Ethiopian Wildlife Conservation Authority

Aerial Survey Report: Gambella Reconnaissance 2009 & Census 2010

Trans Frontier Conservation Initiative (TFCI) Task Force Aerial Survey Report

WILDLIFE CONSERVATION SOCIETY

Horn of Africa
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If we take care of the earth, the earth will take care of us.

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Introduction

Gambella National Park was initially proposed in 1973 but never received official status at a national or federal level. The Park was proposed primarily to protect its outstanding biodiversity and important wetland habitats, and to protect two large mammal species: the White-eared kob (*Kobus kob leucotis*) and the Nile lechwe (*Kobus megaceros*).

In recent years, the wildlife populations in the region are known to have been negatively affected by a combination of illegal hunting and habitat change. The National Park boundaries were never ratified at a national or federal level, nor were many resources allocated for management; as a result, encroachment and illegal hunting have reduced the range and numbers of many of the large mammals species in the park area.

Accordingly, the Ethiopian Wildlife Conservation Authority (EWCA) proposed to examine the nature of wildlife distributions, habitats and human land use in the region, as a background to conservation planning. Several organisations were involved in planning and running the survey, including EWCA, HOARE/C, SDPASE and WCS.

Geography, Biodiversity & People

The elevation in the region ranges from 300-2,200m. The National Park and surrounding areas are primarily a flat plain with little relief, surrounded by highland areas that provide catchments for the rivers in this landscape.

The major rivers are the Baro, Alwero, Gilo and Akobo, which generally tend east-west. Much of the landscape, particularly in the west along the Sudanese border, is seasonally flooded.

The natural vegetation around the Park varies widely. The predominant vegetation type (64%) is an open woodland, crisscrossed with riverine vegetation along the drainage channels. Most of the woodlands are fire-adapted.

The region is home to a wide variety of mammals, birds, fish and reptiles, some species of which are of international importance; the region represents a large and important proportion of the wildlife of Ethiopia.

The landscape has been off limits for much of the last decades due to the civil war in Sudan. Up to the peace accord in Southern Sudan in 2005, refugees and SPLA fighters have been present in much of the landscape and have poached heavily.

The region is lowly populated (4 persons per square km). The Anuak and Nuer people are the two major local communities living around the national park. The Anuak dwell permanently along four major rivers in the eastern part of the park, and are more dependent on crop production. The Nuer live in the western part of the park, and are agro-pastoralists, moving communities and cattle herds with the rise and fall of the main rivers; in the rainy season, from June to November, the rivers overflow the banks and flood the plains. During this period, the Nuers live in the higher/upland areas mainly the woodlands. In November, when water volume of the rivers decrease, they move down to the banks of Baro river and stay there from December to May. According to these rainfall patterns, the Nuers have two cropping seasons in a year: The first one is during the main rainy season of April-August on the higher/upland and the second in October-February when the flood recedes on the bank of the Baro river.

Monitoring & Assessment

This report presents the results of two aerial surveys of the Gambella National Park and some surrounding areas: a reconnaissance survey in November 2009, and an aerial sample count from March 2010. The aim was to map the distribution of wildlife and human activities in the Gambella

area as an aid to protected area planning and to estimate the absolute abundance of common wildlife species in the census zone.

No estimates or spatial data are available for previous surveys. Known previous surveys were in 1978 (Stephenson & Egziabher 1978) and 2002 (GPNRSBA 2004) but data from these surveys were unavailable at the time of this report, and it is unknown if estimates and spatial data were produced.

Wildlife distribution and populations are little known for this region, but it may represent an important range for elephant, Nile lechwe, Shoebill stork and White-eared kob and other species of international conservation importance.

Hunting blocks in the region are considered important by commercial safari operators and the Region (personal communication GM ERVS, Wildlife Safaris)

Conservation Importance

The regional state of Gambella is one of the least known and least developed regions in the country. It consists of the drainage system of the Baro-Akobo rivers. Biodiversity and ecosystem services of the Baro-Akobo landscape are not well known and understood. The rivers of the Baro-Akobo basin originate from the forests of the neighbouring states of Benishangul-Gumuz, Oromia and Southern state.

The area is of international importance because the Baro-Akobo rivers, which rise in the highland forests, form the Sobat on the Sudanese border and provide half of the water flow of the White Nile at Malakal in the Sudan and 20 % in Egypt.

White-eared kob are present in the region during migration but according to recent observations, also may have resident populations , and known breeding areas (leks) are probably important for the migratory as well as resident populations. While White-eared kob are listed as a 'least concern' species (IUCN 2008), they are under increasing threat from development and habitat fragmentation in southern Sudan, and the Gambella area may represent an important part of their range. It is unknown what percentage of the White-eared kob migration uses Ethiopia.

Nile lechwe are an endangered species (IUCN SSC Antelope Specialist Group 2008), present only in Sudan and Ethiopia. The Sudanese population, across the border in the Boma area, was estimated at 4,291 animals; the Ethiopian population is only found in the Duma swamps in the centre of Gambella area and as such represents Ethiopia's only chance to conserve this species. The equally endangered shoebill stork is also only found in the Duma swamps, and in smaller numbers in some swamps along the Gilo river.

Roan antelope and Nubian giraffe are present in the area, and probably represent the only larger populations of these species in Ethiopia.

Predators cannot be counted from the air, but according to expert observations lion and wild dog are present in Gambella.

Methods

Two methods were used for these surveys, both intended to give relative distribution and density across the survey area, and the 2010 survey aiming to estimate population sizes for various species.

- Note that systematic transect wildlife censuses are not ideal for the assessment of large populations of migratory species such as White-eared kob; other techniques such as aerial point sampling are required.
- The sample intensity (6%) of the SRF is suitable for assessment of broad areas, but Gambella region has wetlands and other areas of relatively high animal abundance; wildlife surveys should be stratified for animal density (allocating survey intensity relative to density) but this was not possible at this stage.

Aerial reconnaissance flight, November 2009

A WCS, EWCA and HOARE/C team flew six days, covering much of the lowland areas of Gambella region including the old national park boundaries, a zone west to the Sudan border, and part of the Akobo hunting block to the southeast (see Appendix 1). This was intended to get an idea of the range of species and expected numbers across the old park, and not to estimate absolute densities or actual populations.

No calibrated density observations were made for this survey – instead, estimates of approximate wildlife numbers and observations of human activities were made ad-hoc and maps made on absolute observation and presence-absence basis:

1. Search lines were flown on the UTM grid at 5km intervals, covering the area within the borders of Ethiopia on a north-south pattern.

2. All crew members were involved in spotting and identifying animals and human activities (settlements, agriculture, and livestock).

3. The FSO was primarily responsible for photography, taking georeferenced photographs of all large groups and many individuals.

4. Observations were recorded by georeferenced photograph and also by GPS waypoints (species and approximate number).

Systematic reconnaissance flight, March 2010

A WCS & EWCA team flew almost the same area, but with observations calibrated to generate an estimate of species abundance.

1. The survey took place from the 6th to 16th of March, 2010.

2. The aircraft (Cessna 182) carried a laser altimeter (handheld TruPulse with vertical function) and programmable Garmin GPS unit (GPS296).

3. The aircraft was calibrated at the beginning of the survey, with both observer strip width and laser altimeter function being checked.

4. Transects were laid out north-south on the UTM grid, at 5km spacing. Geographic subunits (programmed into GPS units) were used at 2.5km intervals. GPS tracks were downloaded following each flight.

5. The front seat observer (FSO) in the co-pilot's seat was responsible for recording radar altimeter readings to the nearest 10 feet at the beginning of each subunit. The FSO recorded geo-reference information on data sheets and announced the beginning of each subunit.

6. The FSO recorded human activities in each subunit: settlements, commercial and smallholder agriculture, metal sheeting & villages.

7. The FSO recorded elephant tracks per subunit, and whether they were fresh or old (previous wet season tracks easy to distinguish from recently trampled grass and scuffed earth from more recent tracks).

8. RSOs recorded all animal observations in the calibrated strip, the announced subunits, and photographed animal groups >20. RSOs used handheld tape recorders in flight, and transferred data to paper forms immediately following each flight.

9. Digital photographs were taken by RSOs with Canon Eos cameras. Photographs were geo-referenced with GPSPhotoLinker 1.6. Animal groups were counted immediately following each flight, and observations corrected on data sheets.

A EWCA wildlife survey training workshop and practical took place for three days before the survey flights.

During practical training flights, opportunistic observations were made of species and habitats in the core wetland area of the former National Park, and are reported here.

Study Area

In 2009 the reconnaissance survey area aimed to cover the boundaries of the former Gambella National Park, and areas to the south and west up to the Sudan border. Also included were areas north of Gambella NP in the Jikao hunting block (western side only) and southeast to the Akobo block (see Figure 1).

In the 2010 survey, two main survey blocks were flown and estimates are reported here separately (Table 2). The first ("Gambella block") was the area of the former Gambella National Park and adjacent areas south and west to the Sudanese border. The second ("Upper Akobo block") was south and east of the Gambella National Park up to the Sudanese border. Transect lines are shown in Figure 2 below.

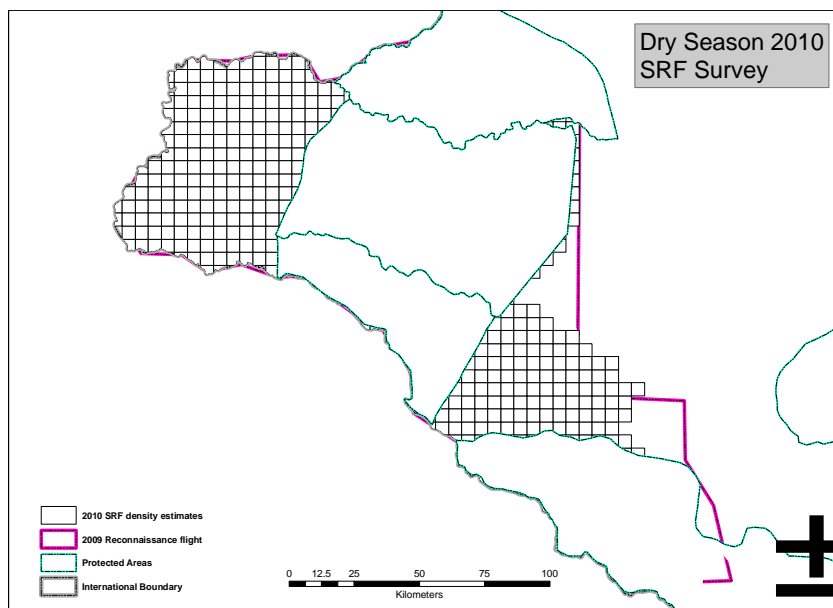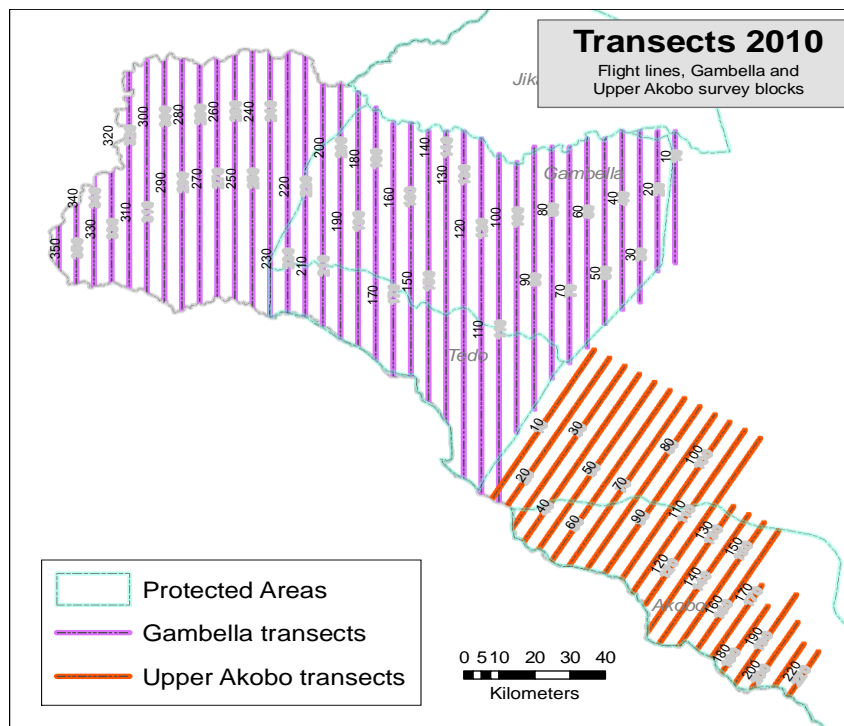**. Figure 1: Gambella survey coverage 2009 wet season and 2010 dry season.**

Figure 2: Transect lines, SRF survey Gambella 2010.

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Lab work

Reconnaissance Survey

Digital photographs were georeferenced using GPS data and a spatial database created of wildlife and human activity observations.

Total numbers of animals seen were tabulated, indicating number of sightings and total number of individuals (Table 1).

Distribution maps were created using ArcGIS 9.3 (ESRI 2008):

- Numbers of each animal species were aggregated on a 5x5 km grid.
- Human activities were not mapped for the 2009 data as the data were not collected at a fine enough scale for reliable mapping.

SRF

Census data were analysed using a private Excel-based application for SRF survey analysis (Frederick 2008). Population estimates were calculated using Jolly's Method 2 for Unequal Sized Units (Jolly 1969). Distribution maps were created using ArcGIS 9.3 (ESRI 2008).

Rear seat observer observations were corrected by reference to photographs taken of groups larger than 20 animals. Photographs were viewed in Adobe Photoshop, contrast corrected ('autolevels' to improve contrast and apparent image quality) and dots placed on each counted animal within each counting group.

Distribution maps were created using ArcGIS 9.3:

- Density of each animal species was averaged on a 5x5 km grid.
- Human activities were recorded on a 5x5 grid of presence and absence:
    - Cultivation, including large agricultural and smallholder;
    - Settlements, comprising houses or villages, and the presence of metal sheeting (an important indicator of community development).
    - Livestock (goats, sheep & cattle).

Results

Reconnaissance survey

Numbers of sightings per species are indicated in Table 2 below.

- Total individuals are roughly estimated from raw sighting data and do not present an estimate of population in the survey area; in particular, groups of White-eared kob were estimated to within the nearest hundred or thousand for large groups.
- Note that smaller species and those that hide in dense vegetation are usually strongly under-counted – oribi, bushbuck, Patas monkey.

Table 1: Wildlife sightings and number of individuals, entire survey area.

Species	No. Sightings	Total Individuals
Elephant	1	6
Ostrich	1	4
Bushbuck	2	2
Crocodile	2	2
Patas monkey	3	8
Waterbuck	3	10
Baboon	5	75
Nile lechwe	5	34
Hartebeest	6	15
Oribi	6	9
Roan	7	23
Shoebill stork	7	7
Giraffe	8	89
Tiang	9	34
Common duiker	17	21
Buffalo	22	1020
Reedbuck	36	57
Warthog	52	140
White-eared kob	163	29685

Systematic survey

Estimates per species are indicated in Table 2 below. Note on accuracy:

- o Small and secretive species (bushbuck, duiker, oribi) are difficult to spot from the aircraft and represent a significant undercount;
- o Observations of <20 individuals of each species are not valid for estimation, and only maps and raw number of observations are shown.

Table 2: Wildlife estimates, Gambella & Upper Akobo survey areas.

Code	Gambella				Upper Akobo			
	Obs	Est	95% CL	Out	Obs	Est	95% CL	Out
Wildlife								
Baboon	32	**484**	643		45	**670**	1,009	
Buffalo	91	**1,378**	2,641	196				
Bushbuck	23	**348**	290		16			
Duiker	27	**409**	230		16			
Elephant	-	**-**	-	4				
Giraffe	1							
Hartebeest	29	**439**	626		9			1
Reedbuck	68	**1,029**	751	5	8			
Roan	85	**1,287**	2,020	100				
Tiang	4							
Warthog	240	**3,633**	3,032	12	33	**491**	279	
Waterbuck	59	**893**	1,382					
White-eared kob	13,422	**203,181**	69,543	4,223	3,491	**51,962**	24,760	238
Oribi					1			
Human activities								
Cattle	1,214	**18,377**	17,178	3,300				
Huts	364	**5,510**	2,276					
Metal sheeting	21	**318**	397	1				
Shoats	84	**1,272**	1,257	78				

Obs – number observed; est – estimate; 95%CL – confidence limit at 0.05; out – number observed outside the strip.

Distribution Maps

Distribution maps have been created to show the relative distribution of wildlife sightings across the survey area (figures following). Observations are summarised on a 5x5 km grid cell.

Two distribution maps are shown for each species, showing very different data:

1. November 2009 reconnaissance flights – relative <u>numbers</u> of animals seen along flight lines.
2. March 2010 SRF – estimated <u>densities</u> of each species, averaged from 1-3 observations per 5x5 km grid cell.

The legend (numbers seen / density) are <u>not</u> comparable, as the reconnaissance flight did not make calibrated observations. However, the relative distributions are important, showing the wet and dry season distributions in temporally close surveys (4 months apart).

Three main sets of maps are presented:

1. Aggregate species density for 2010 (Figure 4 & Figure 3). Figure 3 shows the total of all species; White-eared kob, however, dominate the estimates and as a super-abundant migratory species can obscure patterns of resident wildlife - Figure 4 shows all wildlife <u>without</u> kob to focus on other species.
2. Per-species maps, showing overall abundance (numbers for 2009 data, and density for 2010 data). Some maps indicate hollow outline squares where animals were seen outside the transect (it is still worthwhile to show distribution, though these observations are not included in estimates or density).
3. Human activities & settlements.

