Aerial Census Report for Maputo Special Reserve

2012





CENSUS CONDUCTED: SEPTEMBER 2012
REPORT DATE: JANUARY 2013

T. Bodasing, Ecologist, Ezemvelo Kwazulu-Natal Wildlife, Mkhuze Game Reserve

R. Cumbane, Head of Ecology Department, Ministério Do Turismo, Reserva Especial De Maputo

INTRODUCTION

The overall aim of this census was to determine the current status of some of the most abundant large herbivore species in Maputo Special Reserve, which could be useful in management decisions and would stand as a record of population size for future trend analyses. The locations of some of the more important species (reedbuck, elephant and hippo) were also mapped so as to gain a better understanding of their spatial distribution and habitat relations.

This aerial census was conducted as a follow-up and verification exercise to last year's census during which far fewer animals were seen. There were concerns over the timing and efficiency of the count and it was felt that a census was needed again to verify or improve on the previous results. The aerial census was undertaken at the end of September, a month earlier than last year (beginning of November). It was felt that visibility would be better at this time and that early season rainfall might have some effect. Visibility was slightly better than last year overall mainly due to the thinner canopy cover earlier in the season. The major difference was the distribution of surface water; heavy rains in the week before the census resulted in all waterholes, drainage lines and streams being filled. Water was therefore widely distributed throughout the reserve although the vegetation had not yet responded to this rainfall. It was felt therefore that the timing was much better this year in terms of visibility. Two methods were used to estimate numbers for the different herbivore species. These were (i) total counts for localized species such as hippo and crocodile, and (ii) line transect distance sampling for more widely distributed species.

The aerial census was set up and undertaken by:

T. Bodasing (Ecologist Isimangaliso, Ezemvelo KwaZulu-Natal Wildlife, Mkhuze Game Reserve)
R. Cumbane (Ministério Do Turismo, Ecologist, Reserva Especial De Maputo)
A. Guenha (Ministério Do Turismo, Reserva Especial De Maputo)
C. Banze (Ministério Do Turismo, Reserve Manager, Reserva Especial De Maputo)
B. Revell (Conservation Manager Tembe, Ezemvelo KwaZulu-Natal Wildlife, Tembe Elephant Park)
L. Revell (Tembe Elephant Park)
C. Hanekom (District Ecologist, Ezemvelo KwaZulu-Natal Wildlife, Tembe Elephant Park)
N Ngovene (Ministério Do Turismo, APU Officer, Reserva Especial De Maputo)
V. van Heerden (Pilot, Helicon)
P. Scott (Technical Advisor, Peace Parks Foundation)

This aerial census was made possible due to funding by the World Bank and Peace Parks Foundation.

METHODS

Aerial Counts

1. A helicopter containing four people (pilot and recorder (front) and two observers (back)) was flown on pre-determined, parallel, east-west orientated transects situated 1 km apart in Maputo Special Reserve. These transects were arranged systematically to cover the whole reserve. In the Futi Corridor and the sanctuary, roughly north-south oriented parallel lines 1 km apart were flown **(Figure A in the Appendix**).
2. The helicopter was flown at 90 m (300 ft) above the ground. Last year the airspeed flown was 30-40 knots and it was decided that this was too fast. In order to improve statistical accuracy and reliability of sightings, the airspeed used this year was 25-30 knots. Transects were flown in the morning and afternoon, for periods of up to a maximum of 3 hrs at a time which resulted in up to three survey sessions per day (**Table 1 in Results**). Transects were not flown during the midday hours as animals tend to rest under the shade of tree canopies due to the heat and as a consequence are more difficult to spot.
3. The technique of sampling undertaken for most species was that of Distance sampling (Buckland *et al*. 1993). Counting bars were fitted to both sides of the helicopter which, when flying at a height of 90m, demarcated a distance of 500m on each side of the helicopter. Along these bars, cable ties were used to define five distance sectors: 0-30 m; 31-90 m; 91-200 m; 201-350 m and 351-500 m. Species identification and group size of all visible herbivores were then recorded in the 1 km wide belt in a particular distance sector (1-5).
4. Where large groups of a particular species was spotted, the helicopter deviated from the transect line and flew over the group, an accurate count was undertaken, the locality captured and the helicopter then returned to continue the count from the point of deviation.
5. Total counts were done mainly for crocodile and hippo due to the fact that they were located only in and around large water bodies such as lakes or pans. Some other species were also counted in this manner due to them not occurring in high enough numbers for a distance estimate (e.g. giraffe and impala). Other species were sampled using the Distance sampling protocols described above.
6. All data were captured on a notebook computer using Cartalinx v 1.1 (Clark Labs, Clark University, 1999) which, when connected to an onboard GPS, allowed the simultaneous collection of flight path information, animal species, number and sector (as way points) and the number of the transect being traversed.

Data analysis

1. Plotting of distributions for species and human related factors was done by importing the Cartalinx data into ArcGIS Version 9.3, these in cases where the number of sightings and their distribution allowed visualisation (**Figures in Appendix**).
2. Animal observations recorded in the Cartalinx program during the aerial census were error checked and cleaned exporting to Distance Version 6.0 for final analysis. Where the number of observations allowed,

density along each transect, and from this population size, was estimated using specific statistical routines (Thomas *et al*. 2001). A statistically robust and viable estimate can only be derived for species within the region of 60 or more sightings (Buckland *et al*. 1993). However, due to the low rate of detectability for many species (those that are smaller (duiker); hide under the canopy of trees (nyala/elephant) or are not present in high enough numbers (zebra) certain species having as low as 20 observations were analysed with Distance. These final estimates should not be considered reliable (as indicated in some instances by the percentage variance and confidence interval), but rather as best estimates of population size in species that do not yet occur in high numbers or are more difficult to spot.

RESULTS AND DISCUSSION

The complete aerial survey of the Maputo Special Reserve (79 594 ha) and the Futi Corridor (24 000 ha) linking with the reserve, took four days (19.42 hours) to complete (**Table 1**). It was done in this manner (2-3 sessions per day) so as to allow for refuelling and resting out the hot midday periods. It took longer than last year due to slower flying speeds. Weather conditions during the census were good with clear-partly cloudy skies and warm temperatures.

Table 1: Daily session start times and duration for 2012 Game Census (**Total Duration = 19 hrs 40 min**)

Session *(start time)*	**Time (hrs)**
Day 1 – 1 *(8:40)*	2hrs 40min
Day 1 – 2 *(14:30)*	3 hrs
Day 2 – 1 *(7:00*)	2hrs 45min
Day 2 – 2 *(10:20)*	1 hr 10min
Day 2 – 3 *(15:00*)	2hrs 22min
Day 3 – 1 *(8:00)*	3 hrs
Day 3 – 2 (*11:30*)	1 hr 10min
Day 3 – 3 (*15:00*)	2hrs 30min
Day 4 – 1 *(7:30)*	1hr 5min

a) Total Aerial Count and Distance Estimates

The total number of observations, total minimum count and final distance estimate for each species observed during the census is shown below (**Table 2**). The distribution of sightings for the more abundant and significant species is presented in the Appendix. With respect to distance sampling only reedbuck had greater than 60 observations and could therefore be analysed reliably with Distance Version 6, although nyala, zebra and red duiker estimates can be considered reasonable (**Table 2**). Trends using data from previous counts are displayed below for certain species (**Figure 1 & Table 5**) and for elephant (**Figure 2 & Table 5**). Trends are only shown for years in which data is sufficiently accurate and valid to generate a meaningful trend line. For more widely distributed and difficult to quantify species such as elephant and hippo, additional counts will vastly improve the final estimates, and results in a greater number of repetitions which increases the validity of estimates over time (Buckland *et al*. 1993).

Table 2: Total count, distance estimate and final estimate figures including upper and lower confidence limits for the large herbivore census in 2012

(Blanks in the final estimate column indicate insufficient observations for distance analysis. Unreliable distance estimates are indicated by the **U** sign. Total counts are indicated by **T.** Reliable and accurate estimates are indicated by the **R** sign).

