



soon to become

Review on the deployment and current status of GPS collars  
deployed by  
Save the Elephants – South Africa  
since 2002

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July 2013



## **Introduction**

Save the Elephants – South Africa has three study sites within Great Limpopo Transfrontier Park. At each of these study sites we have deployed GPS collars. The aim of the telemetry programmes was specific to each study area. In total, we have collared 56 elephants during 89 collaring operations in the western, eastern and northern regions of the Kruger National Park (KNP) since 1998. The distribution data are backed up with observations in the field, recording changes in associations between individuals, musth status and the elephant's reactions to observers (perception of risk). Within the Associated Private Nature Reserve (APNR) we have fitted 36 elephants with collars since 1998. We currently have distribution data from eight breeding herds and 28 bulls (ranging in age from 12 to 50 years) within these Private Reserves, spanning more than 10 years. Within the neighbouring Kruger National Park, we have collared 14 bulls and 6 breeding herds since 2006.

In the APNR or western KNP study site, we sought to have approximate 30 collars deployed concurrently in this area as a representative sample of the elephant population to correlate distribution and movement patterns with differential habitat conditions, the social landscape and elephants' perception of risk. In the central Kruger we deployed collars on seven adult bulls to monitor movements from the Park into Limpopo National Park in Mozambique. We also removed and recollared a number of APNR study animals in this region in addition to collaring a new large tusked individual (KCM01). In the northern Kruger, collars were deployed on six bulls and six cows to determine seasonal movement patterns to and from the far northern section of the Park and to establish if there was movement between KNP and Gonarezhou National Park in Zimbabwe and if so the route taken by elephants when moving between these Protected Areas. Sample sizes are aimed at having a sufficient number of concurrently collared study individuals to identify representative patterns of movement within the noise generated by individual variability, that are monitored for long enough to account for natural environmental variability.

The objective of this report is to provide a comprehensive review of the status of STE-SA collars deployed in the APNR and which are currently in the field (end of July 2013) and to make recommendations for the immediate future. We have also tried to present concise summaries which put the telemetry data into their spatial and temporal context to better understand the data and assist the ongoing process of redefining our objectives.

### **Summary with reference to Figures 1 to 2 and Tables 1 to 5:**

- In 2008 we had the highest number of concurrently deployed collars (27) within the APNR (Figure 2).
- Three new study animals were fitted with collars from 2010 onwards.
- To secure the desired number of concurrently deployed collars within the APNR-Kruger west study area we have manipulated collar schedules over time to balance data needs with the lifespan of the collars. The downloading interval of the deployed collars was increased to four hour intervals in 2010 to extend the battery life of the collars. The intention being to acquire sufficient independent data to evaluate habitat selection throughout the diel cycle while extending the life of the collars so that we could raise sufficient funds to meet our original objective of having 30 collars active at the same time.
- In 2010 to 2011, ten collars which may have reached their battery life limit, were replaced in an attempt to keep to the target of 30 concurrently running collars. Eight of these replacements involved GPS satellite collars as they had proved to be more reliable and capable of providing real-time tracking data whilst at the same time developments by the collar manufacturing company (African Wildlife Tracking) made allowance for an extended battery life which was previously only possible for the GPS-GMS collars (*ca* 32000 data points for the GPS-GMS collars versus 3500 data points for the GPS satellite collars on 10 D cell batteries).