Protected area boundaries shown on these maps are from the World Database of Protected Areas (WDPA 2005). The boundaries are not correct for Ethiopia in 2010, as many of the areas never received formal protection at a national level.
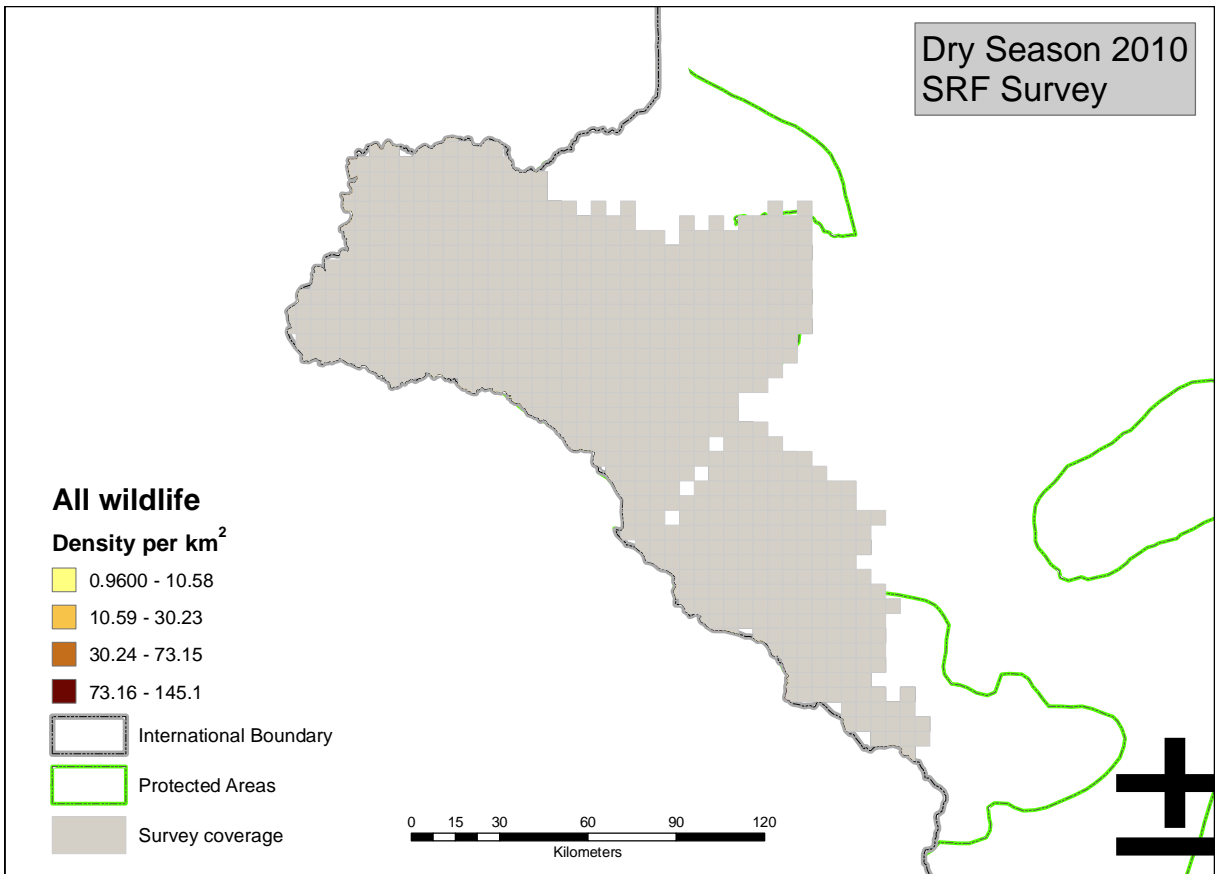
Figure 3: Density and distribution of all wildlife species, Gambella survey area 2010.
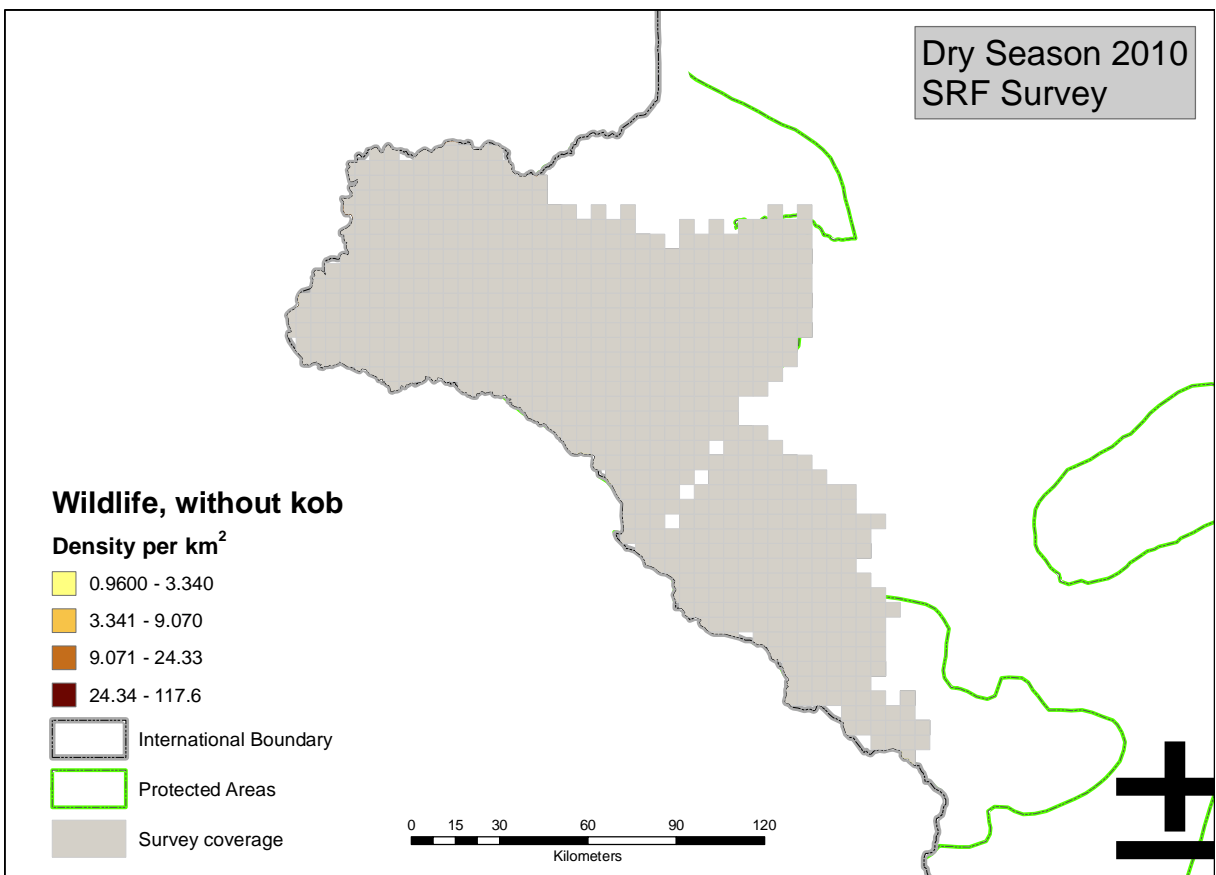
Figure 4: Density and distribution of wildlife excluding White-eared kob, Gambella 2010.

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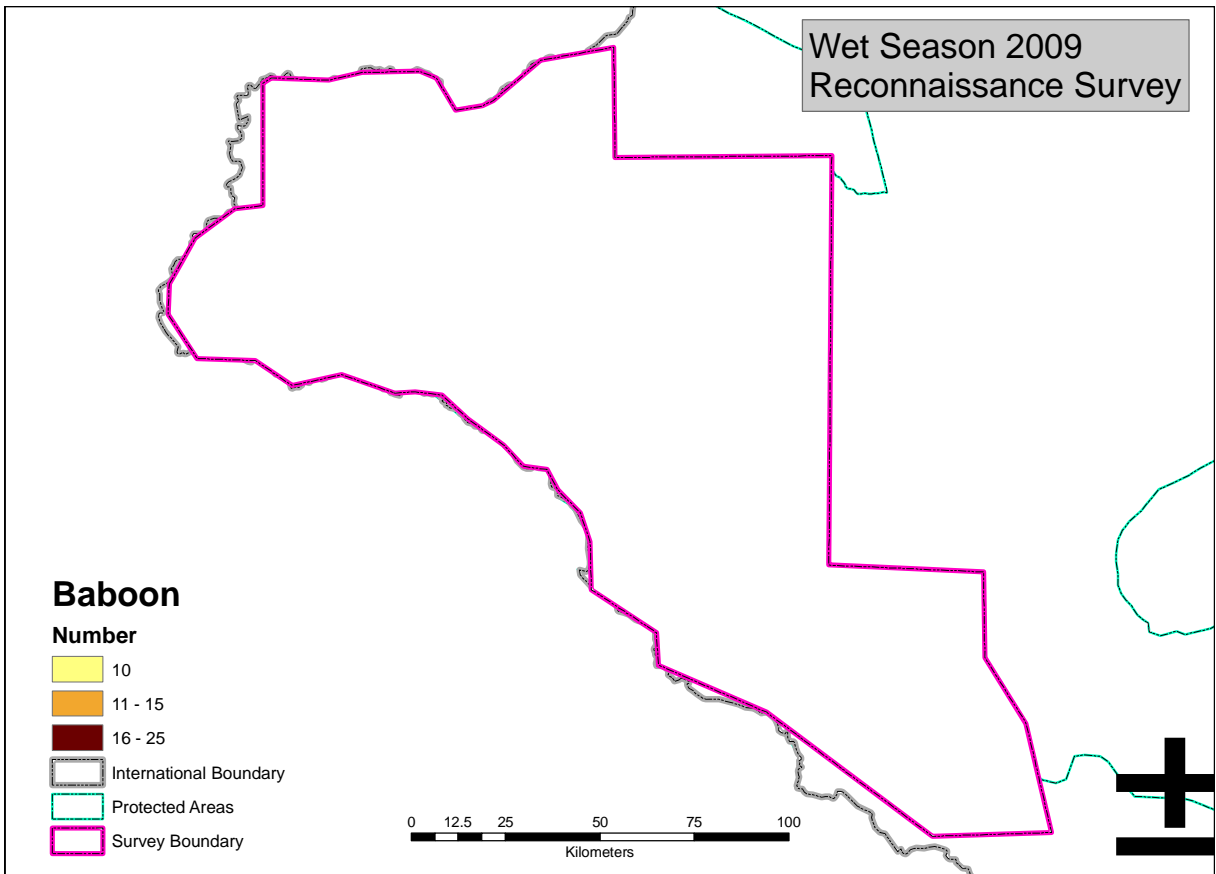
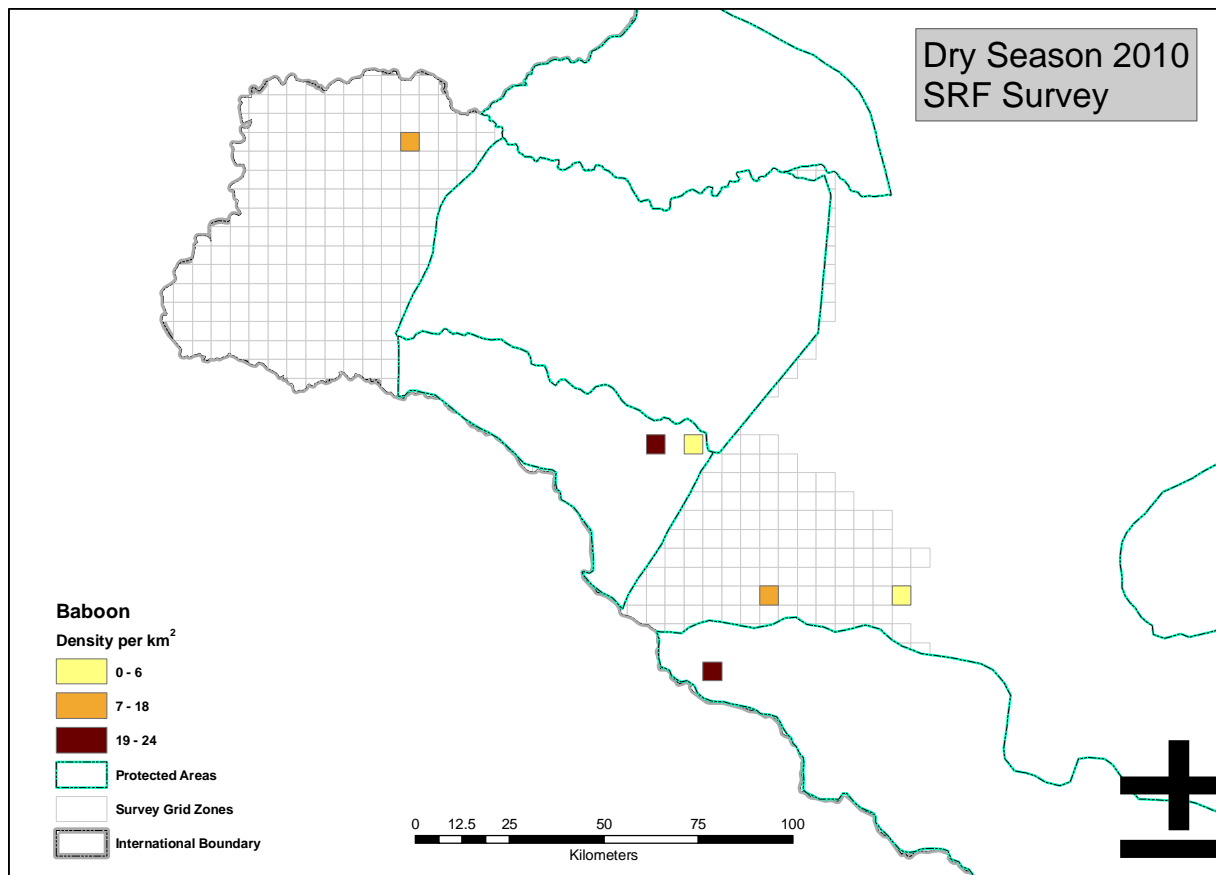**Figure 5: Baboon distribution, Gambella survey area 2009.**

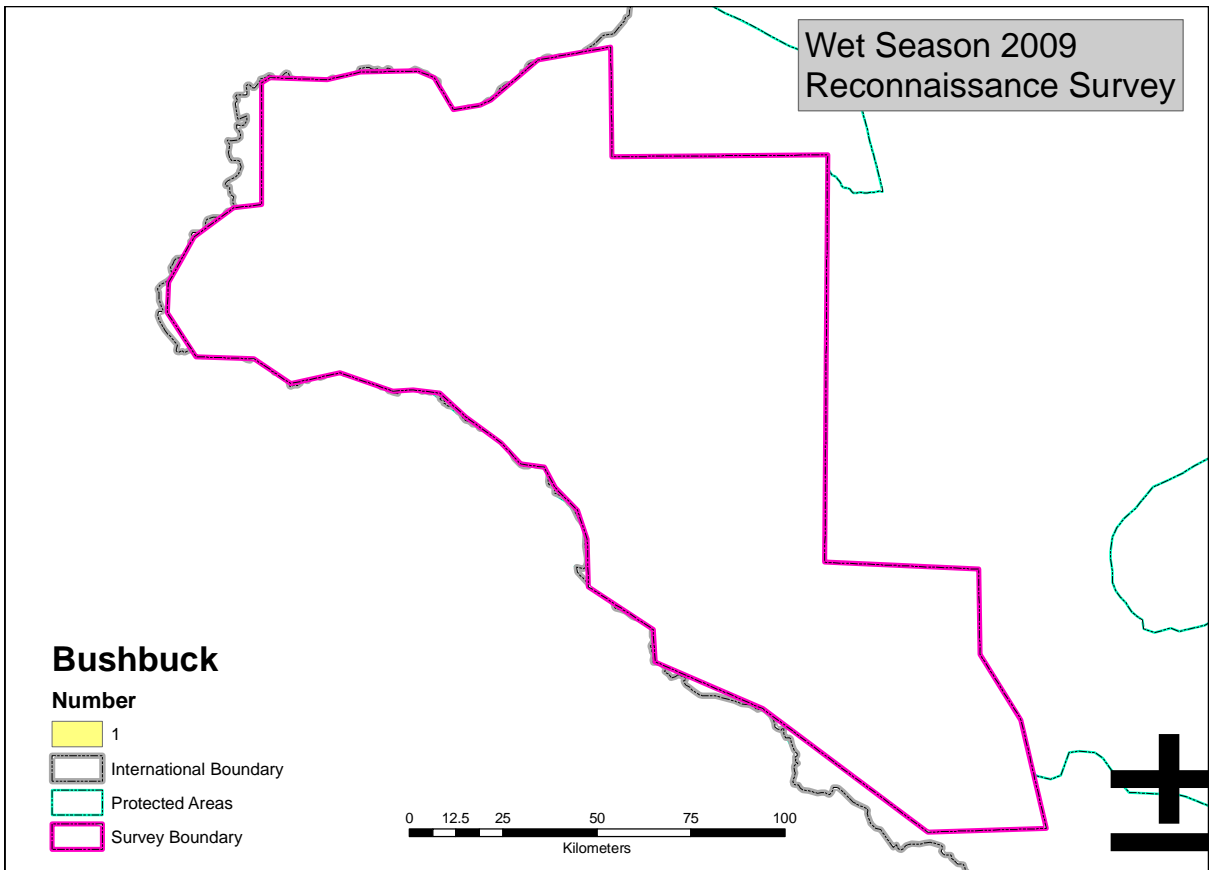**Figure 6: Baboon density and distribution, March 2010.**

