The status of Kenya's elephants 1990–2002

C. Thouless, J. King, P. Omondi,
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A collaboration of the Kenya Wildlife Service and Save the Elephants
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KENYA WILDLIFE SERVICE

SAVE THE ELEPHANTS

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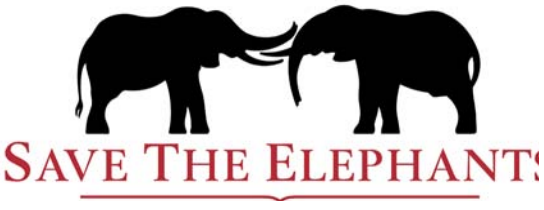

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CONTENTS

Acknowledgements	iv
Abbreviations	iv
Executive summary	v
Map of Kenya	viii
1. Introduction	1
2. Survey techniques	4
3. Data collection for this report	7
4. Tsavo	10
5. Amboseli	17
6. Mara	22
7. Laikipia–Samburu	28
8. Meru	36
9. Mwea	41
10. Mt Kenya (including Imenti Forest)	42
11. Aberdares	47
12. Mau	51
13. Mt Elgon	52
14. Marsabit	54
15. Nasolot–South Turkana–Rimoi–Kamnarok	58
16. Shimba Hills	62
17. Kilifi District (including Arabuko-Sokoke)	67
18. Northern (Wajir, Moyale, Mandera)	70
19. Eastern (Lamu, Garissa, Tana River)	72
20. North-western (around Lokichokio)	74
Bibliography	75
Annexes	83

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ABBREVIATIONS

AERP	Amboseli Elephant Research Project
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
DRSRS	Department of Resource Surveys and Remote Sensing
EMD	Elephant Mortality Databsase
FOC	Friends of Conservation
GIS	global information system
KREMU	Kenya Rangeland Ecological Monitoring Unit
KWS	Kenya Wildlife Service
MIKE	Monitoring of Illegal Killing of Elephants
PAC	problem animal control
WWF	Worldwide Fund for Nature

EXECUTIVE SUMMARY

Elephant numbers

The 1990s have been the first years since the 1960s that Kenya's elephants have not substantially declined in numbers. Major savannah populations such as Tsavo, Laikipia–Samburu and Amboseli have increased significantly; others such as Mara and Meru have remained stable.

Status of forest populations surveyed using dung counts is little known. Given the low confidence in such estimates, other indicators of population trends are employed. Forest area has declined, particularly in the major elephant ranges of Mt Kenya, the Aberdares and the Mau complex, as forests have been converted to farmland. There is no evidence that forest populations were affected by massive poaching of savannah-living elephants in the 1970s and 1980s. Density of most forest populations appear to be moderately high (more than 1 elephant per km^2) and thus are unlikely to increase substantially.

It is evident that the surveyed savannah populations are generally either increasing or stable. But due to the paucity of reliable information on trends in forest elephant populations we cannot make such inferences for the forest populations. Thus it is difficult to establish the overall trend in Kenya's national elephant population.

Mortality and threats

A review of the mortality records since 1990, when the centralized elephant mortality database was established at KWS headquarters, has shown that the quality of data on elephant mortalities varies between populations. By 2002 a streamlined reporting and recording system for elephant mortalities was needed to reduce errors in transferring information from the field to headquarters. Implementing the MIKE (Monitoring of Illegal Killing of Elephants) carcass reporting system at selected sites in Kenya will remove many of these sources of error.

Poaching has remained relatively low in most populations throughout the 1990s up to 2002. However, poaching increased in the last few years of the period in several of Kenya's major elephant populations including Tsavo, Laikipia–Samburu and Marsabit. The major threat to northern elephant populations is likely from the many firearms in the hands of local communities, largely since the breakdown of law and order in Somalia in the early 1990s. Although these arms are mainly for protection against cattle rustling, it appears that in many areas the guns are being used to poach elephants. Should poaching by local people intensify it would be difficult to contain.

Threats to elephants vary across Kenya's elephant range. Encroachment of settlements and agriculture, loss of habitat, cutting off of historical elephant corridors, and compression of elephant populations into small, isolated pockets have all increased human–elephant conflict over the last decade. This is particularly evident in Mt Kenya, the Aberdares and Mau Forests, the Mara and Shimba Hills, and parts of Tsavo and Laikipia. In the mid-1990s to address human–elephant conflict, KWS personnel shot a number of problem animal and elephant-proof fences were constructed. More recently, KWS emphasis has turned to translocating elephants to reduce pressure on habitats and remove problem animals.

This report

This report summarizes all information on elephants since the last major Kenya elephant status report of 1992; it also sets a new baseline of elephant status in 2002, immediately

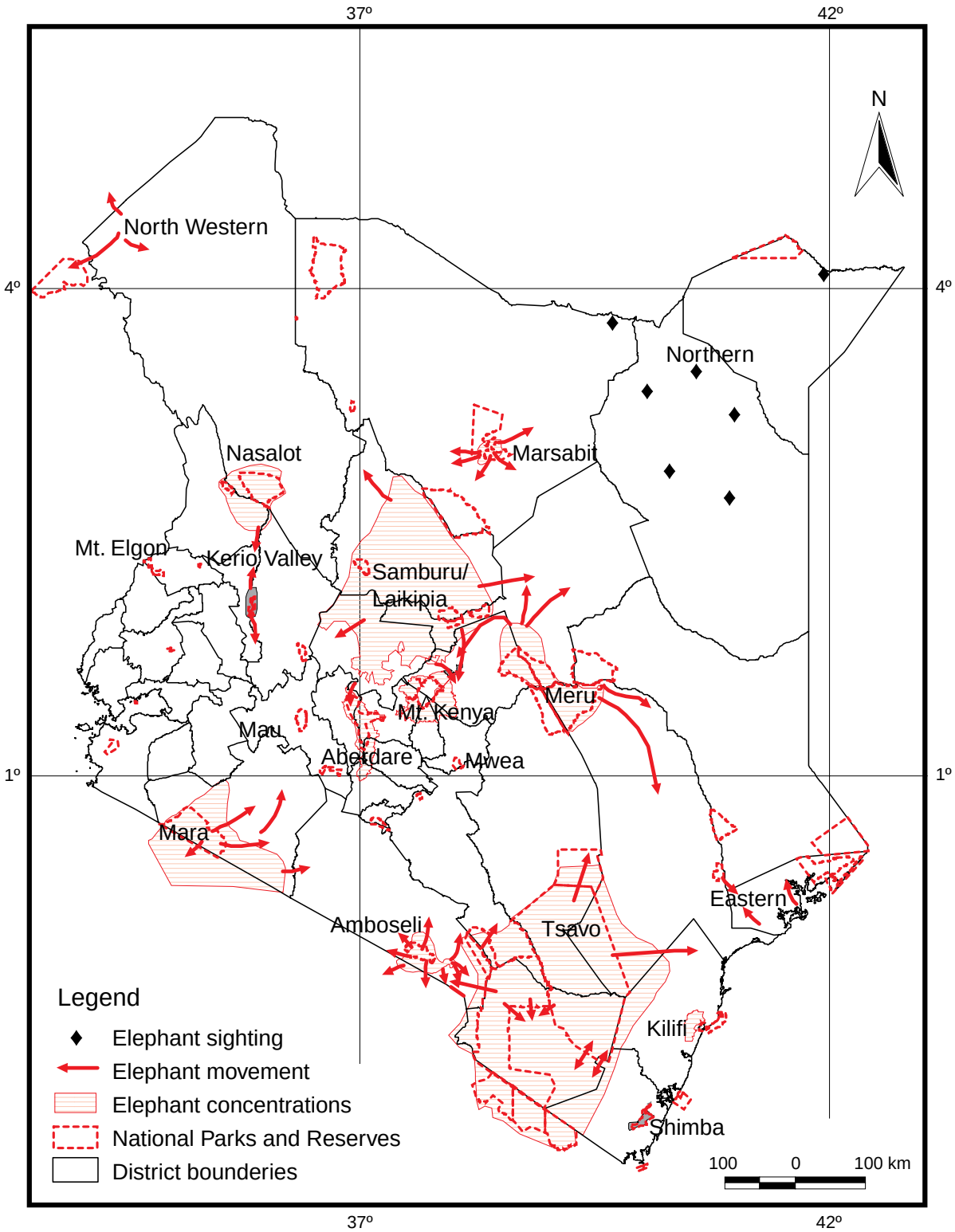
prior to the institution of the new MIKE programme. This can be used as a milestone against which future changes can be measured.

Summary of population estimates and trends, 1995–2002

Population	Lower estimate	Upper estimate	Trend	Year	Survey type	Previous estimate (AED 1998)
Tsavo	9284	9284	increase	2002	aerial total	7371
Mt Kenya	2173	2649	unknown	2001	dung count	4022
Imenti Forest	0	156	decrease?	1997	dung count	156
Samburu–Laikipia	5447	5447	increase	2002	aerial total	3660
Mathews Forest	630	630	unknown	1992	dung count	630
Leroki Forest	212	212	decrease	1997	dung count	210
Aberdares	1822	1822	unknown	1990	dung count	4120
Mara	2116	2116	stable	2002	aerial total	1450
Transmara Forest	36	250	unknown	1997	dung count	200
Mt Elgon	400	400	unknown	1999	guess/dung count	1114
Mau	1003	1003	unknown	1995	dung count	1003
Amboseli	1070	1070	increase	2000	individual recognition	980
Nasolot/South Turkana/ Rimoi/Kamnarok	792	792	stable?	1999	aerial total	852
Marsabit	360	360	unknown	1996	guess	500
Shimba Hills	464	658	unknown	1997	aerial total	464
Meru & Bisinadi	413	413	increase?	2002	aerial total	360
Tana Delta	30	50	unknown	–	guess	–
Eastern (Lamu, Boni, Dodori)	70	150	unknown	1996	guess	150
Arabuko–Sokoke	78	126	unknown	1996	dung count	100
Mwea	55	55	stable	1998	ground count	55
North Eastern (Garissa–Moyale)	50	50	unknown	1999	guess	0
Ngurumans	0	150	unknown	1998	guess	150
TOTAL	26505	27843				27547

– data not available

Date	Notes
1997	–
1998	Lower estimate from GLIM model, higher estimate from recce transects (Vanleeuwe, pers. comm.). Previous estimate extrapolated forest density to entire National Reserve and park, including moorlands
1997	–
1996	–
1992	During the wet season these elephants probably mix with the main Samburu population, but since the Laikipia-Samburu count was carried out in the dry season, it is reasonable to add them to the total count figure.
1997	–
1998	The previous estimate is based on a dung count with a small sample size, carried out in 1997, which gave an improbably high density of 4.0 per sq km.
1998	–
1997	High figure is given in report; low figure is calculated from density and given area.
1996	–
1995	–
1998	–
1997	–
1998	–
1997	Low figure from helicopter count; high figure from individual recognition.
1997	–
–	–
1996	Low figure is actual number seen in 1996 survey.
1996	Different figures based on 1991 survey, and different calculations of decay rate for 1996 survey.
1998	–
–	–
1998	–


37º
42º
4º
1º
N
North Western
Northern
Nasalot
Marsabit
Mt. Elgon
Kerio Valley
Samburu/
Laikipia
Meru
Mt. Kenya
Mau
Aberdare
Mwea
Mara
Eastern
Amboseli
Tsavo
Kilifi
Shimba
Legend
Elephant sighting
Elephant movement
Elephant concentrations
National Parks and Reserves
District bounderies
100 0 100 km

1. INTRODUCTION

The status of Kenya's elephants has long been a matter of public interest as the health of the nation's elephant population is an indicator of the overall success of its conservation programmes. Elephants are also of economic concern as they are a central attraction for the tourism industry, being an important source of foreign exchange.

The history of elephants in Kenya has been one of great contrasts. In the 1960s conservationists reported impending ecological disaster as a result of too many elephants in Kenya's largest elephant range, Tsavo National Park. Proposals to cull were hotly debated but before anything could be done, the situation reversed. In the 1970s and 1980s poaching threatened the very survival of these elephants, which had been reduced to a fraction of the 1960s population. The Tsavo elephant crisis mirrored the decline in Kenya's entire elephant population, causing alarm both nationally and internationally. Between 1973 and 1989, Kenya's elephants plummeted from approximately 167,000 to an estimated 16,000 individuals, although this figure may well have been an underestimate (Douglas-Hamilton 1989). This was primarily as a result of widespread, uncontrolled poaching for ivory.

In response to the failure of the Wildlife Conservation and Management Department to halt elephant poaching, in 1989 the Kenya government created the Kenya Wildlife Service (KWS); a semi-autonomous parastatal with instructions to defend elephants aggressively. The listing of elephants in Appendix I of CITES in October of the same year ensured international commitment to halting the trade in ivory. This rare concurrence of combined global and local action brought to an end the elephant slaughter in Kenya. A detailed account of elephant trends during this turbulent time was compiled by Poole et al. (1992).

This new status report is a chronicle of Kenya's elephants after the period of heavy poaching had ended, between 1992 and 2002. It is a comprehensive account of the numbers, distribution, mortality and threats to Kenya's elephant populations during a decade of relative security. Other summaries have been reported in the *African Elephant Database* (Said et al. 1995; Barnes et al. 1999; Blanc et al. 2003).

To describe fully the status of elephant populations, it is necessary to collect information on the number of elephants and the range that they occupy, whether the populations and areas occupied are increasing or decreasing, and to explain these trends in terms of the factors affecting elephant breeding and deaths. The quality of this information is variable and caution should be exercised when making interpretations. Although some of the data are poor, Kenya has one of the most comprehensive data sets on elephant populations available on the African continent. Aerial count methods for savannah populations are well established (both total and sample counts) and a fair degree of standardization in these techniques is used across Africa. Trends can be reasonably deduced from these data. There are problems, however, with the forest dung count methods that have been used in Kenya for the last decade, and they are still being perfected. It is not unreasonable, therefore, that some figures will be revised following new developments with this technique.

Elephant numbers

Establishing the exact number of elephants in Kenya at any one time is complicated because the methods are specific to the habitats, and results are not easily comparable due to the nature of the errors associated with the techniques. Population estimates have two types of errors associated with them. First, the counting may be inaccurate if elephants are

under- or overcounted. This may occur if guesses are used for the estimates, techniques are inaccurate, or enumerators are inexperienced. The second error is imprecision where sampling error results in a wide range of estimates for the same population. Elephants occur in a diversity of habitats, from the mixed grasslands and woodlands of the Masai Mara to the thickly forested, rugged slopes of Mt Kenya. In dense forest, estimates can be obtained only from indirect methods such as dung counting, which may be less accurate and less precise than aerial counts if, as has been the case in many Kenyan surveys, not all variables have been measured on site. Aerial counts, used only in open habitats, can be accurate but are expensive to conduct. Total aerial counts are prohibitively expensive when elephant ranges are large, and many population estimates are obtained by 'sampling' a part of the area and then extrapolating to obtain an estimate for the entire population. A small sample fraction will magnify any sample errors, thus reducing the precision of the estimate.

Range

An elephant population's range is the area within which the elephants are found. Range is difficult to define exactly because elephants move long distances, often in response to patchy rainfall, and bulls in particular often explore new areas. Where there is a 'hard edge' such as an electric fence, a definite boundary may be identified, although occasional individuals may break fences and travel beyond the defined boundary. Defining range is especially difficult in remote areas with low-density elephant populations and in areas adjacent to international borders. It is also difficult to document reductions in elephant range, which is partly due to the fact that people are more likely to notice when elephants are newly seen in an area than when they have not been seen for some time. The edge of elephant range is sometimes defined by the occurrence of conflict with humans.

Trends

To evaluate the success of elephant conservation efforts in Kenya it is necessary to know what is happening to populations—if they are increasing or decreasing, if so at what rate and how this is affected by external influences such as changes in CITES regulations. Calculating trends in elephant numbers is not easy, particularly at the national level, because changes tend to be slow and data quality is variable due to different survey techniques. Apparent changes in population size are often simply due to use of different techniques and not actual changes in numbers of elephants.

In savannahs, Kenya's most consistent counts have been carried out by the Department of Resource Surveys and Remote Sensing (DRSRS) using standard techniques unchanged since the late 1970s. As these are sample counts the sample error attached to the estimate is substantial. Furthermore, because DRSRS covers only rangeland areas and not forests, their counts cannot be used in isolation to study national trends.

Another source of data is the total aerial counts that have been carried out in the Tsavo ecosystem and the Masai Mara using methods consistent throughout the last decade, thus permitting reliable trends to be deduced. More recently, regular total aerial counts of other savannah elephant populations (including Laikipia–Samburu, Meru and Nasolot) have been conducted that can also be used to establish trends in these populations over a shorter time.

Factors affecting populations

Change in elephant population size in a closed system is determined by the difference between birth and death rates. These data are difficult to obtain except in the most intensively studied populations. Most elephant populations are not limited by food and therefore birth rate is not as important as death rate. Under natural conditions, mortality rates tend to be constant and low, and populations may increase at a rate of about 5% per annum. Due to their relatively slow rate of natural increase and low rates of natural mortality, elephant populations are particularly susceptible to increased levels of human-induced mortality.

Mortality rate is an important indicator of the health of a population, and KWS monitors this through a central database of elephant mortality that has been maintained since 1990. However, because of the remote location of most elephant populations, it is rare for wildlife authorities to record more than a small proportion of the animals that have died. The number and location of dead elephants is usually related to the distribution and amount of patrolling conducted by wildlife rangers. Therefore, as the anti-poaching efficiency in an area increases, the number of dead elephants found may increase. Conversely, where the level of law enforcement declines, the rate of reporting elephant mortalities may decrease despite an increase in mortality. For these reasons, indirect measures of mortality may give valuable information on factors affecting elephants. For example, the ratio of elephant carcasses discovered by authorities with their tusks in place or with tusks removed may be a more sensitive index of levels of poaching, and thus of overall rates of mortality (assuming that natural causes do not vary much). Where there is little control and rangers are acting in collusion with poachers, few carcasses will be reported, and the vast majority are likely to have had their tusks already removed. Conversely, where there is effective patrolling, more carcasses may be found, but typically the rangers will find them before other people have had a chance to remove the tusks.

An independent measure of mortality rates is the carcass ratio, which is the proportion of dead elephants to the total of dead and live elephants observed in aerial surveys. Use of carcass ratios must also be treated with some caution, for the following reasons:

- Carcasses are difficult to detect from the air, and visibility is affected by vegetation. Cover has more effect on the counting efficiency for carcasses as compared with counting live animals.
- Carcasses remain visible for up to five years and therefore provide an indication of the history of an area, but the ratios may not respond rapidly to changing circumstances.
- Because carcasses are more difficult to see than live elephants, carcass ratios tend to be highly dependent on the survey intensity and the skill of the observers. During total counts observers scan a relatively large area and are likely to see fewer carcasses. They therefore calculate a lower carcass ratio for the same area than under intensive scanning during sample counts.
- Except under conditions of high poaching pressure, the total number of carcasses will be considerably lower than the number of live animals, and therefore confidence limits associated with the carcass estimates will be high.

Despite these limitations, carcass ratios can be used to examine differences in mortality over time in the same area, and for gross differences between areas.

2. SURVEY TECHNIQUES

Elephants occur in a wide variety of habitats, necessitating the use of several different counting techniques. These fall into four main classes: ground counts, aerial surveys, dung counts, and guesses.

Ground counts

The greatest accuracy in counting elephant populations is achieved where every animal is individually known and identified by means of distinctive features. The Amboseli Elephant Research Project has maintained recognition files on individual elephants for 30 years, and this is the best-known elephant population in the world. Individual recognition files have been created for other populations, including Samburu, Sweetwaters Sanctuary, and Lewa Downs (all part of the Laikipia–Samburu population), some of the Tsavo National Park population, and elephants in Shimba Hills. However, none of these have approached the Amboseli study in terms of population coverage and time span and can only be treated as a minimum estimate of population size.

Aerial surveys

Many of Kenya's elephant populations have been surveyed using aerial counts. In the 1960s and early 1970s, these surveys were not systematic and observers attempted to count the entire populations of large areas without the aid of accurate navigational instruments. As a result it is likely that many of the early counts were underestimates.

During the 1970s, the techniques of sample counting using systematic reconnaissance flights were developed, and Norton-Griffiths (1978) codified these techniques into a system that is essentially unchanged today, except for improvements in navigational accuracy and in data presentation using geographical information systems (GIS).

In sample counting, the counting crew counts only the elephants within a defined fraction of the total area and extrapolates from the sample area to a total population estimate. Counting is typically done by a four-person crew of pilot, recorder and two rear-seat observers, who record all animals seen between two rods or streamers projecting back from the aircraft struts. The proportion of the total area that has been surveyed is calculated from the width of the strip on the ground that is counted. The area covered is determined by flying over fixed markers on the ground at different heights above ground level to find the relationship between flying height and strip width. Sample counts are subject to sample error, which means that the results are quoted as a range of estimates within 95% confidence limits. The error will be relatively low if a high percentage of the area is covered and if animals are widely dispersed in relatively small groups rather than clumped in large herds.

Most aerial sample counts in Kenya have been conducted by DRSRS, formerly the Kenya Rangel Ecological Monitoring Unit (KREMU). This organization has carried out systematic surveys of livestock and wildlife in the rangeland areas of Kenya since the late 1970s using the same techniques and, to a large extent, the same crews. These data are extremely valuable for comparing population estimates over a long period; however, because of the relatively wide confidence limits for population estimates of elephants, the data lack precision. Population trends can be measured from DRSRS data only over a long period unless dramatic changes have occurred. In addition, since DRSRS surveys are carried out at a district level, with low percentage coverage, the data for all but the largest protected areas tend to be imprecise.

More precise elephant counts for individual protected areas and of some elephant populations have been carried out using the total counting technique. This technique has evolved from survey efforts of the 1960s and has improved through a systematic approach and the use of modern navigation devices. In the late 1980s a series of total counts of Tsavo National Park were carried out. These involved a large number of aircraft attempting to count the whole area over a number of days. Unlike DRSRS counts, which involved only two aircraft with professional crews, these counts brought in pilots and observers with widely varying experience and knowledge of the terrain. Navigation was difficult in areas with few natural features, and this sometimes made it difficult to achieve uniform coverage of the survey area. However, the introduction of global positioning system (GPS) units in the early 1990s made navigation much easier and made it possible to adopt more uniform systems of coverage with most surveys being carried out at 1-km transect intervals. This means that the maximum distance at which an elephant herd had to be spotted was 500 m. Further improvements came about with the use of recording GPS units, which allowed data to be downloaded directly into a geographical information system and for pilots to record their actual tracks.

Although total counts have the advantage of providing complete coverage and do not suffer problems of sampling error, they have been criticized as being more subject to variation in the competence of observers. Whereas in sample counts, observers have to count only within a strip that is generally 250 m or less, in total counts observers are required to scan and spot within a strip of 500 m or more, and to ensure that the same animals are not being counted twice in successive passes. However, field tests have shown that under moderately open savannah conditions, elephants are easily visible from the air at a distance of 500 m, and the use of recording GPS units has reduced the chance of counting the same group twice (provided that the counting strips are fairly short). Counting of large groups is also likely to be more accurate in total counts because the aircraft can deviate from the flight path and circle, whereas in sample counts without photography the herd must be counted quickly and judgement made about which members of the herd are inside the counting strip.

Although most aerial surveys in Kenya have been carried out using fixed-wing aircraft, these become relatively less effective as tree cover increases. In forests with a relatively open canopy it is possible to use a helicopter, although under these conditions a significant proportion of animals may be missed. Helicopter counts have been used for many years to count elephants in Kruger National Park in South Africa, but high cost limits their use for elephant counting in Kenya.

Dung counts

A significant proportion of Kenya's elephants live in dense forest where aerial surveys and direct counts are impractical. In these habitats, it is possible to calculate population estimates of forest elephants using indirect techniques. The usual method involves counting elephant dung along line transects. A population estimate is derived using knowledge of the density of elephant dung in an area, the rate at which it decomposes, and the frequency with which elephants defecate. Sampling errors can be substantial in dung surveys and arise from various sources. The dung density is calculated using a 'sightability function', which calculates the probability of observing dung at different distances from the transect centre line. This distance can vary along the same transect or between transects, depending on vegetation. Dung decay rate affects the duration of dung on the ground, and this is extremely variable, depending on the diet of elephants, habitat,

microclimate and detritivore behaviour. Finally, the daily defecation rate is assumed to be the same for all elephants although few empirical studies have been conducted.

Barnes (2002) has shown that dung counts should have narrower confidence limits than aerial sample counts because dung is more evenly distributed across transects than are elephants. In many Kenyan forest surveys, however, dung counts have had wide confidence limits because only a small number of short transects have been surveyed.

Ideally, surveys on dung decay rates and defecation rates should be carried out on site. In practice, studying defecation rate is impractical and it is assumed that site-specific defecation rates are unlikely to be a serious problem. Of greater concern is variation in decay rate. Most dung surveys carried out in Kenya have not made use of site-specific decay rates; however, this value is extremely variable and therefore assumptions may have a significant effect on population estimates. In addition, some surveys have not taken into account the sampling error associated with measurements of decay rate, thus giving spurious precision to the results.

Survey design is of great importance when sampling a population or an area. With total counts and systematic reconnaissance flights, the study area is fully surveyed in a systematic way, and variations in local density of elephants will not affect the results seriously. However, dung surveys typically sample a small proportion of the total range, and logistical challenges result in transect placement that seldom approaches the ideals of random or systematic design. Transects are likely to be concentrated in areas where access on foot is relatively easy. Dung densities in these areas are unlikely to be representative of the entire range as elephant densities are not homogeneous but are affected by human disturbance and terrain. This means despite rigorous calculations, substantial errors in the overall population estimate are likely to occur if extrapolation to the entire range area is based on flawed survey design or inaccurate estimates of total range size.

Guesses

Before 1960 most population estimates for Kenya's elephants were informed guesses. Wardens and people with good knowledge of a particular area would come up with a figure based on the largest herds that they saw, the typical number that they would see in a day in the area, and the area over which the elephants ranged. While these figures are better than nothing, they may diverge considerably from the true number. It is now widely believed that the true number of elephants in the middle part of the 20th century was much higher than was generally supposed, and that large areas of the country holding elephants were overlooked in these countrywide estimates. With the intensity of surveys carried out in the 1990s, there are now few elephant populations in Kenya for which the only estimate consists of an informed guess.

3. DATA COLLECTION FOR THIS REPORT

Survey data

Information on elephant populations has come from a variety of sources. Poole et al. (1992) have summarized most of the information prior to the 1990s, although wherever possible, original reports have been reviewed for this report. Later information comes mostly from survey reports, the majority of which were produced by KWS. Independent researchers have carried out a small number of surveys. Information from DRSRS is mostly in the form of unpublished data abstracts. Although this information is generally quite consistent, some changes have been made in the way that data are handled (such as using correction factors in some of the earlier counts), which means that on occasion different estimates have been produced from the same sets of survey data, and this has had to be taken into account.

Elephant distribution

Sources of data on elephant populations include the following:

- Baseline information from the African Elephant Database
- Survey reports with maps
- Radiotracking data (Amboseli, Laikipia, Meru, Samburu)
- Information from KWS wardens and other interested parties. For a number of populations, wardens indicated distribution on a 1:250,000 scale map.

Mortality information

Mortality figures for several populations (Amboseli, Arabuko-Sokoke, Laikipia–Samburu, Marsabit, Meru, Mt Elgon, Nasolot–Rimoi, Shimba Hills and Tsavo) were reconciled from field data and from KWS's elephant mortality database (EMD). For the remaining populations, mortality figures were taken from the EMD, which includes detailed reports from each carcass.

Data were gathered from various sources in the field, including occurrence books, ivory registers, incoming and outgoing radio messages, researchers' records, intelligence reports, annual and monthly reports, pilots' records and patrol registers (fig. 3.1). The level of documentation at stations varied greatly, as did the reliability of information. During much of the 1990s, information on elephant mortality was recorded in different ways in each station without a consistent method of recording or reporting it. In recent years, however, attempts have been made to ensure that elephant mortalities were reported to KWS headquarters and entered into the EMD and CITES incident report forms. More recently in 2002, data have been entered into the MIKE (Monitoring of Illegal Killing of Elephants) system for specific sites. Nevertheless, some discrepancy remains between elephant mortality records in the field and those in EMD. As far as is possible, these records have been reconciled for most of the populations.

It should be noted that the mortality figures quoted here are for the *reported* mortality—that is, only carcasses that are actually found and reported. The reported elephant mortality represents only a fraction of the actual mortality that occurs in a population, as not all carcasses will be found. Overall reported mortality may be as low as 15–20% of actual mortality in a population. This figure is arrived at assuming an average natural annual mortality of 4% in elephant populations (Laws 1969) and comparing the

calculated expected mortality with the number of reported mortalities. For example, if Kenya's elephant population stood at approximately 24,000 animals in 1999 then the expected annual natural mortality at 4% per year is 960. Reported mortality for 1999 was 164 individuals (excluding animals shot by KWS on problem animal control), or 17% of expected mortality.

Reported mortality figures will vary greatly between areas depending on how well rangers are able to find carcasses in different kinds of habitats. The probability of finding carcasses will depend on patrol intensity, visibility and other factors such as the number of elephants in the population, elephant range and terrain, and the condition of the carcass. The reported mortality should be a representative sample of actual mortality and should indicate the relative contribution of different causes of death (for example, poaching, conflict, natural, sickness) to the overall mortality of the population. It is also important to note that it is not valid to make direct comparisons between reported mortality for problem animal control (PAC) with mortality due to other causes of death. This is because PAC is a known quantity (that is, 100% of cases should be reported). Other causes of death will be under-reported, as not all carcasses will be found. Comparing PAC and poaching records as if they were absolute values is likely to give the false impression that PAC is a major factor of mortality compared with other causes.

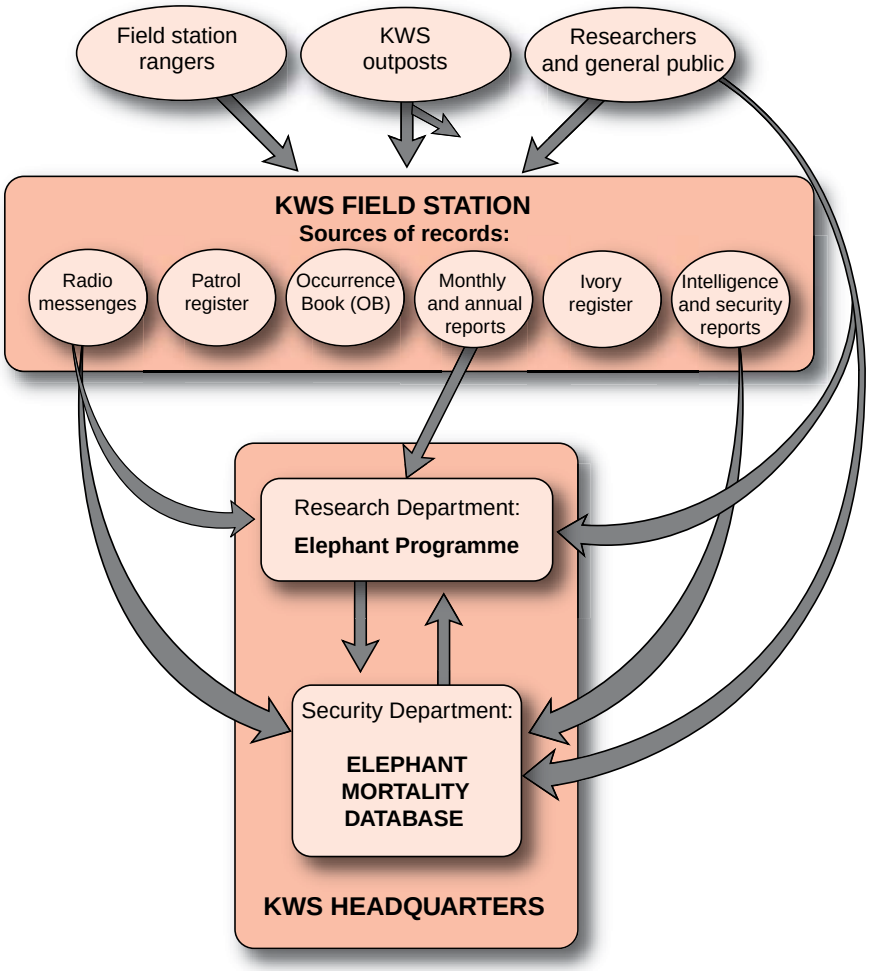


Figure 3.1. Sources of reporting and recording of elephant mortality in KWS field stations and at KWS headquarters.

Interpreting mortality data may be difficult as the classification of death may change depending on the attitude of the wildlife authorities at the time. In particular, changes in PAC mortality during the 1990s are a reflection of different policies within KWS and not necessarily an accurate indication of changes in intensity of human–elephant conflict. However, such factors are impossible to remove from the data and inferences made must bear this in mind.