- However, a run of unforeseen and unfortunate events have meant that we have lost a number of study animals in the last couple of years (Table 4):
  - Two prime bulls died due to natural causes (TKM11 and TKM22)
  - Three bulls were shot as damage-causing individuals (TKM18, TKM25 and TKM26)
  - Three collars' belting snapped (TKM15, TKM17 and TKM 24) and the collars were retrieved.
  - One bull twisted his collar (TKM27) so it was removed it and redeployed on a cow.
  - Two collars have failed prematurely (TKM09 and TKM28) while two collars haven't given a reading for the past month but may still do so (TKM10 and TKM12). These collars are still deployed.
  - Two collars also failed prematurely (TKF03, TKM08), of which the latter has been removed and the former may have dropped off as we can't find TKF03 because her VHF has also stopped functioning.
- Consequently we have 21 study animals left which were originally collared within the APNR. Two of these study animals may have dropped their collars (TKF01 and TKFO3) as they could not be relocated due to failed VHF transmitters.
- We presently only have half of the originally proposed study animals as only 15 study animals, originally collared within the APNR, have active collars on. Two of the four currently deployed inactive collars may start working again as a couple of months without readings does not necessarily mean the collar is no longer functioning and it could rectify itself (African Wildlife Tracking *pers. comm.* July 2013) while the other two inactive collars would need to be removed/replaced (Table 5).
- Of the remaining 15 active collars, one study animal spends a considerable amount of time in the KNP (TKM05), one in Manyeleti (TKM 12) and two at Phalaborwa Mining Company (TKF02 and TKF08). Hence these individuals can not be considered strictly APNR study animals and their range movements influence their accessibility and resightings records (Table 5).
- We assume that collared cows reflected the movements of their corresponding family group. Bulls however move to a greater degree as individuals. To ensure that we are monitoring a representative sample of the elephant population, the APNR – Kruger west (TK) bulls were initially subdivided into four age classes (Table 2):
  - 2) Immature and sub-adult animals - individuals less than 15 years of age that are starting to move independently of their natal herd;
  - 3) Young bulls less than 25 years of age that haven't started their musth cycles but that are moving independently from their natal herd.
  - 4) Adults - animals older than 25 but younger than 35 years of age that have started their musth cycles;
  - 5) Prime bulls – older than 35 years of age with regular annual musth cycles.

In other words, in the western study area we have managed to collar a fair spread of bull ages as was our intention. All collared cows are of calf bearing age and hence classified as adults and an integral part of the family group. Of the currently remaining bulls with active collars, six are prime bulls, with one individual senescing (>55 years old) and two are now considered adults (Table 5). We would like to maintain a sample of 10 prime bulls, 5 adult bulls and 5 females in future to meet the following objectives:

*To conduct research into how habitat resources, the need for safety and the social presence of other elephants, influences changes in elephant abundance and observed patterns in elephant movements (APNR, KNP, GLTP)*

- At present we have six active and three inactive collars deployed on potentially large tusked prime or adult bulls (Table 3 and Table 5). Of the prime and adult bulls, we would like to maintain a sample size of at least 10 potentially large tusked individuals that utilize the APNR in future and in keeping with one of the newly founded objectives:

*To understand the abundance, movements and conservation importance of the big tusked bulls within the GLTP*

This would mean that we need to replace one inactive collar and potentially another two if they prove to remain inactive. In addition, we would like to deploy an additional collar on three new study animals with potentially large tusks, two would need to be considered adults while one would need to be a prime bull.

- Considering the predicted expiry dates and given the longevity of the batteries (Table 5), we would like to ensure that a sample size of at least 20 collars will be running concurrently over the next 3-4 years within the APNR. This would mean that collar download schedules will be adapted and a certain number of collars will need to be replaced or newly fitted. Most collars will be adjusted to hourly downloads with the exception of TKM05's collar which will remain on one download every 24 hours to ensure that this individual does not need to be recollared due to his age and exceptional tusk status. A certain number of the active collars will have to have download frequencies set at less than hourly to synchronise their predicted expiry dates over time (Table 5).

