leaves little grass accessible for elephants for much of the year. The consequence is that elephants must seek grass south of the extent of livestock grazing inside the MMNR or move beyond its boundaries. In the conservancies they are largely dependent on browse. Beyond the conservancies they must balance access to forage with declining security.

This document characterises the status and spatial extent of elephants in Narok County, including numbers, distribution, mortalities, human-elephant conflict, movements and habitat connectivity. It describes habitats that have been interfered with or lost through anthropogenic activities such as land sub-division, settlement and fencing. The report also describes important routes used by elephants between critical habitats, some of which require urgent protection as corridors through the use of available legal and economic instruments, and negotiations with landowners.



Loss of connectivity: Fencing newly subdivided plots with cedar posts sourced from Narok County's remaining forests now characterises the Loita plains.

Objective

To provide information on elephant status and movements and Mara ecosystem connectivity for spatial planning in Narok County towards the long-term survival of the Maasai Mara for the benefit of people and wildlife in the County, the Nation, and the world.

Methods and Results

ElephantVoices (EV), Mara Elephant Project (MEP) and Save the Elephants (STE) have been carrying out elephant projects in the wider Mara ecosystem since 2011 building on earlier knowledge (e.g., Dublin and Douglas-Hamilton 1987, Douglas-Hamilton et al. 1988, Sitati 2003, Sitati et al. 2003, Ariyo 2008, Kaelo 2008, Thouless et al. 2008). Douglas-Hamilton et al. (1988) reviewed all previous research and management plans prior to 1988 and the degree to which plans had been implemented. In this report we provide current information on elephants to inform conservation and spatial planning efforts. This information will contribute toward achieving the goals of the National Conservation and Management Strategy for Elephants (2012-2021).

The area covered runs approximately from the border with Kajiado County in the east, to the Ewaso Ngiro River in the north, to the boundary with intensive farming in the west and the international boundary with Tanzania in the south (**Figure 1a**). The organisations are engaged in the following work:

- a. EV operates a citizen science-based elephant monitoring program gathering data on individually known elephants, groups, signs and mortalities.
- b. STE partners closely with KWS and oversees, collates and analyses real-time tracking of collared elephants and monitoring of elephant mortality.
- c. MEP assists and collaborates with KWS and Narok County authorities, running a quick response unit that acts on the information gathered from both the radio-tracking and poaching intelligence.

These three organisations also collaborate with other individuals and groups that are collecting data on elephants, most notably Elephant Aware working in Siana, Durrell Institute of Conservation and Ecology (DICE) working in Transmara, African Impact operating on Mara Naboisho Conservancy, KWS resident veterinarian, KWS research scientist, WWF, South Rift Association of Land Owners (SORALO) scouts operating in the Naimina Enkiyio Forest and Enkutoto areas as well as numerous individuals.

The following sections highlight the status and spatial extent of elephants including their numbers, distribution, movement and habitat connectivity, mortality and human-elephant conflict.

Historical elephant numbers

The elephants of the Mara ecosystem are part of the Mara-Serengeti elephant population and there is significant movement across the Kenya-Tanzania border. It is, therefore, difficult to precisely define a “Mara elephant population.” Until this report, population data for elephants on the Kenya side of the border have been based solely on aerial surveys, which document the number of elephants occupying the Mara at a particular point in time. These data have been summarised for the years 1959 to 1987 by Dublin and Douglas-Hamilton (1987) and between 1990 to 2002 by Thouless et al. 2008.

In 1961, when the first aerial survey was done, 1,157 elephants were counted in the entire ecosystem, of which 455 elephants were in the Mara (Talbot and Stewart 1964). Elephant numbers continued to increase during the 1960s and by 1970 some 729 elephants were counted in the Mara out of a total of 4,200 in the entire ecosystem. During this period there was very little poaching, but by the late 1970s illegal killing had become such a problem that elephants retreated to within the boundaries of the MMNR. In the 1980s poaching in the Serengeti began to force more elephants northward and a 1984 survey found more elephants than expected in the Mara and fewer in the Serengeti. Elephants continued to increase in the Mara, reaching about 1,500 by 1987, and then stabilised.

Since 1984 onwards WWF and KWS have conducted yearly or twice-yearly total counts. During the 1990s, total counts revealed elephant numbers in the reserve and dispersal areas that varied between

1,031 and 1,705 animals. Typically 60-80% of these elephants were seen inside the MMNR and the Triangle (now Mara Conservancy).

The Mara elephant numbers held relatively steady up until 2010 when 3,071 were counted (Kiambi, 2012). This increase in numbers was primarily observed outside MMNR, where there was a fourfold increase in elephants counted during the period 1984-2007 (Kuloba et al. 2010). The aerial count in June 2014 revealed a marked decline to 1,448, the lowest number and distribution for many years (Mduma et al. 2014). This drop is largely attributed to the southerly movement of elephants into Serengeti National Park, though poaching was a contributing factor (see below) and land transformation cannot be ruled out.

Current elephant status, grouping patterns and habitat use

ElephantVoices' Mara Elephant Who's Who & Whereabouts Databases house geospatial information on elephants from across the ecosystem. By end October 2015 over 4,300 records of elephant sightings, signs of elephants and mortalities had been uploaded and more than 1,160 adult (>15 years) elephants had been identified and registered.

Of registered adult elephants 42% were male and 58% were female. The skew toward females, especially observed in the older age classes, mirrors the imbalance in the mortality figures in which 65% of recorded deaths were male. The higher level of male attrition is primarily due to ivory poaching and human-elephant conflict.

Based on the number of registered adults and a documented ratio of 2 immatures to every adult female, the number of elephants *using* the Mara is at least 2,510 individuals. Since unknown elephants continue to be observed we believe the number of elephants using the Mara ecosystem is well over 3,000 elephants. The discrepancy between our estimate and that of aerial surveys indicates:

- a. a high level of cross-border elephant movement;
- b. the possibility that a large number of elephants inhabit the thick hilltop bush lands where it is difficult to see them or obtain an accurate count and/or;
- c. a good number of elephants spend significant time in areas beyond the boundaries of the aerial counts (e.g. Nyakweri Forest, Naikarra, Olderikesi, Loita and Naimina Enkiyio Forest).

Elephant groups in the Mara ecosystem vary in size from one to over 300 individuals and tend to be found within five km of water. Groups form and are distributed in relation to perceived opportunities (e.g. water, forage, security, other elephants) and threats (e.g. livestock, settlements, poaching).

Elephant families gravitate to areas offering enough forage to permit them to feed in close proximity to one another. Where food is limited families are forced to fragment into smaller groups; when it is plentiful families aggregate to form larger social groups. For example, while MMNR and Mara Conservancy offer similar grassland habitat and good security, the northern and eastern parts of the MMNR offers very little forage for elephants due to heavy livestock grazing. As a result, family groups in the northern half of MMNR are significantly smaller in size and fewer in number than in the Mara Conservancy. These sightings data are corroborated by satellite tracking data, which show a large gap in elephant use of the MMNR from the Mara River to Mara Simba and extending over 10 km into the reserve. This pattern is repeated in the reserve south of Sekenani and southwest of Oloolaimutia village and we believe is a result of lack of forage caused by livestock grazing.