Species	Number of Obs.	Min Count	Distance estimate	Upper/Lower Conf. Intervals and % Variance	*Final Estimate*	
Bushbuck	23	27	*97*	*51 – 183 / 32.7%*	**97**	**U**
Bushpig	16	33	*159*	*79 – 321 / 36.2%*	**159**	**U**
Elephant	34	264	*878*	*452 – 1704 / 34.2%*	**452**	**U**
Grey Duiker	20	22	*73*	*36 – 147 / 35.9%*	**73**	**U**
Hippo	32	168	*N/A*	*N/A*	**168 – 200**	**T**
Kudu	3	15	*N/A*	*N/A*	**15-80**	**T***
Nyala	35	80	*347*	*201 – 600 / 28.1%*	**347**	**U**
Red Duiker	42	50	*324*	*220 – 477 / 19.5%*	**324**	**R**
Reedbuck	251	598	*1212*	*853 – 1722 / 17.7%*	**1212**	**R**
Crocodile	27	41	*N/A*	*N/A*	**41**	**T**
Steenbok	7	8	*N/A*	*N/A*	**?**	**T**
Zebra	25	177	*225*	*128 – 394 / 28.7%*	**225**	**R***
Giraffe	1	1	*N/A*	*N/A*	**8**	**R***
Impala	6	52	*N/A*	*N/A*	**52-100**	**T***

*** Denotes known or close to known number of animals introduced during 2012 (see Table 3)**

Best Estimate of Numbers

Acceptable final estimates for reedbuck, red duiker, hippo, crocodile and zebra were obtained and to some degree elephant, impala and nyala. For the other species confirmation was made of that particular species still occurring in reasonable numbers, such as steenbok, kudu, grey duiker, bushpig and bushbuck.. Accurate total counts of crocodile were not possible due to the focus of the survey and high water levels. For most species the numbers of sightings were way below or marginal for a confident distance estimate, but were analysed so as to have some indication of possible population sizes. A very confident and viable final estimate was obtained for reedbuck. The final estimate used was based on the number of observations, confidence limits/percentage variance and known populations (Buckland *et al.* 1993).

The population size of reedbuck was estimated at 1212 from a sample of 251 sightings. This is still the most abundant species in the reserve and the population appears to be found mainly in the open central areas of the reserve (**Figure B in the Appendix**). A low percentage error (17.7%) indicates that the estimate is confident and reliable. The population is still increasing in size.

The population of hippo was estimated at 168 – 200 based on total counts from last year and this year (**Table 2**). This year, 32 observations were made spread between the different water bodies. During this survey however, fewer hippo were seen compared to last year although there is no reason to suspect that these animals are dead or have moved away. Counting hippo from the air involves timing and accuracy and it is expected that some were underwater when flying over the pans. The hippo estimate given can therefore be regarded as a minimum number of animals present on MSR based on 2011 and 2012 estimates.

The red duiker population is estimated at 324, determined from 42 observations and is a reasonable estimate. Slower flying speeds resulted in more sightings of these animals, particularly in the forest gaps. The percentage variance (19.5%) suggests his is a reasonably confident estimate (**Table 2**). The grey duiker population is estimated as 73 determined from 20 observations and is an unreliable estimate. With small antelope (e.g. suni, red & grey duiker), this type of result can be expected if close to 60 observations are not obtained and the true population size could therefore be much larger. A high percentage error (35.9%) indicates an unreliable estimate mainly due to low detection probability for smaller antelope species (Buckland *et al*. 1993).

The population estimate of 225 for zebra is very reliable due to the fact that a known number of 183 animals have been introduced over the last two years (**Table 3**). Based on this and the fact that 177 animals were actually counted, it is safe to assume that 225 is a reasonable number given some growth and a lack of predators. Zebra were concentrated mainly on the western boundary and around the main camp (**Figure C in Appendix**).

Population estimates for impala, grey duiker, nyala, bushbuck, kudu, bushpig and steenbok are not reliable due to a lack of sufficient observations (**Table 2**) and the inherent low rate of detectability/encounter for some of these species during aerial census (Buckland *et al*. 1993). Numbers could therefore be higher for some species and only frequent repeat counts (aerial, ground or both) may result in improved estimates. For some species like impala and kudu, animals were only re-introduced during the course of 2011/2012 (**Table 3**) and have not yet built up to sufficient numbers to permit analytical estimates to be used. Additional options include the use of camera trap surveys which are often employed to assess abundances and density of smaller and difficult to detect species.

Table 3: Large herbivore introductions to Maputo Special Reserve from EKZNW over last three years

SPECIES	2010		2011		2012		TOTAL	
	Plan	**Actual**	**Plan**	**Actual**	**Plan**	**Actual**	**Plan**	**Actual**
Zebra	200	3	100	24	200	159	400	186
Warthog	40	9	40	0	40	33	120	42
Waterbuck	40	0	40	0	40	0	120	0
Wildebeest	60	0	100	0	100	0	260	0
Giraffe	20	0	20	0	20	8	60	8
Kudu	40	0	80	0	80	84	200	84
Nyala	80	20	80	0	80	74	240	94
Impala	40	22	40	0	40	74	120	96
Steenbok	-	0	20	0	20	0	40	0
Total	**520**	**54**	**520**	**24**	**520**	**97**	**1560**	**510**

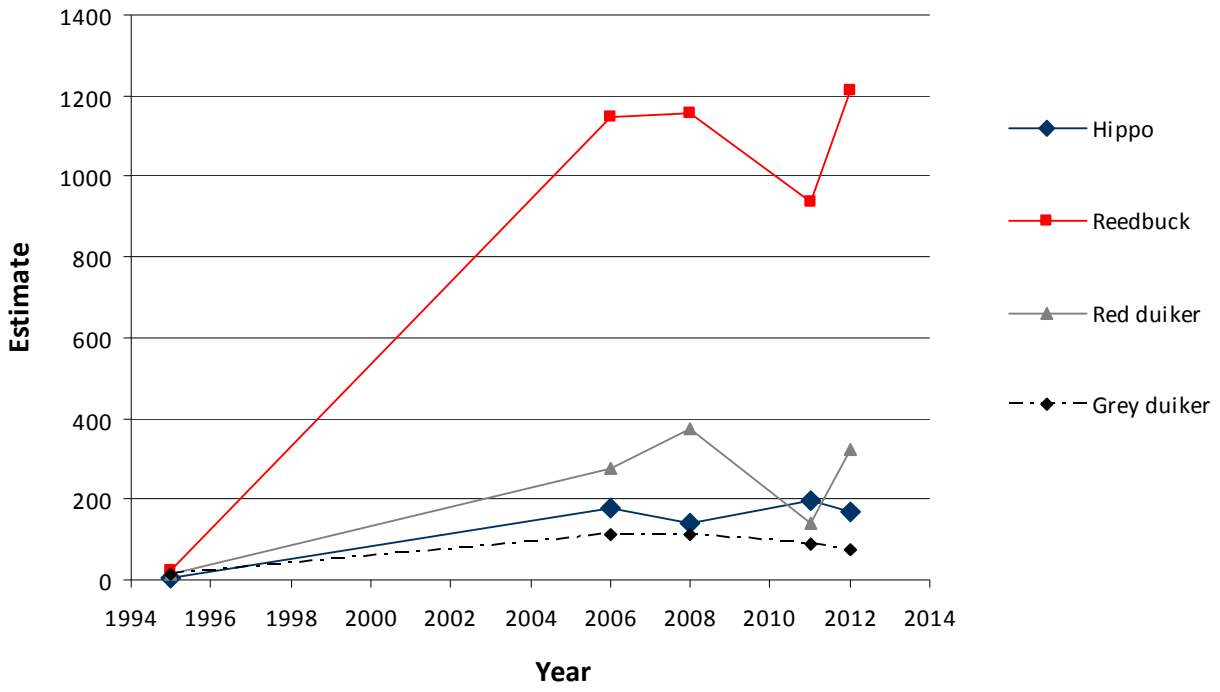


Figure 1: Census trends for some of the major herbivore species counted at Maputo Special Reserve and the Futi Corridor (1995-2012). Final distance estimates are plotted for reedbuck, red and grey duiker and minimum counts for hippo.

