Population dynamics and elephant movements within the Associated Private Nature Reserves and adjoining Kruger National Park

Progress Report
November 2003

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1.1 Aims

In keeping with the mission statement of Save The Elephants (STE) this project ultimately aims to help secure a future for the elephants by taking advantage of opportunities for:

1) monitoring individually identified animals
2) satellite tracking technology
3) understanding the population dynamics and movement of elephants within the Associated Private Nature Reserves (APNR) and the adjacent Kruger National Park (KNP).

1.2 Objectives

1) To determine how many elephant bulls use the APNR.
2) To determine how many breeding herds frequent the APNR.
3) To identify the big tuskers that frequent the APNR.
4) To determine the movement of elephants within the APNR and adjacent areas. As these reserves are linked with the KNP and other Trans-frontier Reserves in Mozambique and Zimbabwe, the study can potentially provide information on the movements of elephants at a meta-population level.
5) To determine the changes in the density of elephants within the APNR and how this changes over time and whether these changes are through births, deaths or elephant movements to and from the KNP.
6) To establish the extent to which elephants frequent different parts of the APNR and KNP.
7) To determine whether food resources and/or social and safety benefits motivate elephant movements.
8) To quantify the impact of elephants on specific tree species.

1.3 Duration:

The following work plan covers the six month period since the project was officially started on the 1st of June 2003.

Period	Activity
1 June – 15 June	Setting up of the research office
15 June – 15 September	Fieldwork: collecting elephant identification records Writing and distributing the first newsletter Writing, distributing and collecting questionnaires Preparation of reports
20th of August	Re-collaring Mac
16 September- 22 September	International Conference attendance in Sri Lanka. Symposium on Human-Elephant Relationships and Conflicts. Paper delivered entitled: *Green Hunting as an Alternative to Lethal Hunting*- Greyling M.D., McCay M., Douglas-Hamilton I. (**Appendix 1**)
25 September- 5 October	Visiting Save the Elephant's research camp in Samburu National Park, Kenya. Please refer to attached report (**Appendix 2**)
10 October- 25 November	Fieldwork: collecting elephant identification records Preparation of reports and the next newsletter

1.4 Materials and Methods:

1.4.1 Identification of individual elephants

Both photographs and drawings of the unique patterns of tears, nicks, holes and veins in the ears of all sighted elephants were collected. These records were kept to enable the recognition of individuals at different localities. The Global Positioning System (GPS) location, group size and composition, tameness index as well as the reproductive status of sighted animals were also documented.

1.4.2 Elephant movements

To track the movements of elephants, a total of 30 satellite collars will be placed on 18 bulls and 12 matriarchs from independent family units over the next five years. To date, only one satellite collar has been deployed on Mac, one of the large tuskers within the APNR. The data on Mac's location was accessed via the programme MS Track Pro and the GPS locations were imported into ArcView GIS 3.2. Mac's travelling speed was estimated between various centres of activity by dividing the distance covered (in kilometres) by the time taken (in hours) to move from one hotspot to the next.

Re-sightings of known individuals throughout the reserves will provide information on elephant distribution patterns over time.

1.4.3 Communication with landowners, lodge mangers, share block owners and other interested parties

The first edition of 'Elephant News' was distributed to 516 people which included the wardens, landowners, lodge managers, share block owners of the APNR and other interested parties such as potential sponsors. This newsletter will be used to generate interest in the project, to encourage donations, to acknowledge sponsorships and to set up a communication base with all relevant parties. The newsletter will be distributed three times a year.

Questionnaires were also distributed to the wardens, landowners, lodge managers and share block owners. To date, 76 questionnaires (under a quarter of those sent out) have been returned. Small frequencies within certain categories of the questionnaire prevented the use of log-linear analysis to determine which category differed significantly from each other (Plackett 1964). Hence I here report on the percentage of respondents which agreed, disagreed or were neutral in their opinions concerning hunting, research, management and their support of the project. As more questionnaires are completed and returned Chi square tests will be used to test for differences between categories. If associations proved significant, log-linear models will thereafter be used to determine which cells within the contingency table differ significantly from expected values (Christensen 1990). All analyses will be done with SAS (Anon. 1989).

The questionnaires will be used to identify specific woody plant species which will be monitored for elephant impact based on the concerns raised by landowners. Previous fieldwork on the utilisation of the vegetation by elephants within the APNR identified five plant species i.e. *Grewia* spp., *Acacia nigrescens*, *Colophospermum mopane, Sclerocarya birrea* and *Lannea schweinfurthii* that may be of possible concern to landowners, lodge mangers and share block owners. In addition the respondent could specify other species of concern. The respondent was asked to rank the species in a decreasing order, ranging from those woody plants that they were most concerned about to those of least concern. Species listed under 'other' by the respondent follow numerically from those provided in the questionnaire. For example if the last species was ranked '3' then all 'other' species were assigned the numerical value of '4'. To enable analyses the data were grouped into the following three categories followed by the corresponding numerical values in brackets: 'concerned' (1-2), 'moderately concerned' (3-4) and 'least concerned' (including all species that weren't marked as well as any species ranked fifth or higher). Questionnaires in which plant species of concern were marked by the respondent but a numerical ranking was omitted were not incorporated into the analysis to prevent biasing the results.

