Aerial wildlife count of the Gorongosa National Park, Mozambique, October 2022

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PARQUE NACIONAL DA GORONGOSA

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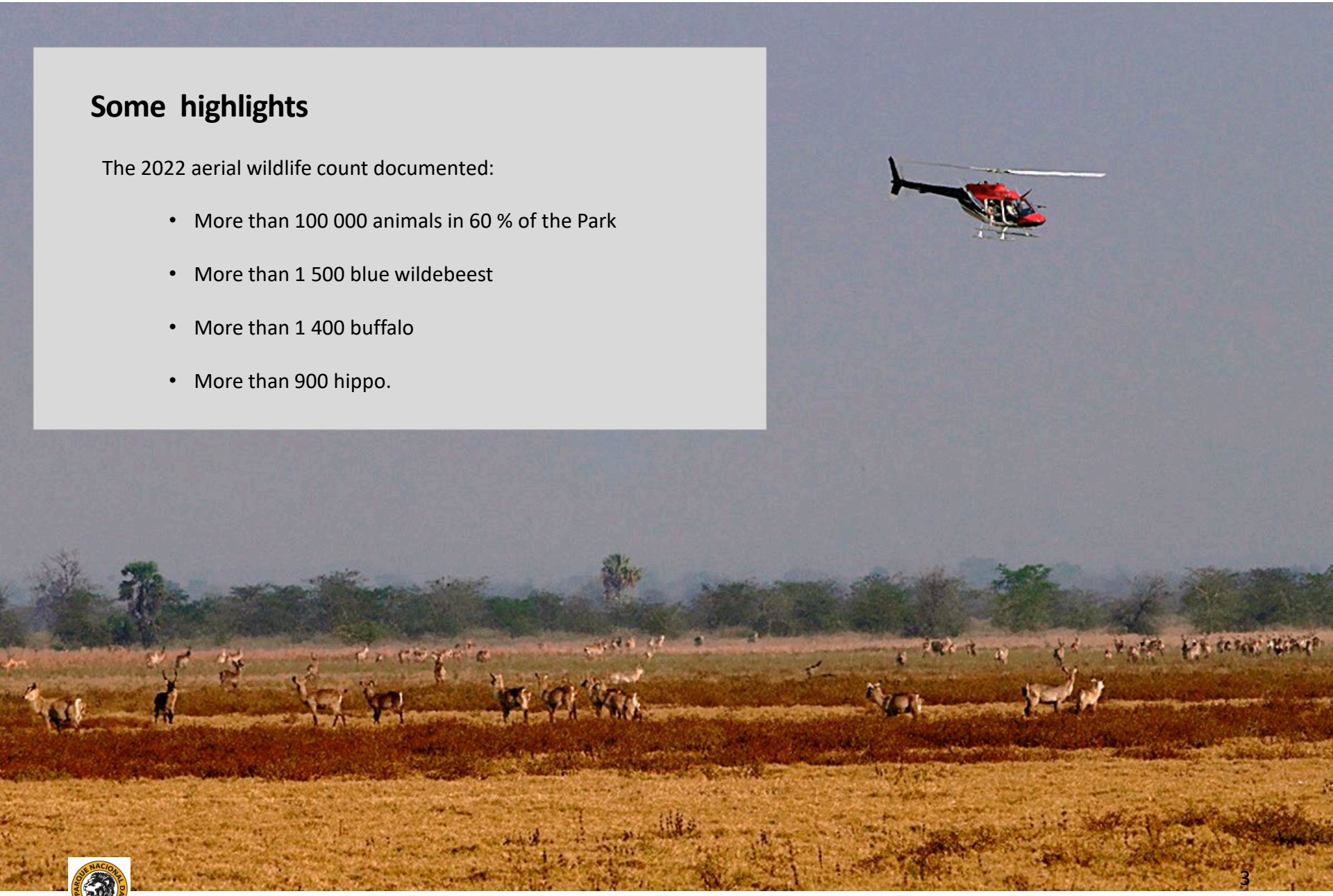
Some highlights

The 2022 aerial wildlife count documented:

- More than 100 000 animals in 60 % of the Park
- More than 1 500 blue wildebeest
- More than 1 400 buffalo
- More than 900 hippo.



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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 11 and 24 October 2022.

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 197 000 hectares was fully covered by means of a helicopter. Systematic, parallel strips that were 500 m wide were assessed. All observed large animals were counted. In addition, a distance of respectively 200, 205 km and 45 km of transects that were 500m wide were flown on the western, eastern and northern side of the core count block. This covered an additional 22 500 ha. The total area that was surveyed represents 59% of the Park.

The core area of the newly proclaimed Community Conservation Areas was also surveyed. This represents the first baseline count of wildlife in these new areas.

A total of 102 346 animals were counted (excluding carnivores). These are actual counts, not estimates. There were 99 471 herbivores of 19 species. A total of 231 baboon troops were also counted. Lake Urema, the rivers and pans yielded a total of 2 875 crocodiles - this the highest figure yet recorded in any aerial count of Gorongosa National Park.

Table 1: total number of large animals counted in 2022 in the count block, the conservancy block and along additional sample lines.

Species	Total number counted
Blue Wildebeest	1 525
Buffalo	1 465
Bushbuck	1 777
Bushpig	381
Common reedbuck	4 752
Crocodile	2 875
Duiker grey	61
Duiker red	24
Eland	139
Elephant	620
Hartebeest	462
Hippo	964
Impala	9 907
Kudu	2 711
Nyala	3 481
Oribi	1 451
Sable	464
Warthog	5 685
Waterbuck	63 561
Zebra	41
TOTAL	**102 346**

Summary - continued

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 of animals recorded along the sample lines to the east and west of the central count block.

This is an open, natural system with increasing levels of predation and shifting patterns of inter- and intra-specific competition for grazing. It is 'normal' that some species will be growing in numbers whilst others will decline. Despite marked declines, the populations of oribi, reedbuck, sable antelope and Lichtenstein's hartebeest remain significant and are viable.

On the other hand, species such as blue wildebeest, hippo, impala, kudu and nyala are showing strong growth. Buffalo also continue to increase in numbers and are spreading further afield. For the first time, breeding herds of elephants were encountered on the western and northern side of the Park .

Good numbers of Crowned Cranes, nesting Marabou Storks and Saddle-billed Storks were recorded. The 426 active nests of Marabou Stork confirms Gorongosa as having the largest known breeding colony of this species in southern Africa.

A total of 238 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.

Fifty-two active vulture nests were observed, including 18 which are confirmed White-headed Vulture nests. Gorongosa represents a very important stronghold for this species that is listed by the IUCN as 'Critically Endangered'.

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 larger-bodied buffalo, wildebeest and zebra in the past.

The 2022 count has re-affirmed the importance of these regular surveys using standardized methods, and consistent teams and equipment. The aerial wildlife count using a helicopter is one of the most important and critical M&E tools to evaluate the status of the recovery and the effectiveness of park management.

1. Survey methodology

1.1. Counting block

A count block of 197 000 hectares within the Park was fully covered by means of a helicopter (Fig. 1). The specific technique used was as follows:

- 5-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 *post hoc*;
- 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 maximizes available light, reduces glare and enhances contrast for better visibility and detection of the animals;
- Sessions lasting between two and 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, western and northern sample lines

In addition to this count block, a length of 200, 205 km and 45 km of transect lines were flown on the western, eastern and northern side of the count block respectively (Fig. 1). The same technique was used as for the count block, except that the sample lines are 1.5 or 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. Community Conservancy Areas

A block of 7,850 hectares of the newly proclaimed Nhampoca and Nhamacuenguere Community Conservancies was assessed using the same technique as for the Park.

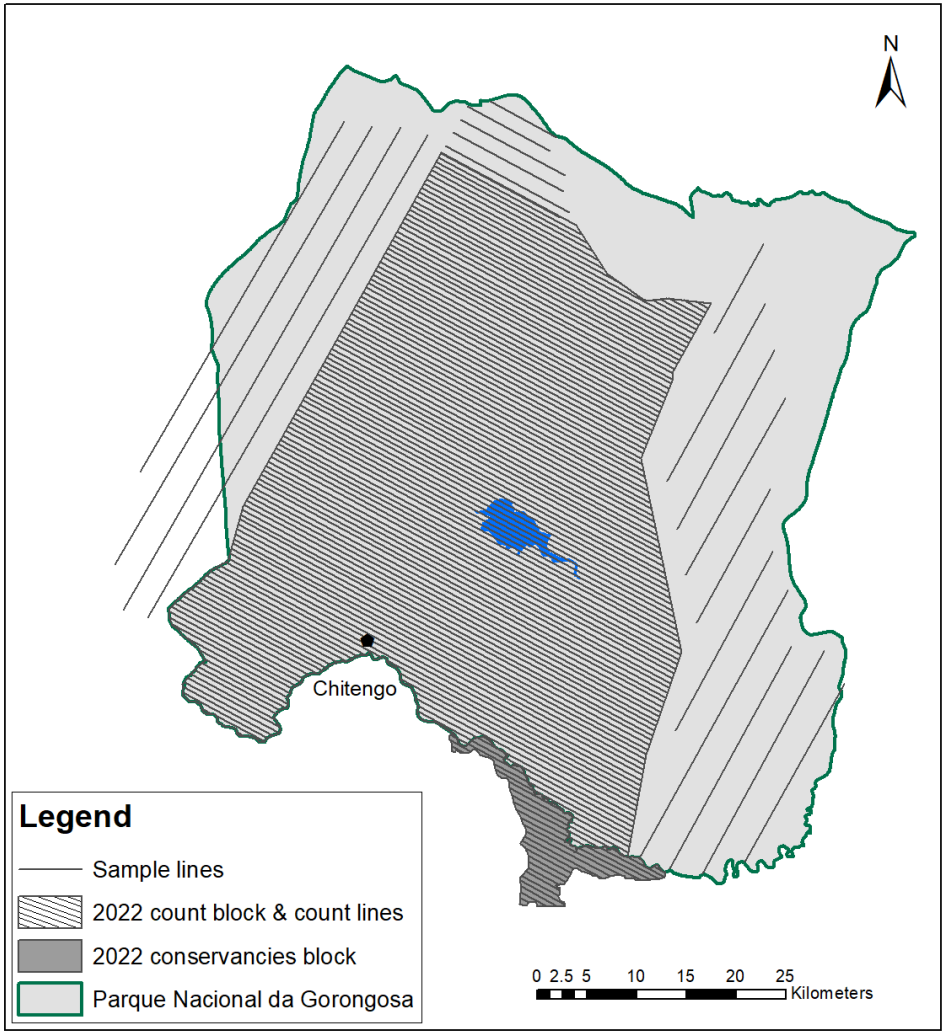

Fig. 1: Count block and additional sample lines covered by the 2022 aerial wildlife count.

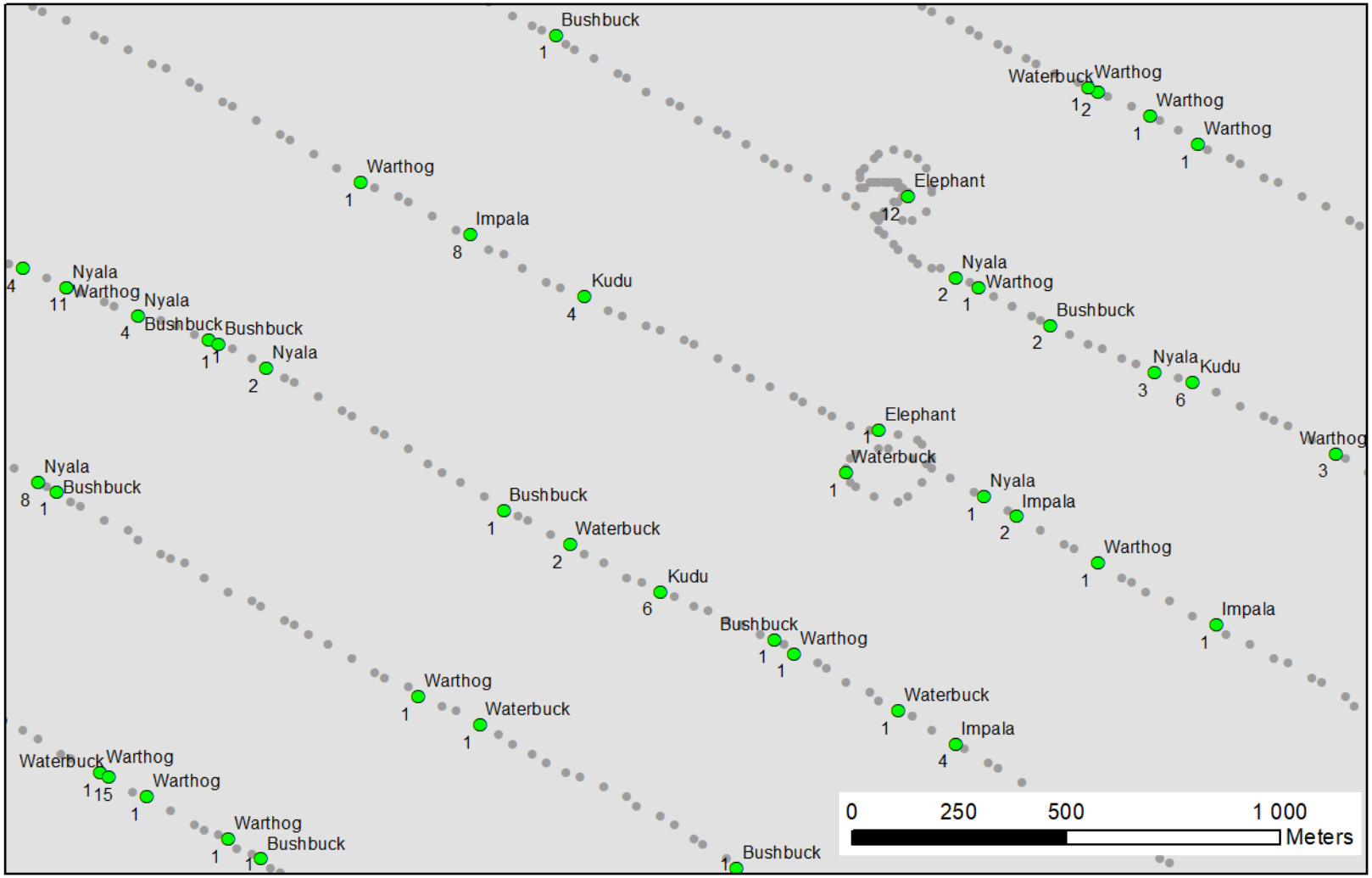

Fig. 2: Flight path and observations that are displayed on-screen during the counting. Lines are 500 m apart. Grey points indicate GPS positions that are automatically downloaded every 2 seconds. Green circles denote wildlife observations that are annotated with the species and number of animals.