Causes of mortality are categorized as follows:

AC accident	CF conflict,	CT control/PAC	PP poached
NA natural	SI sickness	UN unknown	

Poaching refers to the illegal killing of elephants, chiefly for their ivory. The total 'found' carcasses exclude elephants KWS shoots on PAC, as these are a known quantity. Whether the tusks were in place or missing at the time of finding the carcass is also noted. Information about current threats to elephants in each area was gathered from interviews with KWS field officers and other researchers and individuals working in specific areas. This information, although not quantitative, may provide a useful background in interpreting patterns of elephant mortality.

Streamlining the reporting and recording system and removing the emphasis on a centralized mortality record as the only national record may reduce errors encountered between records in the field and at headquarters. For instance, field stations and outposts should keep summarized mortality information in a systematic way common to all stations. Poaching or security-related mortalities, natural mortalities (AED 1996) and PAC reports tend to be kept by separate sections within each station and records are often not pooled into a single mortality report. If all sections within a station use the EMD incident report forms (or MIKE carcass forms) rigorously and keep a copy of all forms in a single mortality file at the station, the summarized information of elephant mortalities submitted to headquarters will be more nearly accurate. A unique identification code will be created for each carcass report in MIKE sites, and a similar national system should be adopted for non-MIKE sites. This would eliminate duplicating reports of the same carcass on different dates. Records in the field and mortality database should include the presence or absence of tusks at the time the carcass was found and the method used to remove tusks (for example, pulled, cut out with panga or axe). The presence or absence of tusks may provide a secondary indication of poaching threat.

It should be emphasized to rangers and other field personnel the importance of reporting and recording *all* elephant mortalities, to reduce bias in the mortality figures. Reviewing the current system of reporting and recording mortalities in the field has shown the need for training field personnel in how to gather accurate information from carcasses and the need for streamlined reporting of mortalities to headquarters. Since inception of the MIKE system many of these issues are being addressed at selected sites (Meru, Mt Elgon, Samburu–Laikipia, Tsavo). However, it would be useful to implement a standardized recording and reporting system for elephant mortality across the country.

4. TSAVO

Introduction

The Tsavo ecosystem encompasses the largest protected area in Kenya and Kenya's largest elephant population. The park, gazetted in 1948, occupies 20,900 km^2. It has been the focus of much of the controversy surrounding elephants in Kenya. During the 1960s and early 1970s international attention was focused on the 'Tsavo elephant problem'. As a result of protection within the protected areas and compression of elephant range outside the parks, elephant densities increased inside the parks. This led to the widespread conversion of bushland to grassland and raised fears of elephant-induced desertification. The combination of a drought and an outbreak of commercial poaching for ivory led to a 70% decline in elephant numbers over a period of four years. In the late 1980s there was another outbreak of poaching. Publicity over this outbreak led to radical reforms of the Wildlife Department (Wildlife Conservation and Management Department), which culminated in the creation of Kenya Wildlife Service as an independent parastatal.

The Tsavo elephant population has been the subject of a series of studies and its status is better known than that of most other Kenyan elephant populations (Laws 1969; Cobb 1976; Inamdar 1996).

Historical information

Little is known about the elephants of the Tsavo area before Europeans arrived. Thorbahn (1984) used archaeological and other evidence to suggest that around the 15th century, hunter-gatherers known as the Wambisha became involved in the ivory trade in the area. At that time the dominant vegetation was open grassland; however, as the ivory trade reduced elephant numbers, bushland encroached, and the area turned into an impenetrable 'nyika' (thicket).

Tyrrell (1985) used information from explorers' diaries and reports to reconstruct elephant distribution in the late 19th century. He concluded that there were small resident populations along the Sabaki (Galana) River in the vicinity of the present-day Tsavo National Park. He considered that the relative openness of the habitat in this area was evidence of its long-term occupation by elephants. However, there was no evidence of the existence of elephants in most of the eastern plains—the Taru–Maungu zone and the area north of it and the Voi–Tsavo zone along the foot of the Taita Hills. The relative scarcity of elephants was considered to be due to the proximity of the major ivory trade routes (Corfield 1975). By the 1920s elephants were noted from the Tsavo Valley, and in the 1930s there was a record of a herd of elephants that had come to Voi from the west (Tyrrell 1985). During the 1940s and 1950s elephant range and numbers presumably increased, although concerns began to be raised about the impact of poaching, especially by the Waliangulu.

Although the National Park was established in 1948, effective anti-poaching measures did not start until 1956. It was estimated that at least 3000 elephants had been killed in the area in the two to three years before 1957 (Laws 1969). The success of the anti-poaching campaign allowed elephants to move back towards the rivers, where poachers had previously operated. During the drought of 1960–61, it is believed elephants moved into the park from the surrounding areas attracted by artificial water supplies and driven by control shooting in nearby farming areas. The result was increased damage to woody vegetation.

Aerial surveys conducted in June and September 1962 indicated that 10,799 elephants were inside the park and 4804 on the perimeter (Glover 1963). The largest number of elephants was seen in the northern part of Tsavo East, particularly along the Galana and Tiva Rivers where there was a continuous distribution of elephants. A subsequent aerial count in October 1965 gave an estimate of 20,300 elephants, of which 15,687 were within the park (Laws 1969).

In the early 1960s there was much debate about the desirability of culling elephants to protect vegetation. A sample cull of 300 elephants took place in Tsavo East in 1966, with a further 120 culled in Mkomazi in Tanzania (Laws 1969). The Tsavo Research Project was set up to look into the relationship between elephants and habitat. A series of survey flights in 1967 provided a provisional estimate of 35,000 elephants, of which some 23,000 were thought to be within the park. It was believed that the main reason for the increase was an improvement in counting techniques. Laws (1969) considered that there were 10 separate populations separated by areas of low elephant density.

Between 1970 and 1971 there was a severe drought in which many elephants died. Aerial surveys of part of the area reported 5900 deaths during this period, comprising mainly juveniles and females (Corfield 1973). Mass mortality was confined to the drier parts of Tsavo East, particularly near Aruba Dam along the Galana River and an area to the north-east of the Yatta Plateau. These were areas with low and erratic rainfall into which elephants had recently immigrated and where vegetation change had taken place. Within these areas, deaths were concentrated close to permanent water.

It was during this period that the price of ivory on the international market was increasing, and people started collecting ivory from dead elephants and shooting them for their tusks (Sheldrick 1976). In an effort to curb this situation, Kenya introduced a hunting ban on elephants in 1973 and in a short time the park was overrun by poachers. The most serious poaching took place between 1975 and 1978 (AED 1996; Ottichilo 1987).

Cobb (1976) described the abundance and distribution of elephants and large herbivores within the ecosystem between 1973 and 1974 and estimated that almost 35,000 elephants were then present, suggesting either that Laws's (1969) estimate was too low or that elephants had migrated into the park since 1967. By 1980 the elephant population had been reduced to about 10,000 animals by illegal hunting, primarily for ivory (Ottichilo 1987; Douglas-Hamilton 1987).

While the main decline in elephant numbers in Tsavo took place between 1976 and 1980, it is not clear how much further populations declined during the 1980s. There were no total counts until 1988 and DRSRS surveys in 1980 and 1985 both gave estimates close to 10,000 animals. However, the large number of 'recent' carcasses (less than one year old) seen in the 1988 survey and reports from the field (AED 1996; Woodley and Hamilton 1987) suggest that numbers did continue to drop.

By 1988 a total count showed that only 5000–6000 live elephants remained in the ecosystem (Olindo et al. 1988). Poole (1989) described how the age structure of Tsavo elephants had been affected considerably with families consisting mostly of orphans and adolescents but few mature adults present. McKnight (2000) suggested that the survival rate of young females was reduced because of the stress associated with poaching, and that more than half the families studied were fragmented—old females were missing and there were youngsters that appeared to be orphans.

Recent surveys

Total aerial counts of the Tsavo ecosystem were carried out in 1991, 1994, 1999 and 2002. Inamdar (1996) carried out a detailed series of sample counts in 1993 and 1994 that gave an estimate of 9542 ± 1314, which is higher than the figure given in the total count at that time (see also fig. 4.1). DRSRS has continued its regular surveys.

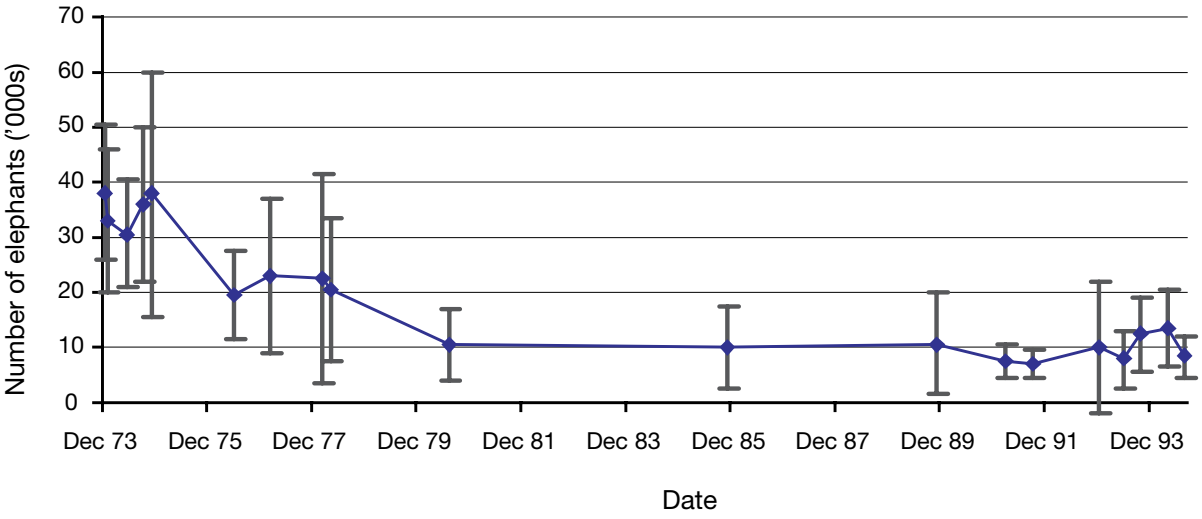


Figure 4.1. Sample counts in the Tsavo ecosystem.

Data from total counts show increasing numbers throughout the 1990s (fig. 4.2) up to the present with 6763 elephants counted in the system in 1991, 7371 in 1994, 8068 in 1999 and 9284 in 2002. The 16% increase in numbers between 1988 and 1989 is surprising. There are two possible explanations. One, that there was a substantial immigration of elephants into the ecosystem between the two counts, is not supported by any other information. The other is that the efficiency of counting in the 1988 survey was low because the area was covered in a short time, and many of the crew were inexperienced as few total counts had been carried out in preceding years. In this count, the average area counted per hour was 321 km^2 as opposed to 283 in 1989. If the 1988 survey is discarded, the other counts show an approximate annual increase of 3% in the elephant population.

The bulk of this increase took place in Tsavo West, and in 1999–2002 in the northern part of Tsavo East particularly. There was a small increase in the southern section of Tsavo East where most of the survivors from the 1980s had concentrated.

Current distribution and movements

By 1988, after a decade of heavy poaching, the distribution of elephants within the Tsavo ecosystem had changed dramatically. Virtually no live elephants remained in the Galana area outside the eastern boundary of the park or in the northern section of Tsavo East, and few were left beyond the south-eastern border of Tsavo West. During the 1990s elephants gradually returned to the north of Tsavo East, increasing in numbers along the Tiva River. In 2002, there was a substantial increase in the number of elephants seen in northern Tsavo East, evidence for the first time since 1988 that elephants were returning to the northern part of their range. There was little evidence that Galana was being recolonized.

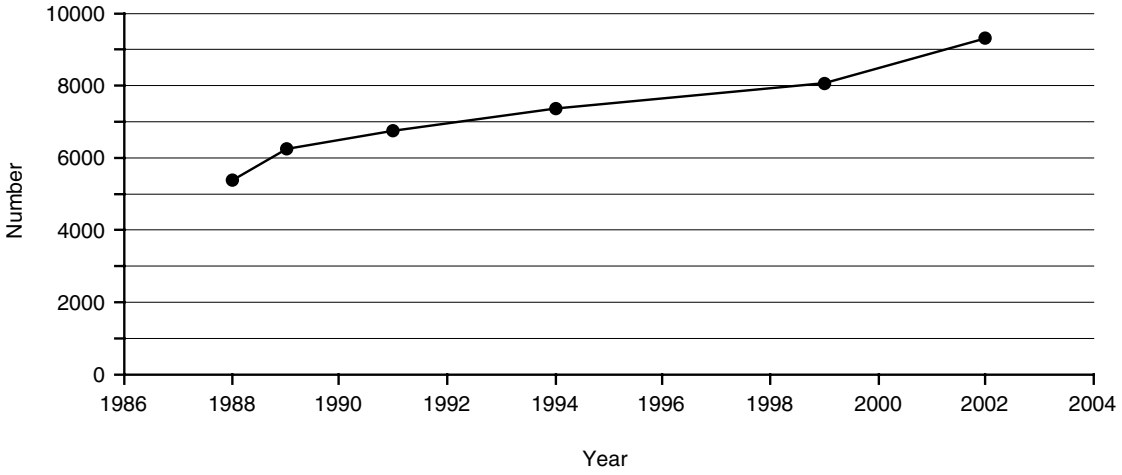


Figure 4.2. Total counts in the Tsavo ecosystem.

Relatively small numbers of elephants were counted outside the protected areas of Tsavo East and Tsavo West National Parks.

In the 2002 count, 89.9% of elephants in the ecosystem were within the National Parks, with the highest number in the northern part of Tsavo East (4089 elephants or 44.4% of the total counted), mostly between Galana and Tiva Rivers within the National Park. The remainder (828) were almost all in the Taita area—mostly around Lualenyi and Rukinga—with very small numbers in Galana (14) and other areas (33). In Tsavo West 2168 elephants were counted and in the southern part of Tsavo East there were 2087.

Elephants tend to concentrate around permanent water in the dry season and disperse in the wet season. During the *El Niño* rains of 1997–98, elephants dispersed further than they had in the previous 15–20 years. There were reports of elephants moving north of the Tiva River to the Thua River, and some farther north, as far as halfway between the Garissa road and the northern boundary of the park (KWS warden, Tsavo East, pers. comm.).

In 1999, 28 elephant bulls were captured in Mwaluganje Elephant Sanctuary near Shimba Hills and translocated to Tsavo East. Some of these were believed to have settled in their new area, but one moved 150 km in five days to Mida Creek, on the coast north of Mombasa. He was pushed into the Arabuko-Sokoke Forest where there is a resident elephant population. Another translocated elephant was found dead in mud at Kilifi Creek (Muir 2000).

Mortality

In 1997 and 1999, the total reported mortality for the Tsavo ecosystem was greater than for other years (table 4.1).

In 1999 and January–May 2002, 59% and 69% respectively of all found carcasses were confirmed as poached, contributing to over half of the reported mortality for found carcasses. In 1999, 37 elephants were reported as poached, 10 in Tsavo West in August alone. Between January and May 2002, 16 elephants were reported as poached, including a herd of 10 poached in one incident in Tsavo East in March 2002 (see fig. 4.3).

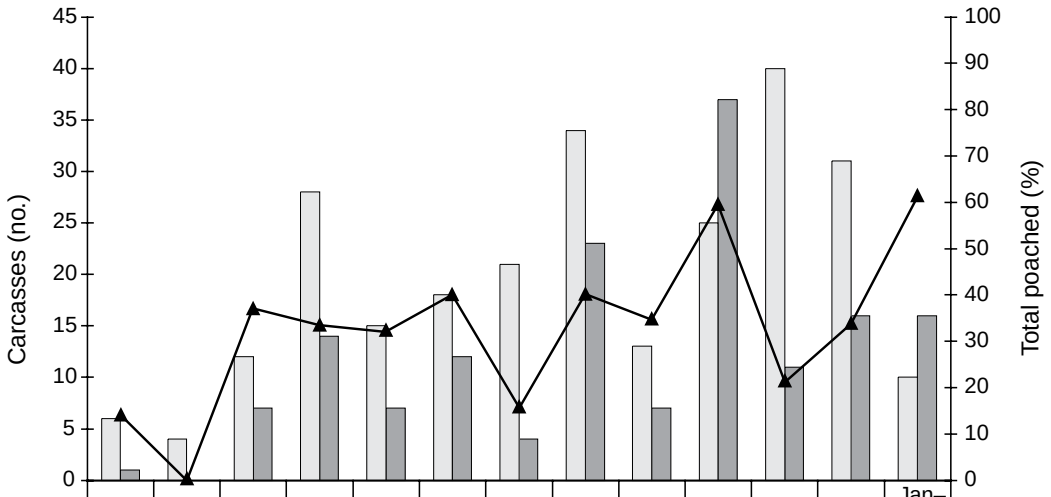
- In 1999 and January–May 2002, 50% of all found carcasses had their tusks missing, compared with 14–43% for all other years.
- In 2000 a large number of elephants were killed accidentally, including 13 that were hit by trains.

These results show that there was an increase in reported poaching in the Tsavo ecosystem in 1999 and again in January–May 2002. Somali gangs and Tanzanian poachers in Tsavo West currently threaten the Tsavo population. In 1999, one gang of Tanzanian poachers operating in Tsavo West was apprehended. Somali gangs were responsible for the intense poaching during the 1970s and 1980s, and this appears to be the case still in the Tsavo area where most of the leases on grazing land surrounding Tsavo National Park have been taken by people of Somali origin. Poachers can easily infiltrate these communities and it is difficult for KWS to trace them. A low level of opportunistic poaching by people from the local communities also continues.

Table 4.1. Mortality figures for Tsavo National Park, 1990–2002

	AC	SI	NA	UN	CF	CT	PP	Total	Total 'found'	Poached of 'found' (%)	Ivory missing of 'found' (%)
1990	2	0	0	3	1	0	1	7	7	14	14
1991	0	2	0	4	0	6	0	12	4	0	0
1992	2	2	4	2	4	15	7	36	19	37	41
1993	3	3	15	8	2	5	14	50	42	33	31
1994	1	0	3	9	2	13	7	35	22	32	36
1995	1	3	4	13	0	27	12	60	30	40	43
1996	2	2	3	14	2	7	4	34	25	16	16
1997	3	2	6	23	2	16	23	75	57	40	39
1998	0	0	4	8	1	2	7	22	20	35	38
1999	1	1	6	15	3	9	37	72	62	60	59
2000	18	2	9	8	5	2	11	55	51	22	19
2001	6	5	5	18	2	0	16	52	47	34	33
Jan–May '02	1	0	3	6	0	1	16	27	26	62	69

AC – accidental; SI – sickness; NA – natural; UN – unknown; CF – conflict; CT – PAC; PP – poached



	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Jan–May 2002
remainder found	6	4	12	28	15	18	21	34	13	25	40	31	10
confirmed poached	1	0	7	14	7	12	4	23	7	37	11	16	16
% poached	14	0	37	33	32	40	16	40	35	60	22	34	62

Figure 4.3. Reported elephant mortality in Tsavo National Parks from poaching and other causes (excluding poblem animal control) and proportion of overall total that were poached, 1990–May 2002.

Conflict

Human–elephant conflict is severe in parts of the Tsavo ecosystem, except where the park's boundary adjoins low-rainfall ranching and pastoral areas. Conflict has increased due to human population growth, especially around the densely populated Taita Hills, which are almost surrounded by the park. Since the National Parks were gazetted the number of people in this area has quadrupled (Low 2000). In the past, the Taita people spent most of their time in the well-watered hills and hardly came into contact with elephants. However, settlements have grown and people have moved down into the lowlands adjacent to the park. This has led to an increase in conflict, particularly in the area to the south of the hills around Bura (Ngure 1992). Conflict in this area may be in part because this is an elephant migration route (Low 2000).

Efforts to mitigate conflict date back to early trials of electric fencing in Tsavo in the early 1950s. These failed (Jenkins and Hamilton 1982) and attention was turned to moats and simple ditches, 2 m wide by 2 m deep, in Aruba and around experimental vegetation plots (elephant exclosures) in the early 1970s. These barriers required heavy maintenance because elephants learned how to break down the moat walls and climb through (Jenkins and Hamilton 1982).

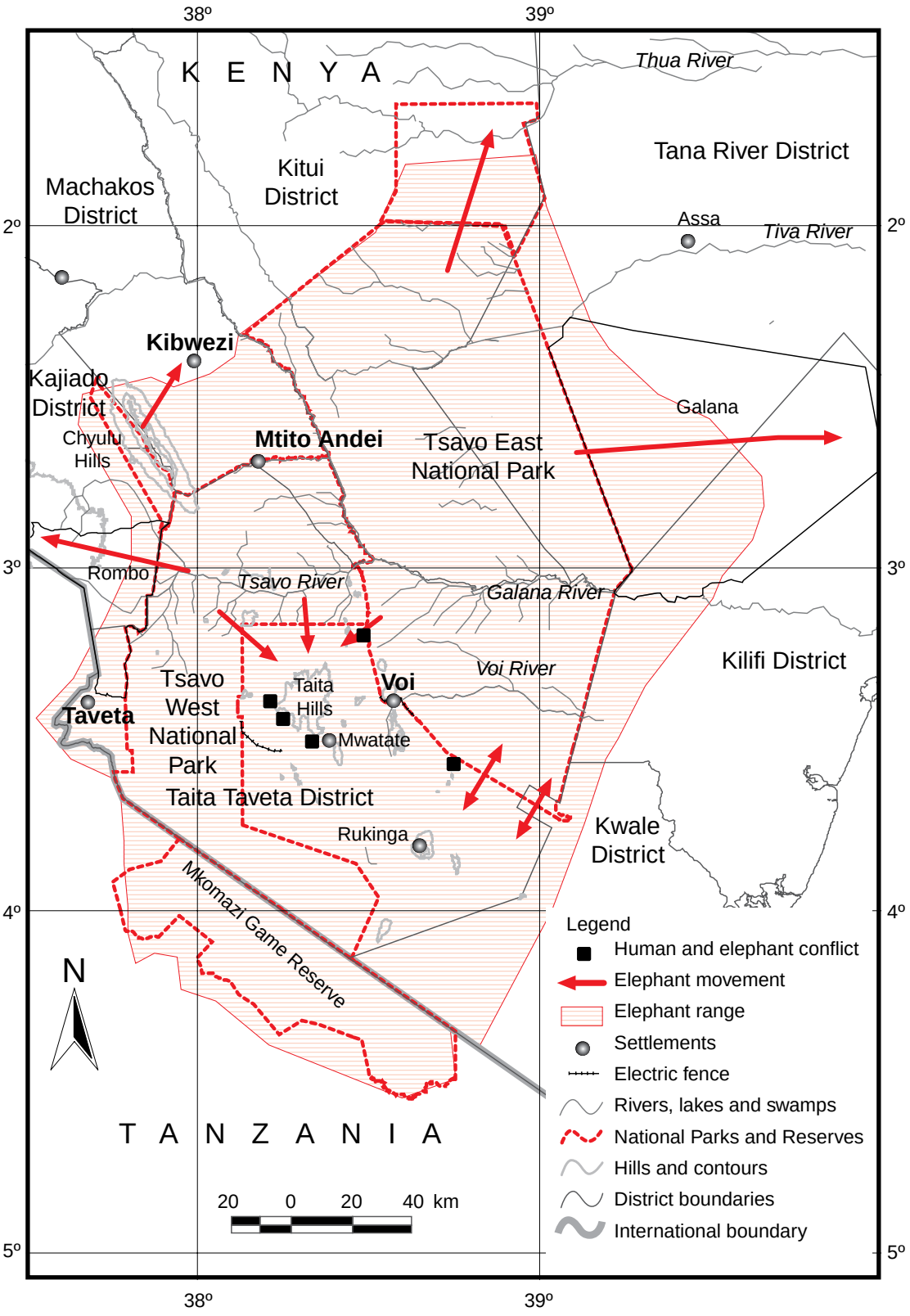
In 1991 a simple solar-powered 6-km fence was constructed to keep elephants out from Voi Sisal Estate (VSE), bordering Tsavo East. This fence also failed due to a number of factors, particularly vandalism by people from the local community. The fence wire was stolen and some of it was used to make snares. During the year that the fence was functional, elephants continued to raid the sisal plantation by circumventing the barrier (VSE manager, pers. comm.).

In 1995 with funding from the European Union, KWS constructed a 30-km solar-powered electric fence along the Tsavo East boundary from Ndi to Ndara to reduce human–elephant conflict in adjacent areas (Mutinda and Waithaka 1995a). Construction work was effectively completed by the end of 1996, although some sections of the fence needed modification. The fence was effective in curbing conflict in Mbololo and Voi locations, until the elephants learned to break the fence and go round both ends of it to cross into the settled area. Though people in villages midway along the fence said that human–elephant conflict had reduced, those at its northern end complained that the elephant problem had actually increased a few months after the fence was constructed. It is likely that the short fence had deflected elephants, thus concentrating them into this area. Crop raiding continued in the Rombo area (Mutinda and Waithaka 1995b) through the 1990s where up to 400 elephants survived and possibly moved between Tsavo West and Tanzania. Nine elephants were shot on control in this area in 1995.

Discussion

The Tsavo elephant population is recovering from its low point in the late 1980s. Each of the five counts carried out since 1989 has shown a consistent increase of approximately 3% per annum since 1989. Given that, at its peak, the Tsavo population exceeded 30,000 elephants with the majority inside the park, it is likely that this increase can be sustained for a number of years without any major impact on the vegetation, even with the loss of range outside the park.

Although the level of illegal elephant killing in Tsavo during the 1990s has never approached the levels of the 1970s and 1980s, it has continued to be a threat.


38º
39º
K E N Y A
Thua River
Tana River District
Kitui
District
Machakos
District
Assa
Tiva River
2º
Kibwezi
Kajiado
District
Galana
Chyulu
Hills
Mtito Andei
Tsavo East
National Park
3º
Rombo
Tsavo River
Galana River
Kilifi District
Voi River
Tsavo
West
National
Park
Taita
Hills
Voi
Taveta
Mwatate
Taita Taveta District
Rukinga
Kwale
District
Mkomazi Game Reserve
4º
N
T A N Z A N I A
20 0 20 40 km
5º
Legend
Human and elephant conflict
Elephant movement
Elephant range
Settlements
Electric fence
Rivers, lakes and swamps
National Parks and Reserves
Hills and contours
District boundaries
International boundary

5. AMBOSELI

Introduction

The elephants of Amboseli National Park and its surroundings are the best-known wild elephants in the world as a result of 30 years of continued research conducted by Cynthia Moss and her collaborators (Moss 1988). Amboseli is in southern Kajiado District, close to the Tanzanian border. It consists of a former lake basin, which is mostly dry country as it lies in the rain shadow of Mt Kilimanjaro. However, there is abundant water in swamps that are fed by underground water from the mountain.

The area was part of the Southern Game Reserve established in 1906. In 1948 it was reduced to 1260 miles^2 (3263 km^2) and renamed the Amboseli Game Reserve under the management of the Kenya National Parks. In 1961 it was placed under the administration of Kajiado County Council. Although it was primarily for wildlife protection, cattle grazing was allowed. In 1974 the central area of 150 miles^2 (389 km^2) was gazetted as a National Park. This was a controversial decision because it partially excluded the Maasai and their cattle from an important dry-season refuge. Although efforts were made to ameliorate the impact of this decision, it remains a sensitive issue and has affected the attitude of the local people to the park and its wildlife. Amboseli is surrounded by Maasai community-owned group ranches that are important dispersal areas for wildlife, particularly because of the small size of the park itself.

Amboseli has played a critical role in developing policies on wildlife and its relationship to local communities because of its controversial history and the extent to which the area and its elephants have been studied.

Historical information

Although elephants were not often reported in Amboseli in the accounts of early travellers, the largest tusks ever taken came from the northern slopes of Kilimanjaro in the late 1890s and elephants have been well established in Amboseli for at least the last 65 years. The Amboseli population once extended from Ol Donyo Orok in the west to the Chyulu Hills in the east, near the town of Emali in the north and to Kilimanjaro in the south. As a result of poaching and other human activities, the range of the population was reduced considerably in the late 1970s and through the 1980s. During the 1990s and into the new millennium, their range has begun to expand again.

A survey in 1973 estimated 1000 elephants in the Amboseli ecosystem, but there were also at least 250 carcasses seen. Thus, in the early 1970s the population of eastern Kajiado probably numbered around 1200 elephants. The population continued to decline and regular aerial counts of the population by D. Western (1977) indicated a mean population size of 600 between 1973 and 1976. In 1977 an aerial survey counted 469 carcasses, indicating very high mortality. At the time these carcasses were thought to be due largely to natural mortality related to two drought periods.

In 1972 the Amboseli Elephant Research Project (AERP) was initiated and by 1978 all elephants were individually known. This detailed study of known individuals showed that a large proportion of adults, particularly males, were lost between 1969 and 1977 (Moss 1988) and it now appears that Amboseli went through a significant period of poaching, which reduced the population to 480 individuals by early 1978.

Poaching pressure was greatest in the elephants' wet-season range, when they were

dispersing and not in their dry-season concentration area within the park boundaries (Western and Lindsay 1984). By 1977 three factors, poaching, changing land-use patterns and removing the Maasai and their livestock from the National Park, contributed to a change in the seasonal migration and home range of the Amboseli elephants, which until that time had been little affected by human pressures (Western and Lindsay 1984). The elephants responded by abandoning their wet-season dispersal areas and concentrating their numbers within the park boundaries where they have enjoyed protection through the presence of tourists and researchers and the cooperation of the local Maasai community. With improved security, numbers increased through recruitment and immigration and by 1992, 790 elephants were present. By the 1980s, the growing number of elephants using the National Park and the loss of acacias led to the familiar complaint of 'too many elephants'.

With better cooperation and understanding between the Maasai and KWS, which coincided with a series of dry years, elephants have once again begun to spend increasing time outside park boundaries. Frequent movements south across the border to Tanzania and up into the forests of Kilimanjaro have been recorded. Availability of this land to the elephants in the future will become increasingly important. Indeed, the future of Amboseli and its elephants will to a large extent depend on the continued cooperation between KWS and the wildlife authorities of Tanzania.

Recent surveys

The Amboseli elephant population has increased through the 1990s at an average rate of approximately 4% per annum (fig. 5.1). A January 2000 aerial survey of the entire Amboseli ecosystem carried out by the African Wildlife Foundation produced a result very close to that of the known population, with a total of 1087 animals counted (Muruthi pers. comm. 2000). Most were seen inside the National Park, with smaller numbers in Olgulolui and the Kimana Sanctuary, and very small numbers in Kimana and Kuku Group Ranches and Longido in Tanzania. There were no fresh or recent carcasses and only nine older carcasses were seen, giving a very low carcass ratio.

A 1994 survey of the Ol Doinyo Orok forest to the west of Amboseli revealed small amounts of elephant dung, suggesting that only 20 to 30 elephants used the forest during April 1994 (Litoroh et al. 1994a). It is likely, but not confirmed, that these animals came from Amboseli.

Current distribution and movements

During the late 1970s and 1980s elephants concentrated in the park, probably for security. In the 1990s there was a greater dispersal out of the park, particularly during the dry season.

Amboseli elephants are generally found in small groups in the dry season and larger aggregations in the wet season. Previously elephants were concentrated in the park in the dry season and dispersed out in the wet season. Now during the dry season (July–September) elephants leave the park and return for water every few days while spending more time inside the park during the wet season. This is probably the result of reduced food availability inside the park.

Some Amboseli elephants move as far as the Chyulu Hills where it is possible that they meet up with the Tsavo West elephant population. Some families and bulls move west towards Namanga, others south into Tanzania (Poole and Reuling 1997), others move east to Kimana and north to Eselenkei (Douglas-Hamilton 1998).

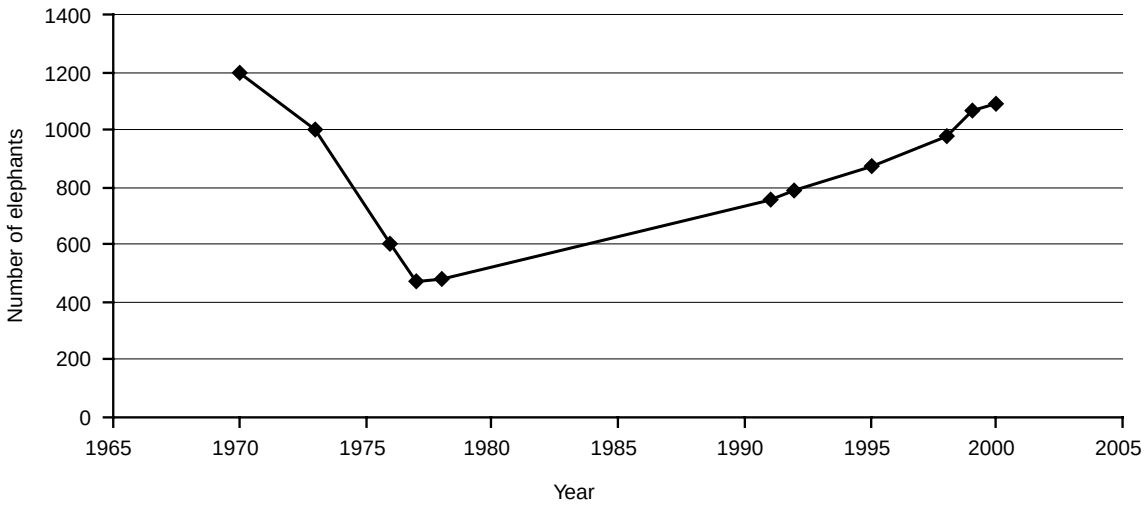


Figure 5.1. Amboseli elephant population estimates.