1.4.4 Determining the proportion of the population removed through either hunting or natural causes.

All records of elephant deaths were obtained from the wardens. Where data were lacking, historical records were consulted to gather information on elephant deaths for the past 12 years. The proportions of animals dying of natural causes were first calculated separately before the addition of deaths due to trophy hunting. All deaths caused by means other than trophy hunting were classified as being 'natural'. Where the lower jaw of a carcass was available, the animal was aged according to the categories used by Laws (1966).

1.5 Results and discussion

1.5.1 Identification of individual elephants

A total of 98 individual bull elephant's identification records have been collected. These records will be added to the existing database of 528 individual elephants collected from 1997 until 2002 and systematically checked to establish whether any of these bulls represent re-sightings from previous years. Ten different bulls have been re-sighted regularly since the study was innitiated.

The identikits of individuals within 11 independent family units have also been collected. Not all individuals within these family units have been identified.

1.5.2 Elephant movements

With time, re-sightings will provide valuable information on elephant movements. Before re-sighting information can be used to its full extent I would first need to reach a plateau in the number of new sightings over time (Figure 1) and thereafter establish a set driving protocol to equalise the distribution of data collection across habitat types. As new sightings are still a regular occurrence throughout the APNR, I have not reached the desired plateau region.

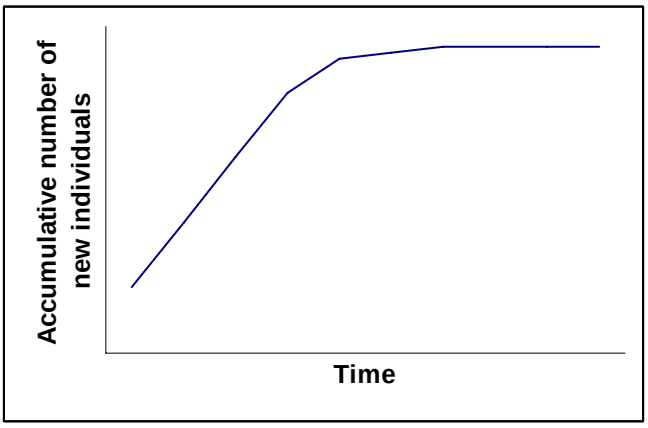


Figure 1 Schematic representation of the data obtained from elephant identification studies. Once the plateau region has been reached and the majority of elephant sightings are of known individuals, specific questions can be addressed i.e. whether social-, safety- or nutritional benefits motivate elephant movements.

The last report (August 2003) gave a detailed account of the home range size, utilisation hotspots and patterns of movement of Mac, the satellite collared individual. As Mac is following a similar pattern of activity to that of 2002, I here report on his movements since his re-collaring on the 20th August 2003 (Figure 2). From August until the 26th of November Mac has moved approximately 569 km (Figure 3). Five 'hotspots' along his route north can broadly be described as having sufficient water with *Colophospermum mopane* featuring as the dominate vegetation type. Although Mac moved the greatest distance between Letaba (hotspot 3) and Mooiplaas (hotspot 4), he moved the fastest between Mvubu spring (hotspot 2) and Letaba (hotspot 3) averaging 1.2 km/h (Table 1).

Table 1 Landscape features relating to 'hotspots' along Mac's route north after leaving the Associated Private Nature Reserves in August 2003. The speed of travel and distance covered between and within hotspots are also indicated.

Hotspot number	Area	Approximate distance travelled within hotspot	Soil type	Vegetation type	Available water sources	Approximate distance travelled between hotspots	Speed (km/h)
1	±3 km west of Luttig Trust and Buchner properties in the Umbabat	16 km	Granite	Mixed Bushwillow/ Mopane Bush Savanna	Peru south (borehole)	From re-collaring site to hotspot 1: 18 km	0.6
2	± 5 km north east of the boundary of the Buchner property in the Umbabat	12 km	Granite	Mixed Bushwillow/ Mopane Bush Savanna	Mvubu (spring)	From hotspot 1 -2: 8km	0.3
3	10-30 km west of Letaba	211 km	Granite	Mixed Bushwillow/ Mopane Bush Savanna Mopane Shrub Savanna	Jumbo, Nandzana, Xivhulani, N'wanetsi, Shongile, Ledeboer (boreholes) Shipukuyika (natural pan) Nwashidzundzu (spring)	From hotspot 2-3: 39km	1.2
4	± 5 km east of Mooiplaas	60 km	Basalt	Mopane Shrub Savanna	Nshawu, Nwatimofu (boreholes)	From hotspot 3-4: 52 km	0.5
5	5-10 km south of Shigwedzi	122 km	Basalt	Bushwillow/ Mopane Rugged Veld Mopane Shrub Savanna	Maxagadzi, Ndlophiini (boreholes) Dzombo, Kannidood (dams)	From hotspot 4-5: 31km	0.7