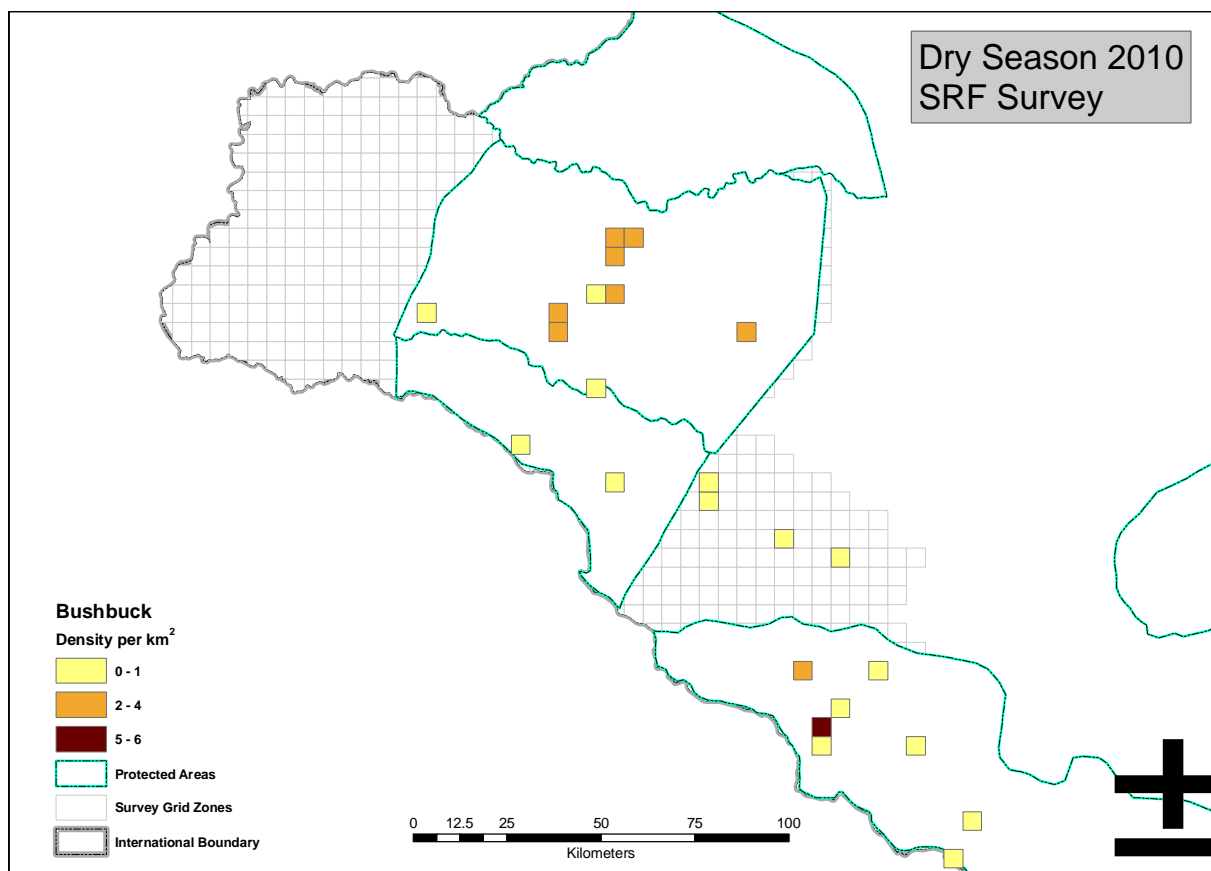**Figure 7: Bushbuck distribution, Gambella survey area 2009.**

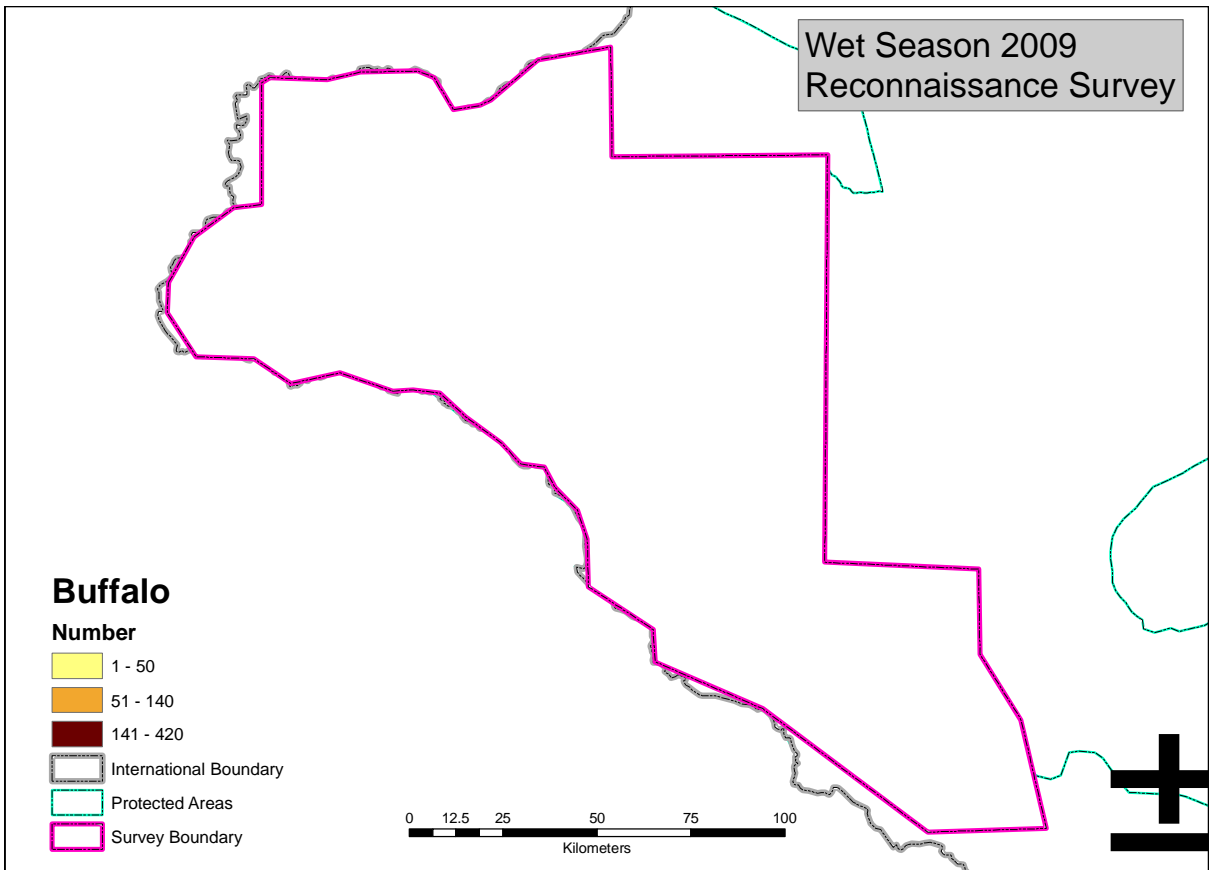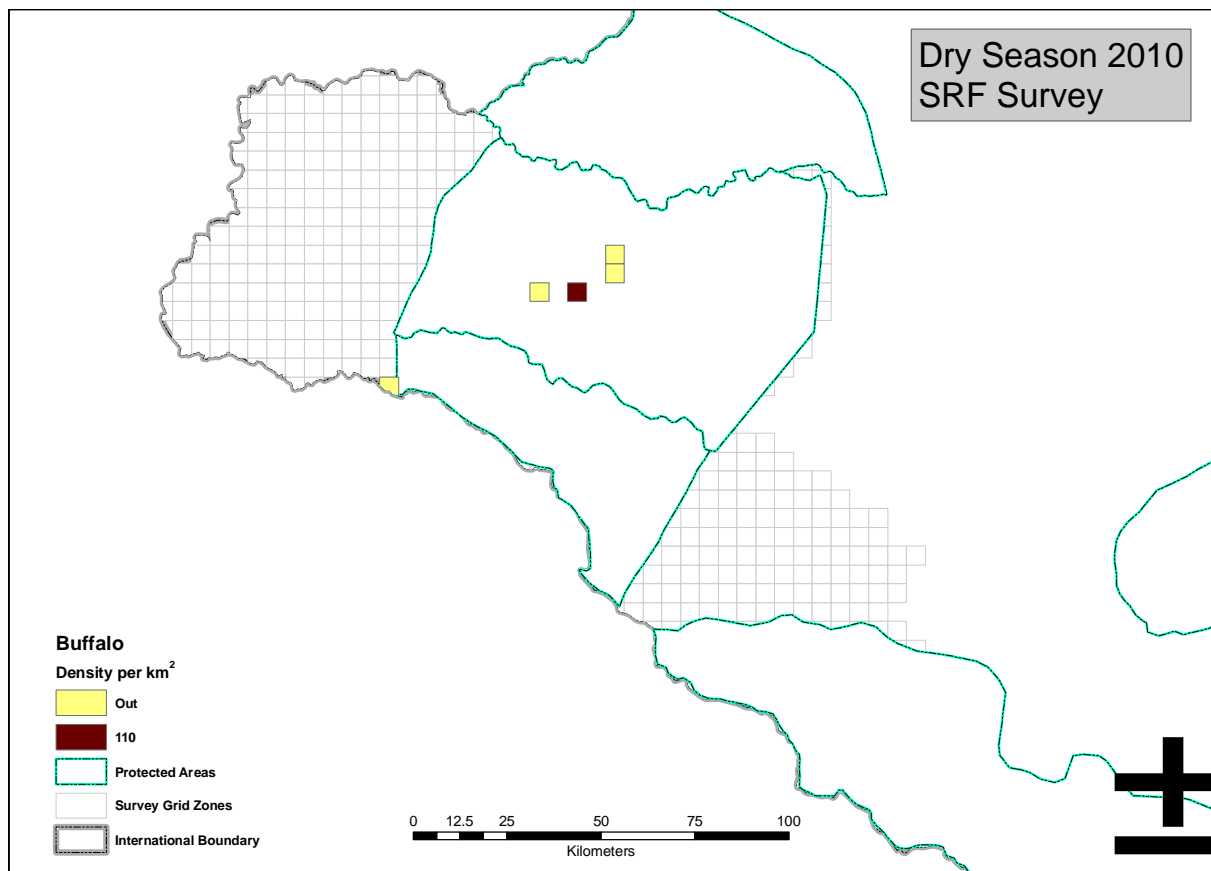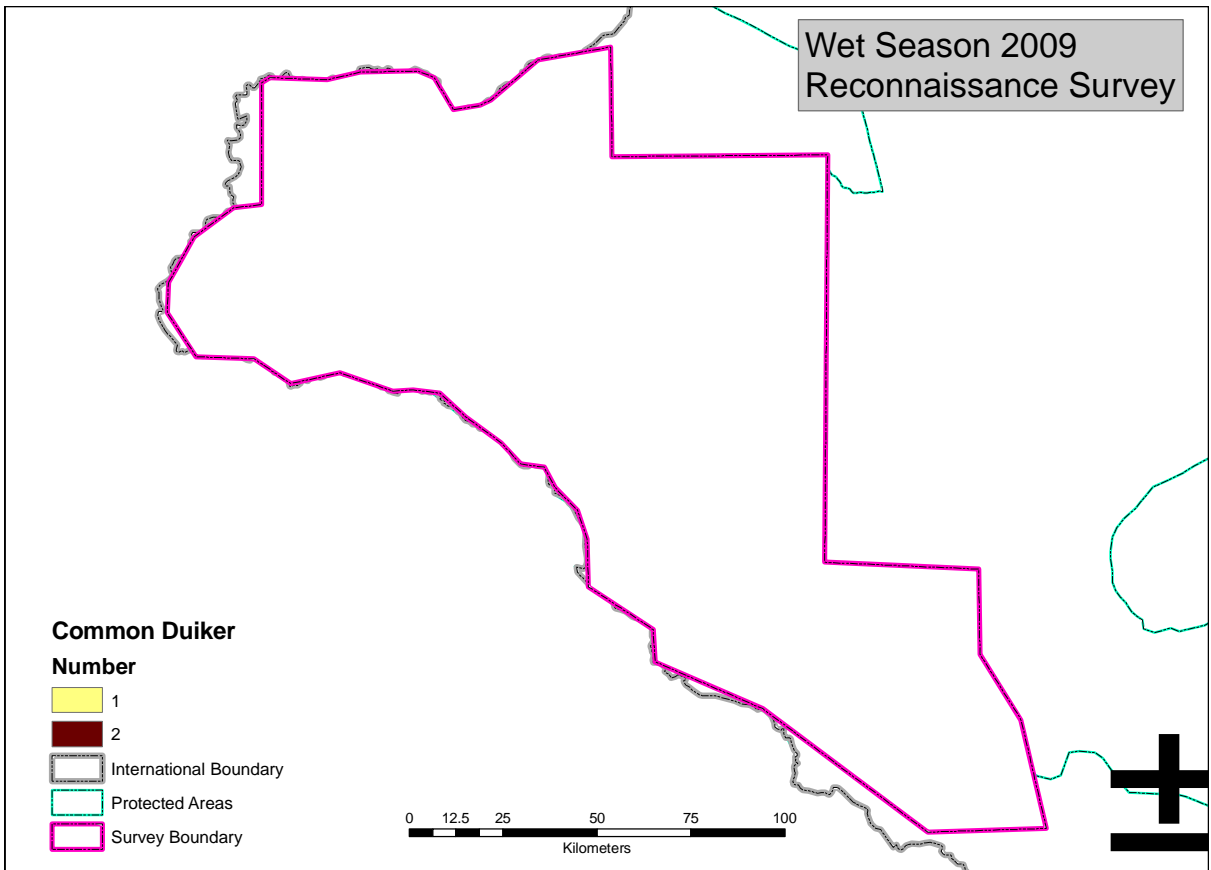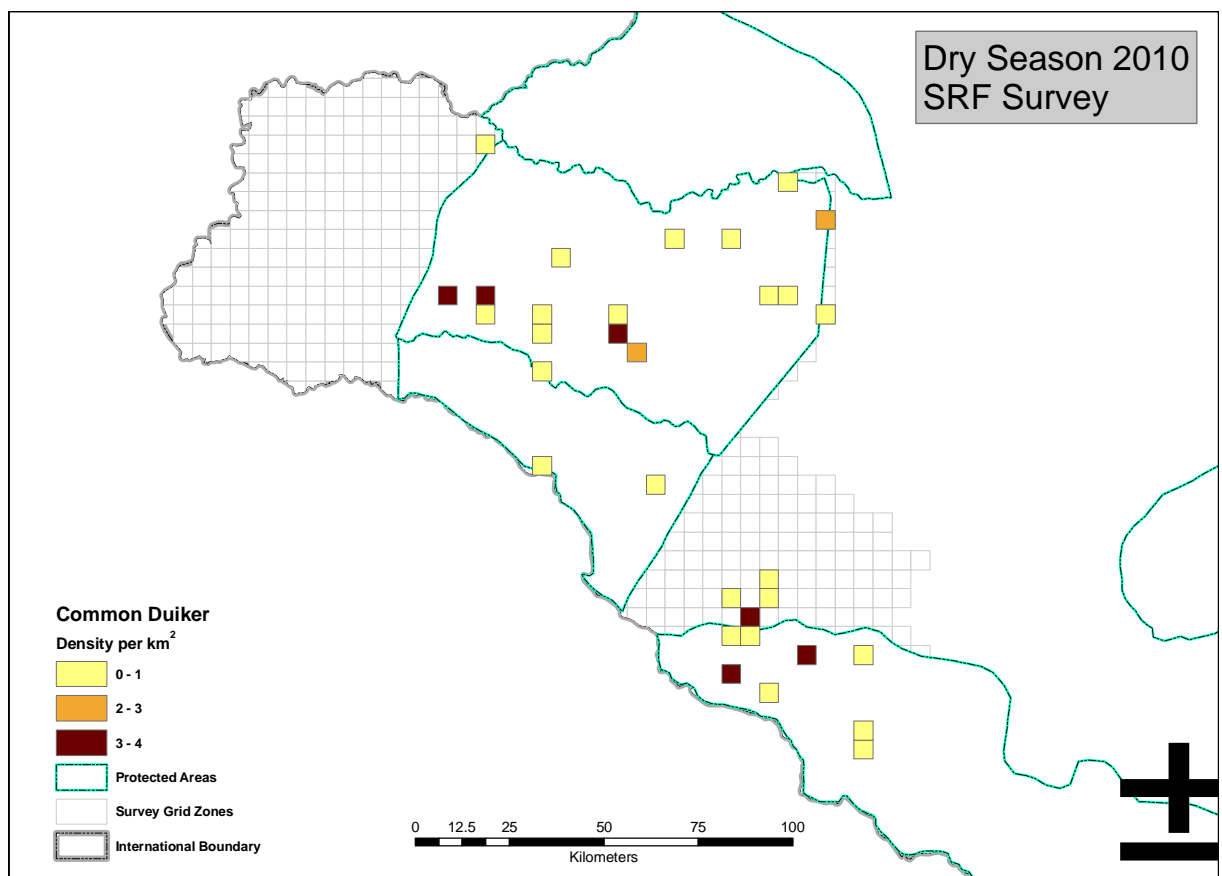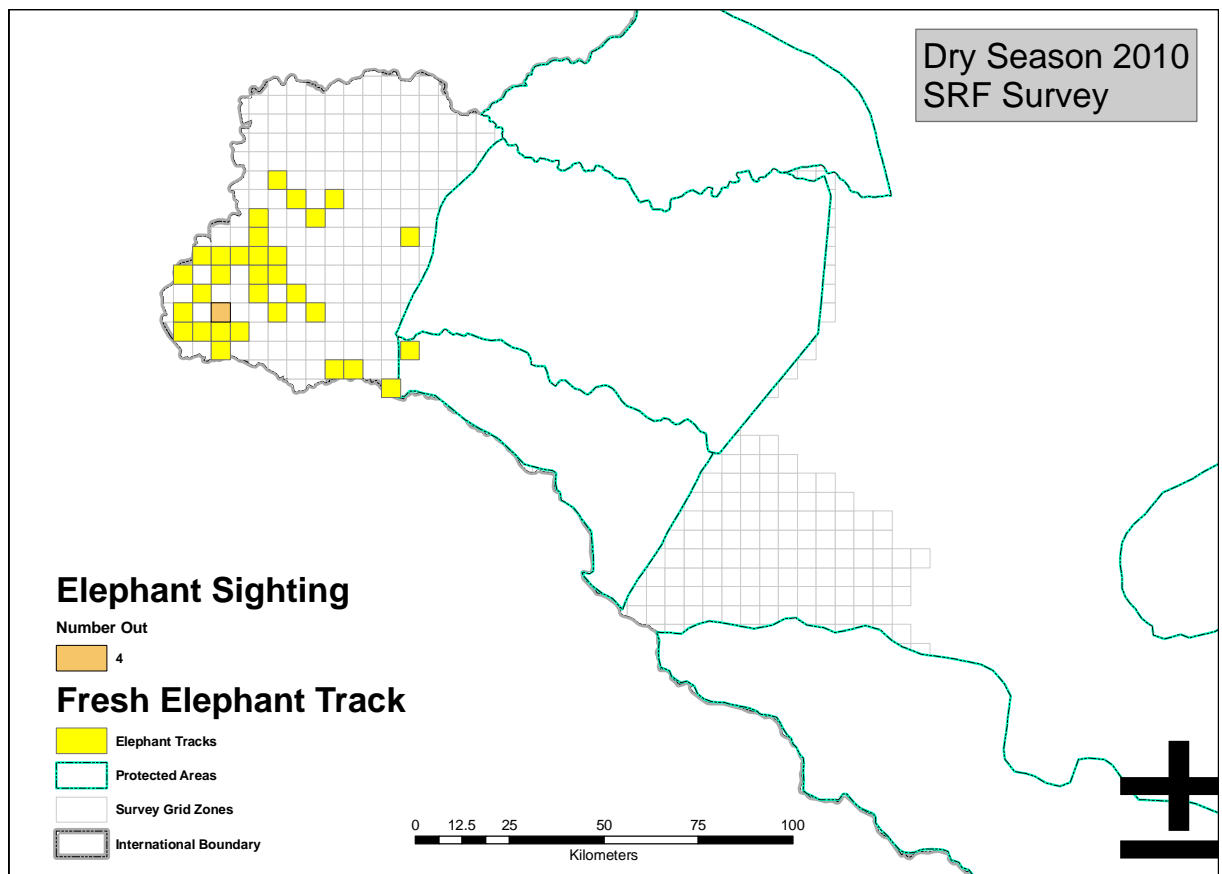**Figure 8: Bushbuck density and distribution, March 2010.**