Mortality

Elephant mortality records from KWS (sources, Occurrence Book and EMD) and AERP (source, C. Moss) illustrate considerable discrepancy (table 5.1). This is explained largely by the fact that AERP records of elephant mortalities include known elephants that are presumed dead when they are not observed for a period of time and these records include a large number of calves. In most cases of juvenile mortality the cause of death is unknown and they are included in the 'unknown' category. AERP mortality records are likely to be a more accurate reflection of actual mortality of the population since all individuals in the population are known. KWS records on the other hand are carcass reports only and in many cases, particularly for calves, the carcasses are not found. The data from both sources show that poaching increased in 1996, predominantly as a result of one poacher operating across the Tanzania–Kenya border. The poacher was arrested and convicted towards the end of 1996 and from that point on poaching decreased. Mortality in 2000 was exceptionally high because it was a drought year and included deaths of 48 calves.

In general elephant mortalities in Amboseli are as a result of the following (C. Moss, pers. comm.):

- environmental conditions, such as droughts and floods
- natural causes, such as accidents and illness
- Maasai political activities, such as spearing as a form of protest
- changes in land-use patterns, such as setting up of irrigation farming in Namalog and Kimana, leading to human–elephant conflict
- poaching for ivory in both Kenya and Tanzania
- sport hunting of elephants in Tanzania
- inadequate garbage handling by lodges

Conflict

Conflict between elephants and local Maasai people has been studied by Kangwana (1995). Displacement of the Maasai from their land and from key water sources in swamps in the park, as well as failure to provide compensation as promised, has at times led to a

hostile relationship between park authorities and some of the Maasai. The Maasai have a tradition that encourages young men, or morans, when newly initiated into manhood by the ceremony of circumcision, to spear wild animals, including elephants, to prove their bravery. More recently spearing of wild animals in the Amboseli region has taken on political significance, with the Maasai using these gestures to show their dissatisfaction with park management. The average annual loss of the Amboseli population to spearing was 0.6%. Over the years, KWS has tried to change Maasai attitudes to wildlife and make wildlife exploitation a feasible land-use option by sharing revenue with them and providing facilities such as boreholes and schools.

Elephants adopt a number of strategies to minimize confrontation with Maasai. According to Kangwana (1995), they generally avoid the immediate vicinity of Maasai settlements, and when they do approach these settlements they do so at night when the Maasai and their livestock are secure in their compounds, they visit water holes at times of day when Maasai are least likely to be present, and they demonstrate considerable caution in the presence of morans in traditional dress and at the sound of cattle bells.

Despite this, attitudes towards elephants are generally positive among the Maasai, although those who have adopted agricultural lifestyles are slightly more negative. The main reasons for supporting the continued presence of elephants are that they bring benefits, they are gentle, and they have always been there.

The level of spearing required to maintain a fear of Maasai appears to be very low—at a level that does not threaten the population—and this provides a rare example of a traditional practice influencing animal behaviour in a way that promotes coexistence.

Crop raiding is also an issue particularly around Ol Molog (Tanzania) and Oloitokitok. Electric fences were built by KWS around the Kimana irrigation area. This has reduced conflict in this area, but elephants have moved further south towards Oloitokitok in search of water and food and this has led to conflict with locals. Conflict also occurs in the area to the south of the National Park along the corridor used by elephants between Amboseli National Park and Mt Kilimanjaro (Poole and Reuling 1997).

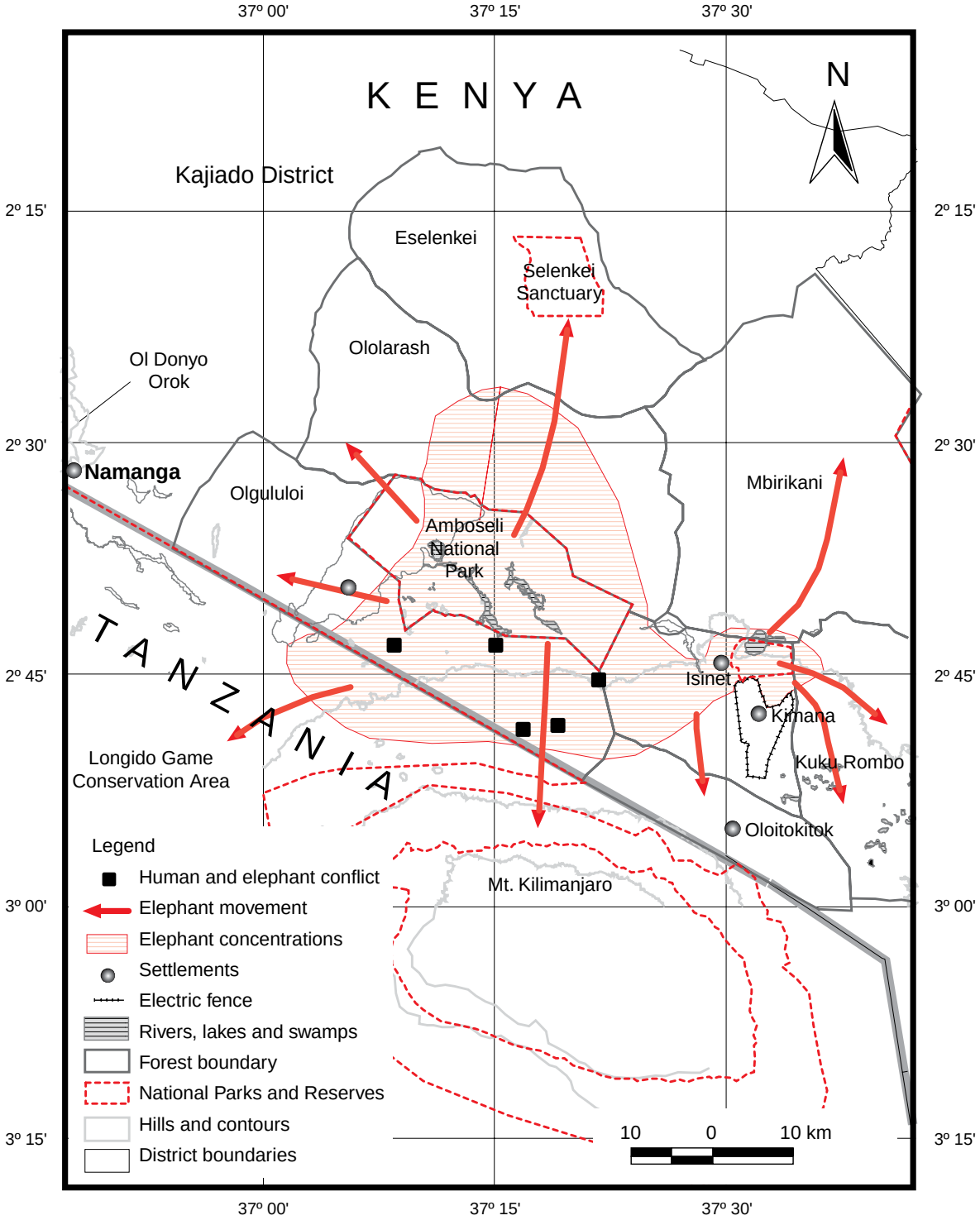
Table 5.1. Mortality figures for Amboseli National Park, 1990–2002

	AC		SI		NA		UN		CF		CT		PP		Total	
	KWS	AERP	KWS	AERP	KWS	AERP	KWS	AERP[a]	KWS	AERP	KWS	AERP	KWS	AERP	KWS	AERP[b]
1990	0	1	0	0	0	4	0	7	0	2	0	0	0	0	0	14
1991	0	0	0	0	0	2	3	22	0	5	0	0	0	6[b]	3	35
1992	0	0	3	0	0	1	0	17	0	2	0	0	0	4	3	24
1993	0	0	0	0	1	2	1	7	0	2	1	0	0	4[b]	3	15
1994	0	0	0	0	0	0	4	10	0	7	4	1	0	6[b]	8	24
1995	1	0	1	0	0	1	0	10	0	4	1	0	0	1	3	16
1996	0	1	0	0	0	1	4	7	4	3	5	1	9[b]	6	22	19
1997	1	2	1	0	2	3	3	34	4	8	2	2	4	2	17	51
1998	0	0	0	0	1	3	1	11	2	3	1	1	0	0	5	18
1999	0	0	0	0	0	1	0	5	2	2	4	2	0	0	6	10
2000	3	1	1	0	1	16	1	34	0	9	1	2	3	1	10	63
2001	0	0	3	0	2	3	0	15	1	3	0	0	2	5	8	26
Jan–May 02	0	0	1	0	3	2	0	7	0	0	0	0	2	2	6	11

AC – accident; SI – sickness; NA – natural; UN – unknown, CF – conflict; CT – control/PAC; PP – poached
[a]AERP mortality records include juvenile mortalities from researchers' records (most cases cause of death unknown)
[b]includes elephants hunted: 1991, 2 hunted;1993, 2 hunted; 1994, 3 hunted; 1996, 1 hunted

Discussion

The Amboseli elephant population has continued to increase since the early 1980s, and this trend shows no sign of changing. Considerable efforts have gone into encouraging greater tolerance towards the elephants among local communities, which would allow the elephants to disperse more widely outside the park. While they do seem to spend more time outside the park, there is some uncertainty as to what extent this is due to changing attitudes or to reduction in suitable food within the park.



6. MARA

Introduction

The Masai Mara National Park, and the surrounding dispersal zones, is one of the most important wildlife areas in Kenya, forming the northern section of the Serengeti ecosystem. In 1948 the area to the west of the Mara River, known as the Mara Triangle, was declared a national game reserve. In 1961 another substantial area was gazetted to the east of Mara River. The reserve measures 1510 km^2 but there are Maasai-owned group ranches surrounding it, which are also important for wildlife.

Elephants occur throughout the reserve and there are also contiguous elephant populations in the Transmara Forest to the west of the reserve and in the Loita Hills and Ngurumans to the east, as well as scattered, probably rather mobile groups in the Seyabei area of Narok. The origin of the latter is not known for certain—KWS believes they came from the Loita Hills, They have been a major cause of human–elephant conflict.

Historical information

Elephants were present in the Serengeti system in the 19th century (Fosbrooke 1968); however, they did not occur in the area in the first part of the 20th century, possibly having been exterminated by ivory hunters. Partly as a result of this reduction in elephant numbers, much of the vegetation cover in the Mara area changed from open grassland to thick bush (Dublin 1991c). Elephants were resighted in the northern Serengeti in 1937. It was thought that these elephants had been displaced from the Lambwe Valley by a control shooting campaign (Lamprey et al. 1967). Elephants were present, though not plentiful, within the Mara area in the 1940s and 1950s.

In the first aerial survey of the Mara–Serengeti system, carried out in 1961, 455 elephants were counted in the Mara out of a total of 1157 in the entire ecosystem (Talbot and Stewart 1964). Elephant numbers increased during the 1960s and 729 were counted in the Mara in 1970 (out of about 4200 in the entire ecosystem). Very low numbers of dead elephants were observed in early counts, but in 1977 many carcasses were observed, particularly to the north-east of the Mara (Dublin and Douglas-Hamilton 1987). The effect of this poaching was to compress the elephants into the reserve, and by 1984 this population was virtually confined to the reserve boundaries.

By 1984 elephants in the Serengeti began to seek refuge in the Mara Game Reserve. The 1984 survey results showed that while elephant numbers in the Mara were greater than expected (861 elephants), a significant drop had occurred in northern Serengeti. The Mara showed a 5% carcass ratio, indicating a relatively low level of mortality (and/or immigration of elephants) while northern Serengeti had a high carcass ratio of 38%. Numbers in the Mara continued to increase to about 1500 by 1987 and then stabilized at about this number.

In 1975 KREMU/DRSRS began sample aerial surveys in Narok District, and from 1984 onwards, Dublin and associates (Dublin and Douglas-Hamilton 1987; Dublin 1985–87, 1990a–91b, 1992a–93b; Dublin and Watkin 1994) and later KWS (Muriuki and Mulama 1997; Muriuki et al. 1997, 1998, 2000) have conducted yearly or twice yearly total counts of the reserve and surrounding dispersal areas. These two sets of data have provided broadly similar results, though there has been more variation in the sample count figures, partly as a result of sampling error when large herds are either seen within the strips or

missed, and possibly because of the difficulty of observing elephants in dry conditions when they may shelter in thick riverine woodland (Ottichilo 1999).

Recent surveys

Twice-yearly total counts of the Mara ecosystem have been carried out since 1990 by WWF/Friends of Conservation (FOC), and later by KWS, in wet and dry seasons, with the exception of 1995 and 1996, when no dry-season counts were conducted, and 1997, when there was no wet-season count. These surveys used the standard methodology developed in 1984 (see fig. 6.1) (Dublin 1985–87, 1990a–91b, 1992a–93b; Dublin and Watkin 1994; Muriuki and Mulama 1997; Muriuki et al. 1997, 1998, 2000).

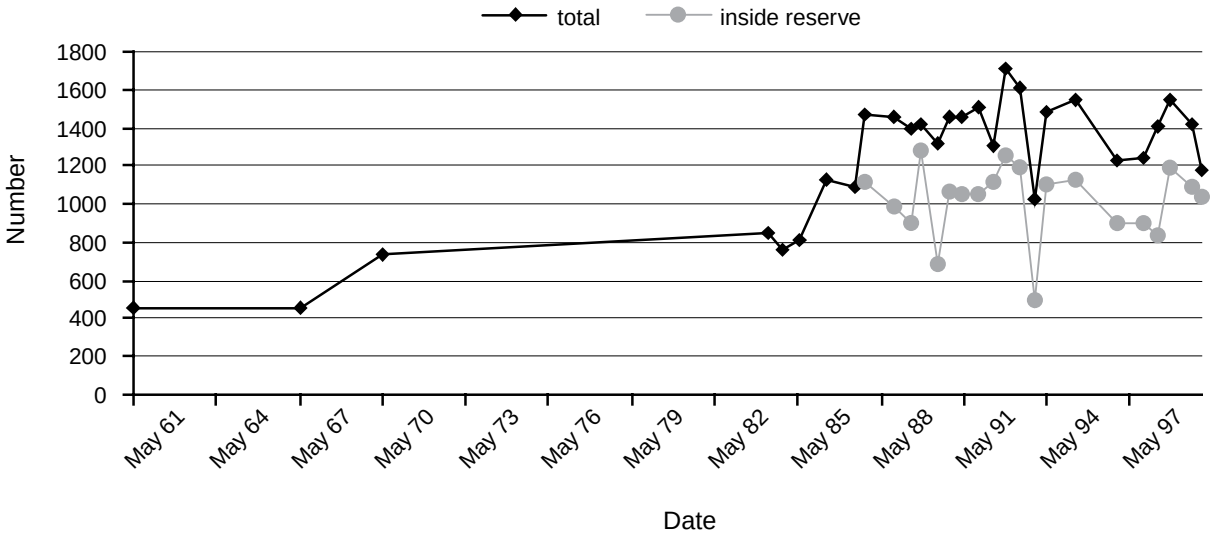


Figure 6.1. Elephant numbers in the Mara ecosystem.

During the 1990s, total counts revealed that elephant numbers in the reserve and dispersal area varied between 1031 and 1705 individuals, but 12 out of 16 surveys gave results between 1200 and 1600. There were unusually high numbers of elephants in the October 1992 dry-season count, for unknown reasons. Numbers were particularly low in November 1993, possibly due to a drought, which may have pushed elephants into the Serengeti or surrounding forest areas. There was no substantial difference between wet- and dry-season counts (mean estimates 1290 and 1433, respectively). Typically 60–80% of the elephants were seen inside the reserve, although this varied from 48 to 90%. There was no consistent difference between wet and dry seasons.

During the 1990s DRSRS surveys of the district gave results varying from 867 ± 768 to 10,249 ± 6241. The majority of these animals were observed in the National Reserve and dispersal areas immediately to the north, although small numbers were seen in the Ngurumans, on the edge of Mau Forest in the north of the district, and there was a single sighting to the south of Ntulelei (east of Narok) in 1992.

A 1997 KWS dung survey of the Transmara forests, above the Siria escarpment to the west of the reserve, estimated 200–300 elephants in an area measuring 53 km^2. However, reanalysis of the results revised this figure down to 46 elephants, which is more probable in view of expected elephant densities. However, even this figure must be treated with some caution because the dung decay rates of Mt Kenya were used. Since the Transmara is at lower altitude, with high rainfall, a higher decay rate might be expected.

The Ngurumans are a range of forested hills lying close to the Tanzanian border between the Masai Mara and the Rift Valley lowlands around Lake Magadi. In 1998 the number of elephants in the Ngurumans was estimated from a questionnaire as 150 (Chege 1998). Little is known about these elephants. It is possible that they form part of the Mara population. There have been occasional sightings of elephants in the southern Rift Valley close to Magadi, and it is likely that these animals have come from the Ngurumans.

There have been no systematic counts of the Narok–Seyabei elephants between the Mara and the Mau escarpment, although 158 were counted from the air in 1999 (Muriuki et al. 2000). It is not clear if these are a separate population or if they move seasonally from the Loita Hills, although this number of animals exceeds the entire estimated Loita population.

Current distribution and movements

The highest densities of elephants occur within the Masai Mara National Reserve, and in dispersal areas immediately to the north. Although they are spread through the reserve, they are concentrated along the northern part of the Mara River, close to Musiara and Kichwa Tembo, and along Sand River, particularly during the dry season. Outside the reserve, the greatest numbers are seen between the Talek River and the Bardamat Hills, with smaller numbers to the east around Cottar's Camp.

Although no radiotelemetry studies have been conducted, it is thought that elephants from the reserve move up the Siria escarpment, upstream along the Mara River, to the Loita Hills–Laleta area east of the reserve, south into Serengeti National Park, and even as far as Narok town to the north. Wasilwa (2000) studied movement routes from the Mara up the Siria escarpment and found that the most heavily used route was between Kichwa Tembo and Olkurruk Lodge. Most elephants using this route moved out of the reserve in the evening and returned in the morning, travelling a distance of about 10 km. Elephants from the Mara Buffalo area use another corridor, moving across into the northern Transmara Forest, during dry periods, especially in February and August. Elephants resident in the Transmara Forest north of Lolgorien also move along the Migori River.

Mortality

Data reported in table 6.1 and figure 6.2 are records only from EMD; they have not been cross-checked with field records.

- In 1992, a group of seven elephants (32% of all found carcasses) were reported poached. The result of a single incident in the Mara Ngerende area, these elephants died on different dates.
- In 1992 and 1993, a large number of elephant deaths were reported with the causes unknown. In 1993, 10 of the 20 reports of 'unknown' deaths had no details included. It is difficult to interpret these data to explain why reported deaths were so high in these two years.
- Seven elephants were poached in 1993. These were found on different dates and in different areas. Two of the carcasses were found in Kilgoris in March. However, the proportion of all reported mortalities that were due to poaching was less than 20%.
- The number of elephants shot on PAC increased between 1993 and 1997, and this is likely to be a result of changes in KWS policy during this period. Between 1995 and 1997, over 50% of the mortalities reported resulted from PAC; 1995 was the only year for which the proportion of reported mortalities due to poaching was greater

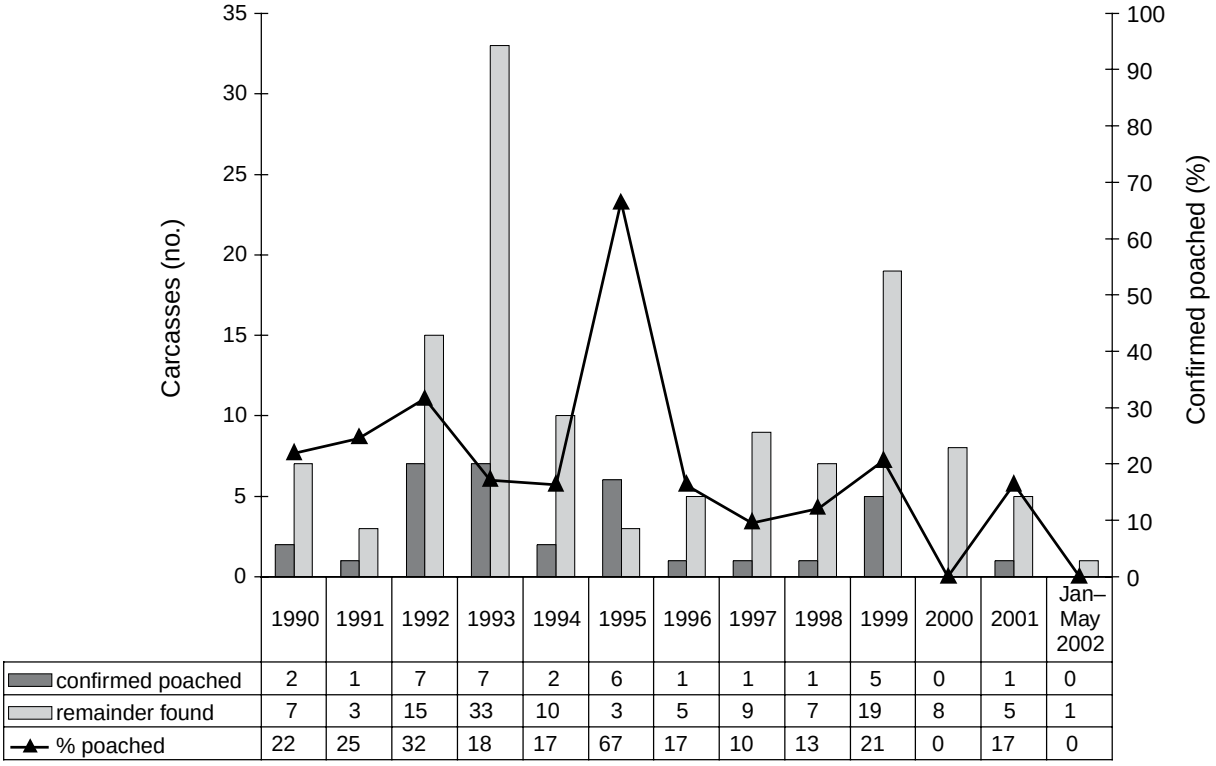
than 50%. For all other years, reported poaching accounted for less than 32% of all reported mortalities (excluding PAC).

- In 1999 the proportion of reported mortality due to poaching (20%) was greater than for the three previous years. Five elephants were poached in 1999 in one incident in February in Naimenenkio Forest. The elephants died from gunshot wounds. A notorious poacher was known to be operating in the area and local people reported hearing gunshots. There has been only one report of poaching between 2000 and May 2002.

Table 6.1. Mortality figures for Masai Mara Game Reserve, 1990–2002

	AC	SI	NA	UN	CF	CT	PP	Total	Total 'found'	Poached of 'found' (%)
1990	0	0	4	3	0	0	2	9	9	22
1991	0	0	0	3	0	1	1	5	4	25
1992	0	1	0	13	1	3	7	25	22	32
1993	1	5	2	20	5	11	7	51	40	18
1994	1	0	0	9	0	6	2	18	12	17
1995	0	0	0	3	0	12	6	21	9	67
1996	0	0	2	2	1	9	1	15	6	17
1997	0	2	1	4	2	12	1	22	10	10
1998	0	0	1	5	1	3	1	11	8	13
1999	0	0	2	8	9	0	6	24	25	21
2000	0	0	1	4	3	4	0	12	8	0
2001	2	1	0	1	2	2	1	9	6	17
Jan–May 2002	0	1	0	1	0	0	0	2	1	0

AC – accident; SI – sickness; NA – natural; UN – unknown, CF – conflict; CT – control/PAC; PP – poached



	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Jan–May 2002
confirmed poached	2	1	7	7	2	6	1	1	1	5	0	1	0
remainder found	7	3	15	33	10	3	5	9	7	19	8	5	1
% poached	22	25	32	18	17	67	17	10	13	21	0	17	0

Figure 6.2. Reported elephant mortality for poaching and other causes (excluding problem animal control) and proportion of elephants that were poached, May 1990–May 2002. (Source: EMD).

Conflict

Narok is one of the most controversial human–elephant conflict areas within the country. There are three main foci of conflict. One is in the dispersal areas on the northern boundary of the reserve, which are mostly occupied by Maasai pastoralists. Here the problem is chiefly one of people and livestock being killed by elephants. There is also serious conflict in Transmara District above the Siria escarpment where farmland is interspersed with forest areas. Finally there has been much trouble in the vicinity of Narok and Seyabei, where mobile groups of elephants move into farming areas for variable lengths of time.

Wasilwa (2000) has studied in detail the conflict in the Transmara area. Between the 1960s and 1999 there are records of 28 people being killed and 15 injured by elephants. There was a considerable increase in cases in the 1990s. KWS Occurrence Books show that crop raiding peaked from June to August and in January when maize has ripened. Again, there was a considerable increase in the 1990s, with the most incidents in the second half of the decade. The most serious damage occurred in the area north of Lolgorien. It was calculated that maize valued at Ksh 1,080,000 (US$15,400) was lost to elephants.

Large herds of elephants have appeared intermittently in the Seyabei area south-east of Narok and have been responsible for serious crop damage. It is believed that these animals come from the Loita Hills. In response to the public outcry against these elephants KWS organized helicopter drives in 1993 and 2001 to force them away to the south.

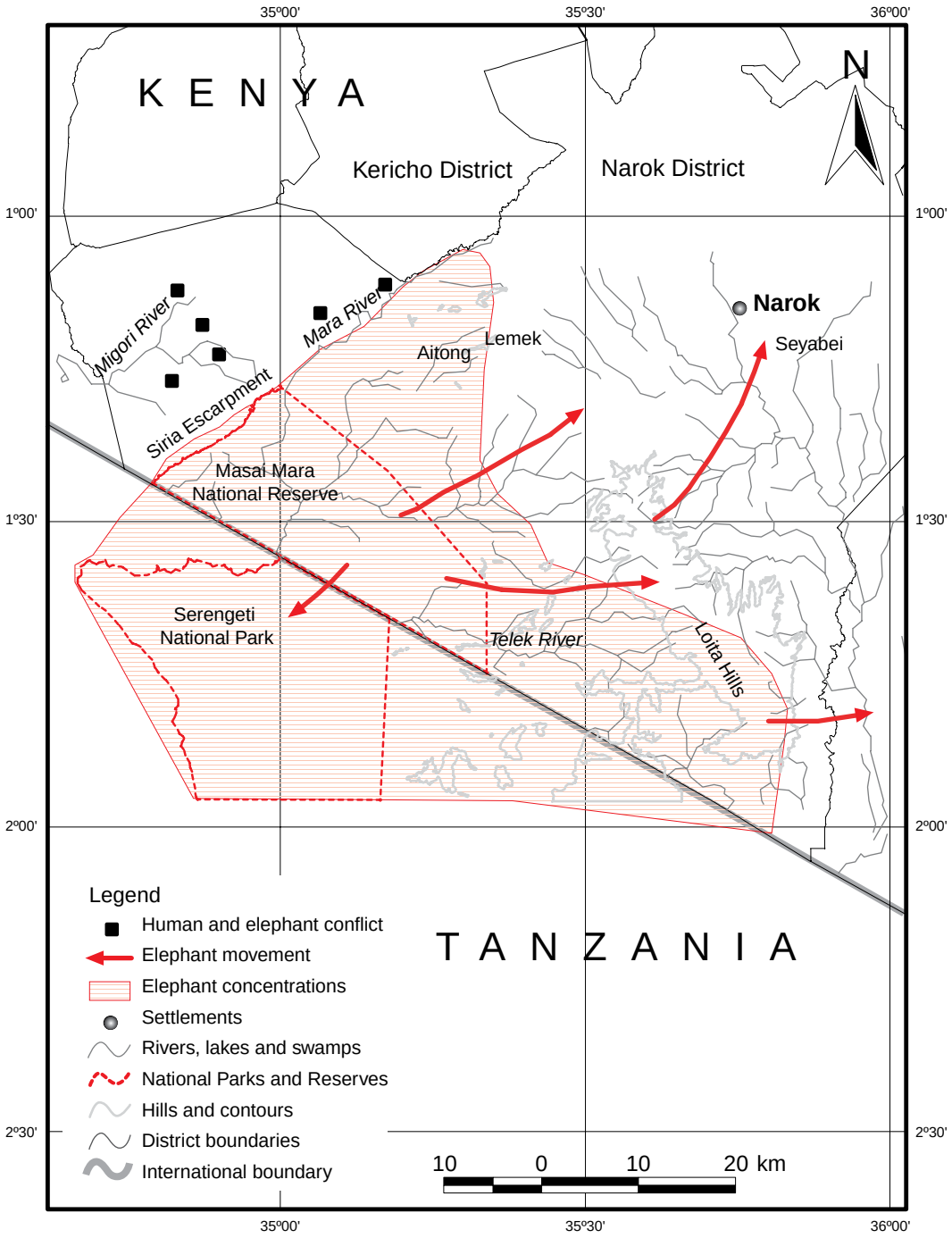
Human–elephant conflict is not particularly serious in the Ngurumans area because there is little agriculture. The only location significantly affected is Kalema, which lies on the extreme eastern end of the elephant range below the Nguruman escarpment (Chege 1998).

Discussion

The elephant population of the Mara region has been stable over the past 10 years. Given the few incidents of poaching, one would have expected this population to increase. That it has not done so is probably due to a combination of factors, including emigration to the Serengeti and unreported mortality from conflict. There are increasing reports of elephants injured by spears and snares. Some snaring is done within the reserve, but there is a high level of conflict in areas on the western bank of the Mara River north of Kichwa Tembo, which have recently been settled by Kisii farmers.

The elephant population of the Serengeti increased at a surprising rate in the 1990s. In 1989 the population was estimated to be 467 animals (Michelmore 1990), and this had risen to 1357 by 1994 (Said et al. 1995) and 2015 in 1998 (Barnes et al. 1999). While emigration from the Mara cannot explain all the increase, it is likely to have been a substantial contributory cause.

While the Mara elephant population is not under immediate threat, it is likely to be placed under increasing pressure from the spread of arable farming into the dispersal areas to the north and west of the reserve, and from continued loss of woodland and bushland within the reserve—a process into which elephants have had a considerable input.


35º00'
35º30'
36º00'
K E N Y A
N
Kericho District
Narok District
1º00'
Migori River
Mara River
Aitong
Lemek
Narok
Seyabei
Siria Escarpment
Masai Mara
National Reserve
1º30'
Serengeti
National Park
Telek River
Loita Hills
2º00'
Legend
Human and elephant conflict
Elephant movement
Elephant concentrations
Settlements
Rivers, lakes and swamps
National Parks and Reserves
Hills and contours
District boundaries
International boundary
T A N Z A N I A
2º30'
10 0 10 20 km

7. LAIKIPIA–SAMBURU

Introduction

Kenya's largest elephant population living primarily outside National Parks and reserves occupies a substantial part of Laikipia and Samburu Districts and the western extension of Isiolo District. These elephants move between private ranches, arid pastoral areas and montane forests. They come into conflict with small-scale farmers on the southern edge of their range (Thouless 1994), have an impact on vegetation and fences in the ranches (Thouless and Sakwa 1995), and are under pressure from heavily armed poachers in the northern reaches of this range.

Surveys of the Laikipia–Samburu elephant population are complicated by the existence of forest populations in the Mathews Range, Ndoto Mountains, Karisia Hills, Rumuruti and Marmanet Forest. Some of these elephants are believed to move down into savannah areas during rainy periods; thus aerial surveys expect to count more in the wet season than in the dry season. In addition, radiotelemetry studies have shown that a large proportion of the Laikipia population moves northwards into Isiolo and Samburu Districts in the twice-annual wet season (Thouless 1993, 1995b, 1996).

Historical information

Considerable change in the number and distribution of elephants in the Samburu–Laikipia area occurred during the 20th century. Elephant numbers in the Samburu area have decreased since the beginning of the century, but in Laikipia to the south there has been a substantial increase in both numbers and range.

Little information exists on the distribution of elephants prior to 1880, largely because the warlike reputation of the Maasai deterred European travellers until internal wars and disease reduced their control (Beachey 1967). During the last two decades of the 19th century tribes that specialized in elephant hunting and sold ivory to Swahili traders included the Yaaku, who occupied Mukogodo, and large visiting hunting parties of Wakamba. Samburu gained a reputation as a good hunting area and was visited by many parties of European hunters around the turn of the century (Neumann 1898, 1906). Elephants were hunted mainly near the Milgis and Seya luggas between the Mathews Range and the Ndotos Mountains. No elephants were recorded along the lower Ewaso Ngiro, except at Lorien Swamp, where it finally disappears (Neumann 1906; White 1912; Radclyffe Dugmore 1913; Maxwell 1925) and where it comes close to the upper Seya lugga (Höhnel 1894).