Male elephants require areas of high browse to meet their high growth rates and large bodies. All-male groups are typically *not* found in grassland areas of MMNR or Mara Conservancy, but are dependent on the bush lands beyond the reserve in Mara Naboisho, Motorogi, Ol Kinyei Conservancies and areas such as Oldonyo Erinka, Pardamats, Siana, and Maji Moto.

The level of security also has a strong effect on elephant group type, size and distribution and elephants adopt strategies to augment their safety. They:

- a. seek safety in numbers;
- b. abandon highly insecure areas and seek refuge in protected area "safe-havens";

- c. hide in dense habitat during the day;
- d. move rapidly through settlement or open areas at night or;
- e. use the cover of dense river valleys or luggas to move from one safe place to another.

The movement of family groups is more easily curtailed by insecurity than is the case with male groups. As an example, families are less willing to cross major roads or travel through settlement than are males. Human activity strongly influences the location of elephants, their behavior, patterns of movement and tendency to aggregate. The current impact of elephants on woodland habitat in the conservancies is a consequence of unsustainable levels of livestock in the MMNR and insecurity in the greater ecosystem. Unless livestock and other anthropogenic activities are carefully managed conflict with elephants is likely to increase.



Males on the boundary between Mara Naboisho and Ol Kinyei Conservancies near route 4 (see Figure 1c). The MMNR cannot meet the needs of male elephants who require the dense browse found in the conservancies and beyond to meet their high growth rates and large bodies. Many of these areas are insecure and high male mortality due to poaching has been witnessed.

Elephant routes and habitat connectivity

In an ecosystem fragmented by human settlement wildlife routes and corridors can form critical linkages, which allow animal movement between important habitats. We plotted the human settlement footprint in the study area by drawing polygons around the settlements visible on Google Earth (**Figure 1a**). A best attempt to map all settlements was made, however, those illustrated must be viewed as an underestimate since,

- a. many of the satellite images were not up to date;
- b. some of the images were low resolution making settlements difficult to see;
- c. settlement is taking place rapidly and the last entries were made in February 2015. Google Earth images of the study area ranged in date from 30/11/2009 to 11/02/2015 (Table 1).

Table 1. Dates of primary satellite images on Google Earth from where settlements were viewed and polygons drawn. GR=Group Ranch; Cons=Conservancy; E=Eastern; NE=northeastern; NW=Northwestern; SE=Southeastern; W=Western.

| 30/11/2009 | 4/10/2012 | 22/6/2014 | 17/07/2014 | 30/07/2014 | 12/1/2015 | 11/2/2015 |
|---|--|--------------------------------------|---|------------------------------|---|--|
| Loita Hills, Ol Kinyei GR (NE), Maji Moto GR (NW) | MMNR (SE), Olderkesi Cons, Siana GR (SE), Olderkesi GR (W) | Mara Cons, Naikarra GR, Olderkesi GR | Nyakweri Forest, Kimintet Cons, Olorien GR (E), Kimentet GR | Kerinkani GR, Olorien GR (W) | Naimina Enkiyio Forest, Enkutoto/ Elogata Enderit GR, Kamorura GR, Narosura GR, Loita | MMNR (N), Mara North Cons, Olare Orok/ Motorogi Cons, Mara Naboisho Cons, Ol Kinyei Cons, Olarro Cons, Siana Cons, Lemek Cons, Olchoro Oiroua Cons, Pardamat Cons Area, Ol Kinyei GR |

In this document **routes** are defined as linear landscape features that serve as linkages between historically connected natural habitats (e.g. Pardamat Hills, Lemek Hills, Ngama Hills, Loita Hills, Nyakweri Forest, Naimina Enkiyio Forest) or between protected areas (e.g. the national reserve and conservancies) and these habitats. We identified primary routes used by elephants to move between key habitats and protected area through the GPS tracking of 27 elephants by STE, MEP, KWS and ACC (**Figure 1b**); and via the collection of elephant sightings, camera trap images, signs and interviews with local people by ElephantVoices and DICE. To determine the principal routes used by elephants we studied the satellite tracks of each elephant individually and drew lines to mark the most prominent route used by each to move between particular habitats or protected areas. From these lines we created a kml (keyhole markup language) file. We then amalgamated these separate kml files to create one picture of the main routes used and, once again, chose the most salient of these. Finally, we compared these results to those gathered via elephant sightings and signs and discussions with people to corroborate the tracking data and to augment information where it was lacking. The 27 elephants collared have a western bias (primarily Mara Naboisho Conservancy and west) and therefore routes on the eastern side of the Mara have relied more heavily on elephant sightings and signs and interviews with local people.

Connectivity is the degree to which the landscape and human activities facilitate or impede animal movement between resource patches. Both routes and connectivity increase the effective area available to wildlife, help to maintain ecological processes and improve genetic viability by reducing inbreeding. Such connectivity should also lower human-elephant conflict by providing elephants with a “path of least resistance” to navigate through an otherwise dangerous landscape. *Formal safeguarding of these routes by the establishment of protected corridors is paramount to ensuring the sustained connectivity and biodiversity of the Mara ecosystem.*

We here want to draw special attention to the critical importance of the Naimina Enkiyio Forest for biodiversity, as a water tower, for dry season grazing, and as key habitat for wildlife connectivity both within and beyond the greater Mara ecosystem. Satellite tracked elephants (2 by ACC and 1 by KWS/STE; (see Fig 1b), and elephant signs and interviews with people (ElephantVoices), have confirmed traditional movement of elephants from the MMNR to the forest and from there via the Nguruman escarpment to Shompole Conservancy, thus connecting the Mara elephants with populations in the Rift Valley and beyond to Amboseli and Tsavo (e.g. recent satellite tracking by IFAW/SFS/KWS). In the last five years intense elephant poaching and rapid, unplanned settlement within the forest and along elephant routes has caused these migrations almost to cease. The traditional community-based way of protecting the Naimina Enkiyio is no longer effective against pressures of human population growth

and increasing immigration. Poor governance and local conflicts and politics enabled the high levels of poaching (see Figure 3 below), settlement within the forest, and illegal logging of hardwoods. Indeed, the current fencing of land across South Narok is directly correlated with illegal logging of cedar and is exerting added pressure on the Forest. The Naimina Enkiyo Forest's importance as a key resource for the Loita community, for Narok County and for Kenya as a country cannot be underestimated. The situation is urgent, and we believe national attention is needed to help the Loita community to conserve the Forest.

Table 2 numbers and describes the salient routes used by elephants to move between core habitats, many of which need to be secured as protected corridors to ensure the connectivity of the Mara ecosystem. **These are presented in four sections: a) Routes to connect MMNR/Mara Conservancy and the conservancies; b) Routes to connect the conservancies; c) Routes to connect the conservancies and critical unprotected habitat; d) Routes to connect the Naimina Enkiyo Forest with the greater Mara ecosystem and populations further east.** The locations of these routes are depicted in the map, **Figure 1c** by their corresponding numbers. Note that the routes are, by design and by default, highly simplified illustrations. The exact location of most favoured routes between particular destinations and the level of threat to these identified elephant routes will have to be determined on the ground. Possible formal protection of each as a corridor will need to be weighed against other land use requirements.



A group of males walks in procession toward the boundary of Ol Kinyei Conservancy where route 6 (see Figure 1c) leads to Siana and Olarro.