Elephant Count

The total number of elephant counted during the entire survey was 264 in 34 separate observations (**Table 2**). Similar to the last count, most of the animals were seen during the morning and afternoon session transects rather than during the middle of the day. Many elephants were again counted in the Futi Corridor with a few large herds numbering close to 80 in total observed in the middle of the Futi and north of the Tembe Elephant Park boundary fence (**Figure D in Appendix**). Many smaller groups and bulls were observed along the south-western boundary and in the central parts of the reserve (**Figure D in Appendix**). In addition to those that were counted, there was a report of a herd of unknown size that was outside the reserve in the far north at Santa Maria. Although a flight was undertaken, only signs of the elephant but no visual contact could be obtained. It is still unclear as to how many elephant there were in this group.

Table 4: Elephant numbers counted at different times of day according to census flight sessions

Session	Total observed
Day 1 – 1	0
Day 1 – 2	2
Day 2 – 1	32
Day 2 – 2	8
Day 2 – 3	45
Day 3 – 1	76
Day 3 – 2	27
Day 3 - 3	72
Day 4 - 1	2

Figure 2 below indicates the variability in minimum count records for elephant across all previous game counts at Maputo Special Reserve. This inherent variability combined with large gaps in the sampling over time make it extremely difficult to accurately estimate true numbers of elephant. For example, in 2004 only 80 elephant were counted, followed by 330 in 2006. Similarly, our minimum count of 228 in 2011 is somewhat lower than the 2008 count of 348. This is now followed by a count of 264 in 2012. This serves to illustrate the importance of repetitive or more focused sampling for certain species and the necessity for further statistical analysis.

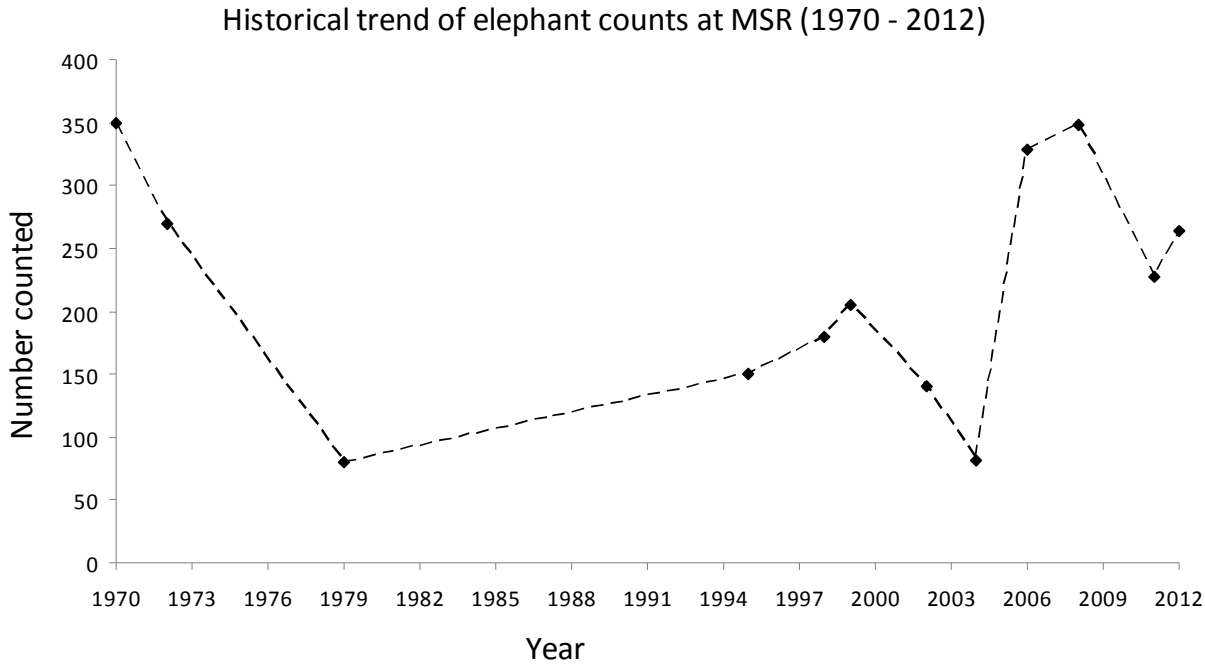


Figure 2: Historical trend depicting total number of elephant counted (minimum count) during previous game surveys (* these are not final estimates but only actual number counted)

In this survey, large family groups were most often encountered in the reed beds, Musi swamp system and in the sand forests close to the main camp. Many were also observed but not accurately counted under the thick canopy of sand forest patches in the south-west of the reserve adjacent to the Futi. A breakdown of the numbers and age classes of observed elephants is given below.

Recent counts at Maputo Special Reserve and the Futi Corridor have estimated between 330-350 elephant in total (Matthews, 2006 and Matthews, 2008b) based on minimum counts and the degree of error in the distance estimate. Last year we suggested that the final estimate would be in the region of 400-450 animals. Our suggested estimate would then agree with previous observations on the growth of the MSR elephant population (Matthews, 2008b) which indicate a steady increase over time. Furthermore, and as pointed out by Matthews (2008b), this is also substantiated by the large proportion of juveniles and infants being encountered in the surveys. This years distance estimate of 848 is completely inaccurate and excessively high; we suggest using the lower confidence figure of 452 (**Table 2**) which is more in line with expectations and with previous estimations.

Once again we suggest that more frequent counts focussing on elephant are the only way to obtain accurate and reliable estimates for elephant numbers. Frequent total counts throughout the year and constant monitoring of the population will improve final estimates dramatically. Information on female identities, new births, mortalities, and group size and herd associations will allow growth rates to be calculated for the population and predictive modelling to be done. This level of monitoring must be done in order to gain a proper understanding of elephant numbers and movements in Maputo Special Reserve.

Human Activity

Various signs of human activity are still obvious across much of Maputo Reserve and are still prevalent in the northern and eastern parts of the park. This pattern of activity is the same as that observed in the 2008 and 2011 game censes (Matthews, 2008b; Bodasing, 2011) and indicates little or no change in the spatial distribution of settlements (**Figure E in Appendix**). Indicators of human activity over the last two surveys are displayed below (**Table 5**). These figures should be taken as a representation of what was observed only and it is likely that a number of goats, cattle and possibly homesteads were not accounted for due to the thickness of the canopy cover in some areas. Large numbers of livestock observed in the reserve continues to be a major point of concern (**FIGURE G in Appendix**) from an ecological (Fritz *et al*. 1996) and a vetinary perspective, especially given the ongoing reintroductions of large numbers of other herbivore species. Measures will have to be implemented to bring these animals under control considering the future potential for mixing of domestic and wild large herbivores in Maputo Reserve and the Futi Corridor.

Table 5: Measures of human activity recorded over the last three surveys of MSR

Human activity	**2008**	**2011**	**2012**
	Total	*Total*	*Total*
Homestead	388	166	242
Gillnets	0	1	9
Cultivation	191	13	82
Goats	623	466	355
Cattle	277	149	321
Burning/Clearing	0	4	5
Fish Traps	0	0	70
Dogs	0	0	5

There are major concerns in particular around the increase in cattle, fish traps and gill nets and the presence of dogs. These are all signs of increasing rather than decreasing numbers of people within the reserve. The number of cultivated fields is also a concern (**FIGURE F in Appendix**) as well as homesteads. The above factors all present major problems in terms of security, disease, poaching, and resource use and general negative impacts on the ecology and conservation status of the reserve. If larger and rarer species are to be re-introduced in the future, or will move across after fences are dropped (e.g. rhino, cheetah, lion) all the above points be addressed adequately to ensure security for these species. The game census team strongly recommends that measures be implemented in order to counter some or all of these threats to conservation of habitats and species in Maputo Special Reserve. Experience from dealing with similar issues in South African protected areas has identified human and human-related factors as the largest threat to conservation and eco-tourism. A more concise and detailed description of these problems and other general points of concern is listed in the **Appendix**.