In 1900 Jubaland Reserve, extending from the Northern Frontier District south to the Ewaso Ngiro River, was created to 'give a last shelter to the fast-vanishing elephant' (Patterson 1910). Effective protection, however, was not imposed until about 1906 when access was limited under the Outlying Districts Ordinance (Jackson 1907; Simon 1962). During this time, there were few elephants on the Laikipia plains, which was colonized by the Purko Maasai following their defeat of the Laikipia Maasai. The only records of elephants in Laikipia were from Rumuruti Swamp (Patterson 1910) and from the forested areas to the west of the district. In 1912, the colonial authorities moved the majority of Maasai from Laikipia to Narok District. European settlement of Laikipia started immediately after the Great War, with most farms being taken up under the Soldier Settler Scheme. The first area to be settled was between Rumuruti and Nyahururu; crop raiding by elephants

was reported soon afterwards (Kenya Colony 1927). Between 1926 and 1935 substantial effort was made to control this situation, and at least 238 elephants were killed by game wardens during this time.

Between 1920 and 1970 there was effective protection of the Northern Frontier Province, and elephant numbers were believed to have increased substantially in the Samburu area during this time. In 1952 George Adamson reported an increase in both numbers and range, and suggested that there had been an expansion southwards (Kenya Colony 1952). By the early 1950s elephants began to appear in Laikipia in greater numbers than before, and in areas where they had not previously been seen. Initially, they only appeared during exceptionally dry years but later some became virtually resident every year from June until November.

Some aerial surveys were carried out in the Samburu area during the 1960s and early 1970s; however, these were done using non-standard techniques and all the results are likely to have been considerable underestimates. For instance, D.R.M. Stewart carried out a series of total counts between May 1960 and December 1962 covering large parts of Samburu District, but fewer than 1000 elephants were observed. Between 1968 and 1969, R.L. Casebeer carried out sample counts in Samburu and came up with a total population estimate of 2728 individuals. Total counts were conducted in green areas and in drainage lines by H. Croze in 1973 and a total population estimate of 2752 was derived for the whole Samburu area. Jarman (1973b) estimated larger numbers of elephant, based largely on unpublished sample counts conducted by R.M. Watson. The total population of elephants in Samburu, Laikipia and Isiolo Districts was 14,500, of which 9000 were in Samburu. Although some doubts were expressed about the accuracy of these counts (Jarman 1973a), they were probably more accurate than previous figures. The first KREMU sample counts were conducted in 1977 after the initial period of heavy poaching, giving a population of 5032 ± 1981 live elephants and 3601 ± 587 carcasses for the three districts combined.

Poaching in Samburu rapidly escalated in the early 1970s, and by 1973 Somali gangs armed with rifles and automatic weapons were carrying out large-scale elephant poaching (Jarman 1973a). Internal problems in the Game Department made anti-poaching operations difficult. By 1974 the Game Department in the north had become non-functional and record keeping virtually halted that year. Members of the Game Department together with other sections of the security forces were responsible for most of the poaching. In 1975 poachers had a foothold within the Samburu–Isiolo Reserves and elephants were virtually eliminated from the Mt Nyiru and South Horr area. It is not certain how the intensity of poaching changed after 1975, but carcass ratio data from KREMU suggest that it was lower in the 1980s than in the 1970s (Douglas-Hamilton 1980).

Through the 1970s concern and delight about the presence of elephants in Laikipia continued. Some ranchers in the southern part of the district, where elephants had previously been intermittent visitors on their way to Mt Kenya and the Aberdares, complained about the impact of elephants on their ranching activities. By 1978 the situation had become sufficiently serious for the Game Department to begin attempts to move the elephants back to the north. Over 400 elephants were pushed into the Aberdares and connecting South Laikipia forests using aircraft, helicopters, vehicles and lines of men (Woodley and Snyder 1978). Later in 1978 two operations pushed 400 elephants away from farming areas in the south of the district towards the large ranches. It is not known what, if any, long-term effect these interventions had, but the last operation was a total failure because the elephants broke away.

The situation in Laikipia changed during the 1980s. Most large-scale ranchers who had complained about the presence of elephants fenced their properties or changed their ranching practices to accommodate the presence of wildlife. In addition, many ranches were sold for subdivision into small-scale arable farms, and the nature of the main problem changed, with the loudest complaints about elephants expressed by representatives of small-scale ranchers. Throughout this time the level of poaching in Laikipia was very low, in contrast to the situation in the north (Jenkins and Hamilton 1982).

Recent surveys

Surveys of the Laikipia–Samburu elephant population are complicated because the population extends over a large area, seasonal movements are substantial, and some elephants live in montane forests, which cannot be surveyed from the air.

Reliable data from before 1990 are available only from DRSRS surveys carried out on a district-by-district basis (DRSRS 1999). The Laikipia–Samburu population extends over Laikipia and Samburu Districts and also covers parts of Isiolo and Meru Districts. Meru District is not considered rangeland and therefore has not been covered by DRSRS. Moreover, counting in the other districts was not always done at the same time of year, and as a result, the population may have been double counted in some years as a large proportion of the animals moved between districts.

In 1990, 1992, 1999 and 2002, total aerial counts were carried out in attempts to enumerate the entire population. The population was estimated at 2312 in 1990 (Thouless 1990), 2969 in 1992 (Thouless 1992), 3436 in 1999 (Kahumbu et al. 1999b) and 5447 in 2002 (Omondi, Bitok et al. 2002a). Results from these counts suggest that the population has increased over the last decade. However, this trend may be in part be caused by an increase in area covered in surveys because as knowledge of the area used by the elephants increased and more resources were made available, coverage was extended. The 1990 count included only a small part of Samburu District, although it was conducted at a time when the majority of animals would be expected to be in Laikipia and Isiolo Districts. Even these total counts did not cover the entire population, since there are a number of forests with elephants. These include Marmanet, Rumuruti, Ngare Ndare, Mukogodo, Kirisia, the Mathews Range and the Ndotos. It is believed that the majority of the animals using these forests in the dry season leave for the plains during the rainy season. The 1992 total count, therefore, would have included some of these animals but it is not known what proportion remained behind.

Dung counts have been carried out in some of these forests, including Marmanet and Rumuruti (Litoroh et al. 1992), Leroghi–Kirisia (Mwangi et al. 1993; Bitok 1997) and Mathews Range (Reuling et al. 1992a). However, these have generally been exploratory counts carried out over a short time span, with short transects and no attempt to measure dung decay rates. Bitok (1997) attempted to repeat the same transects in the Leroghi–Karisia area that were established by Litoroh et al. (1992). The 1997 survey estimated a dung density of 3020 piles per km^2, compared with 6317 piles per km^2 for the 1992 survey. This points towards a considerable decline in the elephant population in this area.

In addition to these surveys, a series of total and sample aerial surveys was carried out on behalf of the Laikipia Wildlife Forum (Mpala Research Centre 1996). The main objective of these surveys in Laikipia District was to count plains animals including elephants.

Current distribution and movements

Elephants are widely distributed in Laikipia, Samburu, and nearby parts of Isiolo and Meru Districts. The greatest numbers are found along the Ewaso Ngiro, particularly in the vicinity of Samburu and Buffalo Spring Reserves, and Laikipia ranches such as Mpala and Ol Jogi. The southern limit of their range in Laikipia is defined by the boundary between large-scale ranches and small-scale agriculture. However, in some places this boundary is poorly defined because in marginal agricultural areas, farms are widely separated with patches of degraded natural habitat between them. In these areas, crop raiding is a problem. Part of this boundary is clearly defined by game-proof fences, such as those along the boundary of Laikipia Ranching, Sweetwaters Sanctuary, and Ngare Ndare Forest Reserve.

Historically there were significant elephant populations in the forests on the western side of Laikipia in the vicinity of Nyahururu and Rumuruti, which connected to the Aberdares Range forests in the south. These forests have become increasingly fragmented and surrounded by agriculture, and in recent years several have been illegally exploited, degrading them and in places almost totally destroying them.

Movements of the Laikipia–Samburu elephant population have been studied intensively using both conventional and GPS radiotelemetry. These studies illustrate varied patterns of movement among different sub-populations. Home ranges for individual females were shown to range between 100 and 5000 km^2 (Thouless 1995b). A substantial segment of the population migrates northwards from Laikipia into Samburu during the two rainy seasons, returning south as temporary waterholes dry up. Other sub-populations are confined to the Laikipia ranches and the vicinity of the Mathews Range, while still others show more limited north–south movements than the main 'migrant' sub-population.

There is some uncertainty about the extent of overlap between the forest-living elephants of the Mathews Range, Karisia Hills and Mukogodo Forest, and neighbouring savannah populations. Elephants spending the dry season in the forests appear to move into the plains during the rainy season, but it is not known if any elephants remain in the forests at this time.

The extent of movement between Laikipia–Samburu and neighbouring populations is unknown but is probably limited. Some elephants move between Laikipia, Mt Kenya and the Aberdares. They have been observed crossing the main road north of Timau and south of Nanyuki to go up to Mt Kenya Forest, and there may be some movement between the southern part of Laikipia and Aberdares Forest through Ngobit Valley. However, out of 25 female elephants radio-collared in Laikipia (Thouless 1995b) none took these routes. A single bull collared on Lewa Downs moved to Imenti Forest, which is connected to the northern part of Mt Kenya Forest. It is also possible that elephants from Samburu move through Shaba National Reserve and thence towards Meru National Park. There is no evidence of movement to the north of Samburu towards Marsabit and it is possible that the extensive lava flows in this area present a barrier to elephant movements. However, local people say that elephants migrated between Marsabit and Samburu in the past and it is possible that these old routes still exist, although this has not been verified.

Mortality

The mortality data are shown in table 7.1 and figure 7.1.

- Reported mortality due to poaching was highest in 1993 (30 elephants reported poached). Poaching mainly occurred in three incidents with 7 elephants reported

poached in Shaba in July 1993, 6 in the Kirisia Hills and another 6 in Sarara in November 1993.

- Between January 1995 and June 1997, 96 elephants were shot on control (46% of total reported mortality). Problem animal control was highest during this period and reflects a change in KWS policy at this time. Between 1990 and June 2002, 215 elephants were shot on control—23.9% of all reported mortalities (note that other causes of mortality are under-reported).

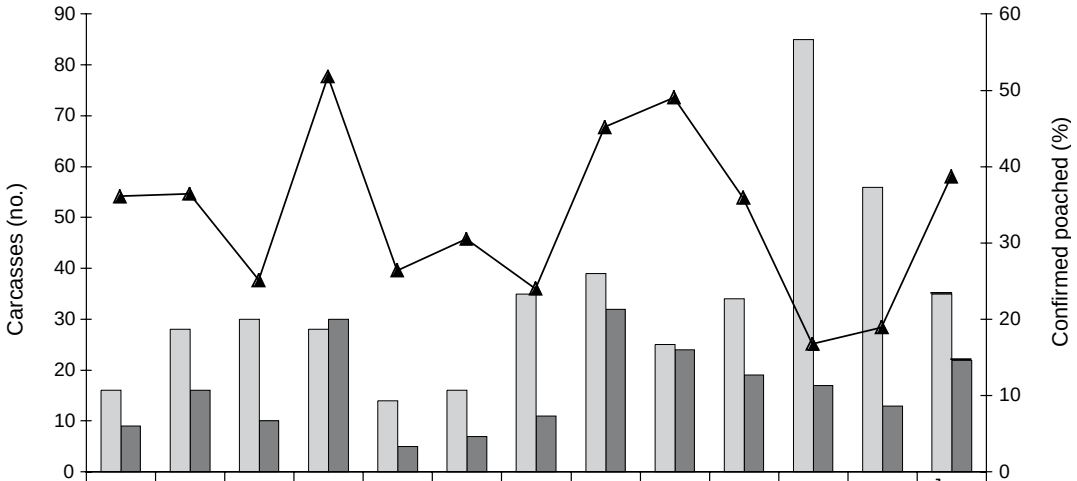
Table 7.1. Mortality figures for Laikipia–Samburu, 1990–2002

	AC	SI	NA	UN	CF	CT	PP	Total	Total 'found'	Poached of 'found' (%)	Ivory missing of 'found' (%)
1990	1	0	8	6	1	6	9	31	25	36	23
1991	1	0	7	16	4	11	16	55	44	36	23
1992	0	12	14	4	5	14	10	59	41	25	21
1993	0	1	9	8	10	19	30	77	52	52	54
1994	2	0	5	6	1	23	5	42	19	26	16
1995	1	0	6	7	2	48	7	71	23	30	5
1996	0	7	12	17	5	42	11	94	46	24	20
1997	1	5	28	10	2	11	32	89	71	45	31
1998	0	0	11	7	7	11	24	60	49	49	43
1999	3	3	13	14	3	15	19	70	53	36	17
2000	4	12	27	31	14	9	17	114	102	17	15
2001	4	10	8	24	16	6	13	81	69	19	14
Jan–Jun 2002	1	3	12	17	3	0	22	58	57	39	26

AC – accident; SI – sickness; NA – natural; UN – unknown; CF – conflict; CT – control/PAC; PP – poached
Total 'found' carcasses exclude animals shot on control (PAC) and sick animals shot by KWS.

- There was an increase in reported poaching in 1997 and 1998 compared with the three previous years, with the proportion of all carcasses confirmed as poached close to 50%.
- The total number of carcasses reported in 2000 was much higher than in previous years. This may reflect an emphasis on reporting and recording all elephant mortalities in the field and at headquarters after the first exercise to gather and collate data on elephant mortalities was carried out in early 2000. The Samburu–Laikipia area also suffered a major drought in 2000 and this is reflected in the high number of natural and unknown mortalities and deaths due to sickness. Ten elephant calves were reported as either dying from starvation or killed by lions in 2000. A high number of elephants were speared by communities in conflict situations, particularly around water points.
- In January–June 2002 there was a substantial increase in the number of carcasses confirmed as poached compared with the previous two years. The proportion of all carcasses so far reported and confirmed this year as poached is almost 40%.
- Total reported mortality in 2002 is likely to be high as there is an increased effort throughout the ecosystem to locate, report and record elephant carcasses since the implementation of the Monitoring of Illegal Killing of Elephants (MIKE) system in Samburu–Laikipia in early 2002.

The distribution of threats to elephants varies across the elephant range and this is evident in the mortality records. Most PAC cases were in central and western areas of Laikipia District including Eland Downs, Rumuruti, Ol Pejeta, Segera, Mugie, Luoniek and



	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Jan–Jun 2002
remainder found	16	28	30	28	14	16	35	39	25	34	85	56	35
confirmed poached	9	16	10	30	5	7	11	32	24	19	17	13	22
% poached	36	36	25	52	26	30	24	45	50	40	17	19	39

Figure 7.1. Number of poached carcasses, remainder of carcasses found and proportion of all found carcasses that were poached, Samburu/Laikipia, 1990–June 2002. (Source: EMD)

Laikipia ranches, as well as PAC reports in Logorat and Lpartuk areas of Samburu District. Conflict cases were reported predominantly in Mugie, Kisima, Segera and Sirata areas. However, conflict and control cases are reported throughout Laikipia District. In contrast poaching cases were predominantly in the northern and eastern parts of the elephant range, including Isiolo, Kirisia, Maralal, Sabachi and Shaba, with several incidents also reported in Mugie, Mukogodo and Ngare Ndare in 1997 and 1998.

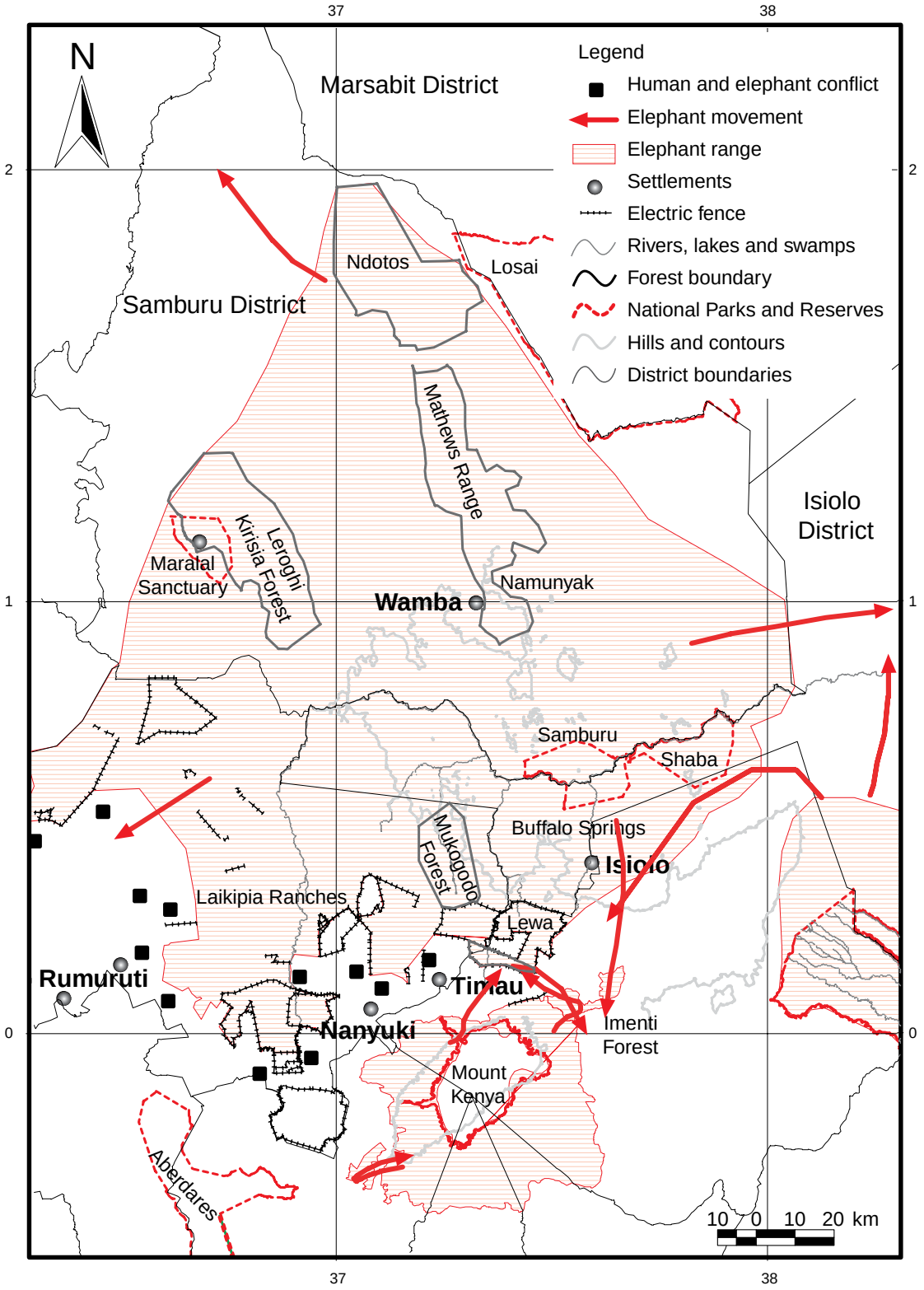
Information from intelligence sources suggests an increase in ivory trade in the Samburu–Maralal area and also that people from local communities are poaching ivory. The Samburu, Rendille and Boran people have only fairly recently become armed, with an influx of arms into this area since the breakdown of law and order in Somalia in the early 1990s. Although these arms are mainly for protecting themselves and their livestock against cattle rustling, it is suspected that they are also being used to poach elephants. Traditionally, these communities have not been involved in elephant poaching; they do not eat elephant meat and were not involved in much of the ivory poaching carried out by Somali gangs in the 1970s and 1980s. The number of guns in the hands of the local communities is a potentially serious threat to elephants in this area and should the level of poaching by the local people intensify it would be difficult to contain.

Conflict

There was intense human–elephant conflict in parts of the area, particularly in southern Laikipia, in the early 1990s. This was particularly severe in new settlement areas where people had bought land to farm in the middle of elephant movement routes, and where large-scale ranches or forest areas were adjacent to areas with intensive arable farming. Conflict eased in some areas following the construction of elephant-proof fencing around Ngare Ndare Forest, Laikipia Ranching and Ol Pejeta Ranch, and after the abandonment of some settlement schemes in marginal areas. Crop raiding is also a problem around Isiolo and Maralal while some conflict also occurs in pastoral areas, primarily over access to water.

Discussion

Laikipia is one of the few districts in which wildlife populations have increased over the last 20 years, and elephant populations have increased likewise. Although there was a substantial decline in elephant numbers in Samburu during the 1970s, and to a lesser extent in the 1980s, the population has been recovering since. Evidence from radio-tracking suggests an increased use of the Samburu area by the migratory elephant population during the 1990s. Poaching has been a relatively minor threat to elephants in Laikipia District, with a much higher mortality resulting from problem animal control. However, Samburu and Isiolo are extremely vulnerable areas due to large numbers of guns and limited KWS presence. The emergence of several strong community-based wildlife organizations emphasizing security has improved the situation in parts of the area and an extension of their efforts will provide a large protected area in the core of the elephant range in Samburu. The security of elephants in the forested areas is less certain. Limited evidence from Kirisia Hills suggests that elephant populations in this area may have been severely depleted by poaching.


N
37
38
2
1
0
Legend
Human and elephant conflict
Elephant movement
Elephant range
Settlements
Electric fence
Rivers, lakes and swamps
Forest boundary
National Parks and Reserves
Hills and contours
District boundaries
Marsabit District
Samburu District
Isiolo District
Ndotos
Losai
Mathews Range
Leroghi
Kirisia Forest
Maralal
Sanctuary
Wamba
Namunyak
Samburu
Shaba
Buffalo Springs
Mukogodo
Forest
Isiolo
Laikipia Ranches
Lewa
Rumuruti
Timau
Nanyuki
Imenti
Forest
Mount
Kenya
Aberdares
10 0 10 20 km

8. MERU

Introduction

Meru National Park, to the north-east of Mt Kenya, together with the neighbouring conservation areas of Kora National Park and Bisanadi National Reserve, has been on the front line of the Kenya government's anti-poaching efforts for many years. The northern and eastern boundaries of this area adjoin some of the most lawless parts of Kenya. Meru's elephant population was greatly reduced in the 1970s and 1980s and has not shown clear signs of recovery in the 1990s.

Meru National Park covers an area of approximately 740 km^2. It was established as a game reserve in 1957 by Meru County Council and gazetted as a National Park in 1967. It lies between 300 m above sea level at the Tana River and 1000 m at the base of the Nyambene Hills. The vegetation is dominated by *Combretum* wooded grasslands and *Acacia* and *Commiphora* bushland. There are 15 perennial rivers, with dense riverine vegetation along them.

Neighbouring are the Bisanadi National Reserve covering 606 km^2, gazetted in 1979 and managed by the Isiolo County Council; Kora, gazetted as a game reserve in 1973 and as a National Park in 1989; and the Mwingi National Reserve covering 745 km^2, gazetted as the North Kitui National Reserve in 1979.

A number of translocations of elephants to Meru National Park and neighbouring conservation areas have been conducted. In 1997, 10 bulls were translocated from Lewa Downs to Kora National Reserve; in April 2000, 10 elephants were moved from Ol Pejeta and Lewa Downs to Meru *(East African Standard,* 13 July 2001); and in July 2001, 51 elephants, including family units and bulls, were successfully moved from Sweetwaters Rhino Sanctuary to Meru.

Historical information

The first aerial survey of the Meru population was carried out in 1965 by E.C. Goss, who counted 554 elephants inside the park (Douglas-Hamilton and Hillman 1976). By the early 1970s, this number had nearly doubled, with 1520 elephants counted in 1974. Several factors were causing compression of the range of elephants that had formerly ranged over a wider area into the park. Expanding populations of Meru agriculturalists to the west had established farms in areas that elephants formerly used as wet-season dispersal areas. Poaching was a serious problem in the area, and although at times it had occurred within the park, it was much more severe outside, with pressure coming on the eastern boundary from Somalis and from the southern boundary by Tharaka and Kamba hunters as well.

In 1969 there was some poaching within the park, but it was brought under control by 1973, thanks to the provision of training and equipment and opening up of tracks in the southern part of the park. Poaching resurged between October 1973 and December 1974, with 79 elephants killed inside the park. This was again brought under control when the field force was increased, but by 1976 the problem had again become intense with the increasing price of ivory on the international market (Douglas-Hamilton 1990).

In 1976 total and sample counts were carried out (Douglas-Hamilton and Hillman 1976), and a series of sample counts were conducted in 1977 (Wetmore et al. 1977). The sample counts gave broadly similar figures, with 2122 in 1976 and 2474 in the 1977 count. The total count gave a lower total of 1328. In 1976 another 620 elephants were

estimated in the Bisanadi area and in 1977, 434 animals. The carcass ratios were much lower inside the park (6.1% in 1976 and 5.7% in 1977) than outside (38.1% in 1976 and 40.6% in 1977).

In the late 1970s poaching was severe inside the park as well as outside, and by 1978 the carcass ratio within the park had risen to 53% and the number of elephants had dropped to below 500. After 1982, the numbers remained relatively stable with roughly 300 counted in 1982 and 430 in 1986 (Poole et al. 1992).

Recent surveys

The number of elephants within the Meru ecosystem has remained relatively stable throughout the 1990s, compared with the dramatic decline in numbers observed during the late 1970s and early 1980s. Four aerial total counts were carried out in the Meru–Bisanadi–Kora area during the 1990s. These all gave similar population estimates, ranging from 251 in 1990 to 360 in 1997, with no consistent trend in numbers over time.

In 1992 an individual photo-recognition file was established, and 223 animals were identified, compared with the 264 animals that were counted from the air in the park in the same year (Litoroh 1992; Meru Elephant Project 1992). There were very few mature males and adult females in the population, indicating a history of heavy poaching (Demmers and Bird 1995). A further individual identification study was conducted in 1993–1994, with 260 animals identified. It was considered that another 20 animals had not been identified (Demmers and Bird 1995).

It is likely that most of the variations in numbers counted within the area have been the result of movements out of the area. For instance, the count for the ecosystem in 1999 was 306 elephants, whereas the senior warden had reported between 171 and 336 individuals earlier in the year (Kahumbu et al. 1999c).

In June 2002, a total aerial count of elephants in the Meru conservation area found 413. Of these 272 were counted inside Meru National Park, 100 in Bisanadi and only 5 in Kora; the remainder were counted in areas adjacent to the protected areas (Omondi, Bitok et al. 2002b).

Current distribution and movements

During the early 1990s, the elephants were mostly seen in a single large group during the dry season, usually in the central part of the park. In the wet season the herd would split into smaller groups and move out of the park to the north.

Two female elephants were radio-collared in Meru National Park and monitored between July 1992 and March 1993 (Njumbi 1995). They moved to near Garbatula, about 40 km north of Meru Park, as part of a group of over 200 elephants during the wet season.

During the 1990s, there was some evidence that elephants had started dispersing more outside the park. In 1992 the main concentrations of elephants were inside the park. However, by the 1999 count more elephants were found in Bisanadi National Reserve than in the park itself.

In 2000, elephant research initiated by Save the Elephants extended knowledge of movements of these elephants through detailed radio-tracking studies. Tracking has confirmed that the Meru elephants move north towards Garbatula, north-west to Imenti Forest on the edge of Mt Kenya by passing around the northern tip of the Nyambene Hills, and one family has been located 120 km south-east of Garissa (King 2002).

Mortality

The mortality data are shown in table 8.1 and figure 8.1.

Table 8.1. Mortality figures for Mcceru, 1990–2002

	AC	SI	NA	UN	CF	CT	PP	Total	Total 'found'	Poached of 'found' (%)	Ivory missing of 'found' (%)
1990	0	0	0	0	0	1	13	14	13	100	100
1991	0	0	0	0	0	1	1	2	1	100	0
1992	1	0	0	1	1	0	3	6	6	50	50
1993	1	0	0	0	0	0	13	14	14	93	93
1994	1	0	1	1	0	2	21	26	24	87	83
1995	0	0	0	0	0	0	18	18	18	100	94
1996	0	0	2	1	0	1	7	11	10	70	70
1997	0	0	3	2	1	0	4	12	10	40	50
1998	0	0	2	0	0	0	4	6	6	66	67
1999	2	0	2	3	1	1	12	21	20	60	55
2000	0	1	0	4	1	0	5	11	10	50	50
2001	0	0	0	3	4	1	7	15	14	50	64
Jan–May 2002	0	1	2	0	0	0	4	7	7	57.14	57

AC – accident; SI – sickness; NA – natural; UN – unknown; CF – conflict; CT – control/PAC; PP – poached.

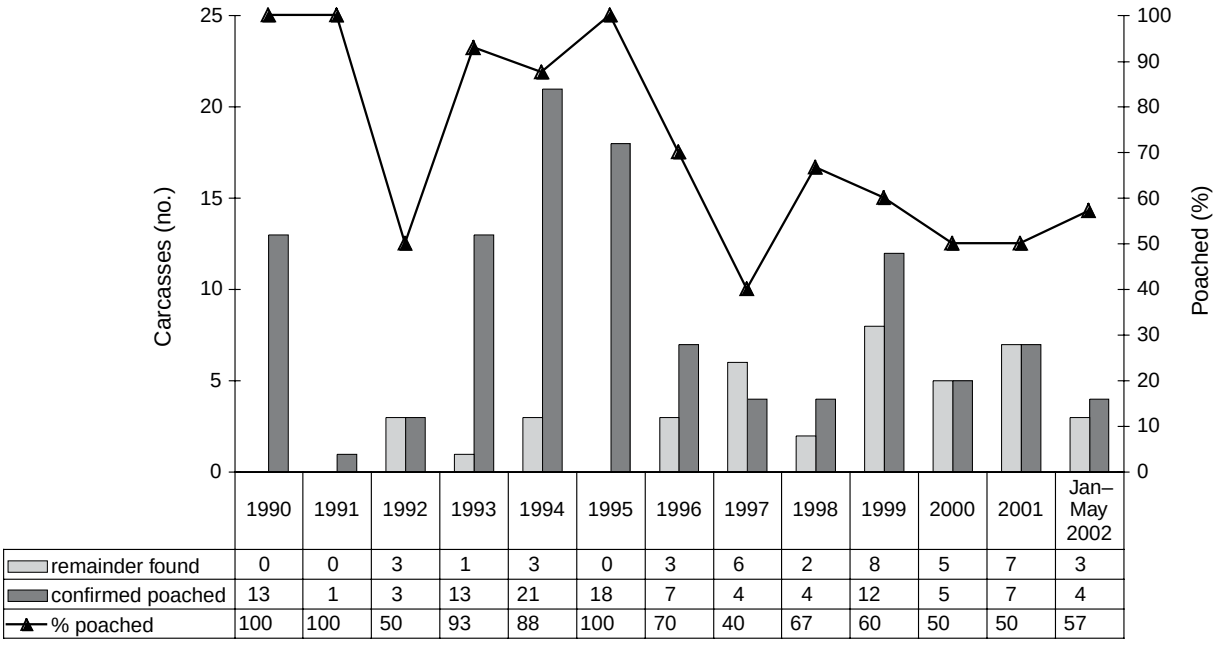


Figure 8.1. Number of confirmed poached carcasses, remainder of carcasses found and proportion of all found carcasses that were poached, Meru elephant mortality 1990–2002.

- Poaching continued in Meru throughout the 1990s. The increase in reported poaching in 1999 may be a combination of an actual increase in poaching and an increase in reporting and surveillance with a resident aircraft in the area.
- A peak of reported poaching occurred in 1993–95. In almost all cases the carcasses were spotted by the resident pilot during routine patrols and the report was then followed up by a ground team who verified the cause of death and often found more carcasses in the area. During 1996–98 no pilot was resident in Meru and it is likely that the low number of carcasses found during this period is a result of this. A pilot returned in 1999 and again the number of carcasses found increased, with a high number of poached carcasses. The number of carcasses reported as poached between 2000 to May 2002 has decreased, and this is likely to be due to increased security and monitoring of the elephant population together with rehabilitation of park infrastructure during this time.
- Between October 1994 and May 1995, 30 elephants were reported poached, mostly to the north and north-east of Meru National Park (Kubisera, Korbessa and Matashara). In most cases the carcasses were seen from the air by the pilot. Carcasses were found together in twos and threes. In one case five carcasses were found together and in another six. This pattern of poaching is typical of commercial ivory poachers.
- The proportion of all found carcasses due to poaching was 50% or greater in all years except in 1997. This is in contrast to the mortality pattern seen in Samburu–Laikipia and Tsavo where many of the carcasses found were due to natural or unknown causes.
- In all years, except 1991 when the number of reported mortalities was exceptionally low, 50% or more of the carcasses found were missing their tusks.