Table 2: Route number, location, land status and current understanding of salient routes used by elephants and threats to their future. We stand available to assist Narok County and its spatial planners with geospatial data required for more detailed mapping. This Table should be read alongside **Figure 1c**; Route numbers below correspond to the numbers on the map.

A. Corridors to Connect MMNR/Mara Conservancy and the Conservancies

| Route Number Location Land status | Current understanding of salient routes used by elephants and threats to their future |
|---|---|
| <p>Route 1 Mara North Conservancy <i>Individual titles</i></p> <p>AND MMNR and Mara Conservancy <i>Protected National Reserve</i></p> | <p>The southern part of Mara North Conservancy is heavily used by livestock and there is increasing settlement along the boundary of the MMNR, despite current lease agreements with the Mara North. The MMNR boundary area is particularly attractive to those who wish to access the Reserve for illegal night grazing. Since this area is very open habitat, its use by people and livestock during day as well as night creates a particular barrier to elephant movement. The town of Mara Rianta also presents a formidable impediment. Elephants mainly use the following routes to move between Mara North and the MMNR:</p> <ol style="list-style-type: none"> The vegetated luggas that flow from the central part of the Conservancy and enter the MMNR near to Musiara Swamp. The river course that marks the boundary between MNC and OOC. Avoiding Mara Rianta by crossing into Trans-Mara between Royal Mara and Olololo. <p>Each of these routes requires elephants to move through human settlement and could become flash points for conflict unless some specific corridors are set aside for them to use. Ideally there should be no settlement between Mara North and the MMNR for the benefit of both wildlife and tourism.</p> |
| <p>Route 2 Mara Naboisho Conservancy <i>Individual titles</i></p> <p>AND MMNR <i>Protected National Reserve</i></p> | <p>Elephants use a number of different routes between Mara Naboisho Conservancy and MMNR each taking them through areas of settlement. As settlement is increasing, setting aside a protected elephant corridor(s) is a way to prevent escalating HEC.</p> <ol style="list-style-type: none"> Southeast corner of Mara Naboisho crossing the Talek River onto private land and into the reserve. Protecting the Talek River and land on either side will secure this passage. Southeast corner of Mara Naboisho following the Talek River course into MMNR by Mara Simba. This route passes through several hundred meters of unprotected land along the river course. If protected it could provide long-term passage through the current gap in settlement as long as Mara Simba is not a major barrier to elephants. Follows the river courses and luggas in the Baar valley and then via a number of routes passes through heavy settlement around Talek. This route goes through 3-5 km of unprotected and heavily settled land and is likely to be unsustainable at the current rate of growth in Talek. Crosses the southwestern boundary of Mara Naboisho into a narrow part of Olare Orok Conservancy before descending into MMNR. There is considerable settlement in this area and it passes a part of Mara Naboisho that may have to be abandoned due to land-owners not wishing to be part of the Conservancy. Without intervention this route may be unsustainable. |



Cattle waiting in Talek for night grazing in the National Reserve.

B. Routes to Connect the Conservancies

| Route Number Location <i>Land status</i> | Current understanding of salient routes used by elephants and threats to their future |
|---|---|
| <p>Route 3 Olare Orok Motorogi Conservancy <i>Individual titles</i></p> <p>AND Naboisho Conservancy <i>Individual titles</i></p> | <p>The boundaries of Mara Naboisho, Olare Orok and Motorogi Conservancies abut in the northwestern corner of Mara Naboisho. Elephants use this thickly vegetated area to move between the three conservancies as it offers safety and forage. As long as the conservancies persist this movement is likely to be secured, though there are quite a number of families that do not wish to be part of Mara Naboisho and have settled on the western plains.</p> <p>To the northeast of this area satellite tracking and signs of elephants indicate a couple of separate routes between Mara Naboisho and Motorogi that pass through open plains and settlement and are used at night. These routes represent a significant potential for human elephant conflict unless the Pardamat Conservation Area is secured and people leave a designated route open for elephants to pass.</p> |
| <p>Route 4 Mara Naboisho/ Ol Kinyei Conservancies <i>Individual titles</i></p> <p>AND Olarro Conservancy <i>Individual titles</i></p> | <p>A main elephant route used at night between Mara Naboisho/Ol Kinyei Conservancies and Olarro Conservancy follows the Talek and Ropili Rivers. The route requires elephants to cross the main Narok-Sekenani road, which (based on individually known elephants) appears to be a barrier to the movement of elephant families though less so for males.</p> <p>This critical route requires elephants to move through private land that is being fenced right down to the river's edge. <i>This is a vital corridor in need of urgent protection as it links the western conservancies to Siana, Olarro and the Loita Hills and is being rapidly settled.</i> The vehicle track that once linked these conservancies is now closed by fencing.</p> |
| <p>Route 5 Mara Naboisho Conservancy <i>Individual titles</i></p> <p>AND Siana Conservancy <i>Individual titles</i></p> | <p>This route crosses the Talek River from the southeastern side of Mara Naboisho and follows several different luggas across private land and the Olmeroi River crossing the Narok-Sekenani road in the vicinity of Sekenani. The use of this route can be seen via satellite tracking, though most tracks stop before the main road. Elephant signs along the road, however, indicate that elephants do cross into Siana.</p> <p>The main road is already a partial barrier to movement of elephant families and the route is at risk depending upon how settlement is controlled in the vicinity of Sekenani and the AA Camp. If movement is to be sustained we suggest that the AA Camp could be approached to support the protection of a corridor for elephant movement.</p> |
| <p>Route 6 Ol Kinyei Conservancy <i>Individual titles</i></p> <p>AND Olarro Conservancy <i>Individual titles</i></p> | <p>Between Ol Kinyei and Olarro Conservancies elephants follow several primary routes.</p> <ol style="list-style-type: none"> Follow the Ropili River (see Corridor 4 above) into Olarro and then the Losoitik, Parakitabu, Lentiangasir Rivers into Loita Hills. Leave Ol Kinyei Conservancy south of the Olare Lemuny salt licks following the Shangalera River east and then go north of Endoinyo Namankewon and into Olarro Conservancy by a variety of paths, some south others north of Ngosuani centre. From Olare Lemuny to Ormuntorobi Hill south of Ngosuani centre. <p>In this area land is being rapidly settled. All of these routes must cross the main Narok-Sekenani road, which is already a partial barrier to elephant family groups and is due to be paved.</p> |
| <p>Route 7 Siana Conservancy <i>Individual titles</i></p> <p>AND Olarro Conservancy <i>Individual titles</i></p> | <p>The recent extension of Olarro Conservancy forms a critical link to securing the passage of elephants between the core Mara population and the Loita Hills. However, until Siana Conservancy is formalised, and corridors (Routes 2, 4, 5 and 6) connecting the conservancies west of the Narok-Sekenani road, secured, the movement of elephants will be in jeopardy.</p> |