Figure 9: Buffalo distribution, Gambella survey area 2009.

Figure 10: Buffalo density and distribution, March 2010.

Figure 11: Common duiker distribution, Gambella survey area 2009.

Figure 12: Common duiker density and distribution, March 2010.
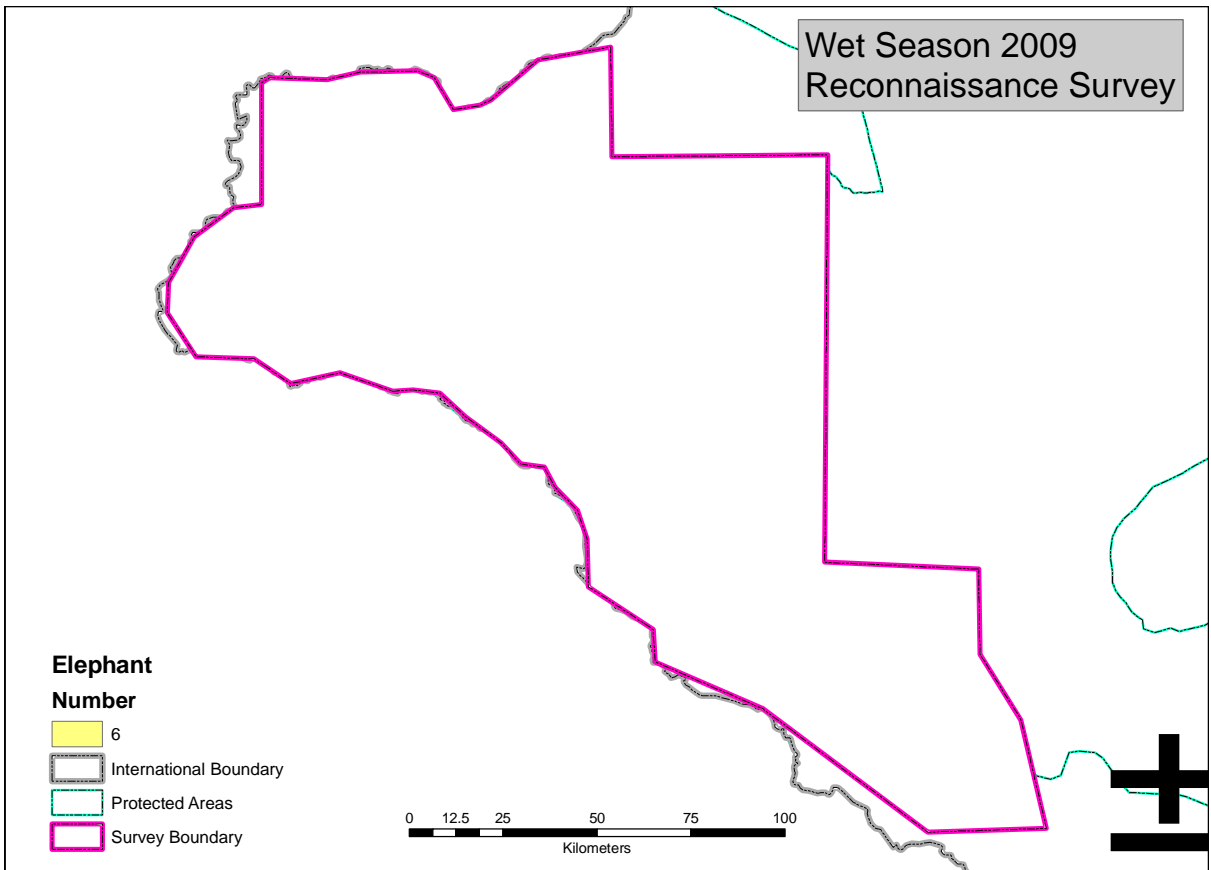
Figure 13: Elephant distribution, Gambella survey area 2009.

Figure 14: Elephant density and distribution of recent tracks, March 2010.
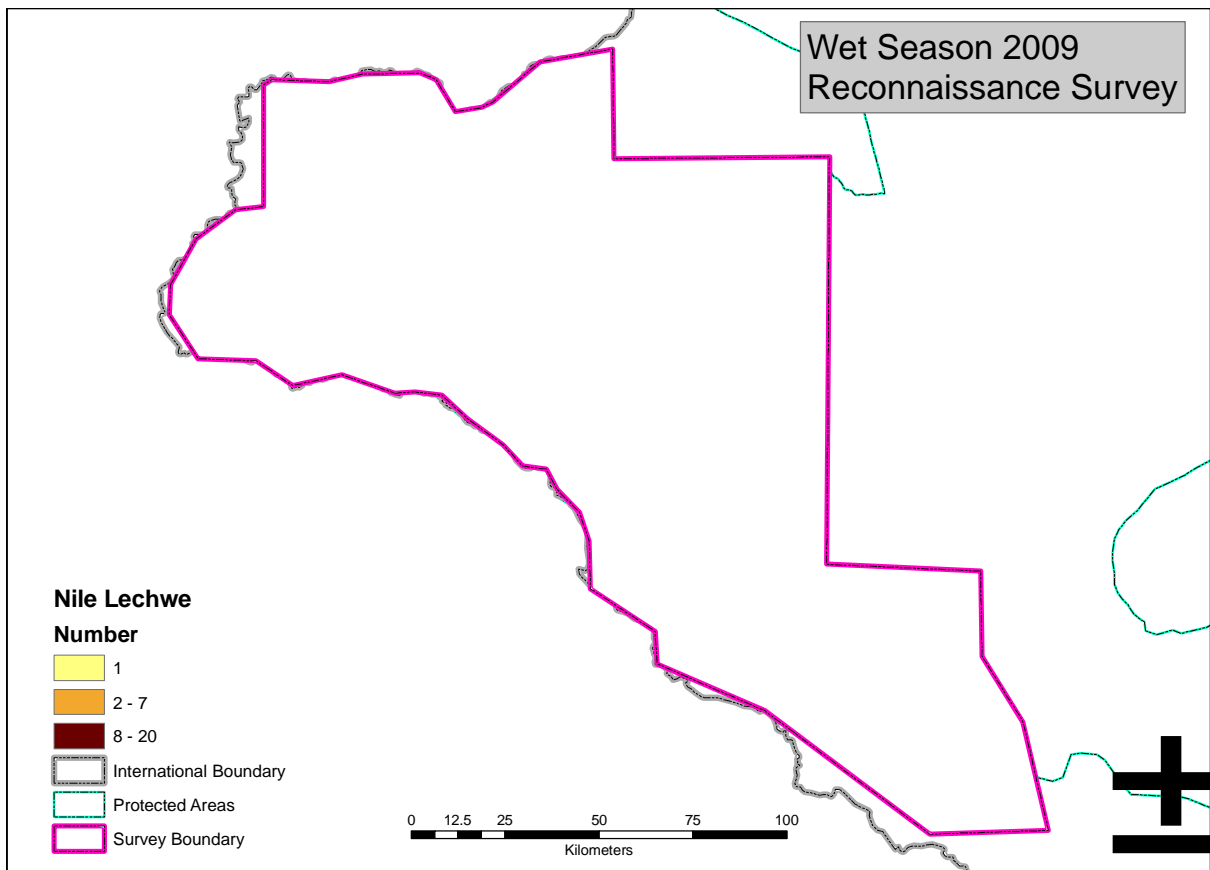
Figure 15: Nile Lechwe distribution, Gambella survey area 2009.

Nile lechwe were not seen during transect flights in 2010. However, one large group (100+) and several smaller groups were sighted during training flights in the wetland areas as indicated in the distribution map for 2009.
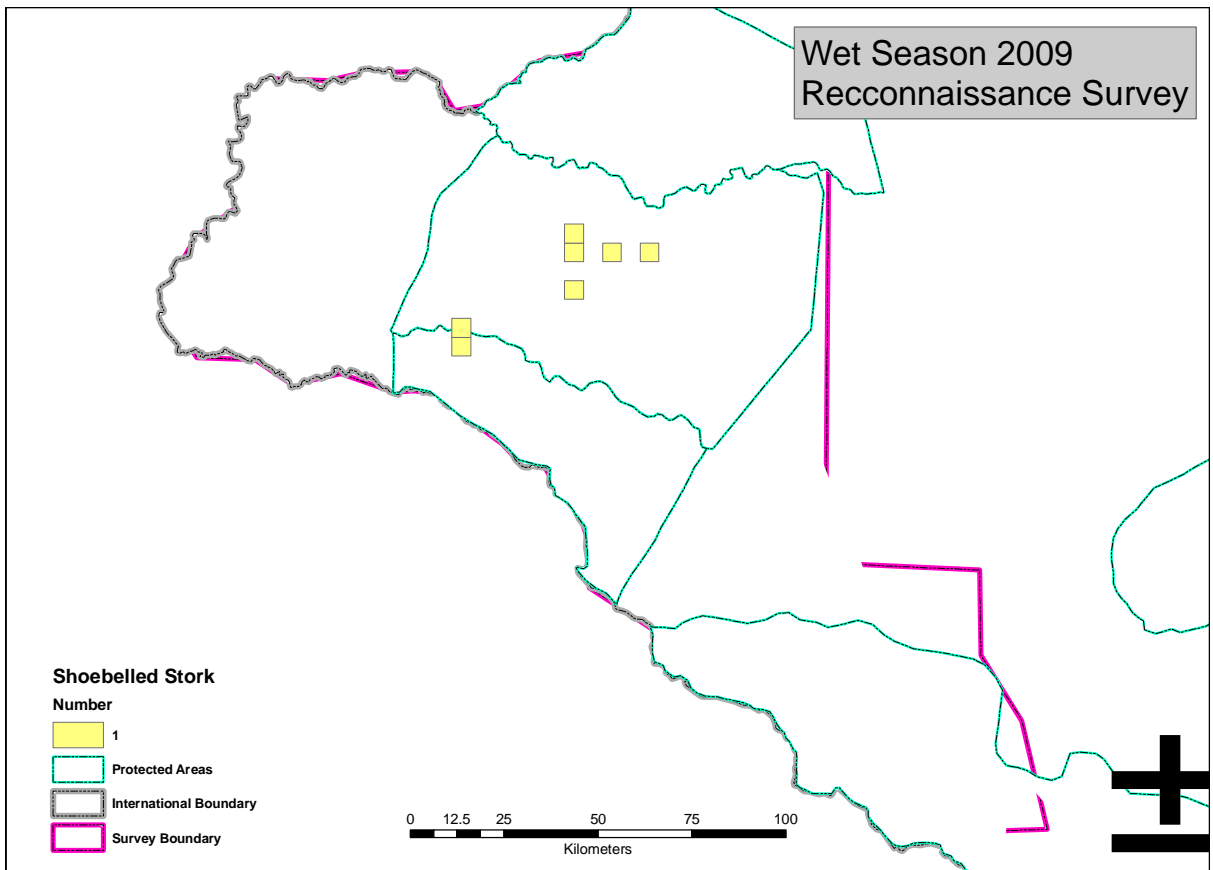
Figure 16: Shoebill stork distribution, Gambella survey area 2009.

