Aerial wildlife count of the Gorongosa National Park, Mozambique, November 2020

Dr Marc Stalmans & Dr Mike Peel

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PARQUE NACIONAL DA GORONGOSA

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This report is dedicated to the memory of Dr Petri Viljoen who tragically died in a plane crash on 23 October 2020 whilst undertaking an aerial count of elephants in the Zambezi Valley in Zimbabwe. He will be much missed as a great human being, a good colleague and an outstanding expert in the art and science of aerial wildlife counting.

Some highlights

The 2020 aerial wildlife count documented:

- 90 000 animals in 60 % of the Park
- more than 760 hippo
- more than 780 elephants
- more than 800 blue wildebeest
- more than 1 200 buffalo.

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Summary

This report documents the results of the recent aerial wildlife count that was conducted in the Gorongosa National Park between 31 October and 15 November 2020.

Whereas initial comments are provided, the report does not attempt to fully explain the underlying causes of some of the documented changes. This forms part of ongoing research.

The focus was on the Rift Valley in the southern and central sector of the Park. A total of 193 500 hectares was fully covered by means of a helicopter. Systematic, parallel strips that were 500 m wide were assessed. All large animals observed were counted. In addition, a distance of respectively 185 and 205 km of 500 m wide transect lines were flown on the western and eastern side of the core count covering 19 500 ha. The total area that was surveyed represents 58% of the Park.

A total of 89 331 individuals comprising of 23 species were counted (Table 1). These are actual counts, not estimates. This represents the absolute minimum number of large animals that occur in the Park. A total of 226 baboon troops were also counted.

Still more animals occur outside of the areas that were not counted. However, the counting block represents the area with the best habitat and the highest known densities of wildlife as clearly illustrated by the lower density and diversity of animals recorded along the sample lines to the east and west of the central count block.

Table 1: total number of large animals counted in 2020 in the count block and additional sample lines.

Species	Total number counted
Blue Wildebeest	815
Buffalo	1 221
Bushbuck	1 719
Bushpig	231
Common reedbuck	5 838
Crocodile	2 745
Duiker grey	60
Duiker red	31
Eland	71
Elephant	781
Hartebeest	473
Hippo	766
Impala	6 491
Kudu	2 023
Lion	42
Nyala	2 656
Oribi	1 946
Sable	553
Warthog	8 509
Waterbuck	52 313
Wild dog	3
Zebra	44
TOTAL	**89 331**

Summary - continued

Elephant, hippo, buffalo, blue wildebeest, nyala and impala show steady growth.

Waterbuck, common reedbuck and oribi are substantially down in numbers from 2018. This would appear to be the result of a combination of inter- and intra-specific animal competition for resources that has been locally exacerbated by the impact of prolonged flooding on the grasslayer around Lake Urema following cyclone Idai in 2019.

The number of herbivores in the Park is currently higher than the numbers documented in the 1960's and 1970's. However, there are more smaller-bodied individuals and waterbuck as compared to the number of buffalo, wildebeest and zebra in the past. Overall, the decline of the waterbuck would seem to indicate a trend towards 're-equilibration' that favors larger-bodied animals such as was documented historically. This is considered as a positive development that indicates a new phase in the restoration history of the Gorongosa National Park.

Lower numbers of sable antelope and Lichtenstein hartebeest were recorded. At this stage it is surmised that this may not represent a true decline, but may reflect a movement out of the counting block.

Sable antelope in particular are known to prefer less utilised rangeland and with the reduction in grazing area due to the cyclone this may be the reason that these species probably moved into the longer grass areas in the west of GNP. This situation will need to be monitored.

More than 2 700 crocodiles were observed – the most ever in an aerial count of Gorongosa National Park.

Good numbers of Crowned Cranes, of nesting Marabou Storks and of Saddle-billed Storks were recorded.

A total of 197 Ground Hornbills were recorded. Gorongosa harbors a high density of these birds that are listed globally as 'Vulnerable' by the IUCN as of 2018, and as 'Endangered' in South Africa, Lesotho, Namibia and Swaziland.

Thirty-three active vulture nests were observed, including 19 of White-headed Vulture (more than in any previous count). Gorongosa represents a very important stronghold for this species that is listed by the IUCN as 'Critically Endangered'.

The 2020 count has re-affirmed the importance of these regular surveys. The aerial wildlife count using a helicopter is one of the most important and critical tools to evaluate the status of the recovery and the effectiveness of park management. The aerial wildlife count constitutes a vital M&E tool for the Park.

1. Survey methodology

1.1. Counting block

A count block of 193 500 hectares was fully covered by means of a helicopter (Fig. 1). The specific technique used was as follows:

- 4-seat Bell Jet Ranger helicopter with the pilot in the right front seat, data capture / observer in the left front seat and two observers in the back;
- For the sake of maximum visibility, all doors of the helicopter are removed during the actual count;
- Parallel strips of 500 m width are flown. This means that observers look for animals in a strip of 250 m wide on each side of the helicopter. Marker bars indicate the strip width to avoid looking too far from the helicopter;
- The helicopter is maintained at a constant height of 50 to 55 m (160 feet) above the ground. Airspeed is maintained at around 96 km/h (60 knots). When a large herd is observed (e.g. buffalo) the pilot circles around to enable an accurate count. Furthermore, photographs may be taken of milling herds to enable an accurate count of the individuals;
- All animals are individually counted. The presence of baboon troops was recorded but the number of individual baboons is not enumerated;
- A GPS-based system (Global Positioning System) is used for accurate navigation. A grid is generated on a notebook computer that is linked to the helicopter's GPS (Fig. 2). Every 2 seconds a flight co-ordinate is downloaded onto the hard drive. When a sighting is made the position together with the species code and number is logged.
- The flight path and the observations are visible on screen. This enables the pilot to keep the helicopter on the pre-determined line and avoids the risk of areas not being covered or being covered twice. The position of the animals that have already been spotted is displayed on screen which assists in preventing double counting (Fig. 2);
- The observers in the back of the helicopter wear yellow goggles that reduce shadows and enhance contrast for better visibility and detection of the animals;
- Sessions lasting about two to three hours are flown. A short break is taken every hour to relieve observer fatigue. Two 3-hour or three 2-hour sessions can be flown in a single day depending on temperature and visibility.

1.2. Eastern and western sample lines

In addition to this count block, a length of 195 and 205 km of transect lines were flown on the western and eastern side of the count block respectively (Fig. 1). The same technique was used as for the count block, except that the sample lines are 3 km apart, resulting in a discontinuous coverage.

1.3. Dedicated crocodile and hippo flight

A separate 105 km long flight was made from the middle Vunduzi River downstream to the confluence of the Urema-Pungue rivers to focus on crocodiles and hippo in the rivers and Lake system.

1.4. Carcass transect

As a significant number of especially waterbuck carcasses were observed during the count, a dedicated transect was flown to formally record these mortalities.

Using the same technique as described for the main count (height, speed and width) a 250 km long x 500 m wide transect was defined in such as way as to intersect the floodplain and woodland habitats (Fig. 3). This represents a 6.5% sample of the count block.

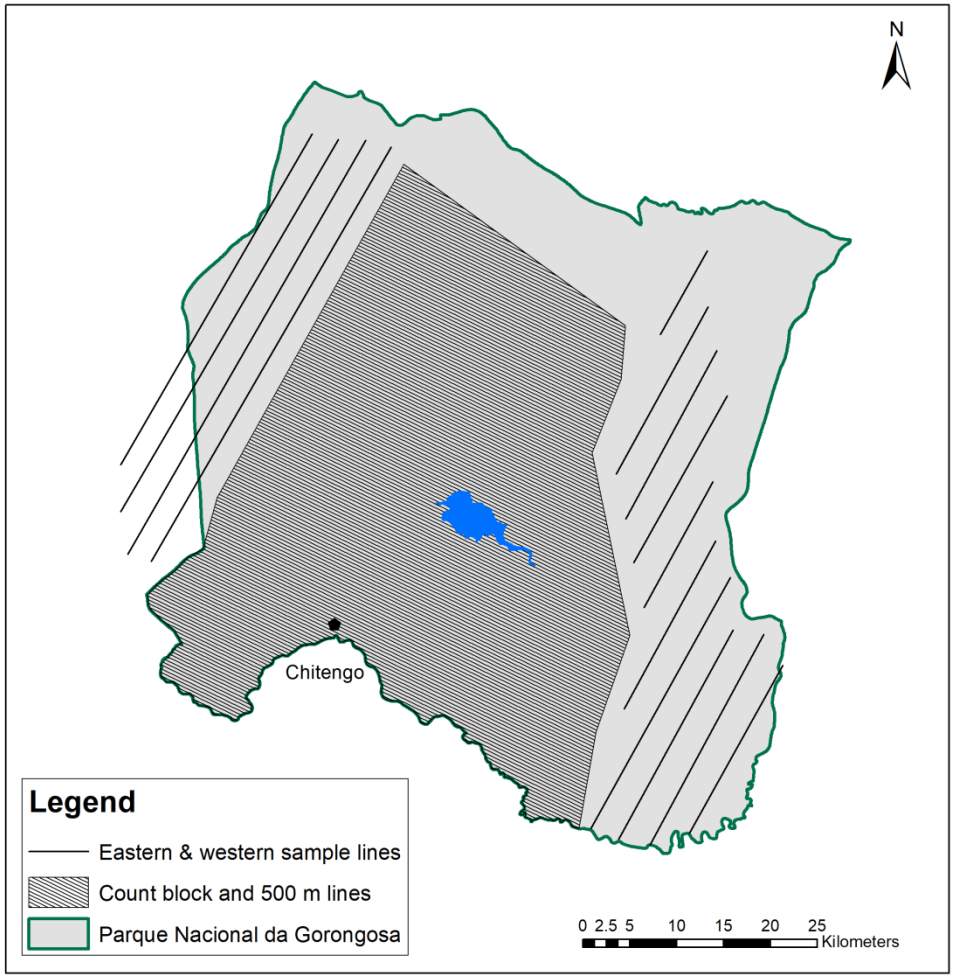

Fig. 1: Count block and additional sample lines covered by the 2020 aerial wildlife count.

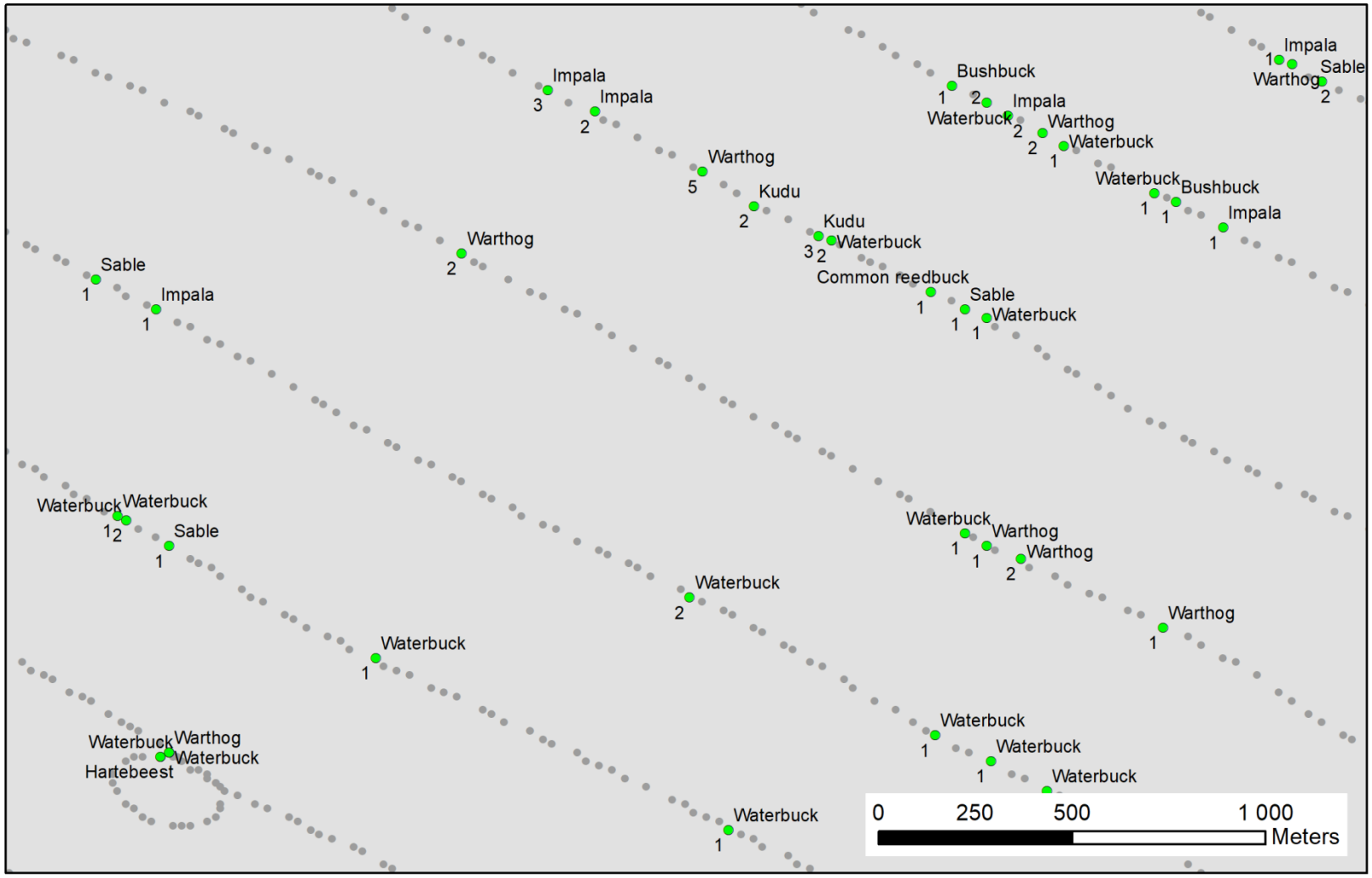

Fig. 2: Flight path and observations that are displayed on-screen during the counting. Lines are 500 m apart. Grey points indicate GPS positions that are automatically downloaded every 2 seconds. Green circles denote wildlife observations that are annotated with the species and number of animals.

