TOTAL AERIAL COUNT OF ELEPHANTS, BUFFALO AND OTHER SPECIES IN THE TSAVO/MKOMAZI ECOSYSTEM

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Cover Photo: Participants during the 2005 Tsavo Count

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Executive summary

A total aerial count of elephants in Tsavo Ecosystem was carried out between 27th to 31st January 2005. Total counts of elephants, elephant carcasses, buffaloes and other wildlife species was done while cattle, and shoats were estimated. Logging sites, settlements, fires, charcoal burning sites and snare lines were also counted.

A total of 10,397 elephants were counted. Most of these elephants (37.5%) were found in the south of Tsavo East National Park. 1,376 elephants (or 13.2%) were found outside the Protected Areas with the majority of these (1,292 or 93.89%) in Taita Ranches. Overall, the elephant population has increased by 11.99 %, or approximately 4% per annum, since 2002 when the last total aerial count was conducted. A total of 138 carcasses were counted out of which 4.3% were recorded as recent and all were found inside the Protected Areas.. The number of carcasses counted has declined since 2002 as a result of visibility decay of old carcasses.

Between 2002 and 2005 buffalo increased from 7,347 to 9,371. This shows an increase of about 27.5%. Most of the buffaloes (90.77%) in 2005 were inside the protected areas of Tsavo East and West with the later having 57.69% of the population. Distribution of other wildlife species such as the giraffe and Eland was almost uniform in the ecosystem with Tsavo West having the highest concentrations (36.3% of giraffes and 44.95% elands). Only 41 hirolas were counted in Tsavo East South. Only one rhino was recorded in Tsavo West. The low number of sightings was attributed to poor visibility due to dense vegetation in rhino areas.

The number of livestock (cattle and shoats) in the ecosystem indicated a drastic increase since 2002. Cattle were estimated at 132,628 of which 37% of them were inside Protected areas with Tsavo West alone having 44,277 (90.2% of all cattle inside PA's or 33.4% of the total estimate). The total estimated number of

cattle in the ecosystem has increased by 64.5% between 2002 and 2005 while that of shoats increased by 72.5%. Most of the shoats (66.5%) were outside the protected areas, with 10.5% of the total found inside protected areas with Tsavo West having the highest number (5,359 or 79.9% of total inside the PA's). Taita ranches had 15.1% of total estimate of shoats in the entire ecosystem.

Introduction

The current survey was done as part of a joint venture between Kenya Wildlife Service and CITES-MIKE Programme to establish the current status of Tsavo's elephant population. It was done with financial support from the United States Fish & Wildlife Service, and a bridging loan from Save The Elephants which allowed the count to go ahead while awaiting funding

The MIKE Programme is an elephant range states programme authorized by a resolution of the parties of CITES at CoP 10 in 1997. It is a site-based system to monitor elephant population trends and the illegal killing of elephants and operates in 29 African and 13 Asian elephant range states. The Tsavo / Mkomazi Ecosystem is one of the 45 MIKE sites in Africa.

Aerial counts of Tsavo ecosystem have been carried out since the 1960's. An aerial count in September 1962, gave an estimate of 10,799 elephants within the park and 4,804 outside (Glover, 1963*)*. In 1967, Laws estimated the population to be 35,000 elephants (Laws, 1969). Between 1970 and 1971, there was a severe drought and 5,900 elephants were recorded dead (Corfield, 1973). By 1980, the Tsavo elephant population had been drastically reduced by poaching to about 12,000 (Ottichilo, 1981) and to only 5,363 elephants in 1988 (Olindo et al., 1988).

The 1988 total count covered an area of 40,000km². Rombo block to the west of Tsavo west national park was included in the 1994 count (Douglas-Hamilton et al., 1994). This same area was covered in 1999, 2002 and in this count for consistency of results. This count also extended the counting blocks to include, South Kitui National Reserve.

There has been a marked increase in the number of elephants since 1991 up to the present with 6,763 elephants counted in the ecosystem in 1991, 7,371 in 1994, 8,068 in 1999 and 9,284 in 2002 (Thouless et al, 2002)

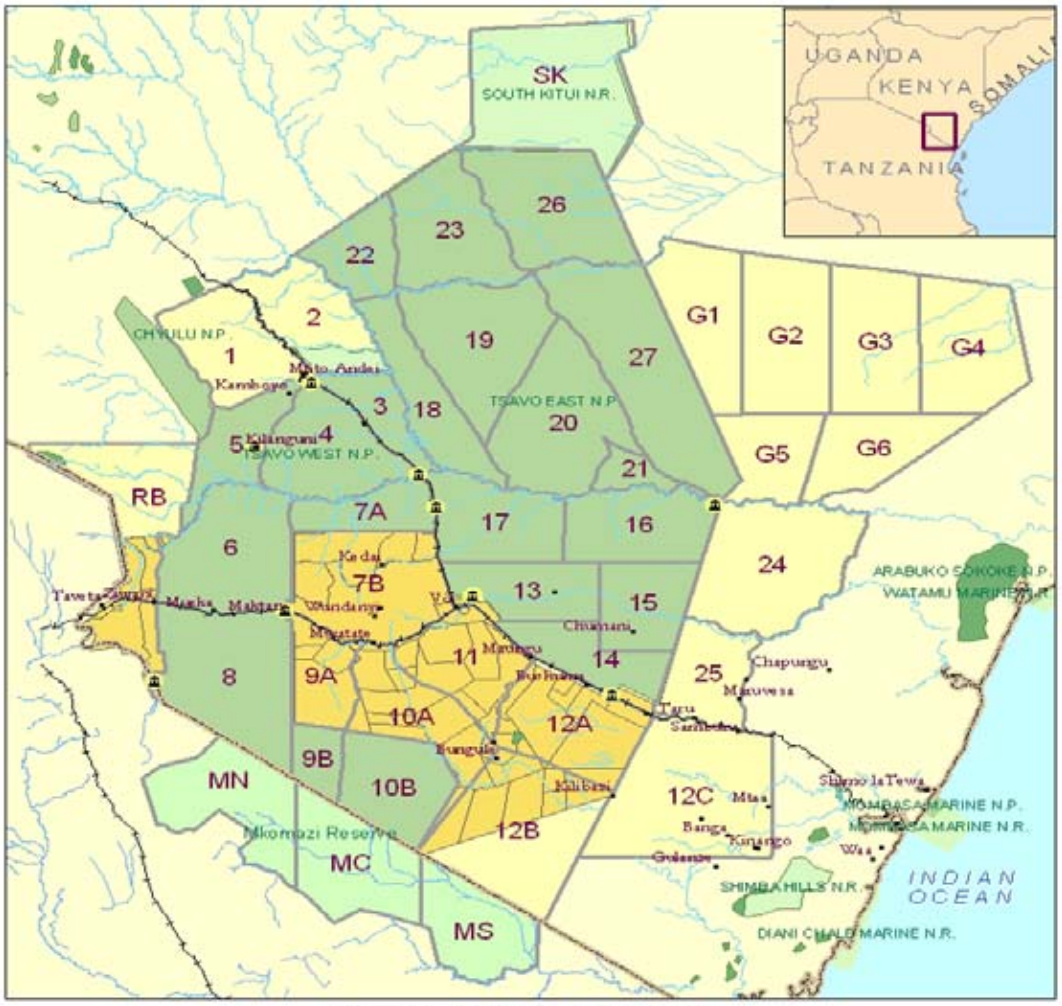
Objectives

1. Establish the current elephant population size and distribution and compare these results with the results of the 2002 count.
2. Determine the number and distribution of elephant carcasses.
3. To study elephant distribution in relation to water sources.
4. To map the incidences of human activities that may be threatening elephants through protected area encroachment e.g. logging and charcoal burning.
5. To document the distribution and numbers of other species in the ecosystem including buffaloes, rhinos and livestock.

Study area

At 40,000 km², the Tsavo ecosystem hosts the largest elephant population in Kenya. The parks (Tsavo East and West National Parks) alone occupy an area of about 21,000 km² with the remaining area being occupied by private ranches, wildlife sanctuaries, sisal plantations, farming settlements and eco-tourism enterprises (Fig 1).