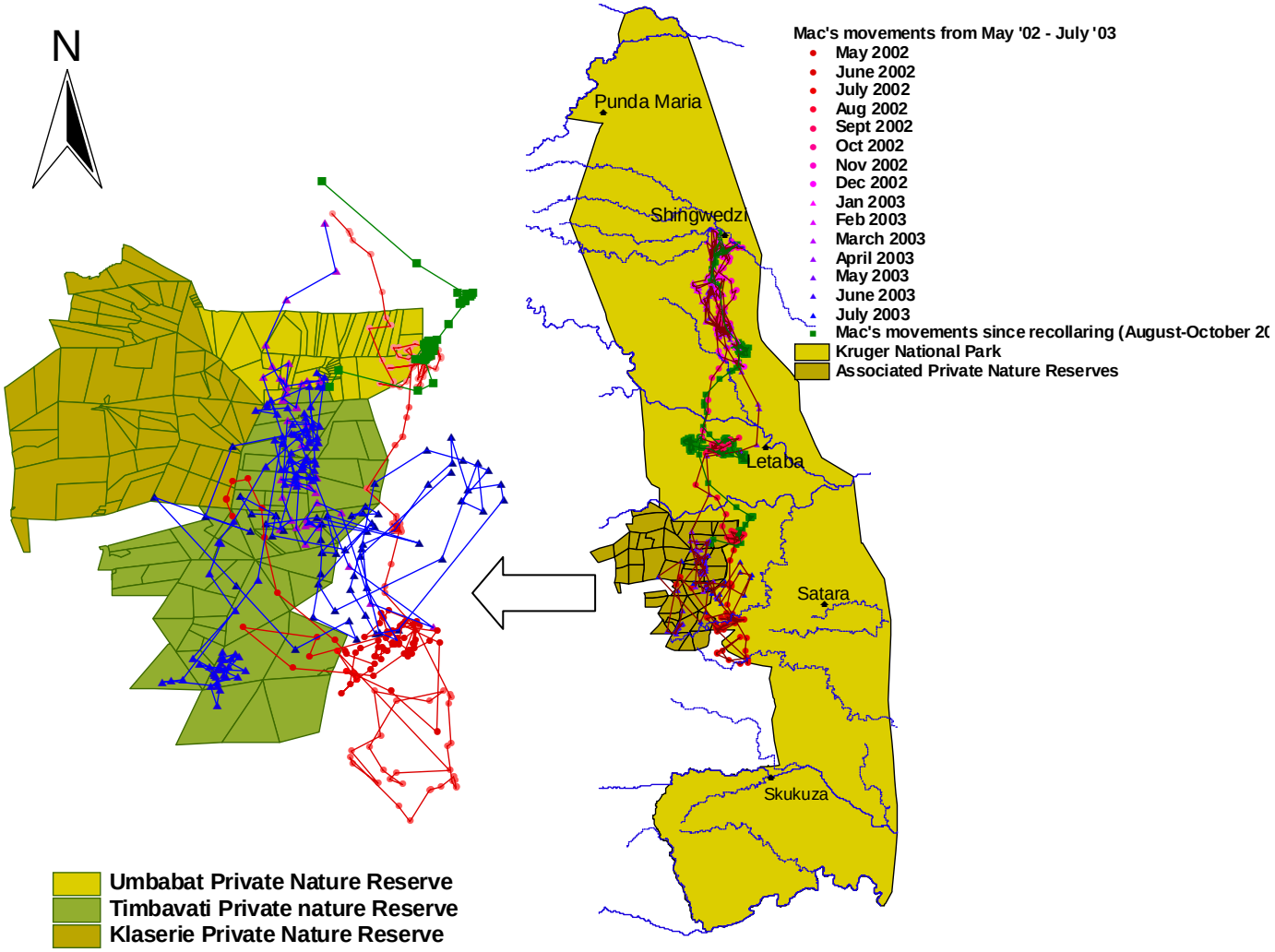


Figure 2 The movements of Mac from May 2002 until November 2003.