1.5. Data handling

The 2022 data were amalgamated with the data from previous counts (Stalmans et al. 2014, Stalmans & Peel 2016, Stalmans et al. 2018, Stalmans & Peel 2020) into an ACCESS database to facilitate analysis and general comparisons. Each data point has the following information (Table 2):

- Unique ID number
- Latitude / Longitude
- Day
- Time
- Count day
- Count session
- 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 2: Extract from the consolidated data for 2022.

ID	LATITUDE	LONGITUDE	DATE	TIME	COUNT_DAY	SESSION	SPECIES	NUMBER
5561	-18.98190	34.56360	10/15/2022	7:36:57 am	5	13	Bushbuck	1
5562	-18.98220	34.56400	10/15/2022	7:36:59 am	5	13	Warthog	1
5563	-18.98260	34.56460	10/15/2022	7:37:02 am	5	13	Impala	3
5564	-18.98280	34.56500	10/15/2022	7:37:03 am	5	13	Impala	5
5565	-18.98290	34.56520	10/15/2022	7:37:04 am	5	13	Warthog	2
5566	-18.98020	34.56260	10/15/2022	7:37:28 am	5	13	Warthog	1
5567	-18.98180	34.56390	10/15/2022	7:37:46 am	5	13	Impala	25
5568	-18.98390	34.56780	10/15/2022	7:38:10 am	5	13	Warthog	9
5569	-18.98480	34.56820	10/15/2022	7:38:16 am	5	13	Waterbuck	70

2. Results

2.1. Survey statistics

The survey was conducted between 11 and 24 October. There were an effective 13 days of counting (1 for the east and west lines, 11 for the different blocks and 1 for the crocodile and hippo survey, followed in the afternoon by the survey of the conservancy block) (Fig. 3).

Total coverage through the central counting block and the additional transect lines in the east and west was 59% of the Park. The daily output was up to 18 000 hectares using up to 7 hours of flying.

This was pilot Mike Pingo's eleventh (11th) 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 sixth survey of Gorongosa. This was also the sixth count of Gorongosa for data recorder Dr Marc Stalmans. The remaining observer seat was occupied by Lukas Manaka from the ARC who has been working in the team of Dr Peel and pilot Mike Pingo. This was his third count of Gorongosa. Dominique Gonçalves (Science) and Marcelino Denja (Conservation) acted as observers for the survey of the conservancy block.

Flying and counting conditions varied with some very hot days being experienced (see Table 3). 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.

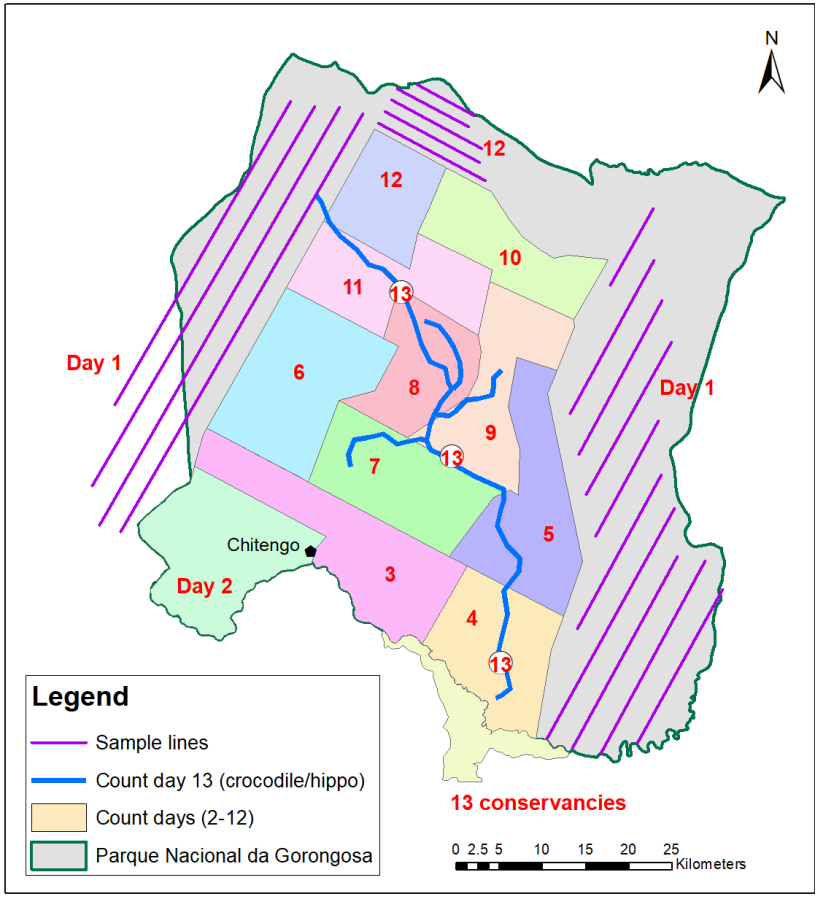

Fig. 3: Count blocks and count days in 2022.

Table 3: Counting conditions during the 2022 aerial wildlife survey.

Date	Session	Cloud cover (0 to 8 scale)	Visibility	Temp. ºC	Team
	No.	**(0 to 8 scale)**	**Very poor (vp), Poor (p), Moderate (m), Good (g)**	**(ºC)**	**Marc Stalmans (MS); Mike Pingo (MPi); Mike Peel (MP); Lucas Lanaka (LM)**
11/10	1	4	p-p-p-p-m	24-29	MS, Mpi, MP, LM, Olivier Grùnewald
	2	3	m-g-m-g	31-34	MS, Mpi, MP, LM, Miguel Lajas
	3	2	m-g-g-g	34-35	MS, Mpi, MP, LM, Miguel Lajas
12/10	1	8-2	p-p-p-p-m-g	23-29	MS, Mpi, MP, LM, Tara Massad
	2	0	g	33-35	MS, Mpi, MP, LM
	3	0	g	37	MS, Mpi, MP, LM
13/10	1	8	vp-p	21-27	MS, Mpi, MP, LM, Dominique Gonçalves
	2	0	g	30-33	MS, Mpi, MP, LM
	3	0	g	38	MS, Mpi, MP, LM
14/10	1	6-0	p-m-g	26-30	MS, Mpi, MP, LM
	2	0	g	32-35	MS, Mpi, MP, LM
	3	0	g	36-38	MS, Mpi, MP, LM
15/10	1	0	e	26-30	MS, Mpi, MP, LM, Simião Mahumana
	2 and 3	0	g	32-38	MS, Mpi, MP, LM
17/10	1	1-4	m-g-g	26-29	MS, Mpi, MP, LM, Tara Massad
	2	3	g-g-g-g-g-m-m	32-34	MS, Mpi, MP, LM, Bento Tenente
18/10	1	2-5	m-g-g-m	26-30	MS, Mpi, MP, LM
	2	3-1	g	32-36	MS, Mpi, MP, LM

Table 3 (continued): Counting conditions during the 2022 aerial wildlife survey.

Date	Session	Cloud cover (0 to 8 scale)	Visibility	Temp. ºC	Team
	No.	**(0 to 8 scale)**	**Very poor (vp), Poor (p), Moderate (m), Good (g)**	**(ºC)**	**Marc Stalmans (MS); Mike Pingo (MPi); Mike Peel (MP); Lucas Lanaka (LM)**
19/10	1	8 9 (high at session end)	p-p-p-g-g	26-30	MS, Mpi, MP, LM
	2	3-2	g	32-34	MS, Mpi, MP, LM
20/10	1	7-3	p-m (east) m-g (west)	26-29	MS, Mpi, MP, LM
	2	2-0	g	32-35	MS, Mpi, MP, LM
21/10	1	8 (high hazy)-4	g-m-m	26-29	MS, Mpi, MP, LM
	2	3	m-g-g-g-m-g	32-36	MS, Mpi, MP, LM
22/10	1	8 (high hazy)-3	p-p-m-m-p-p-m-m	26-32	MS, Mpi, MP, LM
	2	2-1	g	33-37	MS, Mpi, MP, LM
23/10	1	8-7	p	27-28	MS, Mpi, MP, LM
	2	2	g	32-37	MS, Mpi, MP, LM
24/10 rivers/ Lake	1	7	m	27-30	MS, Mpi, MP, LM, Miguel Lajas
24/10 Conservancies	2			32	MS, Mpi, Dominique Gonçalves, Denja Marcelino

2.2. Animal numbers recorded

The 2022 count generated over 21 600 individual observations. These records were amalgamated in the database together with the data from the previous counts. At present, the database holds more than 115 000 individual geo-referenced observations from 17 wildlife counts since 1969.

A total of 102 346 individuals of 23 species of large animals (herbivores and crocodiles) were counted in 2020 (Table 4). These are actual counts, not estimates. This represents the absolute minimum number of large animals that occur in the park given that only 59% of the Park was counted.

A total of 231 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 4: total number of large animals counted in 2022 in the count block, the conservancy block and along additional sample lines.

Species	Total number counted
Blue Wildebeest	1 525
Buffalo	1 465
Bushbuck	1 777
Bushpig	381
Common reedbuck	4 752
Crocodile	2 875
Duiker grey	61
Duiker red	24
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Elephant	620
Hartebeest	462
Hippo	964
Impala	9 907
Kudu	2 711
Nyala	3 481
Oribi	1 451
Sable	464
Warthog	5 685
Waterbuck	63 561
Zebra	41
TOTAL	**102 346**

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. 4).

Certain species are strongly associated with the floodplain (e.g. waterbuck, common reedbuck, oribi and warthog – Fig. 5 to 8), others with the floodplain-woodland interface (elephant and buffalo Fig. 9 & 10), and others still with the woodlands (sable antelope, Lichtenstein's hartebeest, kudu, nyala) or with the ecotones (impala and eland) – Fig. 11 to 20). Hippo and crocodile are, as expected, strongly associated with Lake Urema and the perennial rivers and pans (Fig. 21 & 22).

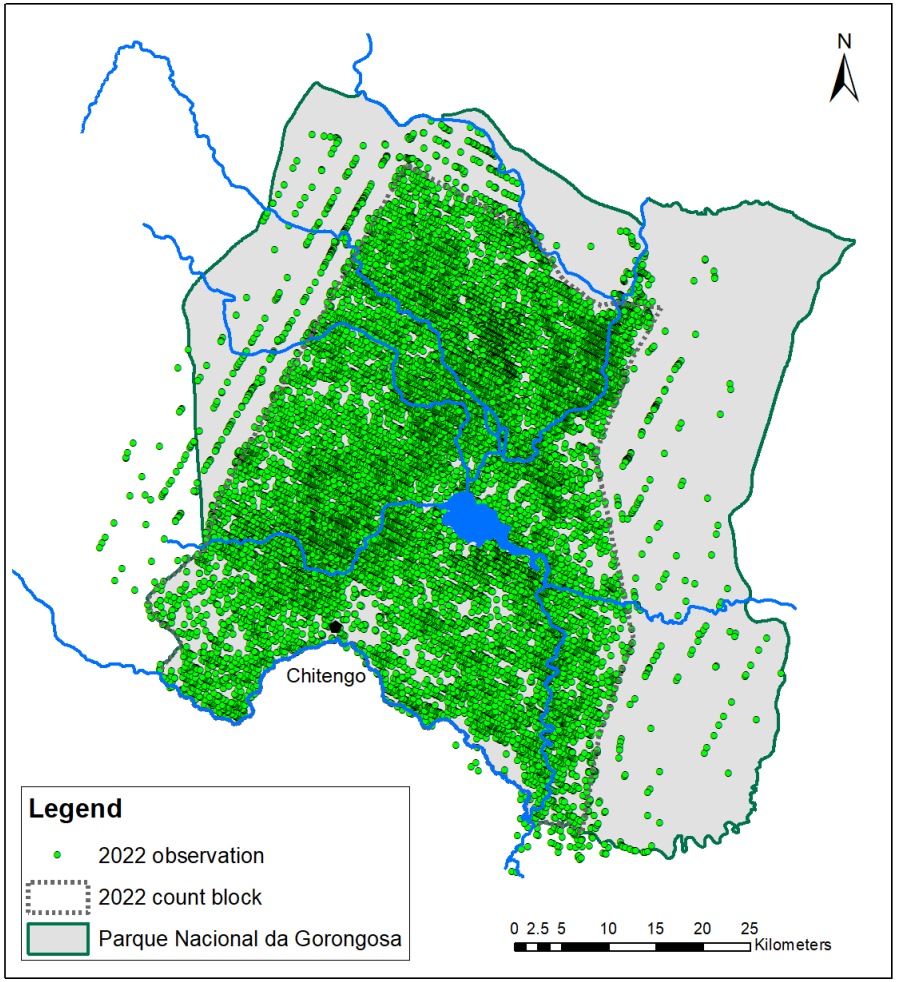


Fig. 4: Spatial distribution of all observations during the 2022 aerial wildlife count.