Fig 1: Study Area Tsavo/Mkomazi Count- 2005

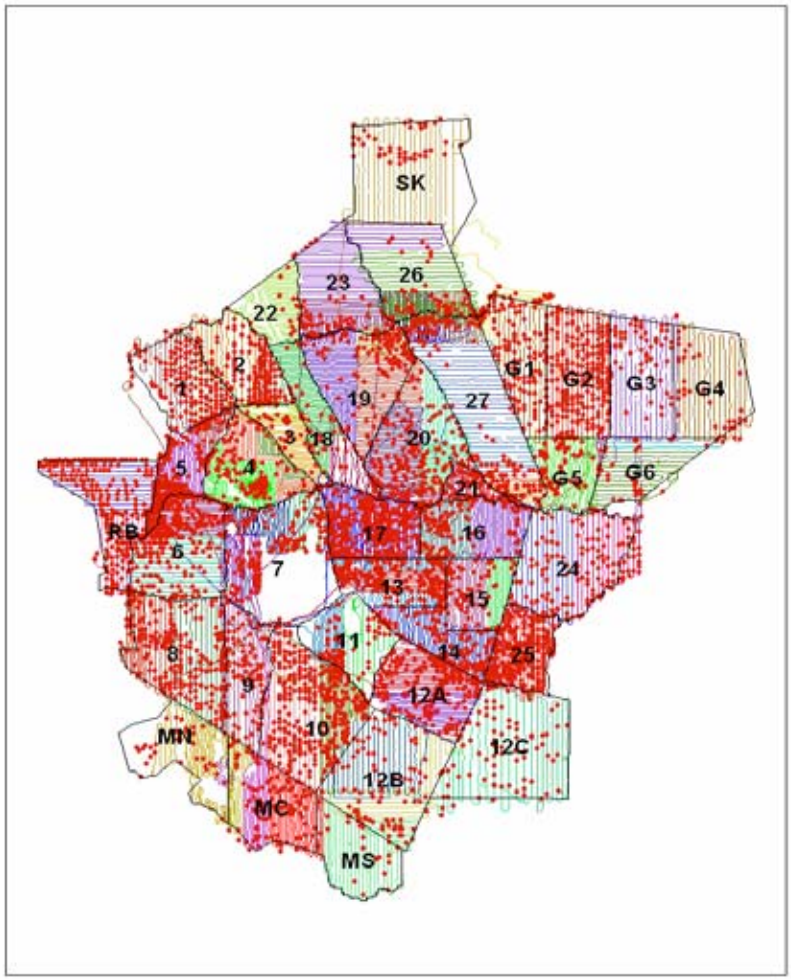


The ecosystem stretches to Mkomazi Game Reserve in North-eastern Tanzania. It is bordered by Mt. Kilimanjaro, Pare Mountains and parts of Usambara ranges to the Southwest. These areas form natural boundaries that limit the distribution of elephants and other wildlife species.

Method

The method adopted for the 2005 was consistent with the previous counts as described in Douglas-Hamilton et al. 1994 and Douglas-Hamilton, 1997. The count employed the Global Positioning System (GPS) technique with Pathfinder software used for plotting all observation made in the form of waypoints (Fig. 2).

Fig 2: Flight Paths and waypoints for all the observation made.



A total of 9 aircraft were used in the count. Each of the aircraft had a GPS for use in navigation recording survey path and waypoints. All observations made were saved in the GPS as waypoints with the geographical location referenced and were used in producing species distribution maps.

Photographs were used to count individuals in large herds, unless the view was obstructed by thick vegetation, in order to establish the correct count (Douglas-Hamilton, 1997). All GPS's were down loaded onto a computer at the operation base each evening and the Front Seat Observers (FSO) did a summary table of each block. Any double counts in neighboring blocks were also worked out and eliminated during these sessions. The exercise started every morning at 7.30am and ended late in the evening. Breaks were taken during refueling of the aircraft and at lunch. Fuelling sites were strategically distributed in survey area to cut down on ferrying time. Each survey crew consisted of 1 observer and a pilot for 2 seater aircraft and a pilot, 1 FSO and 2 Rear Seat Observers (RSO) for a 4 seater aircraft. This is the first time that so many species have been included in the elephant count and buffalo count. All figures given are considerd to be estimates rather than total numbers.

Results

The 2005 total aerial count of Tsavo elephants was conducted between the 27th –31st January 2005. It involved 9 aircraft and took 227.2 flying hours covering an area of 46,437 km2. Total counts of elephants (live and dead), buffaloes were done. Livestock (cattle & shoats) and all other species were estimated. Observations on snare lines; vegetation cover; cattle invasion; charcoal burning; and encroachment into the protected area were also recorded.

Elephants

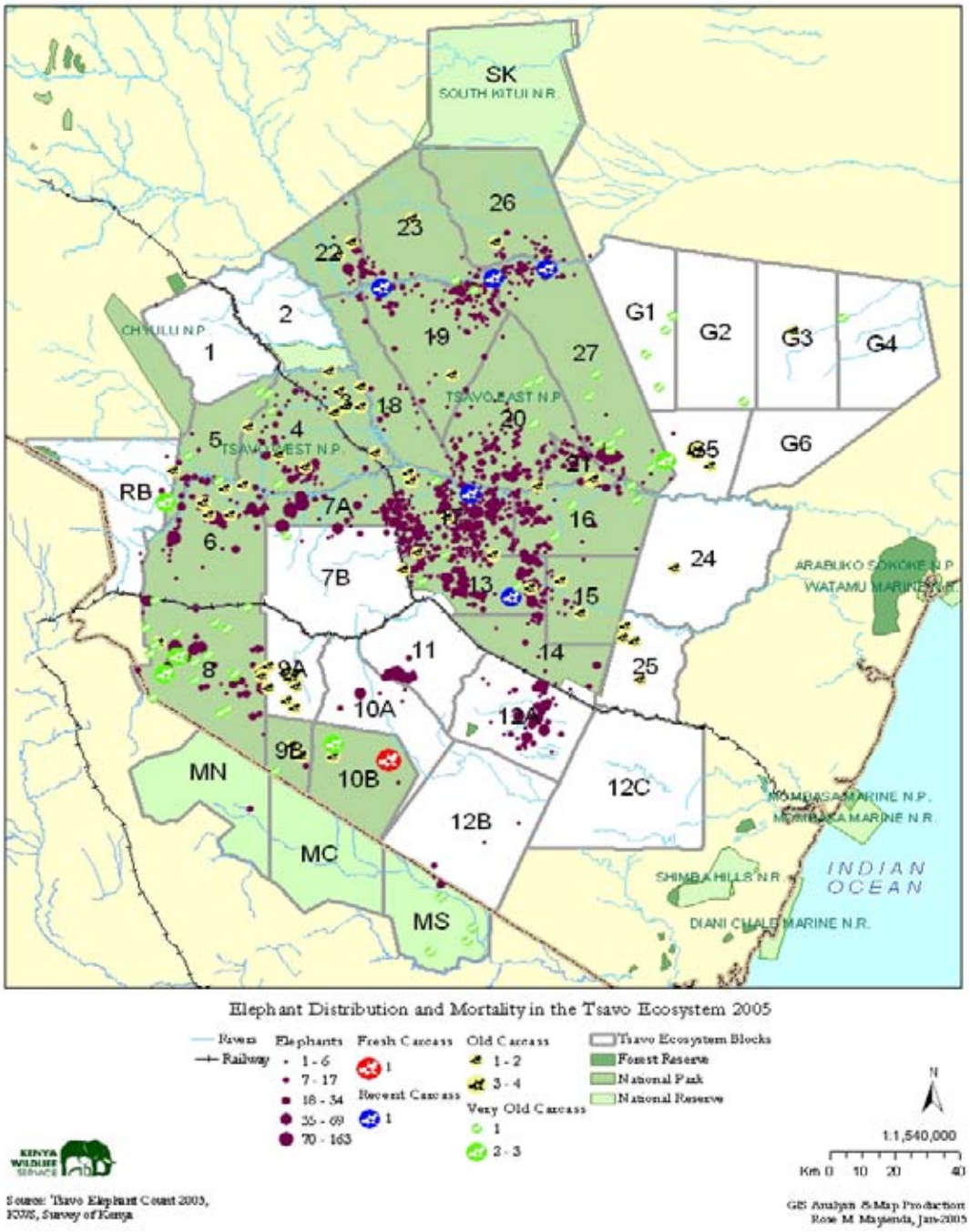
A total of 10, 397 elephants were counted in the Tsavo ecosystem (Table 1).

Table 1: Elephant and Elephant Carcasses Tsavo 2005 Count

	Live elephants	**Recent carcasses**	**Old Carcasses**
Tsavo East North	2,499	3	22
Tsavo East South	3,896	2	19
Tsavo West	2,626	1	58
Taita	1,292	0	11
Remainder	1	0	5
Galana	11	0	13
Mkomazi	41	0	4
Rombo	31	0	1
TSAVO NAT PARK	**9,021**	**6**	**99**
OUTSIDE	**1,376**	**0**	**33**
TOTAL	**10,397**	**6**	**132**

Elephant distribution was not uniform across the area with most individuals (86%) located in the protected areas of the Tsavo East and West National Parks that accounts for approximately half of the total area counted (Fig 3).