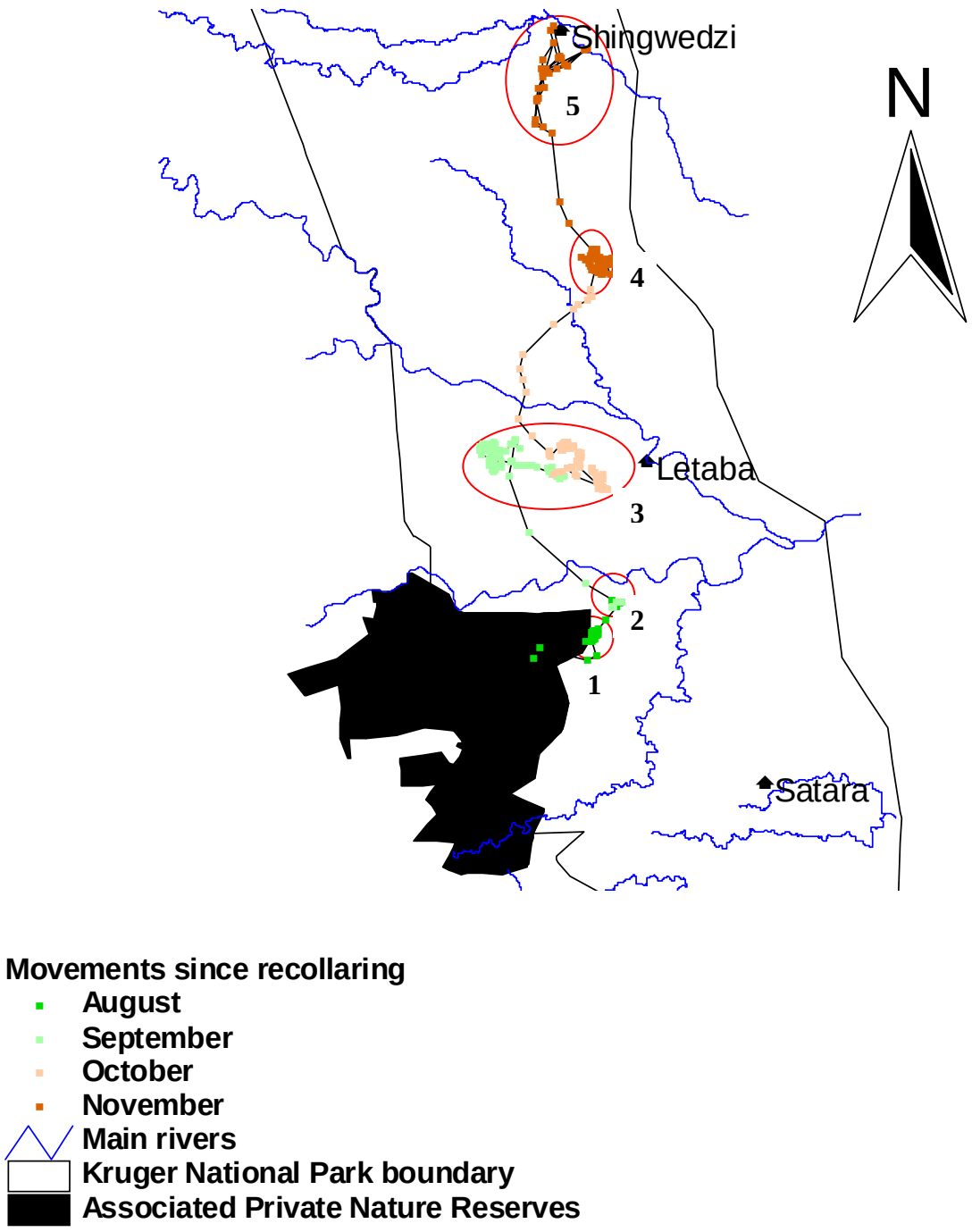


Figure 3 Mac's movements since his re-collaring on the 20th August 2003. The numerical 'hotspots' are described in Table 1.

1.5.3 Questionnaires

The majority of respondents were in favour of green hunting elephant and rhinoceros. While landowners were almost equally divided between agreeing and disagreeing with trophy hunting elephant, they were clearly opposed to trophy hunting rhinoceros and predators. Respondents disagreed with the culling of impala and buffalo but either agreed or disagreed with the culling of elephant to an almost equal extent (Figure 4).

Grewia spp. and *Colophospermum mopane* were identified as woody species of least concern to landowners while *Acacia nigrescens* and *Sclerocarya birrea* were of greatest concern to the respondents. Other plant species of possible concern to the respondents, with regard to elephant utilisation, included *Acacia gerradii*, *Acacia mellifera, Acacia tortilis, Albizia amara, Albizia harveyi, Boscia albitrunca, Combretum apiculatum, Combretum imberbe, Commiphora* spp., *Dalbergia melanoxylon, Diospyros mespiliformis, Lannea discolour, Lonchocarpus capassa, Manikara mochisia, Pterocarpus rotundifolius, Schotia brachypetala, Sterculia rogersii, Xanthocercis zambesiaca.* These species were however infrequently listed by respondents. The majority of landowners thought that the vegetation structure had changed over time with bush encroachment increasing and tall trees being lost to the system (Figure 5).

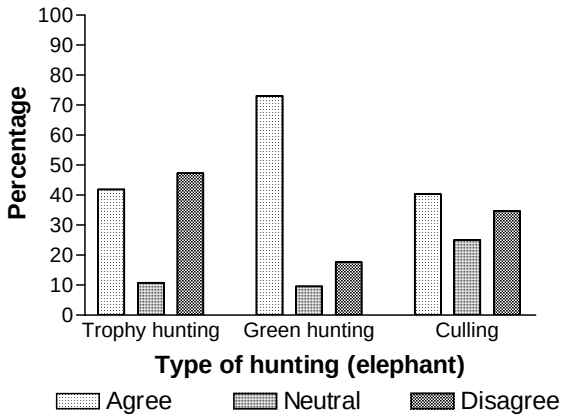
All respondents were clearly in favour of research programs involving either baseline monitoring, research on threatened species or species of economic value to the APNR (Figure 6).

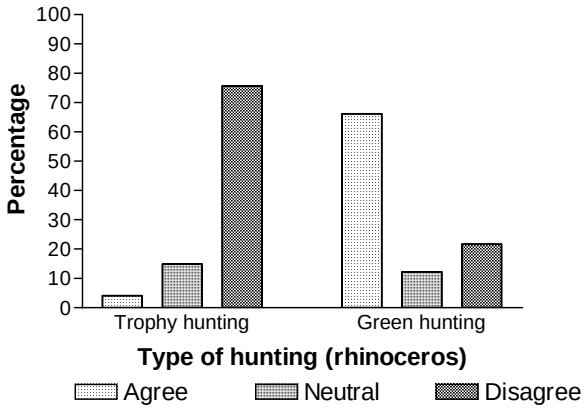
The respondents were clearly in favour of the dropping of the western boundary fence of the KNP. The largest proportion of respondents agreed to the closure of excess waterholes. Landowners were also prepared to assist and support research programs to various extents (Figure 7).