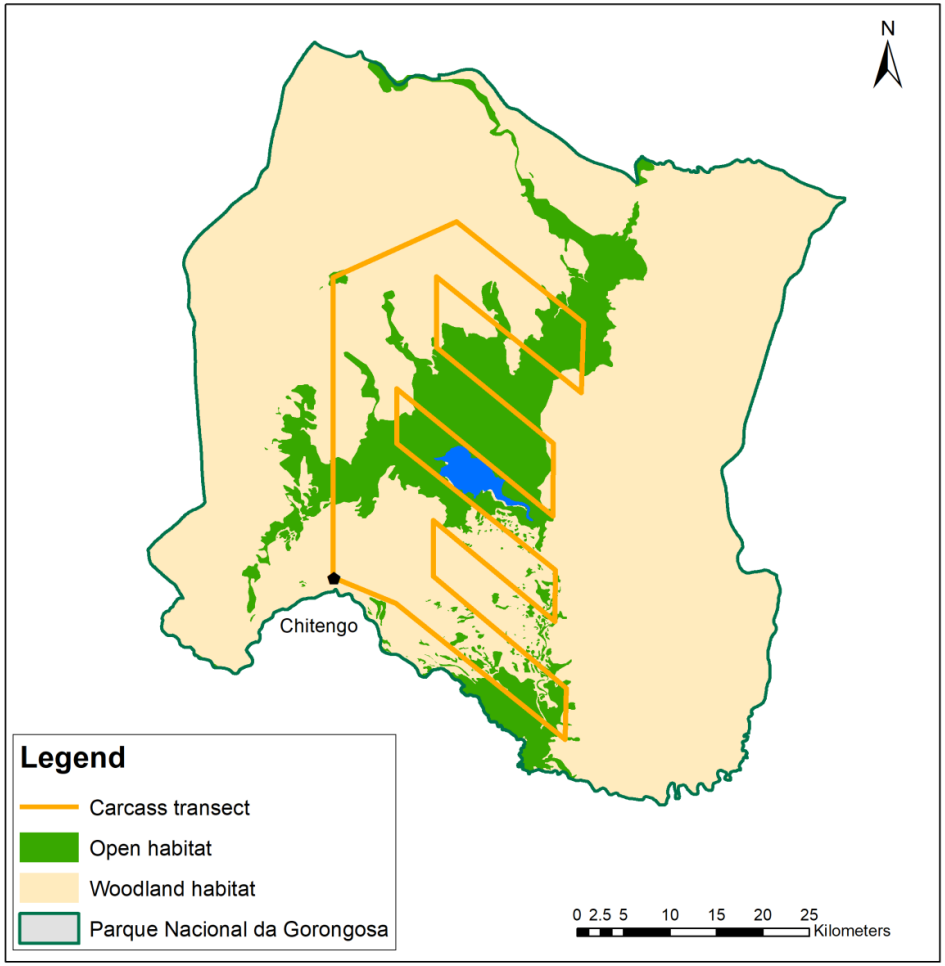

Fig. 3: (left) example of multiple waterbuck carcasses close to Lake Urema. (right) transect of 250 km in length to document mortalities throughout the count block in Gorongosa National Park.

1.5. Data handling

The 2020 data were amalgamated with the data from previous counts (Stalmans et al. 2014, Stalmans & Peel 2016, Stalmans et al. 2018) into an Access database to facilitate analysis and general comparisons. Each data point has the following information (Table 3):

- Unique ID number
- Day
- Time
- Count day
- Count session
- Latitude / Longitude
- Species
- Number of animals.

The relational data base allows for linking these individual observations with other species characteristics such as the average weight for each species that can be used for the calculation of biomass and habitat selection. The count data were also converted to shapefiles for use in ArcGis.

Table 3: Extract from the consolidated data for 2020

Id	Date	Time	Count day	Session	Latitude	Longitude	Species	Number
4005	11/3/2020	6:30:58 am	4	10	-19.14830	34.56720	Elephant	4
4006	11/3/2020	6:31:20 am	4	10	-19.14870	34.57010	Bushbuck	1
4007	11/3/2020	6:32:52 am	4	10	-19.15420	34.59010	Nyala	1
4008	11/3/2020	6:32:57 am	4	10	-19.15320	34.58920	Warthog	4
4009	11/3/2020	6:34:55 am	4	10	-19.14210	34.56860	Elephant	23
4010	11/3/2020	6:35:28 am	4	10	-19.13850	34.56100	Waterbuck	10
4011	11/3/2020	6:35:29 am	4	10	-19.13840	34.56070	Warthog	1
4012	11/3/2020	6:35:46 am	4	10	-19.13620	34.55630	Waterbuck	1
4013	11/3/2020	6:35:47 am	4	10	-19.13610	34.55610	Bushbuck	1

2. Results

2.1. Survey statistics

The survey was conducted between 31 October and 15 November 2020. There were an effective 14 days of counting (1 for the east and west lines, 13 for the different blocks and 1 for the crocodile and hippo survey, followed in the afternoon by the carcass transect) (Fig. 4).

Total coverage through the central counting block and the additional transect lines in the east and west was 57.9% of the Park. The daily output was up to 18 000 hectares using 7 hours of flying.

This was pilot Mike Pingo's tenth (10th) helicopter wildlife count of Gorongosa. Observer Dr Mike Peel from the Agricultural Research Council is very experienced with wildlife counts in South Africa. This was his fifth survey of Gorongosa. This was also the fifth count of Gorongosa for data recorder Dr Marc Stalmans. The remaining observer seat was occupied by Graeme Wolfaard, an experienced counter who has been working in the team of Dr Peel and pilot Mike Pingo. Dr Tara Massad and Bryan Pingo acted as observers on the eastern and western lines.

Flying and counting conditions varied with some very hot days being experienced (see Table 4). The counting sessions were adjusted in order to avoid the hottest time of the day when animals would tend to remain under the shade of trees which made their detection more difficult.

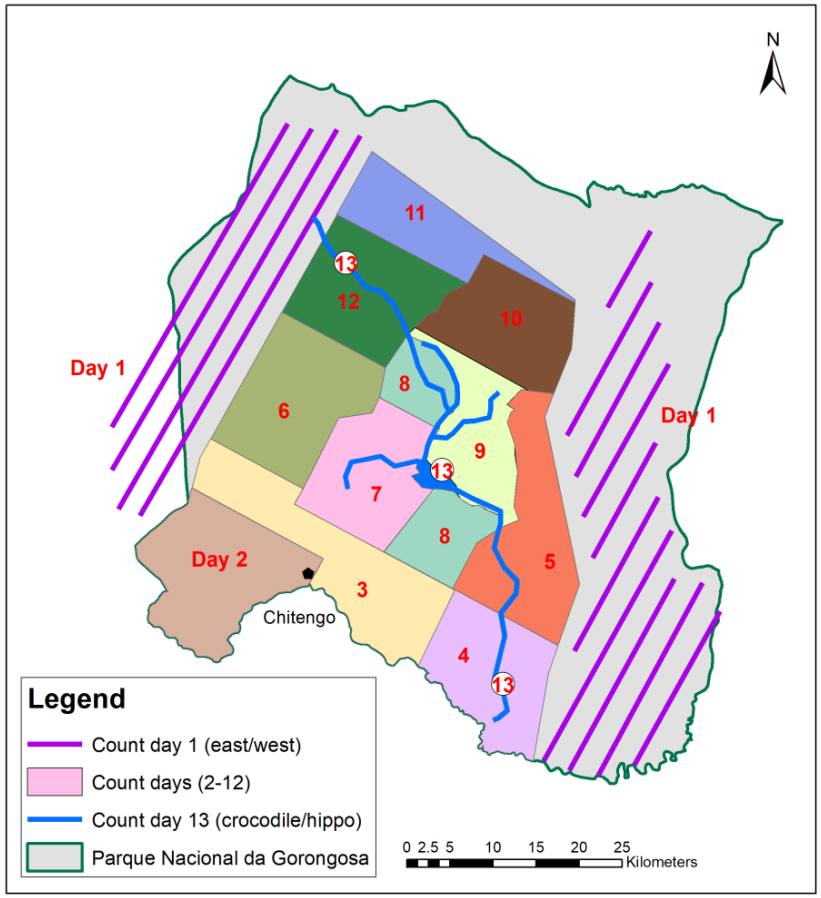

Fig. 4: Count blocks and count days in 2020.

Table 4: Counting conditions during the 2018 aerial wildlife survey.

Date	Session	Cloud cover (0 to 8 scale)	Visibility	Temp. ºC	Team
31/10	All	See conditions 01/11			Marc Stalmans (MS); Mike Pingo (MP); Tara Massad (TM); Bryan Pingo (BP)
01/11	1	7–5	Poor (p)-p-p-p-moderate (m)	26-30	MS; MP; Mike Peel (MP); Graeme Wolfaard (GW)
01/11	2	4-5	Good (g)–m-g-m sun to cloud	30-34	MS; MP; MP; GW; BP
01/11	3	4-2	g-m-m-m-g long shadow later	34-35	MS; MP; MP; GW; Olivia Pereira
02/11	1	8-4	p-p-g	24-29	MS; MP; MP; GW;
02/11	2	4-5	m-m-g	31-32	MS; MP; MP; GW; BP
02/11	3	0	g	36	MS; MP; MP; GW;
03/11	1	0	g-m-g-g-g hazy to begin	26-28	MS; MP; MP; GW
03/11	2	0	g	32-36	MS; MP; MP; GW; BP
03/11	3	8	P Smoke very hazy	36-34	MS; MP; MP; GW;
04/11	1	8-6	p-p-p-m-p-p-m (cloud cover)	26-31	MS; MP; MP; GW; JD
04/11	2	4 High cloud	m-g	34-37	MS; MP; MP; GW;
04/11	3	8	P Smoke very hazy	36-34	MS; MP; MP; GW
05/11	1	4	p-m-g-g-g Start watery sun	27-31	MS; MP; MP; GW; Margarida Victor
05/11	2	0	g	33-37	MS; MP; MP; GW; BP
05/11	3	0	g	42-41	MS; MP; MP; GW; Tara Massad

Table 4 (continued): Counting conditions during the 2018 aerial wildlife survey.

Date	Session	Cloud cover (0 to 8 scale)	Visibility	Temp. ºC	Team
07/11	1	0	m-g-g-g high cloud	27-32	MS; MP; MP; GW; Angus Begg
07/11	2	0	g	37-43	MS; MP; MP; GW; BP
07/11	3	0	g	46 hottest ever in helicopter since 1992	MS; MP; MP; GW;
08/11	1	0	m-m-g	27-32	MS; MP; MP; GW
08/11	2	0	g	36-40	MS; MP; MP; GW; BP
08/11	3	0	m-p-p very smoky	40	MS; MP; MP; GW
09/11	1	0	g - light haze	27-32	MS; MP; MP; GW
09/11	2	0	g	36-42	MS; MP; MP; GW
10/11	1	8	p	27-30	MS; MP; MP; GW, Steve Svendsen
10/11	2	0	g	32-37	MS; MP; MP; GW
10/11	3	6-8	m-p-p-p-p	36	MS; MP; MP; GW
11/11	1	5-6	East m; West p	28-30	MS; MP; MP; GW
11/11	2	6-4	m-g-m-g-m	30-34	MS; MP; MP; GW
12/11	1	8-7	p (90%)-m (10%)	26-28	MS; MP; MP; GW
12/11	2	8 (west rainy) - clearer ≈3-4 (east)	p-p (west) g-g (east)	fairly stable around 28-29	MS; MP; MP; GW
14/11 River	1	5-3	M (20%) -g (80%)	27-30	MS; MP; MP; GW
14/11 Carcass count	2	0	g	32-36	MS; MP; MP; GW
15/11	1	Search for collared bull elephant south of Pungue River in Buffer Zone			MS; Alfredo Matavele, Antonio Paulo (Tonecas)

2.2. Animal numbers recorded

The 2020 count generated 20 910 individual observations. These records were amalgamated in the database together with the data from the previous counts. At present, the database holds more than 94 000 individual observations from 16 wildlife counts since 1969.

A total of 89 331 individuals of 23 species were counted in 2020 (Table 5). These are actual counts, not estimates. This represents the absolute minimum number of large animals that occur in the park given that only 57.4% of the Park was counted.

A total of 226 baboon troops were also recorded which would make it one of the numerically most abundant species in the Park.

Still more animals occur outside the block that was counted, but no estimates have been made. This count block represents the area with the best habitat and the highest known densities of wildlife and is therefore likely to hold the bulk of most species as clearly illustrated by the lower density and diversity of animals recorded along the sample lines to the east and west (see section 3.).

Table 5: total number of large animals counted in 2020 in the count block and additional sample lines.

Species	Total number counted
Blue Wildebeest	815
Buffalo	1 221
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Sable	553
Warthog	8 509
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Zebra	44
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2.3. Spatial distribution patterns

The distribution of the different species across the count block indicates a general preference for the floodplain grasslands[1] and the areas along the perennial rivers such as Vunduzi, Mucombeze and Urema Rivers. (Fig. 5).

Certain species are strongly associated with the floodplain (e.g. waterbuck, common reedbuck, oribi and warthog – Fig. 6 to 9), others with the floodplain-woodland interface (elephant and buffalo Fig. 10 & 11), and others still with the woodlands (sable antelope, Lichtenstein's hartebeest, kudu, nyala) or with the ecotones (impala and eland) – Fig. 12 to 21). Hippo and crocodile are, as expected, strongly associated with Lake Urema and the perennial rivers and pans (Fig. 22 & 23).

The floodplain area immediately north-east of Lake Urema carries low numbers of animals. This is further discussed in section 3.

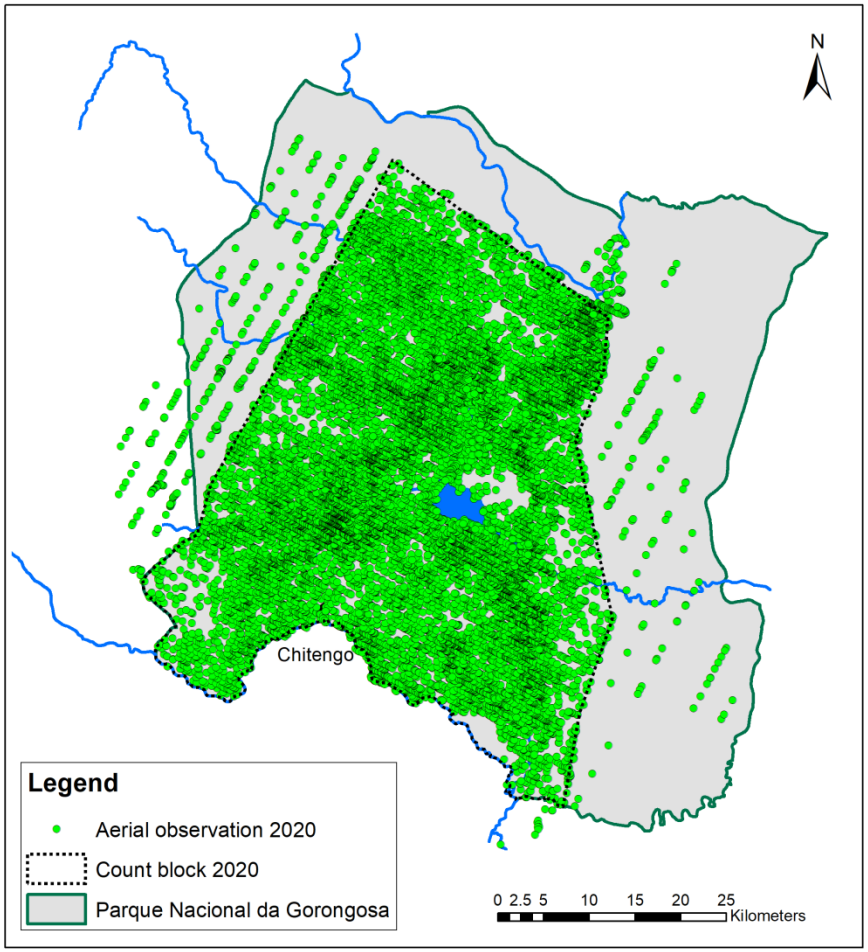


Fig. 5: Spatial distribution of all observations during the 2020 aerial wildlife count.