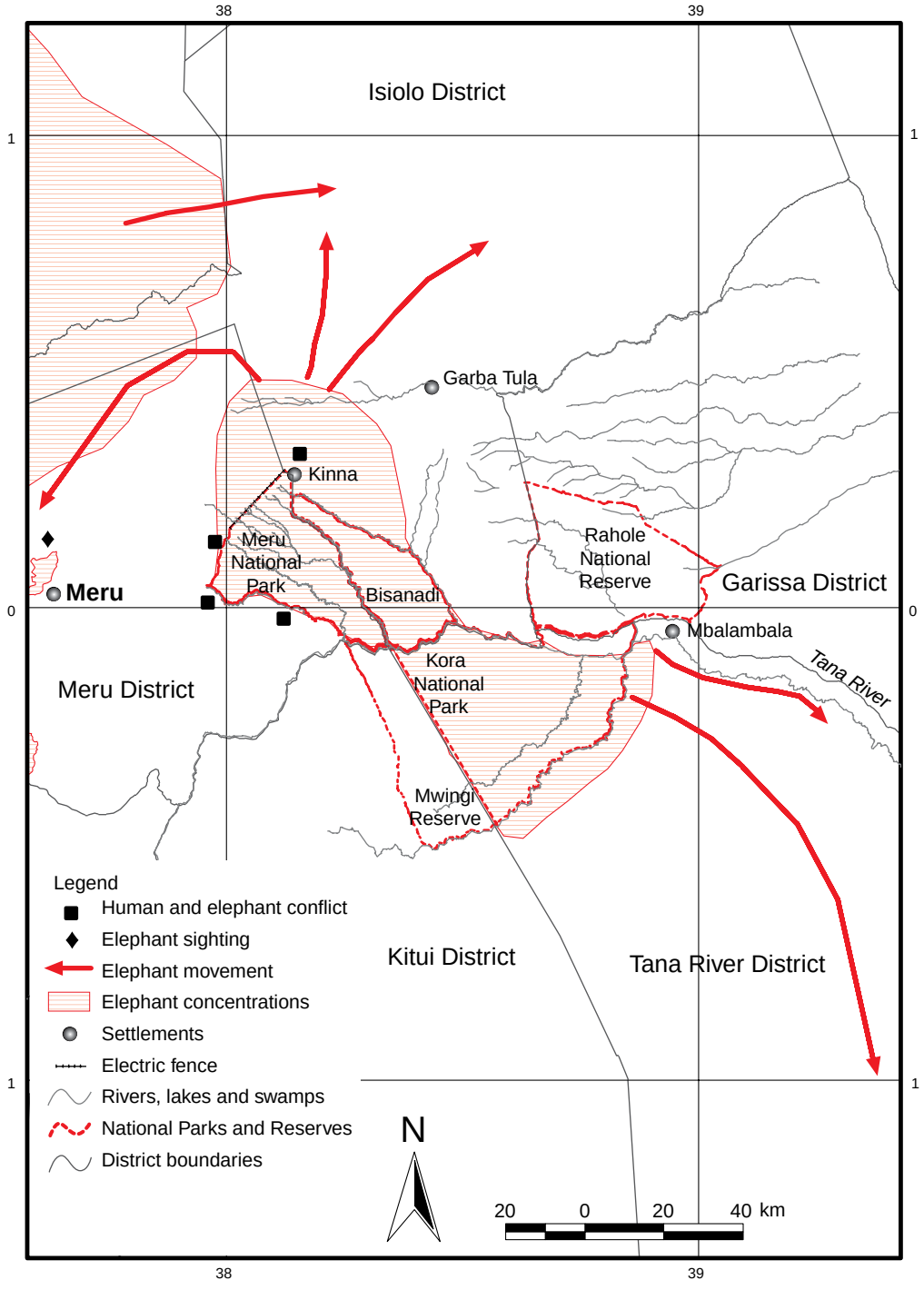
Conflict

Since the western edge of Meru National Park adjoins relatively high-rainfall farming areas, while the northern edge borders insecure pastoralist areas, elephants face different kinds of conflict around the park. The most serious comprises crop raiding on the southern and western boundaries in Tharaka and around the Kinna/Rapsu irrigation scheme to the north-west, which is being relieved by the construction of elephant-proof fences.

Several attempts have been made to fence the western boundary of the park. The first phase was completed in 1985–86; it covered approximately 25 km between Kinna and Kindani on the north-western boundary of the park, which significantly reduced conflict in this area. There are plans to electrify and extend the fence to include the entire western boundary of the park and some of the southern boundary. Work began in 2002 and by April the elephant exclusion fence extended from Kinna to Kanjoo Rangers Post. Elephants also raid crops in the irrigated areas around Kinna, where conflict between humans and elephants is high. In 2001 an exclusion fence was established around Kinna and Rapsu settlements, which has greatly reduced conflict.

Discussion

Meru National Park and the adjoining conservation areas have suffered due to their proximity to banditry areas and from a history of neglect interspersed with periods of good management. It is of concern that the elephant population did not recover significantly during the 1990s. This may be due to high mortality from poachers when the elephants are outside of the park, or because the heavy poaching in the 1980s caused social dislocation that affected breeding behaviour. In 2001, Save the Elephants began a study to investigate these issues.


38
39
1
0
Isiolo District
Garba Tula
Kinna
Meru
National
Park
Meru
Bisanadi
Rahole
National
Reserve
Garissa District
Mbalambala
Tana River
Kora
National
Park
Meru District
Mwingi
Reserve
Kitui District
Tana River District
Legend
Human and elephant conflict
Elephant sighting
Elephant movement
Elephant concentrations
Settlements
Electric fence
Rivers, lakes and swamps
National Parks and Reserves
District boundaries
N
20 0 20 40 km

9. MWEA

Mwea National Reserve, on the Tana River in Embu District, is home to a small population of elephants that is now completely isolated by settlements. It is believed that formerly the elephants moved down the Tana River to the Kiambere Forest and perhaps as far as north Kitui (Litoroh 1994). The reserve was gazetted in 1976 and its size has been reduced from 68 km^2 to 42 km^2 by human settlement (Sakwa et al. 1995). In 1978 it was estimated there were 49 elephants in the reserve; this figure was reduced to 27 in 1984 (Litoroh 1994).

During the 1990s concern was increasing about the high level of human–elephant conflict in the area and the possible effect of a confined high-density elephant population on the vegetation. A series of counts were carried out to get an accurate indication of the number of elephants and to identify possible groups for translocation. Most of these counts gave similar results of between 45 and 48 individuals.

Between September 1995 and June 1996, 16 elephants were translocated from Mwea to Tsavo East National Park, and an additional 5 animals died during the course of the operation, leading to a reduction in the population of 21 animals (Njumbi et al. 1995a, 1996). In 1995 there were also reports of elephants some 50 km to the east of Mwea in the area of Kiambere and one person was killed by an elephant. There were estimated to be 30–50 elephants in the group, and although some were believed to move between Kiambere and Mwea, it was also believed that others were resident in the area (Gachago 1995).

Information on reported elephant mortalities is from EMD; no field records have been checked. Only eight elephants have been reported dead since 1990—seven of these shot on problem animal control, three in 1994.

10. MT KENYA (INCLUDING IMENTI FOREST)

Introduction

Mt Kenya is the highest mountain in Kenya with vegetation ranging from alpine moorland in the central area around the peaks to montane forest at lower elevations. Mt Kenya National Park encompasses the peaks and moorland but only a small proportion of the forest, the majority of which has forest reserve status. Although the lower slopes have been cultivated, there are still substantial areas of indigenous forest on the higher slopes. Deforestation and excisions of the forest reserve have become increasing problems in recent years (Gathaara 1999), and human encroachment in the forest has reduced elephant habitat and exacerbated problems of human–elephant conflict. In July 2000, the forest reserve was regazetted as a National Reserve and all indigenous forests on the mountain were placed under the management of Kenya Wildlife Service.

Historical information

Mt Kenya has probably always been an important elephant range. In 1903, Richard Meinertzhagen observed some 700 elephants crossing from Mt Kenya Forest to the Aberdares Forest while he was close to Nyeri Hill (Meinertzhagen 1957), while Roosevelt (1909) reported that elephants lived permanently in the forest. They lived in the bamboo when it was dry and during the rains they moved onto the lower slopes and raided farms bordering the forest. At times, Roosevelt reported, the elephants would move out of the forest entirely, making migrations that were sometimes seasonal but often irregular and unaccountable.

Two surveys were carried out in 1960 with the entire Forest Guard force and Kenya National Parks rangers covering the area on foot, counting all animals seen or estimating their numbers from fresh tracks and droppings. Approximately 700 animals were estimated to be present in the wet season and 1300 in the dry season. The difference between these two figures was thought to be because of the annual migration of elephants from the forest reserve into Northern Frontier Province in January–February and their return in June–July (Holloway 1962).

In 1948 it was estimated that there were 1000–1500 elephants in the forest (Poole et al. 1992). In 1965 Holloway suggested that some 900 were resident elephants living in the forest from December through June and an additional 1300 were migrant elephants that moved into the forest from July to November. In 1973 it was estimated that there were 2500 elephants on the mountain (Jarman 1973a).

During the 1960s and 1970s game wardens occasionally observed small numbers of elephants moving between the Aberdares and Mt Kenya. One game warden testified that elephants moved from Mt Kenya across the Solio Ranch area and Ngobit to the Aberdares. Another route taken out of the forest was through Ngare Ndare, Mukogodo and the Ewaso Ngiro.

Recent surveys

Three surveys of the elephants of Mt Kenya have been carried out in the 1990s. These have all made use of broadly similar dung survey techniques but have produced widely varying estimates of elephant density and total elephant numbers.

The first set of surveys was carried out in the wet and dry seasons of 1991 by Reuling et al. (1992c).

- The wet- and dry-season surveys gave similar figures with estimates between 3.1 and 3.6 animals per km^2, but the confidence limits were wide. Thus the estimate for March was between 2505 and 5985 animals, and for October 3536 to 7344.
- Population estimates were high compared with previous informed guesses. The density was calculated at more than three elephants per square kilometre. In other areas, more than one elephant per square kilometre is considered high.
- The survey included a study of the dung decay rate, but this was carried out below 2500 m where the decay rate is faster than at higher altitudes.
- Dung transects were done throughout the forest reserve. There is a possibility of bias because they were mostly done in the most accessible areas.

A less extensive survey was carried out in 1998 (Omondi et al. 1998b).

- Compared with the previous survey, the transects were shorter in length and dung decay rates were not measured. The calculations used a lower decay rate than in the previous survey.
- The dung density estimate from this survey was about half that calculated for the previous survey.
- The area of habitat over which numbers were extrapolated was much larger (2810 compared with 1367 km^2). Therefore, the final estimate—just over 4000—was not much lower. However, this area included the National Park, which is mostly not suitable elephant habitat, and including the park in the extrapolation will have led to a considerable overestimate.

These surveys did not include the Lower Imenti Forest, which is connected to Mt Kenya Forest. Two sets of dung counts have been carried out in this forest, providing estimates of 231 elephants in 1994 (Njumbi and Litoroh 1994) and 156 in 1997 (Bitok et al. 1997). However, these studies had high confidence limits and so may have produced overestimates of true numbers.

The most detailed study to date was carried out in 1999 (Vanleeuwe 2000).

- During the study some 500 km of transects were walked (compared with 85 km and 23 km in the previous studies). The transects were each 25–35 km long, extending from the moorlands down to the lower slopes.
- A dung decay study gave a similar decay rate to that of Reuling et al. (1992a).
- During the analysis, it became clear that the techniques previously used for dung surveys in Kenya were overestimating dung density by a factor of about 2. This was because there was a greater density of dung close to the transect line than would be expected from the negative exponential distribution. Thus use of the negative exponential distribution in the program *Elephant*, which has been standard for most recent surveys, creates a major error in the final results. Therefore, this study employed fixed-width transects.
- The final estimate of just under 2000 elephants was much lower than previous dung counts. The figure may be a slight underestimate because a small area of potential elephant habitat in the plantation forest on the lower slopes was not included.
- The decline in the estimate compared with that of Reuling et al. (1992a) does not imply a real decline in elephant numbers because when elephant density was calculated using *Elephant* a figure of 3.52 per km^2 was derived. This is similar to the previous estimate and suggests that the change in estimates is almost entirely due to undetected errors in the calculation methods used in the earlier study.

Because of these concerns about methodology, two further approaches were used to calculate elephant numbers on Mt Kenya (H. Vanleeuwe, pers. comm.). Results from the 1999 count were used to construct a model of elephant density using generalized linear model analysis, relating density to variables including slope, habitat, altitude and rainfall. This gave an estimate of 2173 elephants. Further surveys using the recce transect method were carried out in February 2001. These make use of much shorter straight transects of 200 m separated by 5-km transects, which follow lines of least resistance. This method gave an estimate of 2649 elephants.

Current distribution

Elephants are rare on the moorland above 3500 m and occur at low density between 3000 and 3500 m. Their density is highest at low elevations, particularly in bushland and mixed forest, except in areas of high disturbance from poachers and illegal loggers (Vanleeuwe 2000). Densities in the bamboo–*Podocarpus* forest are intermediate.

The highest numbers of elephants appear to be around Mountain Lodge in the south-western part of the forest. They are present in medium densities in the south and east, but low in the south-east where there is much human disturbance. Occurrence in the north and north-east is seasonal but generally low (H. Vanleeuwe, pers. comm.).

Movements

Data on elephant density at different altitudes collected by Vanleeuwe (2000) indicate that there may be a seasonal movement down the slopes in the dry season. This evidence is in conflict with Holloway's (1962) view that elephants moved down in the rains, and the situation needs to be further investigated.

It is unclear how much lateral movement occurs around the mountain. On the mid-slopes, steep gorges form substantial barriers to movement, and it may be that the need to bypass these barriers leads elephants to move downhill into settled areas.

Former movement routes out of the Mt Kenya forests have been almost entirely cut off. There are still limited movements through Thego Forest in the direction of Sangare Ranch, and occasionally elephants move to and from Laikipia and Isiolo through farmland near Nanyuki and Timau. Three radio-collared bulls have moved between Lewa Downs and Samburu and Lower Imenti Forest, although they have not stayed for any length of time.

Mortality

Reported elephant mortality records are from EMD only; field records were not examined. Records include reports for Imenti Forest (table 10.1).

Conflict

Human–elephant conflict around Mt Kenya consists of elephant damage to both plantation forests and small-scale farms. Elephants damage young plantations by browsing and trampling young trees. In older plantations bark-stripping is a problem.

During colonial times, damage by game was largely prevented by regular control shooting and the practice of housing labour around cultivation and plantations. However, during the 'Emergency' (1952–56), forestry work was restricted, people were housed in villages, and military operations in the higher reaches of the forest drove game to the sanctuary of the plantations below (Holloway 1962). In 1957–58, forest management and control shooting resumed and the animals were driven back into the indigenous forest

Table 10.1. Mortality figures for Mt Kenya (including Imenti Forest), 1990–2002

	AC	SI	NA	UN	CF	CT	PP	Total	Total 'found'	Poached of 'found' (%)
1990	1	0	0	1	0	2	0	4	2	0
1991	0	0	0	2	0	1	1	4	3	33
1992	0	1	0	3	2	3	0	9	6	0
1993	0	0	0	1	0	9	1	11	2	50
1994	1	0	0	0	0	21	0	22	1	0
1995	0	1	0	0	0	15	0	16	1	0
1996	0	0	1	0	0	23	0	24	1	0
1997	0	0	0	1	3	5	1	10	5	20
1998	1	1	2	2	0	6	1	13	7	14
1999	0	1	1	2	0	4	2	10	6	33
2000	0	0	1	1	0	1	2	5	4	50
2001	0	1	0	0	0	0	1	2	2	50
Jan–May 2002	0	1	0	0	1	0	0	2	2	0

AC – accident; SI – sickness; NA – natural; UN – unknown; CF – conflict; CT – control/PAC; PP – poached

132 elephant mortalities were reported between 1990 and May 2002. Of these 68% (90 elephants) were shot on PAC.

The number of elephants shot on PAC was higher in 1994–96 than during other years; this is likely to be due to changes in KWS policy at the time.

Few elephants were reported as poached—only 9 elephants during the reporting period. This accounts for 21% of all found carcasses (excluding PAC).

but the workers continued to live in the villages, and the Forest Department constructed moats to keep elephants out of plantations and settlement areas.

Despite attempts to protect people from wildlife, there was still significant conflict. Between 1951 and 1961, six Forest Department employees were killed by big game (Holloway 1962). In 1960, government control officers shot 50 elephants in the forest or on neighbouring farms and this was considered to be a typical year (Holloway 1962).

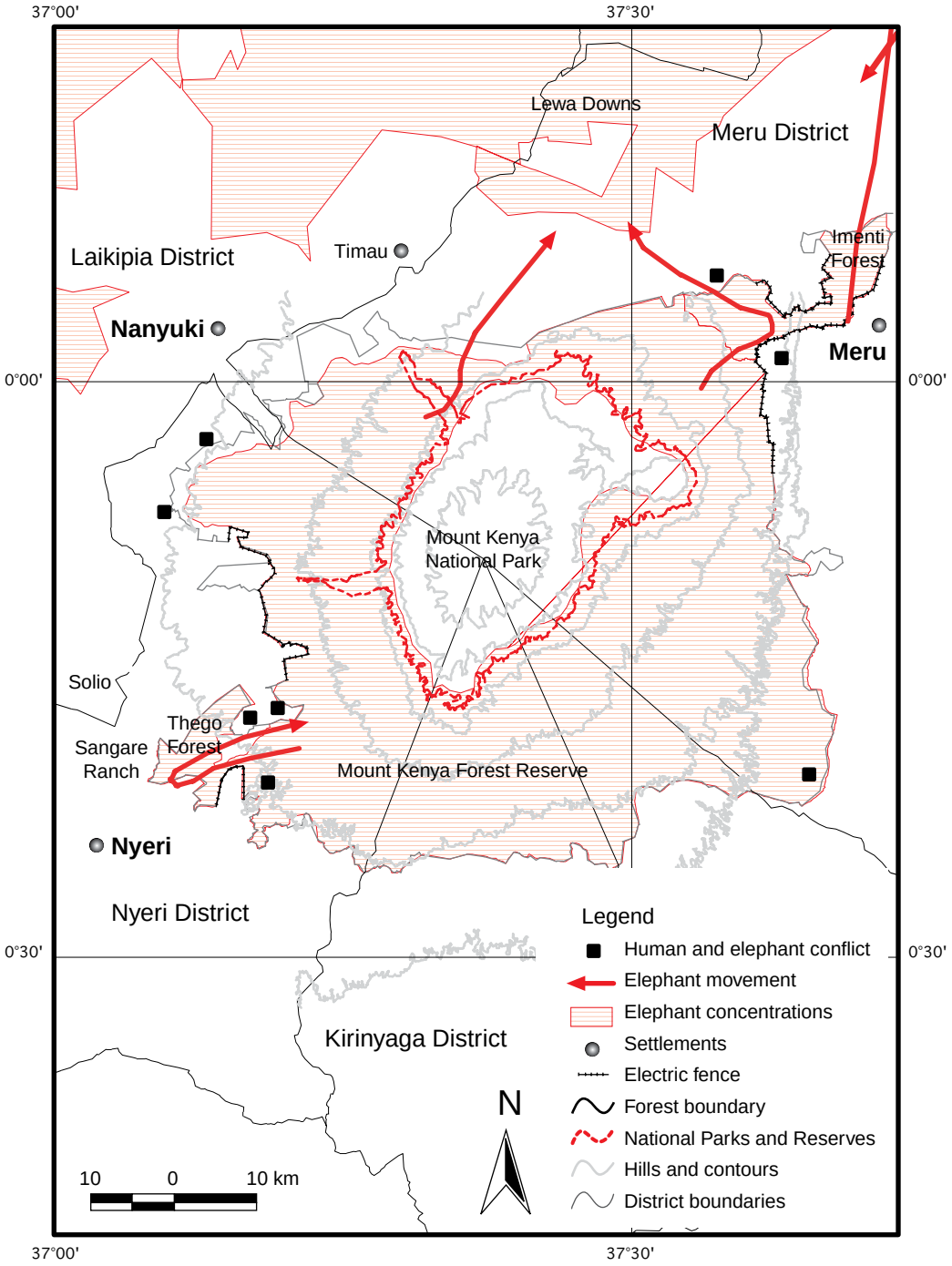
In later years the capacity of the Forest Department declined, moats were abandoned, management of the plantations was less active, and human encroachment on the forest increased. This led to increasing conflict, largely in the form of crop raiding in farms bordering the forest, since many plantations were effectively abandoned. Conflict is particularly acute on the south-western side because of Thego Forest below the Mountain Lodge area with its complex mosaic of natural forest, plantations, and legal and illegal settlements.

Crop raiding around Imenti Forest in Meru District has also been a major concern because it is a narrow corridor of forest extending from Mt Kenya into farmland (Bitok et al. 1997). The Lower Imenti Forest was largely destroyed by 2000. A 22-km electric fence was constructed around the western and northern boundaries of Upper Imenti in 1996–97 to protect the Naari farming area (Mwathe et al. 1998), and additional two-strand fences have been constructed in the south-eastern area.

Discussion

Elephant surveys have not been carried out consistently since 1948. Quantitative dung surveys have been made only between 1991 and 2002; therefore, it is not possible to confirm whether the population has changed. Although levels of control shooting were high during colonial times, it is unlikely that this had a substantial impact on the population. Some elephants are killed in snares, but there is no evidence of large-scale

ivory poaching on Mt Kenya. It is possible that elephant populations have declined, and they are likely to diminish further in the future as a result of habitat loss and disturbance from illegal activities. Habitat loss through selective logging or clear felling may not have an immediate effect since the resulting secondary vegetation may provide more food for elephants. However, replacement of forest by farmland will decrease food availability and increase conflict. To secure the future of elephants on Mt Kenya it is essential that the forest be fenced.



11. ABERDARES

Introduction

The Aberdares Range is a volcanic massif on the edge of the Rift Valley, lying across the Laikipia Plateau from Mt Kenya. Higher parts of the range consist of open moorland, little used by elephants; at lower altitudes there are dense stands of bamboo and wet montane forests. Most of the forest lies within forest reserves, while Aberdares National Park incorporates all the moorland and some forest, particularly in the Salient on the eastern side and in the drier north. Deforestation and conversion of natural forest to plantations have combined to seriously degrade parts of the Aberdares forests.

To protect forests and wildlife from illegal exploitation, and the neighbouring farmland from crop damage by wildlife, the entire perimeter of the natural forest is to be fenced.

Historical information

No systematic surveys of the elephants in the Aberdares Range were carried out before the 1990s. In 1973 it was estimated that there were 3000 elephants in the park and forest combined (Jarman 1973a).

Recent surveys

A dung survey of Aberdares National Park (thus not including the forest reserves) conducted in 1990 indicated that there were 1800 elephants (range 1100–2550) in the National Park alone (Blom et al. 1990). Although Blom et al. (1990) concluded that the elephant population in the National Park seemed stable, the data suggest that the population increased between the 1970s and the 1990 as the National Park comprised only 38% of the area to which earlier estimates were applied. Elephants occur throughout the forest reserves. It has been suggested that at least another 700 animals must have lived in the 62% of the Aberdares not covered by the 1990 survey (Butynski 1999). If so, the total number of elephants in the Aberdares Conservation Area was at least 2500 in 1990.

Bitok et al. (1998) carried out a dung survey of the Aberdares forests in 1998 covering 26 km, but the report does not show where the transects lay. Although the estimate is said to be for Aberdares National Park (767 km^2) and Aberdares Forest Reserve (996 km^2), the total area covered by this census was reported to be only 1030 km^2, not 1763 km^2, which is the combined area of this National Park and forest reserve. Given that the transect length was quite short and that there was no evidence of random sampling or stratification, and the program *Elephant* was used, the population estimate of 4120 elephants for the Aberdares Range cannot be considered authoritative.

Current distribution and movements

During an appraisal of possible fence alignments carried out in 1997–98, Butynski (1999) and colleagues carried out a series of road transects covering 250 km within Aberdares Forest looking for elephant dung. This gave a rapid assessment of the relative density of elephant over a large area. Elephants occurred over nearly all of the Aberdares Range, but their densities varied considerably from place to place. Elephant dung was absent from only two transects, both of which were in plantations of exotic trees in the vicinity of Mutarakwa Forest Station on the west edge of the Aberdares Forest Reserve. From

Mutarakwa to Malewa River, there was little evidence of elephants, although small numbers occasionally visit some sites (that is, one to a few elephants present for brief periods every 1–3 years). The only exception is near Mutubio Road, where elephants move from the park along the road and into the forest reserve and sometimes onto the farmland. The cliffs and steep, rugged terrain located to the east of this region make it impassable for elephants. This is probably the main reason for their low density in this area.

Elephants reached their highest densities in the southern moorlands in the vicinity of Mutubio West Gate, Kiandagoro Gate, Karuru Waterfalls and Fishing Camp. Elephant densities were also fairly high in the Salient. Elephant footprints and dung have been found at altitudes as high as 3700 m.

Historically, elephants probably moved into and out of the Aberdares ecosystem in all directions. A major route from the Salient in the east central Aberdares towards Mt Kenya (Meinertzhagen 1957) is no longer used because of the large human population between the Aberdares and Mt Kenya, and the placement of a moat here during the late 1950s. Today the only movement of elephants in and out of this ecosystem is at the northern extreme of the Aberdares range via Ndaragua Forest, into Laikipia District, and through to Sangare Ranch close to the Salient.

Mortality

Reported elephant mortality records are from EMD only; field records were not examined (table 11.1).

Table 11.1. Mortality figures for Aberdares, 1990–2002

	AC	SI	NA	UN	CF	CT	PP	Total	Total 'found'	Poached of 'found' (%)
1990	1	0	1	0	0	0	0	2	2	0
1991	0	0	0	0	0	0	0	0	0	0
1992	1	1	0	0	0	4	1	7	3	33
1993	0	0	0	0	0	2	0	2	0	0
1994	0	0	0	0	0	6	0	6	0	0
1995	0	0	0	0	0	1	1	2	1	100
1996	0	0	0	0	0	0	0	0	0	0
1997	0	1	0	0	0	2	1	4	2	50
1998	1	0	1	0	0	0	0	2	2	0
1999	0	0	2	0	0	1	0	3	2	0
2000	0	0	3	3	1	0	2	9	9	22
2001	0	0	1	1	1	1	4	8	7	57
Jan–May 2002	0	0	0	0	0	0	0	0	0	0

AC – accident; SI – sickness; NA – natural; UN – unknown; CF – conflict; CT – control/PAC; PP – poached

- Between 1990 and May 2002, 45 elephants were reported dead in the Aberdares area. This number includes elephants found in the Limuru area close to Nairobi, which probably form part of the greater Aberdare population.
- Of the 45 reported elephant mortalities 17 (38%) resulted from PAC. The highest number shot on PAC was in 1994 with 6 elephants killed; 3 of these were shot in

Nyahururu in November that year. Small numbers of elephants have been shot on PAC throughout the 1990s in the Aberdares area.

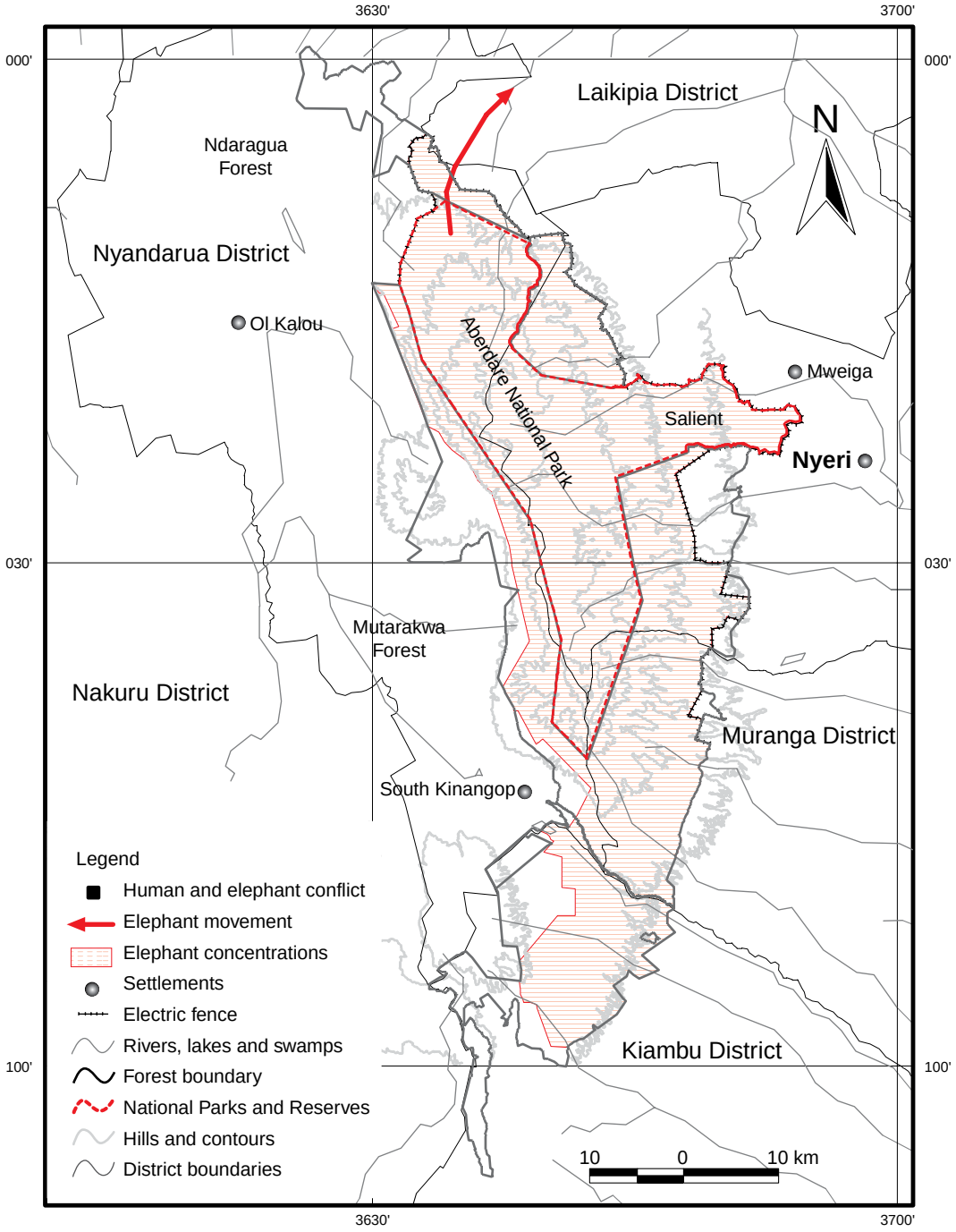
- Only 3 elephants were reported as poached between 1990 and 1999. However, in 2000 and 2001, 6 elephants were reported as poached; most had been speared and the tusks were missing. More elephant carcasses were reported found in 2000 and 2001 than the total for the previous decade.
- Relatively few elephant mortalities were reported in this area considering the estimated population size. Like in other forest habitats it is difficult to find carcasses.

Conflict

Human–elephant conflict continues to be a problem in areas not protected by fencing. The main areas where crop raiding was reported to be a serious issue were Quarry, Shamata, Ruhuruini, Kiandogoro, South Kinangop and Kitiri.

Discussion

The data on elephant numbers in the Aberdares are inadequate for drawing conclusions on population trends. However, existing records do not suggest that elephants were seriously poached. All estimates are based on guesses or relatively inaccurate dung counts. There may well have been an increase in elephant numbers in the Salient as a result of compression, provision of salt and protection, and this has resulted in loss of forest cover, which is particularly marked around Treetops. Elsewhere, particularly in the drier northern part of the range, it is more likely that numbers have declined as a result of loss and degradation of habitat through exploitation and burning.


3630'
3700'
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Laikipia District
N
Ndaragua
Forest
Nyandarua District
Ol Kalou
Aberdare National Park
Mweiga
Salient
Nyeri
Mutarakwa
Forest
Nakuru District
Muranga District
South Kinangop
Kiambu District
Legend
Human and elephant conflict
Elephant movement
Elephant concentrations
Settlements
Electric fence
Rivers, lakes and swamps
Forest boundary
National Parks and Reserves
Hills and contours
District boundaries
10
0
10 km

12. MAU

Introduction

The Mau Forest complex in west central Kenya consists of four adjacent forests: Western Mau, South-west Mau, Transmara and Ol Pusimoru. It is the largest intact area of moist indigenous forest in Kenya and contains a wide range of habitats, including montane forest, bamboo and scrub grassland. It is a vital water catchment area. The forest is under considerable pressure from illegal activities such as logging and charcoal making and human settlement.

Historical information

No systematic surveys were carried out in Mau Forest before 1990. Percival (1924) stated that there were elephants throughout Mau Forest, and that Ndorobo hunted elephants for meat and ivory.