CONCLUSIONS AND RECOMMENDATIONS

This year's census took place in late September as a verification of the one of 2011 that was carried out in late November. The impression of a reduction in elephant and reedbuck populations is clearly a false one, although estimating true elephant population size remains a big problem for various reasons stated above and below. We believe and have stated that elephant observations still lie below the minimum count for satisfactory distance analysis to be used and have again suggested that total group counts be undertaken during the course of the year (either ground or fixed wing) to supplement our figures. However, what is clearly noticeable is that far more observations of all species were made during this year's census and it is felt that this has led to a more accurate and reliable count and end estimates. We believe this census to therefore be a vast improvement on last year's census due to slower flying, better environmental conditions and greater experience. In addition, more animals were introduced in the period between censuses which also affected the sightings in 2012.

- Census conditions were good and the weather did not impede the counts. It is recommended that future counts take place at this time of year (end September-early October) due to the onset of rains and distribution of water as well as thickness of vegetation later in the season. The two methods employed namely minimum counts and distance based sample estimates, produced relatively accurate population estimates. However, the total number of observations for many species is still too low for reliable estimates to be made (Buckland *et al*. 1993) and it will take time for some of the species to build up to decent numbers in order that count estimates will be more accurate and reliable (e.g. impala, kudu, nyala, zebra). Aerial counts with fixed wing aircraft, other forms of survey (e.g. camera traps) and species-specific monitoring will all be beneficial and result in better end estimates being obtained. Further introductions planned for 2013 will also have a major effect on animal numbers and distributions for the next few years.

- Current elephant estimates are inconclusive due to the difficulties of spotting animals within the sand forest vegetation. In addition, surface water distribution and group size also greatly influence the detection probability and accuracy of counts for elephants (Ntumi *et al*. 2005; Smit *et al*. 2007). It is suggested that elephant-specific counts or ad-hoc monitoring be conducted at different times of year (wet and dry season) and specific times of day (midday near water sources) or early morning and evenings in open areas in order to gain a better estimate of total population size and social structure. GPS collaring of separate breeding herds will greatly facilitate this process as they can then be tracked from the ground and air, via vehicle or fixed wing aircraft.

- The high density and increase in numbers of domestic livestock is a concern and solutions need to be investigated immediately. Numbers have increased from last year and it is obvious that no solutions are forthcoming. Cattle and goats may cause damage to indigenous grasses and woody vegetation and out-compete wild herbivores (Fritz *et al*. 1996). Furthermore, the vetinary implications of

disease transfer between domestic and wild herbivores needs to be a priority due to large scale re-introductions of game into the Transfrontier Conservation Area that are currently underway. If the livestock cannot be removed, it is suggested that they be contained within camps or fenced of areas in the reserve, a situation similar to East African protected areas. If cattle and goat numbers continue to grow rapidly and disperse all over the reserve, they will out-compete indigenous grazers and browsers and cause severe degradation to the vegetation and soil. This will decrease the ecological carrying capacity of the land and possibly lead to the IUCN category IV of the Reserve being reduced.

- Considerable human population growth at the north and east of the reserve appears to negatively affect numbers of game in this area. A similar pattern is seen for the southern portion of the reserve between Piti Lake and the main road. Community members were seen in the middle of the bush along with dogs during this year's flight which seems suspicious for a protected area. The encroachment of cultivated plots and human dwellings on the natural vegetation is a major concern that needs to be addressed immediately particularly in the core area of Muvukuza. There are already disturbing signs of bush-clearing, cultivation and burning of forest vegetation that will get out of control if not policed immediately.

- When possible the large herbivore population census for Maputo Special Reserve should continue to be undertaken using the methods described here. This includes using the same equipment and software used in this census and following the same transects in both Maputo Reserve and the Futi corridor. However, in order to improve the precision of the sample estimates, at least 60 sightings per species need to be obtained for the more common species (Buckland *et al*. 1993). In cases where this is not possible, accurate total (minimum) counts should be undertaken for those with known or reasonably estimated population size (e.g. hippo, crocodile)

- Try to complete census at a flight speed of 30kts, making sure that flying is not done during the midday period and that all transects can be completed before nightfall. Graphical analyses of the trends of the more important species should continue to be undertaken and distribution maps produced. Other counts should be undertaken to supplement counts for smaller herbivores, such as small antelope, small carnivores and other priority species.

REFERENCES

Bodasing, T. 2011. Aerial census report for Maputo Special Reserve and Futi Corridor 2011. EKZNW unpublished report. Pgs 1-19.

Buckland, S.T., Anderson, D.R., Burnham, K.P. & Laake, J.L. 1993. Distance Sampling: Estimating abundance of biological populations. Chapman & Hall, London.

Fritz, H., de Garine Wichatitsky, M. & Letessier, G. 1996. Habitat use by sympatric wild and domestic herbivores in an African savannah woodland: the influence of cattle spatial behaviour. Journal of Applied Ecology 33: 589-598.

Matthews, W.S. 2006a. Large herbivore population estimates for Tembe Elephant Park: Ezemvelo KZN Wildlife unpublished report.

Matthews, W.S. 2006b. Futi Aerial survey: November 2006. Ezemvelo KZN Wildlife unpublished report. 1-10.

Matthews, W.S. 2008a. Large herbivore population estimates for Tembe Elephant Park: Ezemvelo KZN Wildlife unpublished report. 1-18.

Matthews, W.S. 2008b. Futi Aerial survey: November 2008. Ezemvelo KZN Wildlife unpublished report. 1-10.

Morley, R.C. & Van Aarde, R.J. 2002. A historical assessment of elephant numbers in Maputaland. In: Restoration of the Tembe-Futi-Maputo Coastal Plains elephant population. R. Van Aarde & T. Jackson (eds).

Ntumi, C.P., van Aarde, R.J., Fairall, N. & de Boer, W.F. 2005. Use of space and habitats by elephants in the Maputo Elephant Reserve, Mozambique. *South African Journal of Wildlife Research*: 35 (2): 139-146.

Smit, I.P.J., Grant, C.C. & Devereux, B.J. 2007. Do artificial waterholes influence the way herbivores use the landscape? Herbivore distribution patterns around rivers and artificial water sources in a large African savannah park. *Biological Conservation* 136: 85-99.

Thomas L., Laake J.L., Derry J.F., Buckland S.T., Borchers D.L., Anderson D.R., Burnham K.P., Strindberg S., Hedley S.L., Burt M.L., Marques F., Pollard J.H. & Fewster R.M. 1998 Distance 3.5. Research Unit for Wildlife Population Assessment, University of St. Andrews, UK.