[1] Floodplain landscape as defined by Stalmans & Beilfuss (2008) with subsequent refinements

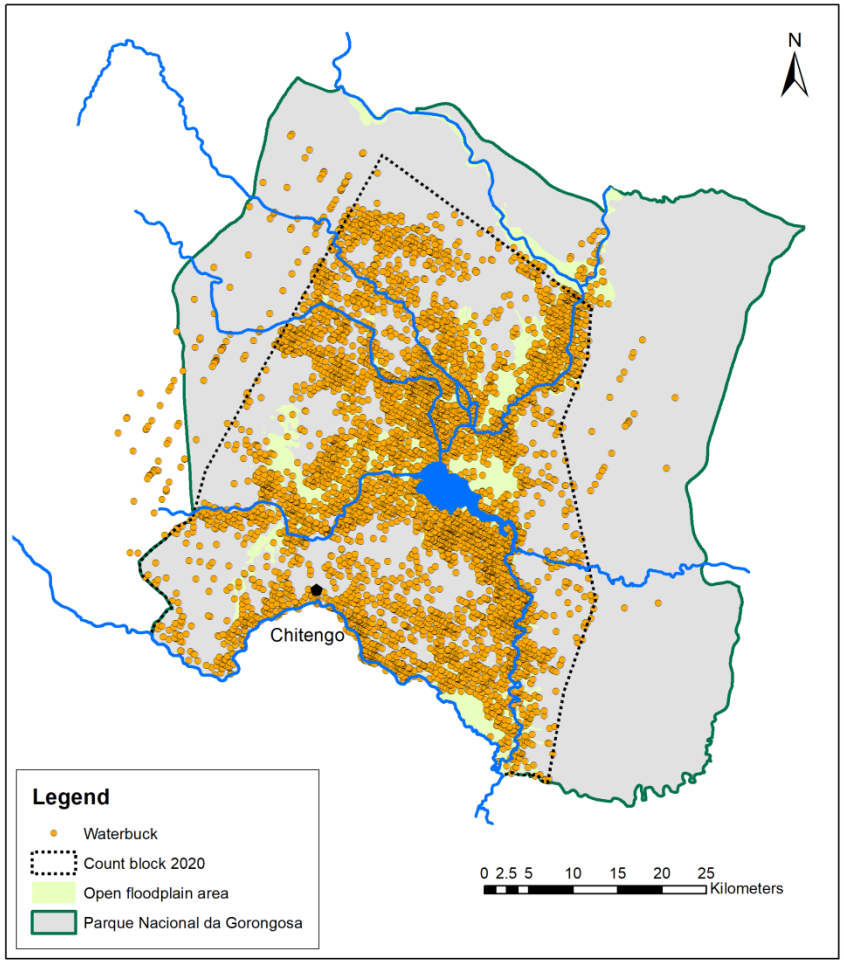


Fig. 6: Spatial distribution of waterbuck during the 2020 aerial wildlife count.

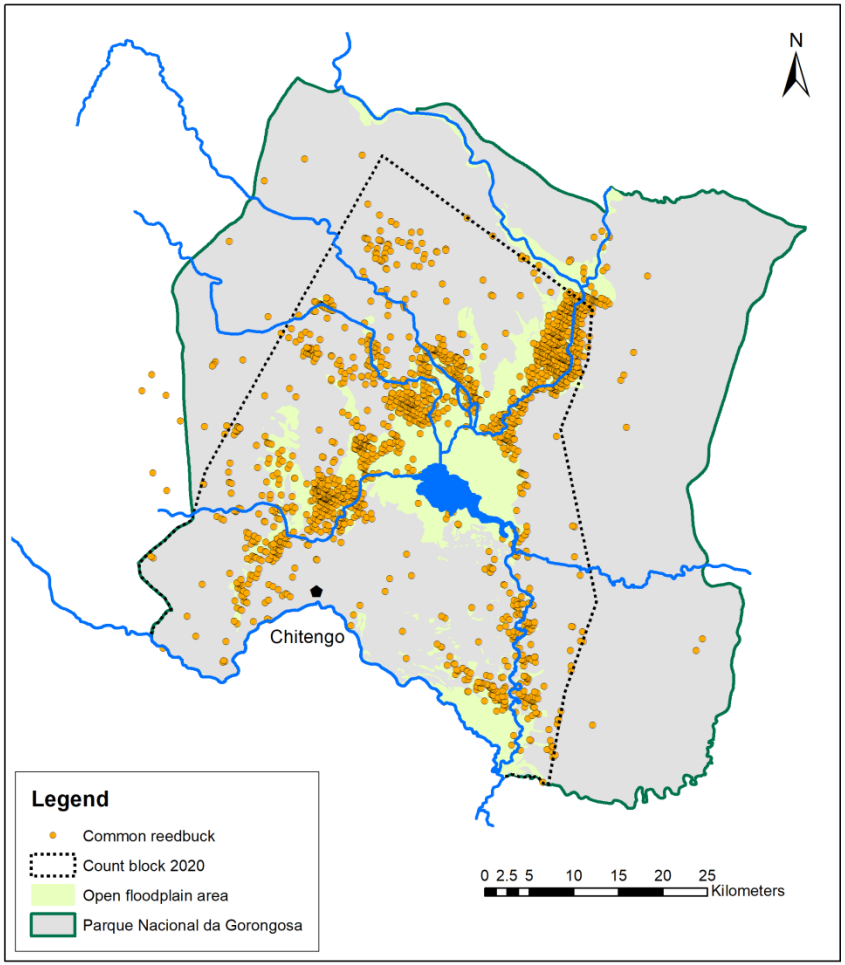


Fig. 7: Spatial distribution of common reedbuck during the 2020 aerial wildlife count.

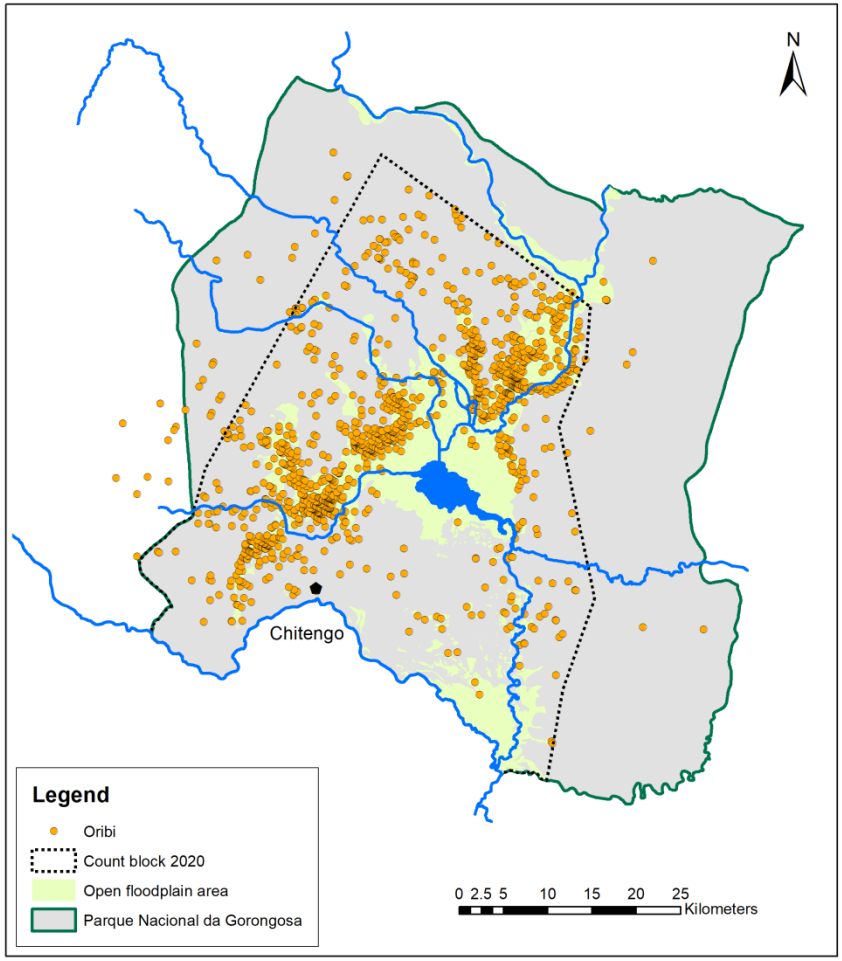


Fig. 8: Spatial distribution of oribi during the 2020 aerial wildlife count.

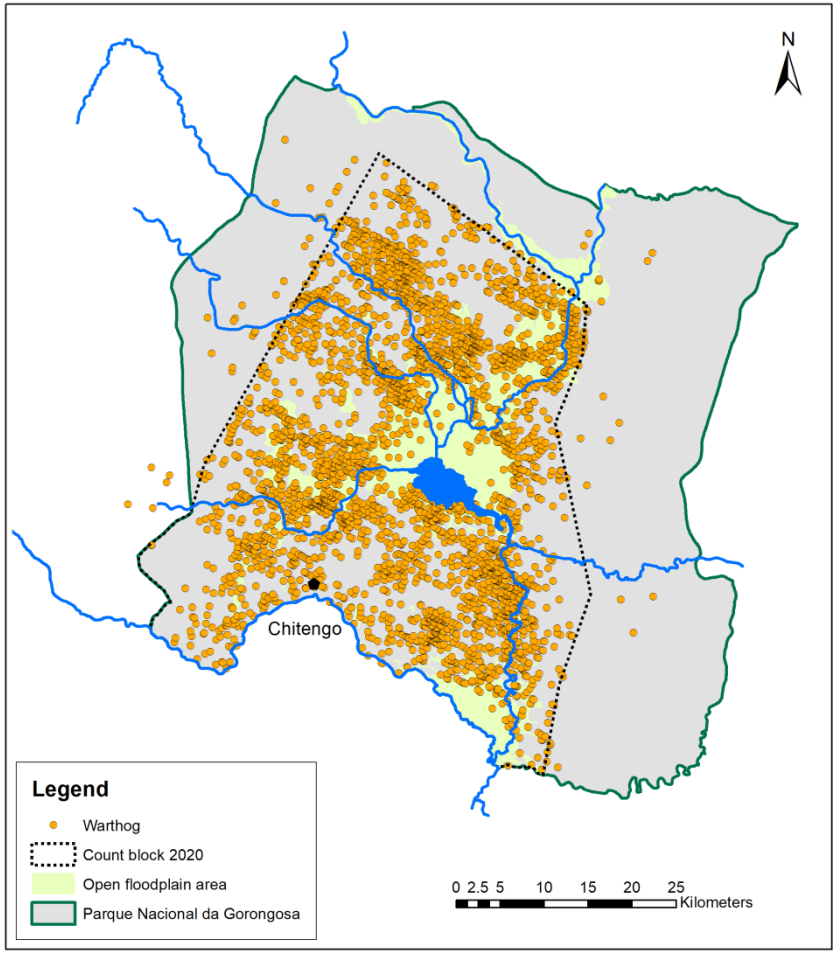


Fig. 9: Spatial distribution of warthog during the 2020 aerial wildlife count.

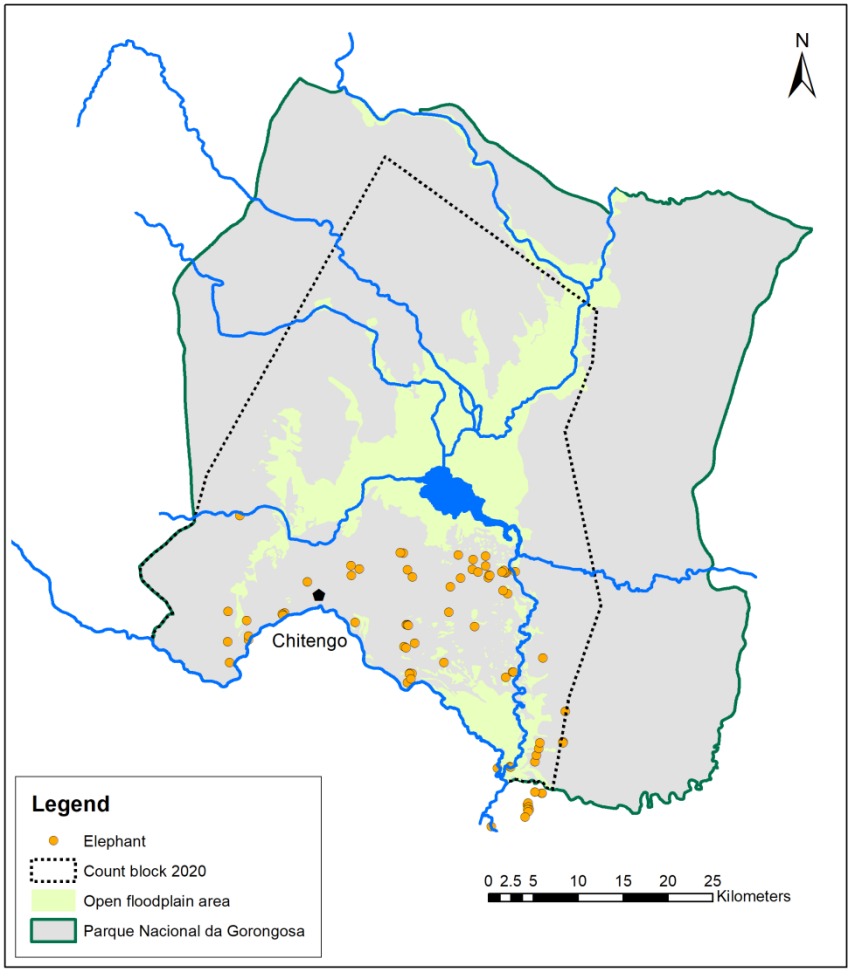


Fig. 10: Spatial distribution of elephant during the 2020 aerial wildlife count.