Fig 3: Elephant distribution 2005 Tsavo Ecosystem count



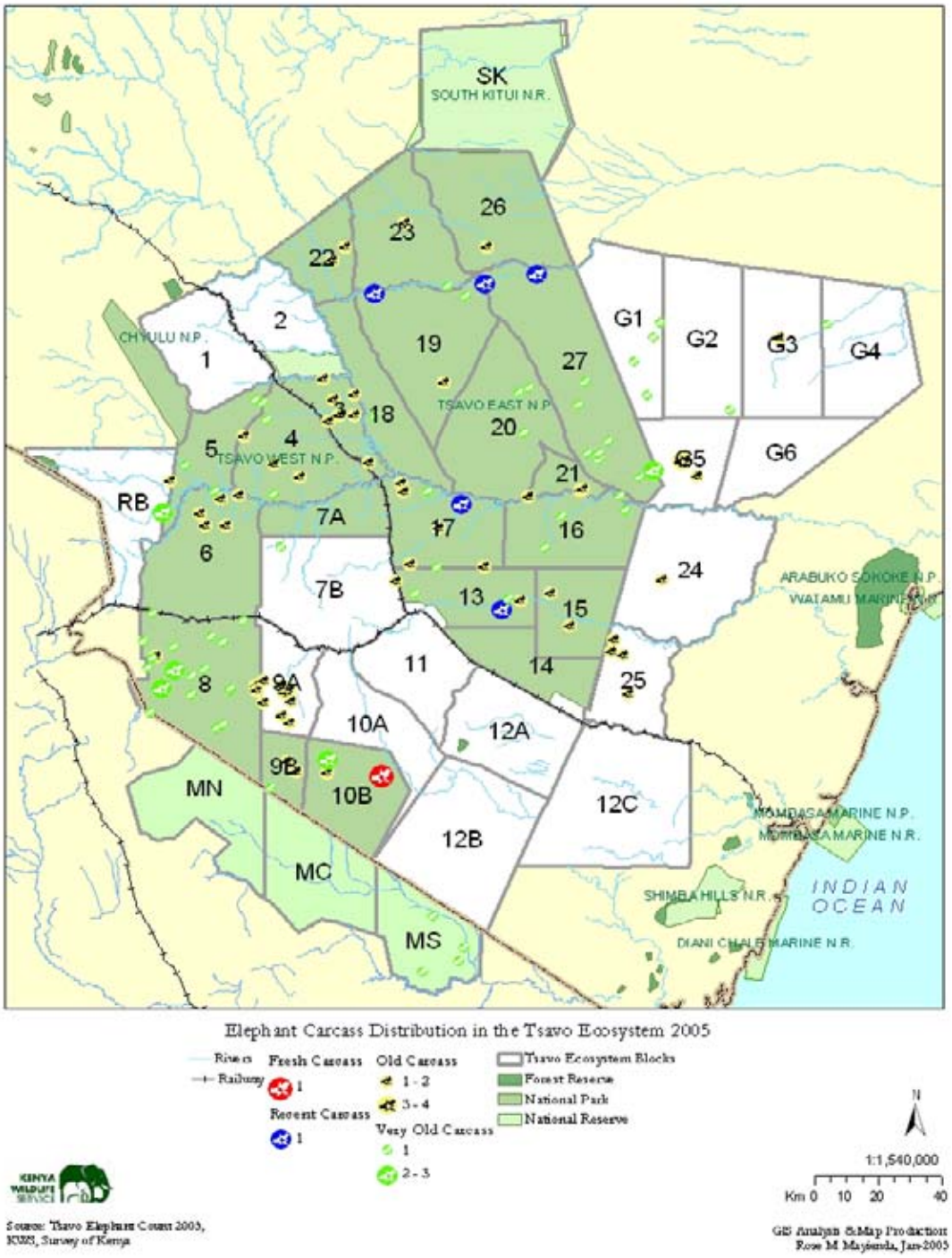
Within the parks, almost half of the elephant population (or 37.5% of the total population) was found in the southern part of Tsavo East. Tsavo West had (29.1%) of the park population, while the northern part of Tsavo East had 24% of the total population.

Outside of the Tsavo National Park protected areas, only Taita contained a significant number of elephants 12.4% of the total, which accounted for 93.8% of all the elephants counted outside the parks. All other areas combined excluding Taita recorded only 0.8% of the total ecosystem population.

Carcasses

Six recent carcasses were detected during the count and all were found within the park. Three were in the northern part of Tsavo East, two were found in the southern part of Tsavo East and one in Tsavo West. One of these carcasses was very fresh. One hundred and thirty three old carcasses were also recorded. Of these, 74.4% were found within the protected areas of the Tsavo National Parks. The highest concentration was in Tsavo West National Park with almost 41.7% of all carcasses found (Fig. 4).

Fig 4: Carcass Distribution 2005 Tsavo Count

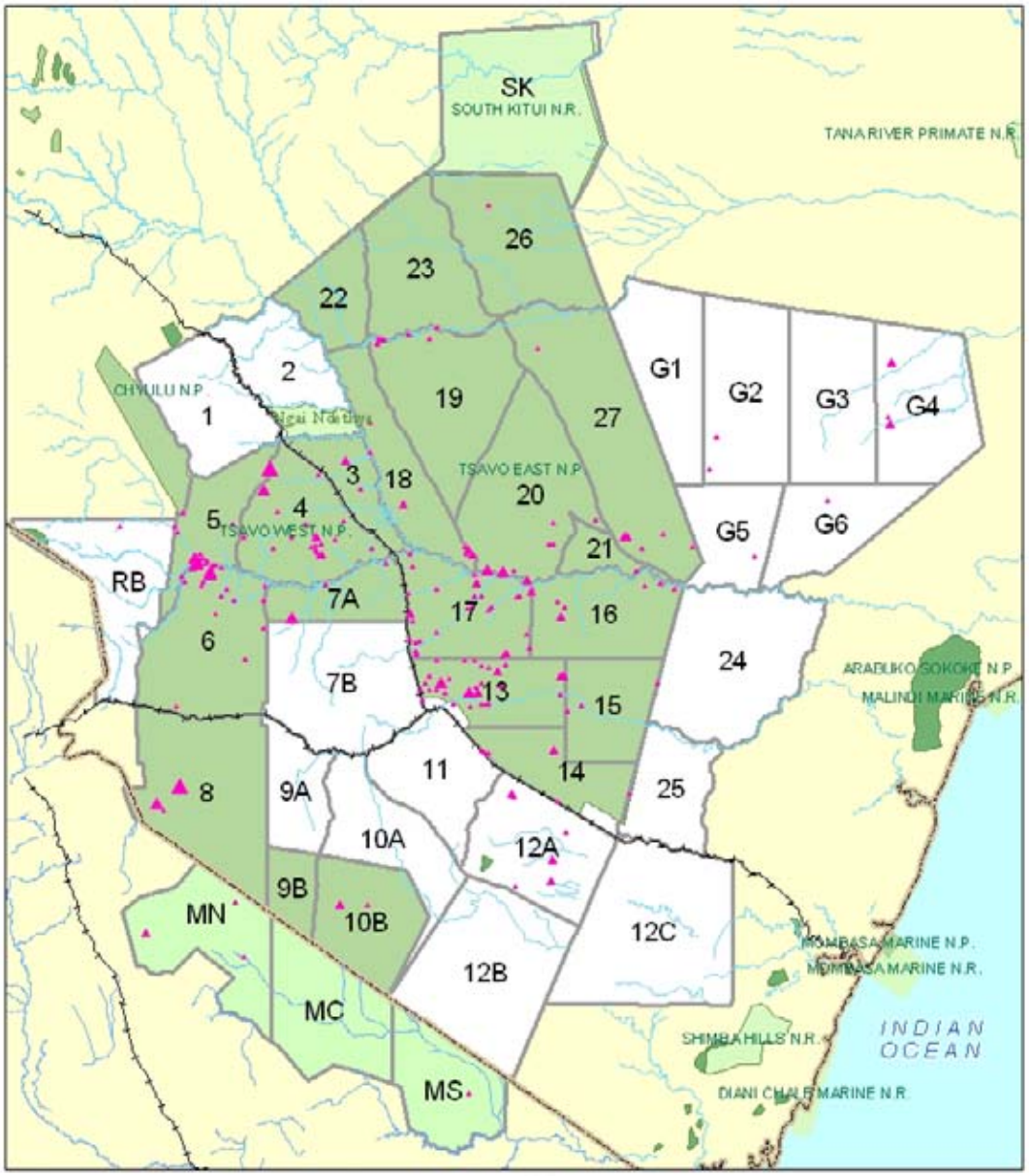


Outside of the Tsavo Parks, the highest concentration of carcasses were in the Galana ranch and in Taita accounting for 17.2% of the total. Four carcasses were found in Mkomazi while six were found in the other areas.

Other animals

One rhino was observed at Ngulia. A total of 9,371 buffaloes were counted in this count. 90.8 % of them were found mainly in the protected areas of the Tsavo National Parks. Tsavo West National Park recorded the highest number of buffalo of 52.4% of the total population counted. Block four and eight in Tsavo West contained the largest proportion of the total with almost double that found in any other block (Fig 5).