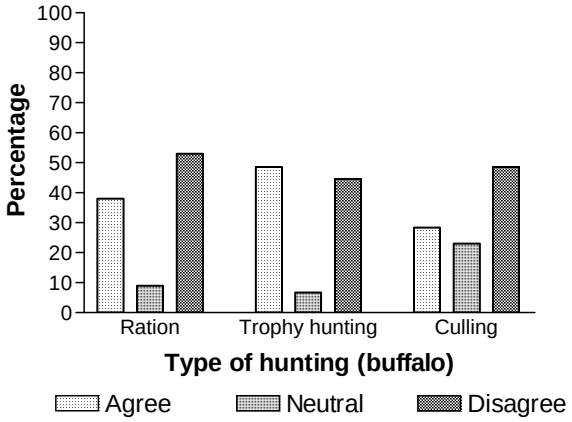
1.5.4 Proportion of the population removed annually through trophy hunting and natural causes

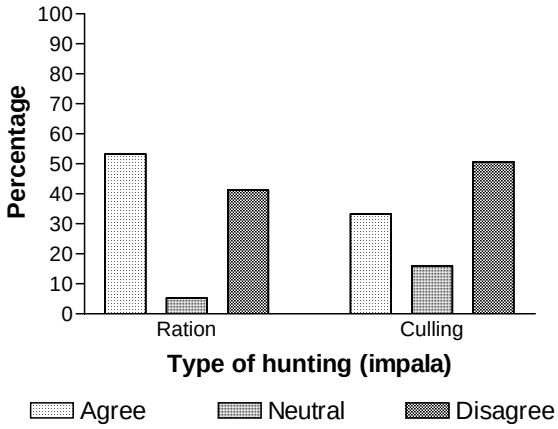
Whyte (2001) estimated the mortality rates for the Kruger National Park elephant population at 3.2% per year. Although the elephant population has increased within the APNR over the past 12 years, mortality rates have decreased. The estimates obtained in Table 2 are however likely to be an underestimate. Trophy hunting records had to be divided into minimum and maximum numbers as the numerous records that were consulted (De Villiers 1994, warden's reports, questionnaires to landowners, outfitter's records and Environmental Affairs and Tourism reports) produced different figures for the same year. The minimum number of trophy animals shot within a year was thus used in the calculations. Furthermore, not all elephants that died due to natural causes would have been recovered or reported.

The most trophy hunting took place from 1992-1995 when 43 animals were shot, thereby artificially inflating the mortality rates calculated during this period. Fifteen bulls were trophy hunted from 1996-2003. When the effects of trophy hunting are excluded from the analysis, natural mortality rates have remained below 1% for the past 12 years. From the lower jaws that were recovered, most animals were bulls and approximately 39 years of age (Table 3).









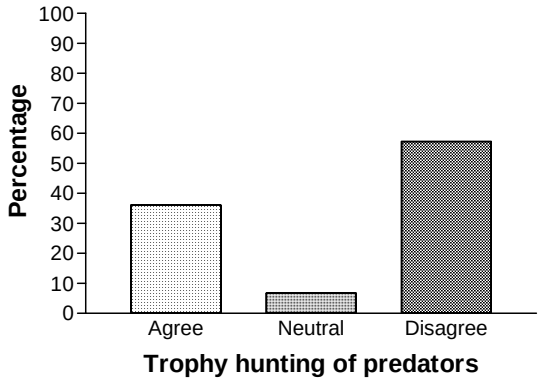
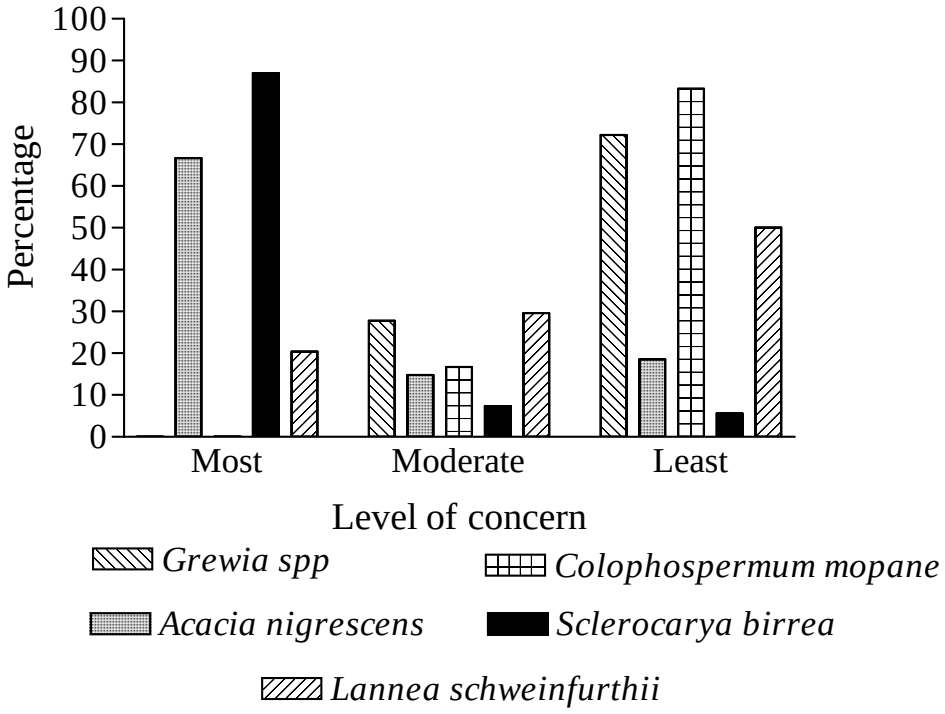