C. Routes to Connect the Conservancies and Critical Unprotected Habitat

| Route Number Location <i>Land status</i> | Current understanding of salient routes used by elephants and threats to their future |
|---|--|
| <p>Route 8 Mara Naboisho/OI Kinyei Conservancies <i>Individual titles</i></p> <p>AND Pardamat Hills <i>Individual titles</i></p> | <p>Elephant movement between Mara Naboisho/OI Kinyei Conservancies and the Pardamat Hills has been documented by satellite tracking as well as observations of elephants, their signs and interviews with people. The movement follows two routes that need to be protected:</p> <ol style="list-style-type: none"> The eastern route follows the Osepekue River (forming boundary between Mara Naboisho and OI Kinyei Conservancies), with movement through settlement occurring at night. The western route is used at night and follows the lugga that forms the boundary between Mara Naboisho and the Olesere community. <p>The long neck of Mara Naboisho stretching northward to the Pardamat Hills is key to the sustained movement of elephants, but settlement is rapidly developing at the base of the hills and to the north and west of Mara Naboisho, including many fences. High levels of poaching in this area also need addressing. The creation of the Pardamat Conservation Area should help to secure this movement, although its success will depend upon the level of fencing and settlement and the narrow passage at the northern end of Mara Naboisho will need special attention.</p> |
| <p>Route 9 Motorogi Conservancy <i>Individual titles</i></p> <p>AND Endonyo Erinka, Pardamat Hills <i>Individual titles</i></p> | <p>The movement between Motorogi and the Pardamat Hills can be clearly seen on the tracking map (Figure 1b). Elephants follow the main drainages that flow westward from Endoinyo Erinka and the Pardamat Hills across the plains and the Aitong-Talek road and into the eastern side of Motorogi. These drainages cross open and settled plains and elephant movement across this area typically occurs at night. This part of the ecosystem is changing rapidly with increasing livestock, settlement and fencing.</p> <p>To ensure the connectivity of these habitats and to avoid human elephant conflict provision of a corridor for elephants and other wildlife to move through is critical. The creation of the Pardamat Conservation Area may help, but to avoid escalating conflict a dedicated route should be set aside free of settlement.</p> |
| <p>Route 10 Mara North Conservancy <i>Individual titles</i></p> <p>AND Lemek Hills <i>Individual titles</i></p> | <p>Elephants move between the northern Mara North Conservancy and the Lemek Hills following the watercourse that flows from the Lemek Hills past Aitong and into Mara North Conservancy as can be seen on Figure 1b. In recent years settlement around Aitong has increased dramatically. Fencing is now taking place right up to the banks of the watercourse. The result is that elephants must pass through dense human settlement causing frequent conflict.</p> <p>We recommend further study of this area to determine how best to solve the problem, if it is not already too late.</p> |
| <p>Route 11 OI Kinyei Conservancy <i>Individual titles</i></p> <p>AND Maji Moto Salt Licks <i>Individual titles</i></p> | <p>Elephants move between OI Kinyei Conservancy near the Olare Lemuny salt lick following the lugga north toward Oldoinyo Narasha. We have rather little data on this route (from signs and a couple of satellite tracked individuals – see Figure 1b.) but elephants seem follow watercourses where there is forage and cover and travel at night.</p> <p>The Maji Moto salt licks and the Loita Hills are an important destination for elephants. We require more information about this movement to know how best to protect elephants and to contain and reduce conflict.</p> |
| <p>Route 12 Siana/Olarro Conservancies <i>Individual titles</i></p> <p>AND Maji Moto/Narosura <i>Individual title deeds/In process of subdivision</i></p> | <p>Very little data exist on the routes used by elephants in this area, but we know from satellite tracked individuals, from elephant signs and conversations with people that they travel over the Loita Hills following river valleys and luggas and move toward the Maji Moto and Narosura salt licks.</p> <p>Collared elephants using this area go to a particular spot north east of Narosura, where we are informed there are salt licks and more research is required to understand the value of this area to elephants. Based on discussions with people, we suspect that if more elephants in the east were collared that we could expect to see significantly more movement along this route.</p> <p>The risk of losing movement/increased HEC depends on the rate of settlement on the slopes and tops of Loita Hills.</p> |

D. Routes to Connect Critical Unprotected Forests with the Greater Mara Ecosystem and Populations further East

| Route Number Location <i>Land status</i> | Current understanding of salient routes used by elephants and threats to their future |
|--|--|
| <p>Route 13 Mara Conservancy <i>Protected National Reserve/</i> Mara North Conservancy <i>Individual titles</i></p> <p>AND Nyakweri Forest, Forest Fragments and greater escarpment <i>In process of subdivision to individual titles</i></p> | <p>Elephants use 20+ defined pathways to move up and down the Siria Escarpment to the Nyakweri Forest and forest fragments beyond, as well as to crop raid. These have been mapped and elephant usage monitored by Lydia Tiller. Elephants travel up the escarpment to access browse and other important resources such as salt licks. The pathways themselves contain forest habitat and provide important areas of browse for elephants, particularly since Mara Conservancy is primarily grassland. Movement tracked via satellite collars is illustrated in Figure 1b. As can be seen from these data elephant movement is focused on the remaining forest patches and elephants move relatively rarely beyond the escarpment pathways in Kerinkani (closest to the Tanzanian border) that lead to farms.</p> <p>Land in Transmara is heavily settled and habitat is undergoing intense transformation through charcoal burning, agriculture and settlement. The Nyakweri, Mugor and Laila forests have been steadily cleared and settled and the remaining forest is highly fragmented. Forest patches are surrounded by farms, which tempt elephants to crop raid and this leads to HEC.</p> <p>Subdivision of the Nyakweri Forest was recently halted and it has been proposed as a conservancy. Charcoal burning, however, is continuing unabated and urgent measures are required to protect it as a water tower and for biodiversity. We recommend a management plan to be developed for this area to highlight forest conservation and HEC mitigation strategies.</p> |
| <p>Route 14 Maasai Mara National Reserve <i>Protected National Reserve</i></p> <p>AND Naimina Enkiyo Forest <i>Community forest</i></p> | <p>Elephants use several routes between MMNR/Olderikesi Conservancy and the Naimina Enkiyo Forest. Each of these passes through Olpua, which has recently been proposed as a conservancy. During the subdivision process some 100 plots encompassing 2,500-3,000 HA have been set aside as a core area for this conservancy with the anticipation that additional plots will become incorporated in due course.</p> <ol style="list-style-type: none"> The northern route follows the Sand River valley and surrounding hills east then after Olpua curves northeast past the salt licks at the base of Olopilukunya and the dam at Ilkerin, and then south passing to the north of Baata village and joining the southern route north of Olmesutye. The southern route branches away from the Sand River after Olpua and heads southeast across the Ilkerin plains, passing south of Baata village and then following either the Olosirami or Olmesutye Rivers (north or south of Olmesutye) to the Olkeju Arus River and salt licks. Here the route angles sharply northeast up a narrow spit of forest following the Enkare Nanyukie River into the Naimina Enkiyo Forest. This migration path is an ancient route used by elephants covering a distance of 70 km (as the crow flies) of unprotected land, most of which is in the process of subdivision and rapid settlement. This route is absolutely critical to sustain connectivity between the Mara elephants and elephant populations to the east. A third branch of this migration route (b) follows the Olosirami and Olaragai Rivers into the forest near to Entesekera. A fourth route branches off the Olosirami and follows the Olaragai and then Kiloni Rivers. <p>The use of these routes was curtailed in recent years due to severe levels of poaching and increasing settlement. With poaching in decline and the development of Olpua as a conservancy we can expect to see migration of elephants restored.</p> <p>Naikarra and Olderikesi Group Ranches are in the process of subdivision. Naikarra distributed title deeds in May 2015 and has subdivided the entire group ranch to 30-acre plots running from the bottom to the top of hills. Only 30 meters on either side of rivers is secured. They are to be commended, however, for setting aside Olpua Conservancy as this is a critical habitat for elephants and will provide a key link for this route.</p> <p>Olderikesi intends to follow the same subdivision plan. Loita has not yet begun the adjudication process but individuals are laying claim to plots by cutting down forest in anticipation of subdivision. A number of these cut across the routes used by elephants. Both Olmesutye and Tiamenangen villages are discussing how to protect the corridor to permit the passage of elephants and their use of the salt licks, but local disagreements and political wrangling threaten to derail any conservation initiative.</p> |