Fig 5: Buffalo Distribution- 2005 Elephant Count

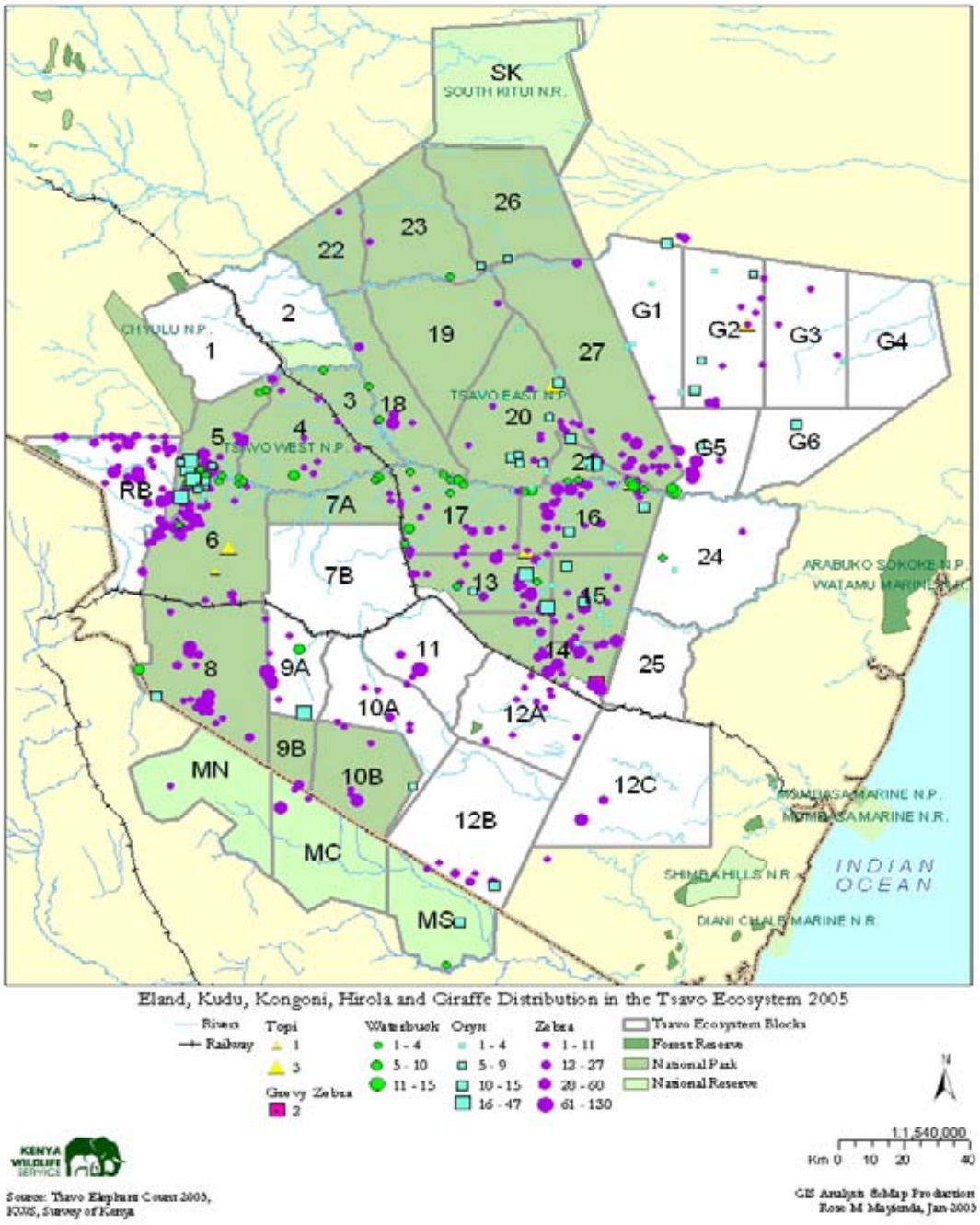


Outside of the protected areas, Taita contained significant numbers of buffalo with 442 individuals accounting for only 4.72 % of the total population (*see table 2*).

Table 2: Buffalo, Giraffe, Eland, Hirola, Kudu and Kongoni

	Buffalo	**Giraffe**	**Eland**	**Hirola**	**Kudu**	**Kongoni**
Tsavo East North	1,274	281	59	0	32	15
Tsavo East South	2,325	261	66	41	1	181
Tsavo West	4,907	568	900	0	13	533
Taita	442	148	252	0	7	164
Remainder	6	111	188	0	11	16
Galana	235	135	54	0	2	8
Mkomazi	182	62	483	0	12	44
TSAVO NAT PARK	**8,506**	**1110**	**1,025**	**0**	**46**	**729**
OUTSIDE	**865**	**456**	**977**	**0**	**32**	**232**
TOTAL	**9,371**	**1,566**	**2,002**	**41**	**78**	**961**

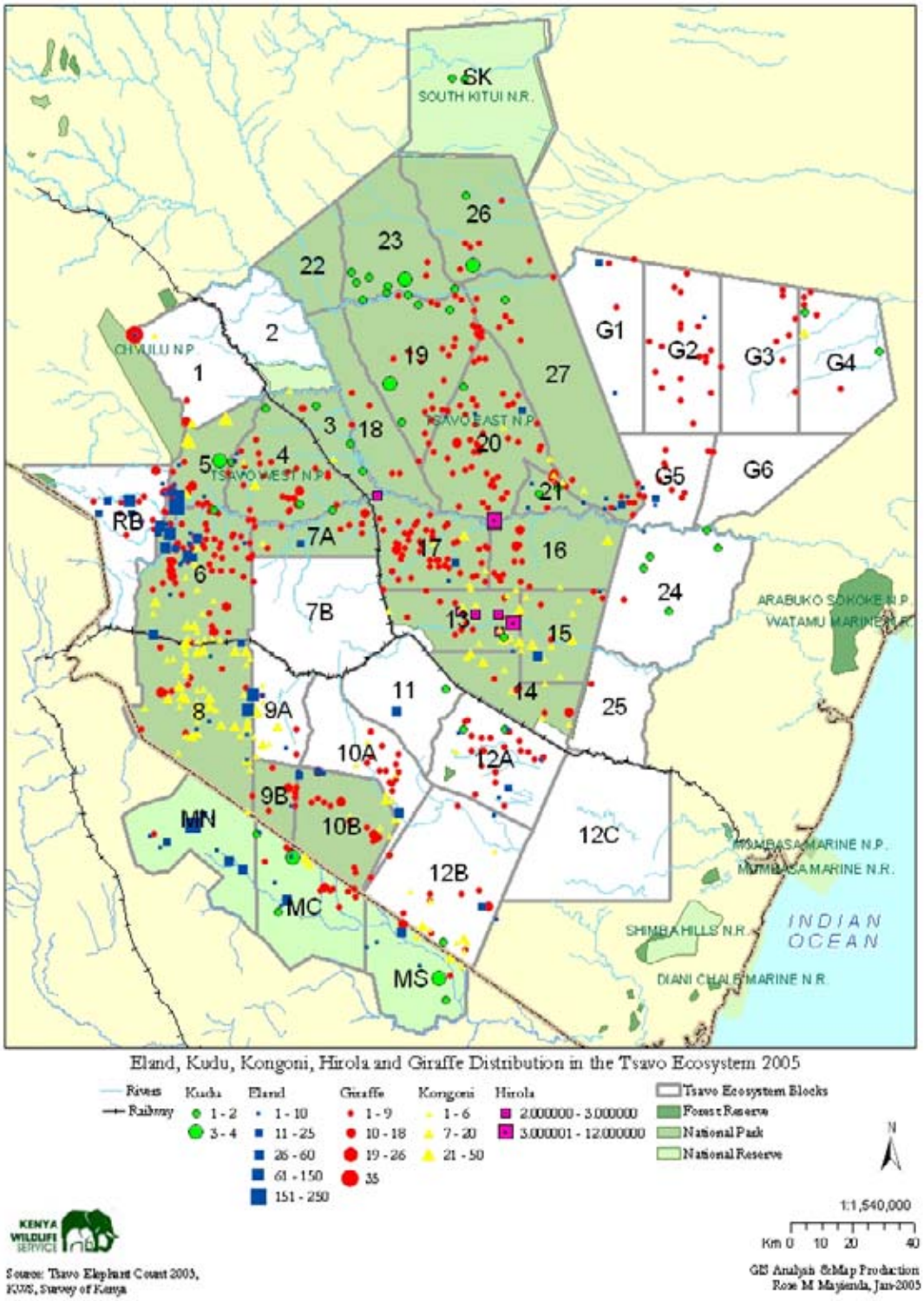
Fig. 6 Distribution of Topi, Waterbuck, Oryx and Zebra in 2005.
(Rose to Note and rectify legend below map showing Eland, Kudu etc instead of above species)



Other species counted include Eland, Kudu, Kongoni, Hirola and Giraffe (fig.7) which were much less common than either buffalo or elephant with a total

population estimate of 2,002; 78; 961; 41 and 1,566 respectively. Unlike the buffalo and elephant distribution, the giraffe are nearly equally distributed in the Tsavo National Parks and areas outside. The highest concentration of giraffe was in Tsavo West (36.3%) while the lowest number was observed in the Mkomazi National Park, Tanzania. Fourty-one Hirolas were counted in Southern Tsavo East National Park (Fig 7).