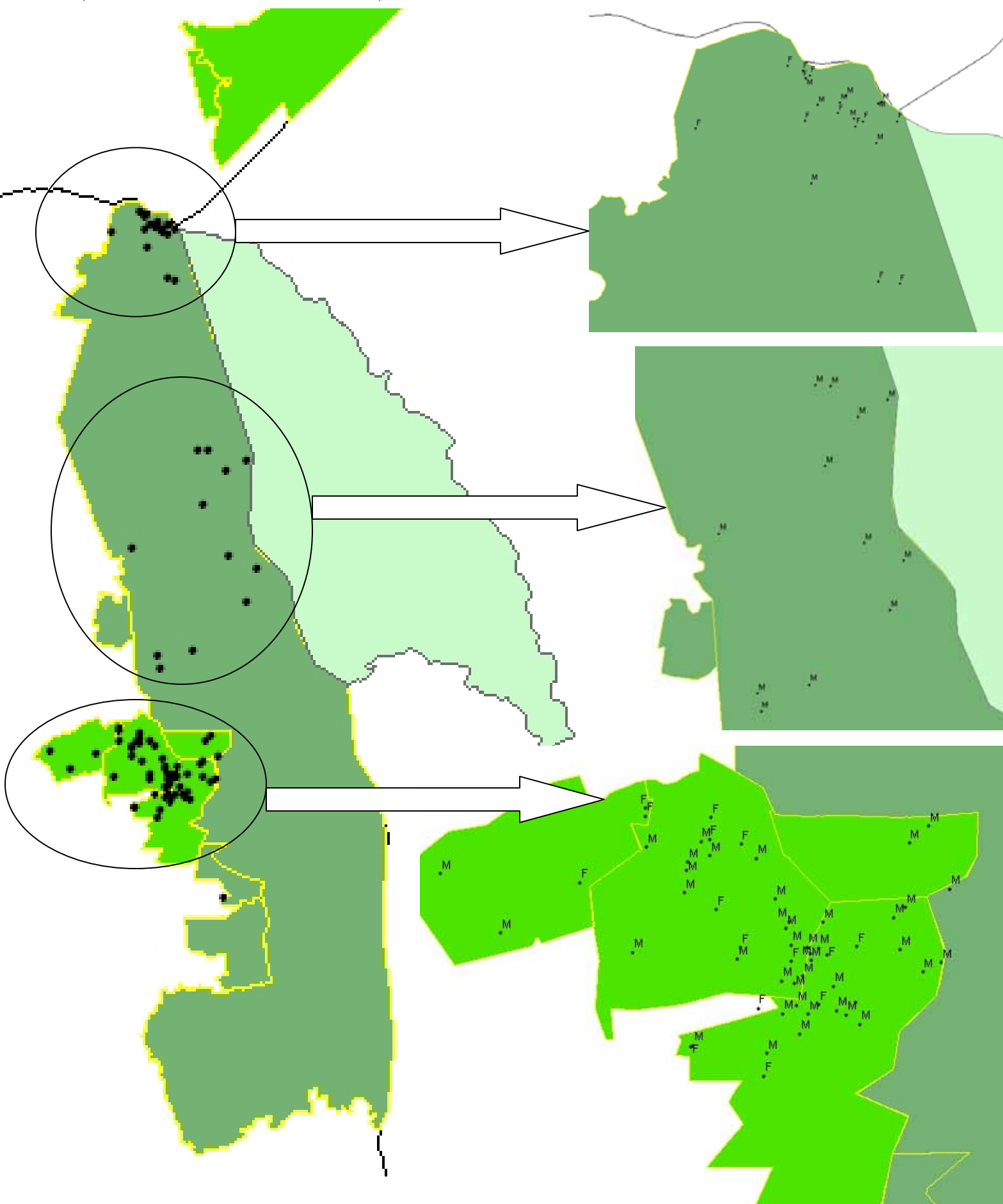
## Conclusion

- Total sample size to be maintained in the APNR over the next 3-4 years = minimum 20 study animals with five being females, five adult bulls and 10 prime bulls. Of the prime and adult bulls, 10 would need to be potentially large tusked individuals.
- Recollaring schedule to be re-evaluated in 2016 when most of the collars are predicted to expire
- To meet objectives, we would need to:
  - recollar TKM09 and potentially recollar TKM07, TKM10, TKM12 depending on their collar performance over the next couple of months. As the VHF may start failing on TKM07 and has failed on TKM12, these animals will be prioritised.
  - recollar TKF04 as her VHF has stopped working
  - collar 1 new prime bull with potentially large tusks
  - collar 2 new adult bulls with potentially large tusks
- The following collars can be removed if the opportunity presents itself:
  - TKF01 and TKF03 if the collars are still on the study animals and they are seen within the APNR. TKF01 has been known to spend a considerable amount of her time in the Olifants Rugged veld to the north of UPNR. TKF02's collar is predicted to expire soon but this cow frequents PMC. Access to TKF01 and TKF02 may prove very difficult and impractical.
  - TKM28