| Route Number Location Land status | Current understanding of salient routes used by elephants and threats to their future |
|--|---|
| <p>Route 15 Naimina Enkiyio Oln'garua <i>Under consideration</i></p> <p>AND Loita Hills <i>In process of subdivision</i></p> | <p>A route once used by elephants joins the Naimina Enkiyio Forest and the Loita Hills around Oln'garua. In 2014 people interviewed in Leshuta stated that they had not seen elephants for some years, yet in April 2015 a group of 50 elephants was sighted near Oloitokito, Oln'garua, and residents claimed they had come from the Mara via Emorogi Hill. It may be that this route was temporarily abandoned due to the high levels of poaching and may be in use again. Elders note that elephants also once moved northwest from Inkonyiek Ekanunka through the escarpment and into Olemegili Hill.</p> <p>More research is needed to understand the routes used to cross the Loita Hills and across to Olarro, and how this links with the elephant presence above Naikarra town where HEC occurs. Alternatively, whether elephants are following the Sand River northeast and crossing to Naimina Enkiyio via Emorogi Hill.</p> |
| <p>Route 16 Naimina Enkiyio <i>Community forest</i></p> <p>AND Elangata Enderit</p> | <p>Signs of elephants and interviews with people indicate that elephants move between the Forest through Enkutoto to Elangata Enderit. The northern part of the Forest is the best conserved area, with the highest presence of elephants and the least sign of human activities.</p> <p>This is also an area that requires further study, especially as to the health of the elephant population following the extreme levels of poaching and the connectivity of this route to the Mara via the Loita Hills and/or Maji Moto. There is ongoing resource assessment of this section of the forest by the Olkonyil Association.</p> |
| <p>Route 17 Naimina Enkiyio <i>Community forest</i></p> <p>AND Kamorora/ Olkiramatiem/ Shompole</p> | <p>Based on earlier satellite tracking by the African Conservation Centre (ACC; see Figure 1b), elephant signs collected and discussions with local people, we know of two main routes used by elephants to move up and down the Nguruman escarpment from Naimina Enkiyio Forest to Kamorora/Olkiramatiem Group Ranch/Shompole Conservancy in Kajiado County.</p> <p>Elephants took refuge in Kamorora during the heavy poaching that took place in the Naimina Enkiyio Forest in recent years. In the last year, however, there has been a great influx of livestock to Kamorora and elephants have apparently moved back into the Forest and down to Shompole Conservancy.</p> |



Olkeju Arus salt lick is an important resource for livestock and elephants and forms part of the route elephants use to access the Naimina Enkiyio Forest.

Drivers of Human Elephant Conflict - the Way Forward

Human elephant conflict has been well documented in the Mara ecosystem (Sitati 2003, Ariyo 2008, Kaelo 2008). There is little browse available in MMNR and elephants roam beyond its boundaries in search of adequate forage as has been demonstrated by aerial counts, group sightings data (as described above) and tracking data (Figure 1b). Narok has been classified among the counties with the highest level of human elephant conflict in the country (KWS, 2012). Many mitigation efforts have been tried in the greater Mara ecosystem with different levels of success (Sitati, 2005). These include, though are not limited to, elephant drives and translocations, partial fencing, chilli fences, beehive fences, problem animal management. Some of these interventions have proven to be short lived, others too expensive to sustain in the long-term, while still others do not contribute to the achievement of elephant conservation. As subdivision takes hold and the spread of human settlements and farms increases, escalating conflict between humans and elephants and subsequent loss of lives and property can be expected, unless measures are taken now to avoid it.

Primary drivers of human-elephant conflict in the Mara ecosystem are correlated with habitat fragmentation in the ecosystem and include the following:

- a. Isolated farms, located in fragmented elephant habitat, bordering core elephant habitat, or adjacent to primary elephant routes.
- b. Subdivision of group ranches into plots in which a few acres of each may be farmed.
- c. Settlement and fencing along water-courses that block elephant movement.
- d. Destruction of forested habitat creating a longer interface between farmland and elephants.
- e. Competition between people and elephants for the same resources (e.g. grazing grounds, water troughs and wells, salt licks; Sitati 2003).

Many of the above drivers create tempting targets that are difficult to defend from elephants. Mitigation strategies for the drivers of HEC are highlighted in the **Priority Actions and Recommendations** section of this report. Developing a holistic, county level spatial plan that takes both people and elephants into consideration will minimise conflict. Such a plan should encourage people to settle in closer-knit communities by providing them access to modern amenities (e.g. running water, schools, health facilities, cell phone network, internet) leaving more land open for livestock grazing and wildlife and “funneling” elephants into the areas left open for them.

Spatial planning and its implementation is a key tool to mitigate HEC and will decide the future of the Mara ecosystem, and the welfare of people and animals alike.

Elephant mortality

Previous studies in the Mara have documented the primary causes of elephant mortality as ivory poaching, human-elephant conflict and revenge attacks, problem elephant control and natural causes (Sitati 2003, Wakoli and Sitati 2012). Elephants are highly sensitive to changing levels of security and patterns of illegal killing of elephants will influence their distribution, movement, group size and behavior. Thus, monitoring elephant mortality is a key to understanding the dynamics between elephants and people, as well as that between elephants and their habitats.

Monitoring of Illegal Killing of Elephants (MIKE), an initiative of CITES (Convention on International Trade in Endangered Species), was initiated in 2002. In 2010 the poaching rate escalated across the elephant range and the research partners in the Mara ecosystem adopted the MIKE protocol to record elephant mortalities. Since then various Mara stakeholders, including communities, have participated in the monitoring of elephant mortality. **Figure 2** gives a breakdown of the carcasses recorded by year and cause of death from 2010-2014. Although the numbers and causes of death have fluctuated, the Proportion of Illegally Killed Elephants (PIKE) at between 58% and 83% remained above the sustainable limit: A population is deemed to be in decline when a PIKE of 54% or above is recorded (Wittemyer et al. 2014).

Incidences of illegal killing occurred mainly outside the MMNR with comparatively higher PIKE values than inside the Reserve (**Figure 3**). Some areas such as Siana and the Naimina Enkiyio (Loita) Forest

recorded PIKE values of over 90%, which are among the highest levels of illegal killing of elephants recorded in Kenya.

Figure 2: A summary of causes of elephant mortalities and the Proportion of Illegally Killed Elephants (PIKE) in the Mara Ecosystem. An elephant population is deemed to be in decline when a PIKE of 54% and above is recorded.