APPENDIX

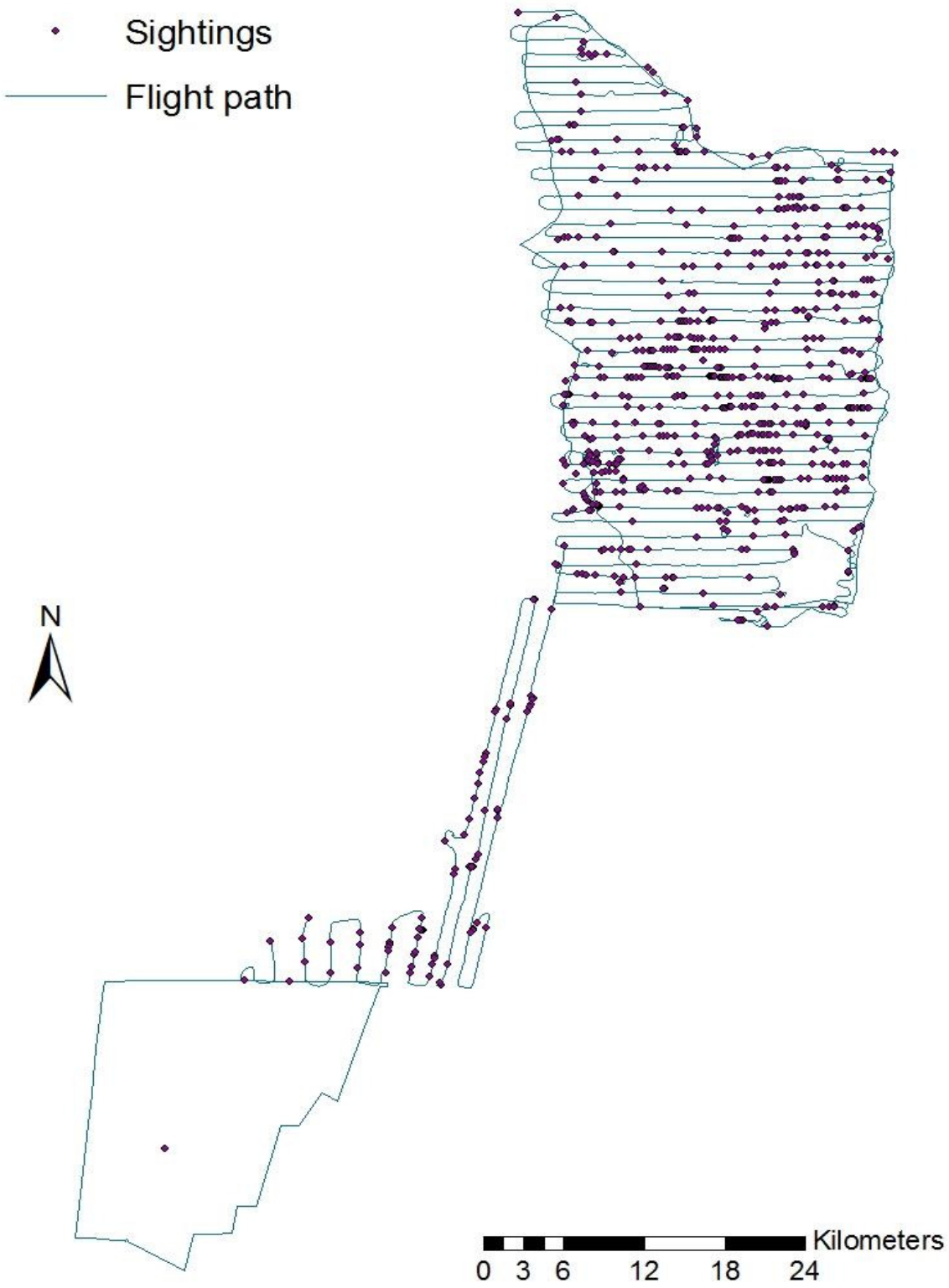


FIGURE A: MAP DEPICTING THE TRANSECTS FLOWN (LINES) AND LOCATION OF ANIMAL SIGHTINGS (POINTS) DURING THE 2012 GAME CENSUS OF MAPUTO SPECIAL RESERVE AND THE FUTI CORRIDOR