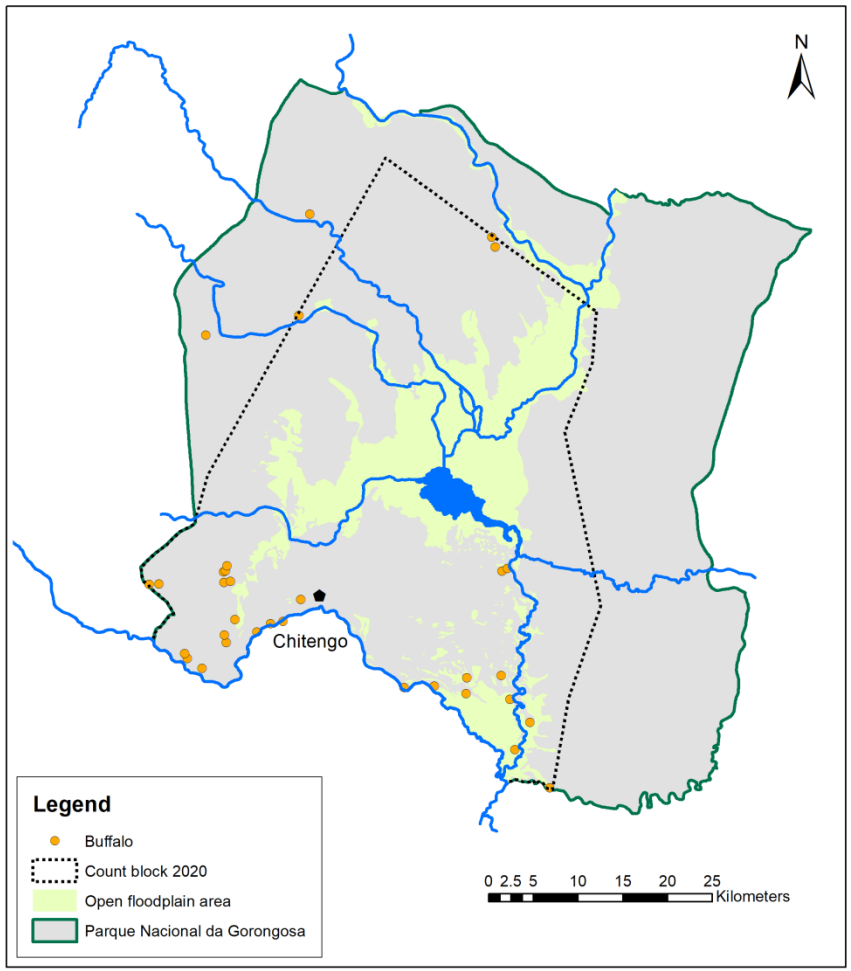


Fig. 11: Spatial distribution of buffalo during the 2020 aerial wildlife count.

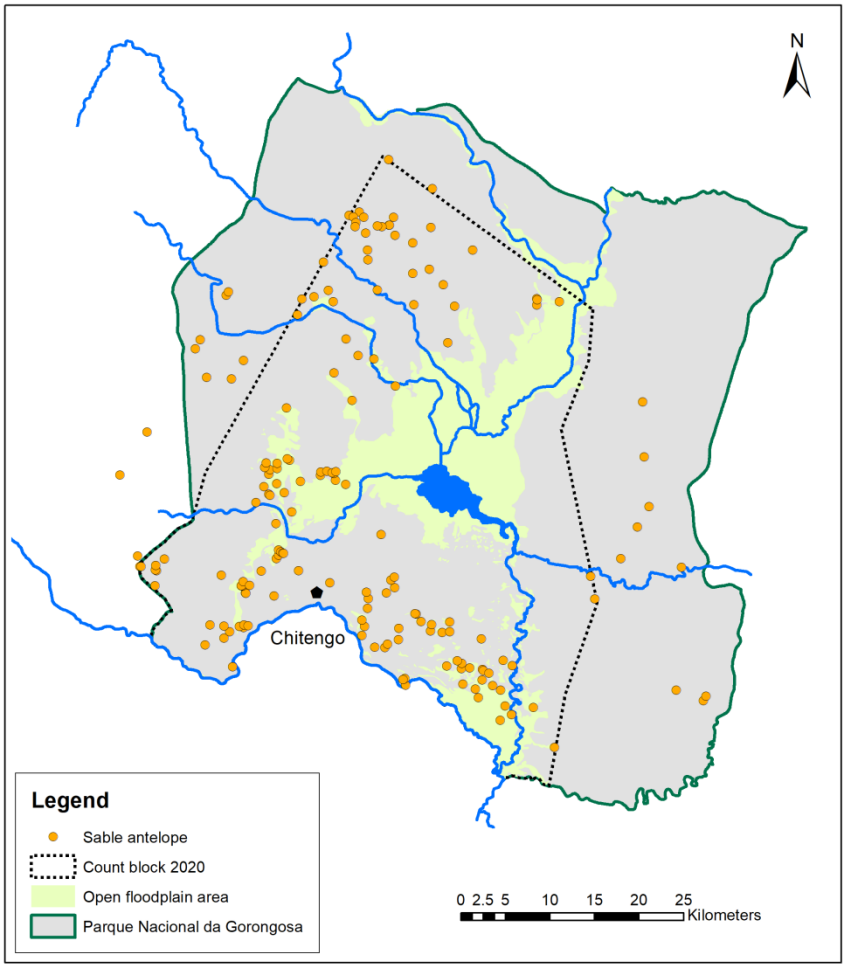


Fig. 12: Spatial distribution of sable antelope during the 2020 aerial wildlife count.

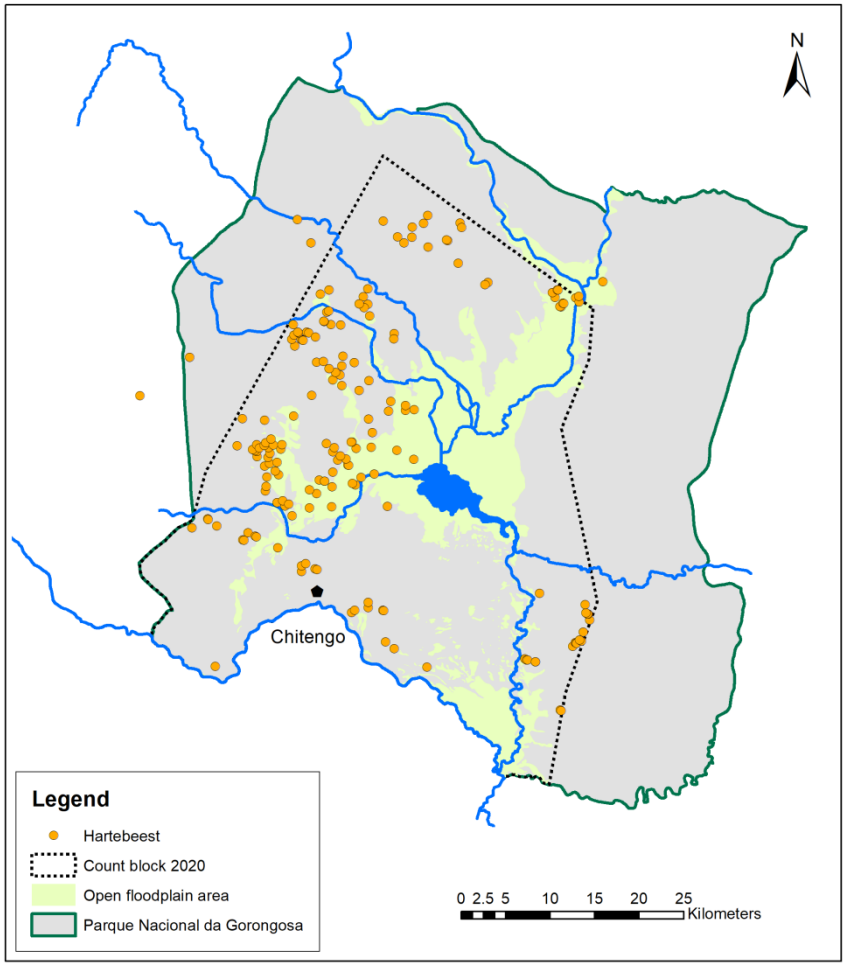


Fig. 13: Spatial distribution of Lichtenstein's hartebeest during the 2020 aerial wildlife count

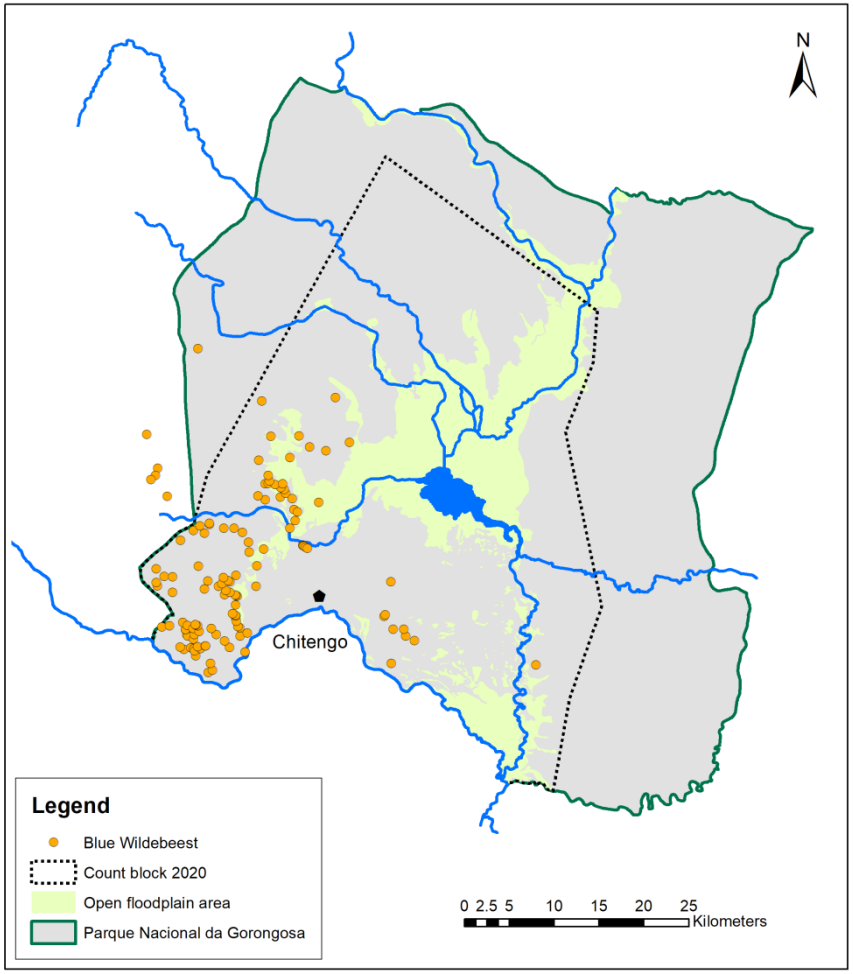


Fig. 14: Spatial distribution of blue wildebeest during the 2020 aerial wildlife count
(including the very first observation of wildebeest east of the Urema River since aerial counts resumed in 1994).

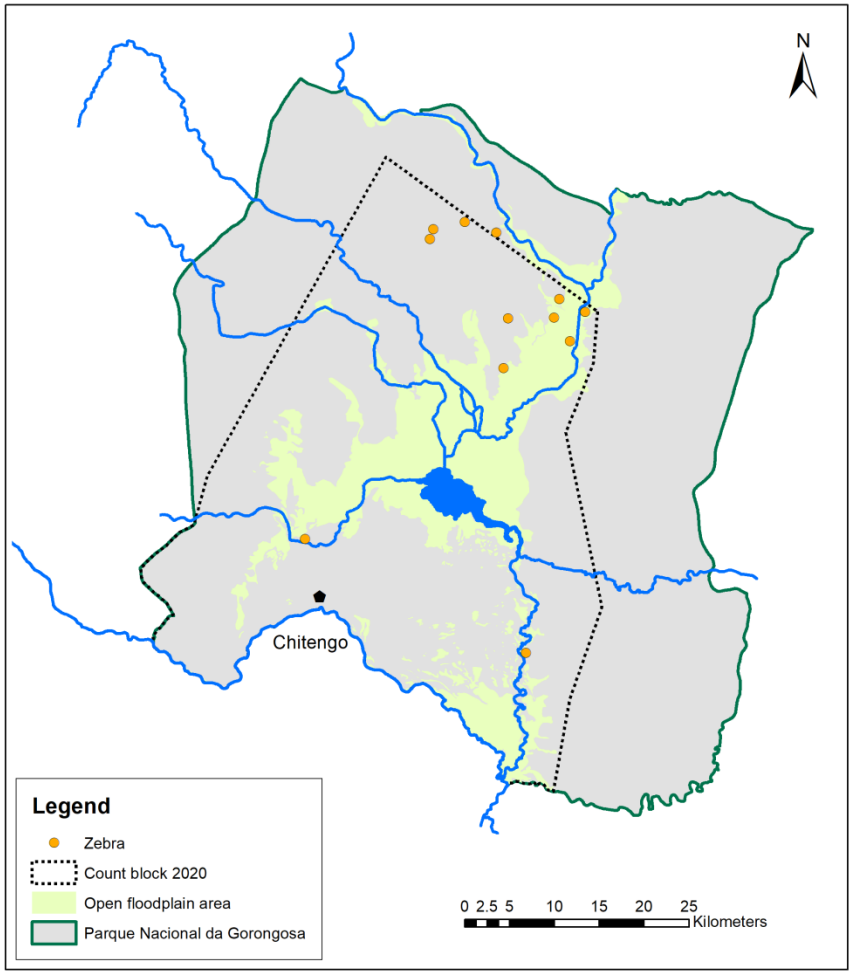


Fig. 15: Spatial distribution of zebra during the 2020 aerial wildlife count.

