GARAMBA NATIONAL PARK

Institut **C**ongolais pour la **C**onservation de la **N**ature

AFRICAN PARKS NETWORK

Aerial animal census 2012

Democratic Republic of Congo
03-09 April / 04-12 May

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28/05/2012

AERIAL ANIMAL CENSUS 2012, GARAMBA NP (RDC)

INTRODUCTION

Garamba National Park is situated between 4º and 3º north and 29º and 30º east in the north east of Democratic Republic of Congo and cover an area of 4900km². It is surrounded by three hunting reserves at west, south and east and limited with South Sudan on the north.

The south part of the park comprises especially open long grass savannah and gallery forest. As it´s going into the north, the park is gradually getting cover with bushes and trees. The reserves are dominated by a complex woodland and gallery forest that difficult the visibility from the air, fact that was considered on the census design.

An aerial animal census of Garamba National Park it´s been carried out through the years as part of the ecosystem monitoring program. The objectives of this census are to determine the status of large mammals and assess signs of poaching and other human activities in the Park.

In order to get the most precise and accurate result, a total count of the south part of the park and north of Gangala na Bodio reserve has taken place in April as it was done in 2007 (Reid, 2007). As the grassland was still too dry and burned, the same transects were repeated in may once the new green grass had covered the whole area. It means that in the end two surveys were carried out in the same area but during different seasons to make sure that it couldn´t affect the final number of the counted key species.

The plane used was a Cessna 206 provided with inboard communication, GPS and a radar altimeter. It flew the area following vertical transects with a distance of 1km between them. The average altitude was 355ft for the census done in dry april and 357ft for the second one at a speed of 150-180km/h. The crew was formed by the pilot, a front observer-coordinator and two middle seat observers. A camera D3100 with a 28-55mm zoom was used to photography big herds of animals to help the counting.

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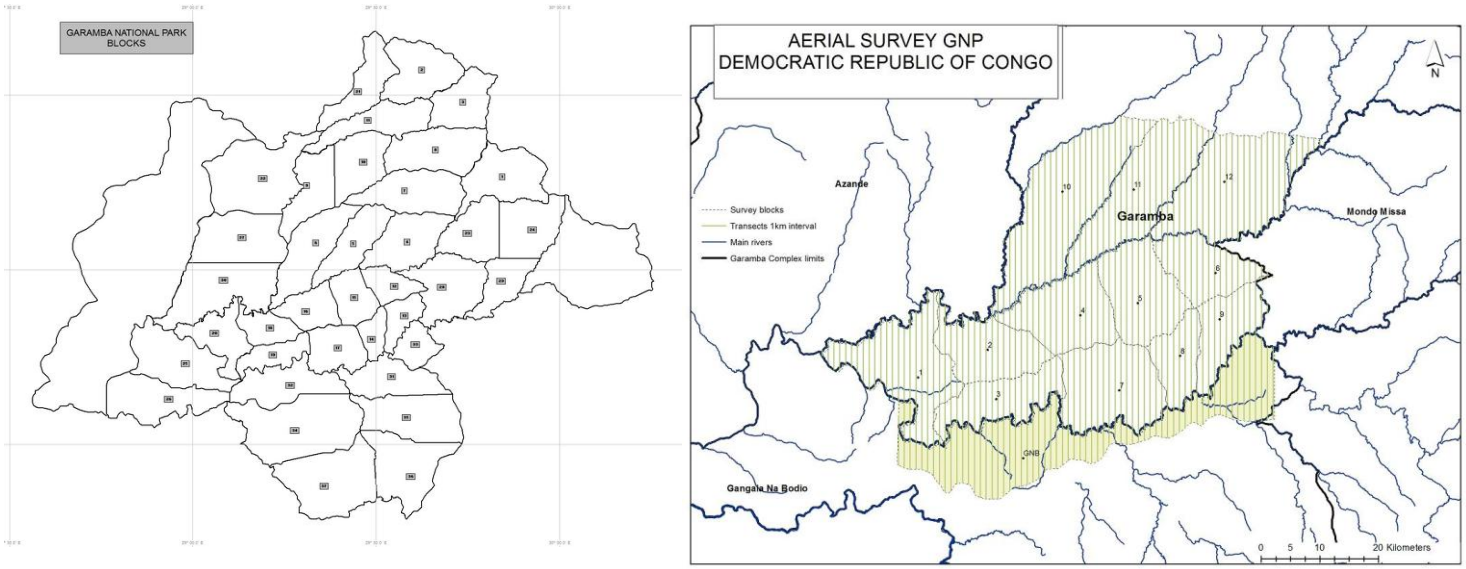
PLANNING, DESIGN AND METHOD

In the beginning, a total census for the central-south area and a sampling for the north were planned to locate and count every animal in Garamba National Park.

The area planned for the total census was selected according to the area covered in the previous census (Reid, 2007), that covered the south of the park and the north side of Gangala na Bodio reserve comprised between the main road and the Dungu River. All this zone it´s been extended this year toward the central-north, attempting to cover the area with the roads that have been reopened and patrolled recently.

After the first flight of the north area (sampling), it´s been decided to stop counting this part of the park as most of the zone is too thick to see animals from the plane and the density is lower according to previous census (Hillman Smith et al, 1995). The cost of the fuel and the time saved there, were used to carry out a second total census of the same central-south area instead. This new census followed the same transects and same methodology than the first one but different timing in order to compare results between dry and beginning of rainy season.

Figure 1. Survey blocks and area covered



Due to the good visibility of open savannahs from the air, it was thought that a space of 1km between transects would be good and accurate enough. In order to be sure, a flight took place to see the differences between counting animals through transects of 500m distances and transects of1km distances. As the result was the same, it was decided to flight transects with a spacing of 1km to reduce the cost and the time.

The plane was calibrated the days before the census to calculate the position of the streamers according to the eye of the two middle observers (Norton-Griffiths, 1978). Only one outside streamer was set in both wing struts to show the 500m limit that should be covered on each side of the transect.

The observers were trained the week before the census in order to reduce counting bias. During this training, aerial colour slides depicting herds of wildlife in typical habitats were projected for 10 seconds each. After that, the slides were projected again to review in detail (J. Dirschl et al, 1981). The flying speed and the altitude were planned to be 150km/h and 350ft. The flying time (6.30-10.30am and 2.00-5.00pm) was thought to minimise the death time but also considering the factor fatigue always that have been possible.

SURVEY METHODS

The method used was a total aerial count using parallel transects (M. Norton-Griffiths, 1978). These transects were flown vertically and perpendicular to the main rivers.

The plane was a fix wing aircraft and the crew was constituted by four people. The pilot, John Sidle, navigated through transects using GPS coordinates. Marina Monico or Natalia Casado (alternatively) occupied the front observer seat and recorded all data, time and altitude and also photographed big herds; and two middle observers, Nzia Bariki (right seat) and Matokaloma Abiandroa (left seat), were responsible of counting the animals and the human activity listed (Annex, table 1).

Two counting were done, one in April and a second in may in the same conditions. Timing was chosen for the first counting according to the last census (Reid, 2007). The second counting it´s been in the beginning of the rainy season as the grass is already green and it offers a better visibility as the first rains have cleared the atmosphere but the grass is not long enough yet. At the same time it´s believe to be the best time for greatest accuracy in population estimation (Hillman Smith et al, 1995).

All animal listed were counted in the April while only big mammals were counted in may.
The data was downloaded after each flight and every photo of herds was counted by marking the animals with a pencil using the paint program. This job was done by the two front observers and the final number was reviewed and contrasted in the end.

MINIMISING BIAS

Flying altitude: The time that is too high is normally compensated for the time that is too low. In any case, the front observer reads the radar altimeter and record the altitude of each transects.

Animals moving: Animals don´t get disturbed with the aircraft for what it shouldn´t imply a problem and the animals than move in and out should be compensated.

Navigation: as it is made by following transects from a determined waypoint to another, no visual errors can be done.

Counting bias: In order to diminish bias, observers were chosen in base of their experience with aerial patrols and trained before the census. Photos of groups bigger than 10 individuals were taken during the counting. A correction bias based on the results between the visual number and the one

counted in photo was applied to the herds without photo (Norton-Griffiths, 1978). A different correction was calculated for each observer and each key species (Table 1).

Table 1. Correction Factor for key species

03-09 APRIL 2012								
	ELEPHANT				BUFFALO			
	NUMBER		C.FACTOR (%)		NUMBER		C.FACTOR (%)	
	LEFT SIDE	RIGHT SIDE	LEFT SIDE	RIGHT SIDE	LEFT SIDE	RIGHT SIDE	LEFT SIDE	RIGHT SIDE
VISUAL	583	861	113	146	952	3116	72	88
PHOTO	517,5	589			1326	3535,5		
04-12 MAY 2012								
	ELEPHANT				BUFFALO			
	NUMBER		C.FACTOR (%)		NUMBER		C.FACTOR (%)	
	LEFT SIDE	RIGHT SIDE	LEFT SIDE	RIGHT SIDE	LEFT SIDE	RIGHT SIDE	LEFT SIDE	RIGHT SIDE
VISUAL	1011	1095	169	138	2267	3746	115	117
PHOTO	598,5	792,5			1973,5	3202,5		

RESULTS

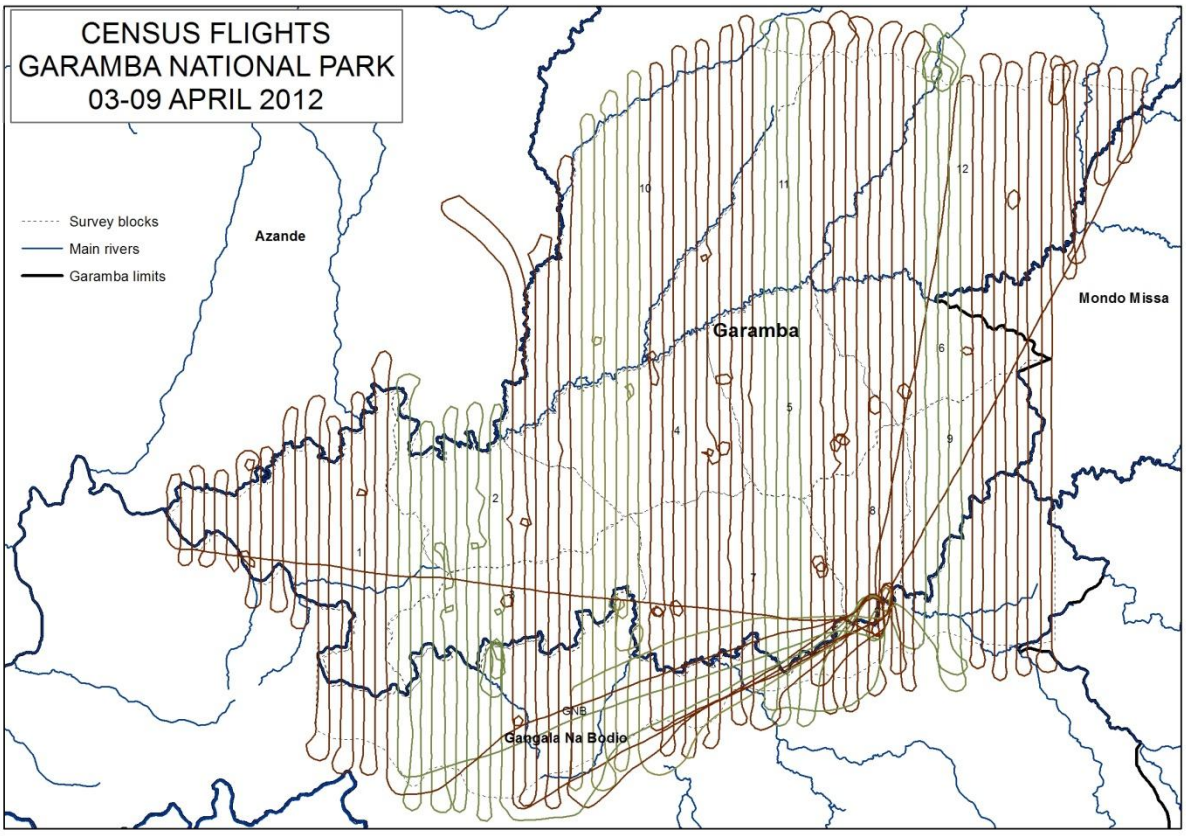
AREAS FLOWN

A total of 86 transects were flown over an area of 3010 km² during each counting. The area flown in both censuses was the south part of the park comprised from block 1 to block 12 and also 503 km² of the north part of Gangala na Bodio Reserve.