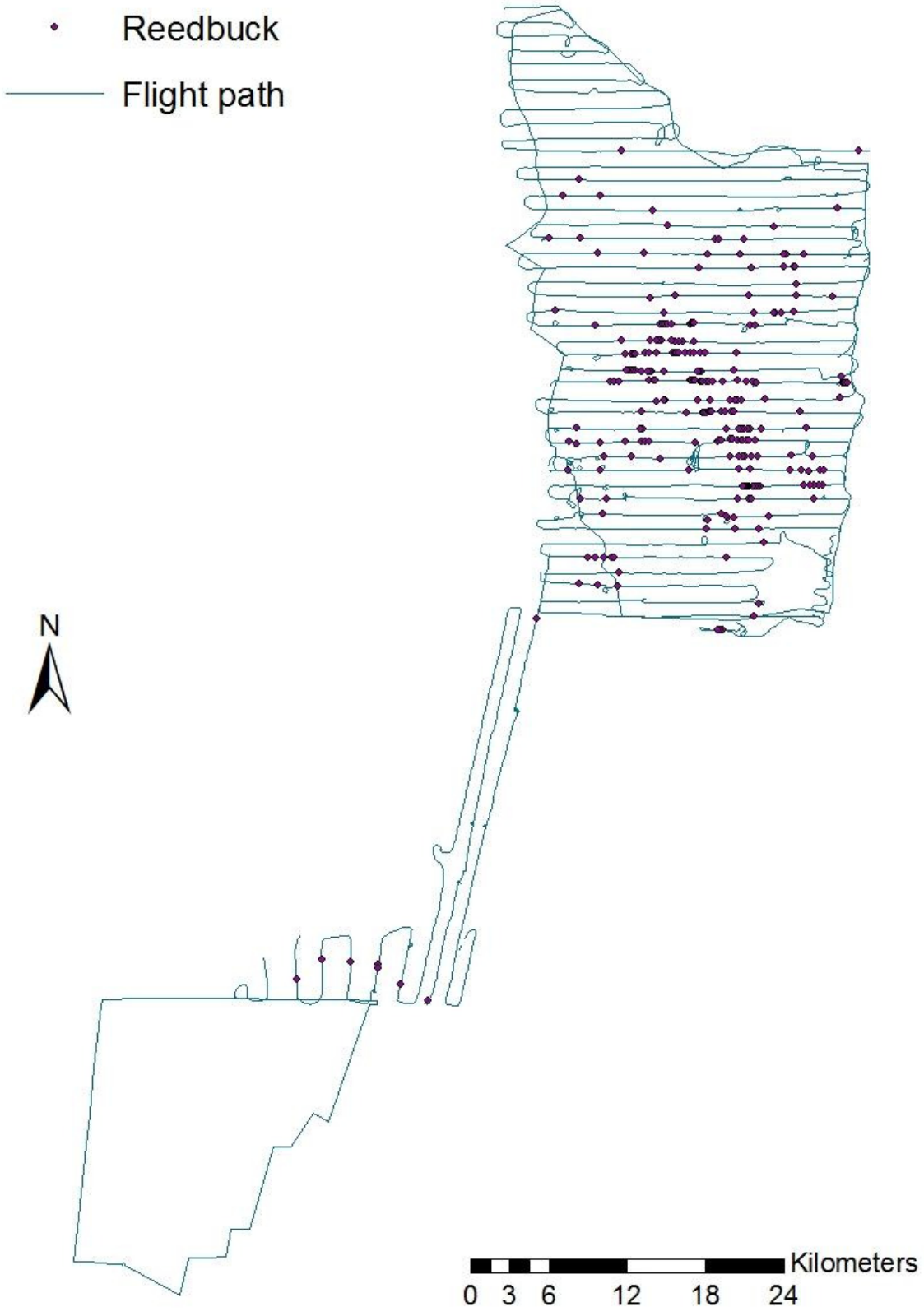


FIGURE B: MAP SHOWING THE DISTRIBUTION OF REEDUCK IN MAPUTO SPECIAL RESERVE IN THE 2012 SURVEY

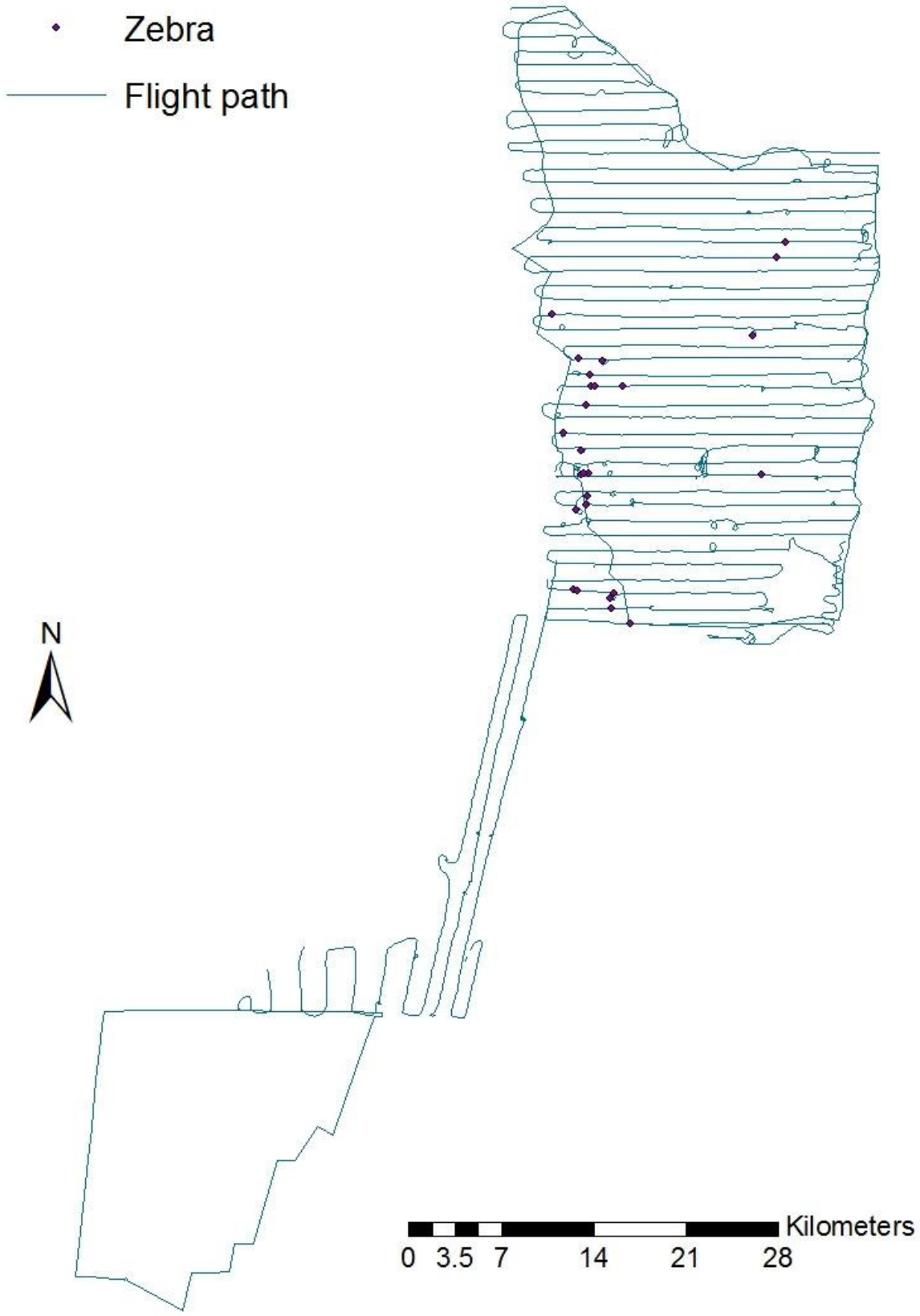


FIGURE C: MAP SHOWING THE DISTRIBUTION OF ZEBRA IN MAPUTO SPECIAL RESERVE IN THE 2012 SURVEY