Fig 7: Distribution of Eland, Kudu, Hirola and Giraffe-Tsavo 2005 Count



Livestock

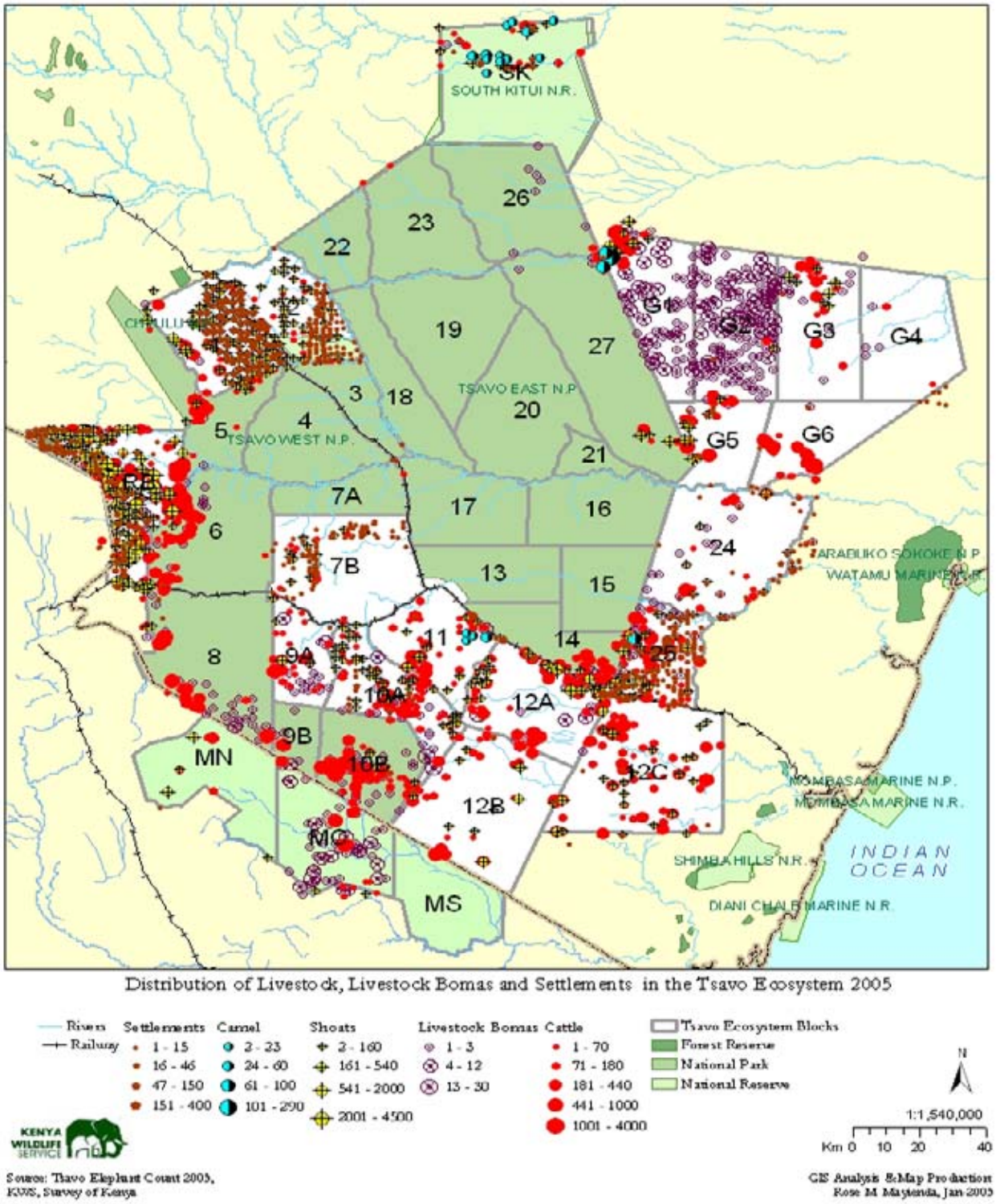
Livestock combined accounted for 72.4% of all animals recorded. Cattle were more numerous than shoats, making up 67.5% of all livestock recorded in the area. 80% and 90.2 % of all shoats and cattle counted in the parks respectively were found in the Tsavo West National Park. (Table 3 & Fig. 8).

Table 3: Livestock recorded- Tsavo 2005 Count

	Cattle	**Shoats**
Tsavo East North	1,110	780
Tsavo East South	3,715	560
Tsavo West	44,277	5,359
Taita	24,672	9,664
Remainder	38,992	42,521
Galana	16,827	4,265
Mkomazi	3,035	800
TSAVO NAT PARK	**49,102**	**6,699**
OUTSIDE	**83,526**	**57,250**
TOTAL	**132,628**	**63,949**

Areas outside of the Parks and Rombo block in particular had extremely high concentrations of shoats (Fig 6). The distribution of cattle was slightly different with a much greater proportion found inside the Tsavo Parks, Tsavo West block contained the highest concentrations.

Fig 8: Livestock distribution, Tsavo 2005 Count.



Mkomazi National Reserve in Tanzania had exceptionally high numbers of cattle and shoats deep in the Reserve.. Only the northern part of Tsavo East National Park had low numbers of livestock.

DISCUSSION

Elephant distribution and trends

The number of elephants continues to increase steadily (Fig.9) Most of the elephants (37.5%) were concentrated in the Southern parts of Tsavo East National Park. This was unlike in 2002 when most elephants (44%) were counted in the Northern parts of Tsavo East (Omondi et al 2002) due do unseasonal rains.The distribution observed during this count was almost similar to that recorded by Kahumbu et al in 1999.

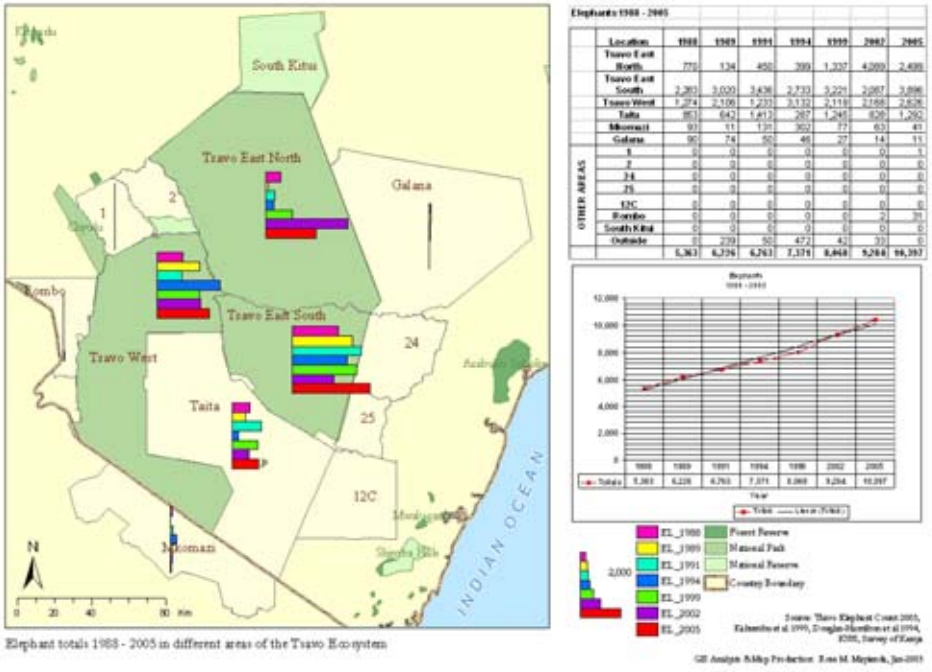
As seen in Appendix 2, apart from being near major water sources, most elephants were in the tree and shrub savannah. During this count, the Northern Tsavo had 24% of the total population and this shows a marked decline as compared to 2002. . In Tsavo West National Park, elephant numbers have not shown any significant changes. The park had 23% of total population in 2002 while 2005 it had 25.3%. From the results in table 1 it is evident that 86.7% of all the elephants were inside Protected Areas of Tsavo East and Tsavo West national Parks. The rest (1,376 or 13.2%) were outside the protected areas. This distribution shows some increase in the number of elephants outside protected areas as compared to 10% or 940 in 2002 (Omondi et al). However as compared to 1999 (Kahumbu et al) the number of elephants outside the protected areas is slightly lower (17% or 1,391 in 1999).