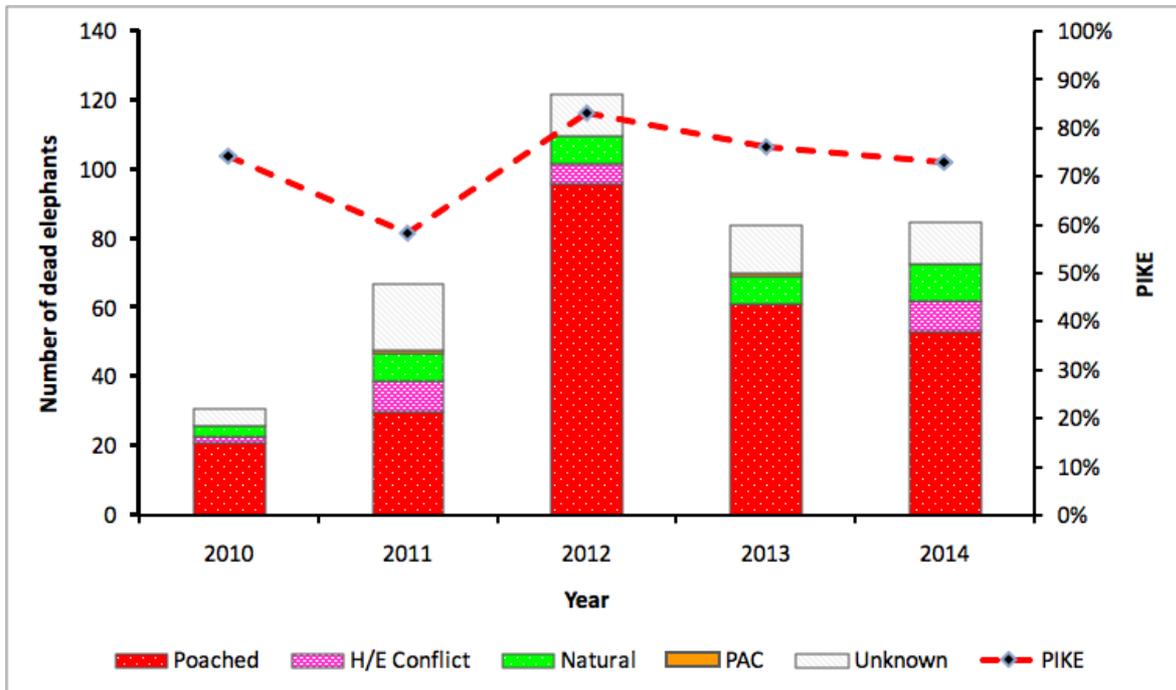
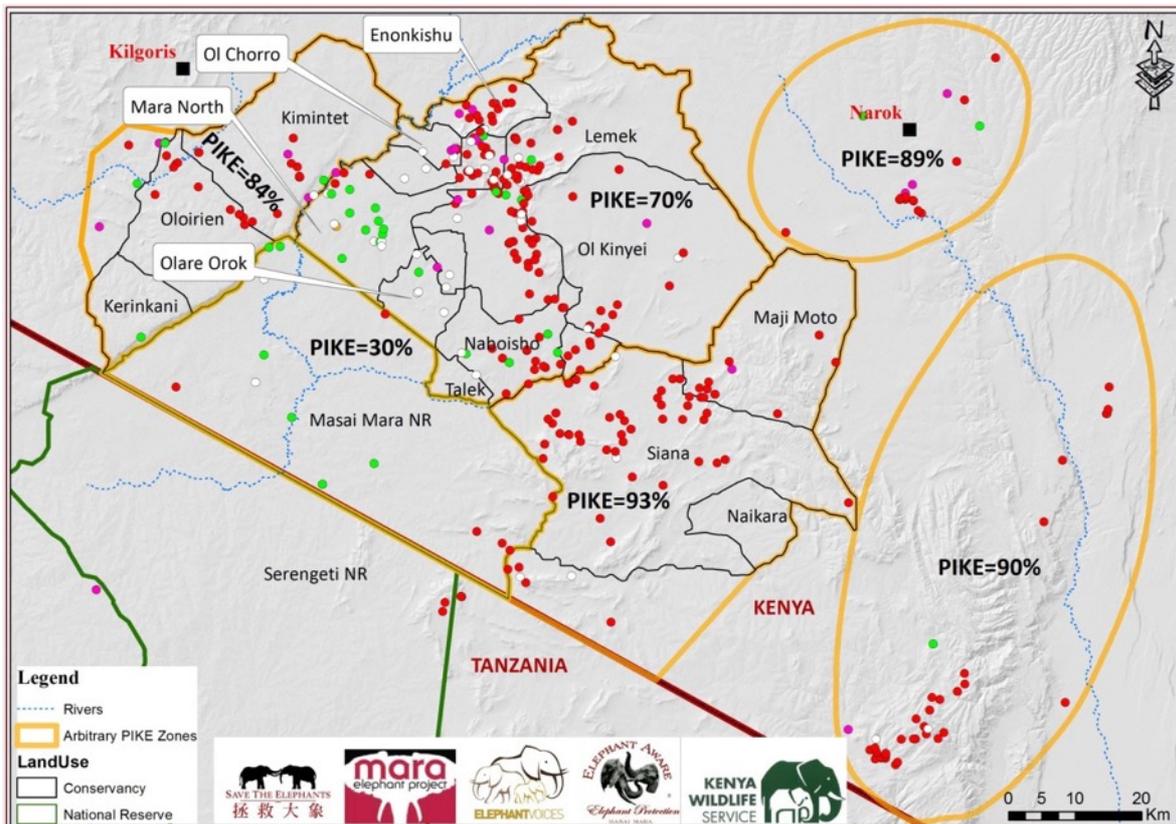


Figure 3: Elephant mortality by causes and distribution of carcasses in the Mara ecosystem from 2010 to 2014. An arbitrary zoning (bold orange polygons) of the Mara ecosystem has been done for purposes of comparing average PIKE values between areas. The PIKE values were above 54% except for Maasai Mara NR indicative of a population in decline from illegal killing.



Discussion

The Mara ecosystem is, by its very nature, a complex system. Impacts on one part can have far-reaching effects on the ecosystem as a whole. Elephants are called the ‘architects of the savanna’ because they can affect the form and functioning of an entire ecosystem. Through their foraging and movement they are nature’s constant gardeners, depositing seeds far and wide in ready-made “potting soil.” Their browsing opens up bush lands creating pasture for livestock and other grazers. Their digging maintains salt licks benefitting other species. In their absence the bush may encroach until no pasture remains. Likewise, human beings and their livestock can affect both the structure and functioning of an ecosystem: over grazing by livestock can lead to massive loss of topsoil through erosion. The cutting of trees along watercourses can result in the drying up of springs and rivers. Fencing can close off migration routes critical to the movement of wildlife upon which biodiversity depends. All of these changes can be observed in the Mara ecosystem.

Elephants are hypersensitive to the activities of people, whether attracted by maize fields or the offer of good security, or repelled by lack of forage or poaching. The consequent shift in their movement patterns has knock-on effects that we can see cascading across the ecosystem. In the Mara changes in security caused by high levels of poaching or human-elephant conflict on the one hand, or the establishment of the conservancies on the other, have influenced elephant distribution, movement and grouping patterns, as well as their behavior. Elephants adopt strategies and tactics to enhance their security. They may:

- a. seek refuge in the conservancies;
- b. hide in dense hilltop bush during the day;
- c. move through settlement when people are sleeping or;
- d. use the cover of dense river valleys or luggas to move across the landscape from one safe-haven to another.