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

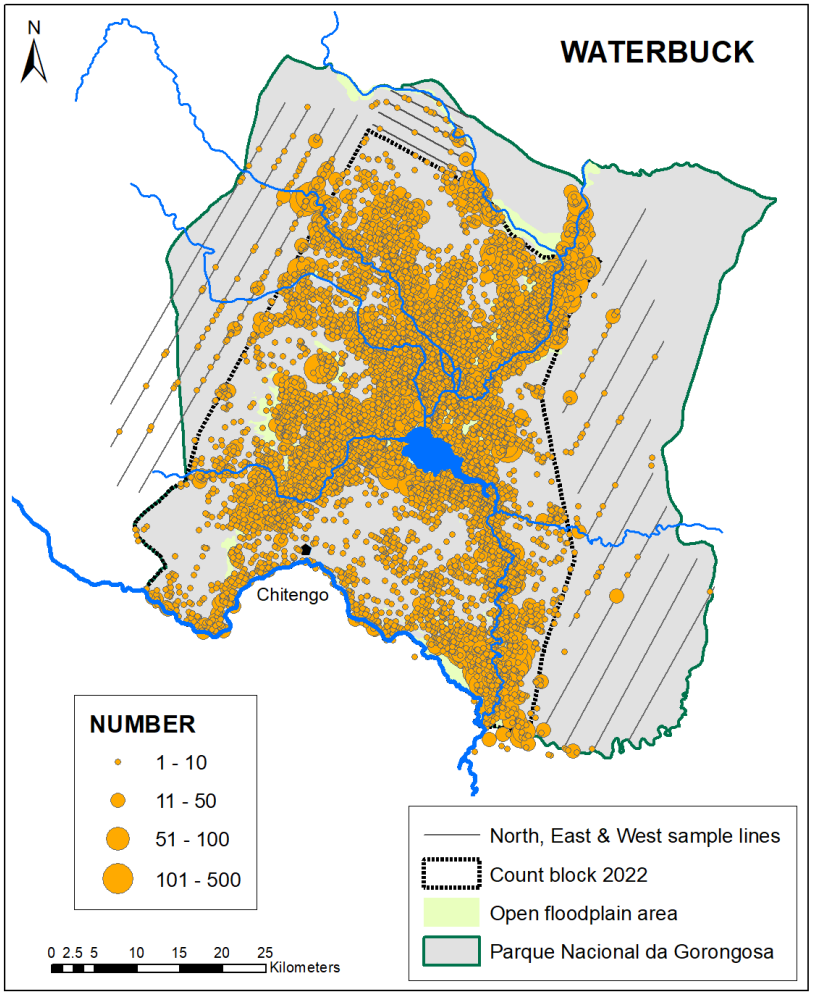


Fig. 5: Spatial distribution of waterbuck during the 2022 aerial wildlife count.

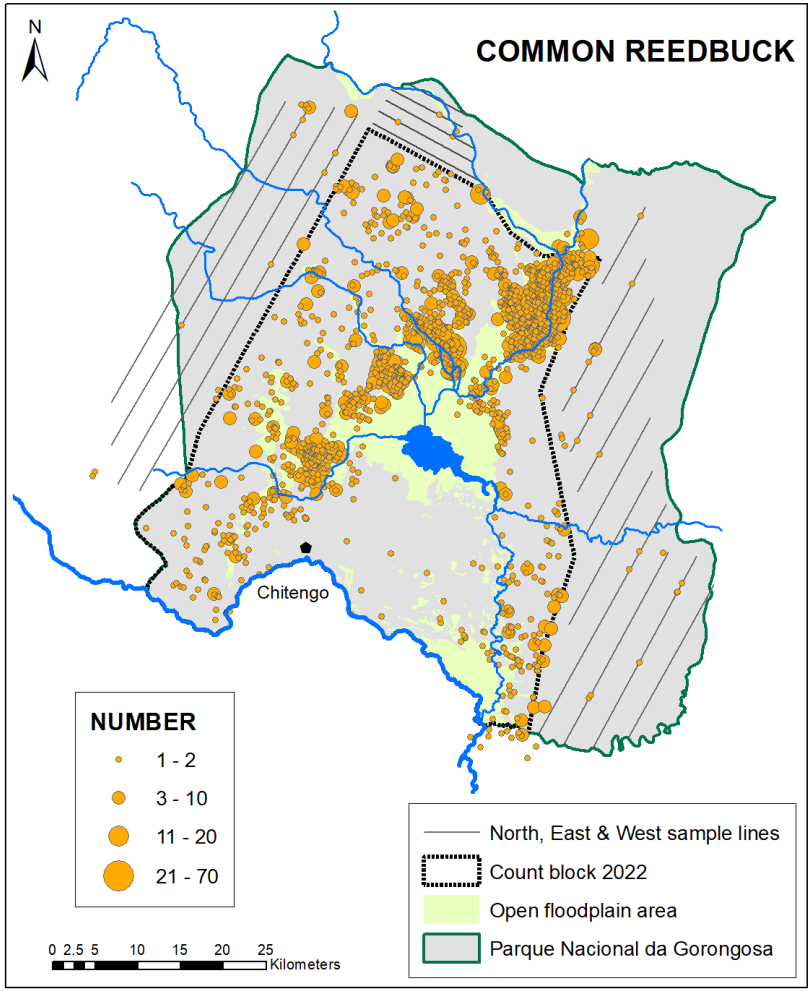


Fig. 6: Spatial distribution of common reedbuck during the 2022 aerial wildlife count.

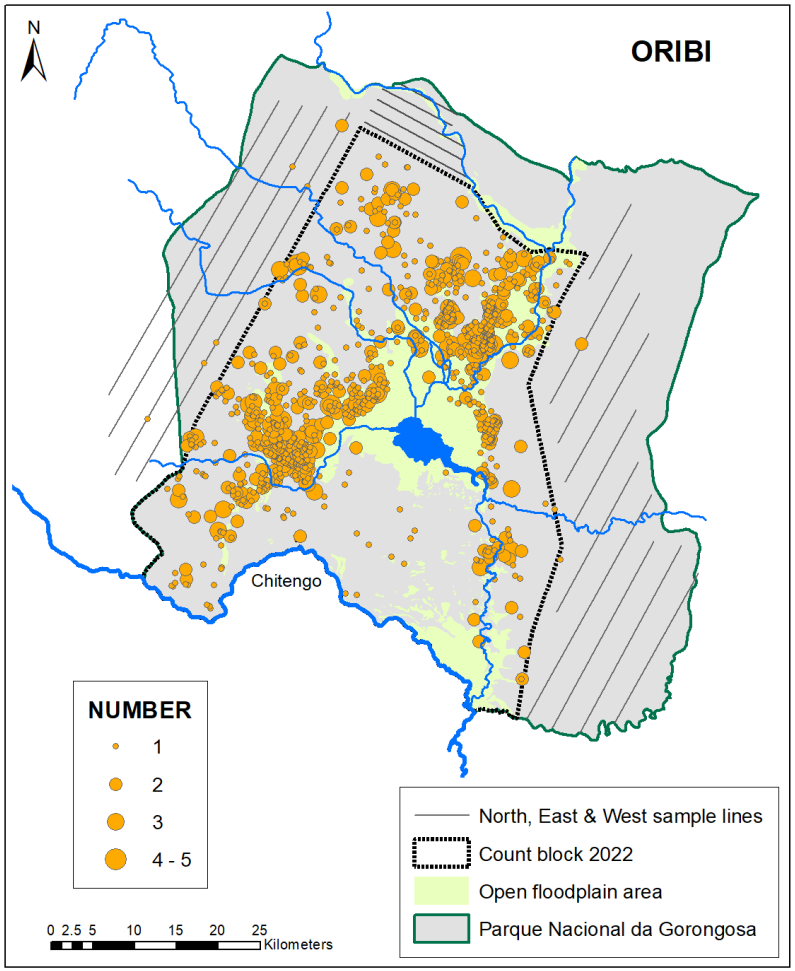


Fig. 7: Spatial distribution of oribi during the 2022 aerial wildlife count.

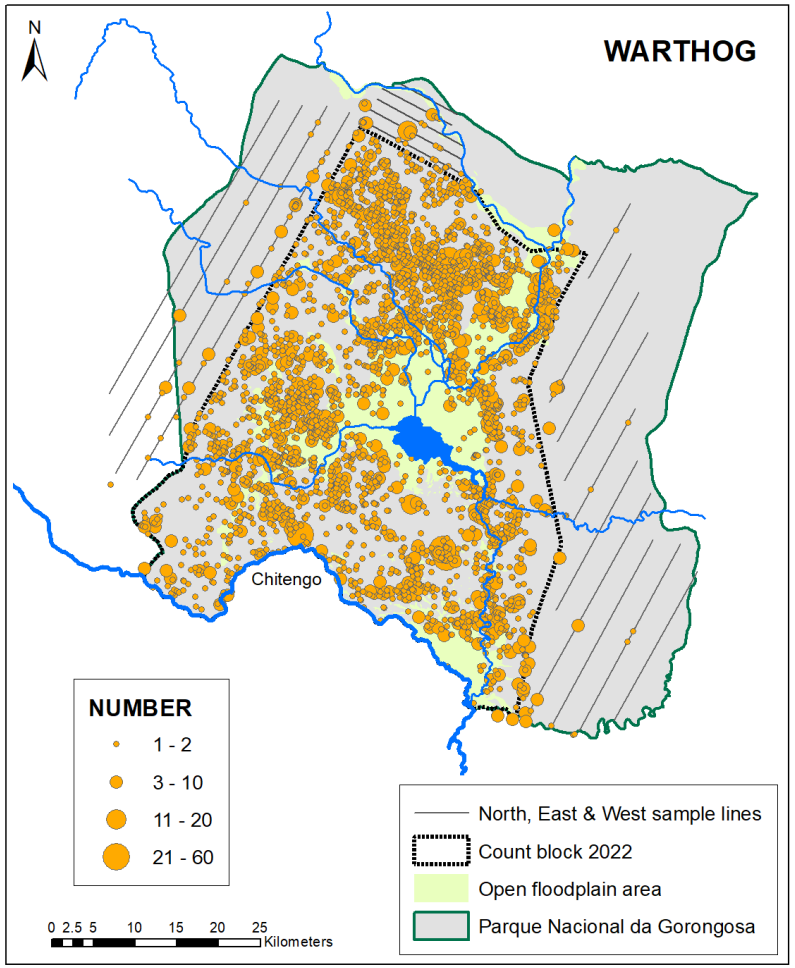


Fig. 8: Spatial distribution of warthog during the 2022 aerial wildlife count.

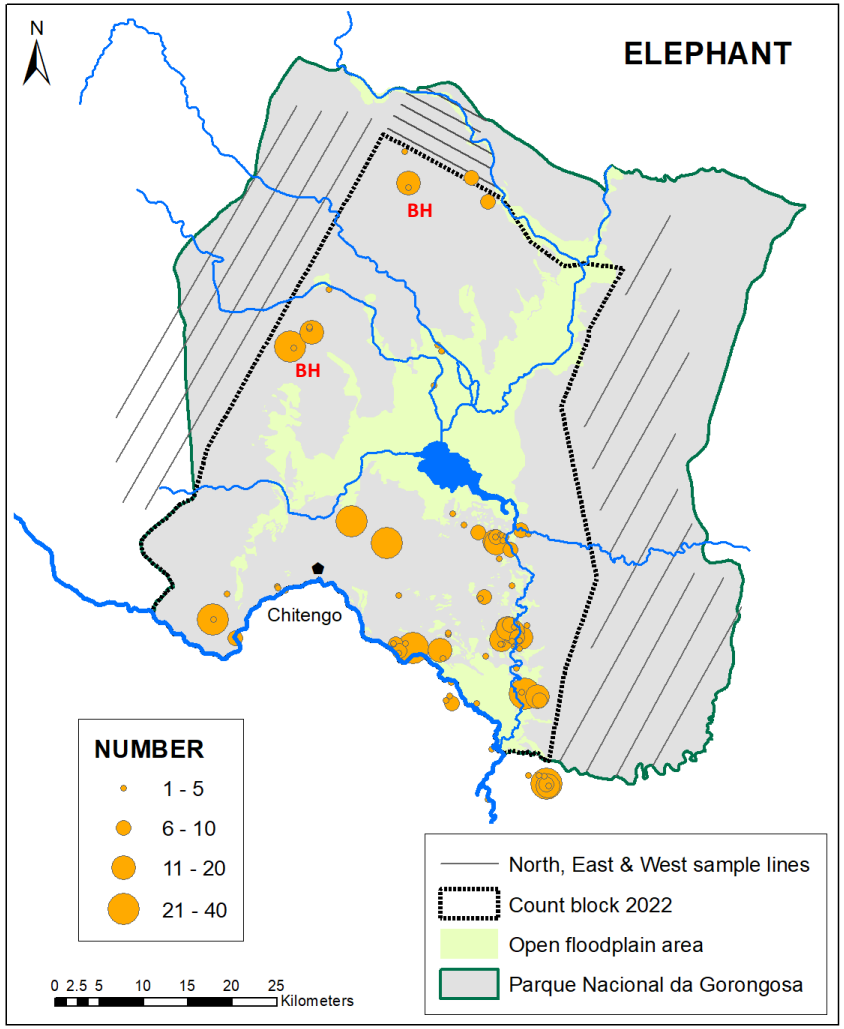


Fig. 9: Spatial distribution of elephant during the 2022 aerial wildlife count (BH = breeding herds in the north and the west).