## Acknowledgements

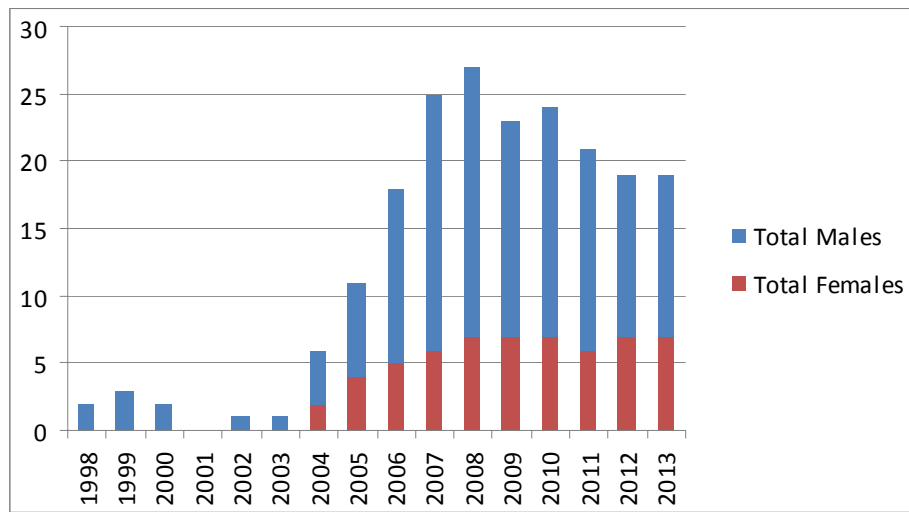
We would like to thank all the Wardens of the APNR who have kindly got up early in the mornings to assist with the collaring operations. We are very grateful for the wonderful veterinary services that we have received over the years from SANParks (Dr. Markus Hofmeyr and Dr. Peter Buss), WildVetsSA (Dr. Cobus Raath) and ProVet (Dr. Peter Rodgers). Ben Osmers and Grant Knight are thanked for representing wildlife pilots *par excellence*. We are also very grateful to numerous private donors who have contributed towards the cost of collars or collaring operational expenses. The following organisations are thanked for financially contributing towards either collars or collaring operations in one way or another: Aalborg Zoo, African Wildlife Tracking, Pennies for Eles, Tanda Tula Safari Camp, Transfrontier Africa, USFWS, Wildcon, the Wild Spirit Group, WESSA.

**Figure 1:** Collaring and recollaring locations for male (M) and female (F) elephants within the three study regions of STE-SA which include northern Kruger National Park, central Kruger National Park and the western Kruger National Park (Associated Private Nature Reserves).

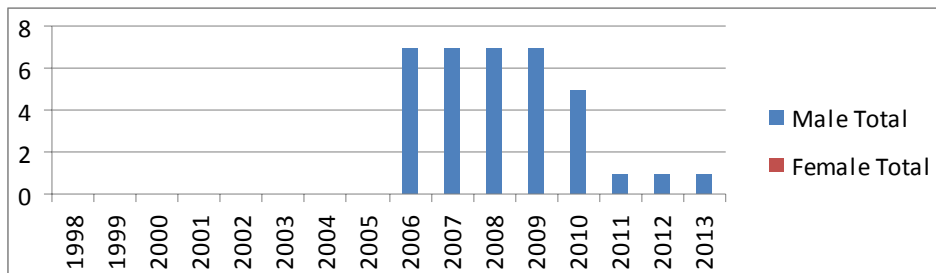


**Figure 2:** The number of elephants with active GPS collars within a year and over time since 1998 for each of the three study sites (Kruger west, Kruger east and Kruger north).