Where elephants are subject to poaching or conflict interactions, they typically become more fearful/aggressive and the incidences of killing and injuring of people and livestock increases. A large proportion of Mara elephants carry scars from arrow and spear wounds and aggression toward people is, consequently, high. These sorts of occurrences can be mitigated through careful planning and zoning that permit elephants to move from one place to another without coming into conflict with people, and people to move about without fear of meeting elephants.

Elephants have long inhabited Narok County, both in the reserve and across a broad swath of landscape beyond. As human settlements and anthropogenic activities expand, elephants are being contracted into ever-smaller spaces. As livestock grazing in the national reserve has reached unsustainable levels, more elephants have been forced out of the reserve to find forage. For grass they must go to Serengeti or Mara Conservancy. For browse they must go north and east. During the severe poaching of the last four years the newly formed conservancies have been safe-havens for elephants. But also here they meet competition with high numbers of grazing livestock, leaving little but browse for elephants especially in the dry season. Their presence is, therefore, already changing the appearance of these favoured habitats, and loss of biodiversity and tourism revenue may be long-term consequences.

The MMNR and conservancies alone cannot sustain the population of elephants using the Mara ecosystem. Elephant’s natural drive to find food will lead them to continue to move far and wide, as long as that is an option. If people block their routes with farms and fences, as is the current trajectory, they will force their way through new settlements, causing destruction and conflict. Alternatively, based on proper spatial planning, we can encourage them along paths of least resistance by leaving open their well-trodden routes. In areas where this is no longer possible we can offer new routes for them to learn. These options are surely favourable to conflict, but will require collaboration and active engagement, investment and management by the County Government, KWS, NGOs and the community.

During the Narok South land adjudication process, group ranches have been carved directly into individual parcels, rather than first organising the landscape into areas most suited to farming, settlement, livestock grazing or wildlife. Most of the group ranches have already been subdivided and plots are being sold, settled, fenced and farmed; many of them along elephant routes that have been trodden for generations. As a consequence, radical interventions will have to be made to avoid escalating human-elephant conflict and the decimation of wildlife. Avoiding both is fundamental to the further development of Narok County and its people. The need for action is urgent.

We strongly recommend a spatial plan that considers a Landscape Species Approach. Such an approach will incorporate protection of the elephant routes, promotion of MMNR and conservancies and protection of the remaining forests, watercourses and other key habitats. Moreover, such a plan will help to mitigate human elephant conflict and reduce illegal killing of elephants.

Proposed Priority Actions and Recommendations

Elephants are highly intelligent, long-lived social mammals and they are extremely aware of and sensitive to anthropogenic activities. They respond to changes in human activities by making adjustments to their movements (speed, time of day, location), habitat use and/or grouping patterns, as well as their behavior (becoming more or less aggressive) toward people. These responses may have long-term and knock-on effects and cause either beneficial or detrimental impacts on habitat and/or on human livelihoods.

The importance of elephants as a landscape species, the critical role they play in sustaining biodiversity, their economic and cultural value, and their vulnerability to, and significant impact on people and livelihoods, are all factors contributing to these five priority actions and additional recommendations.

Five priority actions

Given the grim and urgent situation facing elephants and wildlife in general, we suggest that Narok County Government consider five priority actions. The purpose would be to create a viable platform for the sustained connectivity, biodiversity and conservation of the Mara ecosystem for the long-term benefit of wildlife and the people of Narok County.

- i. Halt development in all critical conservation and migratory areas and establish protected corridors (as identified in Figure 1c and described in Table 2), to sustain biodiversity and prevent escalating human-elephant conflict. Use legal and economic instruments in consultation with local communities and landowners to this end.*
- ii. Suspend further sub-division of land and issuance of title deeds until the ongoing spatial planning process is completed and approved.*
- iii. Halt destruction by loggers, charcoal burners and settlement of the Mau Forest Complex and of the Forests of Naimina Enkiyio, Nyakweri, Mugor and Laila to protect crucial water towers, biodiversity and dry season grazing lands and to prevent escalating human-elephant conflict. Securing the Mau Forest is vital for the survival of the Mara River and the entire ecosystem.*
- iv. Manage the grazing of livestock in the MMNR and conservancies sustainably and such that elephants and other wildlife are not negatively impacted.*
- v. Ensure the equitable and transparent sharing of benefits from the MMNR to improve livelihoods and mitigate human wildlife conflict among those communities in the Mara hosting wildlife.*

We further put forward the following additional policy recommendations:

Sustaining Conservancies

Considering that the survival of the MMNR and the entire Mara ecosystem is dependent on the success of conservancies,

- i. Narok County to contribute financially to the long-term sustainability of conservancies in the ecosystem, acknowledging that downturns in tourism can threaten their existence.
- ii. Establish a collaborative, predictable and transparent relationship between Narok County, MMNR and the conservancies to inspire governments, NGO's and other potential donors to contribute toward ecosystem sustainability, the purchase or lease of wildlife habitat and the development of local Mara communities and amenities.
- iii. Encourage communities to form conservancies as alternative land-use where appropriate and economically viable.

Improving Wildlife Conservation and Management

Considering the rapid decline of natural resources and wildlife numbers in Narok County,

- i. Establish a Mara Wildlife Task Force to address acute and upcoming threats to wildlife, with representatives from the County, KWS, MMWCA, and other conservation NGOs working in the Mara.
- ii. Ensure the coordinated monitoring of wildlife and sharing of data by KWS, County, MMWCA and NGOs/researchers, nurturing a collaborative spirit and growing research expertise in the county.
- iii. Ensure proper wildlife crime law enforcement, proactive collaboration between KWS, County, MMWCA, NGOs, police, judiciary.
- iv. Improve collaboration with Tanzania for the Mara/Serengeti elephant population, as a reflection of the high degree cross-border elephant movement.

For the spatial planning process we have the following specific recommendations:

Spatial planning for ecosystem connectivity and human elephant conflict mitigation

Bearing in mind that human encroachment is one of the primary drivers of human-elephant conflict, that the level of conflict in Narok is among the highest in Kenya, and that when elephants are properly conserved and managed they can be of benefit to human livelihoods,

- i. Within the overall Narok County spatial plan define which areas are to be used as conservancies, protected as forests or as other natural habitat, or set aside as livestock grazing or other multiple use zones that wildlife can inhabit.
- ii. Establish zones that keep people and elephants as separate as possible: villages/towns for habitation (with amenities such as running water, neighbourhood schools, health facilities, woodlots, Internet, cell towers) and areas for farming away from elephant habitat; and more open zones for other land use (such as livestock and wildlife).
- iii. Ensure the sustained connectivity of the protected areas, conservancies, forests and other key wildlife habitat in Narok South through the establishment of defined corridors for elephants and other wildlife, and prioritising mapped elephant routes between these core habitats, particularly along rivers, seasonal watercourses and luggas (see Figure 1c; Table 2).
- iv. Explore ways of avoiding settlement, fences and farms along, or in the vicinity of, these corridors, i.e. Compulsory Acquisitions Act, purchase or lease of land, negotiation of easements, setting of caveats on title deeds, incentives (e.g., payment for ecosystem services; opportunity costs of not engaging in alternative land-uses) or disincentives (e.g., no compensation), endowment funds, tax rebates, carbon sequester.
- v. Introduce legislation that prohibits settlement, fencing and farming within 30 meters of springs and along rivers, seasonal watercourses, and luggas, as such areas are critical waterways and are also vital for the movement of elephants and other wildlife.