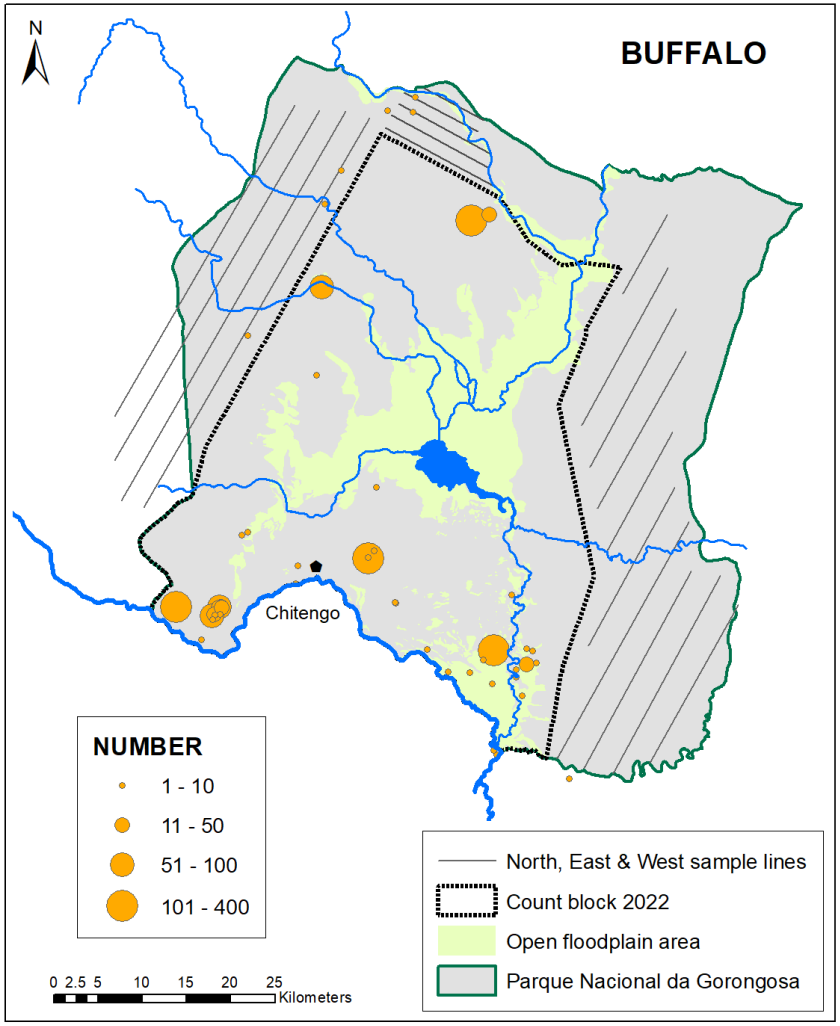


Fig. 10: Spatial distribution of buffalo during the 2022 aerial wildlife count.

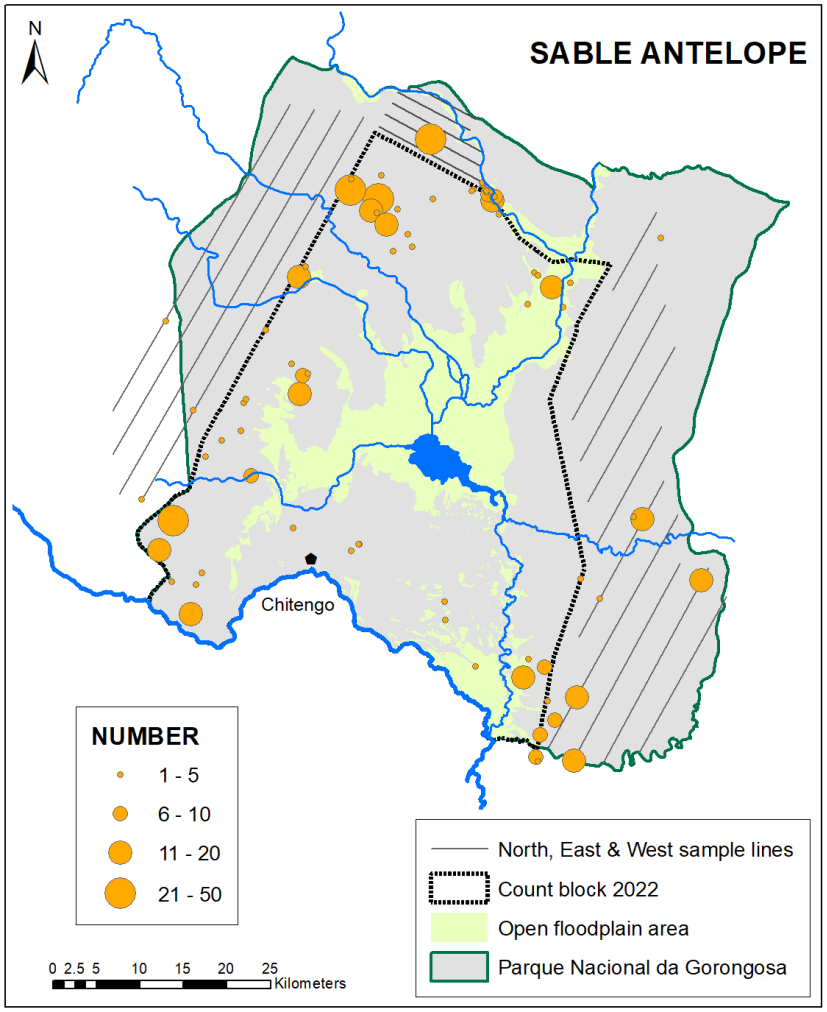


Fig. 11: Spatial distribution of sable antelope during the 2022 aerial wildlife count.

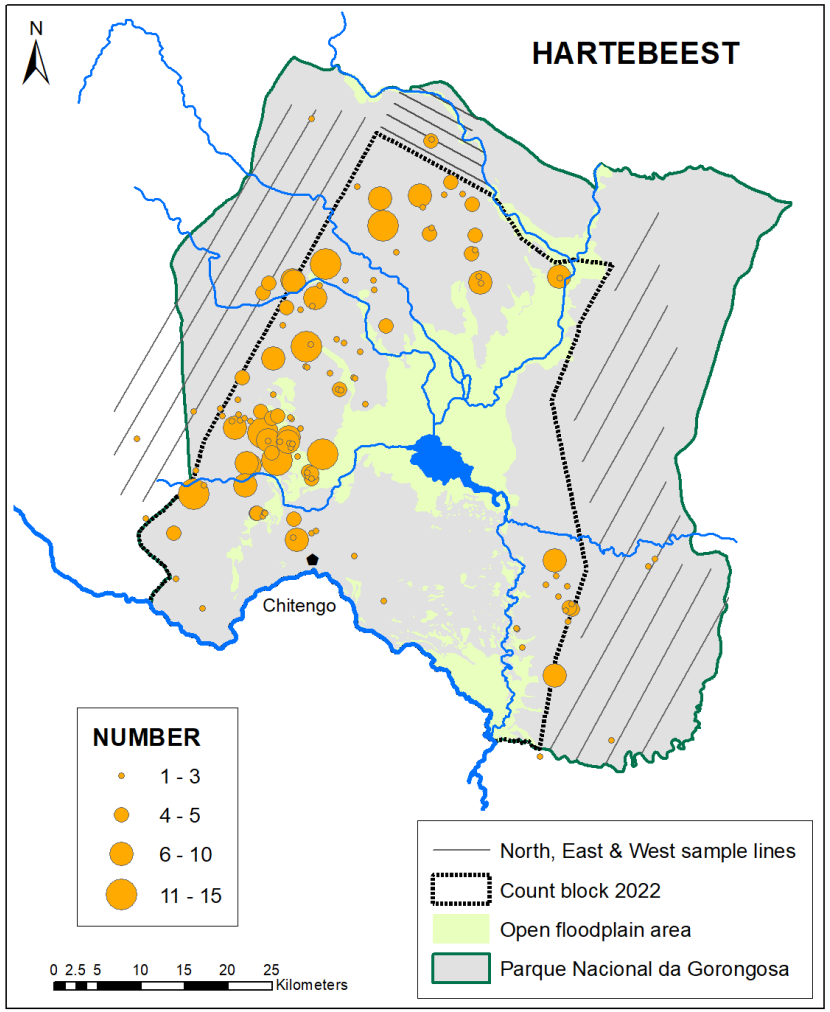


Fig. 12: Spatial distribution of Lichtenstein's hartebeest during the 2022 aerial wildlife count

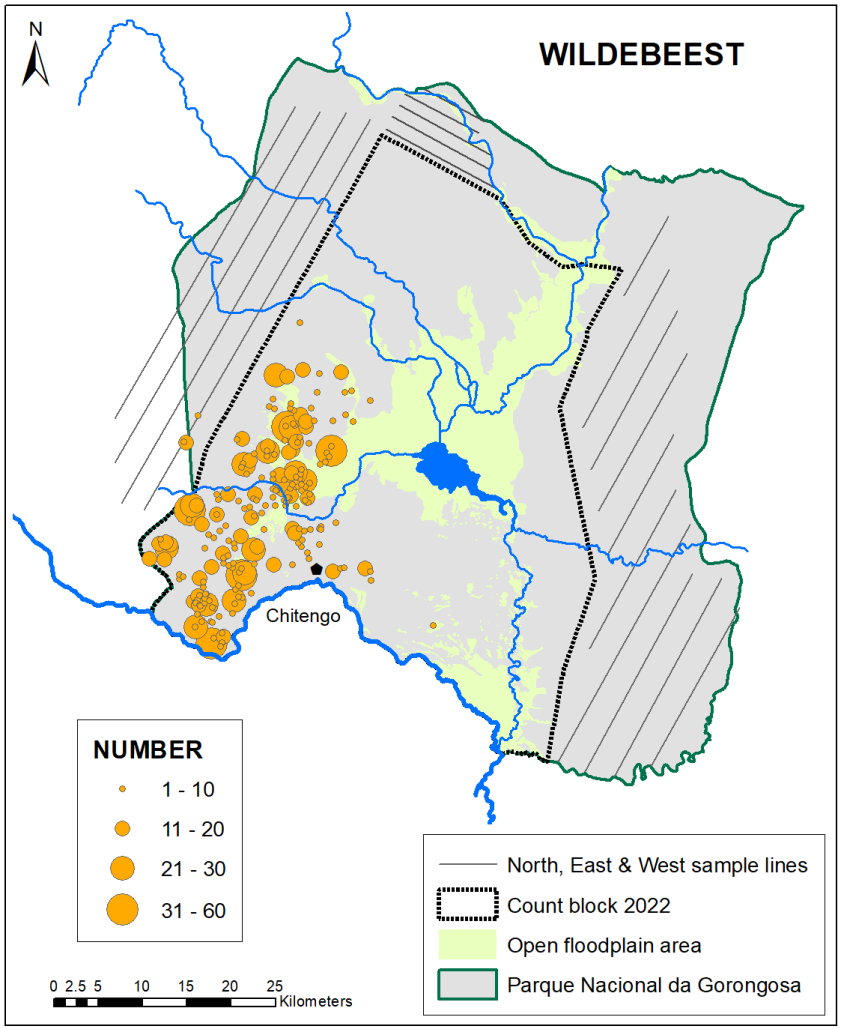


Fig. 13: Spatial distribution of blue wildebeest during the 2022 aerial wildlife count.

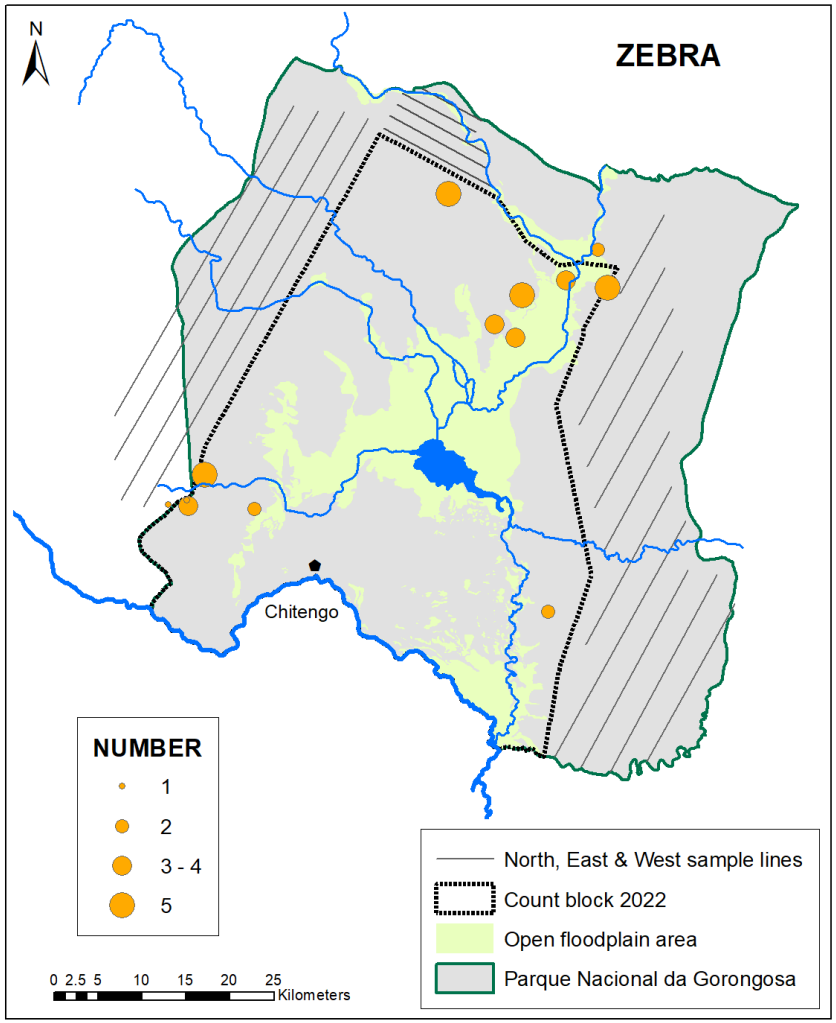


Fig. 14: Spatial distribution of zebra during the 2022 aerial wildlife count.