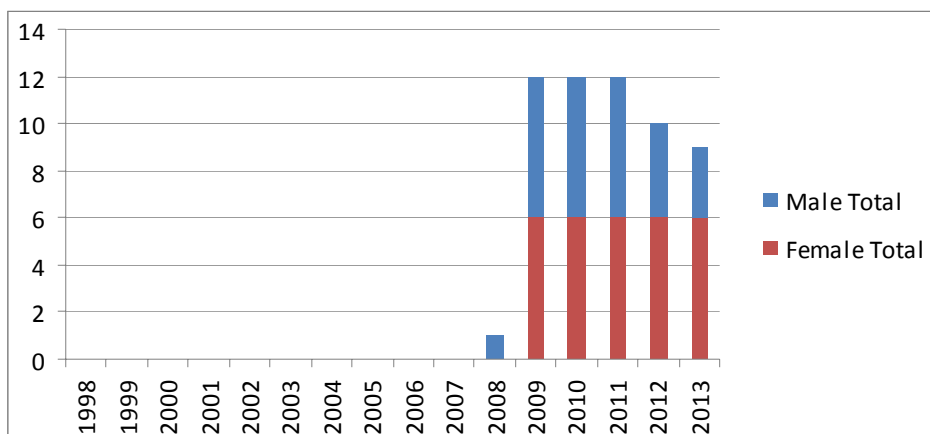
Kruger west study site (APNR)



Central Kruger study site



Kruger North study site





**Table 2:** Study animal information within the APNR study site indicating age estimates, age categories and highest location densities for animals with both active and inactive collars deployed in the past. Note that BKM01's collar has only been deployed for a month.