03-09 APRIL

The counting was carried out in 6 days during 9 different flights, from which 3 of them took place in the afternoon and the rest were in the mornings. The total flight time including the death time was 27 hours and 13 minutes with an average speed of 164 km/h (±4,35) at a mean altitude of 354 (±33).

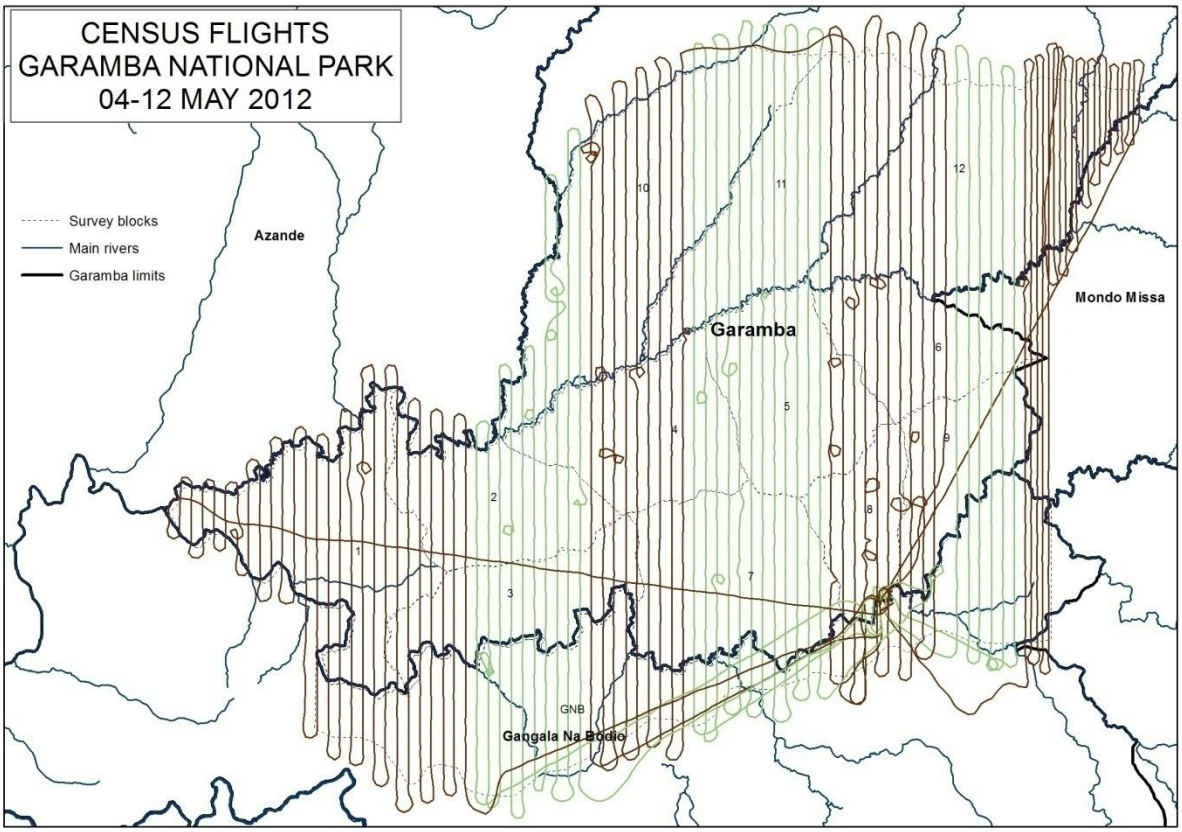
Figure 2. The 9 flights of the first census carried out in april starting from east to west.



04-12 MAY

The counting was carried out in 7 days during 8 flights, from which only 1 of them took place in the afternoon and the rest were in the mornings. The total flight time including the death time was 27 hours and 26 minutes with an average speed of 159 km/h (±4,23) at a mean altitude of 357 (±39).

Figure 3. The 8 flights of the second census carried out in may starting from east to west.



COUNT RESULTS

The following maps and tables show the total population, densities and distributions of the animals.

Table 2. Summary of total numbers

2012 Dry season (03-09 APRIL2012)					
Animal	GNPS	Reserv	Total	Area (km²)	Density (ind/km²)
Elephant	1629	219	1847	3010	0,613677741
Buffalo	5913	62	5975	3010	1,98527907
Giraffe	11	5	16	3010	0,005315615
Hippo	702			3010	
Hartebeest	436	0	436	3010	0,144850498
Warthog	466	63	529	3010	0,175747508
Waterbuck	513	169	682	3010	0,226578073
Kob	2079	161	2240	3010	0,744186047

2012 Rainy season (04-12 MAY 2012)					
Animal	GNPS	Reserv	Total	Area (km²)	Density (ind/km²)
Elephant	1668	40	1708	3010	0,56744186
Buffalo	5587	61	5648	3010	1,876421927
Giraffe	11	11	22	3010	0,00730897
Hippo	2863	2	2865	3010	0,951827242
Hartebeest	552	0	552	3010	0,183388704
Warthog	617	73	684	3010	0,227242525
Waterbuck	660	121	781	3010	0,259468439
Kob	2803	107	2879	3010	0,956478405

Table 3. Summary of numbers and densities of key species during the first census per blocks (03-09/04/12)

DRY SEASON (03-09 APRIL2012)							
BLOCK	AREA (km²)	NUMBER			DENSITY (ind/km²)		
		Elephant	Buffalo	Giraffe	Elephant	Buffalo	Giraffe
1	254	70,22	156	4	0,276456693	0,61417323	0,01574803
2	164	348,48	495,5	0	2,124878049	3,02134146	0
3	147	30,21	482	0	0,205510204	3,27891156	0
4	188	79	922,65	0	0,420212766	4,90771277	0
5	183	396,86	876,32	0	2,16863388	4,78863388	0
6	155	295,54	397,8	0	1,906709677	2,56645161	0
7	227	2	1329,36	0	0,008810573	5,85621145	0
8	97	156,2	23,95	2	1,610309278	0,24690722	0,02061856
9	123	187,78	285,91	5	1,526666667	2,32447154	0,04065041
10	371	0	602,33	0	0	1,623531	0
11	263	56,2	277,37	0	0,213688213	1,05463878	0
12	335	6	64	0	0,017910448	0,19104478	0
GnaB	503	42	61,68	5	0,083499006	0,12262425	0,00994036
Azande		176,68					
Total	3010	1847	5975	16	0,613621262	1,98504983	0,00531561

Table 4. Summary of numbers and densities of key species during the second census per blocks (04-12/05/12)

RAINY SEASON (04-12 MAY 2012)							
BLOCK	AREA (km²)	NUMBER			DENSITY (ind/km²)		
		Elephant	Buffalo	Giraffe	Elephant	Buffalo	Giraffe
1	254	319	92	1	1,25590551	0,36220472	0,00393701
2	164	92,5	212,11	3	0,56402439	1,29335366	0,01829268
3	147	29	741,38	4	0,19727891	5,04340136	0,02721088
4	188	52	643,5	0	0,27659574	3,42287234	0
5	183	45	977,5	0	0,24590164	5,34153005	0
6	155	0	758,5	0	0	4,89354839	0
7	227	6	1136,1	0	0,02643172	5,00484581	0
8	97	359	723,5	0	3,70103093	7,45876289	0
9	123	679,5	69	1	5,52439024	0,56097561	0,00813008
10	371	85	180,63	2	0,22911051	0,48687332	0,00539084
11	263	1	7	0	0,00380228	0,02661597	0
12	335	0	46	0	0	0,13731343	0
GB	503	40	60,81	11	0,07952286	0,12089463	0,02186879
Total	3010	1708	5648	22	0,56744186	1,87641196	0,00730897

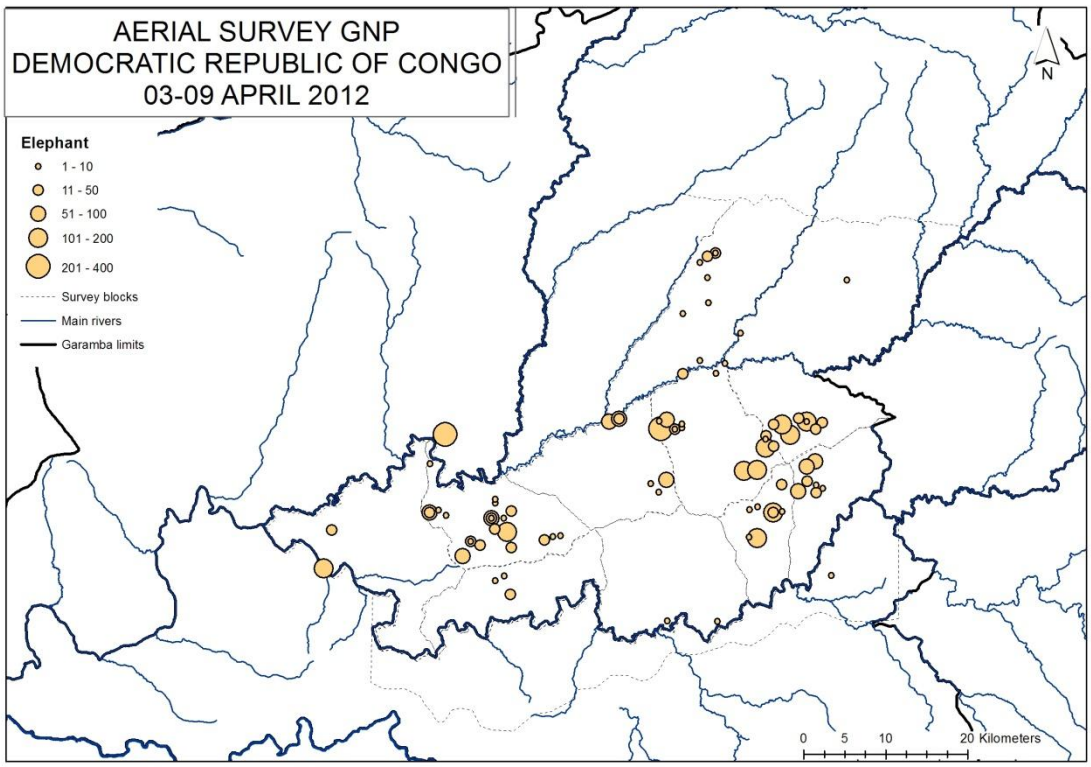
Table 5. Summary of numbers of other species

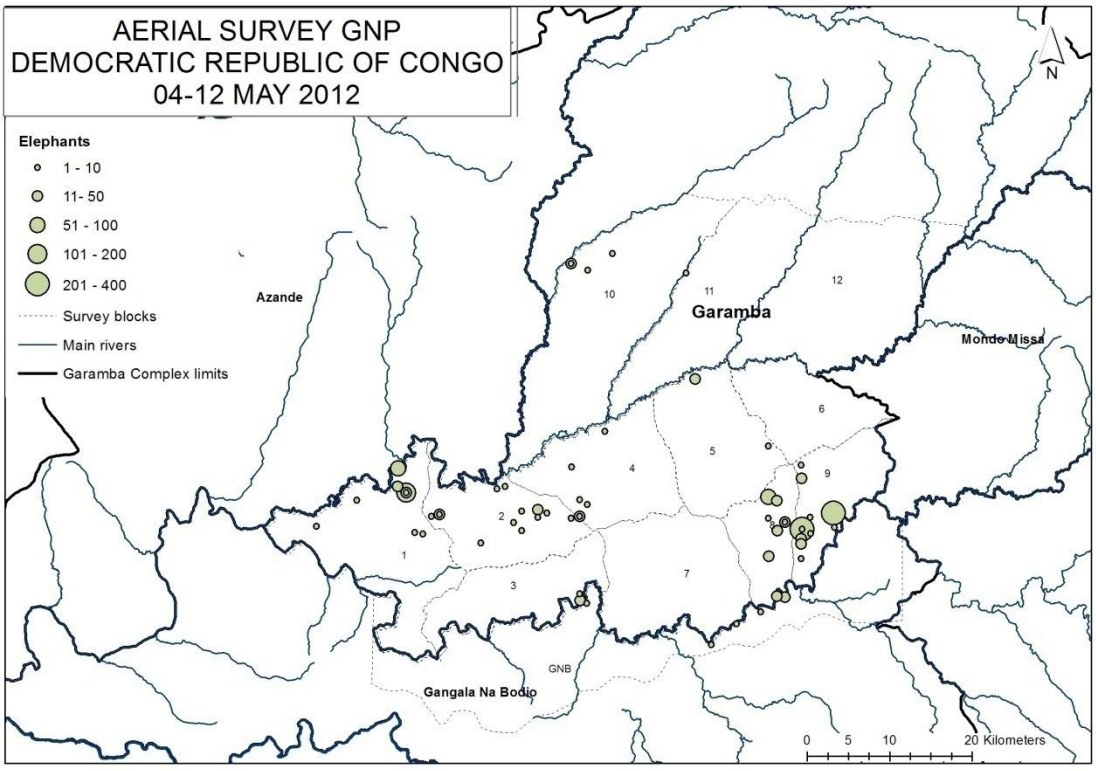
03-09 APRIL	
SPECIES	NUMBER
Roan	5
Lion	10
Crocodile	10
Duiker	18
Bushbuck	39
Baboon	30
Hyenna	12
Oribi	5
Redbuck	20
Colobus M.	8
Vervet M.	1