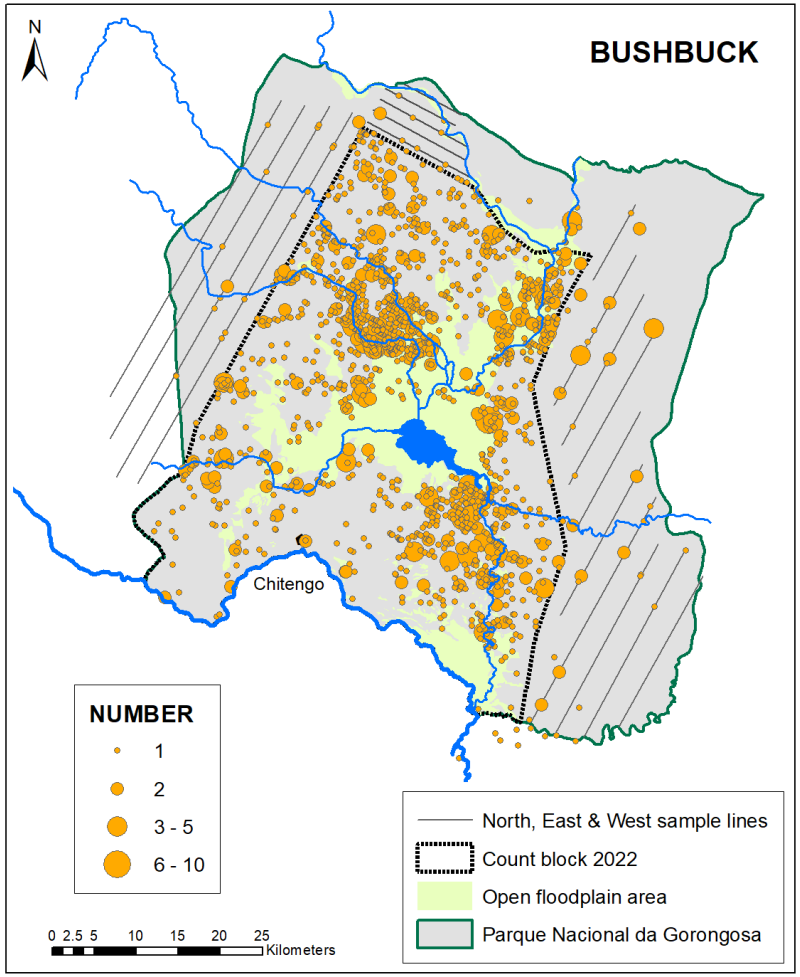


Fig. 15: Spatial distribution of bushbuck during the 2022 aerial wildlife count.

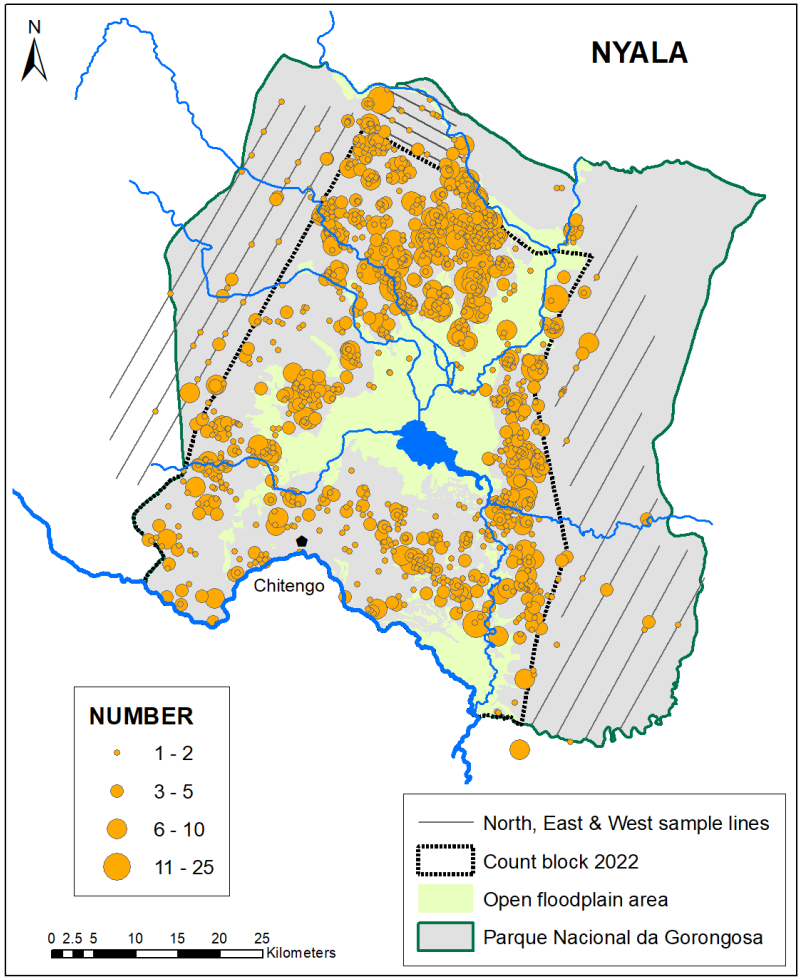


Fig. 16: Spatial distribution of nyala during the 2022 aerial wildlife count.

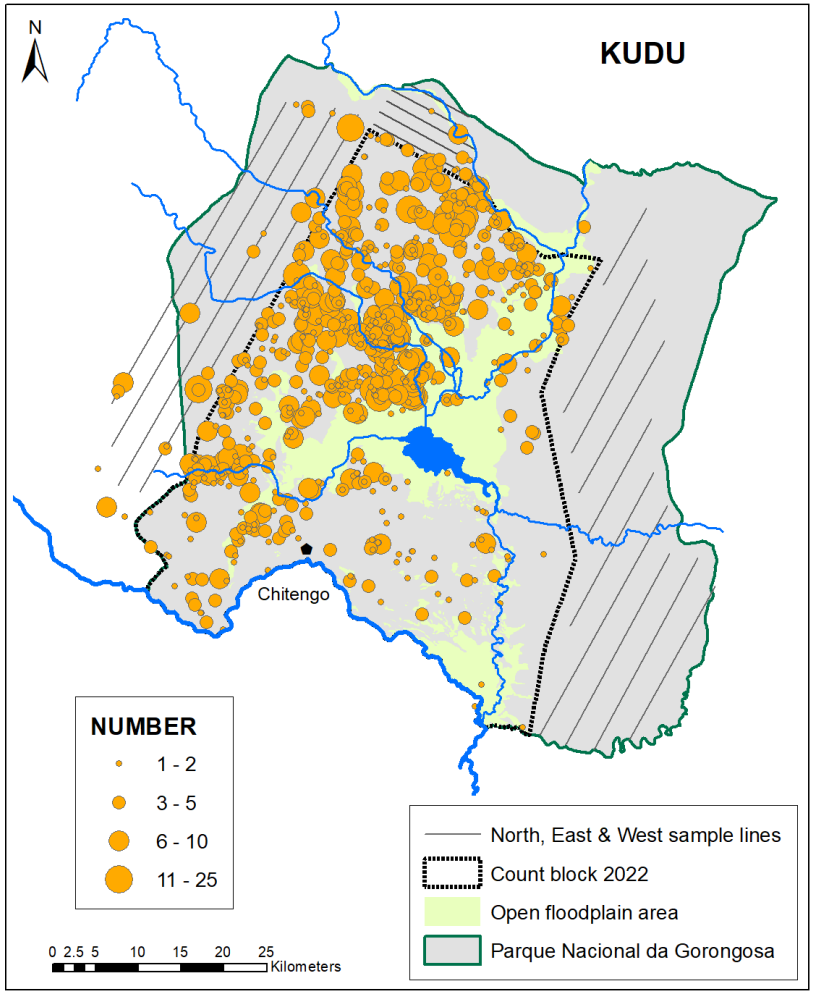


Fig. 17: Spatial distribution of kudu during the 2022 aerial wildlife count

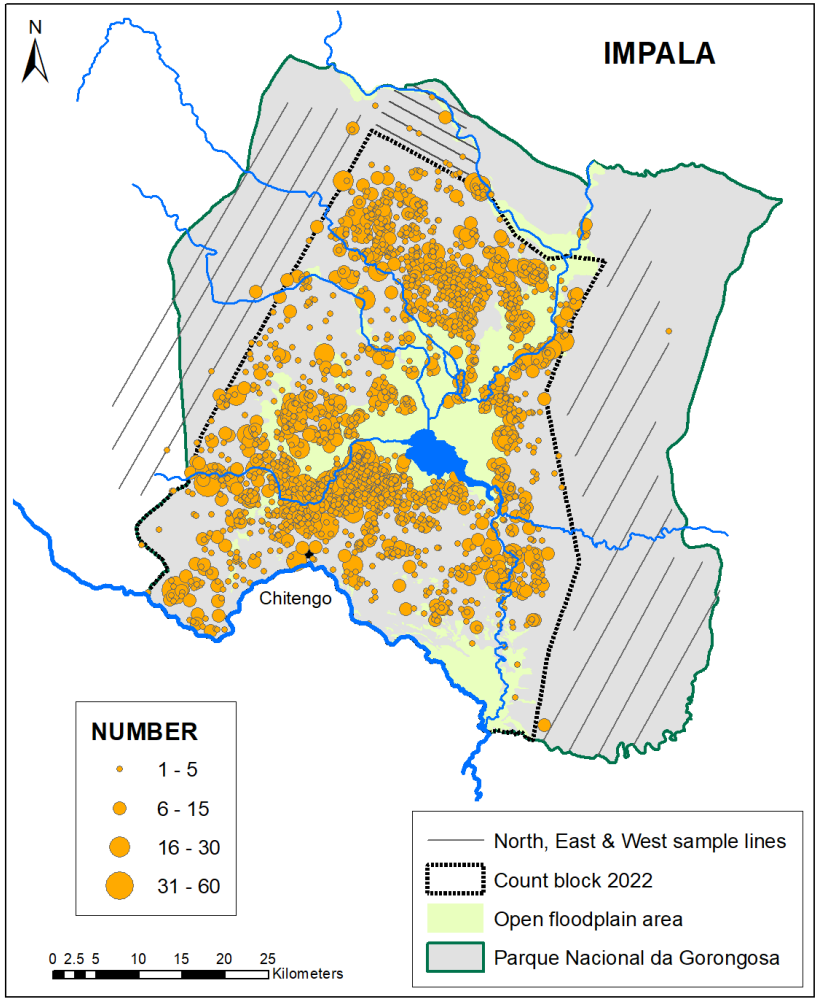


Fig. 18: Spatial distribution of impala during the 2022 aerial wildlife count

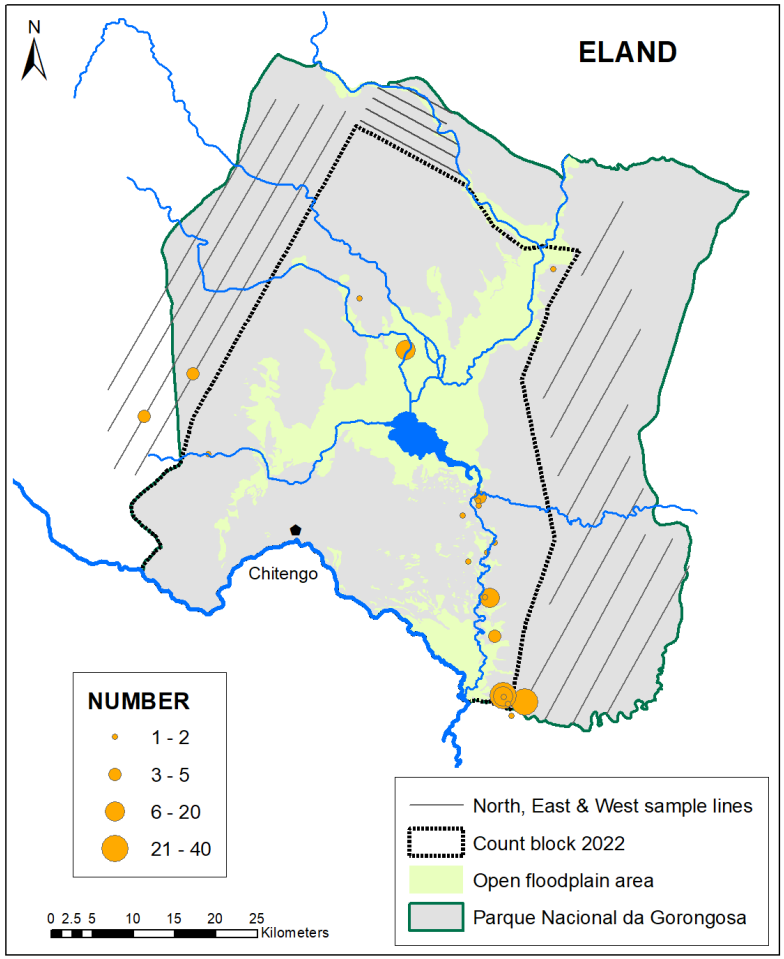


Fig. 19: Spatial distribution of eland during the 2022 aerial wildlife count.