- vi. Alleviate current HEC hotspots by 1) creating alternative passages for elephants in areas where they can persist 2) by encouraging denser but well-planned human settlement in areas where elephants have no future.
- vii. Pursue options of securing lands found critical for long-term survival of elephants and reduction of human elephant conflict.



“The boundary of the Naimina Enkiyo Forest is at the last shamba.” There is urgent need to define the boundaries of the Naimina Enkiyo Forest as it is rapidly being eroded by settlement.

References

- Ariyo, O. G. 2008. An evaluation of local people's attitudes and perceptions towards a human-elephant conflict in Transmara District, Kenya. MSc. Moi University, Eldoret.
- BBC. 2009. Mara wildlife in serious decline. <http://news.bbc.co.uk/2/hi/africa/8008700.stm>
- BBC. 2010. Poisoning drives vulture decline in Masai Mara, Kenya. BBC. http://news.bbc.co.uk/earth/hi/earth_news/newsid_9290000/9290103.stm
- Constitution of Kenya. 2010. <https://www.kenyaembassy.com/pdfs/the%20constitution%20of%20kenya.pdf>
- Coughenour, M., R. Reid, and P. Thornton. 2000. The savanna model: Providing solutions for wildlife preservation and human development in Eastern Africa and the Western United States. Developed by Colorado State University and the International Livestock Research Institute in collaboration with Future Harvest, Washington, D.C.
- Didier, K. A., M. J. Glennon, A. Novaro, E. W. Sanderson, S. Strindberg, S. Walker, and S. DiMartino. 2009. The Landscape Species Approach: spatially-explicit conservation planning applied in the Adirondacks, USA, and San Guillermo-Laguna Brava Argentina, landscapes. *Oryx* **43**:476-487.
- Douglas-Hamilton, I., H. T. Dublin, D. Rottcher, M. A. Jama, and P. V. Byrne. 1988. Identification Study of the conservation and sustainable use of the natural resources in the Kenyan portion of the Mara-Serengeti Ecosystem. Report to European Development Fund of the European Economic Community.
- Dublin, H. T., and I. Douglas-Hamilton. 1987. Status and trends of elephants in the Serengeti-Mara ecosystem. *African Journal of Ecology* **25**:19-33.
- Guardian. 2015. The Marsh Pride: end of an era. The Guardian. <http://www.theguardian.com/environment/africa-wild/2015/dec/09/the-marsh-pride-end-of-an-era>
- Guardian. 2013. The Masai Mara: 'It will not be long before its gone' The Guardian. <http://www.theguardian.com/travel/2013/aug/23/masai-mara-tourism-politics>
- Kaelo, D. 2008. Human-elephant conflict in Koyiaki-Lemek-Olkinyei Group ranches adjacent to Masai Mara National Reserve, Kenya. MSc. Moi University, Eldoret, Kenya.
- Kenya Vision 2030. www.vision2030.go.ke
- Kiambi, S., B. Kuloba, L. Kenana, D. Muteti, and E. Mwenda. 2012. Wet season aerial count of large herbivores in Masai Mara national reserve and the adjacent community areas. Mara Research Station, Kenya Wildlife Service.
- Kuluba, B., L. Kenana, D. Muteti, and E. Mwenda. 2010. Aerial count of large herbivores in Masai Mara National Reserve and the Surrounding Areas. Kenya Wildlife Service.
- KWS. 2012. Conservation and Management Strategy for the Elephant in Kenya 2012 - 2021. Kenya Wildlife Service, Nairobi. <http://www.kws.go.ke/download/file/1402>
- Mduma, H., C. Musyoki, D. Maliti Kyale, S. Nindi, K. Hamza, R. Ndetei, M. Machoke, D. Kimutai, D. Muteti, M. Maloba, S. Bakari, and E. Kohi. 2014. Aerial total count of elephants and buffaloes in the Serengeti-Mara ecosystem. TAWIRI, KWS, WWF, FZS and Paul G Allen Foundation, WWF Nairobi. <http://www.kws.go.ke/kws/sites/default/files/Mara%20Elephant%20Count%20Report.pdf>
- Millenium Development Goals (Kenya). <http://www.indexmundi.com/kenya/millennium-development-goals.html> Ogotu, J. O., H. P. Piepho, H. T. Dublin, N. Bholá, and R. S. Reid. 2009. Dynamics of Mara-Serengeti ungulates in relation to land use changes. *Journal of Zoology* **278**:1-14.
- Sitati, N. W. 2003. Human-elephant conflict in the Masai Mara dispersal areas of Transmara District. PhD, University of Kent (Canterbury).
- Sitati, N. W., M. J. Walpole, R. J. Smith, and N. Leader-Williams. 2003. Predicting spatial aspects of human-elephant conflict. *Journal of Applied Ecology* **40**:667-677.
- Sitati, N. W., M. J. Walpole, and N. Leader-Williams. 2005. Factors affecting susceptibility of farms to crop raiding by African elephants: using a predictive model to mitigate conflict. *J. Applied Ecology* **42**:1175-1182.
- Talbot, L. M., and D. R. M. Stewart. 1964. First wildlife census of the entire Serengeti-Mara region, East Africa. *J. Wildlife Management* **28**:p815-827;tables;maps;refs.
- Thompson, D. M., S. Serneels, D. O. Kaelo, P. C. Trench, K. Homewood, P. Kristjanson, and P. C. Trench. 2009. Staying Maasai? Livelihoods, conservation and development in East Africa rangelands. <http://www.ilri.org/ilri/news/index.php/archives/664>
- Thouless, C., J. King, P. Omondi, P. Kahumbu, and I. Douglas-Hamilton. 2008. The Status of Kenya's Elephants 1990-2002. Save the Elephants and Kenya Wildlife Service. <http://savetheelephants.org/wp-content/uploads/2014/03/2008StatusofKenya'sElephants.pdf>
- Wakoli, E., and N. W. Sitati. 2012. Analysis of temporal and spatial patterns of elephant attacks on humans and elephant mortality in Transmara District, Kenya. *Greener Journal of Environment Management and Public Safety* **1**:027-037.
- Wildlife Conservation Society Resources. 2001. The landscape species approach: A tool for site-based conservation. *Wildlife Conservation Society Bulletin*. http://s3.amazonaws.com/WCSResources/file_20110518_073528_Bulletin_AToolForSiteBasedConservation_Msku.pdf
- Wittemyer, G., J. M. Northrup, J. Blanc, I. Douglas-Hamilton, P. Omondi, and K. P. Burnham. 2014. Illegal killing for ivory drives global decline in African elephants. *Proceedings of the National Academy of Sciences of the United States of America* **111**:13117-13121.



www.elephantvoices.org www.savetheelephants.org www.maraelephantproject.org www.kws.go.ke