04-12 MAY	
SPECIES	NUMBER
Roan	11
Lion	25
Crocodile	5
Bongo	2

ELEPHANT

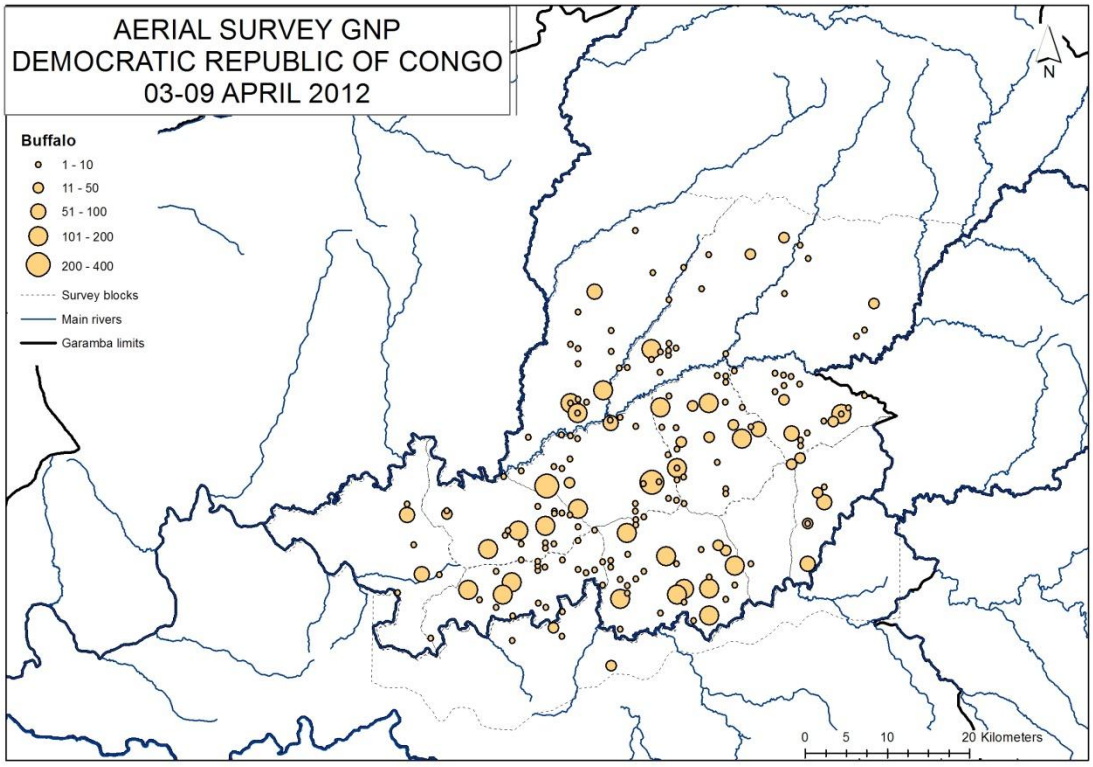
Figure 4. Elephant distribution

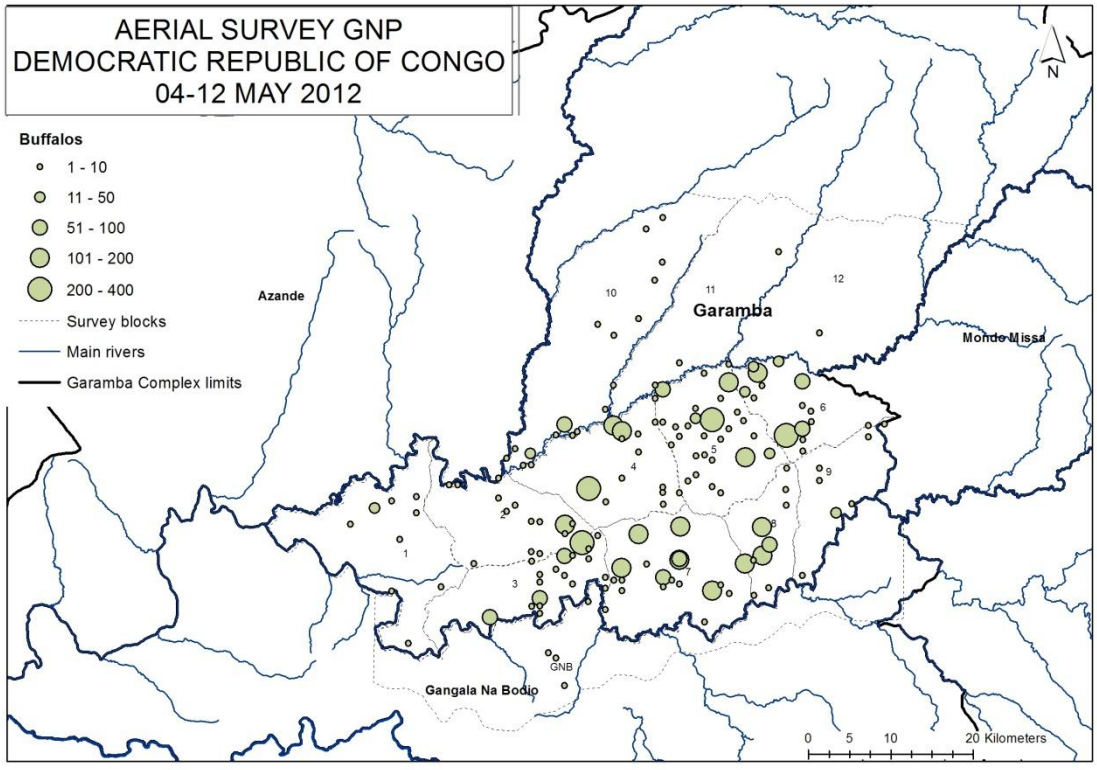




BUFFALOS

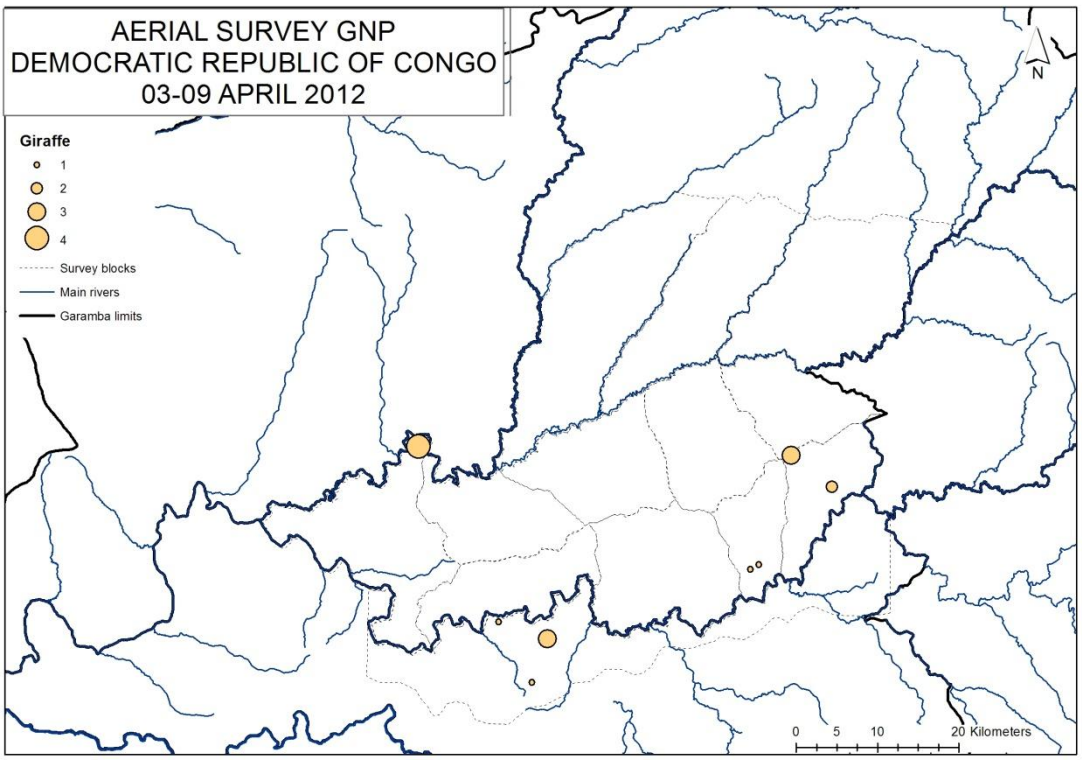
Figure 5. Buffalo distribution

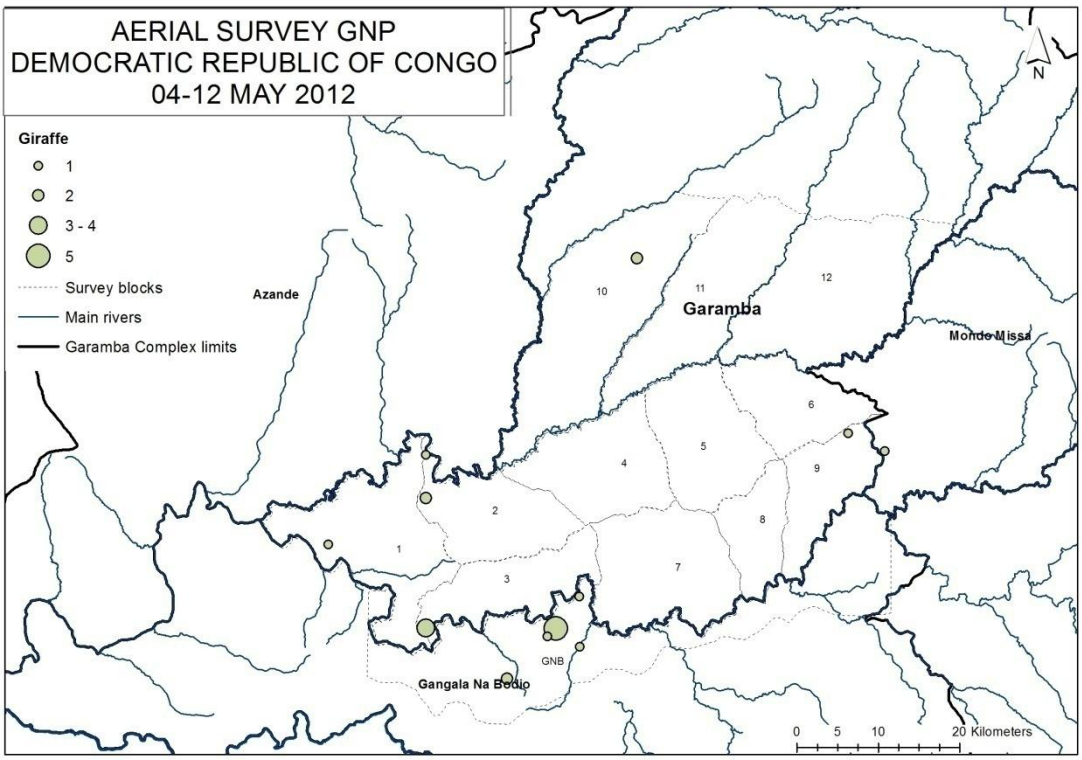




GIRAFFES

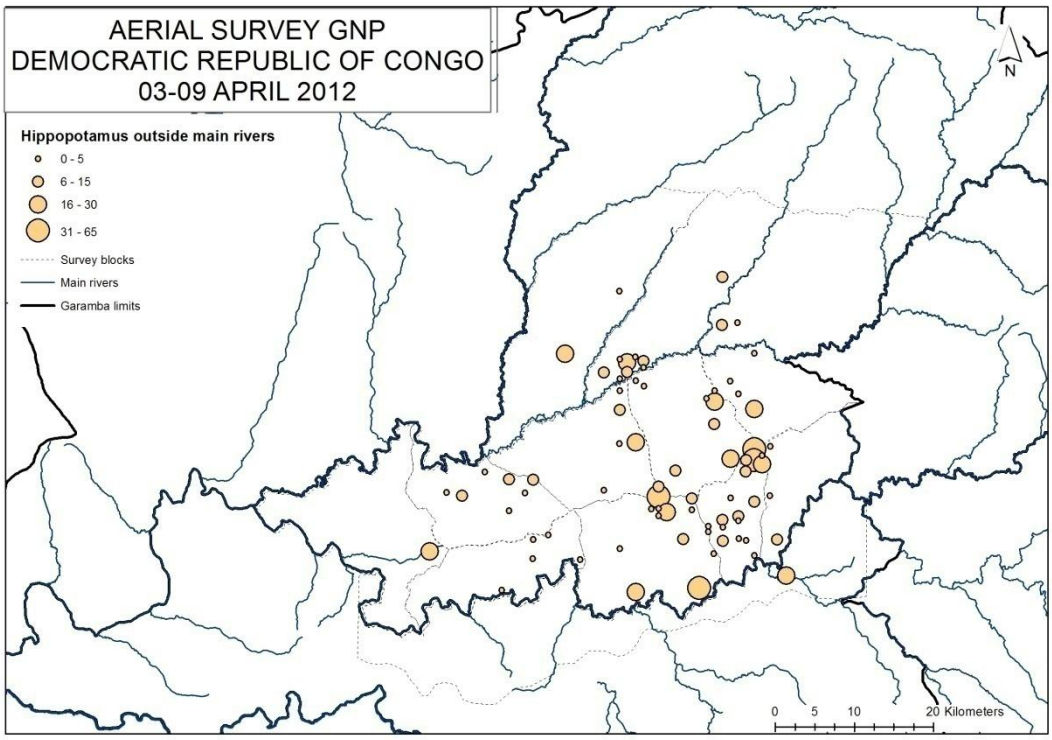
Figure 6. Giraffe distribution