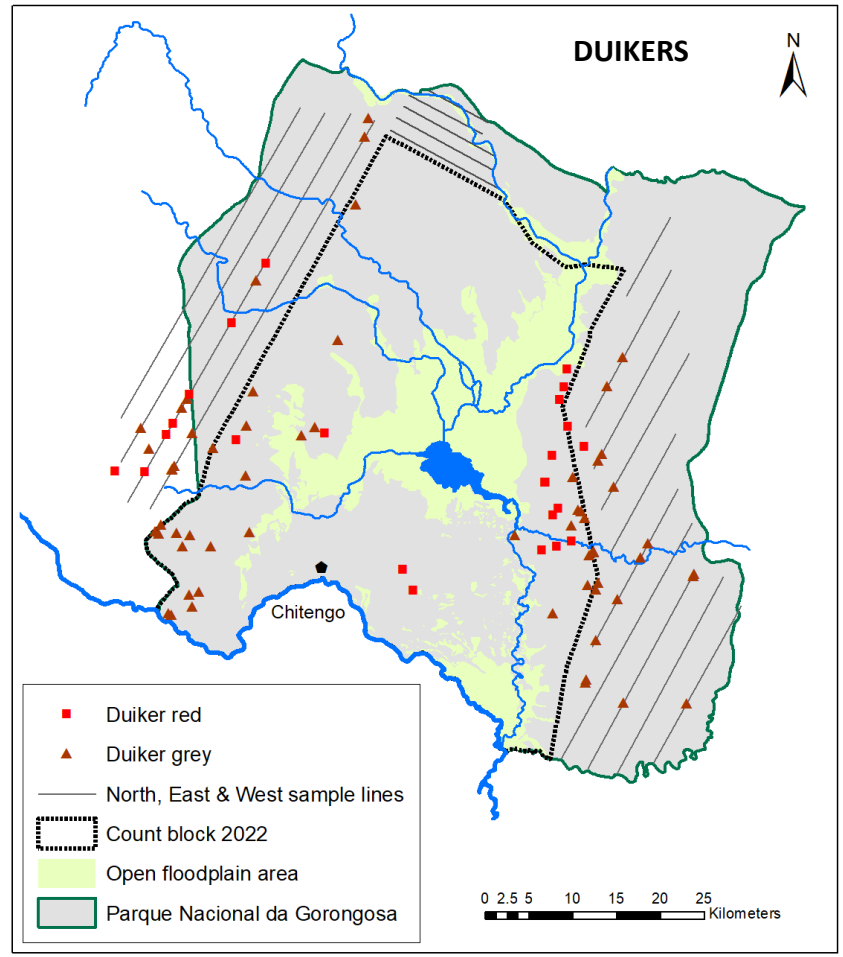


Fig. 20: Spatial distribution of red duiker and grey duiker during the 2022 aerial wildlife count.

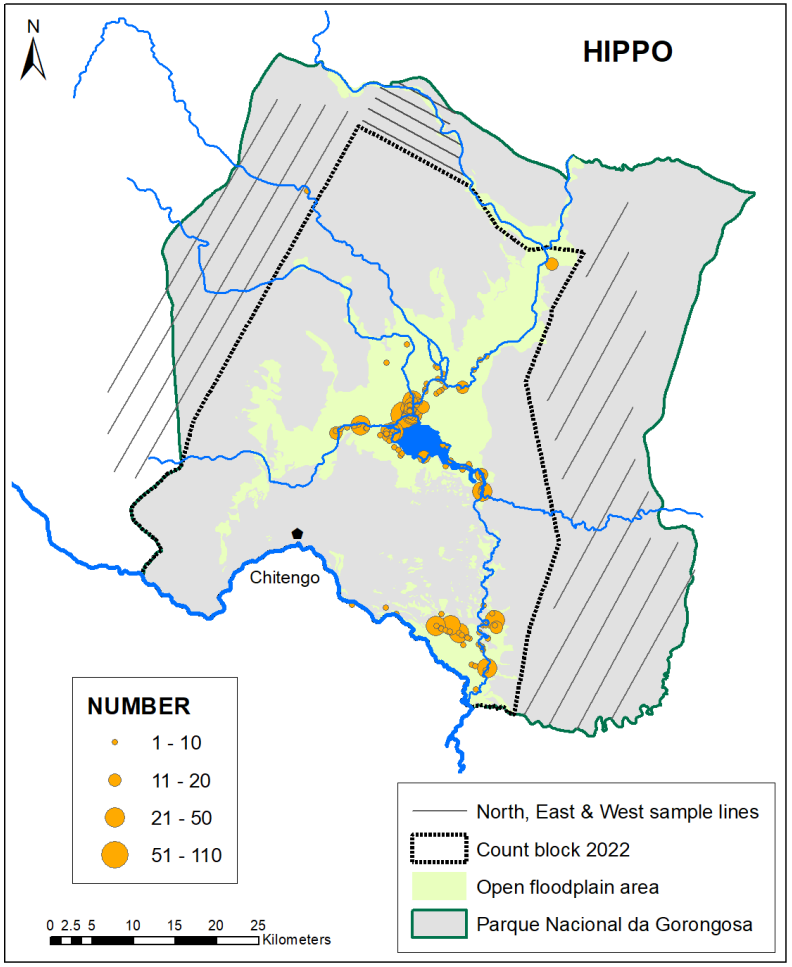


Fig. 21: Spatial distribution of hippo during the 2022 aerial wildlife count.

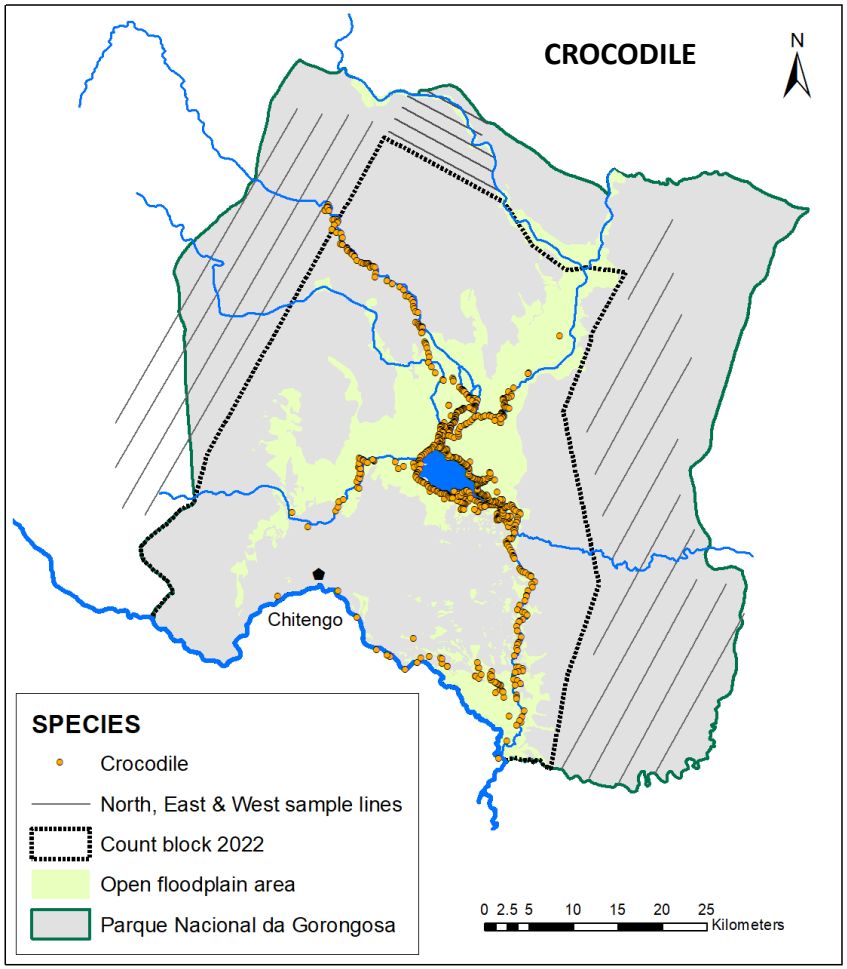


Fig. 22: Spatial distribution of crocodile during the 2022 aerial wildlife count.

2.4. Wildlife biomass

These animal numbers translate into an average biomass of 10,242 kg per km^2 within the common count block. 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.

Waterbuck represents 64% of the total animal biomass in the count block. Their biomass remains concentrated in the open floodplain areas (Fig. 23).

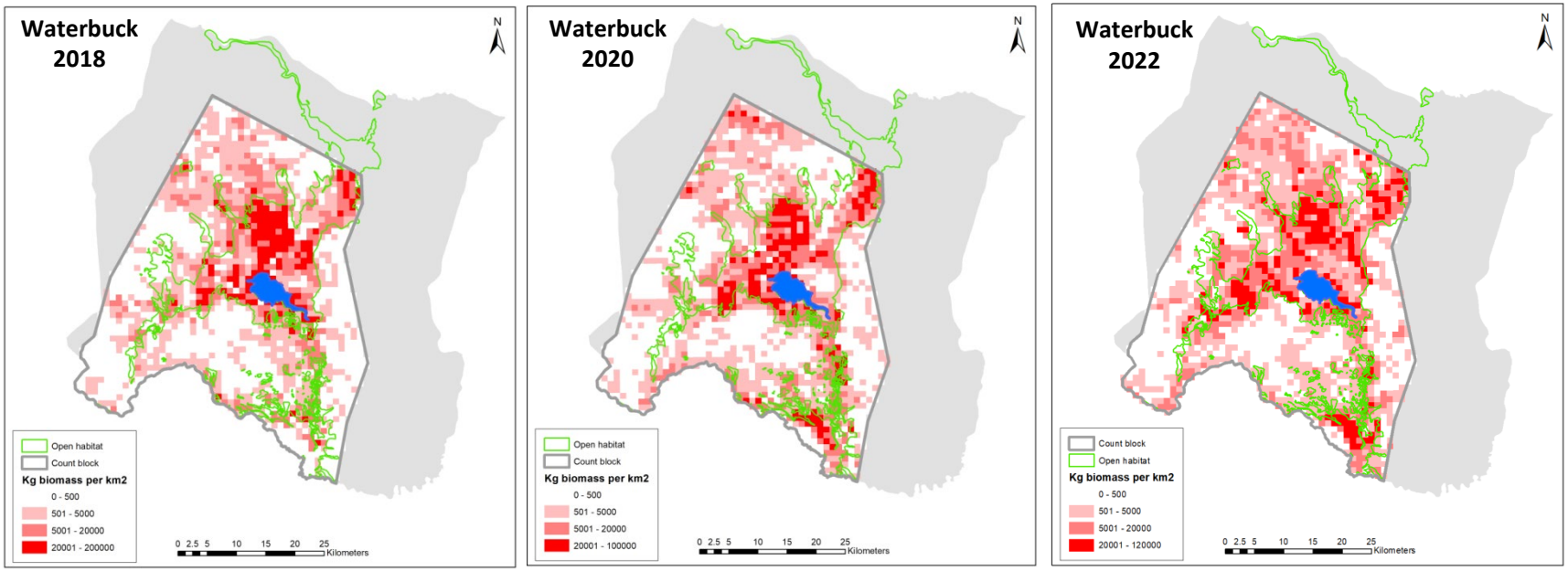


Fig. 23: Biomass of waterbuck (kg km^2) across the common count block in 2018, 2020 and 2022 respectively.

2.5. Additional species observations

The presence of Crowned Cranes, Saddle-bill Storks and Ground Hornbills were recorded during the aerial survey. These conservation state of these large birds is tenuous in southern Africa. A total of respectively 238 Ground Hornbills (197 in 2020), 220 Grey Crowned Cranes (162 in 2020) and 82 Saddle-bill storks (65 in 2020) were observed.

A total of 52 active vulture nests were counted of which 18 were from White-headed Vultures (Fig. 23). This further supports 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 426 active nests of Marabou Storks were recorded. This represents the single largest known breeding population of Marabou Stork in the SADC region (Stalmans et al. 2020) (Fig. 23).

A Pel's Fishing Owl and three Palmnut Vultures were also observed.

A total of 231 baboon troops (226 troops in 2020) were recorded. This information will be useful to the ongoing primatology research project.

Although not a good tool to census lions, the helicopter count did yield 35 lions including some that are 'new' to the Conservation team that tracks the growing lion population in the Park. Two honey badgers were observed.