The confinement to the Protected Areas could be attributed to the increasing number of settlements and livestock on the peripheries of the Park. The Taita ranches had the highest population (93%) of all elephants outside protected areas while 2.9% and 2.3% where in Mkomazi and Rombo respectively. Omondi

et al (2002) and Kahumbu et al (1999) observed similar trends in which the Taita ranches featured as major elephant dispersal areas.

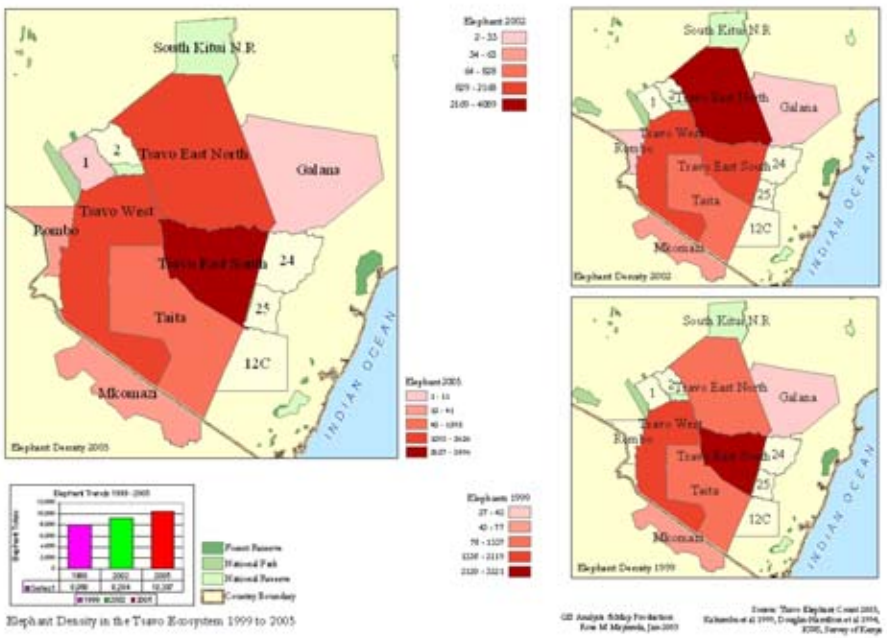
In other areas outside the Parks such as Mkomazi, elephant numbers have continued to decline from 77 in 1999, 63 in 2002 to 41 in 2005. Rombo on the other hand has shown some increase from 2 elephants in 2002 to 31 in 2005. The general decline of elephant in these areas is generally associated with increase in human and livestock populations and the subsequent changes in land use types. In Galana, the number of elephants (11) has remained almost steady since 2002 (14). Omondi et (2002) attributed the insecurity as the cause of low elephant numbers in this region. See Fig. 10

Fig. 9 Trends in Elephant numbers in the Tsavo Ecosystem between 1988 and 2005.



Elephant totals 1988 - 2005 in different areas of the Tsavo Ecosystem

Figure 10: Elephant distribution and trends in 1999, 2002 and 2005



The results of the 2005 count indicate that the elephant population in the Tsavo ecosystem has increased by 11.9% since 2002. This shows an annual increase of about 4% per annum over a period of three years. As compared to the growth rate of 5% between 1999 and 2002, there is a slight. Kahumbu et al (1999) noted that the overall growth rate between 1994 and 1999 was 2% Despite the fact that elephants live long, such fluctuations in population growth rates need to be investigated and monitored so as to establish causes and possible future impacts on the population. Low population increase observed in the early to mid 1990s (1994-1999) is likely to be a result of a low reproductive rate in a disturbed and fragmented population recovering from the heavy poaching that occurred in the 1980s. Since 1999 the population has shown an increase of between 4-5% per annum which is comparable with other populations where most mortality is natural rather than human induced.

Carcasses trends

During the survey, a total of 138 carcasses were recorded in the ecosystem. Six of these were categorised as recent and all were found inside the Protected Areas. Of all the carcasses, 95% were categorised as old (71.7% of them were inside the Parks). As compared to 2002 (Omondi et al), the total number of carcasses declined by 54.3% while the decline for recent fell by 57%. In 1999, the number of recent carcasses was similar to that recorded in 2005 however the proportions of recent to old carcasses during these periods greatly differ. In 1999 (Kahumbu et al) the percentage ratio was 1.41but in 2005, ratio was 4.34% (Table 4). The later is almost similar to the ratio (4.64%) obtained in 2002 count (Omondi et al) .The total number of carcasses found has decreased steadily between 1999-2005 as a result of visibility decay of old carcasses. The only fresh carcass observed during the count was in Tsavo West. It is interesting to note that all the recent and 75% of old carcasses were found in the protected areas. From the aerial survey, cause of death could be immediately determined. However information obtained by the MIKE/CITES monitoring programme indicate that in 2004, 64 elephants died of various causes.

Table 4. Proportion of recent carcasses for the Tsavo ecosystem between 1988 and 2005. (Adapted from Kahumbu et al. 1999)

Year	Recent	Total carcass	% new carcass
1988	162	2421	6.69%
1989	115	1752	6.56%
1991	4	1210	0.33%
1994	1	1362	0.07%
1999	6	427	1.41%
2002	14	302	4.64%
2005	**6**	**138**	**4.34%**

Buffaloes and other species

. The majority of the buffalo population was found within the National Parks (Fig.5) along major streams, rivers and close to watering holes. Tsavo West National Park had the highest proportion (52.4%) of the total population (Fig 11).

It is appears that buffalo distribution is been influenced by availability of water and the green forage observed. These results therefore confirm that for effective management of this population, water availability and appropriate distribution network is very crucial.

Fig. 11 Buffalo Population densities in 1999, 2002 and 2005

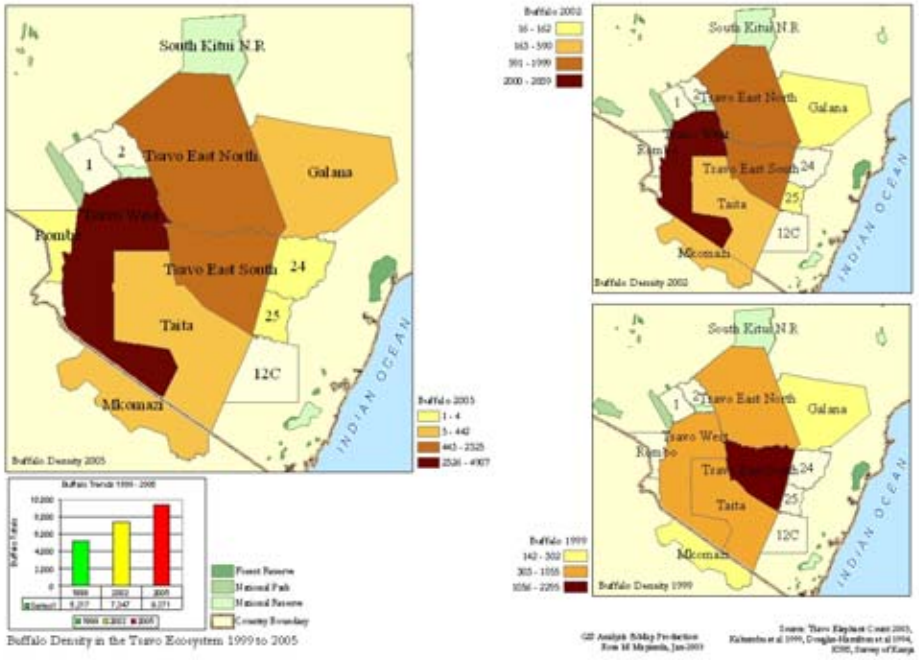
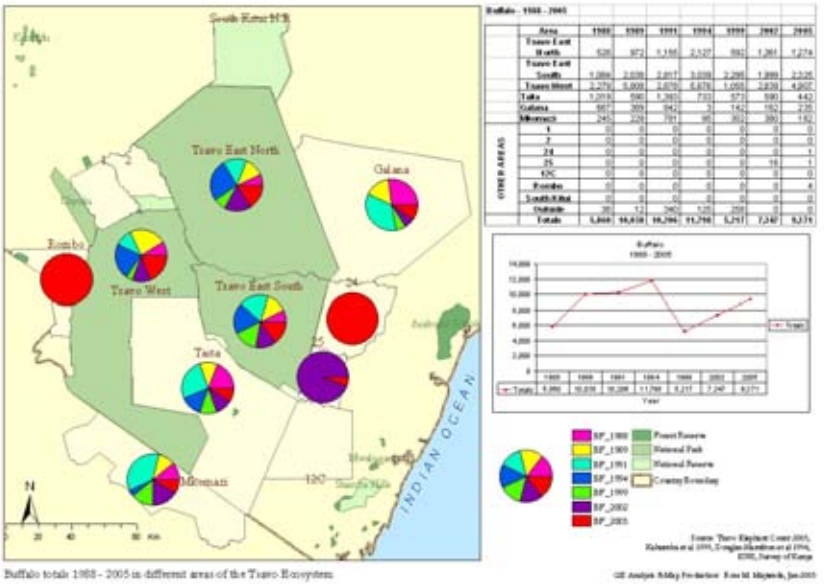


Fig.12. Trends in Buffalo numbers between 1988 and 2005.