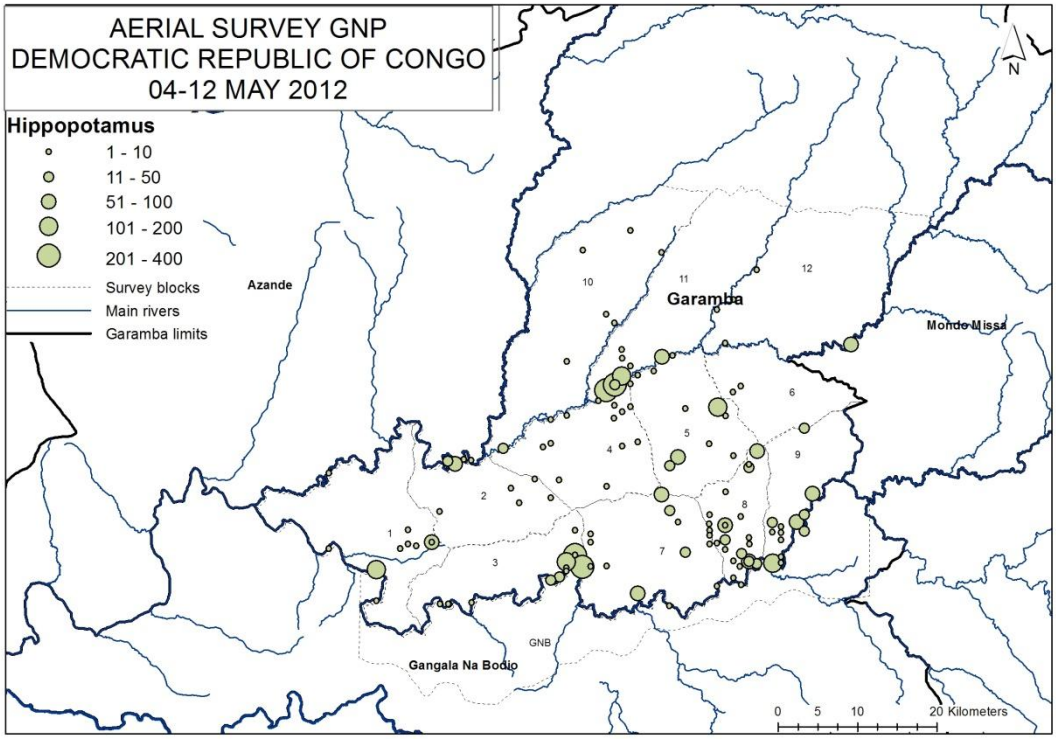




HIPPOPOTAMUS

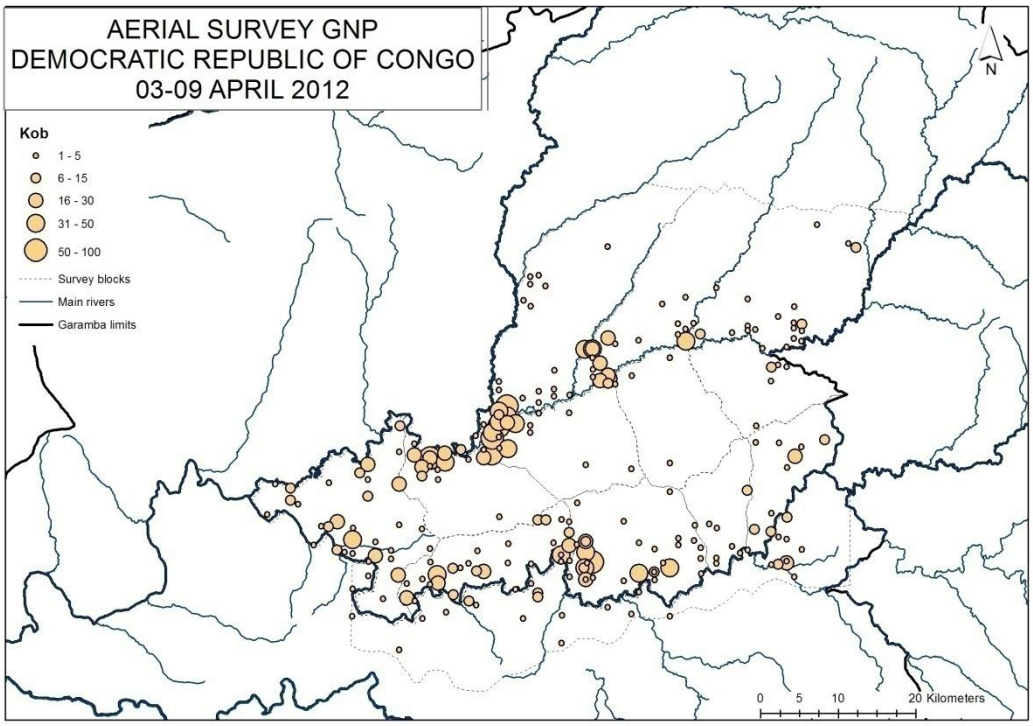
Figure 7. hIppopotamus distribution

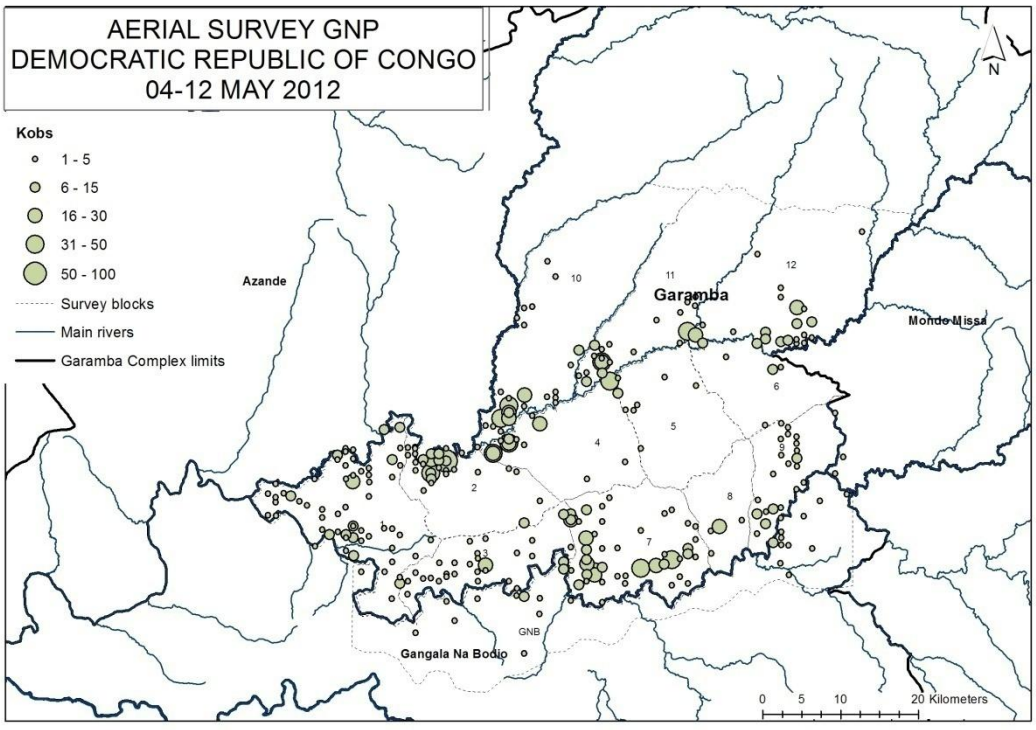




KOBS

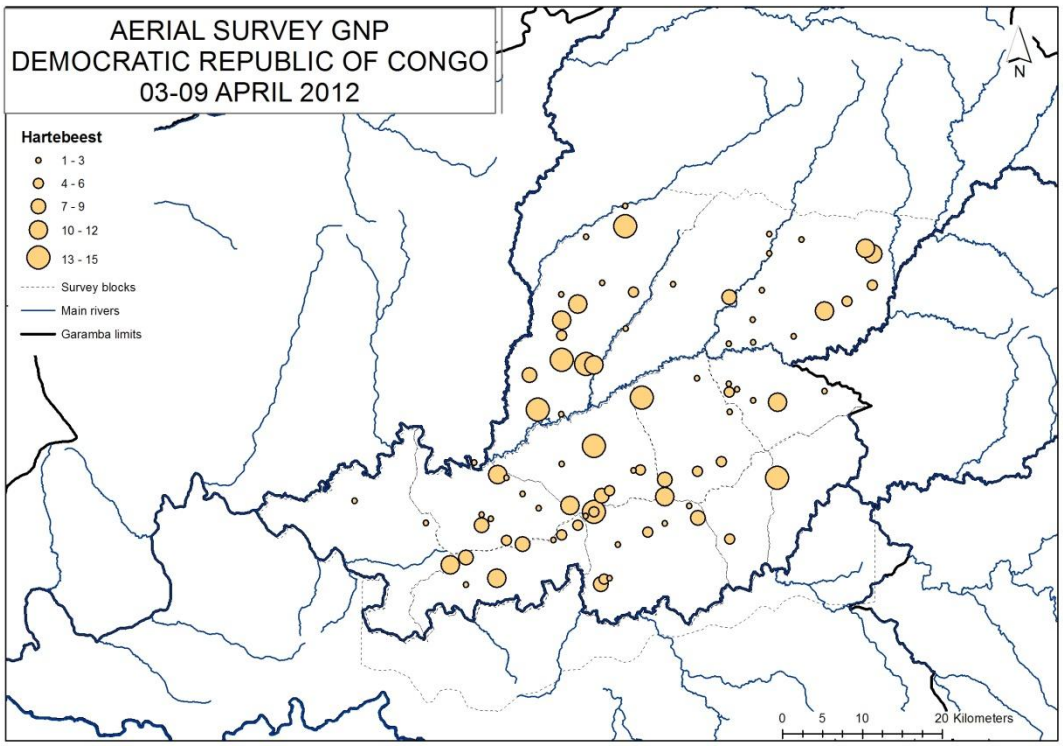
Figure 8. Kob distribution

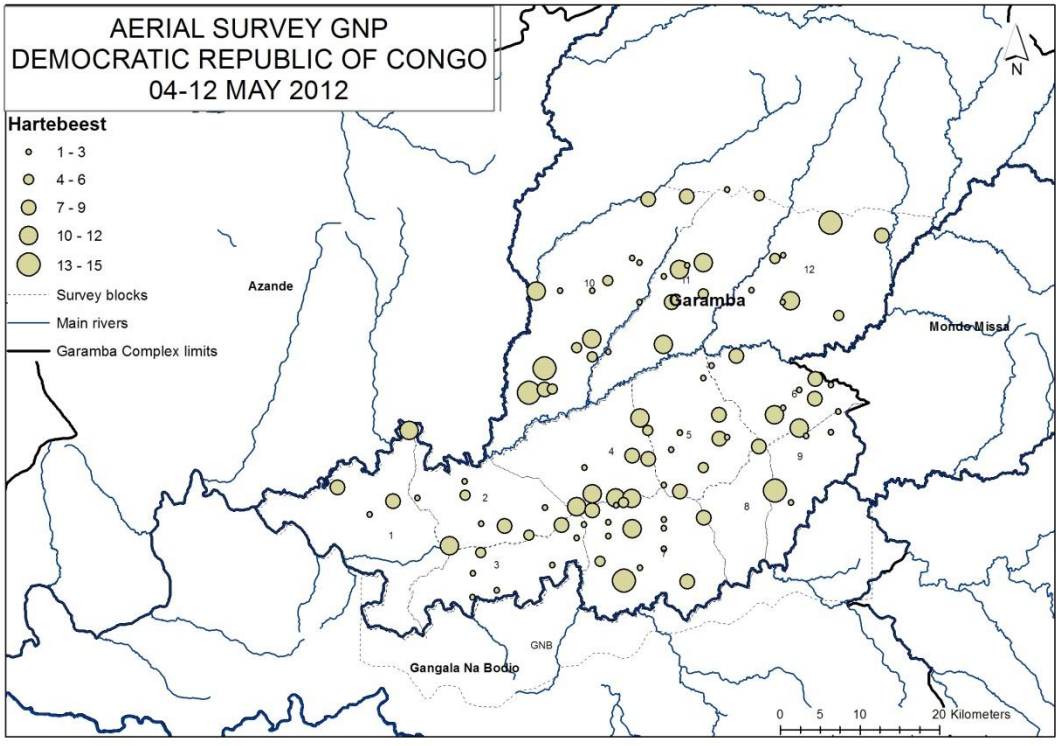




HARTEBEEST

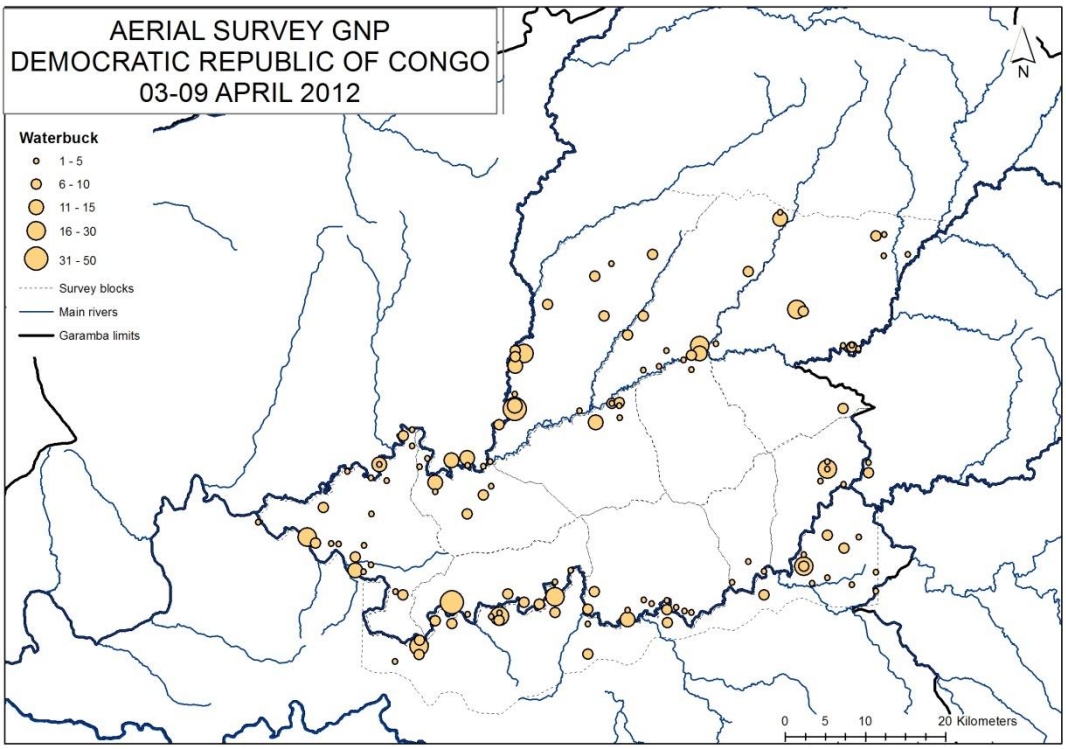
Figure 9. Hartebeest distribution

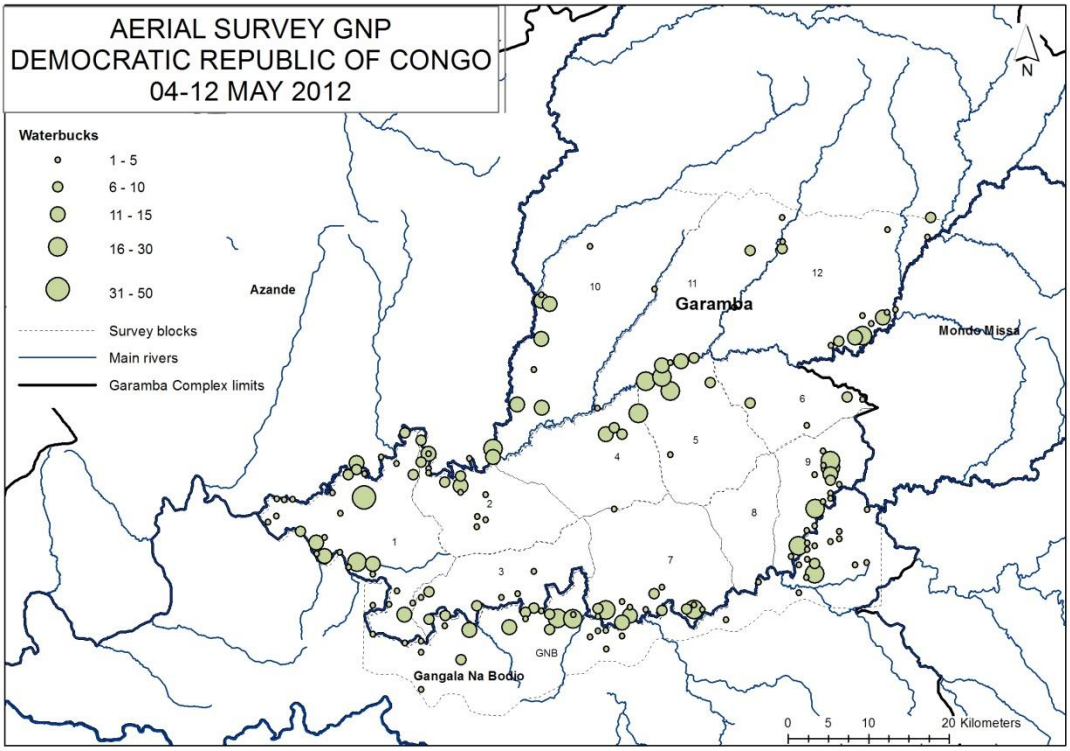




WATERBUCK