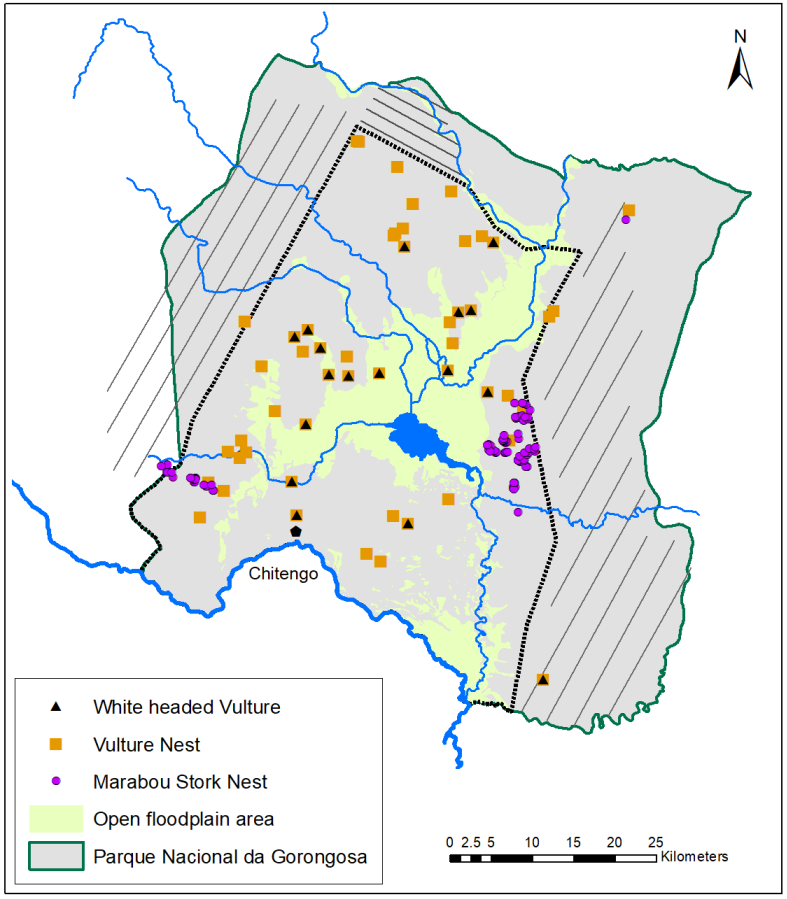


Fig. 24: Distribution of vulture nests and of Marabou Stork nests observed during the 2022 aerial wildlife survey.

2.6. Conservancy block

The following species and numbers were observed (Table 5 / Fig. 25) in the Nhampoca and the Nhamacuenguere Community Conservancy Areas - note that these numbers are already included in the overall numbers of Table 1 and Table 4.

Table 5: total number of large animals counted in 2022 in the community conservancy block.

Species	Total number counted
Buffalo	15
Bushbuck	7
Bushpig	7
Common reedbuck	17
Eland	1
Elephant	74
Hartebeest	1
Nyala	7
Sable	14
Warthog	9
Waterbuck	182
TOTAL	**334**

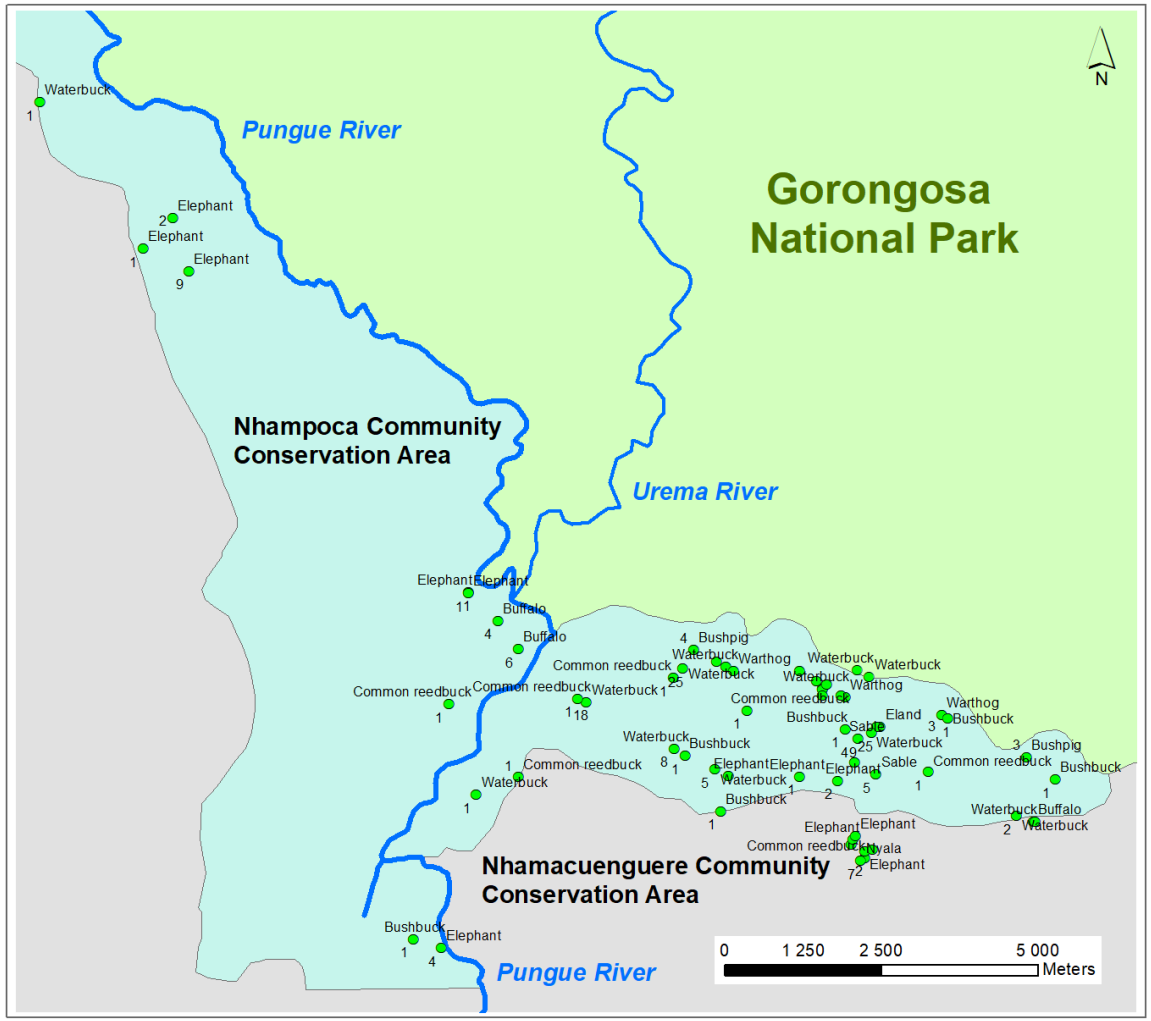


Fig. 25: Distribution of wildlife in the Nhampoca and Nhamacuenguere Community Conservancy Areas.

3. Discussion - general & individual species trends

The count block offers an excellent base for comparisons across time as it was surveyed in 2014, 2016, 2018, 2020 and 2022 respectively (Table 6).

Whereas the overall number of herbivores dropped between 2018 and 2020 by more than 15%, the 2022 count yielded a 10% growth. Some species including blue wildebeest, impala, kudu and nyala have shown much stronger growth(Fig. 26). Other species have declined in numbers (Fig 26). This may be a real change. A lower count does however 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 such that many animals will spend their life within its boundaries.

Predation by the growing lion and wild dog population is probably playing a significant role in reducing oribi, bushbuck, reedbuck and warthog populations.

Generally, it would appear that animals are spreading further especially in westerly and northerly parts of the Rift Valley outside of the count block. The north-western part of the Park, north of the Vunduzi River currently carries large numbers of wildlife. Animal densities are also increasing in the miombo areas to the west and east of the Rift Valley (Fig. 27).

Table 6: side-by-side comparison between the numbers of herbivores in the 184 500 hectare common counting block surveyed in 2014, 2016, 2018, 2020 and 2022.

Species	2014	2016	2018	2020	2022
Blue wildebeest	361	363	587	754	1 406
Buffalo	670	696	960	1 212	1 223
Bushbuck	2 277	2 022	1 665	1 592	1 550
Bushpig	167	108	183	226	346
Common reedbuck	11 871	10 451	10 220	5 386	4 145
Duiker grey	61	49	42	50	26
Duiker red	26	21	21	25	15
Eland	105	94	117	27	94
Elephant	535	567	544	691	496
Hartebeest	613	562	578	440	383
Hippo	436	440	546	744	938
Impala	2 727	4 705	6 122	6 229	9 446
Kudu	1 200	1 466	1 928	1 831	2 279
Nyala	945	1 299	1 934	2 341	2 730
Oribi	4 485	3 884	3 958	1 853	1 383
Sable	757	810	805	451	240
Warthog	9 086	5 383	10 739	8 086	5 123
Waterbuck	34 482	44 948	55 351	48 515	57 284
Zebra	33	34	33	33	20
TOTAL	**70 837**	**77 902**	**96 633**	**80 486**	**89 125**

The species are now discussed individually:

- **Waterbuck** have recovered from their decline following cyclone IDAI. An all-time high was recorded overall and in the count block. Their density is also increasing in the east and west (Fig. 27).
- **Blue wildebeest** are exhibiting strong growth. Herds are increasing in size with the largest herd numbering 43 wildebeest.
- **Buffalo** are also growing well but have dispersed hence the virtually stationary number in the count block. The largest herd numbers 382 animals and was found near the confluence of the Pungue and Urema Rivers.
- **Hippo** have also continued with their strong recovery. Large pods are found in Lake Urema with up to 109 animals in the largest pod.
- **Nyala** are being undercounted due to their preference for closed habitats but their strong upwards trend continues.
- **Impala** now for the first time become the second-most numerous herbivore with a year-on-year growth of 22%.
- **Kudu** numbers are growing and have exceeded 2 000 for the first time**.**
- **Eland** are a highly mobile species. This probably accounts for their virtual absence in 2020 when environmental conditions were poor for eland and their return this year.
- **Elephant** numbers are lower in the count block. This does not reflect the reality of the elephant population that is growing strongly – see Box 1. Breeding herds were observed for the first time in the west and the north.
- **Bushbuck** number seem to have stabilised. Wild dog have likely had a significant initial impact on their numbers especially south of Lake Urema.
- **Sable antelope** declined sharply in the count block. This may be partly offset by their spreading northwards and westwards. For example, a herd of more than 20 sable antelope was seen by staff near Xivulo a few days after the count in an area not covered by the count. A strong herds numbering 46 animals was observed north of the count block.
- **Lichtenstein's hartebeest** numbers were once again lower within the count block. Yet, the overall number across the whole count was 462 hartebeest which is only marginally lower than the 473 counted in 2020.
- **Warthog** numbers continue their downward trend which is probably partly due to predation.
- **Common reedbuck** declined in the count block, probably as a combination of inter-specific competition and predation.
- **Oribi** numbers are only 30% of what they were in 2014. Inter-specific competition and predation are impacting on them.
- **Zebra** numbers remain stagnant. Their total number in the Park remains probably less than 50. An introduction of zebra is required to set this species on an upward trajectory.

This is an open, natural system with increasing levels of predation and shifting patterns of inter-specific and intra-specific competition for grazing. It is 'normal' that some species will be growing in numbers whilst others will decline. The populations of oribi, reedbuck, sable and hartebeest remain significant and are viable.

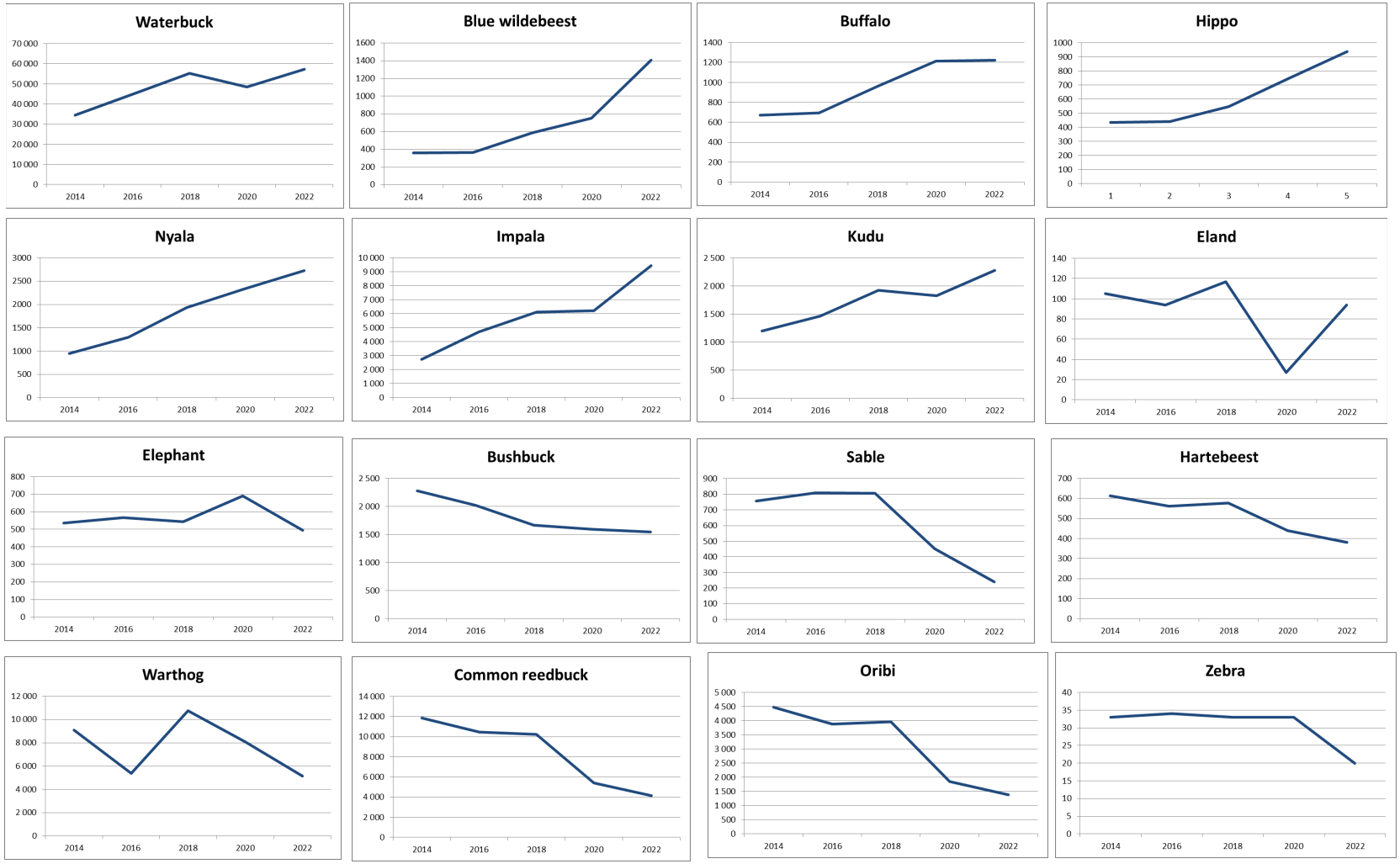


Fig. 26: Trajectories of herbivore species in the common count block since 2014.