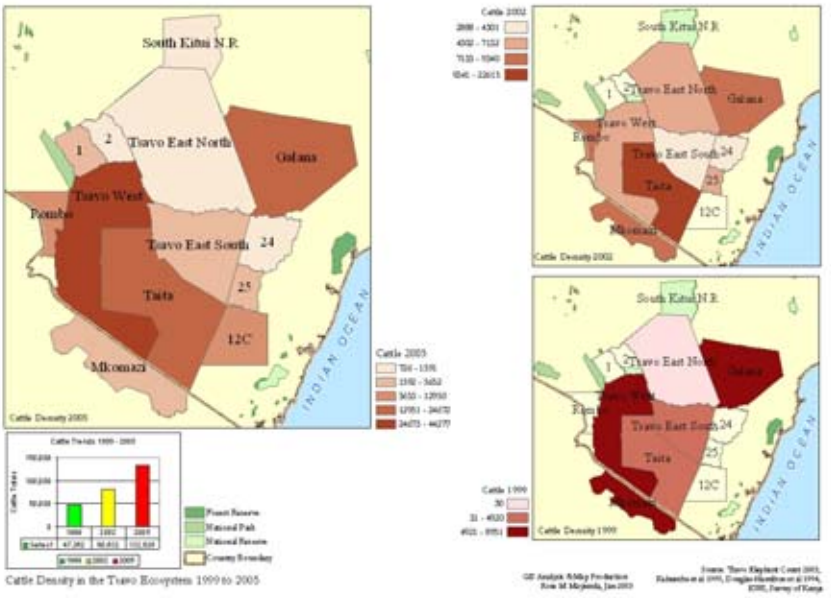


The distribution of all other wildlife species show that most of the wildlife in the ecosystem prefer to stay inside the parks except the giraffe and the zebras whose distributions in the ecosystem are almost even (Figs 6&7). The same case was observed for the elands. This phenomena may indicate less attachment by these species to water.

Livestock

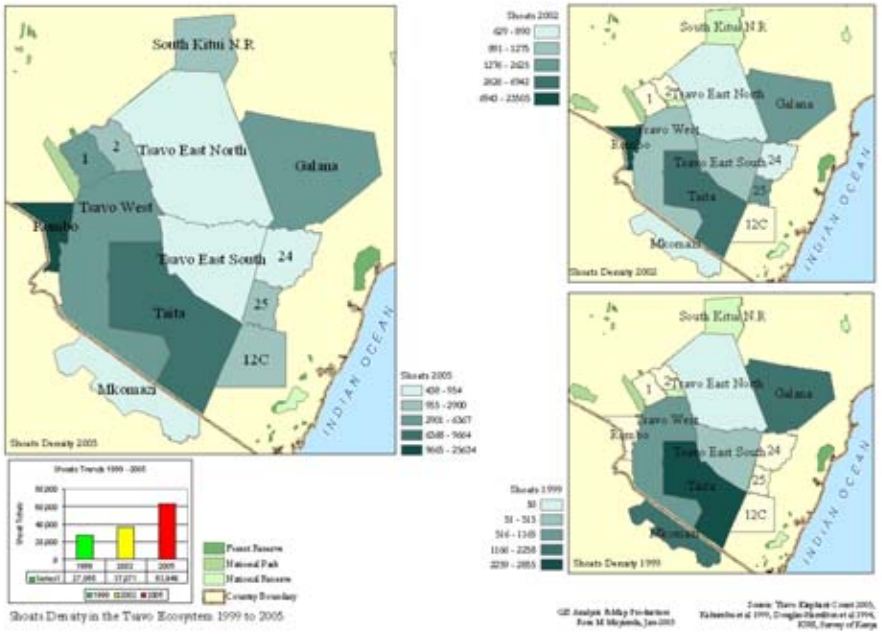
Livestock numbers especially that of cattle has continued to increase inside the parks. According to Kahumbu et al (1999), the number livestock inside Tsavo East was less than a hundred in 1999 but by 2002, Omondi et al recorded an increase to 1,834 and 9,491 shoats and cattle respectively. During this count (2005) Tsavo East recorded a decline of 26.9% and 49.1% in the number of shoats and cattle respectively since 2002. The number of livestock in Tsavo west has drastically increased since 2002. Cattle have increased by 520% while the shoats have increased by over 320% See Fig. 13 and Fig. 14.

Fig. 13.Cattle Trends 1999, 2002 and 2005



The number of livestock in the parks has increased from 16,623 cattle and 3,109 shoats in 2002 to 49,102 and 6,699 respectively in 2005. These trends are alarming and pose a great challenge to park management. Their presence inside the park may led to increased human-wildlife conflicts, as well as causing serious ecological imbalances through habitat destruction as observed in some parts of Tsavo West National Park. Apart from the potential ecological impacts, livestock are competing directly with wildlife for limited resources such as grazing and water. Such competition is a disadvantage for both groups as it may increase chances of disease transmission between livestock and wildlife. The continued presence of livestock in the parks may also force wildlife to move out into adjacent private lands leading to increased conflicts. The cause of this livestock influx into the parks may be attributed to overstocking in adjacent ranches and private farms which has forced livestock owners to encroach in search of water and forage. To address this problem there is need to enforce the wildlife laws and provide water outside the Parks. Encouraging locals to practice good husbandry such as stocking appropriate number of livestock would also minimise the number of animals encroaching into the park.

Fig. 14 Trends of Shoats in 1999, 2002 and 2005



Several human activities (Apendix 1) such as charcoal burning, mining, logging, snare lines and fires were also recorded during the survey. Charcoal burning was limited to areas outside the parks except on the northern boundaries of Tsavo West National Park near Chyulu area. Intense charcoal burning was also observed to the south-eastern parts of Tsavo East National Park. This area also had some snares both outside and inside the park. Logging was mainly confined outside the parks especially in Taita ranches, Galana Ranch. Once again quite a number of logging sites were recorded in Northern Tsavo West towards the Chyulu.

Conclusion

The results in this count have indicated that Tsavo elephant population is recovering from intensive poaching for commercial ivory trade that reduced the numbers from over 35,000 (1974) to just over 5,000 (1988) . Because of increasing human population in areas adjacent to the PA's the ecosystem is expected to be able to accommodate a population of up to 20,000 animals, particularly if water, which is seen as major factor in determining distribution, is provided in northern Tsavo East.

From the results obtained, buffalo numbers have also continued to increase. This shows some recovery from the impacts of disease outbreaks in the 70's. As for livestock, the numbers in the PA's are alarming and the management should take an active role in minimizing this in order to contain potential habitat degradation and disease transmission. To achieve this, there is need to boost surveillance along the Parks boundaries by deploying more resources as well as providing water outside the PA's. The provision of water would reduce the pressure being exerted on the parks by the pastoralists. Other stakeholders such as the Ministries of Livestock, Agriculture and Water should take an active role in formulating appropriate policies on land use outside that do not conflict with conservation of wildlife. Human activities in parts of the parks were also evident and this can only be addressed by improving on patrols.