Recent surveys

Dung surveys carried out in Mau Forest in October 1991 found the highest dung densities in Western Mau Forest and in the bamboo region of South-west Mau Forest, but overall densities were low (Reuling et al. 1992b). In a February 1992 survey, the bamboo regions of South-west Mau and Transmara Forests were sampled more extensively and more elephant dung was found (Reuling et al. 1992b). However, unlike many forests surveyed, there were substantial areas with no elephants at all. The total estimate for the forest complex was 207 ± 82 elephants. This was calculated only on the basis of the 314 km^2 of bamboo and bamboo–forest habitat in South-west Mau Forest and Transmara Forest where it was calculated that there was a density of 0.66 elephants per km^2.

Njumbi and others carried out a further dung survey in 1995 (Njumbi et al. 1995b), which focused on three of the four forests making up the Mau complex. Ol Pusimoru Forest was not sampled. The highest dung density was found in the mixed bamboo and forest area of Kirenget in South-west Mau Forest and the montane areas of Kerisoi–Githima. Virtually no elephants were found in the western side of the forest. The total population estimate was 1003 animals. A possible reason for the higher dung densities found in later surveys was that the elephants moved towards the drier eastern edge of the forest during the wet season, and the earlier wet season count did not cover the eastern side of the forest while improbably high estimates of over five elephants per square kilometre were derived for the mixed forest in South-west Mau. The differences in estimated dung densities between the two sets of surveys are substantial, and both sets of estimates should be treated with caution since no measurements of dung decay rate were done on site. They show that it is essential to carry out more detailed surveys of the Mau Forest elephant population, particularly in view of its fragile status.

Mortality

Since 1990, 16 elephant mortalities have been reported (records are from EMD only, field records were not examined). Of these eight (50%) were as a result of PAC in 1992–94, one elephant was shot on PAC in 1999 and another in 2000. There were only two reported poaching cases in this area, both in April 2000 when two adult elephant carcasses with tusks missing were found in Mau Forest.

13. MT ELGON

Introduction

Mt Elgon is a large, isolated dormant volcano on Kenya's western border with Uganda that rises to over 4000 m. Although there is moorland at higher altitudes, it is surrounded by forest. In 1968, 169 km^2 of the forest was gazetted as National Park. There is 125 km^2 of forest reserve to the north of the park and 408 km^2 to the south. Mt Elgon Forest is under the joint management of the Forest Department and KWS (Mulama et al. 1996).

Mt Elgon is perhaps best known for its 'underground' elephants, which go into Kitum and other caves to ingest calcium- and sodium-rich deposits. The elephants use their tusks to pick at irregularities in the cave wall; they catch the loosened rock with their trunks, then grind it with their molars before swallowing the material, which acts as a nutritional supplement. Elephants normally enter the caves during early evening and at times remain there for up to six hours excavating and eating the salty rock material. It is believed that the caves have been formed or at least enlarged by the elephants. (Redmond 1982a,b,c, 1984, 1986; Redmond and Shoshani 1987).

Recent surveys

In 1977 it was estimated that there were 500 elephants on Mt Elgon (Jarman 1973a). Poaching with automatic weapons increased in 1986, and it was believed that numbers might have dropped to fewer than a hundred (Redmond and Shoshani 1987).

In 1991 KWS carried out a dung count, but the exercise was not completed because of an incident involving armed poachers during the survey. Initial results gave an estimate of 86 elephants (Reuling et al. 1992c) in the park alone. Substantial differences in dung density were found, with much higher densities in the lower part of the forest.

A further dung survey was carried out in 1996 (Mulama et al. 1996). This was a more detailed study that included a measurement of dung decay rate. The population estimate was a surprisingly high figure of 1114 individuals, though this did have confidence limits of 75%, indicating a very wide range of possible estimates. This compares with the warden's estimate of 200–400 elephants. The reason for the much higher estimate is partly because this survey covered both forest and park areas. However, the dung density found was still twice that of the earlier survey.

Conflict

Elephants are mainly found within the park and surrounding forest reserves. Former corridors to the east are now cut off by cultivation. The elephants used to move to the Ugandan side of the mountain. However, due to insecurity there, they are believed to stay mainly on the Kenyan side.

Human–elephant conflict is an issue in areas to the south-east of the park and where there is cultivation up to the boundary of the park, but the elephants are usually chased back into the forest by rangers.

Mortality

Poaching was a serious problem in 1990; in one incident six carcasses were found at Kisigon (table 13.1). In 1994 there was another peak in poaching with five elephants

reported as poached; three carcasses were found at Kono–Barwesa area with their tusks removed but the ivory was later recovered and a suspect arrested.

Since 1994, few incidents of poaching have been reported. In 1998, poachers shot two elephants and shot and killed a ranger in the same incident. There have been no reports of poaching since then, and only one carcass has been reported between 2000 and May 2002.

No elephants have been reported shot on problem animal control in the Mt Elgon area although human–elephant conflict is an issue, particularly in the south and eastern part of the mountain.

Threats to elephants may come from gangs of armed cattle rustlers who frequently cut through the park. Game-meat poaching is also a concern in the park and it is possible that these poachers may opportunistically shoot elephants if they come across them.

Table 13.1. Mortality figures for Mt Elgon, 1990–2002

	AC	SI	NA	UN	CF	CT	PP	Total	Total 'found'	Poached of 'found' (%)
1990	1	0	0	1	0	0	13	15	15	87
1991	0	0	0	3	0	0	3	6	6	50
1992	0	0	0	0	1	0	2	3	3	67
1993	0	0	0	0	0	0	1	1	1	100
1994	0	0	0	0	0	0	5	5	5	100
1995	0	0	1	0	0	0	1	2	2	50
1996	0	0	0	1	0	0	1	2	2	50
1997	0	0	1	0	0	0	0	1	1	0
1998	0	0	1	0	0	0	4	5	5	80
1999	0	0	1	0	0	0	0	1	1	0
2000[a]	0	0	1	0	0	0	0	1	1	0
2001[a]	0	0	0	0	0	0	0	0	0	0
Jan–May 2002[a]	0	0	0	0	0	0	0	0	0	0

AC – accident; SI – sickness; NA – natural; UN – unknown; CF – conflict; CT – control/PAC; PP – poached

[a] Elephant mortality records for 2000–02 are from EMD only, field records were not examined for this period.

14. MARSABIT

Introduction

Mt Marsabit is an isolated forested massif rising out of the deserts of northern Kenya. It has long been known as an important elephant area and was the home of Ahmed, a famous tusker who died in 1974. It is believed that elephants from the area spend the dry season in the forests and disperse out into the surrounding country during the rains.

Marsabit National Reserve, created in 1948, covered a large portion of the then Northern Frontier District. It was reduced in size in 1960 and now covers 2000 km^2 extending mostly to the north and west of Mt Marsabit. Marsabit Forest Reserve, which falls within the National Reserve, covers 144 km^2. Parts of the forest and National Reserves are managed by KWS.

Historical information

No detailed surveys were carried out in Marsabit before 1990. However, Marsabit District was covered by KREMU, later DRSRS, as part of their systematic aerial surveys of the rangeland districts. Four surveys in the 1970s and 1980s gave widely varying estimates of elephant numbers—from less than 150 to more than 2000—but all estimates on DRSRS surveys had high confidence limits. All elephants were seen around Marsabit or to the south, to where they are known to disperse during the wet season. Part of the reason for the variability in the estimates is that when the elephants are concentrated in the forest during the dry season, they are unlikely to be counted. Carcass ratios were generally low. The count for 1978 gave an anomalous result; the carcass ratio was high not because a large number of carcasses were observed, but because few live elephants were seen.

Recent surveys

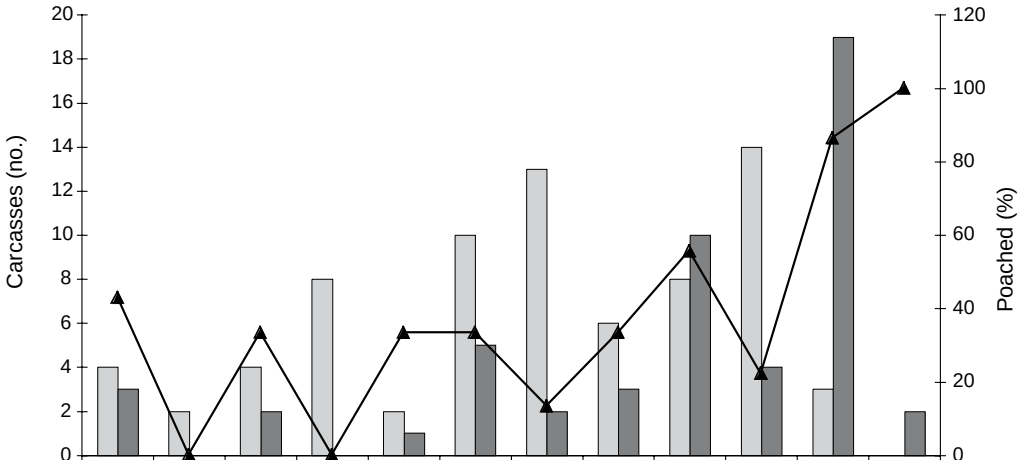
Litoroh et al. (1994b) carried out a combined ground and aerial survey. The dung count covered 36 km of transects. No studies of dung decay rate or defecation rate were carried out. The dung density was 5211 per km^2. No details were given of the method used to calculate this density. The density of dung was found to be highest towards the forest periphery where the forest is more open. The estimated number of elephants was 400.

A total aerial count was carried out at the same time. Average search rate was 191 km^2/hr; 267 elephants were counted from the air.

In 1996 the warden and pilot counted approximately 360 elephants (warden, pers. comm.) coming out of the forest at the end of the dry season. No surveys have been carried out since that time.

Distribution and movements

During the dry season elephants are found only within the forest areas. During the rains they disperse out of the forest, mostly in a southerly direction. No telemetric studies have been carried out, so information on their movements comes from KWS pilots and intelligence reports. It is believed that most elephants move towards the south-west, with smaller numbers going south-east and north-east, but here they are vulnerable to poachers. Most do not disperse far and are found in the nearby areas of Chop, Jaldessa, Karare and Songa. It is believed that some may move further south-west across the Kaisut Desert and along the Milgis lugga towards Laisamis and the Losai Mountains, and even



	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Jan–May 2002
remainder found	4	2	4	8	2	10	13	6	8	14	3	0
confirmed poached	3	0	2	0	1	5	2	3	10	4	19	2
% poached	43	0	33	0	33	33	13	33	57	22	86	100

Figure 14.1. Number of poached carcasses, remainder of carcasses found, proportion of all found carcasses that were poached, Marsabit 1991–May 2002.

reach Ngurunet in the Ndotos Mountains. However, this is not confirmed. In November and December 1999 a small herd was seen in Bule Marmar, in the lava country east of Marsabit, returning in January 2000.

Conflict

Marsabit town forms an enclave within the Marsabit National Reserve. Local communities have gradually encroached onto the reserve. Farmland is now going almost half way around the mountain, and the inhabitants rely heavily on Marsabit Forest for water, firewood and dry-season grazing. These settlements now interfere with elephant movement routes. Two NGOs, the National Council of Churches of Kenya and Food for the Hungry, erected a fence from Abdul Gate to Badusa in 1995. There is additional fencing to the south of the forest. Although it does not enclose the forest entirely and elephants can still move through, it does restrict their movement and concentrates areas of conflict. The main crop-raiding areas are in Badessa, Karare and Songa.

Mortality

Mortality records pre-1993 were unavailable other than a few cases that were reported in the ivory register. No sources of information were available for 1990 (table 14.1 and fig. 14.1).

- In 1997, six elephants died of illness or disease. In all cases the dead elephants had swollen legs and were thought to have died of septicaemia.
- In 1999 also, reported poaching was high. Eleven elephants were confirmed as poached in 1999 (58% of all 'found' carcasses), compared with 0–5 elephants poached per year between 1991 and 1998 (0–43% of all 'found' carcasses).
- In 1999 and 2001, the reported elephant mortality due to poaching was greater than the number 'found' for all other causes combined. These are the only two years since 1991 for which this was the case. (Data for 2002 not complete here as only five months of records were available at the time of this publication.)

Table 14.1 Mortality figures for Marsabit, 1990–2002

	AC	SI	NA	UN	CF	CT	PP	Total	Total 'found'	Poached of 'found (%)'	Ivory missing of 'found' (%)
1991	0	0	0	3	1	0	3	7	7	43	60
1992	0	0	0	2	0	0	0	2	2	0	0
1993	0	0	0	2	2	0	2	6	6	33	0
1994	0	2	2	4	1	0	0	9	8	0	0
1995	0	0	0	2	0	1	1	4	3	33	67
1996	1	2	3	4	0	1	5	16	15	33	33
1997	0	6	3	5	1	0	2	17	15	13	13
1998	0	1	1	4	0	0	3	9	9	33	14
1999	1	1	3	4	0	0	10	19	18	55	50
2000	1	3	6	4	1	0	4	19	18	22	15
2001	0	1	0	3	0	0	19	23	22	86	73
Jan–May 2002	0	0	0	0	0	0	2	2	2	100	100

AC – accident; SI – sickness; NA – natural; UN – unknown; CF – conflict; CT – control/PAC; PP – poached

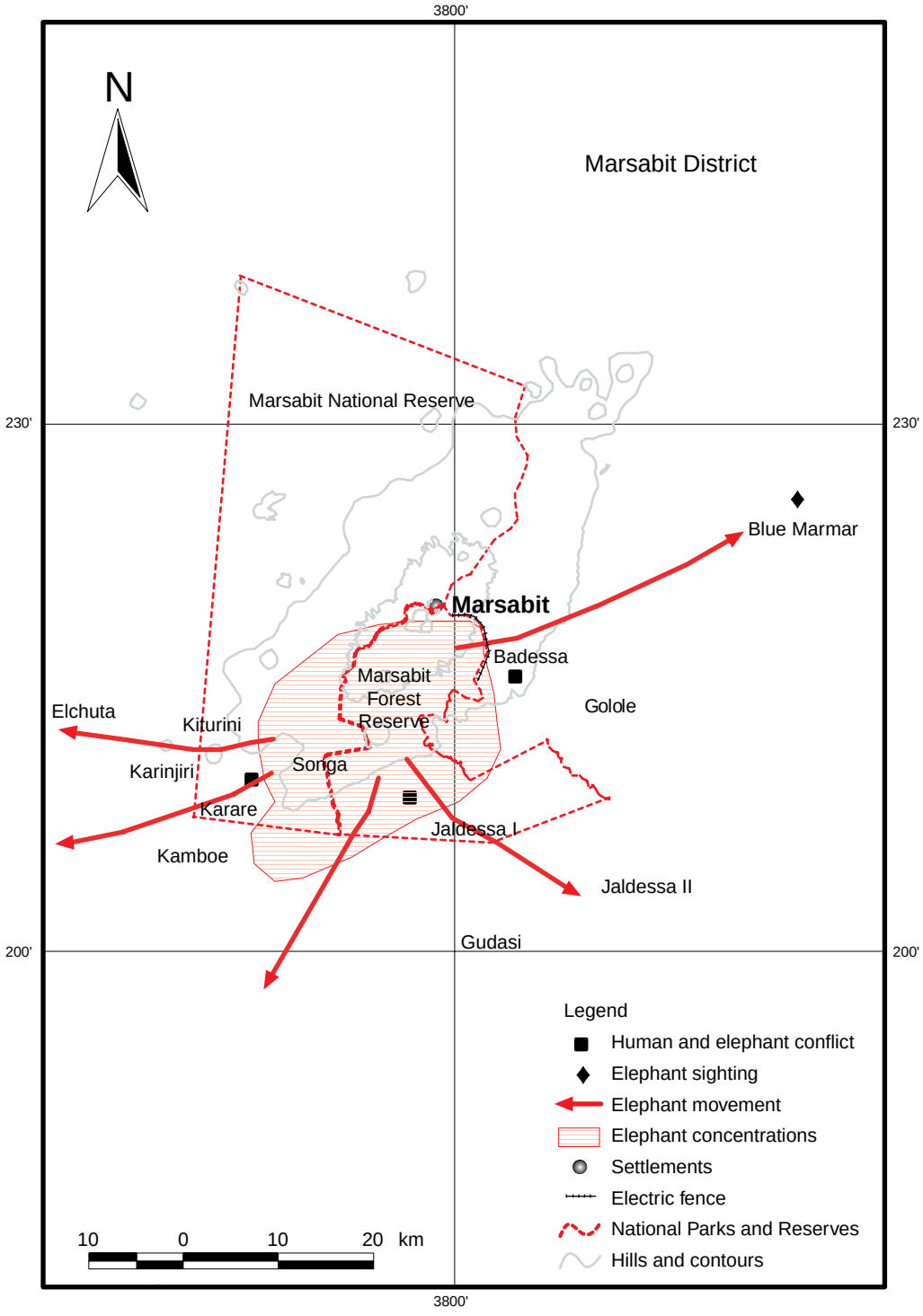
- In 2001, poaching increased substantially in the Marsabit area. Both the number of reported poached elephants and the proportion of 'found' carcasses due to poaching were higher than for all years since 1991. Nineteen elephants were confirmed as poached (86% of all found carcasses). In one incident in January 2001, four elephants (three adults and one juvenile) were shot and all tusks removed in the Bongole area, immediately south of the forest. Two elephants have been reported as poached between January to May 2002, accounting for 100% of the total reported mortality.
- The proportion of 'found' carcasses that had ivory missing varied throughout the 1990s, although the actual number of 'found' carcasses with ivory missing was greater than 50% in 1991, 1995, 1999, 2001 and so far in 2002.
- Only two elephants have been shot on problem animal control since 1991.

Discussion

In the absence of repeated surveys it is impossible to confirm whether the Marsabit elephant population is increasing or decreasing. Unlike many other populations in remote areas, there is no evidence for a substantial decline in numbers although the recent increase in poaching levels is a cause for concern. It is possible that the Marsabit elephant population did relatively well in the past, because of the protection afforded to Ahmed.

The elephant mortality data indicate that the level of poaching in the Marsabit area increased in 1999 and again in 2001. As is the case in much of northern Kenya, firearms in the hands of local communities potentially pose a great threat to the elephants. At present KWS are confident that they can contain the poaching with effective patrolling. Encroachment of people and livestock into the Marsabit Forest Reserve leads to competition between elephants and humans, particularly at water points. There is also pressure to degazette the forest and allow greater use of its resources by the surrounding human population. This would increase conflict between elephants and humans and reduce the area that the elephants can safely use.

To ensure the survival of the Marsabit elephants, it is important to safeguard the forest and to ensure that the elephants can continue to leave the forest to the south during the wet season. Trourism should be encouraged in this area so that the local people can ssee a direct benefit to the local economy from wildlife.


3800'
N
Marsabit District
Marsabit National Reserve
230'
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Blue Marmar
Marsabit
Badessa
Marsabit
Forest
Reserve
Golole
Elchuta
Kiturini
Karinjiri
Songa
Karare
Kamboe
Jaldessa I
Jaldessa II
Gudasi
200'
200'
Legend
Human and elephant conflict
Elephant sighting
Elephant movement
Elephant concentrations
Settlements
Electric fence
National Parks and Reserves
Hills and contours
10 0 10 20 km
3800'

15. NASOLOT–SOUTH TURKANA–RIMOI–KAMNAROK

Introduction

There is a small, little-known elephant population along the Kerio and Turkwell valleys between Turkana, Baringo, West Pokot and Elgeyo Marakwet Districts in western Kenya. This area includes the Nasolot, South Turkana, Rimoi and Kamnarok National Reserves, which are small protected areas with low levels of management and almost no tourist activity.

Historical information

There is little historical information on the elephants in this area. In 1973 it was estimated that there were 1500 elephants in Turkana District but no figures were given for the other districts (Jarman 1973a). DRSRS carried out a few surveys during the 1970s and 1980s. These generally gave low estimates—only a few hundred animals across the whole area—with the exception of one count in Turkana in 1981 that gave an estimate of over 800 elephants outside the reserves.

Recent surveys

In 1990 local KWS staff estimated there were 400 elephants in Nasolot and South Turkana Game Reserves at the northern end of the range, with another 100 in Rimoi and Kamnarok to the south. DRSRS sample counts in the same year gave estimates of 535 for West Pokot (including Nasolot), 0 for Turkana and 596 for Baringo. However, the confidence limits were high. No survey was carried out in Elgeyo Marakwet. A sample aerial count of the area was carried out in June 1992 (Mbugua 1992). Few elephants were seen inside the sample strips, and the count was treated as a low-intensity total count. This provided a figure of 580 elephants, of which 525 were in Nasolot and South Turkana. As this was carried out at a low intensity, it was estimated that the total population could have over 900 elephants.

Total aerial counts of the Nasolot–South Turkana elephants were carried out in June 1997 (Muriuki et al. 1997) and in July 1999 (Omondi et al. 1999). In 1997, 852 elephants were counted and 792 in 1999. In both counts most elephants were found in the northern block of Nasolot–South Turkana, with smaller numbers seen in the southern Kerio block in the vicinity of the Rimoi and Kamnarok Reserves.

Distribution and movements

Very little is known about elephant movements as no studies have been carried out and there are few KWS personnel in the area. There may still be some elephant movement between the northern Nasolot–South Turkana and the southern Rimoi–Kamnarok areas, but direct evidence is lacking and there is increasing human settlement in the intermediate areas (Muriuki et al. 1997). It is also believed that the southern population moves further south to the fluorspar mines for salt (KWS official, pers. comm.).

Mortality

The total mortality reported in 1996 and 1997 was higher than in other years (table 15.1 and fig. 15.1). This was due to a relatively large number of elephants speared in conflict with local communities and a large number of sick animals reported with swollen legs.

- Reported mortality due to poaching has remained relatively high throughout the last decade. In 1998, all of the 'found' carcasses were poached and in 1999 71% of all 'found' carcasses were poached.
- The proportion of 'found' carcasses with ivory missing was greater in 1998 and 1999 compared with the two years previously.
- In most years the number of elephants reported as poached was higher than the total for all other causes combined. This is unusual when compared with the majority of other populations so far investigated, where mortality due to poaching was only occasionally higher than the remainder of 'found' carcasses.

Table 15.1. Mortality figures for Nasalot–South Turkana–Rimoi–Kamnarok, 1992–May 2002

	AC	SI	NA	UN	CF	CT	PP	Total	Total 'found'	Poached of 'found' (%)	Ivory missing of 'found' (%)
1992	0	1	0	3	2	0	3	9	9	33	33
1993	0	0	1	0	2	0	3	6	6	50	40
1994	0	0	1	0	3	0	9	13	13	69	70
1995	0	0	0	1	2	0	6	9	9	67	67
1996	0	2	3	5	3	0	14	27	27	52	44
1997	0	1	4	4	5	0	10	24	24	42	41
1998	0	1	0	0	0	0	9	10	9	100	89
1999	0	0	0	4	0	0	10	14	14	71	71
2000[a]	0	2	1	5	0	0	9	17	17	53	–
2001[a]	0	0	1	0	1	0	2	4	4	50	–
Jan–May 2002 [a]	0	0	1	2	0	0	1	2	2	50	–

AC – accident; SI – sickness; NA – natural; UN – unknown, CF – conflict; CT – control/PAC; PP – poached

[a] Elephant mortality records for 2000–02 are from Elephant Mortality Database only; field records were not examined for this period.

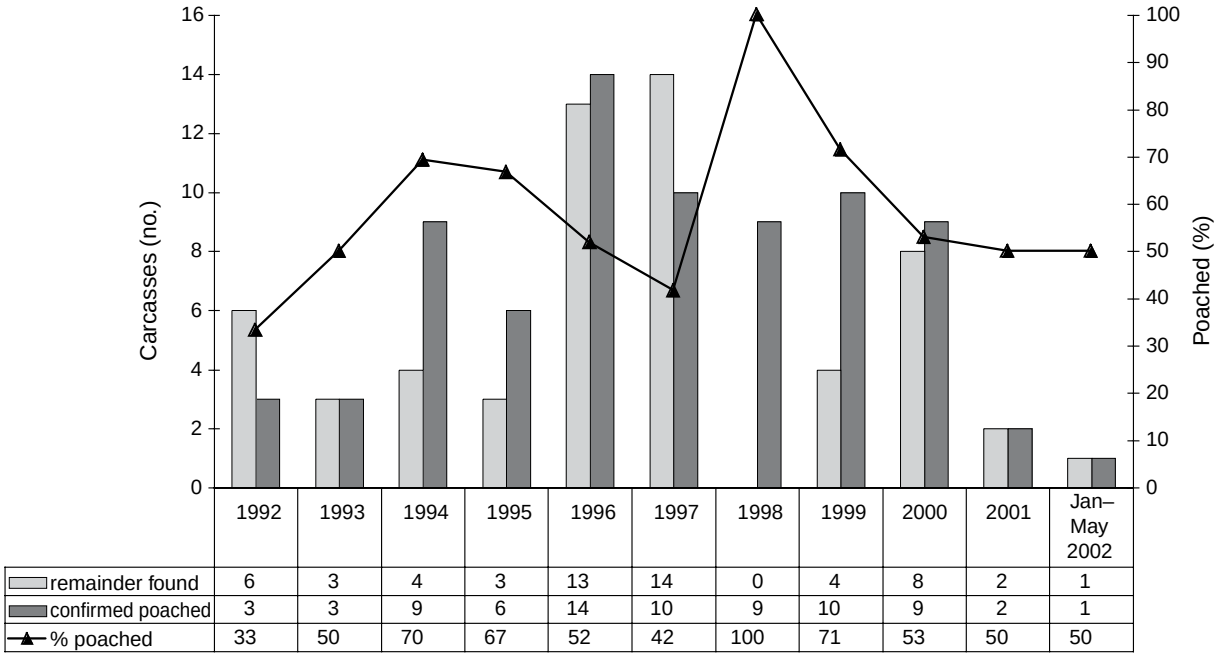


Figure 15.1. Number of poached elephants, remainder of 'found' elephants, and percent of total 'found' elephants that were poached, Nasolot/Kerio Valley 1992–May 2002.(Data for 2000 onwards from EMD only, no field records included.)

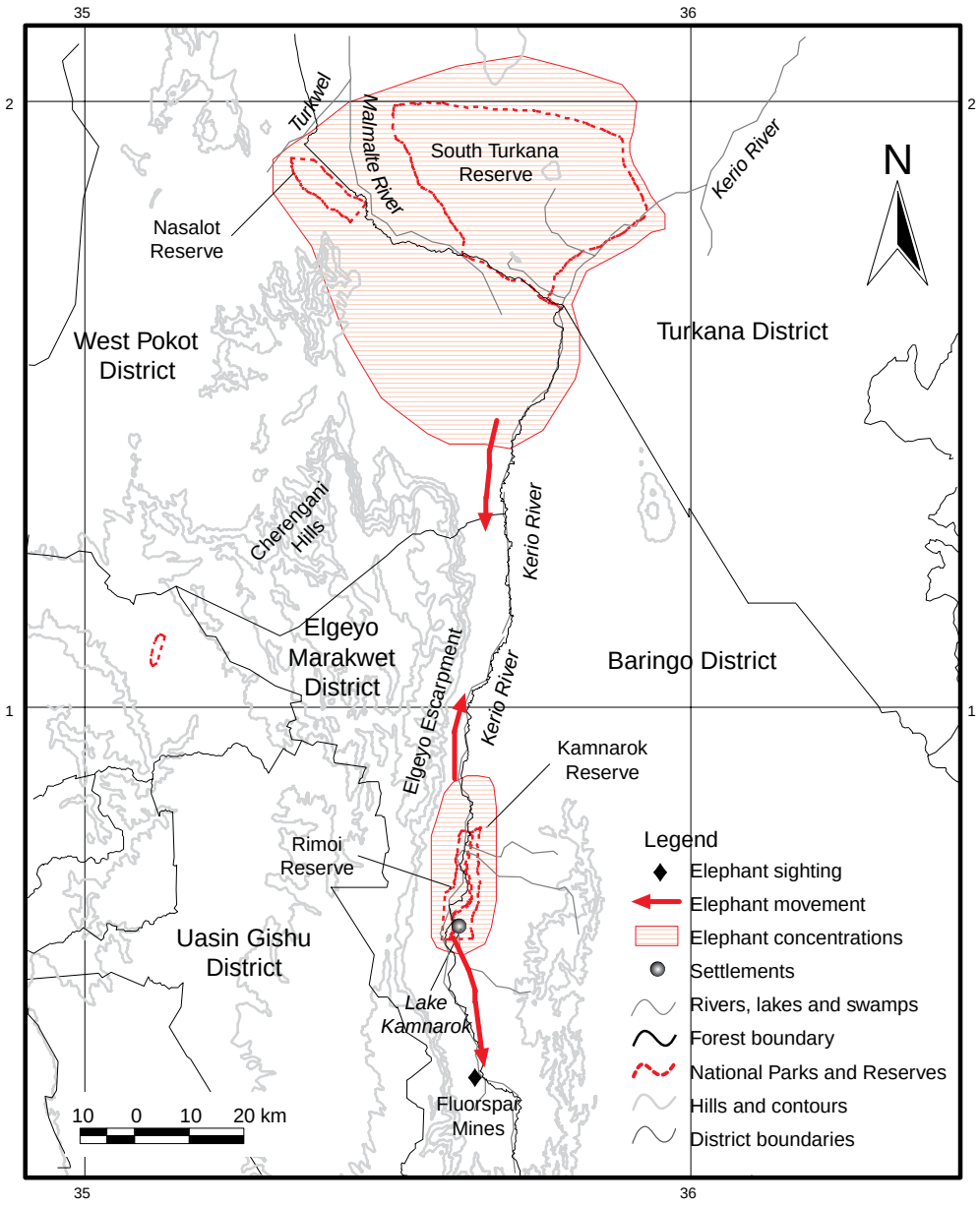
The proportion of poached carcasses in the Nasolot–Kerio Valley population is high when compared with most other populations. Most of the area occupied by the elephants is inaccessible, and KWS resources and personnel are few. The Nasolot–South Turkana area is insecure; cattle rustling has become a serious problem in the last few years and KWS personnel often encounter large parties of armed men. The Pokot and Turkana are known to kill elephants for meat and removing the ivory may be more opportunistic than poaching elephants specifically for their tusks. However, 28 tusks were seized in South Turkana in 1999, suggesting that the commercial ivory trade was active in this area. Reports indicate that elephants are often killed if they are encountered by raiding gangs, the meat is eaten and tusks are taken. It is likely that only a small percentage of the overall elephant mortality is actually reported as many of the carcasses will be in inaccessible areas. As with other northern elephant populations, the number of guns in the hands of local communities poses a serious threat to the elephants. In 2002 the absence of other wildlife and cattle confined to the hills are indicative of meat poaching and cattle rustling.

Conflict

Crop damage has been reported around Nasolot and South Turkana. Kerio Valley is heavily cultivated, and there is conflict between elephants and farmers in this area. During the dry season, the Kerio Valley dries up in the south and the only water source is Lake Kamnarok. There is some conflict between livestock and elephants at this water source.

Discussion

The Nasolot–South Turkana–Rimoi–Kamnarok elephant population has had a different history from most others outside the major protected areas. There is no evidence of a major decline during the 1970s and 1980s. In fact, there is no evidence that numbers have changed significantly during the last 30 years. Surveys have not been carried out in a consistent manner, so direct comparisons are not easy. The survival of this population is surprising given the lack of resources for protection, the security problems in the area, and the relatively high proportion of recorded mortality attributable to poaching. It is difficult to be optimistic about the long-term future of the elephant population given the difficulty of establishing tourism in this area and its low priority for KWS.


35
36
2
1
Turkwel
Malmalte River
South Turkana
Reserve
Kerio River
N
Nasalot
Reserve
West Pokot
District
Turkana District
Cherengani
Hills
Kerio River
Elgeyo
Marakwet
District
Baringo District
Elgeyo Escarpment
Kerio River
Kamnarok
Reserve
Rimoi
Reserve
Uasin Gishu
District
Lake
Kamnarok
Fluorspar
Mines
10 0 10 20 km
Legend
Elephant sighting
Elephant movement
Elephant concentrations
Settlements
Rivers, lakes and swamps
Forest boundary
National Parks and Reserves
Hills and contours
District boundaries

16. SHIMBA HILLS

Introduction

Shimba Hills in south-eastern Kenya comprises the Shimba Hlls National Reserve, the Maluganje Forest Reserve and the Mwaluganje Elephant Sanctuary, which connect the former two. The protected area consists of a long and narrow range of flat-topped hills running parallel to the coast only 15 km to the east. The hills rise steeply to 448 m, forming a plateau that is incised steeply by streams. The vegetation of this area comprises lowland coastal rainforest, dry forest, tropical deciduous forest and woodlands, bushlands and grasslands with fire-induced grassland. Exotic exotic plantations take up a small percentage of the land area.