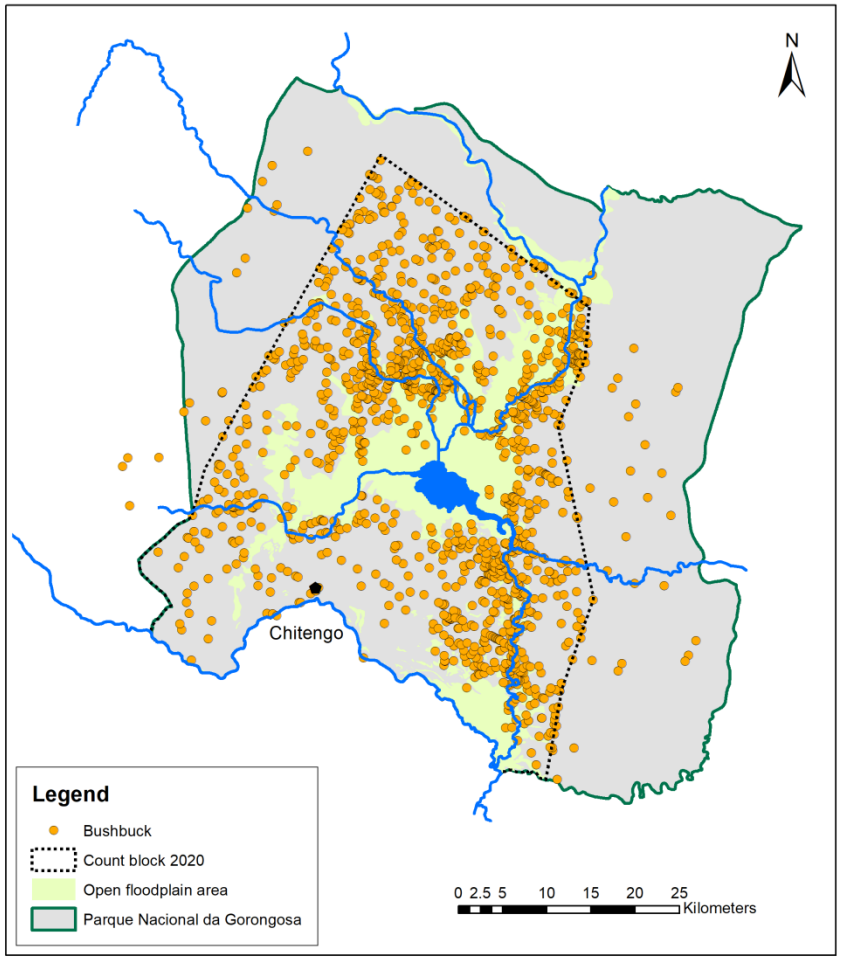


Fig. 16: Spatial distribution of bushbuck during the 2020 aerial wildlife count.

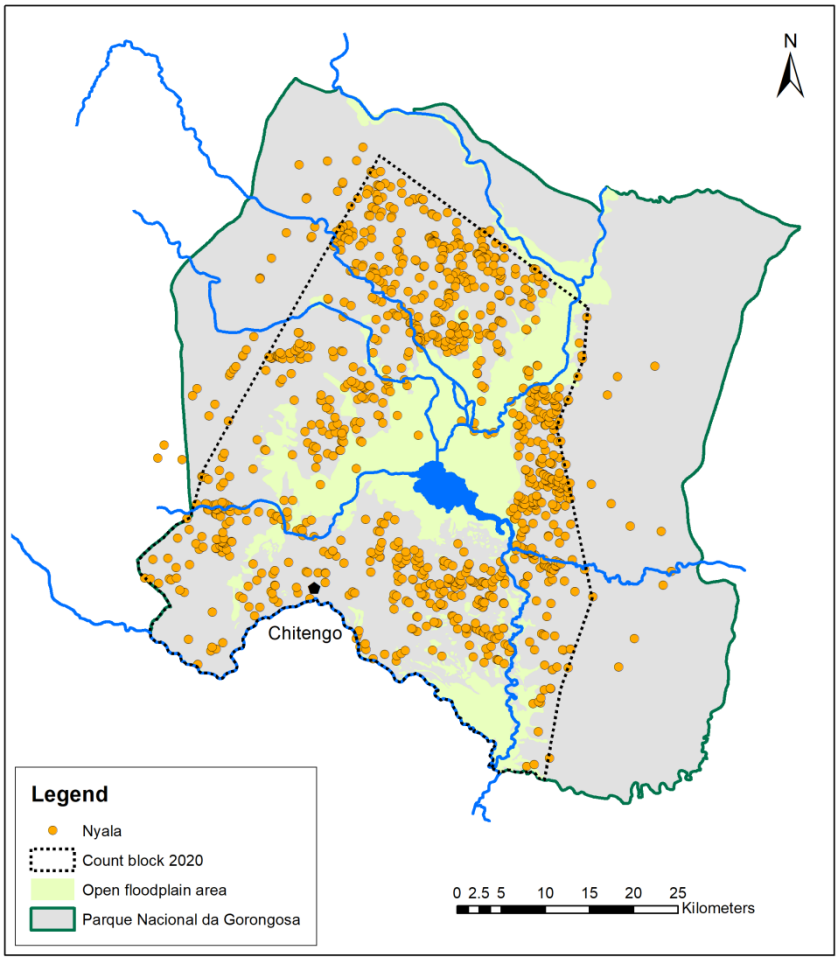


Fig. 17: Spatial distribution of nyala during the 2020 aerial wildlife count.

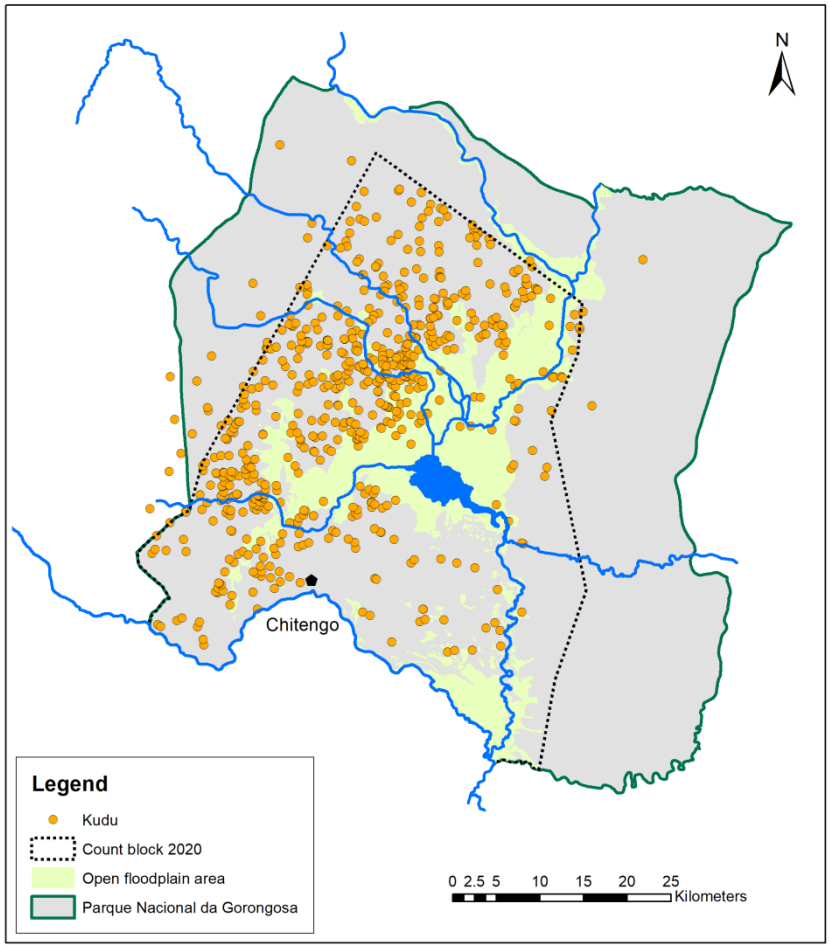


Fig. 18: Spatial distribution of kudu during the 2020 aerial wildlife count

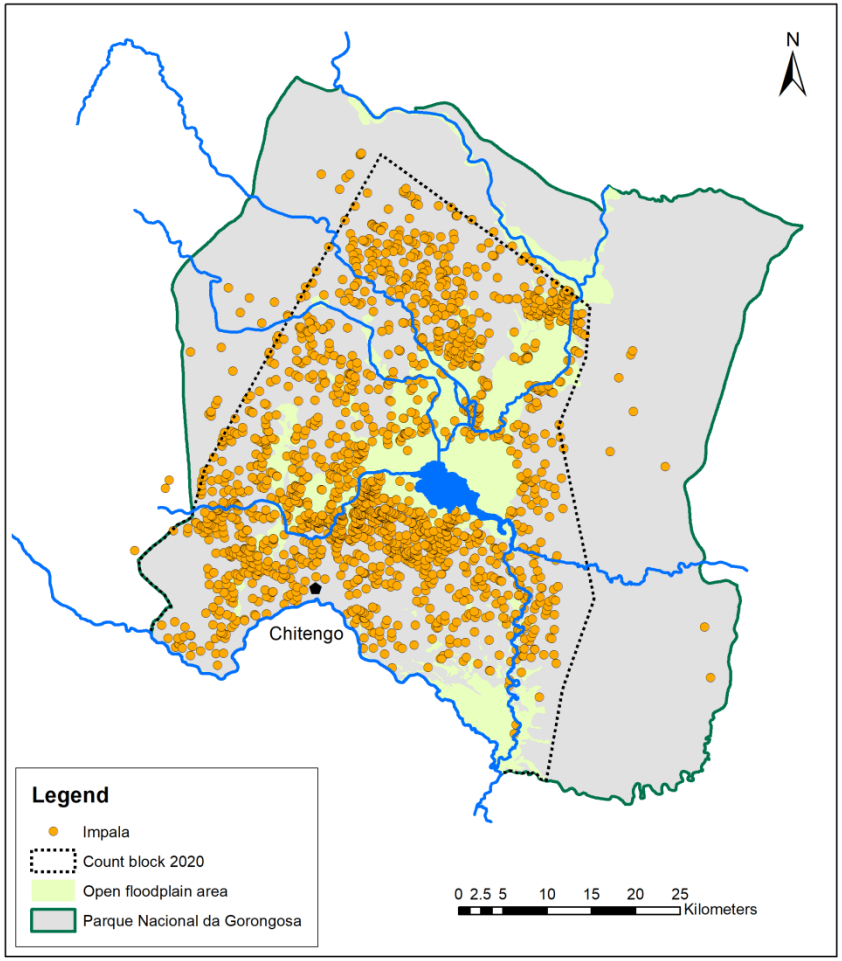


Fig. 19: Spatial distribution of impala during the 2020 aerial wildlife count

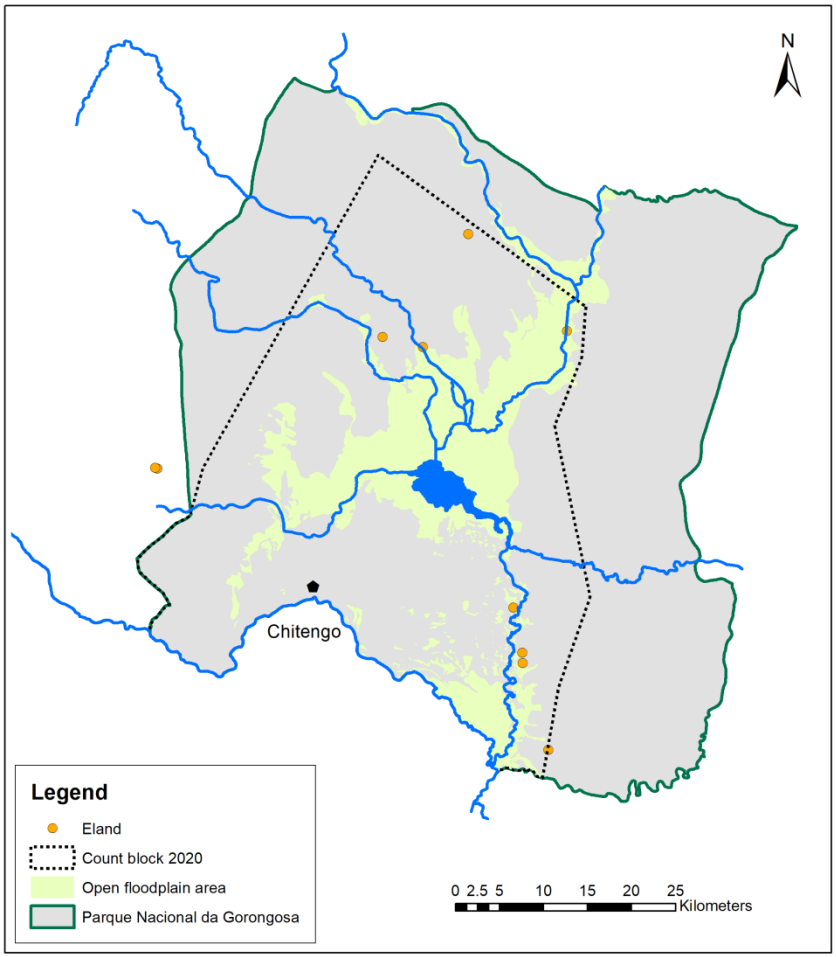


Fig. 20: Spatial distribution of eland during the 2020 aerial wildlife count.

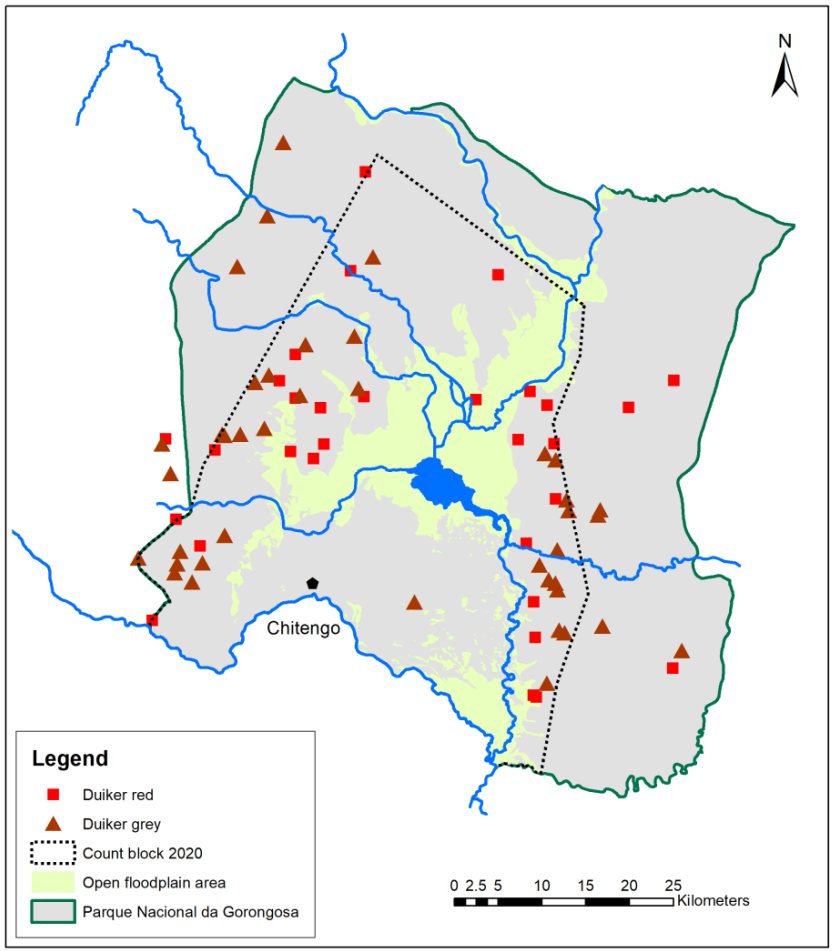


Fig. 21: Spatial distribution of red duiker and grey duiker during the 2020 aerial wildlife count.