Code	Name	Sex	Age estimate when collared (year) <sup>1</sup>	Age estimate category when collared	Present age estimate (2013)	Present age estimate category (2013)	Highest point density areas (active collar)						
							TPNR	KPNR	UPNR	BPNR	Other <sup>2</sup>	KNP	
TKM05	Mac	Male	55±4 (2010)	Senescing	>55	Senescing							(X)
TKM18	Everest	Male	43±2 (2006)	Prime	50±2	Prime	X	X	X				
TKM12	Intwandamela	Male	36±2 (2005)	Prime	44±2	Prime	X	X	X			X	
TKM19	Gower	Male	34±2 (2006)	Prime	41±2	Prime	(X)	(X)	(X)				
TKM06	Classic	Male	36-55 (2011)	Prime	36-55	Prime	(X)	(X)	(X)				
TKM08	Benjamin	Male	36-55 (2004)	Prime	36-55	Prime							X
TKM11	Brazen	Male	36-55 (2005)	Prime	36-55	Prime	X	X	X				
BKM01	Wild Spirit	Male	36-55 (2013)	Prime	36-55	Prime		(X)					
TKM09	General	Male	31-35 (2011)	Adult	36-55	Prime	X	X	X				
TKM22	Mellow	Male	32±2 (2007)	Adult	38±2	Prime	X						X
TKM23	Captain Hook	Male	30±2 (2007)	Adult	36±2	Prime							X
TKM13	Matambu	Male	30±2 (2008)	Adult	35±2	Prime	(X)	(X)	(X)				
TKM20	Proud	Male	28±2 (2006)	Adult	35±2	Prime	(X)	(X)	(X)				
TKM21	WESSA	Male	28±2 (2006)	Adult	35±2	Prime	(X)	(X)	(X)				(X)
TKM25	Iain	Male	28±2 (2007)	Adult	34±2	Adult	X	X					
TKM24	Snap	Male	28±2 (2007)	Adult	34±2	Adult		X					
TKM27	Vee	Male	26±2 (2007)	Adult	32±2	Adult		X	X				
TKM10	Soshangane	Male	31-35 (2011)	Adult	31-35	Adult	X	X	X	X			
TKM17	Caughley	Male	24±2 (2006)	Adult	31±2	Adult	X	X	X				
TKM16	Tussle	Male	22±2 (2006)	Young	29±2	Adult	(X)	(X)				(X)	
TKM07	Big-Al	Male	20±2 (2008)	Young	25±2	Adult	(X)	(X)	(X)			(X)	
TKM15	Striburus	Male	16-20 (2006)	Young	21-25	Adult	X	X	X				
TKM28	Irving	Male	21-25 (2010)	Young	21-25	Adult	X	X		X			
TKM26	Namaste	Male	10±1 (2007)	Sub-adult	16±1	Young	X	X		X			X
TKF01	Diney	Female	26±2 (2007)	Adult	32±2	Adult	X		X				X
TKF02	Joan	Female	20-35 (2006)	Adult	20-35	Adult		(X)				(X)	
TKF03	Mandy	Female	20-35 (2009)	Adult	20-35	Adult	X	X					
TKF04	Umbabat	Female	20-35 (2008)	Adult	20-35	Adult	(X)	(X)					
TKF08	Lapajuma	Female	15±1 (2006)	Adult	22±1	Adult		(X)	(X)			(x)	
TKF09	Yvonne	Female	20-35 (2011)	Adult	20-35	Adult	(X)	(X)	(X)	(X)			
TKF07	Summer	Female	20-35 (2008)	Adult	20-35	Adult	(X)	(X)	(X)				
BKF01	Charlize	Female	20-35 (2012)	Adult	20-35	Adult		(X)			(X)		
Number of active collars likely to be seen in each of the reserves (total number of active and inactive)							10 (16)	14 (19)	9 (13)	2 (4)	4 (5)	2 (3)	
	Active collar												
	Inactive collar due to premature failure, lack of reception for GPS-GMS collars, mechanical failure of collar itself												
	Death of study animal												
	Prime (>35 to 55 years) or senescing bulls (>55 years) according to Henley (2012)												
	Adult bull (25-35 years) according to Henley (2012)												
	Young bull (15 to <25 years) according to Henley (2012)												
	Sub-adult bull (5 to <15 years) according to Henley (2012)												
	Adult cow (20-35 years) based on Kangwana (1996)												

<sup>1</sup>Age estimates based on tooth moulds that were taken (x±y), manual measurements or visual estimates in the field, followed by the year in which the estimates were made

<sup>2</sup>Sabi Sands, Manyeleti, Phalaborwa Mining Cooperation, Great Letaba Ranch



**Table 3:** Study animal information within the APNR study site indicating tusk weight categories estimated from measurements made during particular collaring operations with estimated given when <35 years of age and then between 50-60 years old in order to determine which collared individuals can be considered either large tusked individuals or potentially large tusked individuals in future.

Large tusker = any elephant where at least one tusk weighs a minimum of 100lbs (45kg) and can be more than 1.5m in length

Potentially large tusked elephant = any elephant younger than 35 years of age, where at least one tusk weighs 60lbs (~27kg) and consequently the elephant's tusk/tusks have the potential, given normal wear and tear, to weigh between 80 -100lbs when 50-60 years old, respectively.