The Shimba Hlls National Reserve has been a forest reserve since 1903, and in 1967 the area was gazetted as a National Reserve and put under the joint management of the Wildlife Conservation and Management Department (now KWS) and the Forest Department. The total area of the reserve is 241 km^2. The Mwaluganje Forest Reserve, about 10 km to the north below the escarpment, was gazetted in 1941 and covers 17 km^2. It is connected to Shimba Hills Reserve by the 36-km^2 Mwaluganje Elephant Sanctuary.

Shimba Hills is one of the richest areas of plant endemism in Kenya, containing over 1400 vascular plant species, of which 15% are coastal endemics and including over 20 rare tree species. Its plant diversity is matched with invertebrate diversity. This is also a critically important water catchment for Mombasa and the south coast. Two factors have been identified as a threat to the biodiversity of the area: legal and illegal timber extraction and the increasing elephant population. Human settlement around the forest together with electric fencing to protect crops has meant that the elephants are now confined to Shimba Hills. This compression has resulted in vegetation damage in some areas (Höft and Höft 1995; Schmidt 1992; Kahumbu 2002).

KWS is aware that attempting to resolve the serious conflict between elephant conservation through fencing has aggravated the threat to the unique biodiversity of this area. A workshop on the Shimba elephants held in March 1997 concluded that elephant densities needed to be reduced and recommended culling as the preferred intervention option. This solution was not accepted and instead efforts to reduce the population by translocation were investigated. In a first experiment, 30 bull elephants were translocated in October 1999 from Mwaluganje—the area with the highest elephant density—to Tsavo East National Park. Plans are under way to move an additional 300 and to use contraception on a proportion of the remaining elephants to halt population growth.

Historical information

It is believed that elephants in Shimba Hills in the early 20th century were part of a larger population ranging throughout Kwale District and across to Tsavo (60 km north) and Mkomazi (40 km south) (in Estes 1970). Elephants were gradually eliminated from the rest of the district, initially through control shooting and later through human settlement and poaching. The former district commissioner, Mr Risley, reported annual migrations of over 10,000 elephants through the area every October and November from south to east in search of palm seeds. Some 250 elephants were shot in the area between 1961 and 1962 to create the Shimba Settlement Scheme (Estes 1970).

In 1973 the total estimate for Kwale District was 2000 elephants (Jarman 1973a) and during the 1970s and 1980s a number of DRSRS sample counts gave estimates of up to 1800 animals for Shimba Hills National Reserve. However, using 5% cover for sample counts resulted in wide confidence limits, making these figures relatively unusable. Locally, people estimated the population at that time to be 100 elephants.

By the 1980s the conflict between elephants and people had escalated, forcing the wildlife authorities to begin creating fence barriers to protect farmers.

By 1980 Ross had noted elephant damage to the combretum woodland and bush in the Marere area (Ross 1984), and by 1994 the elephants were considered a major threat to local communities, exotic plantations and the biodiversity of these unique moist forests. It is believed that during this decade of elephant poaching, the Shimba Hills elephants moved into the forest for protection and their numbers have since increased. By the 1990s this was the only place in the district where elephants could still be found.

Recent surveys

In 1992 Reuling et al. (1992d) carried out a dung survey, which gave an estimate of 429 ± 128 elephants. However, dung decay studies had not been completed by the time this estimate was derived, so the decay rate parameter was an estimate.

In 1995 Mwathe (1995) obtained a similar estimate of 453 ± 181 elephants although he documented a considerably lower mean dung density of 4779 as contrasted to 6077 in Reuling's study. Similar population estimates were derived by extrapolating to a larger area and by using a faster decay rate.

During the period at which the possibility of culling elephants in Shimba was discussed, the question of the elephant population size became acute. Kamanga (1997) suggested reducing the elephant population by 200 on the basis of a modelling study using the results of the dung survey by Mwathe (1995), whose estimates had high confidence limits. A further dung survey carried out in 1998 (Omondi et al. 1998a) gave a higher estimate of 598 elephants, with a density of over 2 animals per km^2 in Shimba, and over 4 per km^2 in Mwaluganje.

To resolve some of these uncertainties a helicopter count was carried out in August 1997, which gave a minimum population estimate of 464 animals, an average density of 1.8 individuals per km^2 (Kahumbu 1997; Litoroh 1997), but a much higher density in Mwaluganje Elephant Sanctuary, which held 150 elephants. This figure is twice that found in an earlier survey using fixed wing aircraft (Kiiru 1995). It is probable that this difference is not the result of actual changes but has to do with survey techniques—the 1997 survey used a helicopter flying on transects with 500-m separation, while the earlier survey had transects with 1-km separation. There were additional advantages in using the helicopter: it carried a larger spotting crew, and it could hover over elephant groups, split them, and allow more accurate counting. However, since some of the area has closed-canopy forest cover, it is likely that some animals were not counted when using the helicopter, making 464 animals a low estimate.

This supposition was confirmed in 1999, when a survey based on individual recognition building on earlier work by Kahumbu (2002) derived an estimate of 658 animals, after the removal of the 30 translocated bulls (Muir 2000).

Current distribution

Elephants are found throughout the area (Reuling et al. 1992d). The highest densities are in Mwaluganje and in the corridor joining the reserve. There are also high numbers in Longomagandi Forest, a high-canopy forest in which elephants take refuge during the heat of the day.

Mwaluganje is largely a bull area, with 118 individual bulls sighted in the area, compared with 65 members of family groups (Muir 2000).

Movements

There is no evidence of elephants still moving out of the forest except for short-range crop-raiding forays. Radio-tracking studies have shown that family herds remain in the forest areas using small home ranges for most of the year, but they emerge into the open areas during the rainy season (Kahumbu and Douglas-Hamilton 2002). Also, during the rains they may form aggregations of up to 150 individuals and may make sudden long-distance movements to Mwaluganje Forest (Kahumbu 1997; Kahumbu and Douglas-Hamilton 2002).

Mortality

Between 1990 and May 2002 the majority (61%) of all reported mortalities were animals shot on problem animal control (table 16.1). Since 1994 over 50% of all reported mortalities were due to PAC and in 1995 and 1998 all reported mortalities were from problem animal control. The majority of PAC cases were around Kwale town, the borders of Shimba Hills and Mwaluganje around Mkongani, and Mackinnon Road in Tsavo. Conflict is a major threat to this elephant population as there are areas of high human density and settlement close to the National Park and reserve boundaries.

Table 16.1. Mortality records for the Shimba Hills complex, 1990–2002

	AC	SI	NA	UN	CF	CT	PP	Total	Total 'found'
1990	0	0	1	1	0	1	0	3	2
1991	0	1	0	2	0	2	1	6	4
1992	0	0	0	5	0	1	0	6	5
1993	0	0	4	3	0	1	0	8	7
1994	0	0	2	0	0	7	0	9	2
1995	0	0	0	0	0	4	0	4	0
1996	0	0	5	0	0	6	0	11	5
1997	3	0	1	0	0	7	0	11	4
1998	0	0	0	0	0	8	0	8	0
1999	1	0	1	0	0	6	1	9	3
2000[a]	0	0	1	0	0	0	0	1	1
2001[a]	0	0	0	0	0	0	0	0	0
Jan–May 2002[a]	0	0	0	0	0	0	0	0	0

AC – accident; SI – sickness; NA – natural; UN – unknown, CF – conflict; CT – control/PAC; PP – poached

[a] Reported elephant mortality records for 1990–99 are from Elephant Mortality Database (EMD) and Occurrence Book, records since 2000 are from EMD only, no field records were examined for this period.

Only two poaching incidents were reported. One was in 1999 when a carcass was found with tusks missing near Mwaluganje Elephant Sanctuary. The cause of death was not confirmed but it was thought to be a result of poaching.

The low number of reported mortalities since 2000 is likely to be due to poor transfer of information to EMD at headquarters. Field records for this period need to be examined.

Conflict

Conflict between elephants and people around the Shimba Hills has been a serious problem because the elephants are now confined at high density within the forest, which is surrounded by intensive agriculture. Between 1980 and 1994, 18 people in the area were recorded as having been injured by elephants. In 1995 it was estimated that people around the forest were losing around Ksh 5 million (US$68,000) yearly in crops—mostly coconuts, bananas, oranges, mangoes and cashew nuts—damaged by elephants (Mwathe and Waithaka 1995).

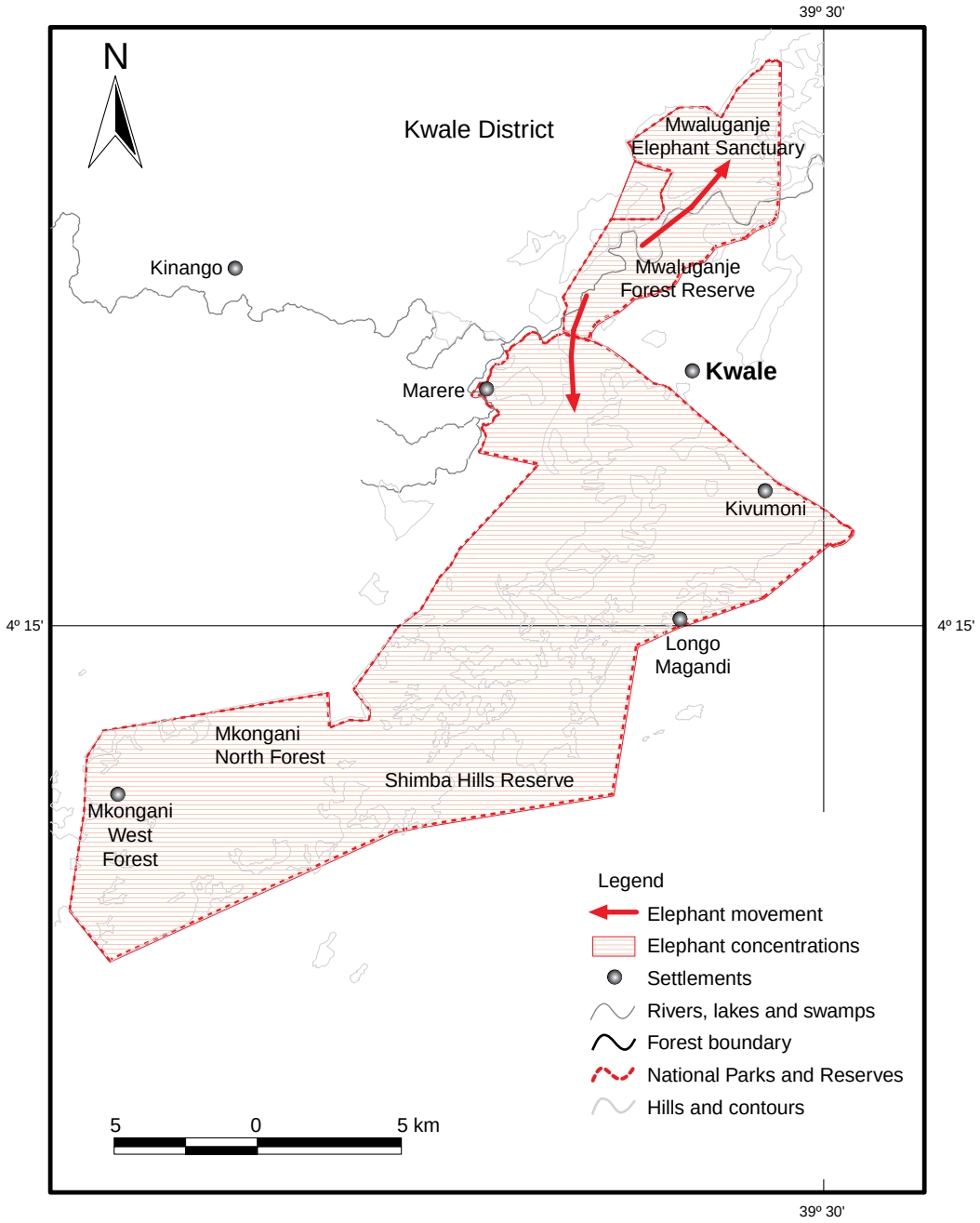
To reduce this conflict, it is KWS policy to erect electric fences around the entire forest. In the 1980s a chain-link fence was built around part of the boundary, but it had little effect. In 1991–92 the Eden Wildlife Trust constructed a 10-km electrified fence in the area close to Kwale town, and in 1993 the same organization rehabilitated and electrified the old fence in the south-western part of the reserve.

Although Mwaluganje Elephant Sanctuary is surrounded by an electric fence except along the boundaries with Mwaluganje Forest Reserve and Shimba Hills, elephants do break through it to raid crops on neighbouring farms at night. They usually reverse up to the fence posts and break them with their rear feet, but they have also been seen using their tusks and even trees to break the wires. There was no evidence that removing the 30 bulls reduced crop raiding (Muir 2000). At the time of writing, large sections of the fence were not working.

Discussion

Many surveys of the Shimba Hills elephant population have been carried out, but it is impossible to draw any firm conclusions from them on the dynamics of the population. In general, recent surveys have given higher estimates of numbers than earlier ones. However, in the case of aerial surveys, this can be explained by improved techniques such as the use of a helicopter rather than a fixed-wing aircraft. Increased estimates from dung surveys are primarily the result of including a larger area for calculating the final figure from the density. Thus, although the 1992 survey gave a population estimate of only 429 elephants compared with 598 in the 1998 survey, the dung density in Shimba Hills proper (excluding Mwaluganje) was almost identical.

Shimba Hills continue to present one of the most severe elephant management problems in Kenya, although an effective fence around the forest could resolve much of the human–elephant conflict, at least in the short term. The existence of a high-density confined elephant population in an area of international importance for plant conservation continues to be a major problem. This population can be controlled only through culling, translocation or contraception. The former is not currently sanctioned by KWS, while the latter two options may be too expensive and logistically difficult to carry out at a level that will keep the population at acceptable numbers for effective conservation of plant biodiversity. Preliminary evidence has shown that removing 30 bulls from Mwaluganje reduced the short-term impact on trees, but further monitoring to follow up on this is essential.


39º 30'
N
Kwale District
Mwaluganje
Elephant Sanctuary
Kinango
Mwaluganje
Forest Reserve
Kwale
Marere
Kivumoni
4º 15'
4º 15'
Longo
Magandi
Mkongani
North Forest
Shimba Hills Reserve
Mkongani
West
Forest
Legend
Elephant movement
Elephant concentrations
Settlements
Rivers, lakes and swamps
Forest boundary
National Parks and Reserves
Hills and contours
5
0
5 km
39º 30'

17. KILIFI DISTRICT (INCLUDING ARABUKO-SOKOKE)

Introduction

In 1973 the elephant population of Kilifi District was estimated to be 10,000 individuals (Jarman 1973a). In 1977 KREMU estimated that there were fewer than 2000 animals, and by 1978 these had almost all been killed. During the 1980s no elephants were recorded in the district by KREMU/DRSRS.

Despite this, a small number did survive in Arabuko-Sokoke Forest. This forest, covering 372 km^2, is of considerable biodiversity value because of its high level of endemism of plants and birds. It is suspected that the Arabuko-Sokoke elephants are young survivors of a fragmented and socially disrupted population. The local community believes that previously, and until the late 1960s, elephants were not resident in the area but moved out of the forest through the northern boundary of the reserve and migrated towards Tsavo. Since this migration route has now been completely cut off by small-scale subsistence farmers, elephants have become permanent residents of the forest, leaving only for short periods to get water and to raid crops.

Recent surveys

A dung survey of Arabuko-Sokoke Forest carried out in 1991 (Gesicho 1991) gave an estimate of 78 elephants for the entire forest. No confidence limits were given but a dung decay study was carried out on site and a sampling strategy was adopted. A separate estimate of 90 animals was derived using the 'short-cut method' (Barnes and Barnes 1987).

Another survey and measurement of dung decay rate was carried out in 1996 (Litoroh and Mwathe 1996; Muoria 2000). These gave a higher estimate of either 126 or 172 elephants for the area, depending on which of the two methods of calculating dung decay rate was used.

Two DRSRS surveys of Kilifi District carried out during the 1990s have provided evidence of some animals returning to other areas. Elephants were sighted along the north-western boundary of the district in the Daka Wachu area. It is possible that these came from the Tsavo population that has been expanding eastwards via Galana Ranch.

Current distribution

Elephant densities varied greatly between different parts of the Arabuko-Sokoke Forest. The highest densities were found in the *Brachystegia* woodland and lowland rainforest on the coastal edge of the forest, while the lowest densities were found in the *Cynometra* thickets and *Manilkara–Cynometra–Brachystegia* forest on the inland part of the forest (Gesicho 1991).

Movements

All the evidence collected by Gesicho (1991) indicated that the Arabuko-Sokoke elephant population is now permanently confined within the forest, except for occasional forays to obtain water and to raid crops.

Mortality

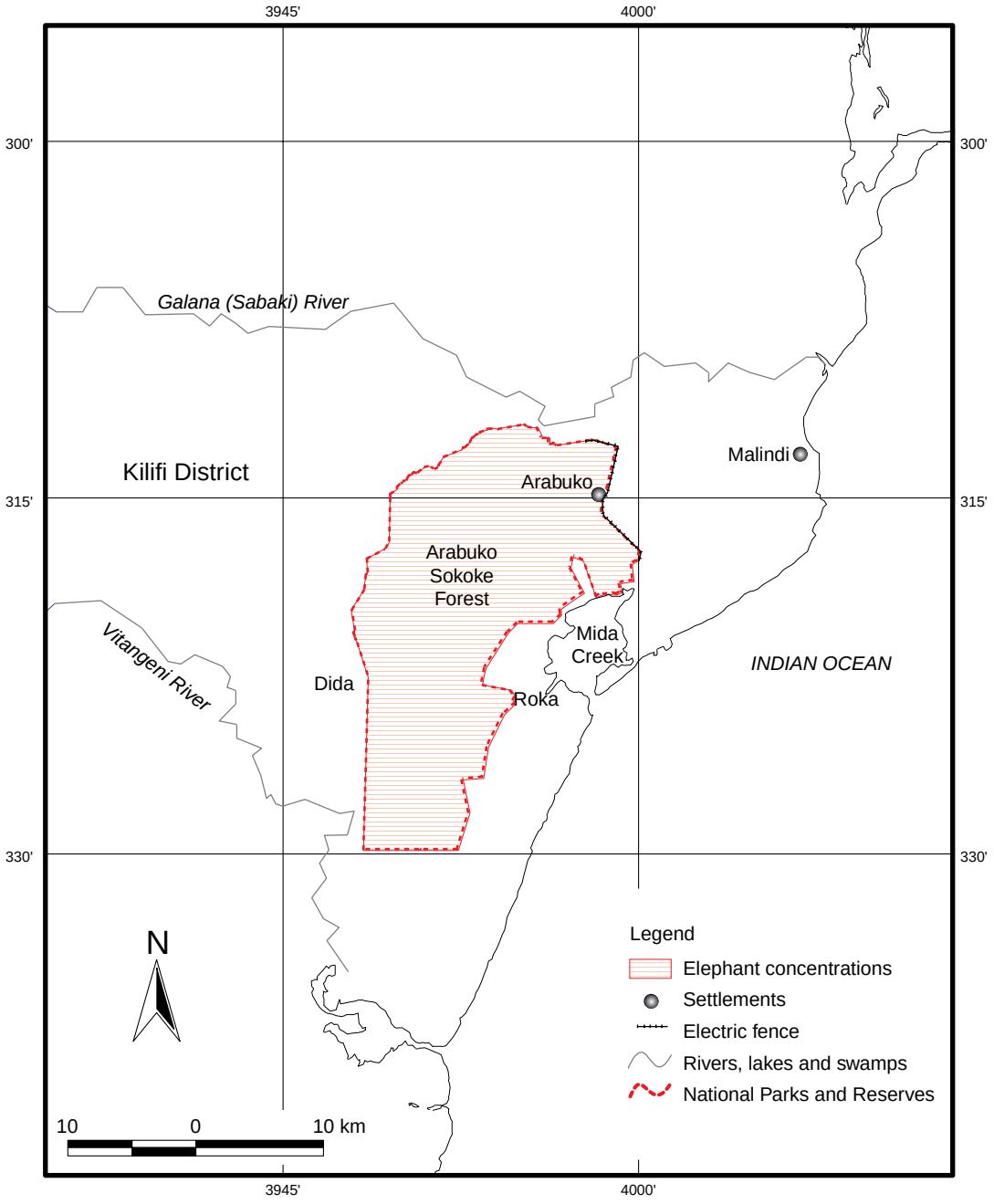
No mortalities were reported before 1994. Since 1994, 12 have been reported, of which 10 (83%) were animals shot by KWS on problem animal control. Between June and August 1995, five elephants were shot on problem animal control around Arabuko-Sokoke, Dida and Roka areas. The increase in PAC possibly reflects a change in KWS policy at the time, as well as increased conflict. In December 1999, one of the elephants that had been translocated from Shimba Hills to Tsavo East in October–November 1999 was found dead—stuck in the mud in Kilifi Creek.

Conflict

Crop raiding by elephants is a serious problem around Arabuko-Sokoke Forest; it occurs on all the boundaries. There are two main peaks of crop raiding—in June and July when crops are ready in the fields and in the dry months of January, February and March when there is no water in the forest and elephants have to travel through the farms to drink.

Discussion

The Arabuko-Sokoke elephant population presents substantial management problems. It is a small, isolated population in a restricted area surrounded by agriculture. Although the estimated density of 0.2 animals per km^2 is not high enough to pose a serious threat to the woody vegetation, the fact that the forest is of high biodiversity value means that the threat from elephant damage must be monitored carefully. Human–elephant conflict may also create a problem for the survival of the forest, in that it may adversely affect local attitudes towards the forest.


3945'
4000'
300'
315'
330'
Galana (Sabaki) River
Kilifi District
Malindi
Arabuko
Arabuko
Sokoke
Forest
Mida
Creek
INDIAN OCEAN
Vitangeni River
Dida
Roka
N
10
0
10 km
Legend
Elephant concentrations
Settlements
Electric fence
Rivers, lakes and swamps
National Parks and Reserves

18. NORTHERN (WAJIR, MOYALE, MANDERA)

There have been intermittent reports of elephants surviving in the desert in the north of Kenya between Moyale and Mandera. They were believed to be part of a population that crossed the border into Ethiopia. An aerial survey conducted in 1995 in the Ethiopian part of the range, however, revealed no evidence of recent occupation by elephants (Thouless 1995a). Nevertheless, there may still be 50–100 elephants in the Wajir–Moyale area. They are extremely nervous and are seldom seen from the ground—only spoor observed or an occasional sighting from aircraft. In 1991 elephants were seen near Batulu and Mansa, and in 1994 some were seen again near Batulu. In 1996 the KWS warden in Moyale reported the sighting of 19 elephants; however, no elephants have been observed near Moyale in any DRSRS count. All sightings from Marsabit District were in the vicinity of Marsabit.

Records from Wajir and Mandera District are similarly sparse, although in the early 1970s it was believed that there were 1500 elephants in this area (Jarman 1973a). In 1978, there was an estimate of 97 elephants for Wajir, with 4 animals being sighted in the northern part of the district close to the boundary with Mandera District and 18 carcasses, giving an estimate of 435 dead elephants. In 1998, a group of 20 elephants was reported in Griftu, about 70 km from Wajir town, and several were reported from Hajahein and Abakore locations. Elephants sighted in the same year in Buna and Bute were believed to have come from either Ethiopia or Marsabit (Waithaka and Omondi 1998).

Similarly 12 elephants were sighted in the central part of Mandera District in 1977, giving an estimate of 596 animals. No credibility can be given to these figures because of the wide confidence limits.

Mortality

Mortality records are from EMD only; no field records were examined. Fifteen elephant deaths have been reported since 1990; in all but three cases the tusks were missing. Of these 13 (87%) resulted from poaching between 1990 and 1993. In 1993, nine elephants were poached, five of these in a single incident close to the Ethiopian border in Wajir District when three adults and two juveniles were shot. Tusks from the three adults were missing.


39
40
41
4
3
2
1
Malka Mari
National Reserve
E T H I O P I A
Mandera
Abakaro
Moyale
1996
Mandera District
Marsabit District
Bule
1998
Buna
1998
Mansa
1991
S O M A L I A
K E N Y A
Tarbaj
Griffu
1998
Wajir
Isiolo District
Wajir District
Legend
Elephant sighting
Settlements
National Reserve
District boundaries
International boundary

19. EASTERN (LAMU, GARISSA, TANA RIVER)

In 1973 the eastern districts of Lamu, Garissa and Tana River were believed to have 75,000 elephants—nearly half of Kenya's entire population (Jarman 1973a). By the time KREMU started its aerial surveys in 1977, the elephant population had declined to 27,000, and 8000 dead animals were observed (Bunderson 1977). In the following year the estimate of live animals dropped by another 8000, with a corresponding increase in carcasses. By the mid-1980s the number of elephants in these districts had dropped to a few hundred as a result of intense poaching.

It was estimated that by the early 1990s fewer than 100 elephants survived in Boni and Dodori Forests (Poole et al. 1992). Further south, a remnant population of elephants existed in the vicinity of Lamu town where two groups of approximately 30 and 20 elephants were regularly seen on Manda Island and on the mainland. Reports suggested that they were highly migratory and it was considered possible that they moved as far north as Dodori.

In 1996, KWS carried out a reconnaissance survey of parts of Lamu and Garissa Districts (Litoroh and Mwathe 1996). A group of 70 elephants was seen on Enganani Ranch close to the Lamu Naval Base, and fresh elephant signs were seen at Mundane Ranch, Dodori Forest, Manda Island, Witu Forest and the Tana River Primate Reserve. On the basis of these sightings, a total population of 150 elephants was estimated for the whole of Lamu District. It is believed that the elephants seen also swim across to Manda Island, where they remain while rainwater pools persist. In 1999–2000 approximately 30 elephants were sighted on the Tana River near the Tana Primate Reserve. It is believed these elephants move between the Tana Primate Reserve and Witu Forest close to the coast.

There is no recent information from Garissa. Only one DRSRS survey was carried out during the 1990s, in 1996, and only old bones were seen.

Although the elephant populations of Lamu, Tana River and Garissa Districts were almost exterminated during the 1970s and 1980s, there is no evidence of a further decline during the 1990s. The animals that survive do so thanks to the thick cover in which they live and the proximity to the KWS post in Lamu. However, given the remote nature of the larger area, its lack of security and its proximity to Somalia, it is unlikely that the population will increase substantially in the near future.

Mortality

Mortality records are from EMD only; no field records were examined (table 19.1).

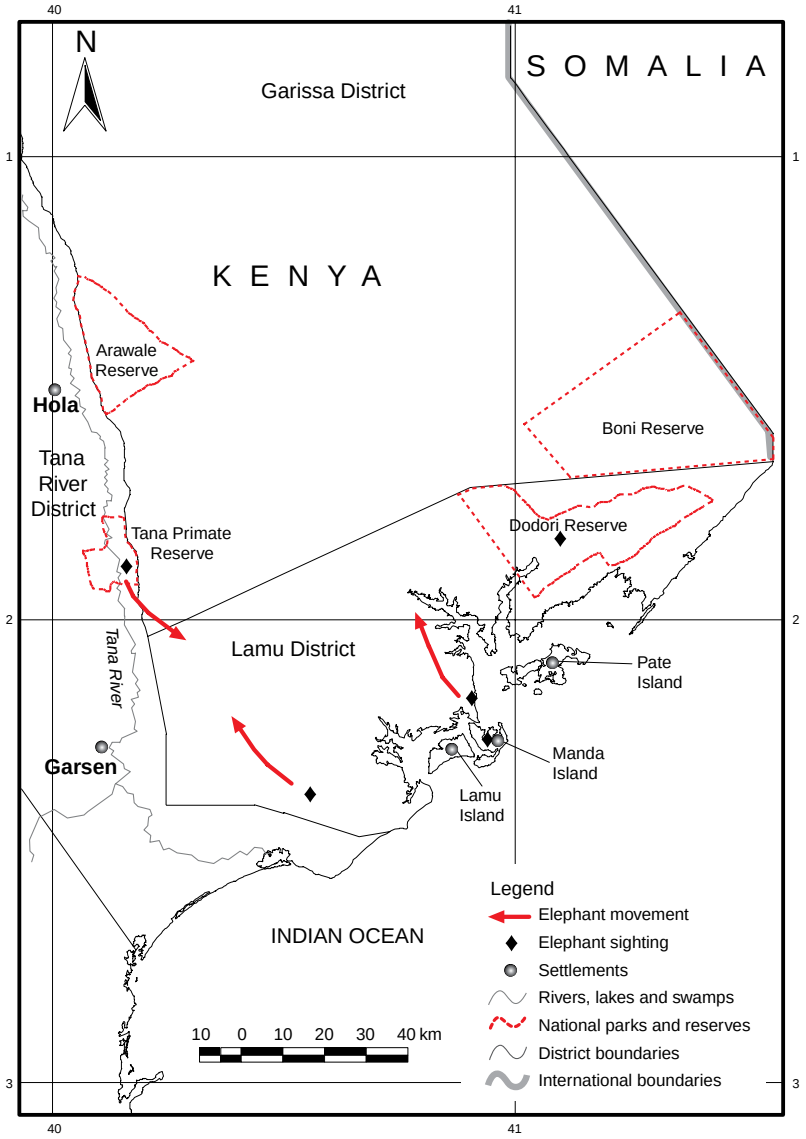
Forty elephant deaths were reported between 1990 and May 2002. Of these, 31 were reported as poached and 5 were a result of problem animal control. The reported poaching represents almost 90% of the total found carcasses (excluding PAC). This is the highest for any population.

The greatest number of elephants poached was reported in 1994. These resulted from a single incident in March in which 12 elephants were shot and their tusks removed in the Lamu–Kibiboni area. Locals reported hearing about 30 gunshots. This was the worst case of commercial poaching reported in this area during the 1990s.

Currently, there is no resident KWS aircraft present in the area. The large distances involved and the remoteness make it difficult effectively to patrol much of the area. The mortality figures are unlikely to be an accurate reflection of true elephant mortality in this area.

Table 19.1. Mortality data for Eastern (Lamu, Garissa, Tana River), 1990–2002

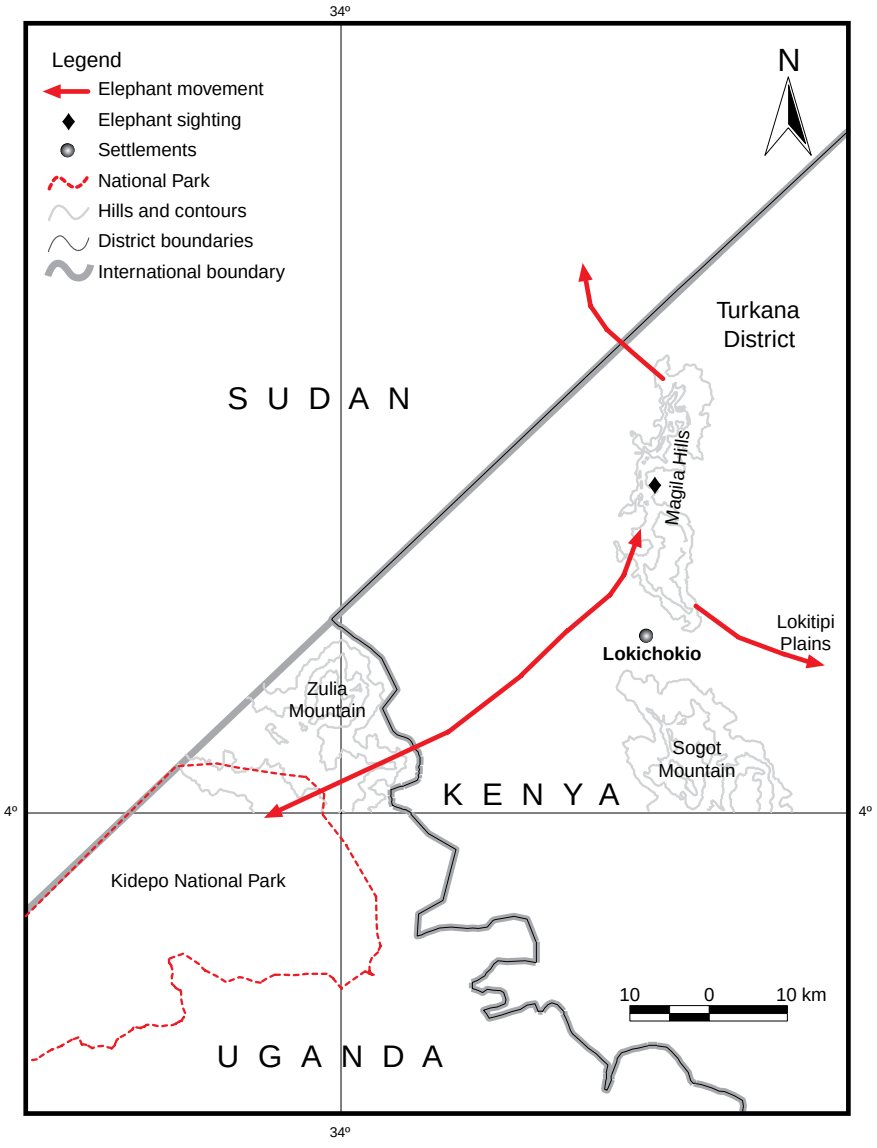
	AC	SI	NA	UN	CF	CT	PP	Total	Total 'found'	Poached of 'found' (%)
1990	0	0	0	0	0	1	3	4	3	100
1991	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	7	7	7	100
1993	0	0	0	0	0	0	2	2	2	100
1994	0	0	0	0	0	0	12	12	12	100
1995	0	0	0	1	0	0	0	1	1	0
1996	1	0	0	0	0	3	1	5	2	50
1997	0	0	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0	0	0
1999	0	0	1	0	0	1	0	2	1	0
2000	0	0	0	0	0	0	4	4	4	100
2001	1	0	0	0	0	0	0	1	1	0
Jan–May 2002	0	0	0	0	0	0	2	2	2	100



20. NORTH-WESTERN (AROUND LOKICHOKIO)

Elephants have occasionally been reported along the north-western border of Kenya. It is possible that there is a single population that moves between north-western Kenya, southern Sudan and Kidepo National Park in Uganda. Some elephants are believed to be in Mogila Hills north of Lokichokio, moving east to the Lokitipi Plains in the wet season and possibly north into Sudan. It is impossible to carry out systematic patrolling as the area is insecure and no KWS personnel are based there. Information on the presence of elephants comes from occasional reports of sightings from aid personnel and information from local people.