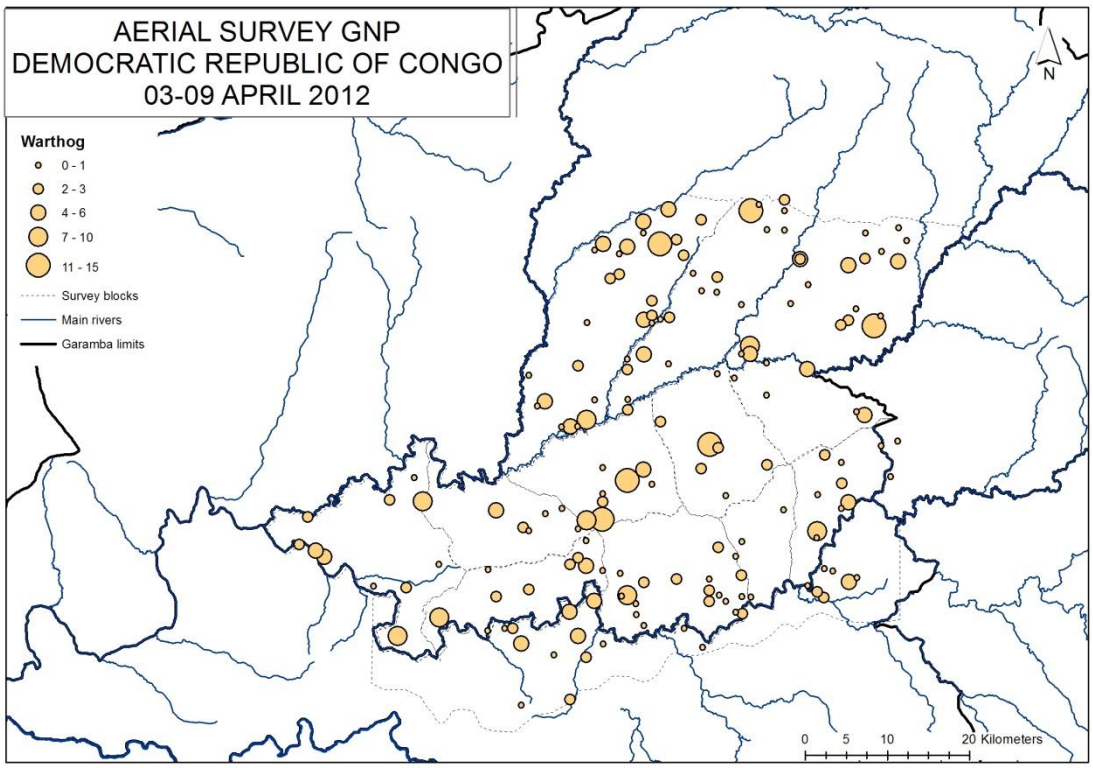
Figure 10. Waterbuck distribution

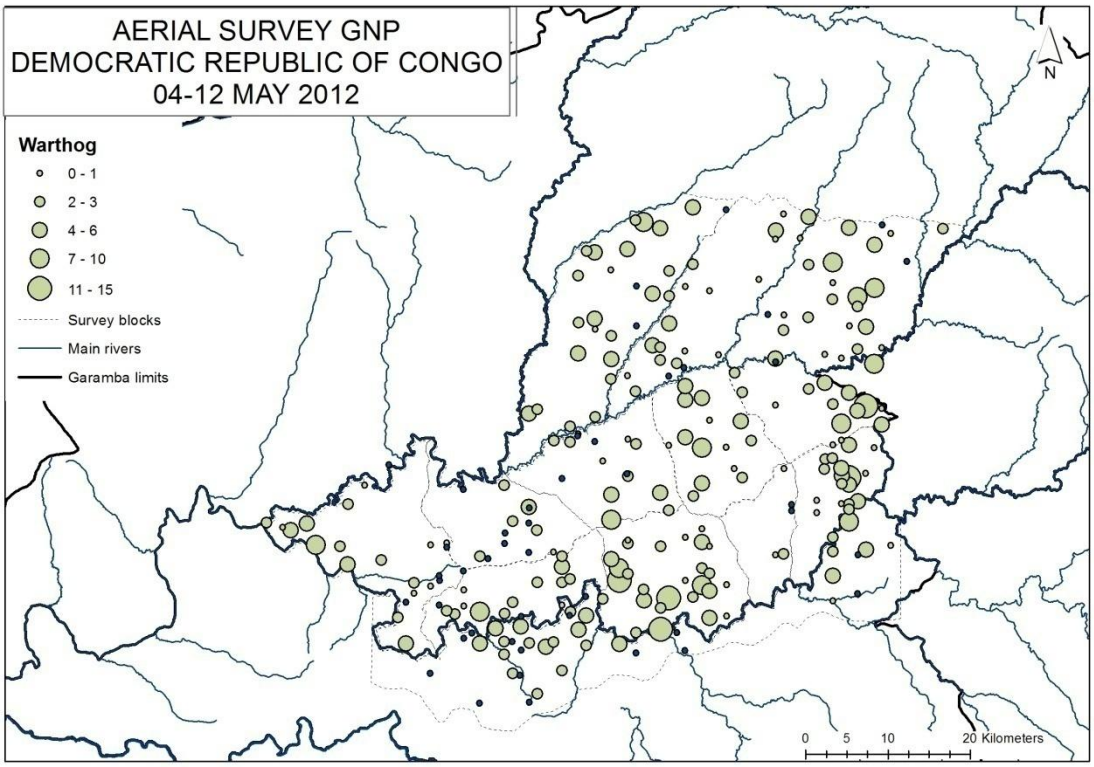




WARTHOG

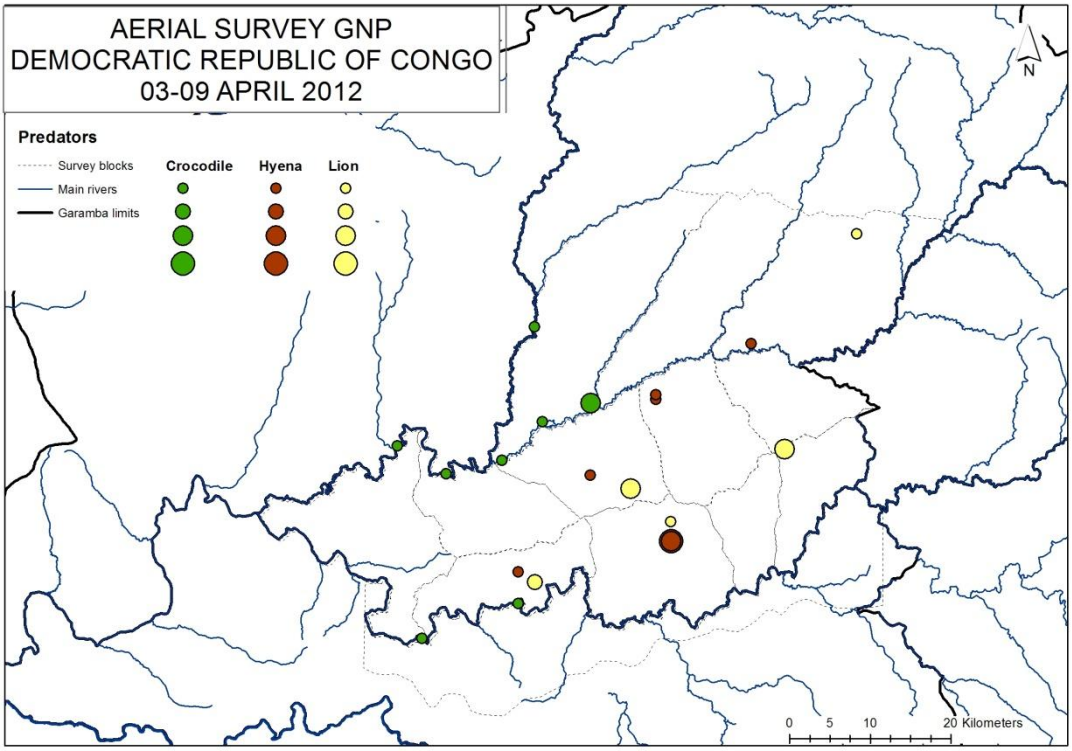
Figure 11. Warthog distribution

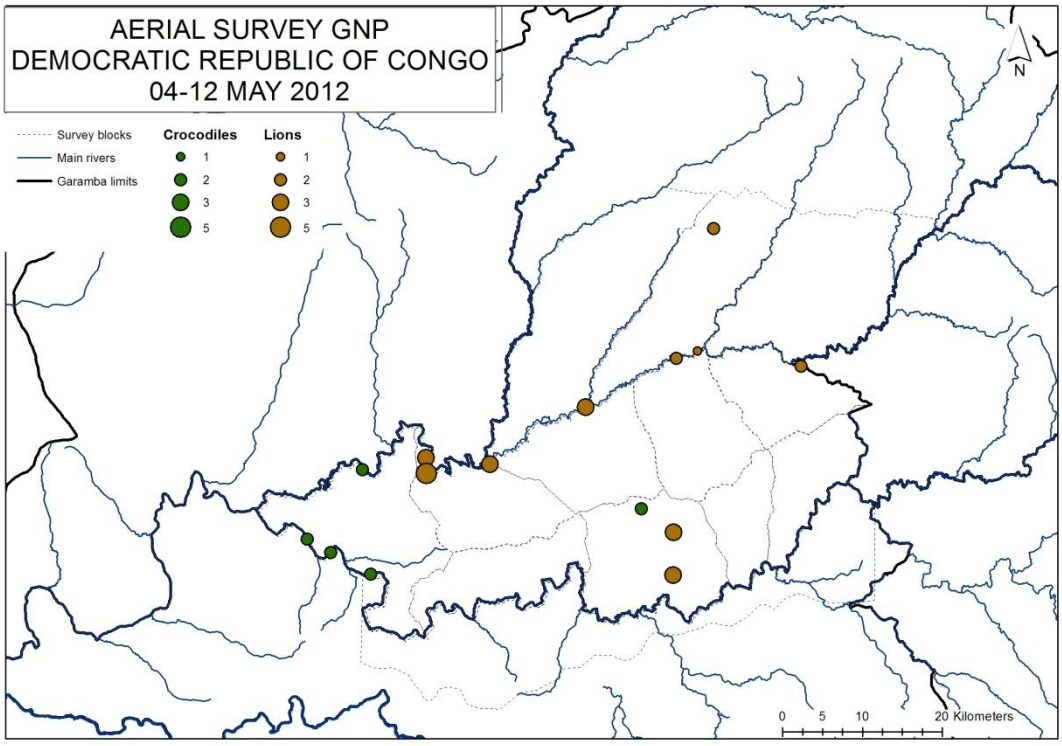




PREDATORS

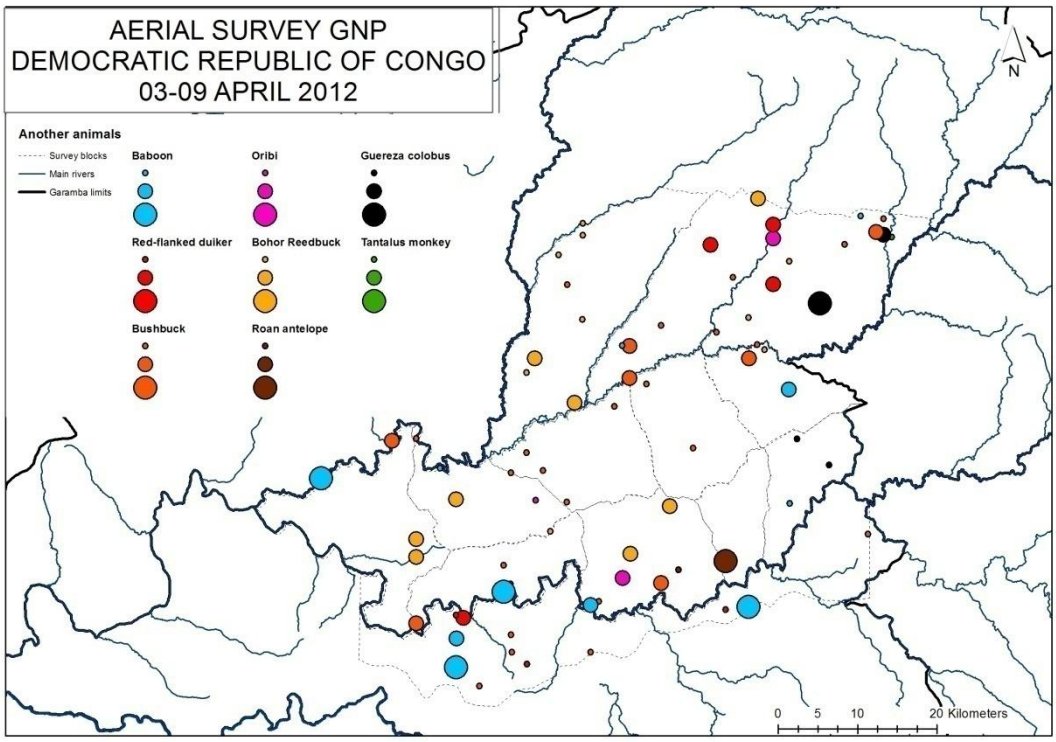
Figure 12. Predator distribution

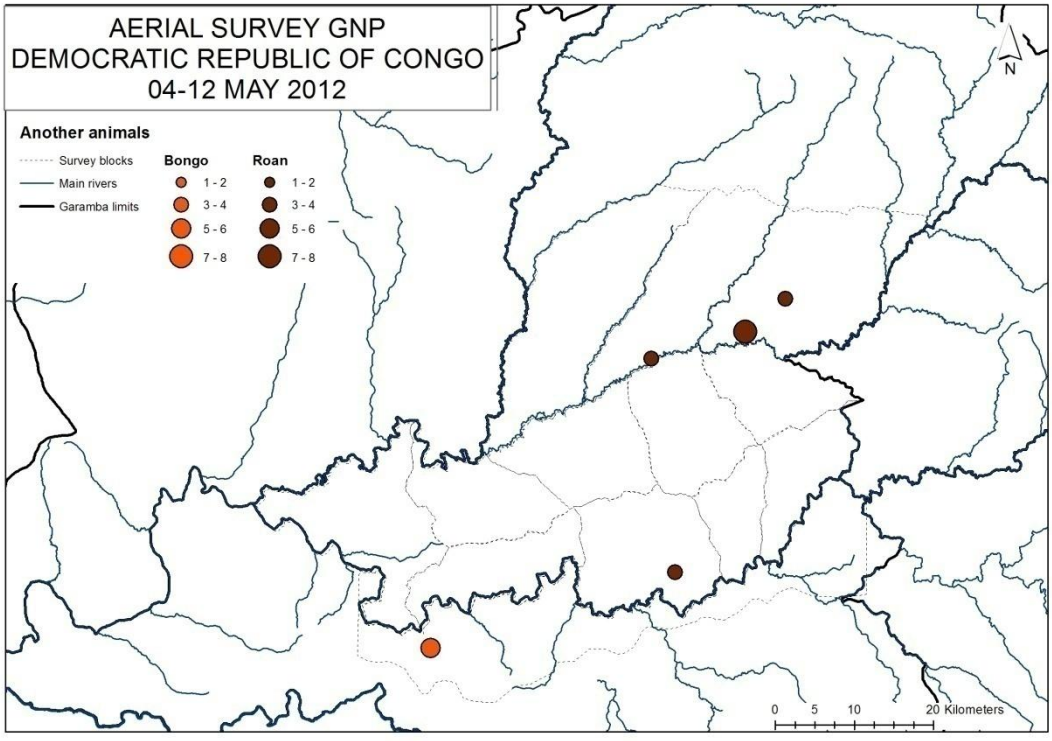




OTHER SPECIES

Figure 13. Other species distribution





POACHER ACTIVITY

A total of 32 carcasses have been observed at the end of dry season and 17 in the beginning of the rainy season. Every carcass found in April was alone excepting the couple of fresh hippopotamus carcass that were found in a poacher camp inside of the park. During the survey in may instead, it was two times that elephant carcasses were found in couples, both of category 4 (table 5).