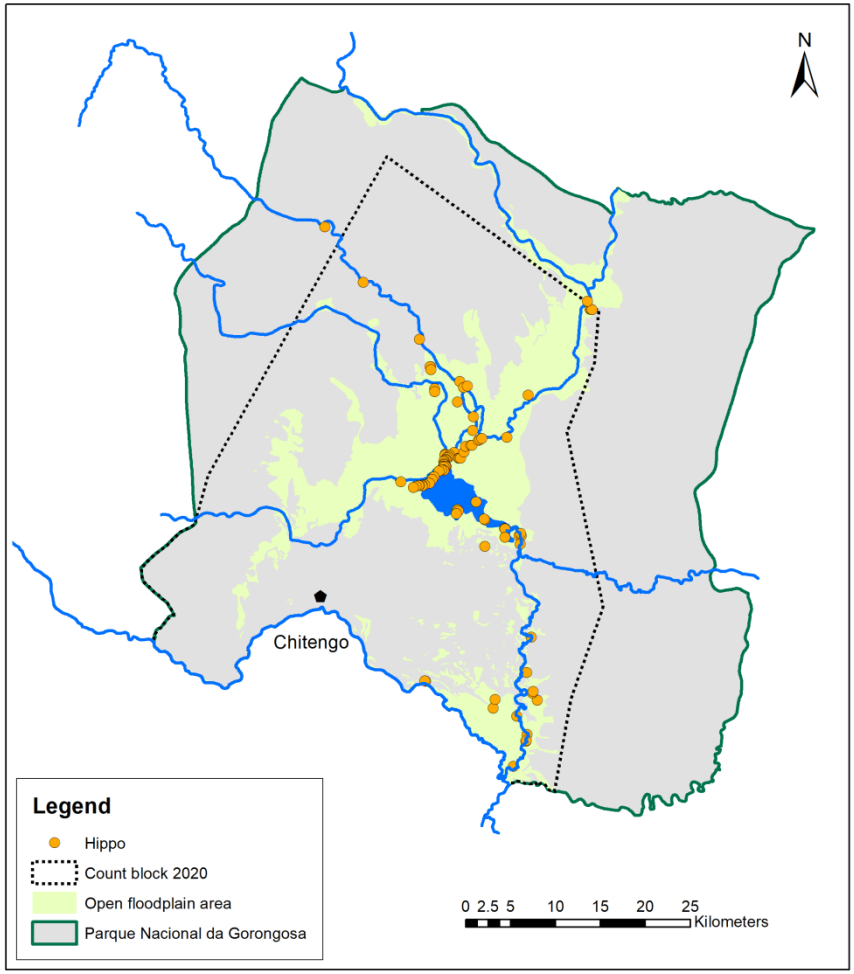


Fig. 22: Spatial distribution of hippo during the 2020 aerial wildlife count.

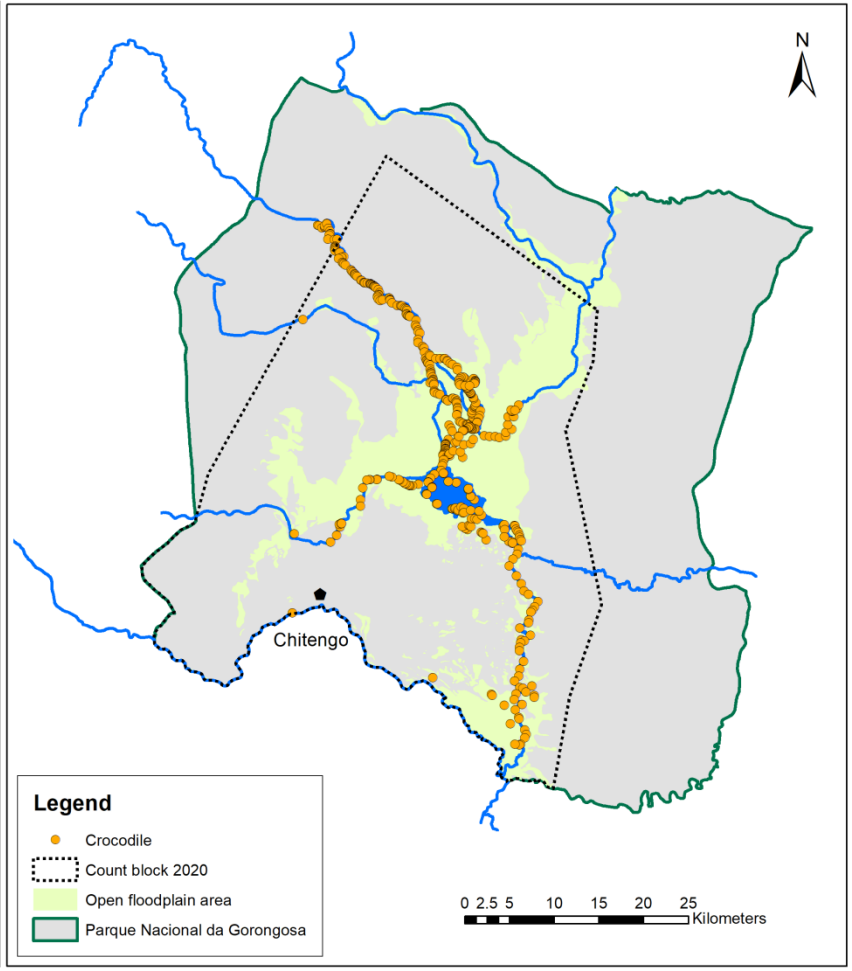


Fig. 23: Spatial distribution of crocodile during the 2020 aerial wildlife count.

2.4 Mortalities

Along the 250 km long transect, a total of 1 warthog, 1 sable antelope, 5 reedbuck and 367 waterbuck carcasses were counted (Fig. 24). This translates to an average of 2.93 dead waterbuck per km^2. However densities are very different for the woodland (0.24/km^2) and open floodplain areas (7.44/km^2) respectively.

Considering that a zone of low (in the south), medium (west and north) and high (central) mortalities can be distinguished, the extrapolation from the transect yields a total of 3 300 old and new waterbuck carcasses that can be linked to the current year. Additionally, a number of waterbuck carcasses were probably dragged into the water by the large crocodile population and thus remain unaccounted for.

The life expectancy of a waterbuck in the wild is 12 to 18 years (Spinage 1982). Based on the previous count figures and expected annual rate of increment, there would have been 700 waterbuck born in 2002 that would reach the end of their 18-year lifespan. There would have been 2 700 waterbuck born in 2008 that in 2020 would have reached the end of a 12-year lifespan. Expected annual natural mortalities for the year 2020 would therefore range from a minimum of 700 to a maximum of 2 700 waterbuck at the time of the count.

The carcass count indicates clear excess mortality. It was also evident that quite a few animals that were observed during the count would not survive into the new rainy season thereby adding to the current carcass count.

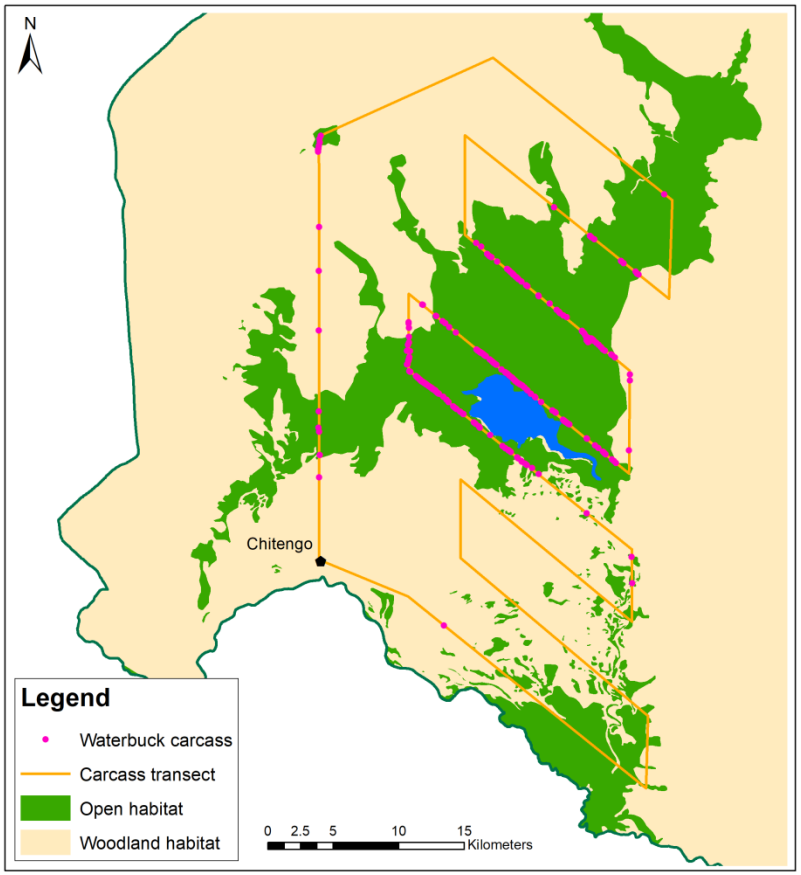


Fig. 24: Distribution of waterbuck carcasses along a dedicated 250 km x 500 m wide transect.

2.5. Wildlife biomass

These animal numbers translate into an average biomass of 9 093 kg per km^2. This is similar to the average biomass recorded pre-war with the difference that species such as kudu, nyala, impala, reedbuck and warthog were not counted in those days.

Whereas waterbuck represented 63.3% of the total animal biomass in the count block in 2018, this has now dropped to 59.1%. The biomass remains concentrated in the open floodplain areas with the marked exception of a significant area to the immediate north-east of Lake Urema (Fig. 25). Some speculation about the reason for this is provided on page 33.

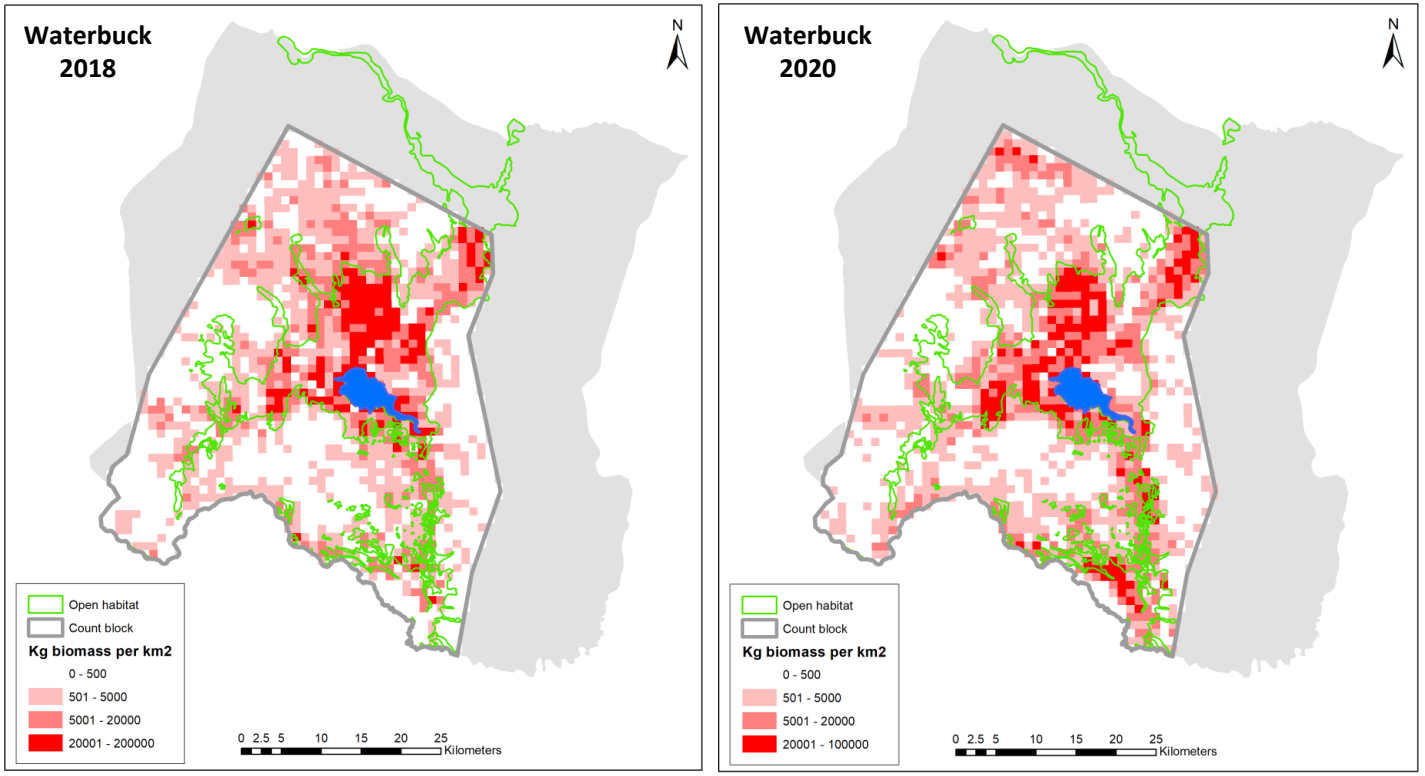


Fig. 25: Biomass of waterbuck (kg km^2) across the count block in 2018 and 2020 respectively.

2.6. Additional species observations

The presence of Crowned Cranes, Saddle-bill Storks and Ground Hornbills were recorded during the aerial survey. These large birds are generally under some pressure in southern Africa. A total of respectively 197 Ground Hornbills (188 in 2018), 162 Grey Crowned Cranes (90 in 2018) and 65 Saddle-bill storks (36 in 2018) were observed.

A total of 11 active nests of White-backed Vultures and 19 active nests of White-headed Vultures were georeferenced (Fig. 26). This would support the view that Gorongosa GNP contains the highest known density of breeding pairs of this Critically Endangered species (A. Botha, Endangered Wildlife Trust, pers. comm. 2020).

A total of 229 active nests of Marabou Storks were recorded. This represents the single largest breeding population of Marabou Stork in the SADC region (Stalmans et al. 2020) (Fig. 26).

A Pel's Fishing Owl was observed along the Vunduzi River.

A total of 226 baboon troops (219 troops in 2018) were recorded. This information will be useful to the ongoing primatology research project. Five troops of samango monkeys were observed as well.