Box 1: Elephants and the 2022 aerial count

The movements of the elephant population is being monitored through GPS Iridium collars. There are now a total of 38 collars of which 36 are actively sending signals. Of those, 18 are deployed on lead females from different family units. Four of the family units have paired collars with one collar on a tusked and one collar on a tuskless female. This is for the purpose of studies on tusklesness in the Gorongosa elephant population.

The other 20 collars are deployed on male elephants. All of these male elephants have at some time or another left the Park to forage in the Buffer Zone south of the Pungue River. Three of them have stayed out of the Park for more than 4 months on end. In the case of the bulls, a collar does not always represent a specific group since some of the young bulls join bigger groups (for raiding parties) during the night and would separate into smaller groups during the day. Some of the older bulls tend to roam by themselves.

Based on the observed number of individuals that each collared elephant was with during the collaring, it is conservatively estimated that these 38 collars represent a total of 353 elephants.

Elephants are highly mobile. Their movements can be very variable depending on the seasonality of resources and their spatial memory (Polansky & Wittemeyer 2015). They can travel long distances in a day. This means that their scale of movement can easily exceed the scale of the area that was counted on a daily basis.

A total of 18 collared elephants were observed in 13 groups comprising 140 elephants. Theoretically, this leaves another 353 - 140 = 213 elephants unaccounted for that are associated with the collared individuals.

This would bring the total for the count to 833 elephant. This is still lower than the current estimate of 1,000+. However, just as a proportion of the collared elephants were not observed, it would be reasonable to expect that a similar proportion of un-collared elephant herds was not spotted.

The matching of the actual elephant movement (based on collar data) and the observations made during the count illustrated the following different scenario's:

- Collared elephants that were not present at all within the counting area and were therefore not 'discoverable';
- Collared elephants that 'switched' counting blocks and that were therefore not 'visible';
- A likely double observation of 2 collared elephants that were observed in a counting block early on in the count and again 10 days later in the Community Conservancies on the last day of the count;
- Collared elephants that were resting in deep shade in densely wooded riverine areas and that were 'missed' by the observers. Despite their size, elephants can be surprisingly difficult to detect from the air – e.g. Morley & Van Aarde (2002) argue that aerial surveys done in Tembe Elephant Park in South Africa constantly underestimate the true size of the elephant population.

The lower elephant count for 2022 should not be alarming. Many calves are being observed both from the air and from the ground. No carcasses were observed during the aerial count, nor are any carcasses found by ground patrols as the result of illegal hunting. **By all accounts the elephant population of Gorongosa is healthy and is growing**.

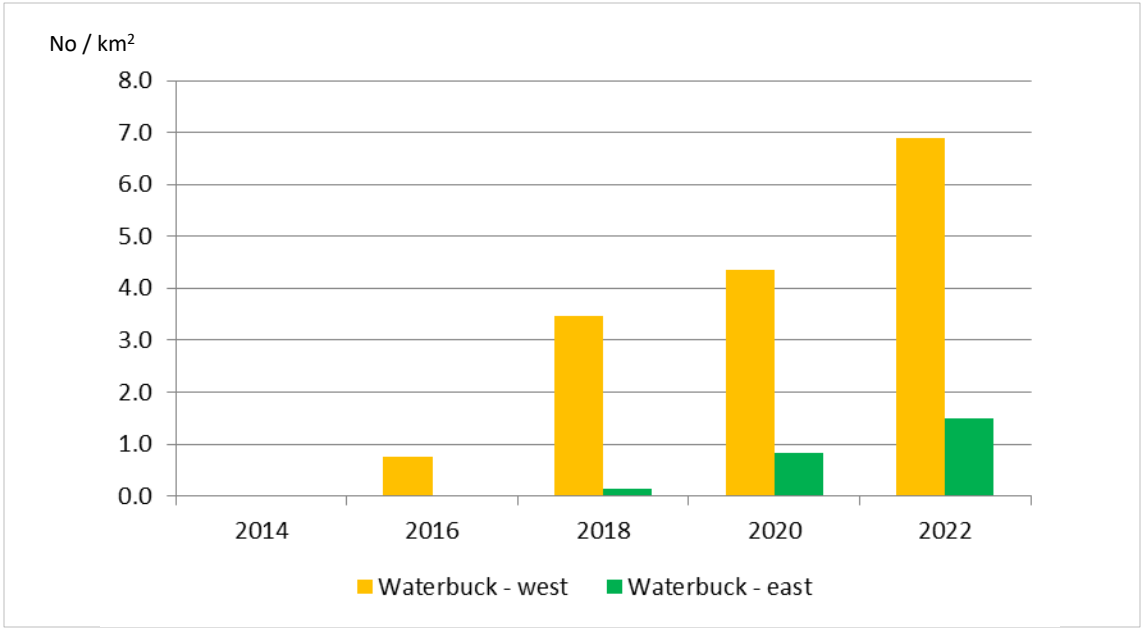


Fig. 27: Density of waterbuck along the eastern and western sample lines (although increasing, these densities are still low compared to the main count block where 31 waterbuck per km² occur).

The current report is mainly aimed at documenting and summarizing 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.

There are likely more herbivores in Gorongosa at present than in historical times (Fig. 28). The first aerial counts at the end of the 1960's were done using a fixed-wing aircraft. As this does not allow for a reliable count of smaller species, only 8 species of larger herbivores were counted (Tinley 1977). In contrast, since the year 2000, with the exception of the year 2004, all counts have been undertaken with a helicopter and all species are being tallied.

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 (Stalmans et al. 2019).

This massive number of waterbuck (likely the single largest population in Africa) creates both intra- and inter-specific competition for the grazing resource.

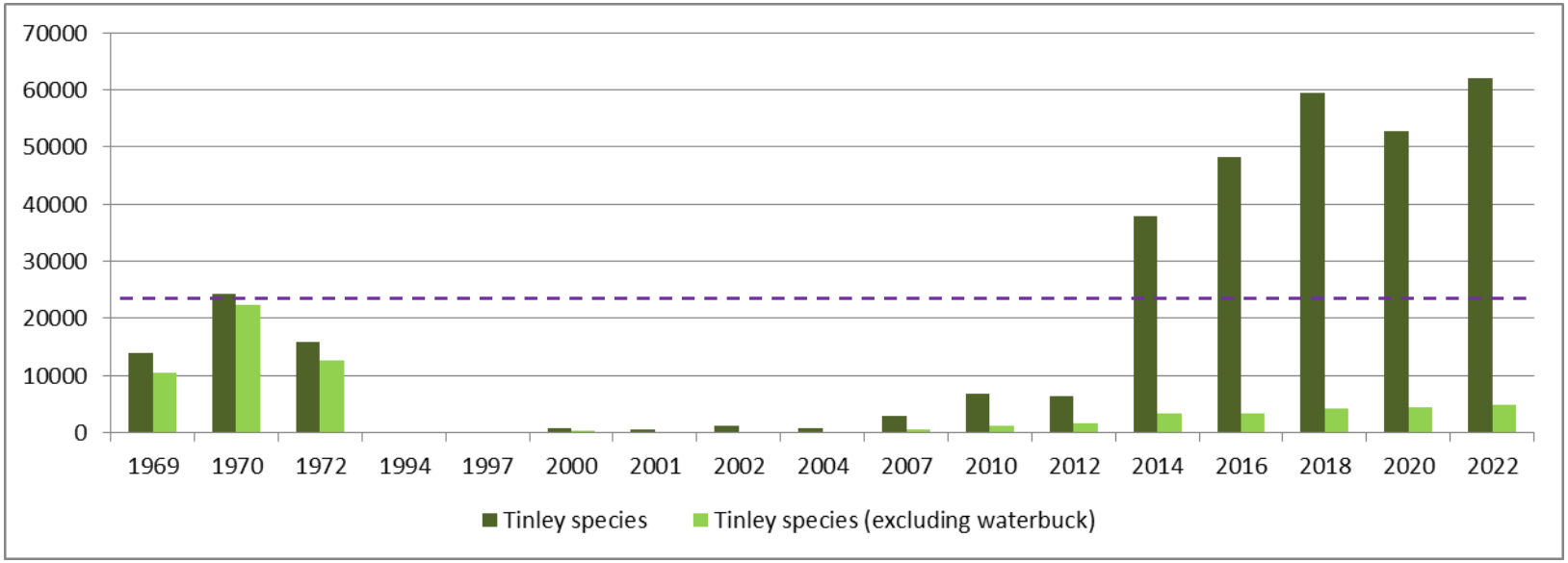
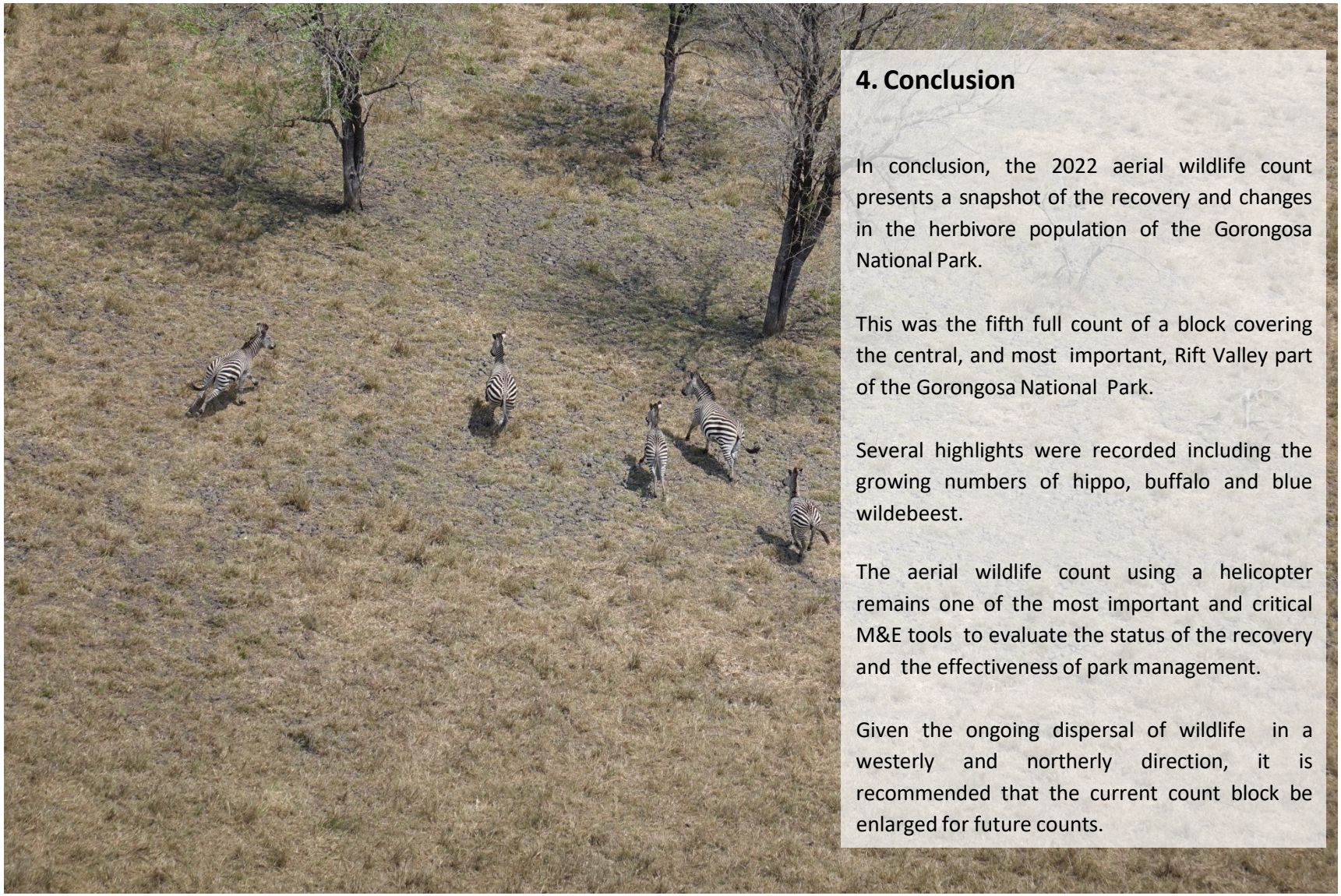


Fig. 29: Trend in the number of 'Tinley' species (elephant, buffalo, zebra, wildebeest, sable, hartebeest, eland and waterbuck) in the count block.



4. Conclusion

In conclusion, the 2022 aerial wildlife count presents a snapshot of the recovery and changes in the herbivore population of the Gorongosa National Park.

This was the fifth full count of a block covering the central, and most important, Rift Valley part of the Gorongosa National Park.

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

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

Given the ongoing dispersal of wildlife in a westerly and northerly direction, it is recommended that the current count block be enlarged for future counts.

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