Figure 4 The proportion of questionnaire respondents that were either in agreement, disagreement or indecisive towards different hunting activities of elephant, rhinoceros, buffalo, predators and impala.



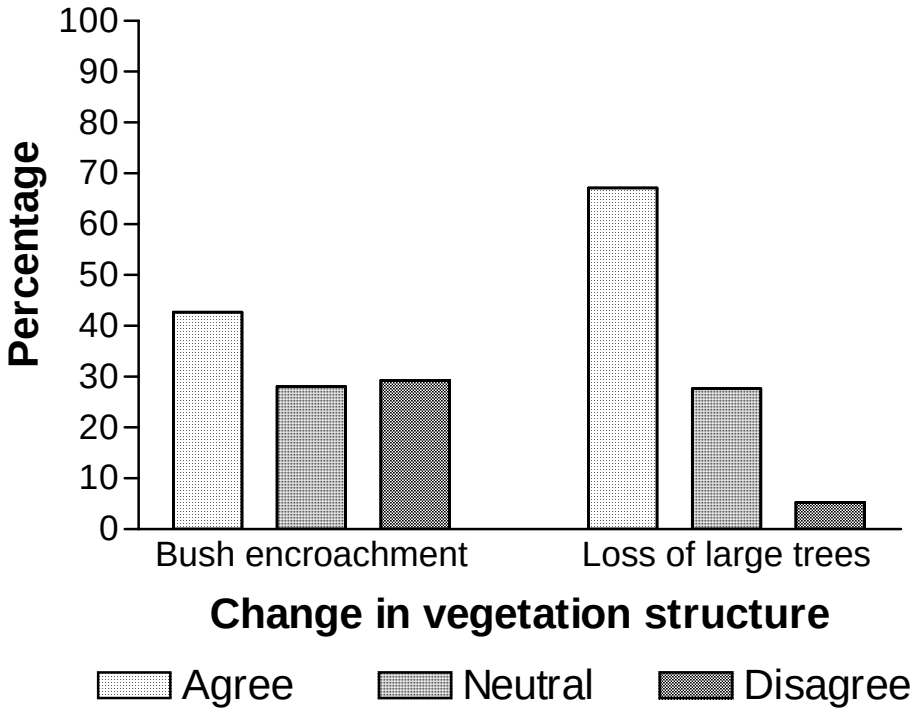
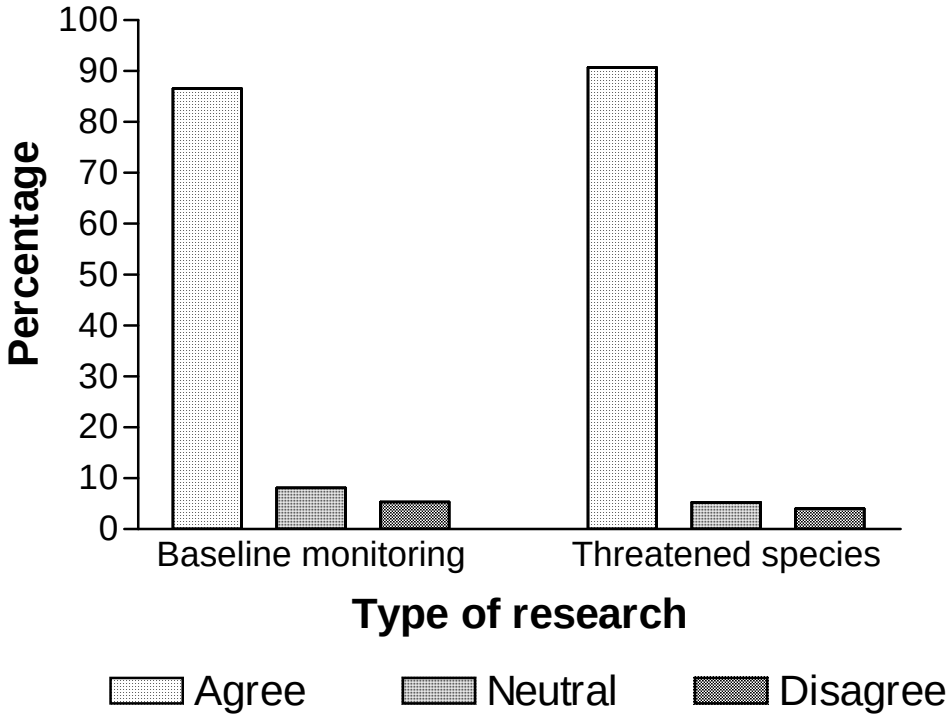


Figure 5 The proportion of questionnaire respondents most concerned, moderately concerned or least concerned about the utilisation of woody species by elephants. The second figure depicts respondents' opinions on the changes in the vegetation structure.