Although not a good tool to census lions, the helicopter count did yield 40+ lion sightings that are of use to the Lion Project. This is a higher figure than in any previous counts and this reflects the known trend of a growing lion population in the Park.

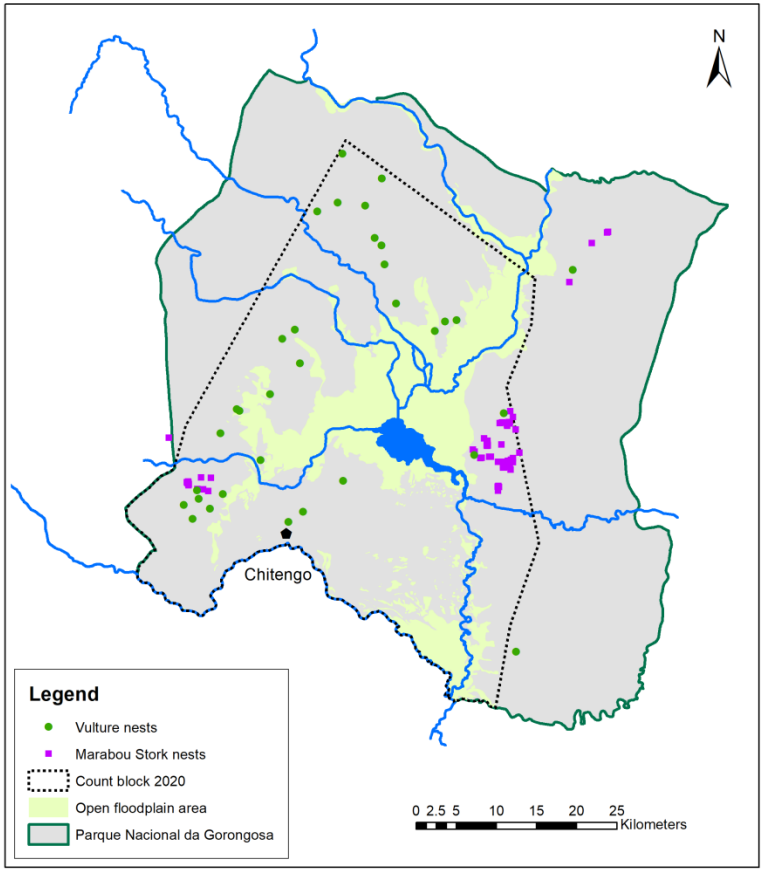


Fig. 26: Distribution of vulture nests and of Marabou Stork nests observed during the 2020 aerial wildlife survey.

3. Discussion - general & individual species trends

The count block offers a good base for comparisons across time as it was surveyed in 2014, 2016, 2018 and 2020 respectively (Table 6).

Since the previous count in 2018, cyclone IDAI made landfall in Beira and impacted the Park through torrential rains, high winds and flooding in March 2019. In 2020, very good rains were once more experienced during the month of February.

The overall number of herbivores has dropped by more than 15% since 2018. A lower count does not necessarily mean a lower number of animals in the Park. The count block as well as the Park are open for animals to move in and out at will. Nevertheless, the scale of the block is so that many animals will spend their life within its boundaries.

The different species can be grouped as follows (Fig. 27):

- Species that have been steadily increasing in numbers – these are especially the browsers and mixed feeders (nyala, elephant and impala), but also buffalo, wildebeest and, perhaps surprisingly, hippo);
- Species that are probably close to the system's carrying capacity and fluctuate around this level rather than showing any firm trend (duikers, bushpig, perhaps kudu);
- Species such as warthog that are known for a 'boom and bust' response to environmental and subsequent rangeland conditions;
- Species that may have partially moved out of the count block in search of taller grass (sable and hartebeest);
- Species that have definitely declined in numbers since 2018 – open floodplain species such as waterbuck, common reedbuck and oribi.

Table 6: side-by-side comparison between the numbers of herbivores in the 184 500 hectare counting block surveyed in 2014, 2016, 2018 and 2020.

Species	2014	2016	2018	2020
Blue wildebeest	361	363	587	754
Buffalo	670	696	960	1212
Bushbuck	2 277	2 022	1 665	1 592
Bushpig	167	108	183	226
Common reedbuck	11 871	10 451	10 220	5 386
Duiker grey	61	49	42	50
Duiker red	26	21	21	25
Eland	105	94	117	27
Elephant	535	567	544	691
Hartebeest	613	562	578	440
Hippo	436	440	546	744
Impala	2 727	4 705	6 122	6 229
Kudu	1 200	1 466	1 928	1 831
Nyala	945	1 299	1 934	2 341
Oribi	4 485	3 884	3 958	1 853
Sable	757	810	805	451
Warthog	9 086	5 383	10 739	8 086
Waterbuck	34 482	44 948	55 351	48 515
Zebra	33	34	33	33
TOTAL	**70 837**	**77 902**	**96 633**	**80 486**

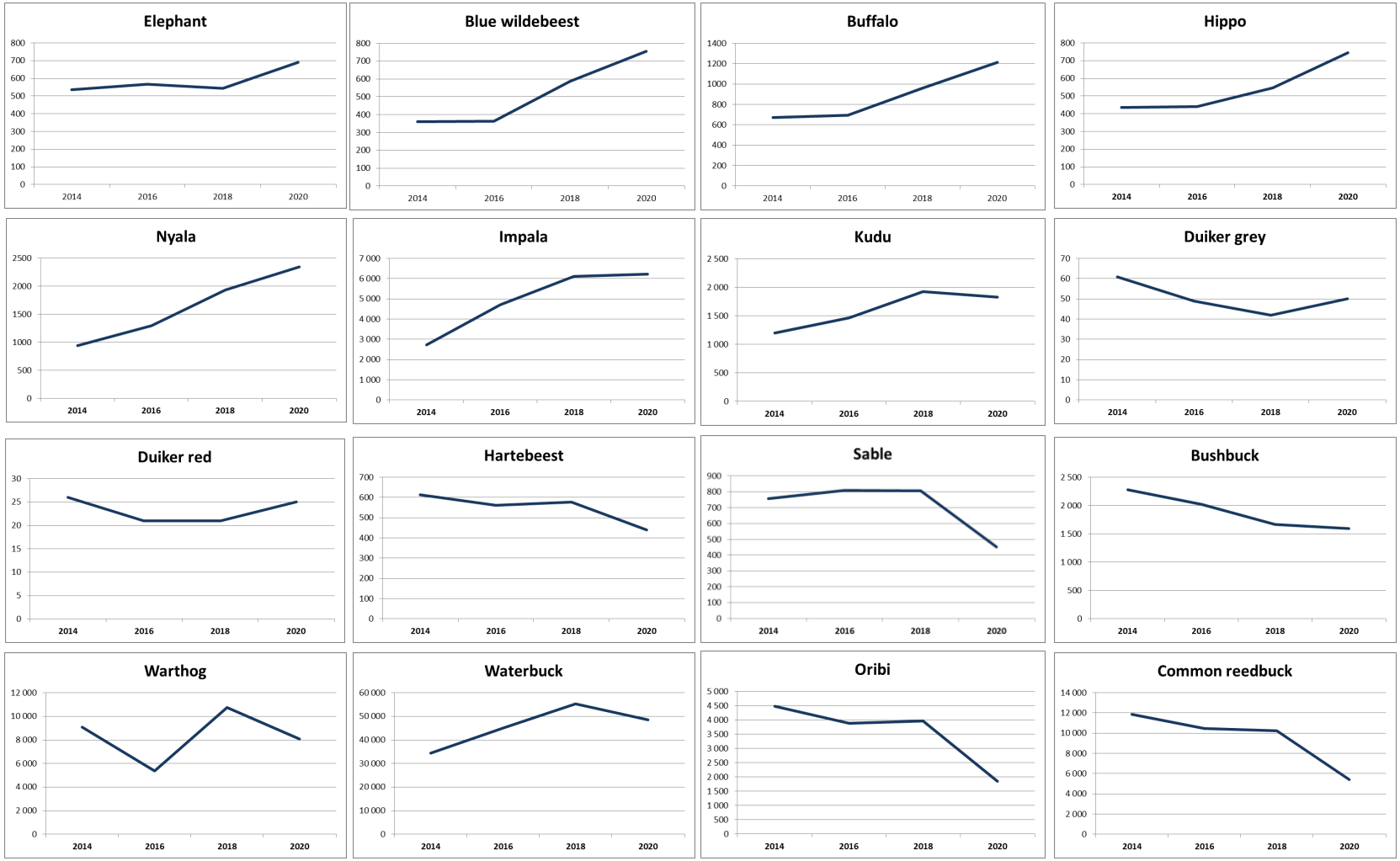


Fig. 27: Trajectories of herbivore species in the common count block since 2014.

Buffalo now number over 1 200. However, a known herd in the far north of the count block was not observed during the count and is not included in this number. It was spotted again from the air on 30 November 2020 and numbers around 100 animals (A. Matavele pers. obs. Nov. 2020).

This has been the highest count ever of elephants since 1994, approaching 800 individuals. In 2018, based on known satellite-collared matriarchs, at least 114 elephants were not seen as they were under the thick riverine canopy along the Pungue River. This year, the position of the collared elephants was again correlated with the day-to-day counts to identify missed herds and to avoid possible double-counting. Seeing that this is a very mobile species, the same herds could potentially be found and counted on consecutive count days. The 781 elephants that were counted represent the minimum number present. The actual population is estimated to be between 800 and 1000 individuals.

A number of sable antelope have been observed dispersing to areas even outside of the Park – as far as in the planned community conservancy near Codzue Caves in the north-east. Their density on the eastern sample lines has also been increasing by 40% since 2018. It is still unclear as to whether their overall number has dropped. This is a species that is very sensitive to negative changes in the length and quality of the grasslayer. At present, conditions are certainly adverse for this species in the areas around Lake Urema.

The density of waterbuck has also been increasing along the eastern and western sample lines, especially in the latter (Fig. 28). Yet, these are still low densities compared to those in the count block (26.3 individuals per km^2). The increase in densities outside of the count block does not make up for the lower number of waterbuck that were counted, especially not if the previous rate of annual growth is being considered.

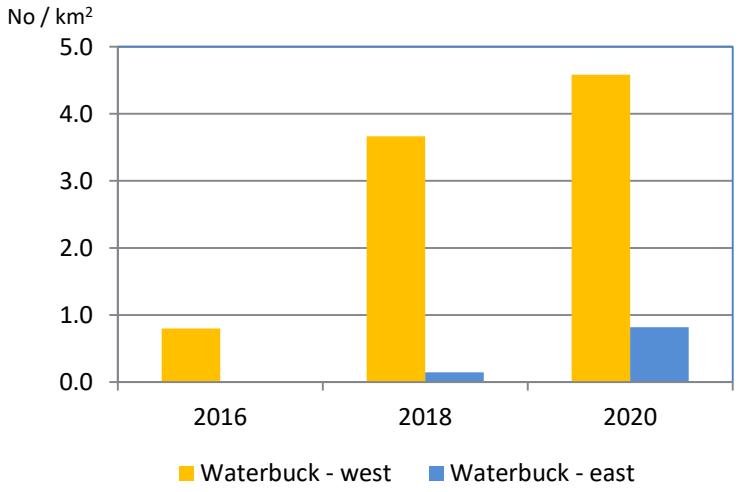


Fig. 28: Density of waterbuck along the eastern and western sample lines.

The current report is mainly aimed at documenting the count results. It does not attempt to fully explain the underlying reasons for any documented changes. This will be the subject of further research. Nevertheless, some initial ideas are being explored here with regard to the waterbuck population.

Currently, there are probably more herbivores in Gorongosa than in historical times (Fig. 29). The first aerial counts at the end of the 1960's were done using a fixed-wing aircraft. As this does not allow for an accurate count of smaller species, only 8 species of larger herbivores were counted (Tinley 1977).

In contrast, since the year 2000 all species are being counted.

From about 2014, the number of animals belonging to the 'Tinley' species had recovered to pre-war levels. However, the make-up is skewed with more than 90% consisting of waterbuck, whereas this species made up less than 10% of the herbivores in the 1960's and early 1970's.

This massive number of waterbuck (likely the single largest population in Africa) creates much competition within this species for the same food resource.

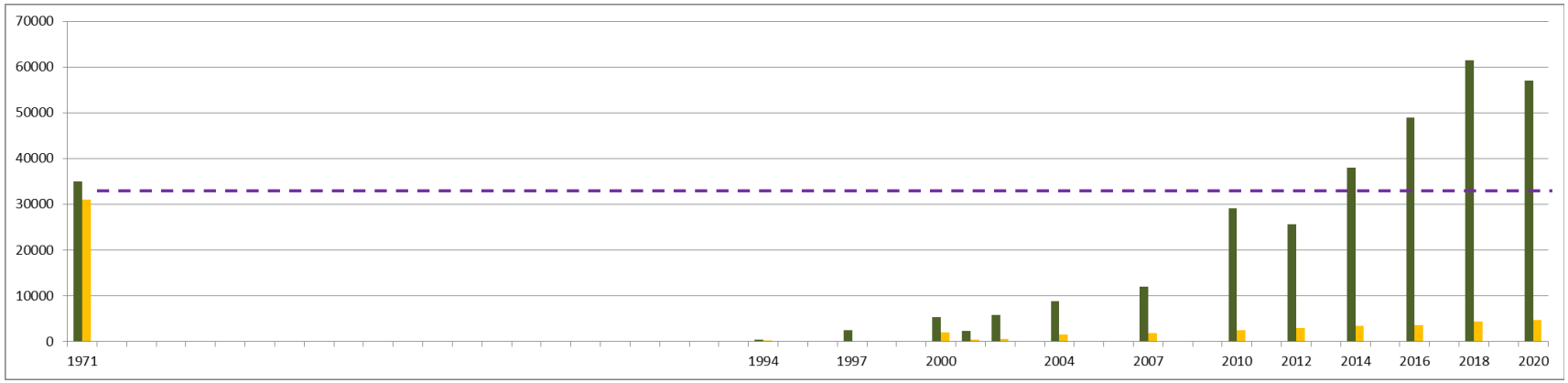


Fig. 29: Trend in the number of 'Tinley' species in Gorongosa National Park.

There are several reasons to think that waterbuck in particular are poor competitors — they have high water and protein requirements, and they are rarely hyper-abundant in 'intact' ecosystems. They had a window of opportunity in Gorongosa, but the count results suggest that the window may be closing (Prof Rob Pringle, pers. comm. November 2020).

These changes are likely the beginning of a re-equilibration process. This may be similar to what happened in Nakuru National Park in Kenya where waterbuck and warthog had explosive population growth early on, and were eventually supplanted by buffalo and zebra, which increased more slowly but steadily throughout the interval (Ogutu et al. 2012).