Shoebill storks were not sighted during transect flights in 2010, but 40+ individuals were seen in the wetland area during training flights, including one aggregation of 14+ individuals.
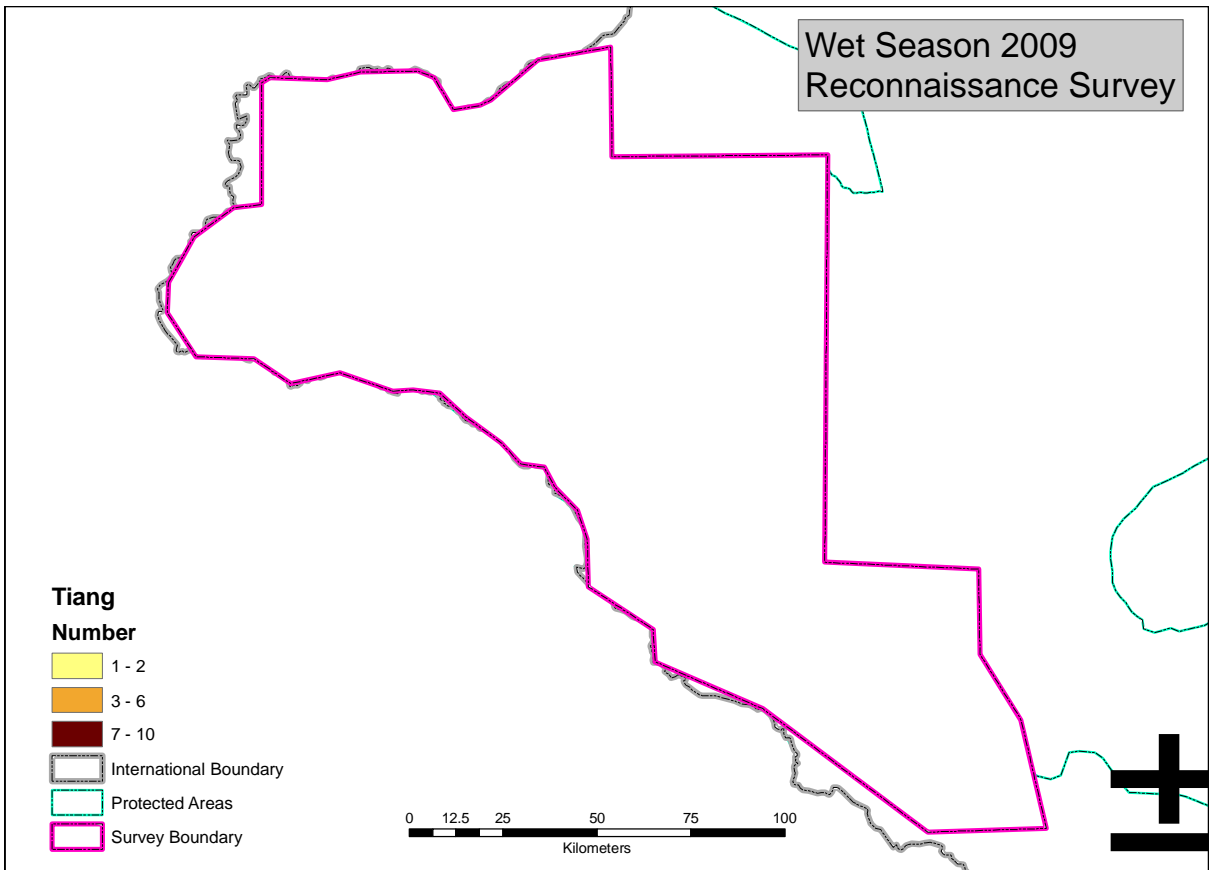
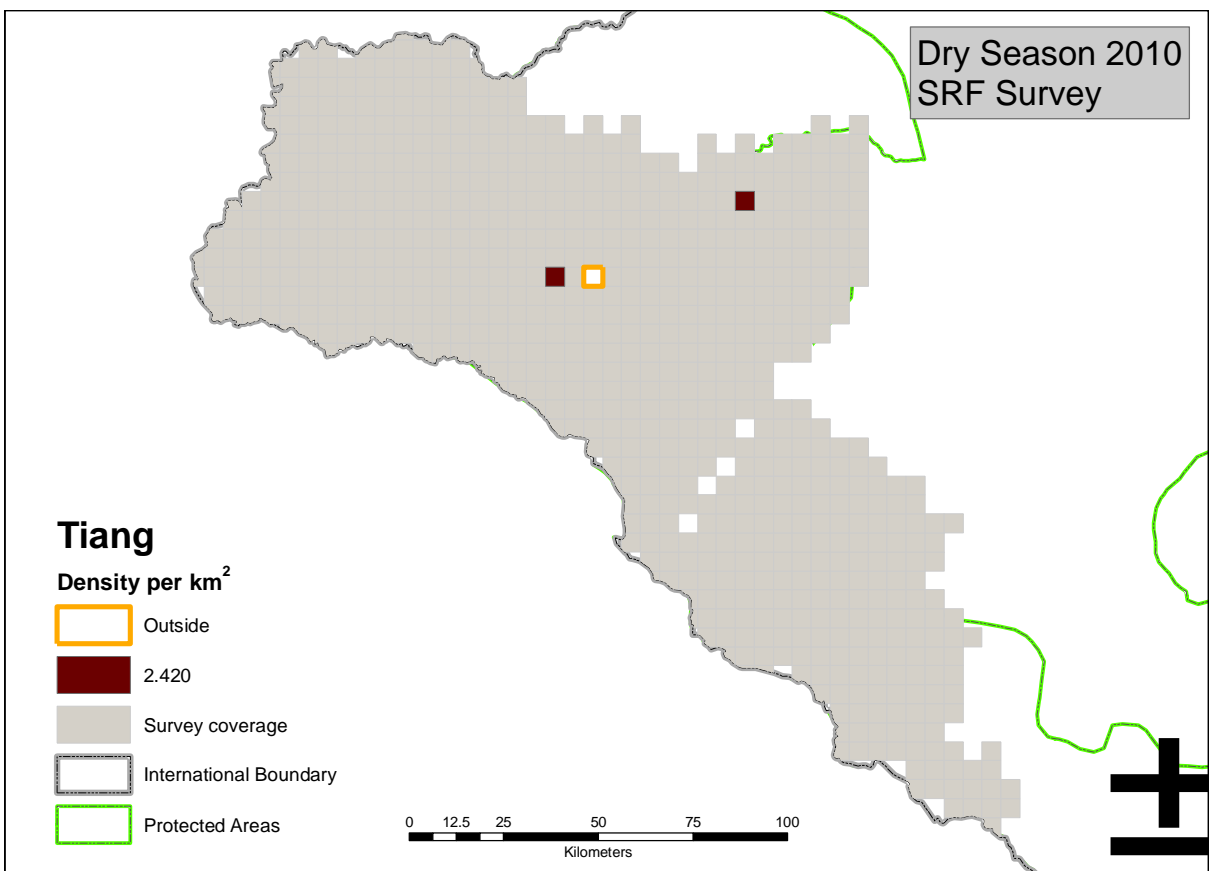**Figure 17: Tiang distribution, Gambella survey area 2009.**

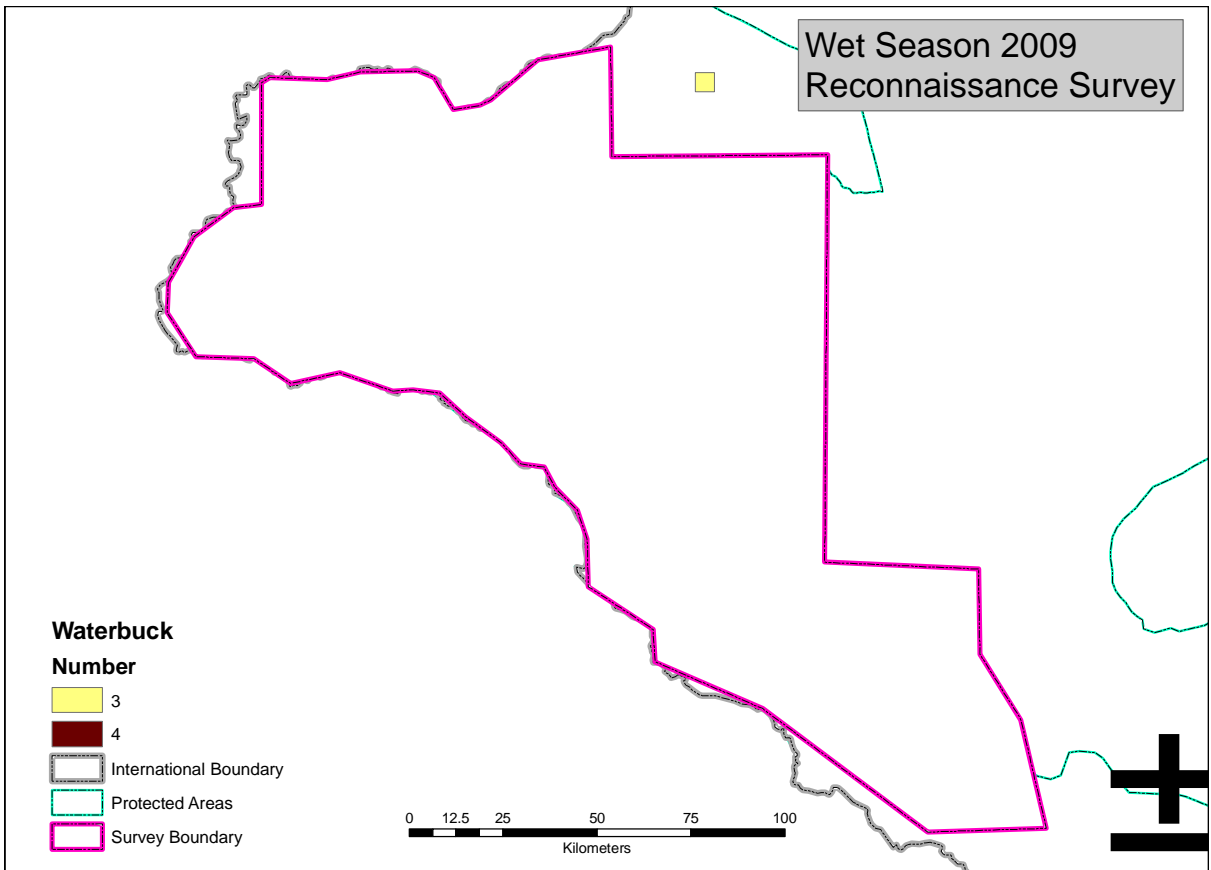**Figure 18: Tiang density and distribution, Gambella survey area 2010.**

Figure 19: Waterbuck distribution, Gambella survey area 2009.
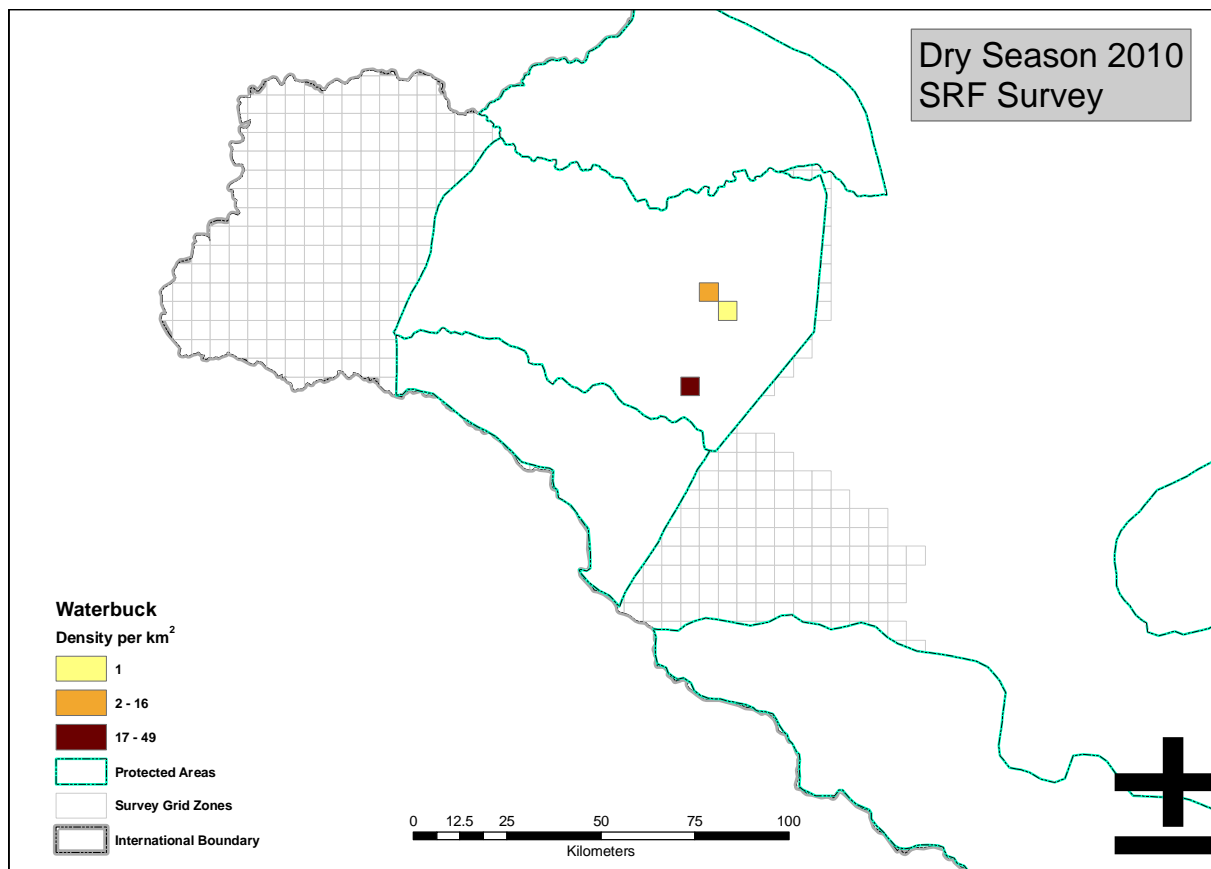

Figure 20: Waterbuck density and distribution, Gambella survey area 2010.
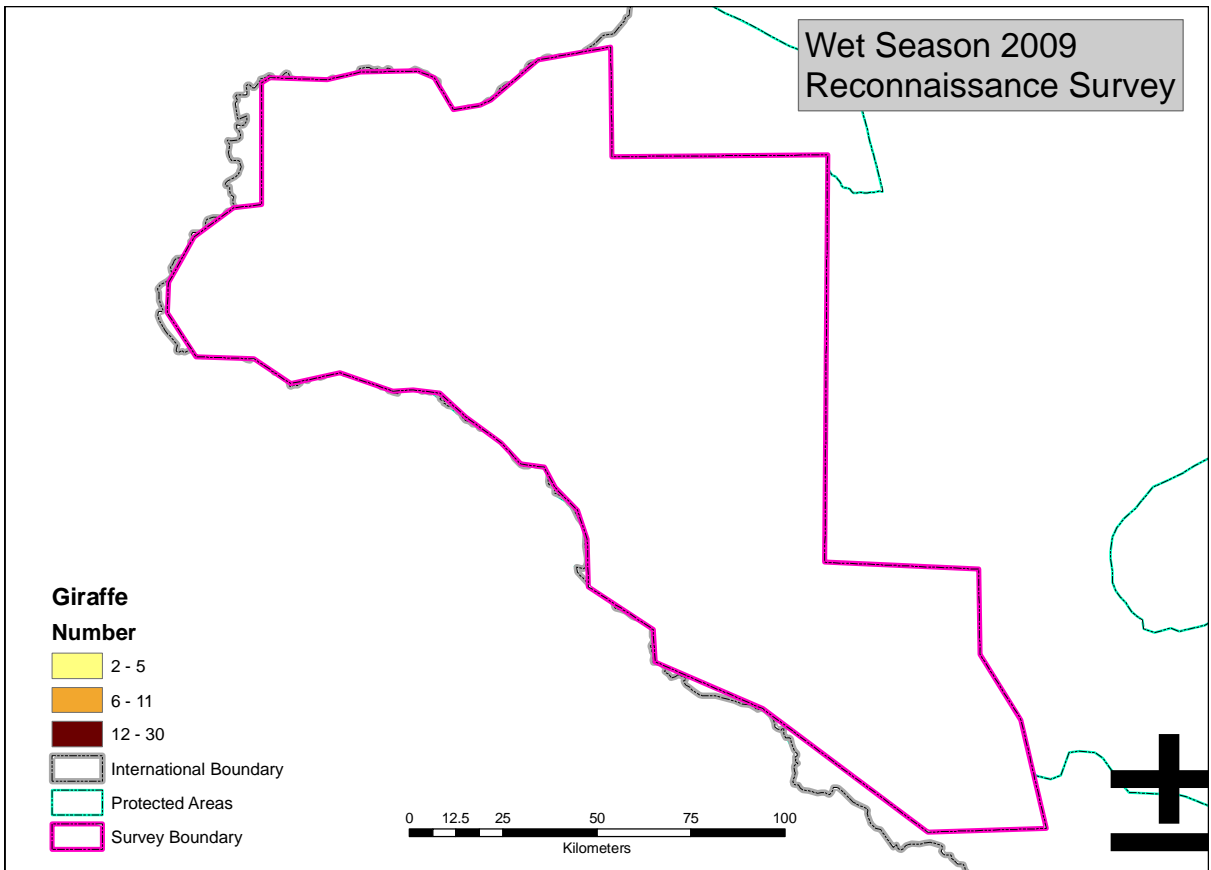
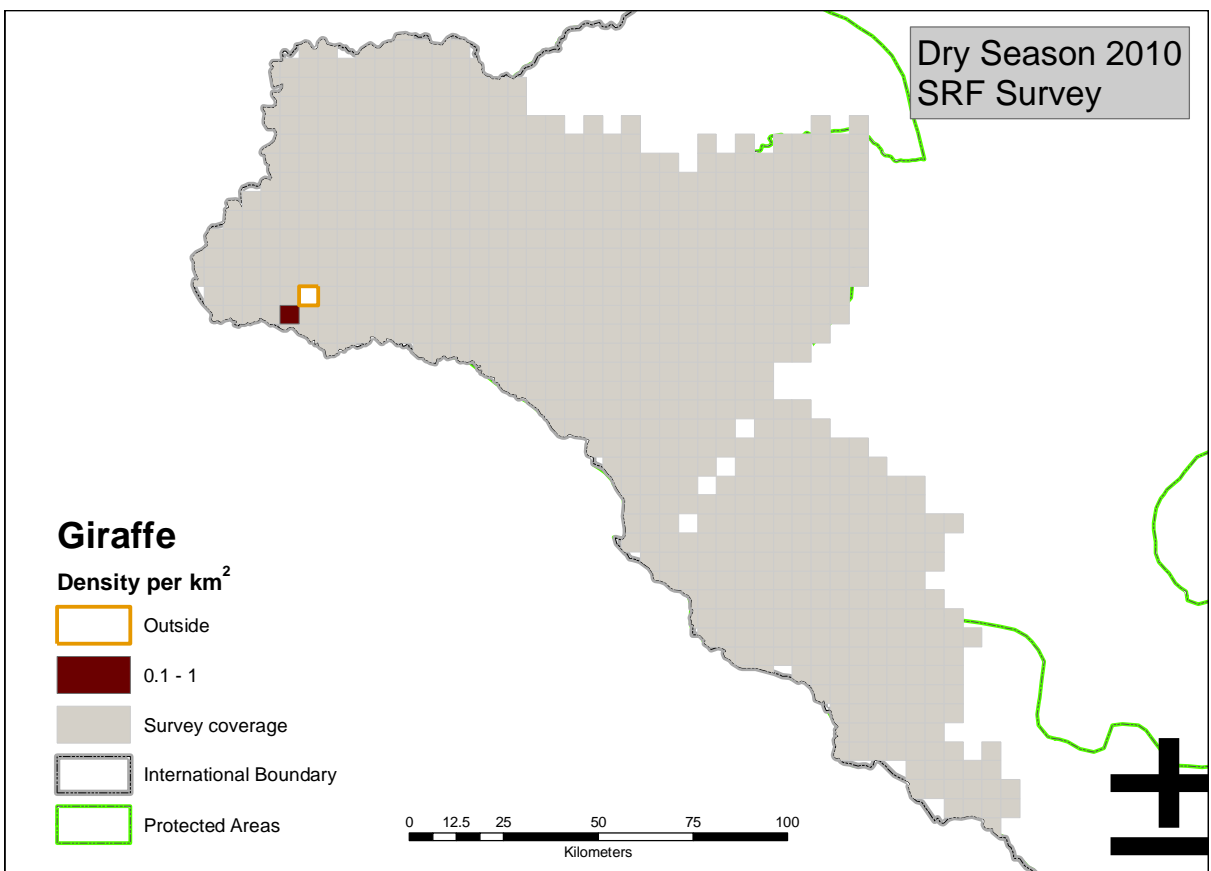**Figure 21: Giraffe distribution, Gambella survey area 2009.**