Mortality records are from EMD only. Three cases of elephant mortality have been reported, all in 1990 when they were shot by home guards around Lodwar. Tusks from all carcasses were recovered. In February 2000 KWS personnel based at Kitale received a report that an elephant had been killed near Lokichokio; however, they were unable to verify the report. No systematic collection of mortality data is possible in this area.



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Annex 1. Dung counts in Kenya

Location	Date	Estimate	Population recalcuated from area & density	Number of transects	Length per transect (km)	Total transect length (km)	Method for calc. density	Dung density (per sq km)	95% confidence limit	Decay rate ('no' indicates not measured on site)	Decay rate value used	Defaecation rate used	Calculated elephant density (per sq km)	Area (sq km)	Reference
Aberdares	1990	1,822	–	27	–	135	–	–	–	–	0.02	17		767	Blom et al. 1990
Aberdares	1998	4,120	4,099	17	–	26	Elephant	6780	2626	no	0.01	17	4.0	1030	Bitok et al. 1998
Arabuko Sokoke	1991	78	57	10	–	27	–	–	–	42	0.009	17	0.2	272	Gesicho 1991
Arabuko Sokoke	1996	126	125	–	–	–	–	869	–	94	0.0066	17	0.3	372	Muoria 2000
Arabuko Sokoke	1996	173	172	–	–	–	–	869	–	94	0.0091	17	0.5	372	Muoria 2000
Imenti	1994	231	231	4	1.5-3	9	Elephant	2622	1584	no	0.015	17	2.3	100	Njumbi & Litoroh 1994
Imenti	1998	156	156	8	–	20	Burnham	3782	3352	n	0.01	17	2.2	70	Bitok et al. 1997
Leroki	1993	439	441	13	2-4	39	Burnham	6317	1896	no	0.002	17	0.7	596	Mwangi et al. 1993
Leroki	1997	212	209	13	–	31	Elephant	3020	–	no	0.002	17	0.4	596	Bitok 1997
Mathews	1992	630	638	5	1-4	13	Burnham	7175	2170	no	0.002	17	0.9	750	Reuling et al. 1992a
Mau	1992	1,003	–	14	–	28	Elephant	–	–	no	0.01	17	–	1267	Njumbi et al. 1995
Mt Elgon	1991	86	85	3	1-3	7	Fourier	1200	n/a	no	0.01	17	0.7	122	Reuling et al. 1992a
Mt Elgon	1996	1,114	1,109	15	1-2	26	Elephant	2423	1813	52	0.016	17	2.3	476	Mulama et al. 1996
Mt Kenya	1991	4,245	4,245	13	1-3	35	Fourier	4708	3812	93	0.013	17	3.1	1367	Reuling et al. 1992a
Mt Kenya	1991	4,842	4,842	18	1-5	50	Fourier	6514	5137	93	0.013	17	3.5	1367	Reuling et al. 1992a
Mt Kenya	1998	4,022	4,018	21	2	23	Fourier	2433	1371	no	0.01	17	1.4	2810	Omondi et al. 1998
Mt Kenya	1999	1,983	1,980	10	25-30	500	Fi–ed	2270	14	60	0.009	17	1.2	1650	Vanleeuwe 1999
Mt Kenya	1999	1,983	2,400	10	25-30	500	Fi–ed	2270	14	60	0.009	17	1.2	2000	Vanleeuwe 1999
Mt Kenya	2001	2,864	2,860	83	0.2	82.2	Recce	–	–	60	0.009	18	1.4	2000	Vanleeuwe unpublished
Mwaluganje	1998	151	151	5	1.5-2	10	Elephant	12300	5498	–	0.0058	17	4.2	36	Omondi et al. 1998
Rumuruti	1992	143	143	4	3-5	15	n/a	4961	1326	no	0.009	17	2.5	58	Litoroh et al. 1992
Shimba	1992	429	386	15	1-3	34	Fourier	6077	2123	350	0.005	17	1.8	217	Reuling et al. 1992b
Shimba	1995	412	412	10	?	20	'run'	4779	n/a	no	0.006	17	1.6	253	Mwathe 1995
Shimba	1998	447	447	10	1.5-2	17	Elephant	6035	2436	–	0.0058	17	2.1	217	Omondi et al. 1998
Transmara	1997	250	36	9	–	27	"computer"	1130	794	no	0.013	17	0.7	53	Wamukoya et al. 1997

– indicates information not given in report

Annex 2. Total counts

Location	Elephant counted	Date	Flight time	Count time	Area (sq km)	Area description	Fresh/ recent carcasses	Old/ very old carcasses	Total carcasses	Original reference	Quoted in
Tsavo	10799	1962	–			Park only	–	–	–		Douglas-Hamilton et al. 1994
Tsavo	15038	1965	–			Park only	–	–	–		Douglas-Hamilton et al. 1994
Tsavo	27390	1969	–			(ecosystem not Mkomazi)	–	–	–		Douglas-Hamilton et al. 1994
Tsavo	25268	1972	–			Ecosystem not Rombo	–	–	–		Douglas-Hamilton et al. 1994
Tsavo	22974	1973	–				–	–	–		Douglas-Hamilton et al. 1994
Tsavo	6229	1978	–			(partial)	–	–	–		Douglas-Hamilton et al. 1994
Tsavo	5363	1988	–	127.1	40862	inc Mkomazi (93)	162	2421	2583	Olindo et al. 1988	
Tsavo	6226	1989	–	144.5	40862	inc Mkomazi (11)	115	1752	1867		Douglas-Hamilton et al. 1994
Tsavo	6763	1991	–	161.7	40862	inc Mkomazi (131)	4	1206	1210		Douglas-Hamilton et al. 1994
Tsavo	7371	1994	–	189.6	39770	inc Mkomazi (302)	1	1361	1362	Douglas-Hamilton et al. 1994	
Tsavo	8068	1999	233	170	39770	inc Mkomazi (77)	6	4221	4227	Kahumbu et al. 1999	
Laikipia	2312	Sep 90	–	59.9	10540		3	62	65	Thouless 1990	
Laikipia–Samburu	2969	1992	–	56	7485		0	78	78	Thouless 1992	
Samburu	4,309	Mar 1993	–	–	–		–	–	–		
Laikipia	1,642	Feb 96	–	–	7300		–	–	–	Laikipia Wildlife Forum 1996	
Laikipia	2,392	Sep 96	–	–	7000		–	–	–	Mpala Research Centre 1996	
Laikipia–Samburu	3436	Jun 99	181.4	129.8	–		6	4	10	Kahumbu et al. 1999	
Mara	455	May 61	–	–	–		–	–	–	Talbot & Stewart 1964	Dublin & Douglas-Hamilton 1987
Mara	460	May 67	–	–	–		–	–	–		Dublin & Douglas-Hamilton 1987
Mara	729	May 70	–	–	–		–	–	–	SRI unpublished	Dublin & Douglas-Hamilton 1987
Mara	853	Apr 84	–	–	–	Reserve & Koyaki, Siana	–	–	–	Dublin & Douglas-Hamilton 1987	
Mara	756	Oct 84	–	–	–	Reserve & Koyaki, Siana	0	14	14	Dublin & Douglas-Hamilton 1987	
Mara	815	May 85	–	–	–	M1, M2, M3	–	–	–	Dublin 1985	
Mara	1134	May 86	–	–	–	M1, M2, M3	–	–	–	Dublin 1986	
Mara	1094	May 87	–	–	–	M1, M2, M3	–	–	–	Dublin 1987	
Mara	1471	Oct 87	–	–	–		–	–	–		Dublin 1992
Mara	1453	Oct 88	–	–	–		–	–	–		Dublin 1992a
Mara	1390	May 89	–	–	–		–	–	–		Dublin 1990a
Mara	1425	Oct 89	–	–	–		–	–	–		Dublin 1992a
Mara	1312	Jun 90	–	–	–		–	–	–	Dublin 1990a	
Mara	1455	Oct 90	–	–	–		6	0	6	Dublin 1990b	
Mara	1463	Apr 91	–	–	–		–	–	–	Dublin 1991a	
Mara	1514	Nov 91	–	–	–		–	–	–	Dublin 1991b	
Mara	1302	May 92	–	–	–		–	–	–	Dublin. 1992a	

Annex 2. Total counts (continued)

Location	Elephant counted	Date	Flight time	Count time	Area (sq km)	Area description	Fresh/ recent carcasses	Old/ very old carcasses	Total carcasses	Original reference	Quoted in
Mara	1312	Jun 90	–	–	–		–	–	–	Dublin 1990a	
Mara	1455	Oct 90	–	–	–		6	0	6	Dublin 1990b	
Mara	1463	Apr 91	–	–	–		–	–	–	Dublin 1991a	
Mara	1514	Nov 91	–	–	–		–	–	–	Dublin 1991b	
Mara	1302	May 92	–	–	–		–	–	–	Dublin. 1992a	
Tsavo	10799	1962	–			Park only	–	–	–		Douglas-Hamilton et al. 1994
Tsavo	15038	1965	–			Park only	–	–	–		Douglas-Hamilton et al. 1994
Tsavo	27390	1969	–			(ecosystem not Mkomazi)	–	–	–		Douglas-Hamilton et al. 1994
Tsavo	25268	1972	–			Ecosystem not Rombo	–	–	–		Douglas-Hamilton et al. 1994
Tsavo	22974	1973	–				–	–	–		Douglas-Hamilton et al. 1994
Tsavo	6229	1978	–			(partial)	–	–	–		Douglas-Hamilton et al. 1994
Tsavo	5363	1988	–	127.1	40862	inc Mkomazi (93)	162	2421	2583	Olindo et al. 1988	
Tsavo	6226	1989	–	144.5	40862	inc Mkomazi (11)	115	1752	1867		Douglas-Hamilton et al. 1994
Tsavo	6763	1991	–	161.7	40862	inc Mkomazi (131)	4	1206	1210		Douglas-Hamilton et al. 1994
Tsavo	7371	1994	–	189.6	39770	inc Mkomazi (302)	1	1361	1362	Douglas-Hamilton et al. 1994	
Tsavo	8068	1999	233	170	39770	inc Mkomazi (77)	6	4221	4227	Kahumbu et al. 1999	
Laikipia	2312	Sep 90	–	59.9	10540		3	62	65	Thouless 1990	
Laikipia–Samburu	2969	1992	–	56	7485		0	78	78	Thouless 1992	
Samburu	4,309	Mar 1993	–	–	–		–	–	–		
Laikipia	1,642	Feb 96	–	–	7300		–	–	–	Laikipia Wildlife Forum 1996	
Laikipia	2,392	Sep 96	–	–	7000		–	–	–	Mpala Research Centre 1996	
Laikipia–Samburu	3436	Jun 99	181.4	129.8	–		6	4	10	Kahumbu et al. 1999	
Mara	455	May 61	–	–	–		–	–	–	Talbot & Stewart 1964	Dublin & Douglas-Hamilton 1987
Mara	460	May 67	–	–	–		–	–	–		Dublin & Douglas-Hamilton 1987
Mara	729	May 70	–	–	–		–	–	–	SRI unpublished	Dublin & Douglas-Hamilton 1987
Mara	853	Apr 84	–	–	–	Reserve & Koyaki, Siana	–	–	–	Dublin & Douglas-Hamilton 1987	
Mara	756	Oct 84	–	–	–	Reserve & Koyaki, Siana	0	14	14	Dublin & Douglas-Hamilton 1987	
Mara	815	May 85	–	–	–	M1, M2, M3	–	–	–	Dublin 1985	
Mara	1134	May 86	–	–	–	M1, M2, M3	–	–	–	Dublin 1986	
Mara	1094	May 87	–	–	–	M1, M2, M3	–	–	–	Dublin 1987	
Mara	1471	Oct 87	–	–	–		–	–	–		Dublin 1992
Mara	1453	Oct 88	–	–	–		–	–	–		Dublin 1992a
Mara	1390	May 89	–	–	–		–	–	–		Dublin 1990a

Annex 2.Total counts (continued)

ocation	Elephant counted	Date	Flight time	Count time	Area (sq km)	Area description	Fresh/ recent carcasses	Old/ very old carcasses	Total carcasses	Original reference	Quoted in
Mara	1425	Oct 89	–	–	–		–	–	–		Dublin 1992a
Mara	1705	Oct 92	–	–	–		1	0	1	Dublin 1992b	
Mara	1610	May 93	–	–	–		–	–	–	Dublin 1993a	
Mara	1031	Nov 93	–	–	–		–	–	–	Dublin 1993b	
Mara	1485	Apr 94	–	–	3508		–	–	–	Dublin & Watkin 1994	
Mara	1551	May 95	–	–	–		–	–	–		Muriuki & Mulama 1997
Mara	1232	May 96	–	–	–		–	–	–		Muriuki & Mulama 1997
Mara	–	Oct 96	–	–	–		–	–	–		Muriuki et al. 2000
Mara	1239	Oct 97	–	–	–		1	0	1	Muriuki & Mulama 1997	
Mara	1401	May 98	–	–	–		–	–	–	Muriuki et al. 1998.	
Mara	1547	Oct 98	–	–	–		–	–	–		Muriuki et al. 2000
Mara	1422	Jul 99	–	–	–		0	9	9		Muriuki et al. 2000
Mara	1179	Nov 99	30.8	23.8	4283		1	36	37	Muriuki et al. 2000	
Mara	1294	Nov 00	29	–	–	Includes Lamai Wedge	3	22	25	Muriuki 2001	
Amboseli	1087	2000	–	–	–		–	–	–		
Nasolot/South Turkana	580	1992	–	–	–		1	–	–	Mbugua 1992	
Nasolot/South Turkana	362	1994	–	–	–		–	–	–		
Nasolot/South Turkana	852	Nov 97	–	–	–	Reserves only	3	10		Muriuki et al. 1998	
Nasolot/South Turkana	792	Jul 99	31.3	24.1	–		9	36		Omondi et al. 1999	
Marsabit	–	1992	–	–	–		–	–	–		
Meru	554	Sep 65	–	–	–	Park only	–	–	–		Douglas-Hamilton & Hillman 1976
Meru	600	1969	–	–	–		–	–	–		Douglas-Hamilton & Hillman 1976
Meru	1520	Oct 74	–	–	–	Park only	–	–	–		Douglas-Hamilton & Hillman 1976
Meru	1328	Aug 76	–	–	844	Park only	–	–	63	Douglas-Hamilton & Hillman 1976	
Meru	2629	1977	–	–	–		–	–	–		
Meru	251	Oct 90	–	–	–	Meru/Bisanadi blocks 1&2	–	–	216	Douglas-Hamilton 1990	
Meru	264	Jul 92	–	–	–	Meru/Bisanadi only	1	0	1	Litoroh 1992	
Meru	360	1997	–	–	–	MCA + dispersal area	–	–	–	Mwathe et al. 1997	
Meru	306	Jun 1999	29.3	20.5	3960	MCA + dispersal area	3	15	18	Kahumbu et al. 1999	
Mwea	46	Apr 1994	0.9	0.9	42		0	0	0	Litoroh 1994	

Annex 2. Total counts (end)

Location	Elephant counted	Date	Flight time	Count time	Area (sq km)	Area description	Fresh/ recent carcasses	Old/ very old carcasses	Total carcasses	Original reference	Quoted in
Mwea	45	Mar 95	–	–	–		–	–	–	Njumbi et al. 1995	
Mwea	34	Jul 95	–	–	–		–	–	–	Njumbi et al. 1995	
Mwea	48	Aug 95	–	–	–		–	–	–	Njumbi et al. 1995	
Shimba	464	Aug 97	6.4	5	250		–	–	–	Litoroh 1997	
Amboseli system	1087	Jan 00	21.25	18.5	4035		0	9	9		

Annex 3. Sample counts

Area	Date	Estimate	Area sq km	Recent carcasses	Old carcasses	Notes	Original source	Reported
Baringo	Nov 80	0	–	0	0		DRSRS	Poole et al. 1992
Baringo	Apr 81	91	–	0	0		DRSRS	Poole et al. 1992
Baringo	Mar 86	90	–	0	0		DRSRS	Poole et al. 1992
Baringo	Sep 90	596	–	0	0		DRSRS	Poole et al. 1992
Elgeyo	Mar 86	84	–	0	0		DRSRS	Poole et al. 1992
Elgeyo	Feb 89	0	–	0	0		DRSRS	Poole et al. 1992
Garissa	Aug 77	5,280	43,623	0	0		DRSRS	
Garissa	Sep 78	7,725	43,623	–	–		DRSRS	Poole et al. 1992
Garissa	Sep 78	1,173	–	0	119	Protected areas only	DRSRS	Poole et al. 1992
Garissa	Sep 78	5,464	–	1,146	3,293	Outside protected areas only	DRSRS	Poole et al. 1992
Garissa	Sep 80	469	–	46	328	Protected areas only	DRSRS	Poole et al. 1992
Garissa	Sep 80	3,053	–	436	4,167	Outside protected areas only	DRSRS	Poole et al. 1992
Garissa	Nov 81	455	–	0	56	Protected areas only	DRSRS	Poole et al. 1992
Garissa	Nov 81	3,138	–	0	1,255	Outside protected areas only	DRSRS	Poole et al. 1992
Garissa	Apr 83	2,904	43,623	–	–		DRSRS	Poole et al. 1992
Garissa	Mar 85	642	43,623	–	–		DRSRS	Poole et al. 1992
Garissa	Mar 88	176	43,623	–	–		DRSRS	Poole et al. 1992
Garissa	Apr 88	0	–	0	51	Protected areas only	DRSRS	Poole et al. 1992
Garissa	Apr 88	176	–	0	844	Outside protected areas only	DRSRS	Poole et al. 1992
Garissa	May 96	0	43,623	0	36		DRSRS	Poole et al. 1992
Isiolo	Sep 78	990	–	0	198	Protected areas only	DRSRS	Poole et al. 1992
Isiolo	Oct 78	0	–	0	817	Outside protected areas only	DRSRS	Poole et al. 1992
Isiolo	Mar 85	169	–	56	113	Protected areas only	DRSRS	Poole et al. 1992
Isiolo	Mar 85	175	–	0	700	Outside protected areas only	DRSRS	Poole et al. 1992
Isiolo	Feb 88	530	–	17	17	Protected areas only	DRSRS	Poole et al. 1992
Isiolo	Feb 88	321	–	0	113	Outside protected areas only	DRSRS	Poole et al. 1992
Isiolo	Nov 90	0	–	0	0	Protected areas only	DRSRS	Poole et al. 1992
Isiolo	Nov 90	1,767	–	0	85	Outside protected areas only	DRSRS	Poole et al. 1992
Kilifi	Jul 80	446	–	60	1,488		DRSRS	Poole et al. 1992
Kilifi	Apr 86	0	–	35	526		DRSRS	Poole et al. 1992
Kilifi	Nov 89	0	–	17	401		DRSRS	Poole et al. 1992
Kitui	Sep 78	293	–	22	0	Protected areas only	DRSRS	Poole et al. 1992
Kitui	Sep 78	1,815	–	26	427	Outside protected areas only	DRSRS	Poole et al. 1992

Annex 3. Sample counts (continued)

Area	Date	Estimate	Area sq km	Recent carcasses	Old carcasses	Notes	Original source	Reported
Kitui	Sep 80	863	–	0	20	Protected areas only	DRSRS	Poole et al. 1992
Kitui	Sep 80	579	–	24	531	Outside protected areas only	DRSRS	Poole et al. 1992
Kitui	Nov 85	71	–	0	17	Protected areas only	DRSRS	Poole et al. 1992
Kitui	Nov 85	0	–	0	34	Outside protected areas only	DRSRS	Poole et al. 1992
Kitui	Mar 90	31	–	0	0	Protected areas only	DRSRS	Poole et al. 1992
Kitui	Mar 90	136	–	0	38	Outside protected areas only	DRSRS	Poole et al. 1992
Laikipia	Oct 78	2,113	–	0	0		DRSRS	Poole et al. 1992
Laikipia	Sep 81	325	–	0	0		DRSRS	Poole et al. 1992
Laikipia	Sep 87	2,492	–	0	34		DRSRS	Poole et al. 1992
Laikipia	Sep 90	1,881	–	0	18		DRSRS	Poole et al. 1992
Laikipia	Feb 97	1,847	9,666	–	–		LWF 1997	
Laikipia	Jun 97	3,435	9,666	–	–		LWF 1997	
Laikipia	Feb 99	2,645	9,666	–	–		LWF 1999	
Lamu	Feb 78	65	–	0	0	Protected areas only	DRSRS	Poole et al. 1992
Lamu	Feb 78	2,071	–	112	224	Outside protected areas only	DRSRS	Poole et al. 1992
Lamu	Jul 80	635	–	0	0	Protected areas only	DRSRS	Poole et al. 1992
Lamu	Jul 80	1,405	–	61	536	Outside protected areas only	DRSRS	Poole et al. 1992
Lamu	Nov 81	171	–	0	0	Protected areas only	DRSRS	Poole et al. 1992
Lamu	Nov 81	3,816	–	0	26	Outside protected areas only	DRSRS	Poole et al. 1992
Lamu	Apr 86	0	–	0	32	Protected areas only	DRSRS	Poole et al. 1992
Lamu	Apr 86	0	–	0	241	Outside protected areas only	DRSRS	Poole et al. 1992
Lamu	Nov 89	0	–	0	15	Protected areas only	DRSRS	Poole et al. 1992
Lamu	Nov 89	0	–	0	87	Outside protected areas only	DRSRS	Poole et al. 1992
Lamu	Mar 93	264	6,153	0	17		DRSRS	
Lamu	May 96	0	6,153	0	0		DRSRS	
Mandera	Sep 78	341	–	85	28		DRSRS	Poole et al. 1992
Mandera	Feb 85	0	–	0	0		DRSRS	Poole et al. 1992
Mandera	Jan-88	0	–	0	0		DRSRS	Poole et al. 1992
Mandera	Nov 90	0	–	0	0		DRSRS	Poole et al. 1992
Mara	Jan-77	711	–	–	–			Dublin & Douglas-Hamilton 1987
Marsabit	Sep 78	77	–	0	51	Outside protected areas only	DRSRS	Poole et al. 1992
Marsabit	Oct 78	22	–	0	113	Protected areas only	DRSRS	Poole et al. 1992
Marsabit	Feb 81	131	–	0	13	Protected areas only	DRSRS	Poole et al. 1992

Annex 3. Sample counts (continued)

Area	Date	Estimate	Area sq km	Recent carcasses	Old carcasses	Notes	Original source	Reported
Marsabit	Feb 81	15	–	15	15	Outside protected areas only	DRSRS	Poole et al. 1992
Marsabit	Nov 87	148	–	0	16	Protected areas only	DRSRS	Poole et al. 1992
Marsabit	Nov 87	0	–	0	36	Outside protected areas only	DRSRS	Poole et al. 1992
Marsabit	Oct 90	0	–	0	0	Outside protected areas only	DRSRS	Poole et al. 1992
Marsabit	Nov 90	0	–	0	0	Protected areas only	DRSRS	Poole et al. 1992
Meru	Jun 05	427	–	–	–			Douglas-Hamilton 1990
Meru	Aug 76	2,948	2,575	–	–		Douglas-Hamilton & Hillman 1976	
Meru	Jun 77	2,893	2,425	–	–		Wetmore et al. 1977	
Meru park	Aug 76	2,122	844	–	–		Douglas-Hamilton & Hillman 1976	
Meru park	Jun 77	2,474	875	–	–		Wetmore et al. 1977	
Narok	Jan-77	1,570	–	0	0		DRSRS	
Narok	Jun 77	2,612	–	0	332		DRSRS	
Narok	Mar 78	2,245	–	0	252		DRSRS	
Narok	Oct 80	3,739	–	0	0		DRSRS	
Narok	Feb 83	1,772	–	0	0		DRSRS	
Narok	Apr 85	2,037	–	0	0		DRSRS	
Narok	Nov 85	1,532	–	0	0		DRSRS	
Narok	May 86	2,552	–	0	0		DRSRS	
Narok	Aug 86	514	–	0	0		DRSRS	
Narok	Nov 86	1,168	–	0	0		DRSRS	
Narok	Apr 87	1,494	–	0	0		DRSRS	
Narok	May 89	1,354	–	0	0		DRSRS	
Narok	Aug 90	1,694	–	0	0		DRSRS	
Narok	Apr 91	1,679	–	0	33		DRSRS	
Narok	Aug 91	1,790	–	0	0		DRSRS	
Narok	Mar 92	1,660	–	0	0		DRSRS	
Narok	Aug 92	867	–	0	17		DRSRS	
Narok	Nov 93	331	–	16	33		DRSRS	
Narok	May 94	1,930	–	0	0		DRSRS	
Narok	Aug 96	2,077	–	0	0		DRSRS	
Narok	May 97	10,249	–	0	0		DRSRS	
Narok	Aug 97	7,012	–	0	0		DRSRS	
Pokot	Oct 77	0	–	0	0		DRSRS	Poole et al. 1992
Pokot	Apr 85	172	–	0	0		DRSRS	Poole et al. 1992

Annex 3. Sample counts (continued)

Area	Date	Estimate	Area sq km	Recent carcasses	Old carcasses	Notes	Original source	Reported
Pokot	Sep 87	0	–	0	0		DRSRS	Poole et al. 1992
Pokot	Aug 90	535	–	0	0		DRSRS	Poole et al. 1992
Samburu	Sep 77	0	–	0	0	Protected areas only	DRSRS	Poole et al. 1992
Samburu	Sep 77	1,929	–	350	2,236	Outside protected areas only	DRSRS	Poole et al. 1992
Samburu	Apr 85	277	–	0	0	Protected areas only	DRSRS	Poole et al. 1992
Samburu	Apr 85	2,562	–	0	396	Outside protected areas only	DRSRS	Poole et al. 1992
Samburu	Nov 87	103	–	0	0	Protected areas only	DRSRS	Poole et al. 1992
Samburu	Nov 87	369	–	0	217	Outside protected areas only	DRSRS	Poole et al. 1992
Samburu	Nov 90	0	–	0	0	Protected areas only	DRSRS	Poole et al. 1992
Samburu	Nov 90	563	–	0	0	Outside protected areas only	DRSRS	Poole et al. 1992
Tana	Sep 78	422	–	0	66	Protected areas only	DRSRS	Poole et al. 1992
Tana	Sep 78	2,346	–	1,429	5,093	Outside protected areas only	DRSRS	Poole et al. 1992
Tana	Sep 80	777	–	19	19	Protected areas only	DRSRS	Poole et al. 1992
Tana	Sep 80	2,928	–	107	5,662	Outside protected areas only	DRSRS	Poole et al. 1992
Tana	Apr 83	103	–	0	34	Protected areas only	DRSRS	Poole et al. 1992
Tana	Apr 83	46	–		1,568	Outside protected areas only	DRSRS	Poole et al. 1992
Tana	Oct 85	385	–	0	0	Protected areas only	DRSRS	Poole et al. 1992
Tana	Oct 85	817	–	34	3,079	Outside protected areas only	DRSRS	Poole et al. 1992
Tana	Apr 88	0	–	0	18	Protected areas only	DRSRS	Poole et al. 1992
Tana	Apr 88	410	–	136	1,780	Outside protected areas only	DRSRS	Poole et al. 1992
Tana	Mar 90	0	–	0	147	Protected areas only	DRSRS	Poole et al. 1992
Tana	Mar 90	0	–	16	1,720	Outside protected areas only	DRSRS	Poole et al. 1992
Tsavo ecosystem	Dec 73	38,167	–	–	–		S Cobb	Inamdar 1996
Tsavo ecosystem	Jan 74	32,904	–	–	–		S Cobb	Inamdar 1996
Tsavo ecosystem	May 74	30,723	–	–	–		S Cobb	Inamdar 1996
Tsavo ecosystem	Sep 74	36,007	–	–	–		S Cobb	Inamdar 1996
Tsavo ecosystem	Nov 74	37,827	–	–	–		S Cobb	Inamdar 1996
Tsavo ecosystem	Jun 76	19,320	–	–	–		Tsavo Monitoring	Inamdar 1996
Tsavo ecosystem	Feb 77	22,906	–	–	–		KREMU	Inamdar 1996
Tsavo ecosystem	Feb 78	22,390	–	–	–		KREMU	Inamdar 1996
Tsavo ecosystem	Apr 78	20,477	–	–	–		WWF	Inamdar 1996
Tsavo ecosystem	Jul 80	10,564	–	–	–		KREMU	Inamdar 1996

Annex 3. Sample counts (continued)

Area	Date	Estimate	Area sq km	Recent carcasses	Old carcasses	Notes	Original source	Reported
Tsavo ecosystem	Nov 85	9,981	–	–	–		KREMU	Inamdar 1996
Tsavo ecosystem	Nov 89	10,656	–	–	–		KREMU	Inamdar 1996
Tsavo ecosystem	Mar 91	7,547	–	–	–		KREMU	Inamdar 1996
Tsavo ecosystem	Sep 91	6,970	–	–	–		KREMU	Inamdar 1996
Tsavo ecosystem	Dec-92	10,034	–	–	–		KREMU	Inamdar 1996
Tsavo ecosystem	Jun 93	7,932	–	–	–			Inamdar 1996
Tsavo ecosystem	Oct 93	12,390	–	–	–			Inamdar 1996
Tsavo ecosystem	Apr 94	13,674	–	–	–			Inamdar 1996
Tsavo ecosystem	Aug 94	8,291	–	–	–			Inamdar 1996
Tsavo NP	Feb 77	20,865	–	–	–	including Galana	DRSRS	
Tsavo NP	Jan 79	20,922	–	1,612	3,113	including Galana	DRSRS	
Tsavo NP	Apr 89	8,541	–	247	3,176	including Galana	DRSRS	
Tsavo NP	Mar 91	4,341	–	0	2,006	including Galana	DRSRS	
Tsavo NP	Oct 91	3,729	–	242	2,370	including Galana	DRSRS	
Tsavo NP	Nov 92	9,542	–	36	2,307	including Galana	DRSRS	
Tsavo NP	Nov 93	11,944	–	0	2,370	including Galana	DRSRS	
Tsavo NP	Aug 94	7,301	–	89	1,958	including Galana	DRSRS	
Tsavo NP	Feb 97	7,178	–	0	808	including Galana	DRSRS	
Turkana	Oct 78	0	–	0	0	Protected areas only	DRSRS	Poole et al. 1992
Turkana	Nov 78	0	–	0	0	Outside protected areas only	DRSRS	Poole et al. 1992
Turkana	Apr 81	119	–	0	0	Protected areas only	DRSRS	Poole et al. 1992
Turkana	Apr 81	822	–	29	0	Outside protected areas only	DRSRS	Poole et al. 1992
Turkana	Sep 85	0	–	0	0	Protected areas only	DRSRS	Poole et al. 1992
Turkana	Sep 85	331	–	0	0	Outside protected areas only	DRSRS	Poole et al. 1992
Turkana	Sep 87	0	–	0	0	Protected areas only	DRSRS	Poole et al. 1992
Turkana	Sep 87	38	–	0	0	Outside protected areas only	DRSRS	Poole et al. 1992
Turkana	Aug 90	0	–	0	0	Protected areas only	DRSRS	Poole et al. 1992
Turkana	Sep 90	0	–	0	0	Outside protected areas only	DRSRS	Poole et al. 1992
Wajir	Aug 78	87	–	24	413		DRSRS	Poole et al. 1992
Wajir	Mar 85	0	–	0	50		DRSRS	Poole et al. 1992
Wajir	Mar 88	0	–	0	54		DRSRS	Poole et al. 1992
Wajir	Nov 90	0	–	0	35		DRSRS	Poole et al. 1992

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