Code	Name	Sex	Estimated tusk weight (collar)		Estimated tusk weight (34)		Estimated tusk weight (50)		Estimated tusk weight (60)		Tusk category (active collar)
			Left	Right	Left	Right	Left	Right	Left	Right	
TKM05	Mac	Male	113	113	80	79	105	105	122	121	(Large)
TKM18	Everest	Male	60	56	46	42	72	68	88	84	na
TKM12	Intwadamela	Male	70	66	62	58	88	84	104	100	Potential
TKM19	Gower	Male	30	43	22	35	48	61	64	77	na
TKM06	Classic	Male	85	22	66	4	92	30	108	46	(Potential)
TKM08	Benjamin	Male	51	62	32	43	58	69	74	85	na
TKM11	Brazen	Male	41	58	23	40	49	65	65	81	na
BKM01	Wild Spirit	Male	85	103	66	84	92	110	108	126	(Large)
TKM09	General	Male	66	61	68	63	93	88	109	104	Potential
TKM22	Mellow	Male	47	48	50	51	76	76	92	93	na
TKM23	Captain Hook	Male	25	63	32	69	58	95	74	111	Potential
TKM13	Matambu	Male	79	75	78	73	103	99	119	115	(Potential)
TKM20	Proud	Male	79	75	77	73	103	99	119	115	(Potential)
TKM21	WESSA	Male	60	64	70	74	96	100	112	116	(Potential)
TKM25	Iain	Male	40	39	50	48	76	74	92	90	na
TKM24	Snap	Male	33	44	42	54	68	79	84	95	na
TKM27	Vee	Male	49	47	62	60	88	86	104	102	Potential
TKM10	Soshangane	Male	58	61	60	62	85	88	101	104	Potential
TKM17	Caughley	Male	33	45	49	61	75	87	91	103	Potential
TKM16	Tussle	Male	44	49	55	61	81	86	97	102	(Potential)
TKM07	Big-AI	Male	28	37	51	60	76	86	92	102	(Potential)
TKM15	Striburus	Male	9	16	35	42	60	68	76	84	na
TKM28	Irving	Male	34	33	52	50	77	76	94	92	na
TKM26	Namaste	Male	12	13	50	52	76	77	92	94	na
TKF01	Diney	Female	na	na	na	na	na	na	na	na	na
TKF02	Joan	Female	na	na	na	na	na	na	na	na	na
TKF03	Mandy	Female	na	na	na	na	na	na	na	na	na
TKF04	Umbabat	Female	na	na	na	na	na	na	na	na	na
TKF08	Lapajuma	Female	na	na	na	na	na	na	na	na	na
TKF09	Yvonne	Female	na	na	na	na	na	na	na	na	na
TKF07	Summer	Female	na	na	na	na	na	na	na	na	na
BKF01	Charlize	Female	na	na	na	na	na	na	na	na	na
	Active collar										
	Inactive collar due to premature failure, lack of reception for GPS-GMS collars, mechanical failure of collar itself										
	Death of study animal										
	Prime (>35 to 55 years) or senescing bulls (>55 years) according to Henley (2012)										
	Adult bull (25-35 years) according to Henley (2012)										
	Young bull (15 to <25 years) according to Henley (2012)										
	Sub-adult bull (5 to <15 years) according to Henley (2012)										
	Adult cow (20-35 years) based on Kangwana (1996)										

\* According to the Mike Flynn calculation, minus 10% of the estimated tusks weights have not been subtracted to account for a 730g ivory increase per annum which does not consider the accelerated growth when the pulp cavity fills up in the later years' of an elephants life (Spinage1994). Hence the estimate in younger age categories will represent a marginal overestimate in tusk size.



**Table 5:** Final recommendation for the maintenance and replacement of currently deployed collars within the APNR which have not been removed and based on the accessibility of the study animal, resightings records, continuous dataset acquisition, predicted expiry dates and VHF functionality.