The intra-specific competition for resources likely has been exacerbated by the impact of the prolonged flooding caused by cyclone IDAI. The striking contrast between the flooding in other 'wet' years and 2019 (cyclone IDAI) is the long time period that parts of the areas around the Lake remained submerged (Fig. 30 & 31).

The extent of flooding is visually illustrated using the Modis MOD09Q1 product. Lake Urema expanded from its dry season extent of 2 000 ha to more than 20 000 ha following cyclone IDAI in March 2019.

The grid of Flood Level Meter sensors that was installed during the dry season of 2018 indicates that some areas remained submerged for nearly 7 months following the cyclone. During the early part of 2020, flooding was again extensive. However, the water retreated much more quickly and the maximum time that areas remained submerged was less than 5 months.

It would seem that this extreme period of flooding actually caused the localized die-off of grasses (Fig. 32). Whereas under 'normal' conditions, even under intense grazing pressure, fallen trees and branches serve as refugia, no grass is found in those areas following the prolonged flooding (Fig. 33).

Warthog and hippo are 'normally' very sensitive to poor habitat conditions. As yet no increased mortality was observed of those two species.

It is likely that no single factor is causing the decline in waterbuck. It is probably the result of multiple factors interacting with each other. A decline in the numbers of waterbuck whilst other species are steadily growing in numbers may indicate that the restoration of Gorongosa National Park is entering a new phase.

The above is mostly based on speculation and casual observation. More research is required into the causality of the observed changes.

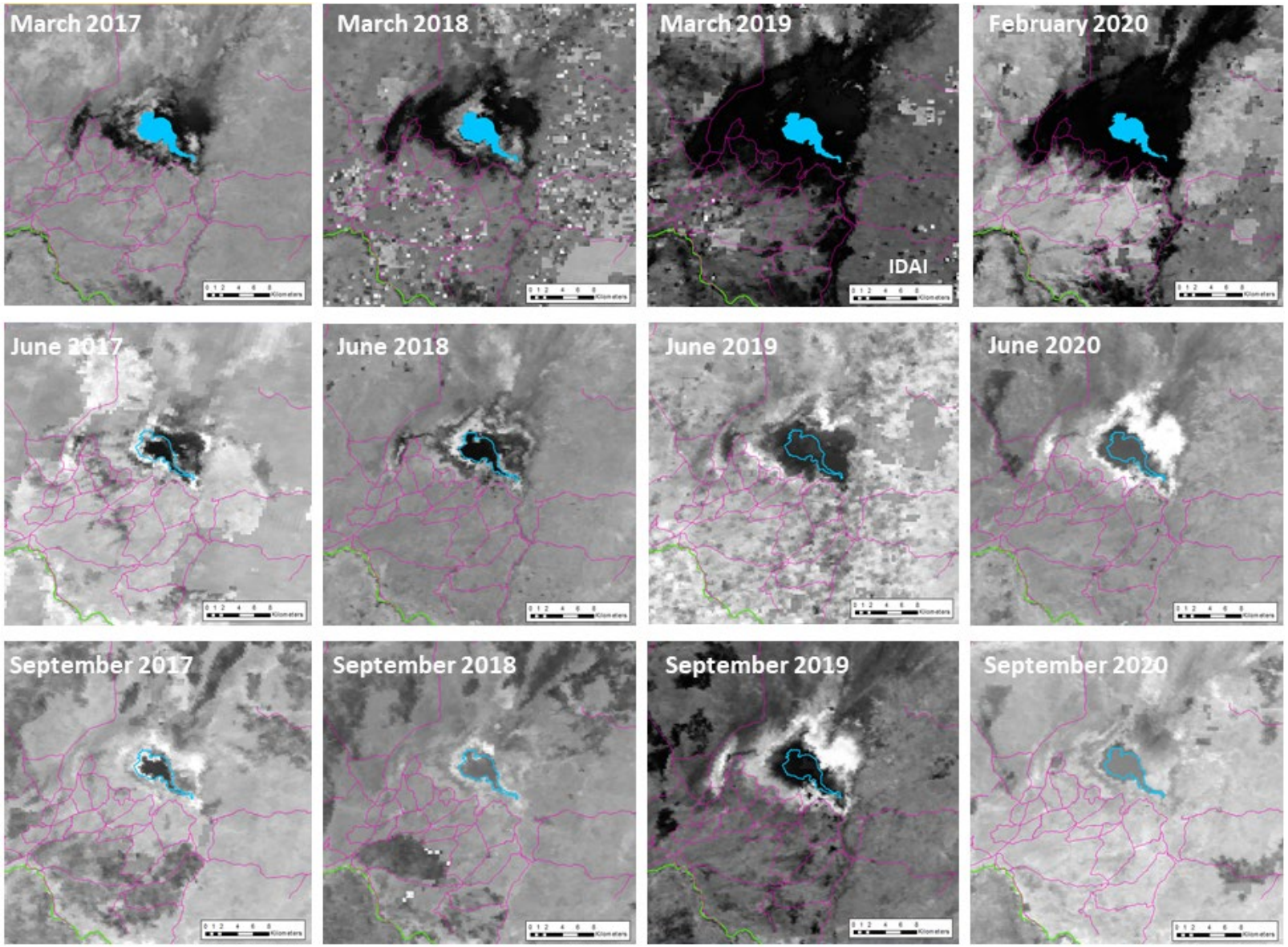
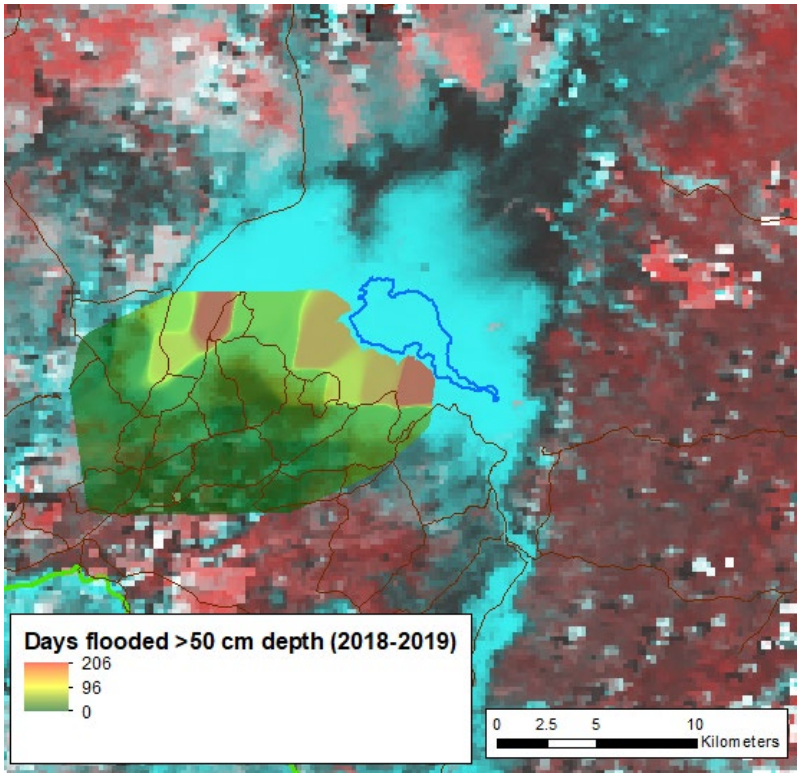
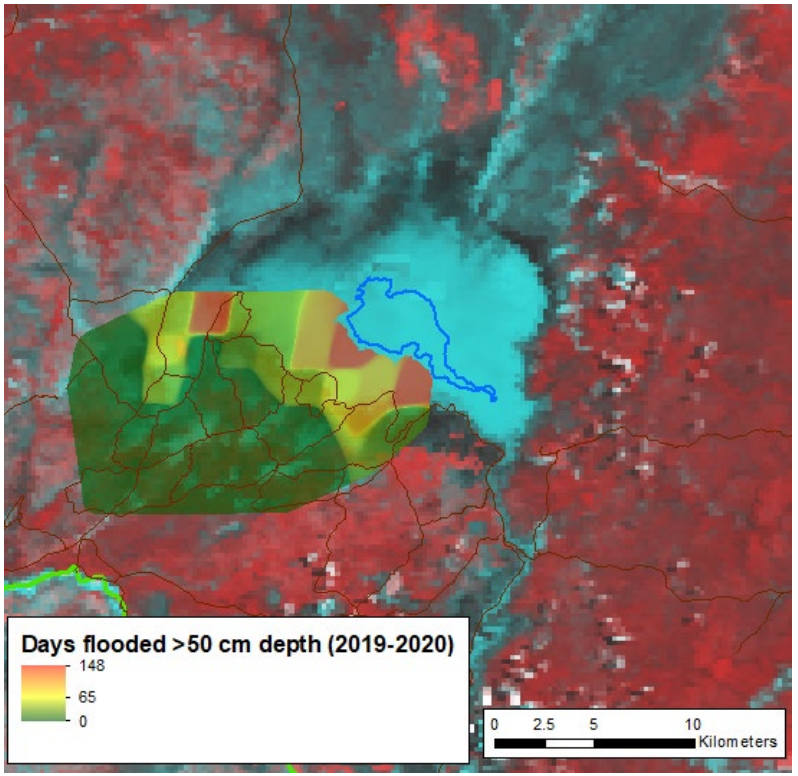


Fig. 30: Visual illustration of the extent of Lake Urema since 2017 using the MOD09Q1 product. Note extreme flooding following cyclone IDAI in March 2019 with the Lake remaining much larger through the dry season compared to other years.



MOD09Q1 – flooded March 2019
with length of flooding period superimposed



MOD09Q1 – flooded March 2020
with length of flooding period superimposed

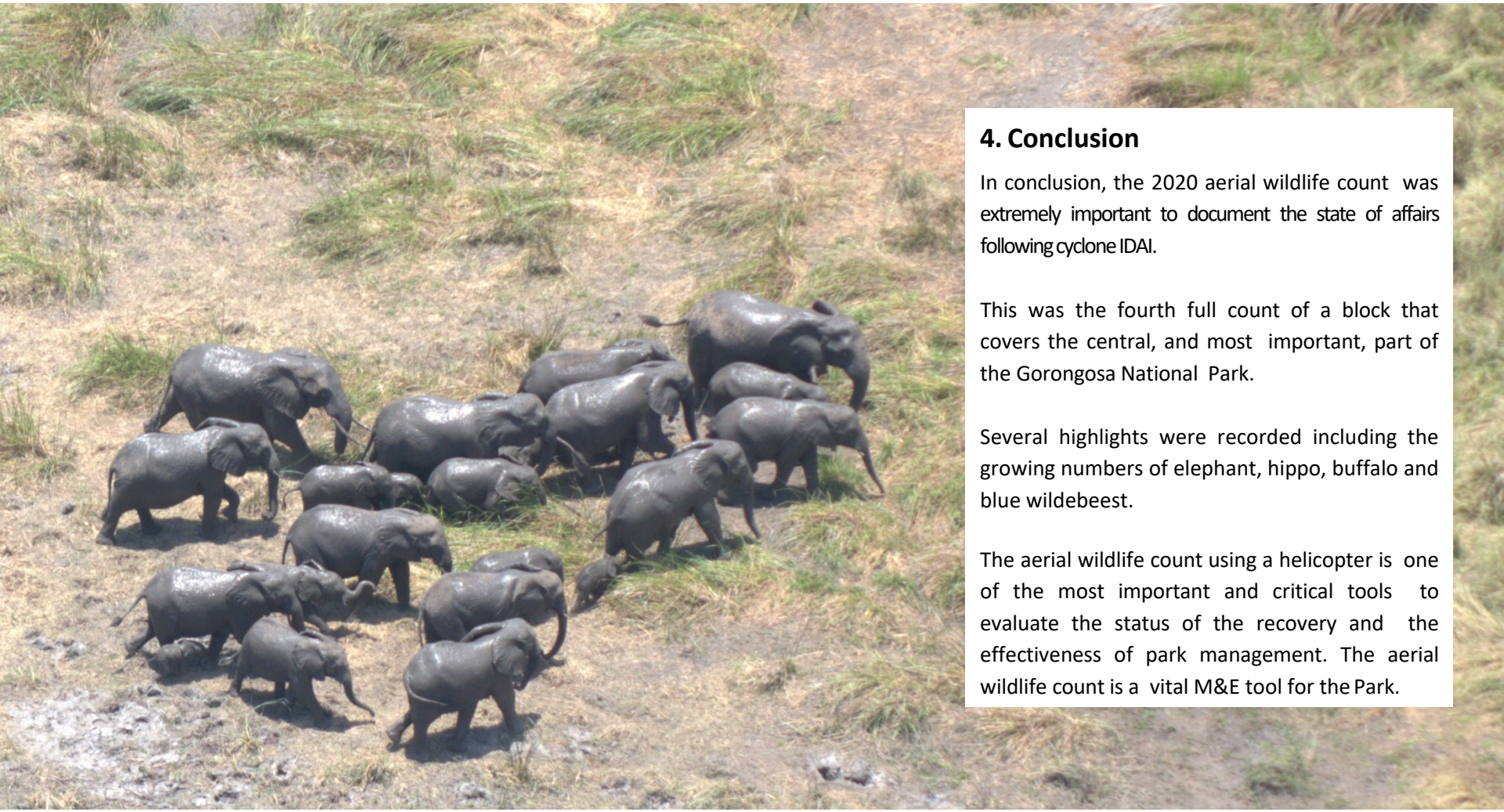
Fig. 31: Extent of Lake Urema in March 2019 and 2020 respectively with data from the grid of Flood Level Meters superimposed to indicate the length of the flooding period over the full season. Note nearly 2 month difference in the length of flooding between 2019 and 2020.

July 2016

November 2020

Fig. 32: Disappearance of *Setaria incrassata* grass sward near the Sungue which coincides with a prolonged period of immersion under the floodwaters of cyclone IDAI.

Fig. 33: Top – 'normal' appearance of grass protected from grazing by a fallen tree and branches. Bottom – current appearance with absence of living grass, a few forbs and large amounts of detritus indicating past flooding.



4. Conclusion

In conclusion, the 2020 aerial wildlife count was extremely important to document the state of affairs following cyclone IDAI.

This was the fourth full count of a block that covers the central, and most important, part of the Gorongosa National Park.

Several highlights were recorded including the growing numbers of elephant, hippo, buffalo and blue wildebeest.

The aerial wildlife count using a helicopter is one of the most important and critical tools to evaluate the status of the recovery and the effectiveness of park management. The aerial wildlife count is a vital M&E tool for the Park.

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The largest buffalo herd in Gorongosa (348 strong) at the confluence of the Urema and Pungue Rivers

6. Acknowledgements

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