Figure 22: Giraffe density and distribution, Gambella survey area 2010.
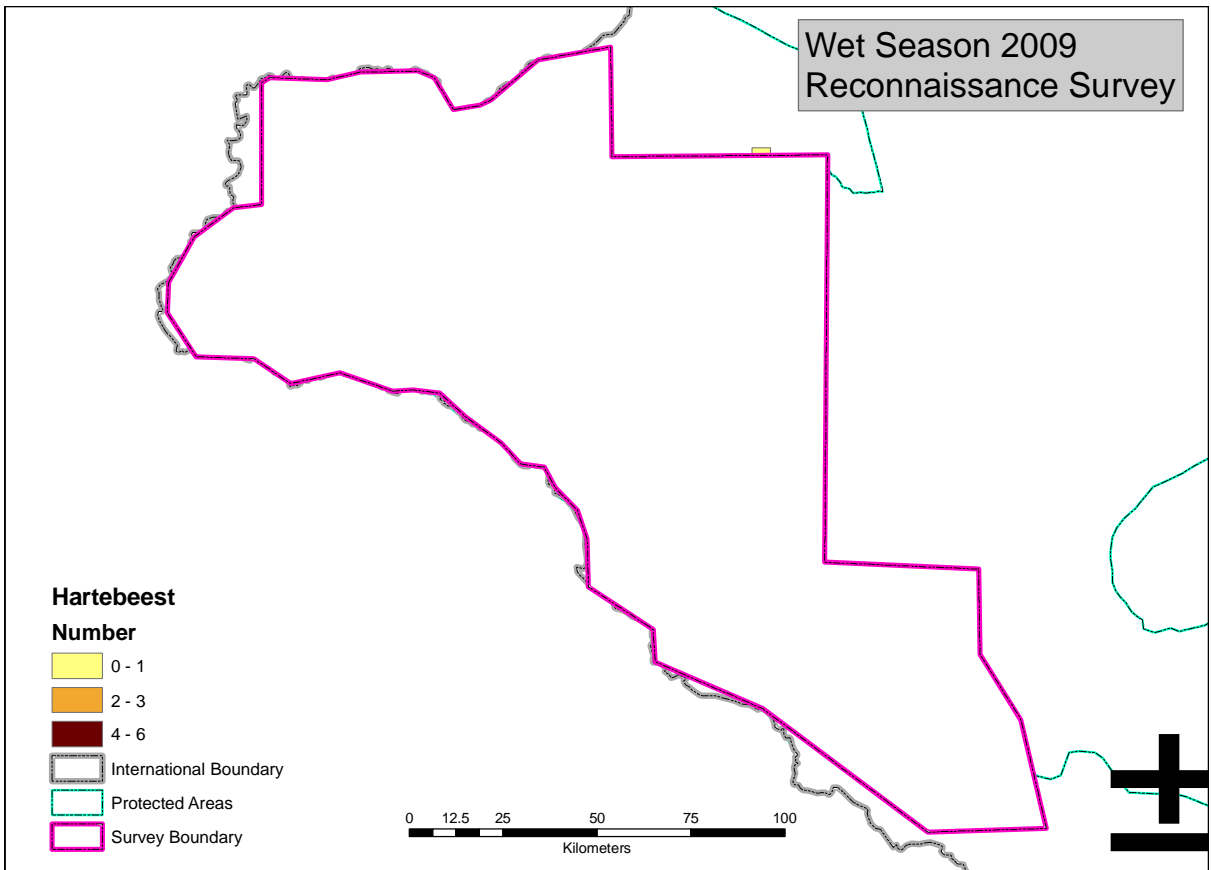
Figure 23: Hartebeest distribution, Gambella survey area 2009.
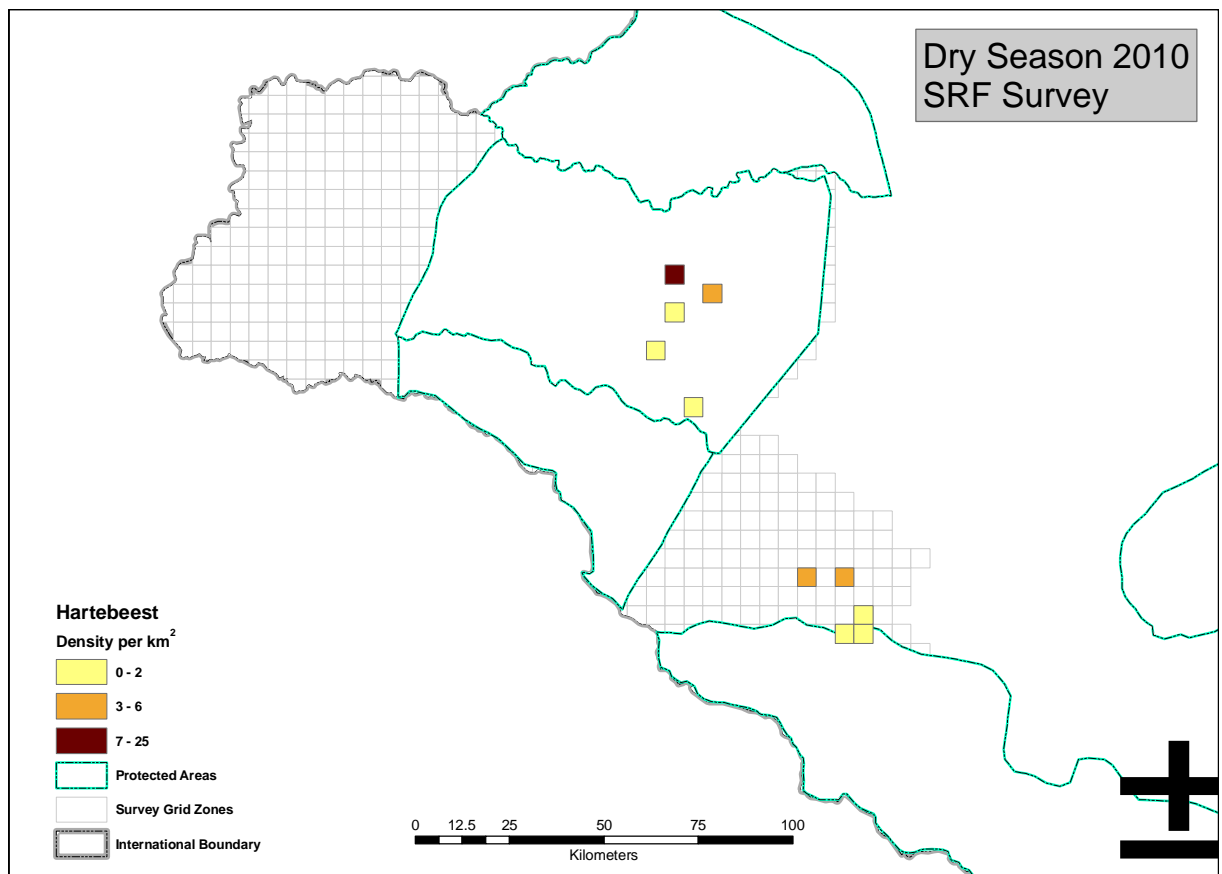

Figure 24: Hartebeest density and distribution, March 2010.
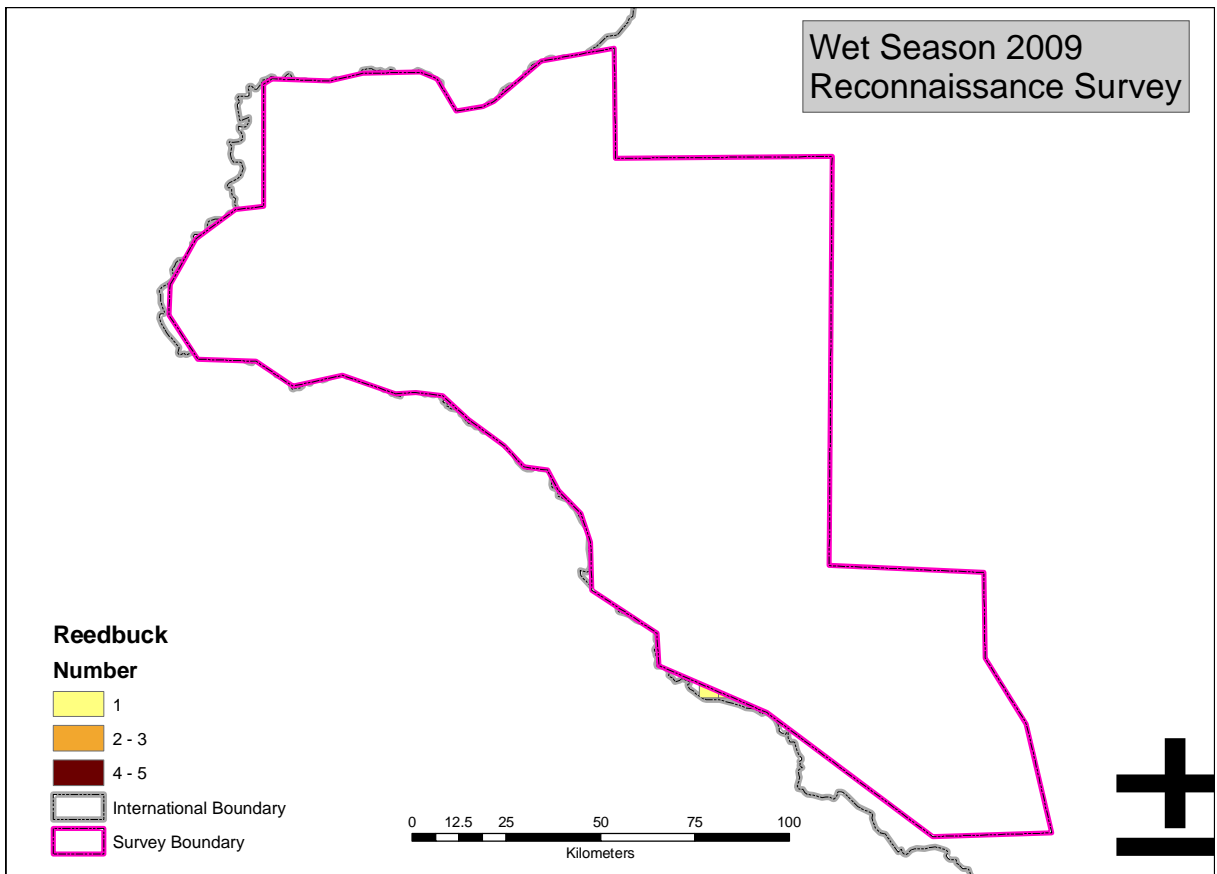
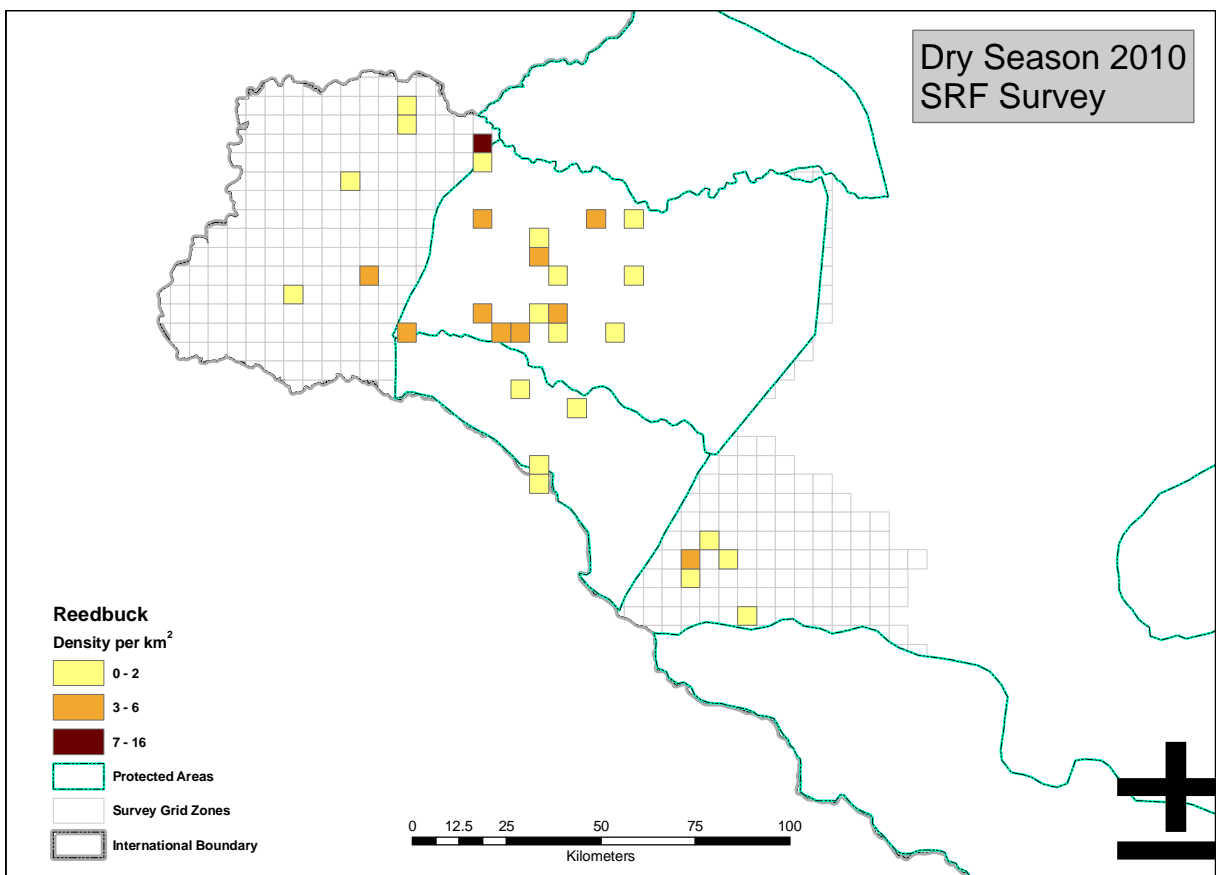**Figure 25: Reedbuck distribution, Gambella survey area 2009.**

Figure 26: Reedbuck density and distribution, March 2010.