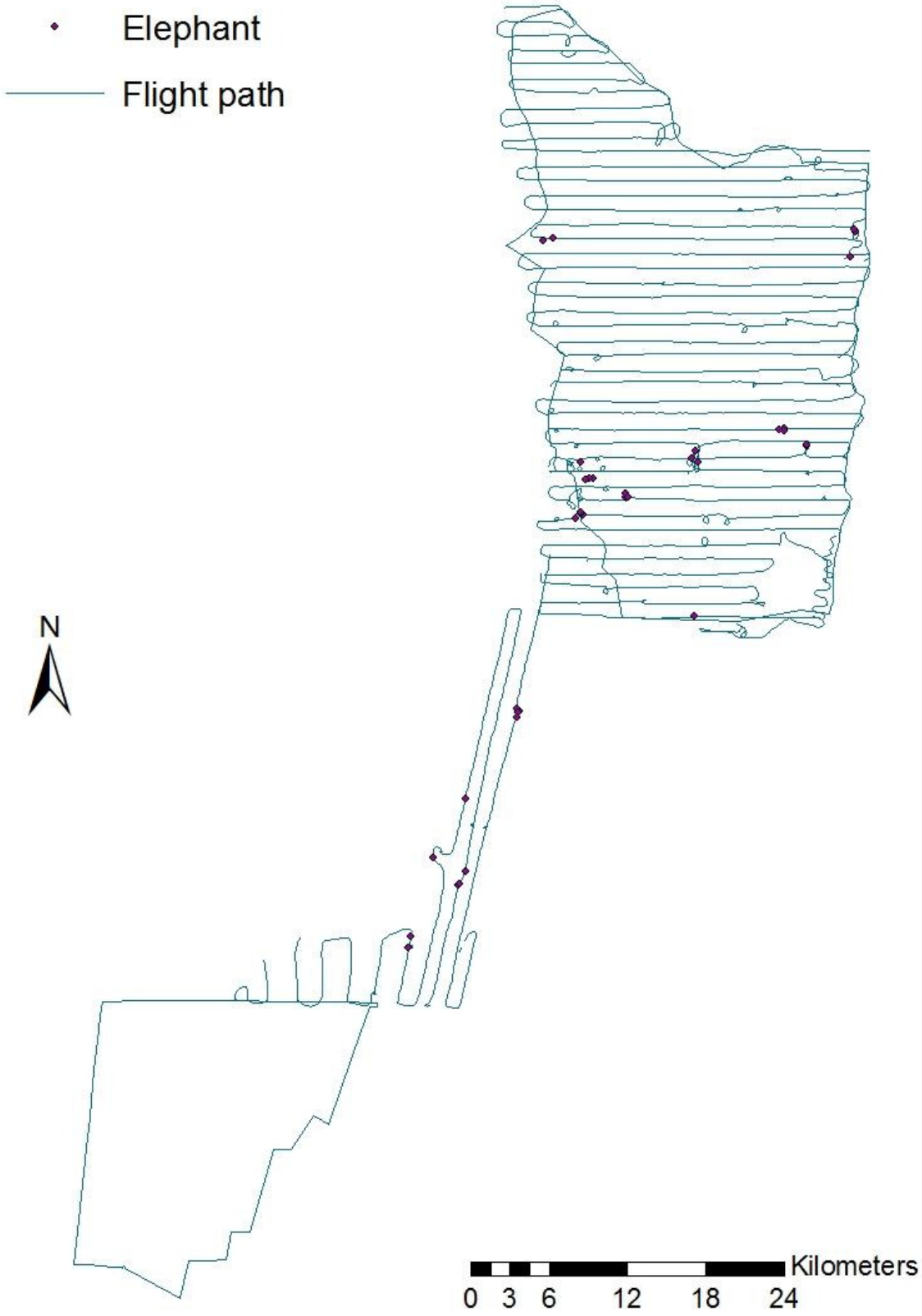


FIGURE D: MAP SHOWING THE DISTRIBUTION OF ELEPHANT IN MAPUTO SPECIAL RESERVE IN THE 2012 SURVEY

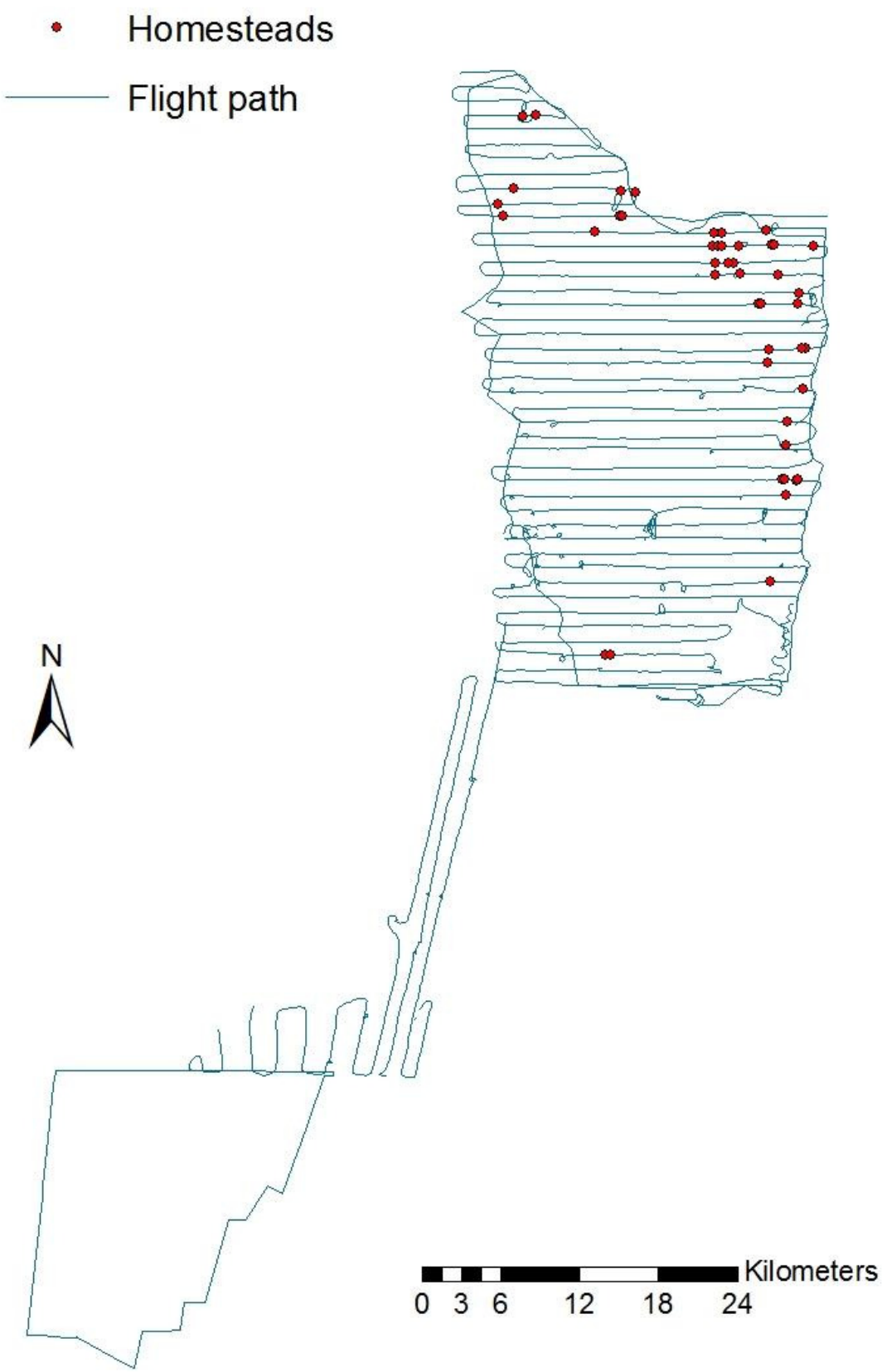
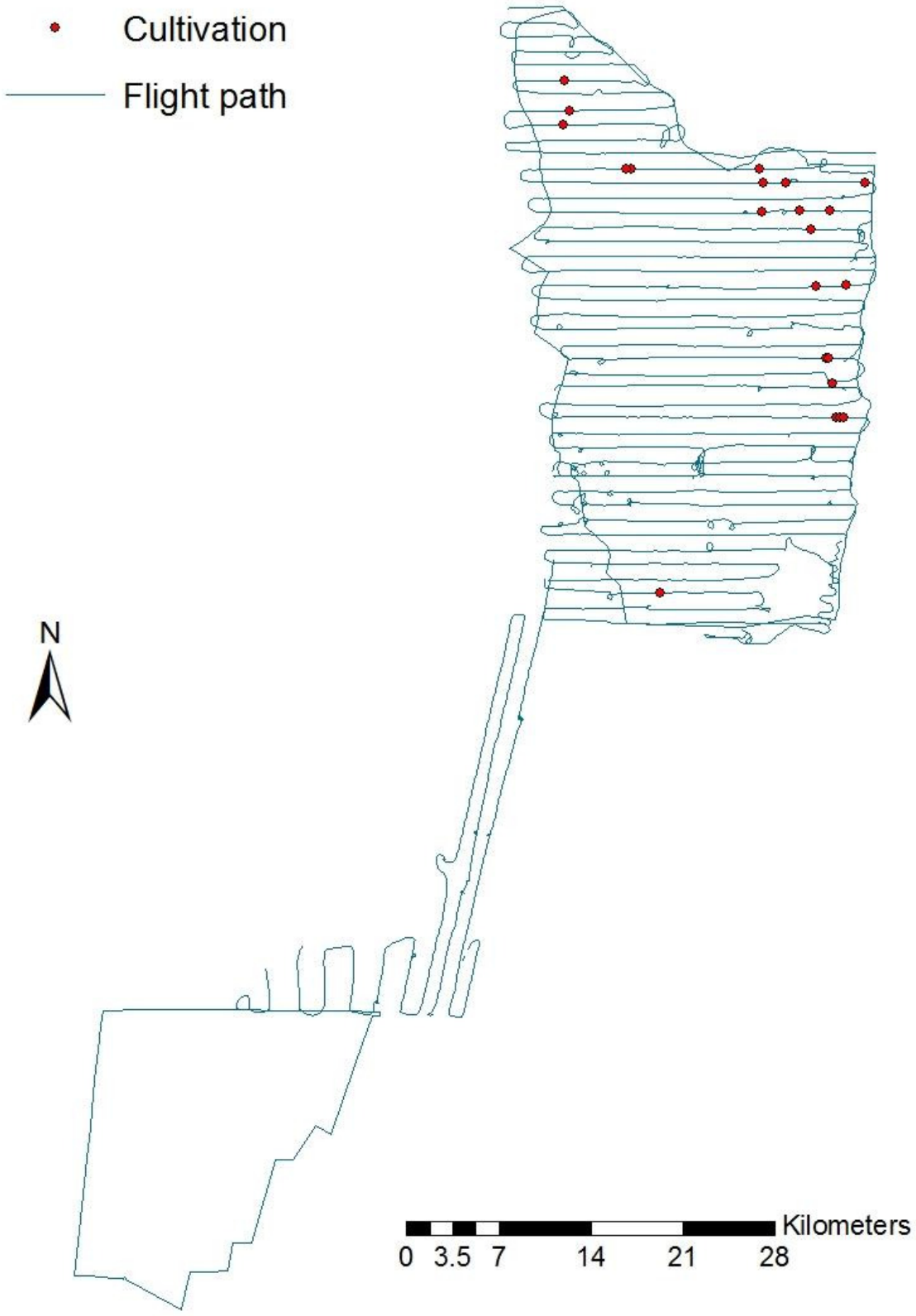