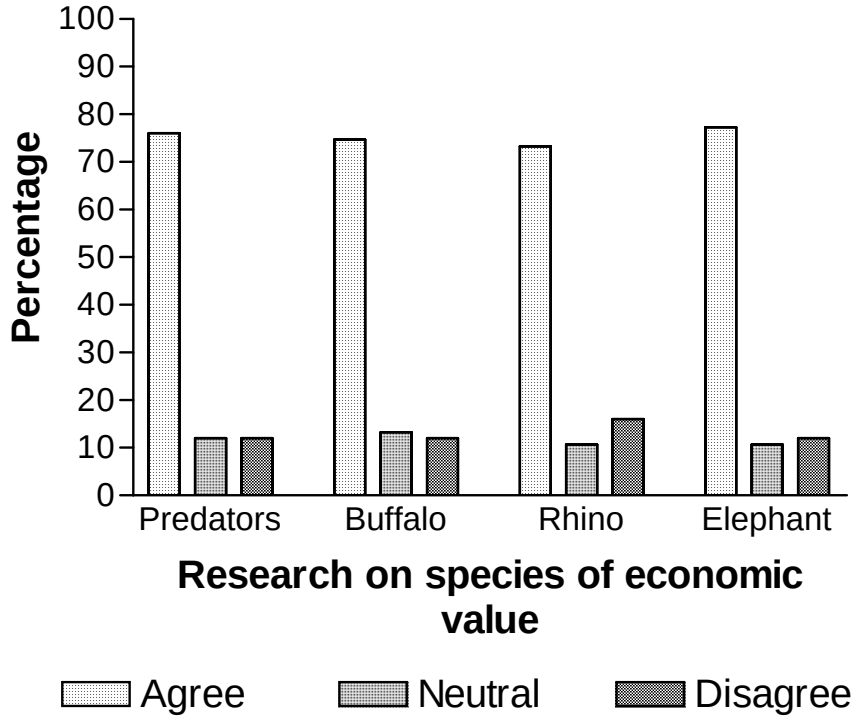
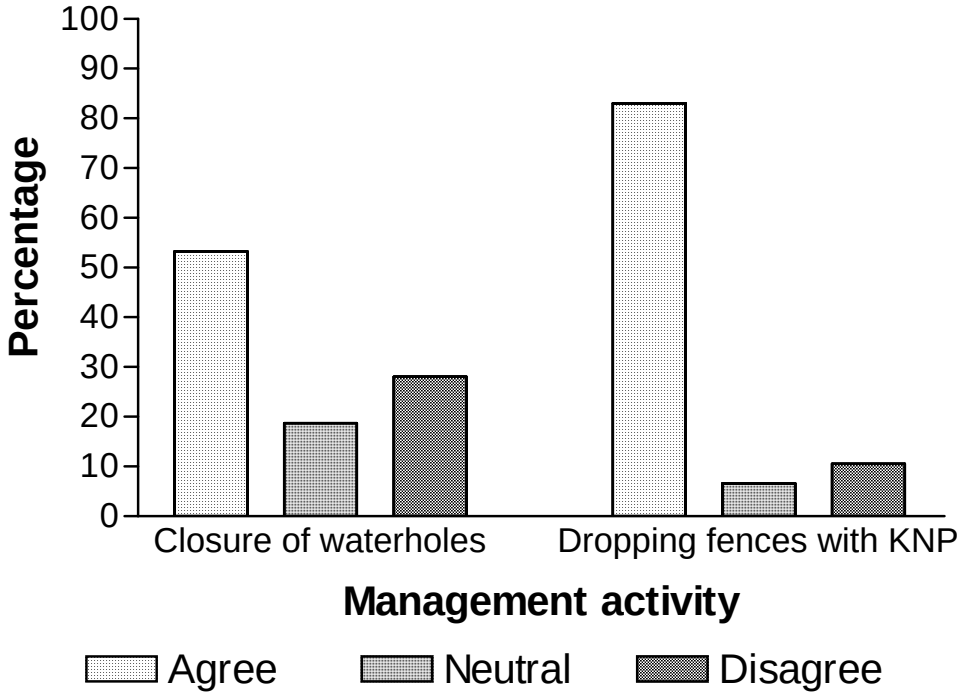


Figure 6 The proportion of questionnaire respondents that agreed disagreed or was indecisive about various research activities.