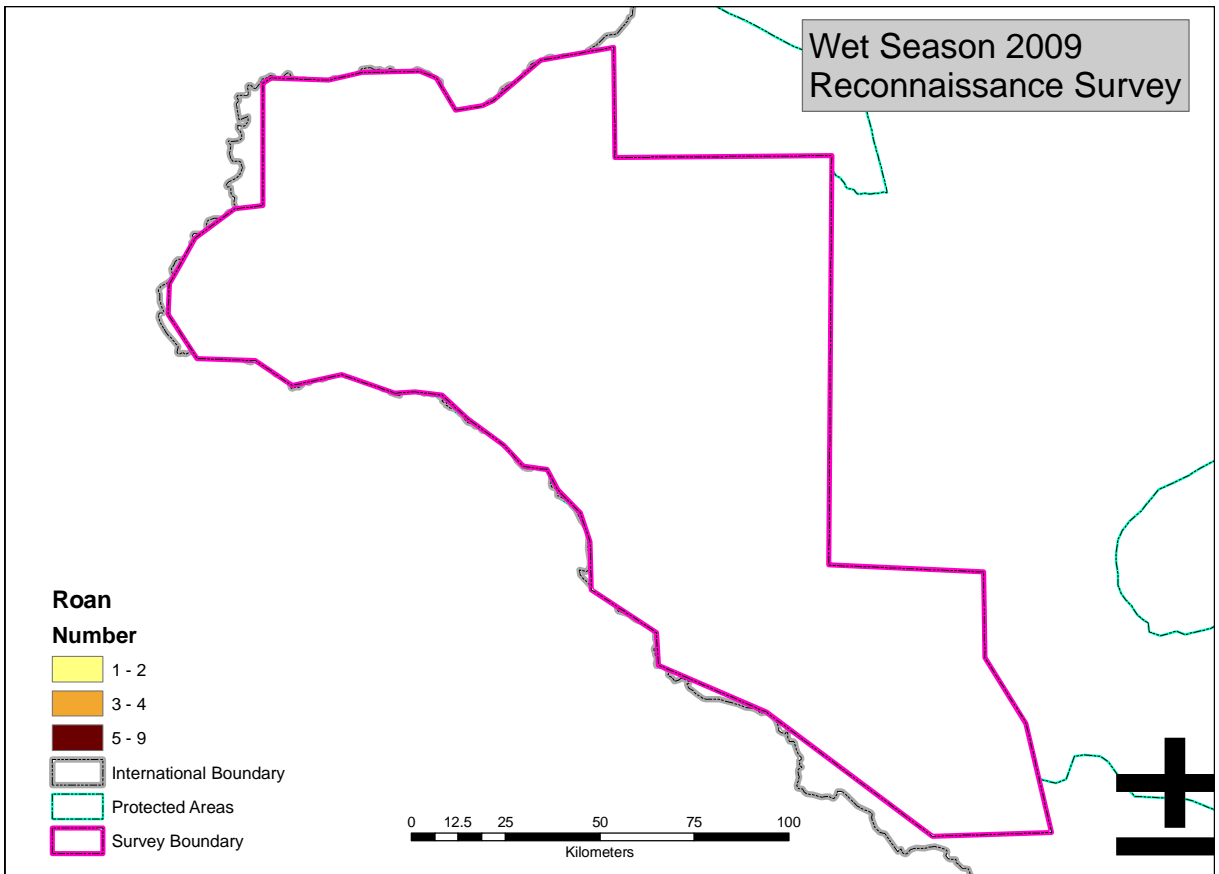**Figure 27: Roan antelope distribution, Gambella survey area 2009.**
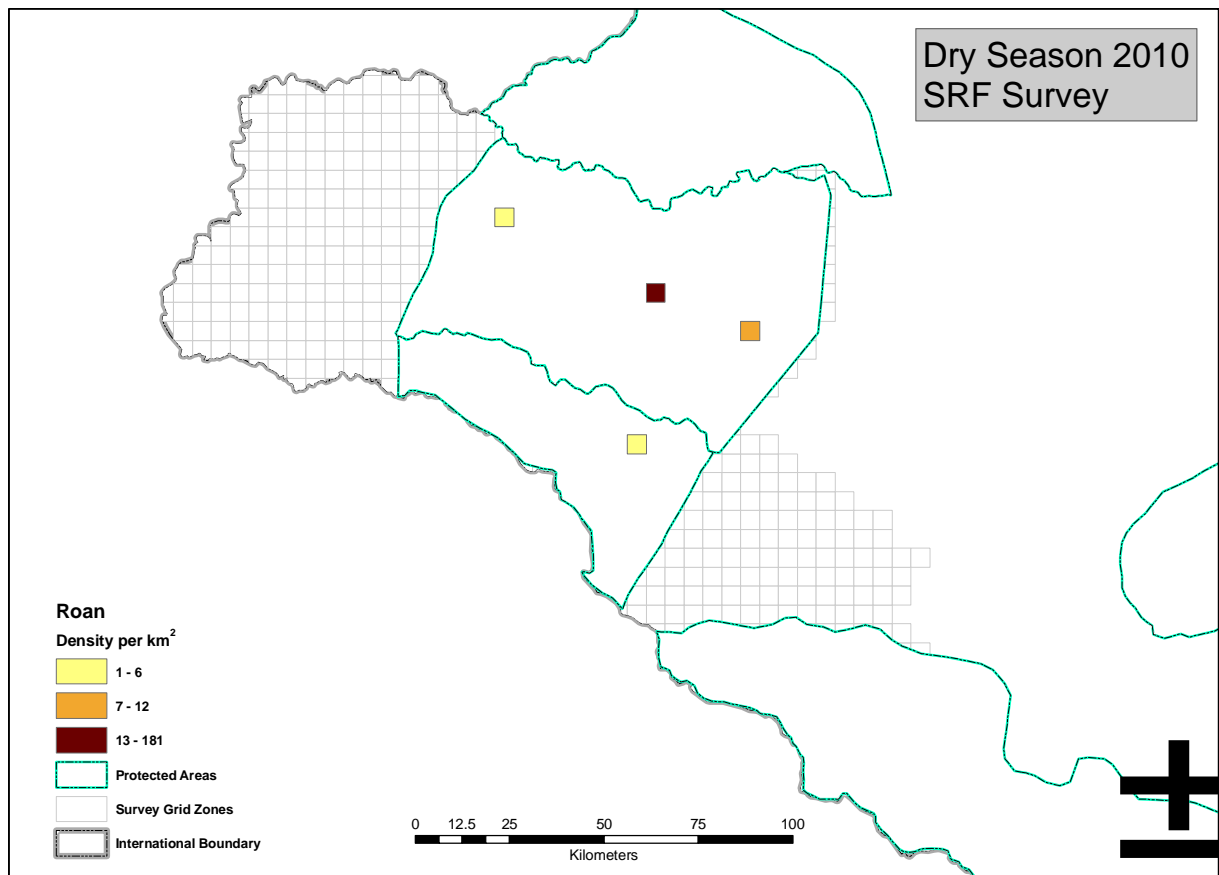
Figure 28: Roan antelope density and distribution, March 2010.
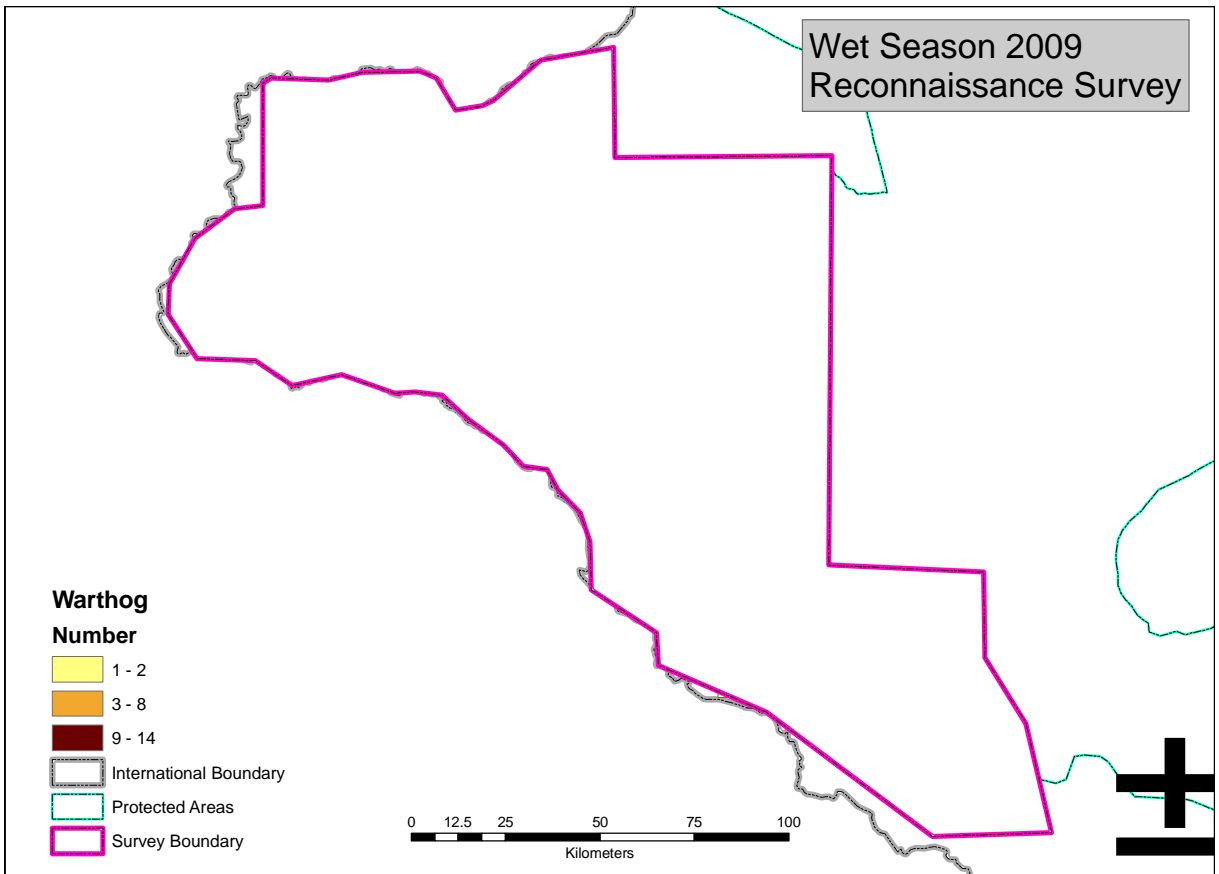
Figure 29: Warthog distribution, Gambella survey area 2009.
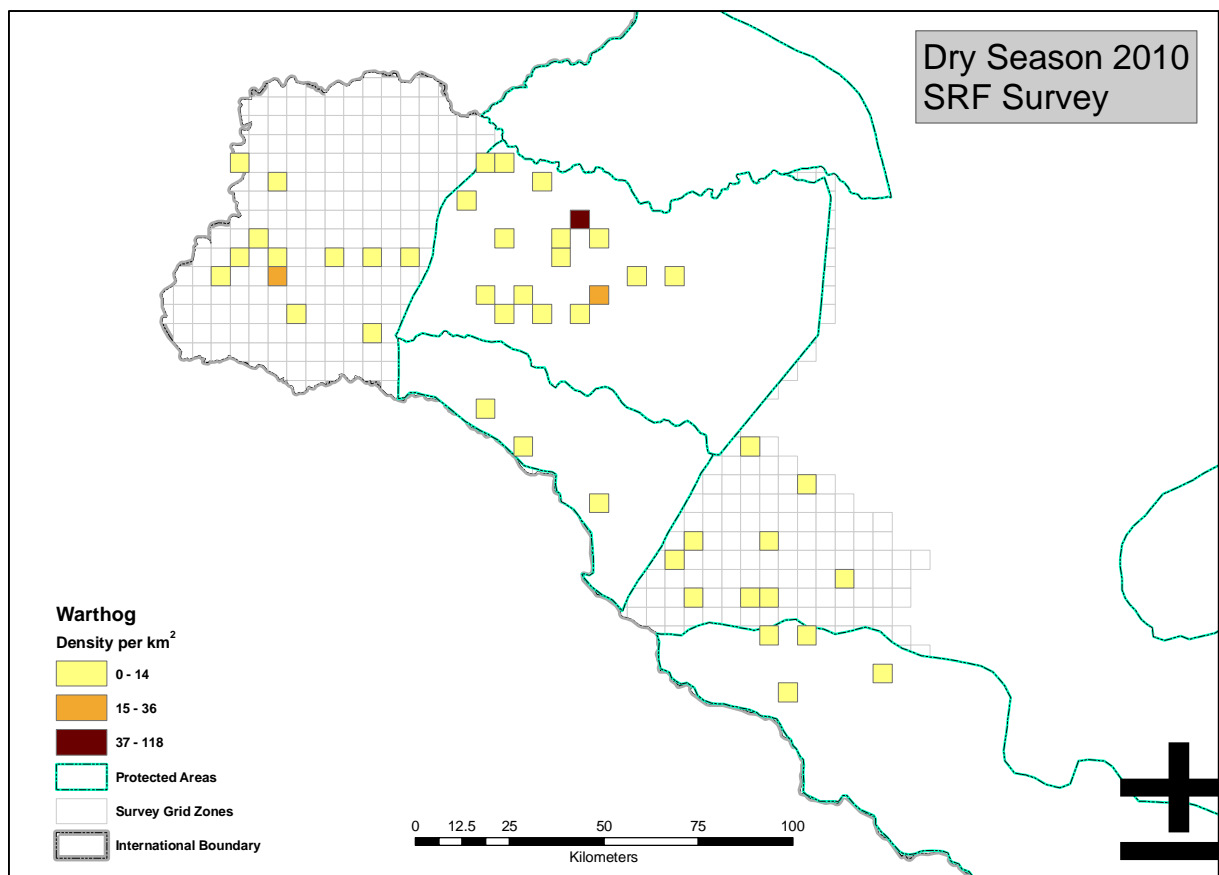
Figure 30: Warthog density and distribution, March 2010.

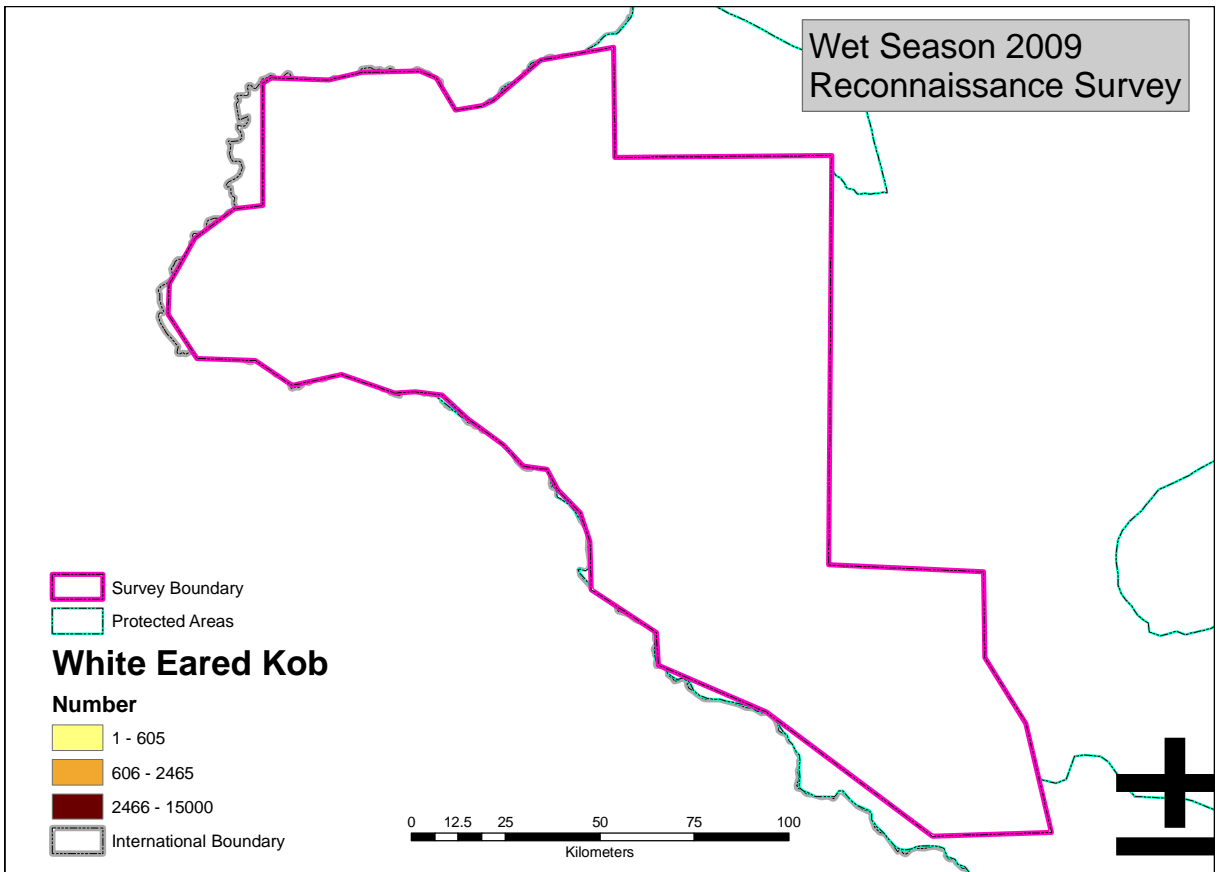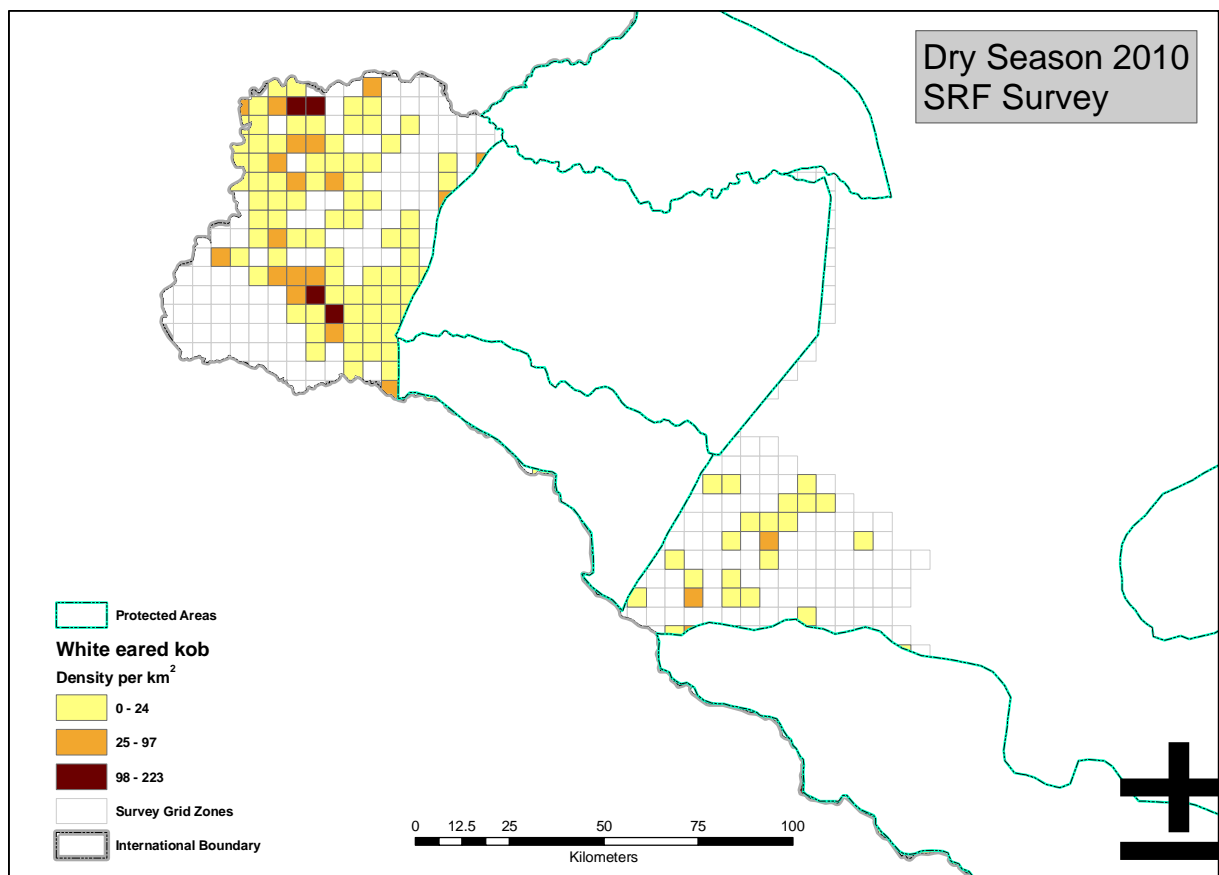**Figure 31: White-eared kob distribution, Gambella survey area 2009.**