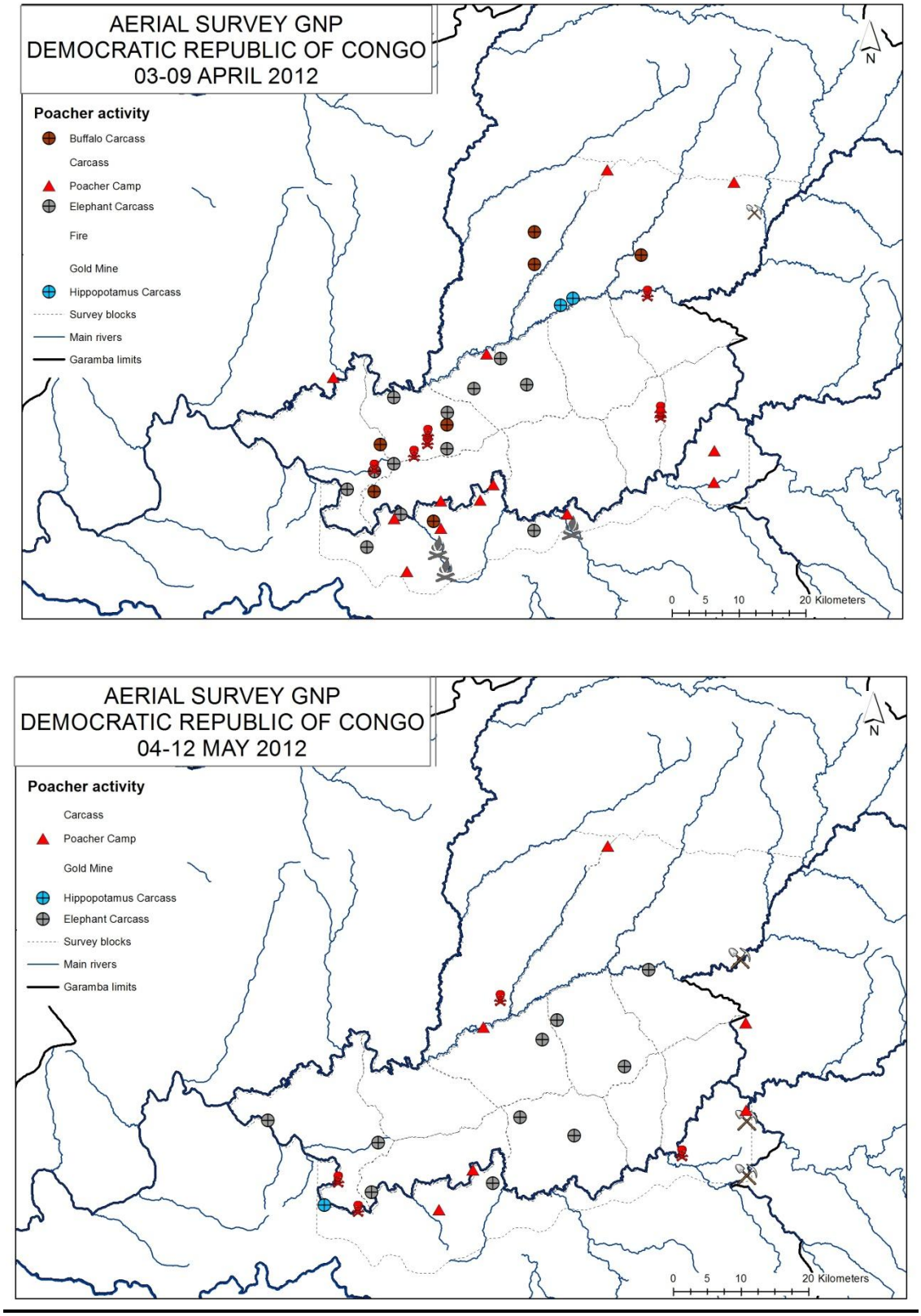
Table 6. Number of carcasses recorded using Douglas-Hamilton´s category system (1996).

CARCASSES APRIL					
	Category				
SPECIES	C1	C2	C3	C4	TOTAL
ELEPHANT	0	3	0	9	12
HIPPOPOTAMUS	2	0	0	2	4
BUFFALO	0	1	1	5	7
UNKNOWN	0	0	0	9	9
TOTAL	2	4	1	25	32
CARCASSES MAY					
	Category				
SPECIES	C1	C2	C3	C4	TOTAL
ELEPHANT	2	3	1	6	12
HIPPOPOTAMUS	1	0	0	0	1
BUFFALO	0	0	0	0	0
UNKNOWN	0	0	0	4	4
TOTAL	3	3	1	10	17

Related to the poacher camps, a total of 15 were found during the first census in april, from which only 1 was new. Besides the camps, smoke was seen in three different places but the thickness of the forest didn´t allowed the observers to see the camp. No recent camps were seen in may and only 7 old camps were recorded.

The maps below show the situation of the poacher activity during both surveys.

Figure 14. Signs of poaching seen



DISCUSSION

Table 7. Last Censuses results in Garamba National Park (Amube, 2007)

YEAR	METHOD	ELEPHANT	BUFFALO	HIPPO	GIRAFE	HARTEBEEST	WARTHOG	WATERBUCK	KOB
1986	SC	4169	29293	3818	237	1957	684	1409	4810
1991	SC	8959	31545	2589	343	915	1427	601	3290
1993	SC	8883	30614	1014	345	3434	2681	1109	6680
1995	SC	11175	25242	3601	178	2819	5606	1680	6600
1998	SC	5874	7772	786	144	1685	4765	1362	6500
2000	SC	6022	13115	967	118	1065	1075	1058	3900
2002	SC	5983	13281	948	62	1139	990	797	3580
2003	SC	6948	14480	3036	62	1224	789	421	6230
2004	SC	9709	10817	2053	172	1059	547	582	5060
2005	TC	1202			48				
2006	TC	3800	8144	2393	70				
2007	TC	3696	5196		79				
2012 (dry)	TC	1847	5975	2841	16	436	529	682	2240
2012 (rainy)	TC	1708	5648	2865	22	552	684	781	2879

SC: Sample count
TC: Total count

The final numbers of the animals counted in this survey are only comparable to the results obtained from 2005 (De Merode et al, 2005; Emslie RH et al, 2006; Reid, 2007; Amube, 2007) as the previous censuses used a sampling count instead of a total count. There are two different reports made in 2007, a first one written in English by Reid and a second one in French by Amube, and both have different results. As there´s no raw data from this survey, the comparison has had to be done distinguishing between the numbers of both authors. The survey done in 2005 is related only to elephants and giraffes as no more animals but rhinos were counted and this last one it´s believe to be already extinct.

The area flown inside the hunting reserves is been different in all censuses since 2005. Moreover, there´s no concrete data about the distribution of the animals on the reserves, what makes impossible to select the hunting reserve´s area that can coincide in every census to contrast the results. For this reason, the comparison it´s been done with the animals counted inside the blocks from 1 to 9 plus the ones located a little bit further north of Garamba river (corresponding to the blocks 10 and 11 given to the surveys of 2006 and 2007).

ELEPHANT

The population of elephant (*Loxodonta Africana*) has fallen since 2007 until these days (table 6, graphic 1) but it remain still higher than the one in 2005 when it was recorded the lowest number with 1202 individuals. This lowest population of 2005 was surprisingly almost triplicate in 2006 and triplicate in 2007 to fall back again in 2012. The causes of this enormous oscillation in number are uncertain. The comparison it´s been made with the numbers of elephants counted from block 1 to 9 as the north part of Garamba wasn´t counted in 2005.

The comparison between the end of dry season and the beginning of rainy season in 2012 doesn´t make a big difference in the number of elephants. Relating to their distribution, it seems that the herds seen in May are bigger than the ones seen in April and with the first rains the elephants tend to concentrate in specific areas like blocks 1, 8 and 9. The density is lower north to the Garamba River and not many animals were counted in Gangala na Bodio reserve maybe due to visibility problems for what it´s believe that some animals are missed in thick areas. The visual number of big herds of elephants comparing to the one counted in photos was overestimated resulting in a high correction factor that reduced the final number.

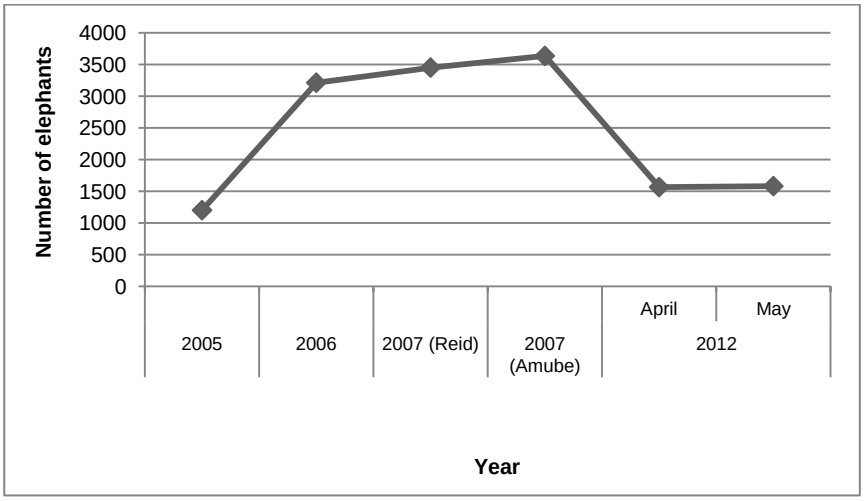
The fact that the last five years have been a difficult time related to security could have influenced on the elephant population. The anti-poaching team has had to deal not only with local poachers but also with armed rebels LRA. It has left unprotected the north of Garamba for few years until 2012, when some roads in the central part of the park have been reopened (from block 10 to 12). In addition to this, professional poachers and organized groups coming from foreign countries have been attracted by the ivory due to the increase of its price in the black market.

Table 8. Comparative numbers of elephants by blocks since 2005

ELEPHANT COMPARISON							
BLOCK	AREA (km²)	2005	2006	2007 (Reid)	2007 (Amube)	2012	
						April	May
1	254		90	117	117	70,22	319
2	164		286	30	30	348,48	92,5
3	147		454	706	958	30,21	29
4	188		167	1154	1160	79	52
5	183		214	239	229	396,86	45
6	155		191	12	12	295,54	0
7	227		1621	930	866	2	6
8	97		85	228	228	156,2	359
9	123		106	36	36	187,78	679,5
TOTAL	1538	1202*	3214	3452	3636	1566	1582

*This survey included 130km² from Gangala na Bodio as it doesn´t specify how many elephants were counted in the park and how many in the reserve, what means that the number used for the comparison is overestimated.

Graphic 1. Trend in elephant population since 2005



BUFFALO

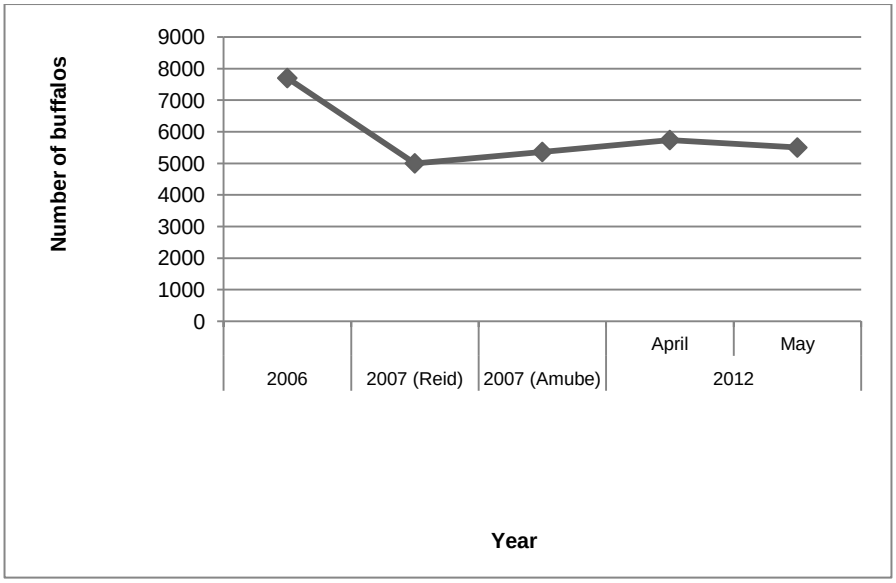
The number of buffalos (*Synceros caffer*) decreased from 2006 to 2007 but it seems that it´s been lightly increased since then (table 7, graphic 2). The distribution has been quite equitable through the area in the end of the dry season, with bigger concentrations during the beginning of the rainy season. In May it´s also seen that the density decreases north to the Garamba River.

Table 9. Comparative numbers of buffalos by blocks since 2006

BUFFALO COMPARISON						
BLOCK	AREA (km²)	2006	2007 (Reid)	2007 (Amube)	2012	
					April	May
1	254	753	461	479	156	92
2	164	253	82	171	495,5	212,11
3	147	838	752	778	482	741,38
4	188	819	727	677	922,65	643,5
5	183	1061	427	332	876,32	977,5
6	155	637	343	343	397,8	758,5
7	227	2039	662	824	1329,36	1136,1
8	97	549	765	770	23,95	723,5
9	123	441	391	391	285,91	69
10	300	307	310	516	707,5	106
11	289	5	81	81	62	42

TOTAL	2127	7702	5001	5362	5738,99	5501,59

Graphic 2. Trend in buffalo population since 2006



GIRAFFE

Despite the effort to minimise undercounting bias, it´s known that animals can be missed as it has happened in the past with the rhinos (*Ceratotherium simum cottoni*) and it clearly has happened this year with the giraffes (*Giraffa camelopardalis*). The ground patrols shows that at least a big group (from 10 to 17 giraffes) it´s been missed in the south east of the park (blocks 9 and 6) during both censuses.

The fact that this animals like the woodland, makes also more difficult the observation from the air. In addition to this and considering that it´s a small population, the aerial census it´s maybe not the most appropriated method to count them as it´s believe that they can move long distances and it is easy to miss them from flight to flight what would makes a big difference in the result.

However , the number of giraffes is been decreasing since1991 until 2004 when the population increased almost three times the number of the year before. The population felt again in 2005, recovered a little bit in 2006 and 2007 and decreases in 2012 to the lowest number known.