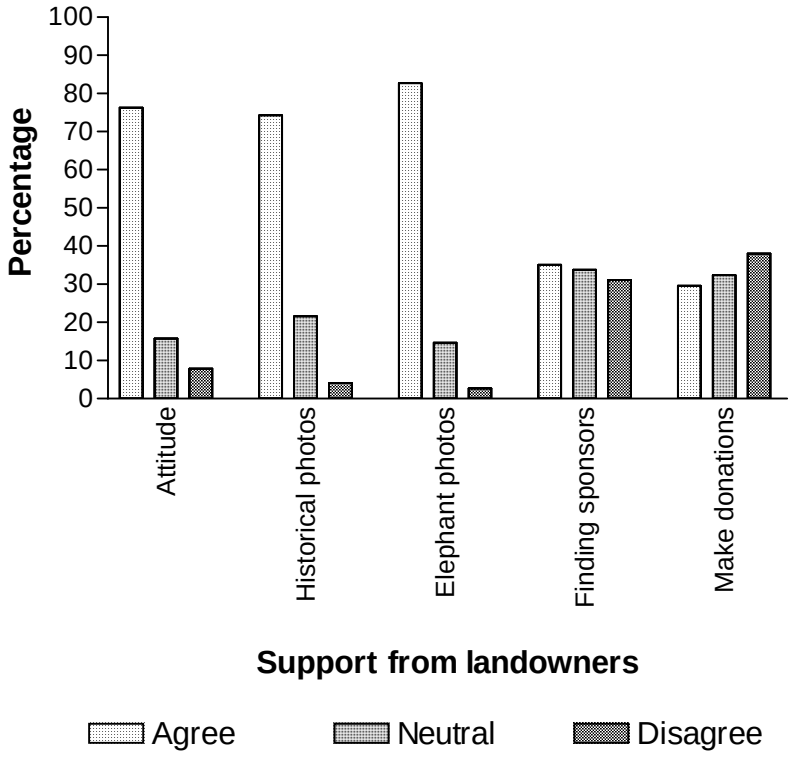


Figure 7 Questionnaire respondents' opinions on specific management activities. The second figure illustrates the respondents' attitude towards researchers and well as the type of assistance they are prepared to offer.

Table 2 Census figures, deaths through natural causes and trophy hunting figures for the elephant population of the Timbavati, Klaserie and Umbabat Private Nature Reserves over the last 12 years.

Year	Census figures					Natural mortality				Trophy hunting					Total deaths	%
	KNP	UPNR	TPNR	KPNR	APNR	UPNR	TPNR	KPNR	APNR	UPNR (min)	TPNR (min)	KPNR (min)	Min APNR	Max APNR		
1992	7632	72	209	232	513	0	2	2	4	1	3	8	12	18	16	3.1
1993	7834	37	207	180	424	0	0	0	0	1	2	8	11	12	11	2.6
1994	7806	117	187	207	511	0	0	1	1	0	4	6	10	10	11	2.2
1995	8064	225	240	61	326	1	0	0	1	2	3	5	10	11	11	3.4
1996	8320	25	223	107	355	0	2	1	3	2	0	0	2	2	5	1.4
1997	8371	134	322	303	759	0	3	1	4	0	3	1	4	4	8	1.1
1998	8869	87	314	216	617	0	3	2	5	0	0	2	2	3	7	1.1
1999	9152	79	331	226	636	0	2	2	4	0	0	1	1	2	5	0.8
2000	8356	98	198	430	726	0	0	2	2	1	0	0	1	1	3	0.4
2001	9276	189	522	113	824	0	1	0	1	0	0	2	2	2	3	0.4
2002	10105	88	372	467	927	0	3	1	4	3	0	0	3	4	7	0.8
2003	11672	86	363	305	754	1	2	4	7	0	0	0	0	0	7	0.9
total						2	18	16	36	10	15	33	58	69	94	

Table 3 Ages of recovered lower jaws within the APNR

Age	Amount in age group
11	1
14	1
16	1
30	2
32	1
39	4
43	1
45	1
>60	1
unknown	1 (teeth missing from jaw)

1.5.4 Conclusion

This report highlights the interest and potential to expand and extend the collection of elephant identikits. Mac has shown us to what extent his movements follow a similar pattern when compared to 2002. We look forward to following him in the Kruger National Park to assess whether he is associating with other bulls whilst not in musth. We hope to gather important information during his next musth cycle when he returns to the APNR. Preliminary results obtained from the questionnaire have indicated that landowners are in favour of green hunting, that vegetation surveys should be directed towards the monitoring of *Sclerocarya birrea* and *Acacia nigrescens* and lastly that they support and are willing to assist research programs within the APNR. The importance of documenting all elephant deaths and collecting the lower jaw from the carcass was discussed and illustrated by the information that was presented.

1.5.5 Acknowledgements

I would like to acknowledge the wardens, Scott Ronaldson and Colin Rowles, for their logistic support of the project. Save The Elephants and David and Marlene McCay from Tanda Tula Safari Camp are thanked for their financial support of the project. Giles King and other staff members at Tanda Tula Safari Camp are thanked for their logistic support while the rangers assisted in the collection of identikits. Yuval Erlich also assisted in collecting elephant photographs. All parties, too numerous to mention, which were actively involved in the searching and re-collaring of Mac are, once again thanked for their enthusiasm and support. The Kruger National Park with special reference to Dr. Ian Whyte and Mr. Richard Sowry are thanked for all their logistical support. Last but not least I am grateful to all the respondents of the questionnaires as well as the numerous landowners who have sent photographs of elephants and who are keen to become actively involved in the project.

1.5.6 References

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