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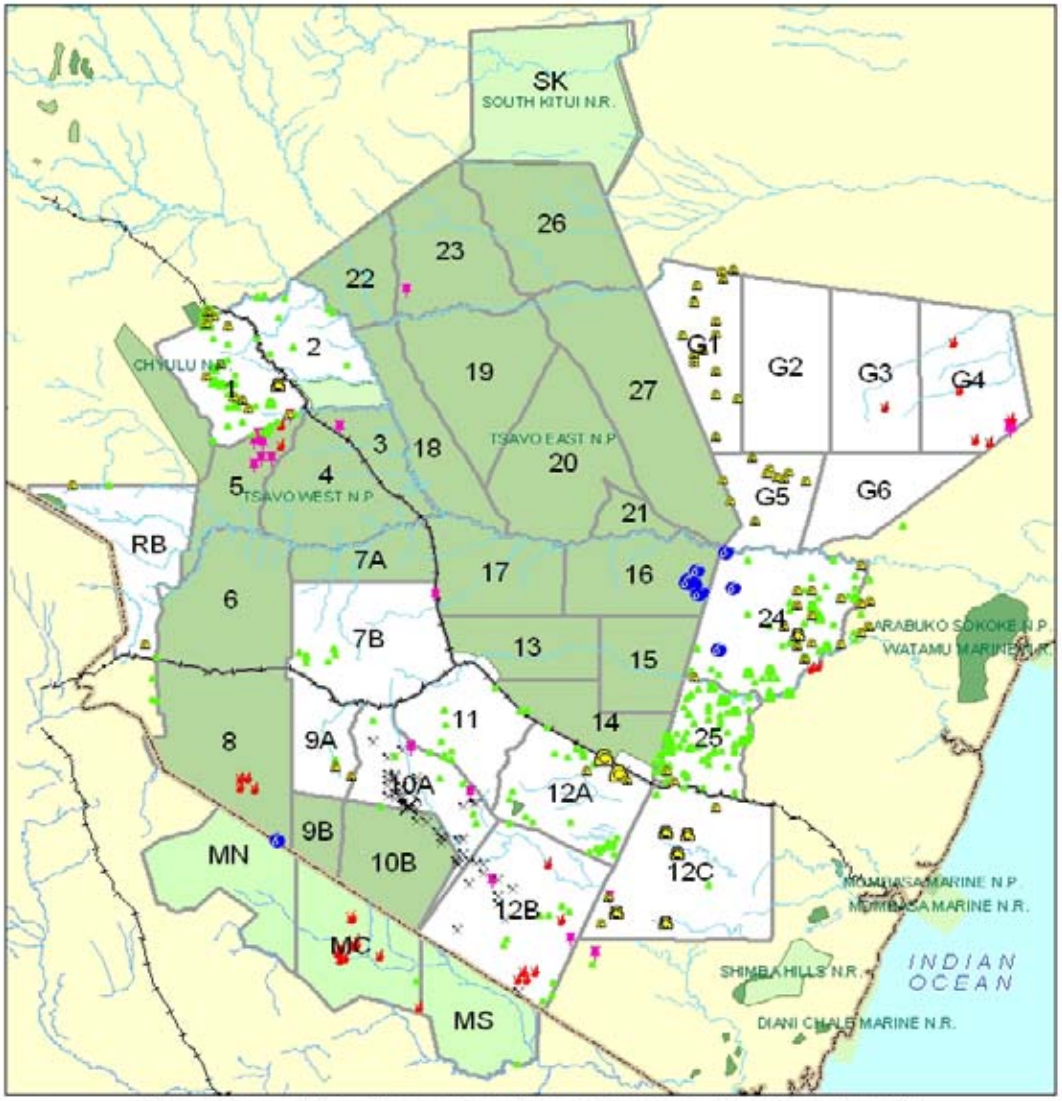
Appendixes
Appendix 1Human activities in the tsavo Ecosystem



Charcoal Burning, Mining, Logging, Snare Lines and Fires in the Tsavo Ecosystem 2005

Rivers	Charcoal Kilns	Charcoal Bags	Logging	Mining	Fire	Tsavo Ecosystem Blocks
Railway	1 - 6	1 - 10	1	1	1 - 2	Forest Reserve
Snare Lines	7 - 23	11 - 30	7	10	3 - 5	National Park
1 - 2	24 - 70	31 - 70			6 - 9	National Reserve

N

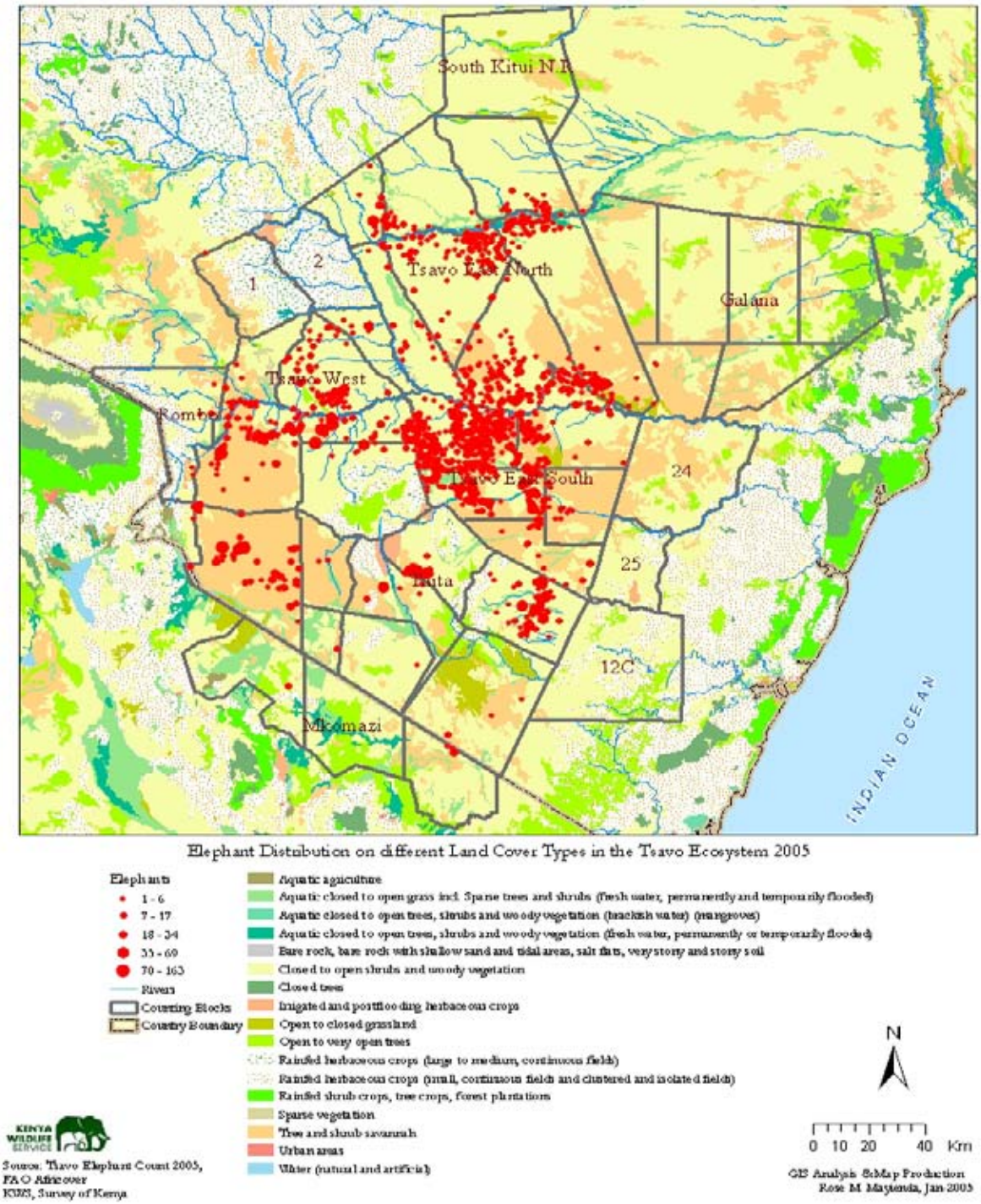
Km 0 10 20 40

KENYA WILDLIFE SERVICE

Source: Tsavo Elephant Count 2005, KWS, Survey of Kenya

GIS Analysis &Map Production Rose M Mayienda, Jan-2005

Appendix 2: Elephant Distribution on different land cover Types in Tsavo Ecosystem



Appendix 3: LIST OF PARTICIPANTS

PILOTS

1. Bongo Woodley
2. Capt. Mulonzi
3. Capt. Rattray
4. Danny Woodley
5. Donno Dunn
6. Julius Leperes
7. Justin Bass
8. Peter Zannetti
9. Robert O'Brien
10. Mike Rose

FSOs

11. Barbara McKnight
12. Bernard Raburu
13. Capt. Minja
14. Dr. Swain
15. Edison Nuwamanya
16. Elphas Bitok
17. George Muriuki
18. Mike Fay
19. Moses Litoroh
20. Patrick Omondi
21. Rob Dodson
22. Salome Gachago
23. Samuel Andanje
24. Simon Mafole

RSOs

25. Alex Mwazo
26. Alfred Masila
27. Anthony Wandera
28. Apollo Kariuki
29. B.B Dhar
30. Chris Chelule
31. David Kones

32. David Korir
33. Dorothy Amwata
34. Edwin Maitho
35. George Mwangi
36. Hesbon Kamula
37. Irene Amoke
38. Jacob Mwanjala
39. Peter Masinde
40. Lineus Kariuki
41. Jackson King'oo
42. Moses Thondu
43. Jaya Prasad
44. John Kariuki
45. Julius Muriuki
46. Michael Kipkeu
47. Onesmas Kahindi
48. Paul Kipkoech
49. Shadrack Ngene
50. Steven Nyaga
51. Wellington Gathungu

52. GROUND TEAM

Drivers
53. Alfred Chagava
54. Edwin Nyoike
55. Peter Muthembwa

GIS personnel
56. Boniface Mworia
57. Christian Lambrechts
58. Janet Akinyi
59. Joseph Mukeka
60. Rose Oloo

Communications & Multi Media
61. Charles Ooro
62. Edward Indakwa

Aircraft Engineer & attendants
63. Christopher Muithia
64. Eng. Samson Sanare
65. Leonard Mwangangi

Support Staff
66. Benson Mugavi
67. Donald Onyoni
68. Juliet Bass
69. Phyllis Thuku

Security
70. Cpl Joseph Legei
71. Rgr Osman Tomno
72. Rgr Douglas Shibeka
73. Rgr Dickson Kiloku