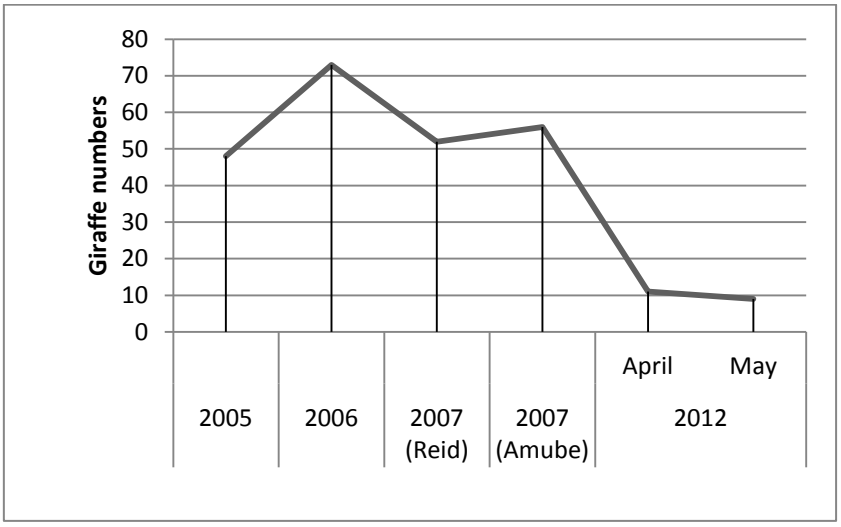
Considering the results obtained in 2012, their distribution is reduced to certain areas (east, Gangala na Bodio and south Azande). For the first time since 1995, giraffes have been observed on the north side of Garamba River.

Table 10. Comparative numbers of giraffes by blocks since 2005

GIRAFFE COMPARISON							
BLOCK	AREA (km²)	2005	2006	2007 (Reid)	2007 (Amube)	2012	
						April	May
1	254		5	15	17	4	1
2	164		0	6	0	0	3
3	147		13	0	6	0	4
4	188		0	0	0	0	0
5	183		0	0	0	0	0
6	155		8	16	14	0	0
7	227		11	3	7	0	0
8	97		14	0	0	2	0
9	123		22	12	12	5	1
TOTAL	1538	48*	73	52	56	11	9

*This survey included 130km² from Gangala na Bodio as it doesn´t specify how many giraffes were counted in the park and how many in the reserve, what means that the number used for the comparison is overestimated.

Graphic 3. Trend in giraffe population since 2005



HIPPOPOTAMUS

During the first census, the team counted only the hippopotamus (*Hippopotamus amphibius*) seen outside the main rivers (Dungu, Garamba and Aka rivers) and a parallel survey was planned to be done with the ULM along those two rivers to obtain a final number. Unfortunately, the ULM arrival was delayed and by the time it was in Garamba, the level of the river was too high to count them. Due to the inconvenience and despite the level of the water, a total count was done during the second census.

According to the number of hippos counted along the rivers last year (schapira et al, 2011) and presuming that it didn´t change too much, it´s been done a first estimation of the hippopotamus population resulting from the hippos counted inside the main rivers in 2011 plus the hippos found on the water pools and medium rivers during the first census done in 2012. The number obtained would be a total of 2841 hippopotamus counted in april.

Table 11. Hippopotamus estimation in april 2012.

HIPPOPOTAMUS			
Zone	**Number**	**Corr. Fact (%)**	**Estimated**
Dungu R. (2011)	1586	91	1743
Garamba R. (2011)	302	91	332
Aka R.(2011)	58	91	64
Outside main rivers (2012)	702		702
TOTAL			**2841**

A second estimation is been calculated by the result from the total number counted in may 2012. As hippopotamus spend a lot of time under the water and it makes impossible to see all individuals at the same time in the surface, the same correction factor that was calculated last year, it´s been applied to the number of hippos counted in photographs.

Table 12. Hippopotamus estimation in may 2012

	Number counted		**Correction Factor (%)**		**Number estimated**		**Number estimated**
	Left	Right	Left	Right	Left	Right	
Big herd photo	802	516	91	91	882	567	1449
Big herd visual	511	751	91	91	562	825	
Individuals	115	147					262
Groups without photo	562	400	64	145	878	276	1154
TOTAL							**2865**

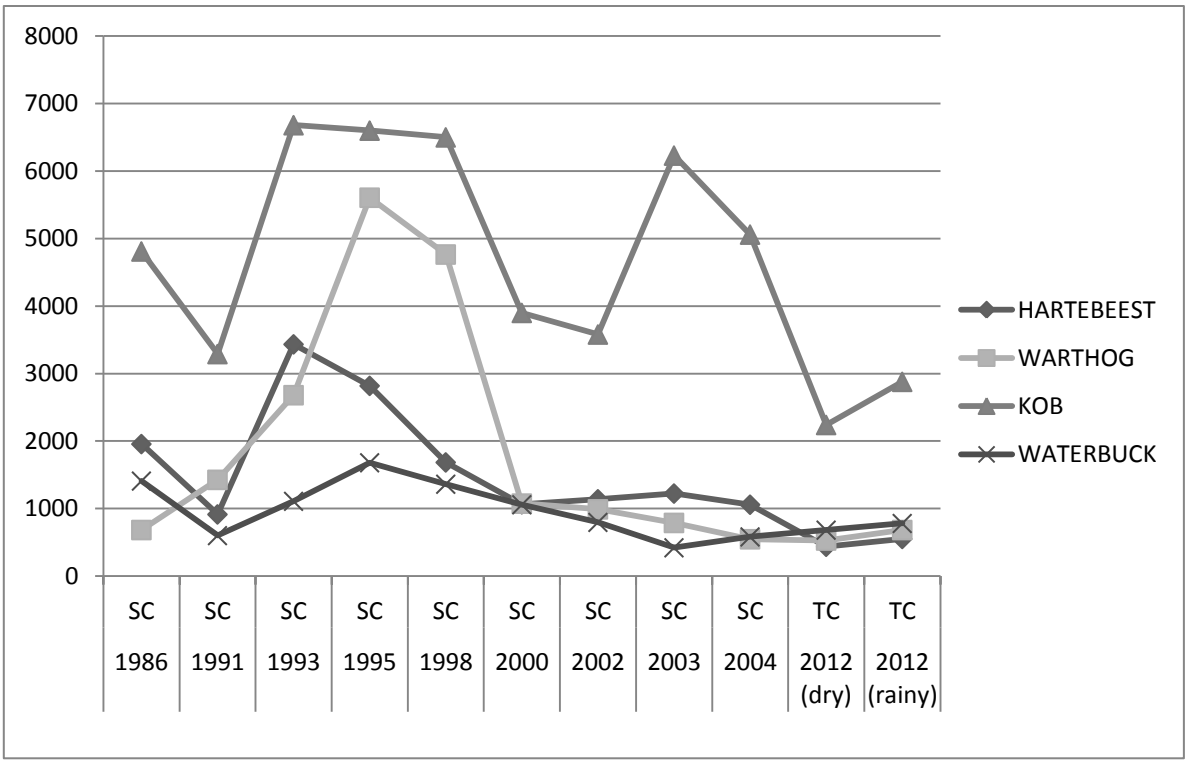
In this case the data is underestimated as the level of the water was too high and not every hippo could have been seen from the air. At the same time, the methodology changed from last year and the possibility of missing hippos is bigger flying through transects than along rivers.

OTHER ESPECIES

The trend of the biggest antelopes and warthogs (*Phaochoerus africanus*) seems to be fallen this year, but it might be due to the different methodology used to collect the data (table 12). No comparison can be made as the previous total counts since 2005 were focused on the key species (elephant, buffalo, hippopotamus and giraffe) and didn´t count any other animal.

Related to their distribution, either in April or in May, antelopes don´t seem to change a lot their territories depending on the season. Hartebeest (*Alcelaphus buselaphus lelweli*) are fairly spread over the whole census area, including the north of Garamba but they have not been observed in the reserves. Waterbucks(*Kobus defassa*) instead rest close to the main rivers and kobs (*Kobus kob thomasi*) have been observed in all areas but the biggest concentrations are close to the main rivers.

Table 13. Trend of antelopes and warthog along the years and counting method.



SC: Sample count

TC: Total count

Other species of interest were recorded, like the Roan Antelope (*Hippotragus equines bakeri*), with the biggest number counted during the survey of may with a total of 11 individuals (9 of them located in the north side of Garamba River). And 3 bongos were seen during the second survey. Another antelopes (reedbuck (*Redunca redunca*), bushbuck (*Tragelaphus scriptus*), oribi (*Ourebi*a *ourebi*), duiker (*Cephalophus*)) and monkeys (baboons (*Papio Anubis*), Colobus (*colobus guereza*) and Vervet (*Cercopithecus aethiops*)) were seen from the plane.

About predators, the biggest number of lions (*panthera leo*)counted in 2012 was 25 individuals during the census in may and 10 crocodiles (*Crocodilus niloticus*) in april. No more carnivores excepting 1 hyena (*Crocuta crocuta*) were observed from the plane.

POACHER ACTIVITY

In this high rainfall and high scavenger density environment, fresh and recent carcasses remain for a considerably shorter time than in East Africa. Carcases monitored have usually remained at category 2, less than 2 months (Hillman Smith et al, 1995). This and the fact that the grass start becoming longer with the first rains, may help to underestimated the final number of carcasses.

RECOMENDATIONS

- To carry out a census at least once per year using the same methodology and during the same season than previous surveys to determine the status of the animals in Garamba. It´s recommended to fly early in the morning as in the mango season (april-may) elephants tend to move to the reserves from the afternoon till the sunrise and it´s too hard to observe them and count them once they are inside the forest.
- To carry out a special survey to confirm the number of giraffes and determine its status.
- To increase the number of aerial patrols with the ULM in order to collaborate with the anti-poaching team by locating carcasses and poacher´s camps.

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ANNEX

Table 1. Species and human activity codes

SPECIES CODES		
CODE	**COMMON NAME**	**SCIENTIFIC NAME**
ELE	Elephant	Loxodonta africana
RHI	Northern White Rhino	Ceratotherium simum cottoni
BUF	Western Buffalo	Syncerus caffer brachyceros
GIR	Northern Savannah Giraffe	Giraffa camelopardalis congoensis
HIP	Hippopotamus	Hippopotamus amphibius
COB	Uganda Kob	Kobus kob thomasi
BUB	Hartebeest	Alcelaphus buselaphus lelwei
WAT	Waterbuck	Kobus defassa
ROA	Roan Antelope	Hippotragus equinus
PHA	Warthog	Phaochoerus africanus
LIO	Lion	Panthera leo
HYE	Spotted Hyaena	Crocuta crocuta
LEO	Leopard	Panthera pardus
BAB	Olive Baboon	Papio anubis
CRO	Crocodile	Crocodilus niloticus
CARCASSES		
GIR-C	Giraffe	
RHI-C	Rhino	
BUF-C	Buffalo	
ELE-C	Elephant:	
1	Fresh elephant carcass (< 1 month): white droppings of vultures visible; vegetation trampled; fluid stain visible on ground around carcass (animal likely to have died within the last 3 months)	
2	Recent elephant carcass, bones with rot patch (<1 year): pieces of hide still attached; skeleton still partly articulated; no vulture droppings; no trampled vegetation; no fluid stain evident (less than 1 year old, but generally since the last rainy season, i.e. 3 to 8 months since death).	
3	Old elephant carcass, White bones without rot patch (>1 year): bones scattered and bleached (probably died during or before the last rainy season, i.e. more than 8 months old, but generally more than 1 year old and up to several years old).	
4	Very old elephant carcass (up to 10 years): Grey bones	
HUMAN ACTIVITY		
CP	Poacher´s Camp	
CF	Fisherman´s Camp	
HAB	Villages, huts...	
AGR	Fields, crops	
LOG	Logging	
GM	Gold Mines	

Table 2. Datasheet

GARAMBA AERIAL SURVEY 2012/APN-ICCN

Date		AM		Flight No/Page	/
Pilot		PM		Transect	
Recorder		Take off		Start	
Left obs.		Landing		End	
Right obs.		Total		TOTAL	

Tr	Alt	s/st	Side	Wpt	spp/obs	vis	photos	ph.c	age	NOTE

EXPLANATION:

Tr	Transect number
Alt	Altitude
s/st	Start and Stop time of each transect (for each transect start a new sheet)
Side	Side of observer
spp/obs	Species, carcass or indices observation
vis	Visual estimates of each group numbers
photos	Photo number
ph.c	Number of individuals counted from the photographs
age	Age of carcass or indices, age class in the herd (M,F,C - 1,3,2)
WPT	Waypoint number