Code	Name	Sex	Age group	Tusk Category	Reserve predominance	Accessibility 1=good, 2=moderate, 3=poor	Resightings	Collar type	Years collared	Latest collaring year	Continuous data	Present state (2013)	Data points remaining	Predicted # years to expiry	Cause of inactivity	Period of inactivity (months)	VHF operational	Recommendation
TKM05	Mac	Male	Senesing	Large	KNP	3	2	GPS-satellite	11	2010	yes	active	2460	6.8	na	na	no	Maintain
TKM12	Intwandamela	Male	Prime	Potential	TPNR/UPNR/Manyeleti	2	2	GPS-GSM	5	2008	yes	inactive	13212	3.0 <sup>a</sup>	premature failure	1	no	Remove and replace with satellite collar
TKM19	Gower	Male	Prime	na	KPNR/TPNR/UPNR	2	2	GPS-satellite	7	2011	yes	active	26855	3.1	na	na	no	Maintain
TKM06	Classic	Male	Prime	Potential	KPNR/TPNR/UPNR	1	1	GPS-satellite	9	2011	yes	active	26885	3.1	na	na	yes	Maintain
BKM01	Wild Spirit	Male	Prime	Large	KPNR	1	1	GPS-satellite	na	2013	yes	active	31850	3.6	na	na	yes	Maintain
TKM09	General	Male	Prime	Potential	KPNR	3	2	GPS-satellite	8	2011	yes	inactive	28339	3.2	premature failure	5	yes	Remove and replace if no reading towards the end of 2013
TKM13	Matambu	Male	Prime	Potential	UPNR/TPNR	1	1	GPS-satellite	5	2013	yes	active	31850	3.6	na	na	yes	Maintain
TKM20	Proud	Male	Prime	Potential	KPNR/TPNR/UPNR	1	1	GPS-satellite	7	2013	yes	active	31850	3.6	na	na	yes	Maintain
TKM21	WESSA	Male	Prime	Potential	KPNR/TPNR/KNP	3	3	GPS-satellite	7	2011	yes	active	27626	3.2	na	na	yes	Maintain
TKM10	Soshangane	Male	Adult	Potential	BPNR/KPNR	3	2	GPS-satellite	6	2011	no	inactive	28185	3.2	premature failure	1	yes	Remove and replace if no reading towards the end of 2013
TKM16	Tussle	Male	Adult	Potential	KPNR/TPNR/KNP	2	2	GPS-satellite	7	2011	yes	active	26847	3.1	na	na	yes	Maintain
TKM07	Big-Al	Male	Adult	Potential	UPNR/TPNR	3	3	GPS-GSM	7	2008	no	active	8156	3.7 <sup>c</sup>	na	na	yes	Maintain and replace
TKM28	Irving	Male	Adult	na	BPNR	3	3	GPS-GSM	3	2010	yes	inactive	20770	2.4	premature failure	11	yes	Remove if no reading towards end of 2013
TKF01	Diney	Female	Adult	na	KNP/UPNR	3	2	GPS-GSM	8	2007	no	inactive	8384	3.8 <sup>e</sup>	premature failure	4	no	Remove if no reading towards end of 2013
TKF02	Joan	Female	Adult	na	KPNR/PMC	3	3	GPS-GSM	9	2006	yes	active	-26	0.0	na	na	yes	Remove
TKF03	Mandy	Female	Adult	na	KPNR/TPNR	3	2	GPS-GSM	5	2009	yes	inactive	22241	2.5	premature failure	39	no	Remove
TKF04	Umbabat	Female	Adult	na	KNP/TPNR	2	2	GPS-GSM	8	2008	yes	active	15576	3.6 <sup>d</sup>	na	na	no	Maintain and replace
TKF08	Lapajuma	Female	Adult	na	KPNR/PMC	2	3	GPS-satellite	7	2011	yes	active	27000	3.1	na	na	yes	Maintain
TKF09	Yvonne	Female	Adult	na	UPNR/TPNR	1	1	GPS-GSM	6	2011	yes	active	26919	3.1	na	na	yes	Maintain
TKF07	Summer	Female	Adult	na	UPNR/TPNR	1	1	GPS-GSM	5	2008	yes	active	15609	3.6 <sup>e</sup>	na	na	yes	Maintain
BKF01	Charlize	Female	Adult	na	KPNR	1	1	GPS-satellite	1	2012	yes	active	29420	3.4	na	na	yes	Maintain

<sup>a</sup>Collar download schedule set to once every two hours

<sup>b</sup>Collar download schedule to remain at once every four hours

<sup>c</sup>Collar download schedule to remain at once every four hours

<sup>d</sup>Collar download schedule set to once every two hours

<sup>e</sup>Collar download schedule set to once every two hours