FIGURE E: MAP SHOWING THE DISTRIBUTION OF HOMESTEADS IN MAPUTO SPECIAL RESERVE IN THE 2012 SURVEY



FIGURF: MAP SHOWING THE DISTRIBUTION OF CULTIVATED PLOTS IN MAPUTO SPECIAL RESERVE IN THE 2012 SURVEY

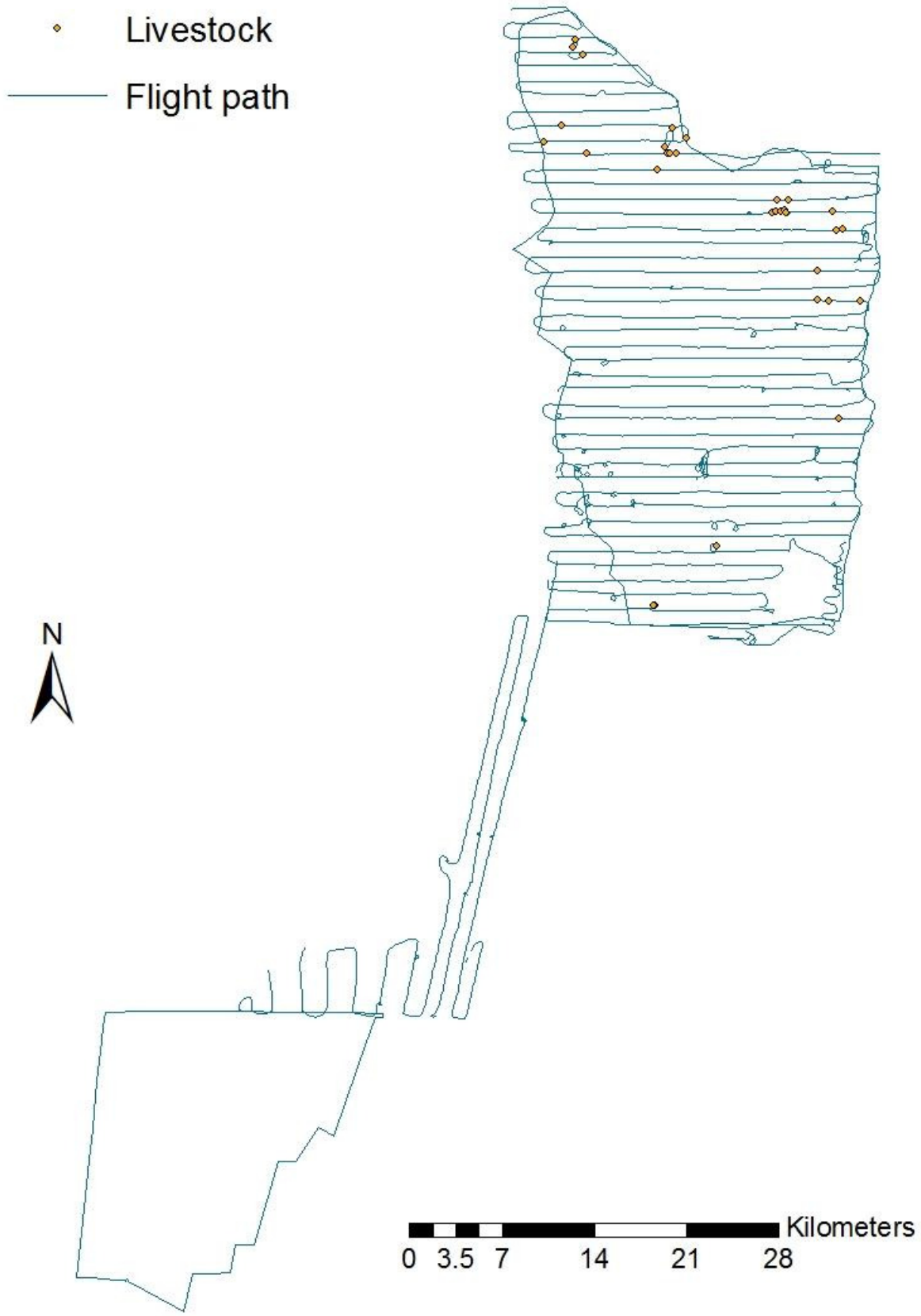


FIGURE G: MAP SHOWING THE DISTRIBUTION OF LIVESTOCK IN MAPUTO SPECIAL RESERVE IN THE 2012 SURVEY

POINTS OF CONCERN FROM CENSUS TEAM DURING 2012 CENSUS

1. Presence, extent and distribution of people and homesteads within the reserve

This is an historical issue and not one that is easily solved. Although the overall distribution of people and developments within the MSR has not changed much (mainly north-eastern corner, along the coast down to the south-eastern corner and some scattered buildings in the central areas), there seem to be more homesteads and we observed greater numbers of people walking about in the middle of the reserve, some of them with domestic dogs. In addition, old patches and many new patches of cultivated land were observed indicating that the influence of these communities on the landscape is spreading outside the confines of the villages. Large numbers of cattle and goats were observed again this year, in some instances mixing with zebra and impala groups. This is of course undesirable from a resource competition and disease perspective.

2. Gill-netting and other subsistence poaching

Numerous gillnets were observed from the air while flying over or adjacent to the many pans within the MSR. Gillnets pose a massive threat to fish stocks due to mass overexploitation of the resource. Gillnetting is an indiscriminate method that results in fish of all species and all sizes and ages being caught and dying before even being pulled out of the nets. As crucially, the presence of gillnets appears to result in the complete disappearance of crocodiles from the lakes (based on examples from areas outside EKZNW reserves such as the Pongola and Mkhuze floodplains and pans) over time, either due to getting caught directly in nets and drowning or because fish stocks are extremely depleted. Other signs of land based poaching were suspected including at least 3 reedbuck carcasses with some meat removed. These are major causes of concern particularly considering the large numbers of antelope that are being re-introduced to the MSR. This point is linked to the first one and is part of the resource exploitation issue within reserves. It is suspected that some poaching is already occurring (due to the fact that people were observed walking through the bush in strange areas and due to some of the carcasses seen from the air). An increase in the placement, numbers and efficiency of law enforcement personal could counter these threats but the threat will remain unless people can be removed from the reserve.

3. The Futi fencing and animals outside the park boundaries

There are concerns about the fencing of the Futi corridor and the southern part of the MSR. While it is understood that this is a long and time consuming process, there are potentially serious issues that require immediate attention. One of the most important of these is the fact that numerous animals, including some zebra and reedbuck that were counted, were already outside the park boundaries and are therefore at risk of being poached as they get closer to settlements. During the census, we received information of elephant herds (some of unknown size) being outside the park, both in the far north east and along the western boundary of the Futi. The elephant movements are expected due to the distribution of water along the swamp in the Futi corridor and we suggest that there will be huge problems in future regarding fence maintenance due to the current proposed Futi fenceline location. These are issues that require urgent attention before animals become fenced outside the park or begin to feel restricted and therefore stressed in any way. There are possible solutions to overcome fence breakers should this take place. Elephant breakouts in particular may become a frequent occurrence as the population continues to grow. Proper measures must be implemented to solve this as quickly as possible.

4. Distribution of game across the MSR

We suggest that it is no coincidence that the portion of the park with the highest people, settlement and livestock densities also happens to be the part of the park with the fewest animal sightings. In all places where groups of homesteads, cultivation and livestock were observed, very little or no game was seen for some time around the area. Poaching pressure can have negative impacts on all game species and not just the target species (snaring often catches other animals than desired). The risk of poaching in these parts of the MSR is quite high and we suspect it may be happening already (again due to examples of similar situations within EKZNW reserves e.g. Mkhuze.

5. Burning and bush-clearing

We noticed an alarmingly large number of patches of mangroves, sand forest, coastal forest and woodland habitat that had been cleared/burned or was in the process of being cut down or burned presumably for the purposes of space for crops and/or more homesteads. This is unacceptable within a protected area and needs to be addressed immediately. Similar situations with EKZNW reserves lead to major problems unless dealt with swiftly and effectively (e.g. Ndumo Game Reserve land invasion). Sand forest is very sensitive habitat that takes a number of years to regenerate and mangrove habitat in the north and north-east is even more prone to permanent damage and is irreplaceable. We suggest that the extent of both the mangrove

and forest habitat across the reserve be mapped so as to keep a continuous record of the nature and degree of loss of sensitive and important natural habitat.

6. Southern MSR fenceline

The team noticed what appeared to be a large remnant patch of swamp forest along the southern boundary elephant restraining fence not too far from Gala Gate. The current plan appears to be to fence through this forest or to exclude it from the park. We feel that this would be a great waste due to the nature of this habitat (very rare and under threat all over South Africa) and containing a large number of rare or restricted distribution plants. The presence of this patch of swamp forest requires on the ground confirmation and then perhaps a plan can be made to fence this into the reserve.

T BODASING
15 JANUARY 2013