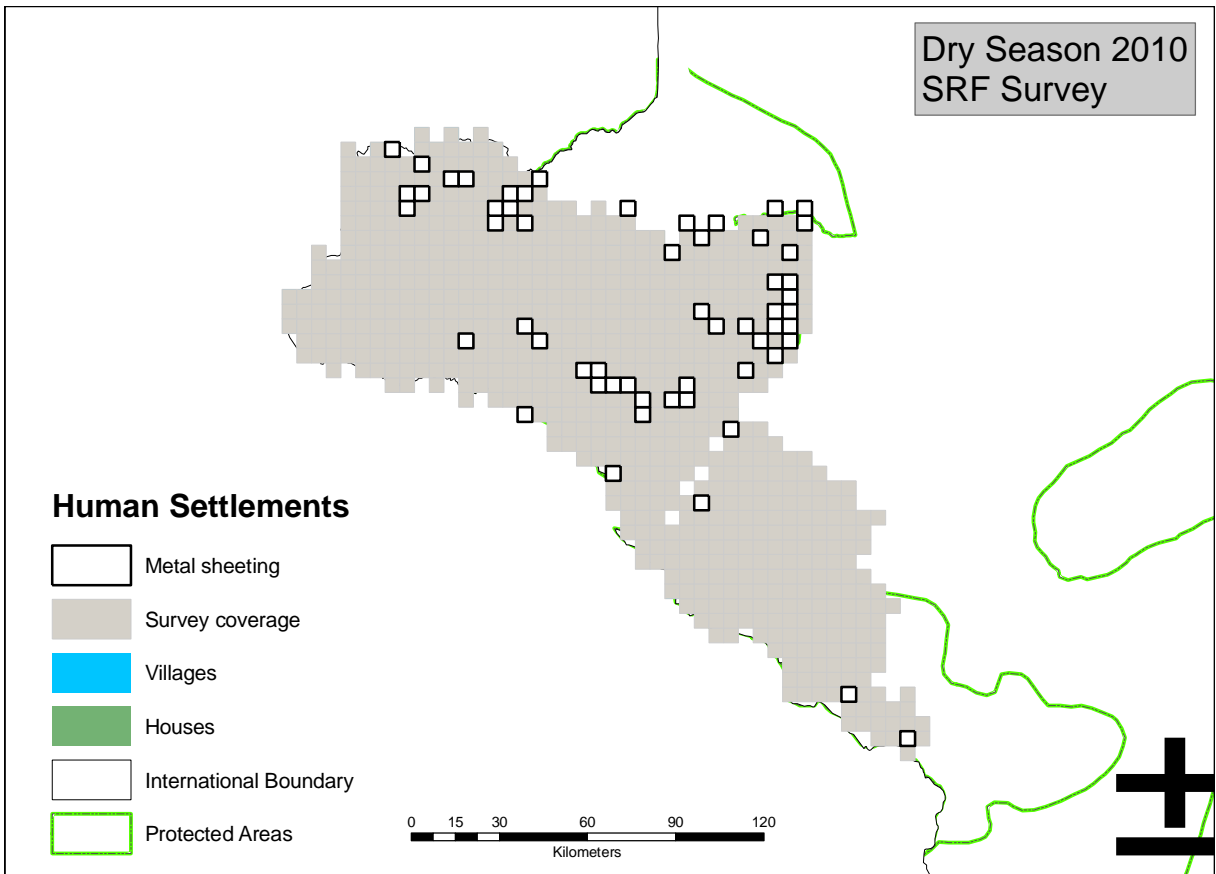**Figure 32: White eared kob density and distribution, March 2010.**

Figure 33: Presence of settlements, Gambella survey area 2010.
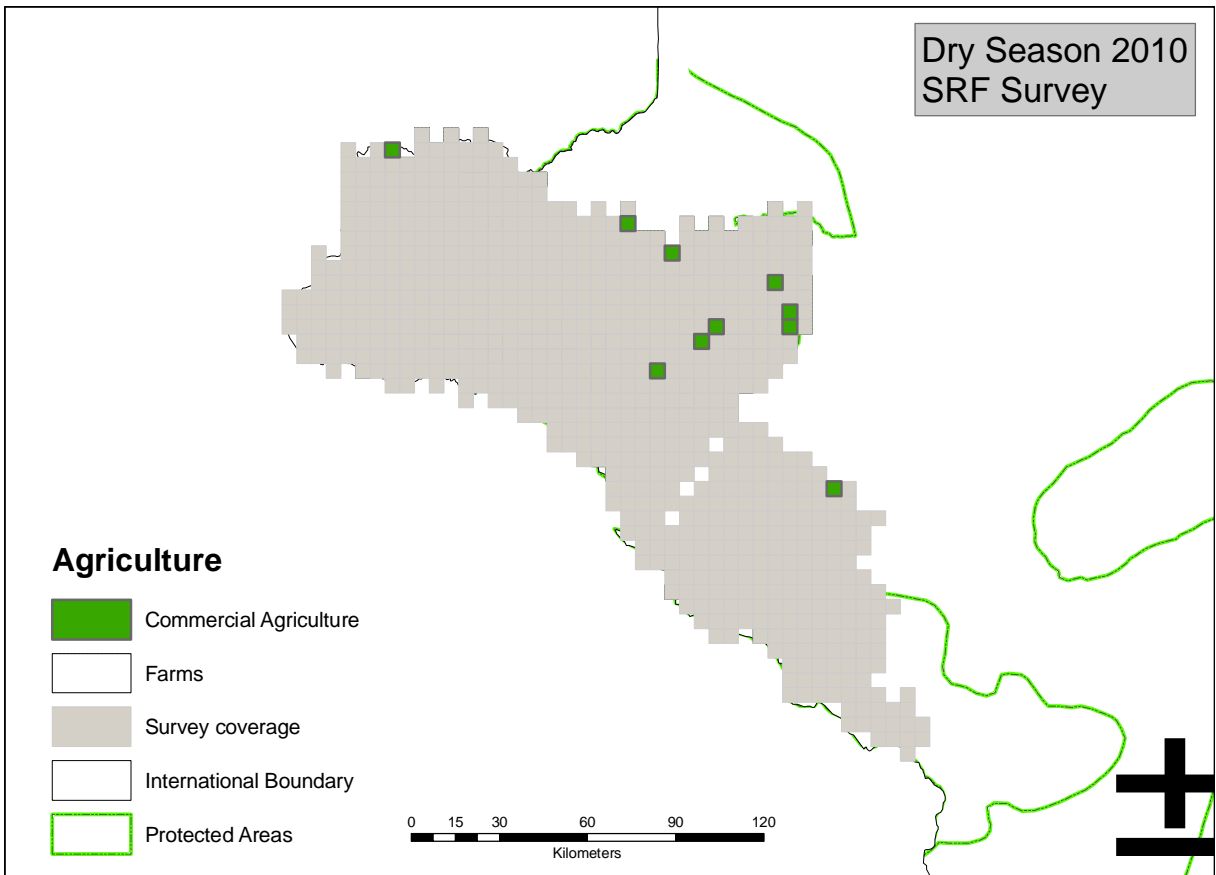

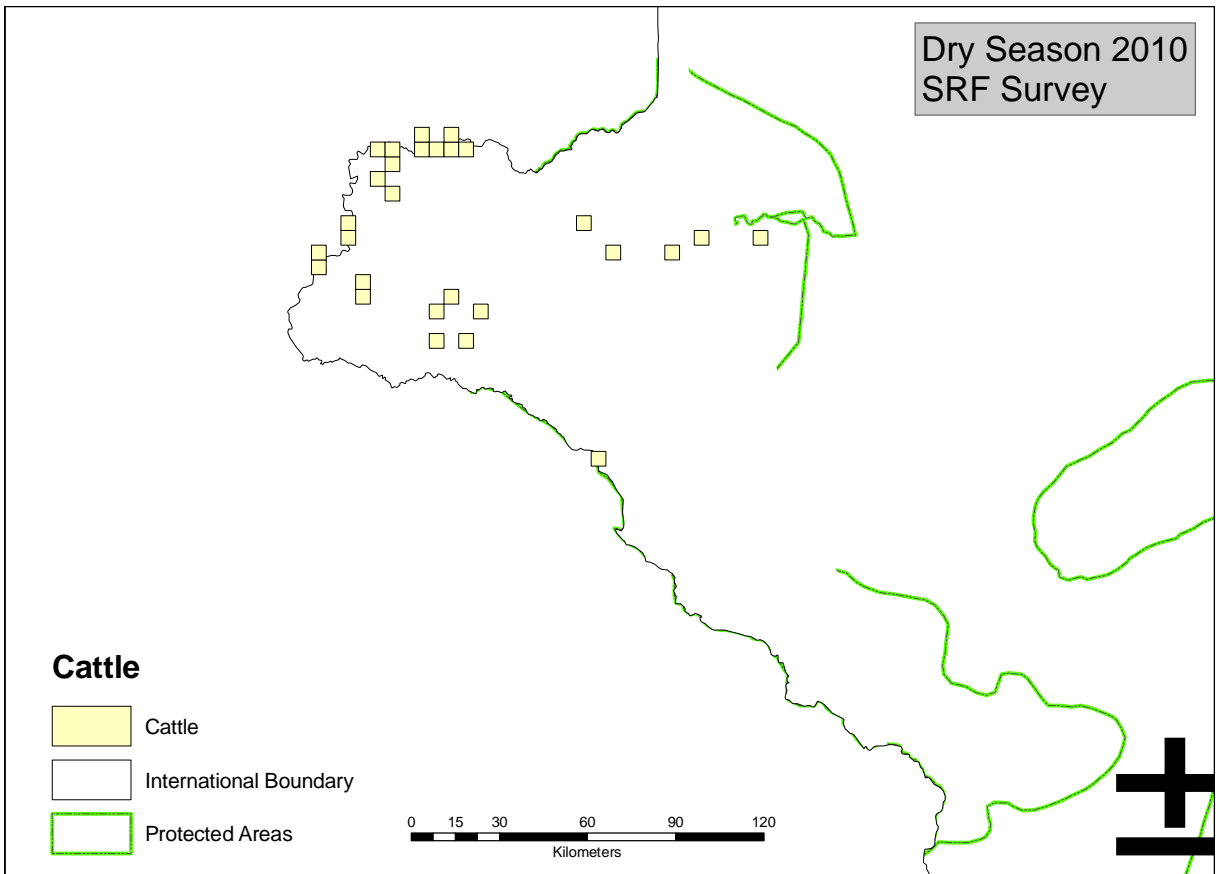**Figure 34: Distribution of agriculture, Gambella survey area 2010.**

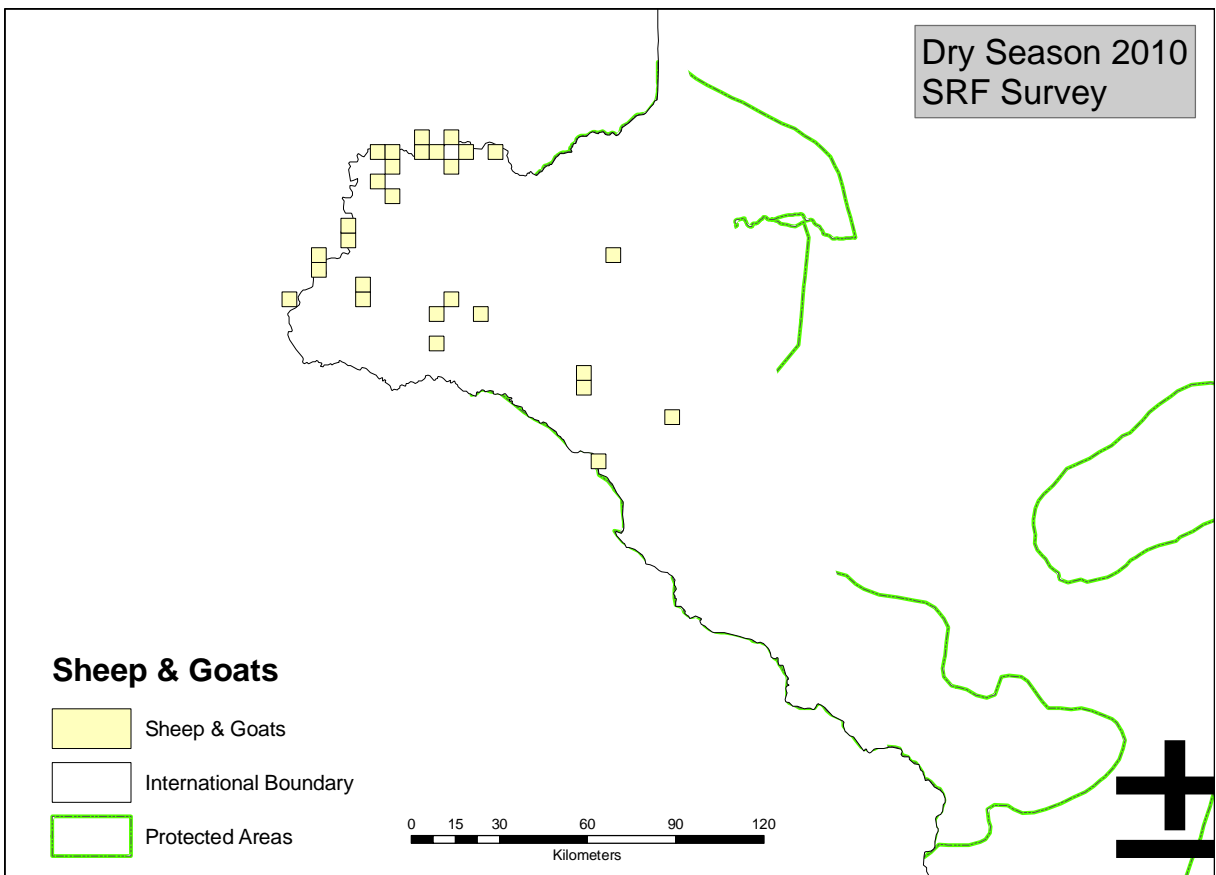**Figure 35: Distribution of cattle, Gambella survey area 2010.**

Figure 36: Distribution of sheep & goats, Gambella survey area 2010.

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Conclusion

Discussion

These two wildlife surveys provide a chance to examine the conservation importance of the region, and to comment on the conservation of individual species.

Species specific notes:

1. Nile lechwe were not seen in transects in 2010; they were seen in the wetland area of the former Park in 2010 training flights (100+) and in the 2009 reconnaissance flights (34). It seems likely that their only range is within this wetland area. An accurate estimation of their numbers and range is vital to determine the best course of action for their protection.

2. The total White-eared kob migration that moves between Sudan and Ethiopia was estimated at around 750,000 animals (Fay et al, 2007). While, as mentioned in the Methods, it is difficult to assess migratory species' populations, and the estimate from Fay (2007) and our estimate presented here are inaccurate, it is likely that a substantial proportion of the White-eared kob migration (255,143 +/- 36,909 combining the estimates from both survey blocks) uses the Gambella region. Radiocollaring of kobs is recommended to find out more about migration patterns.

3. Elephant were never seen in large numbers, but recent and old tracks indicate that they are resident in the area to the west of Gambella. Groups of several hundred animals have been seen and photographed in this area in recent years. Like other species, elephant range back and forth across the border, and this area may represent an important part of the range of elephant in the broader landscape. Small, highly-mobile populations of elephant are extremely difficult to assess with sample counts, and it may be worthwhile to implement a project similar to the WCS elephant collaring and tracking research in Sudan, to determine their use of the Gambella area and approximate numbers.

4. Buffalo are usually targeted by local hunters, both legal and illegal. Over 1,000 buffalo were seen in the 2009 survey and over 1,300 were estimated in 2010; buffalo are particularly problematic to assess in sample counts, and a total count of buffalo in their core area (the Duma swamps and surrounding area) would establish a better estimate of their numbers. Their range is restricted and the wetland area vital for their preservation.

5. Some Shoebill stork were seen in the Duma swamps and an area to the SW in 2009, and dozens were seen during training flights in 2010. This wetland area may be the sole range in Ethiopia for this species.

General wildlife & human distribution and core areas:

1. Based on these two surveys, three areas stand out for particular attention in the region (see Figure 38):

    a. The western part of the region represents the only elephant range at present, and may have a resident population of White-eared kob.

    b. The Duma swamps at the core of the old National Park have relatively large numbers of roan, buffalo and other species, and are the only place where Shoebill stork and Nile lechwe are consistently found.

    c. The Upper Akobo block was densely populated with White-eared kob, and had a large number of smaller antelope and hartebeest.

2. The kob migration probably uses the entire southern and western border area of the region, 20-40 km inside Ethiopia. The importance of this area for the conservation of this species should be a research priority, working with the conservation authorities in Sudan.

3. Human settlements and activities were generally overlapping with wildlife distributions (Figure 37), except for the Upper Akobo area. Community conservation activities will have to play a major part of any conservation efforts in the region.
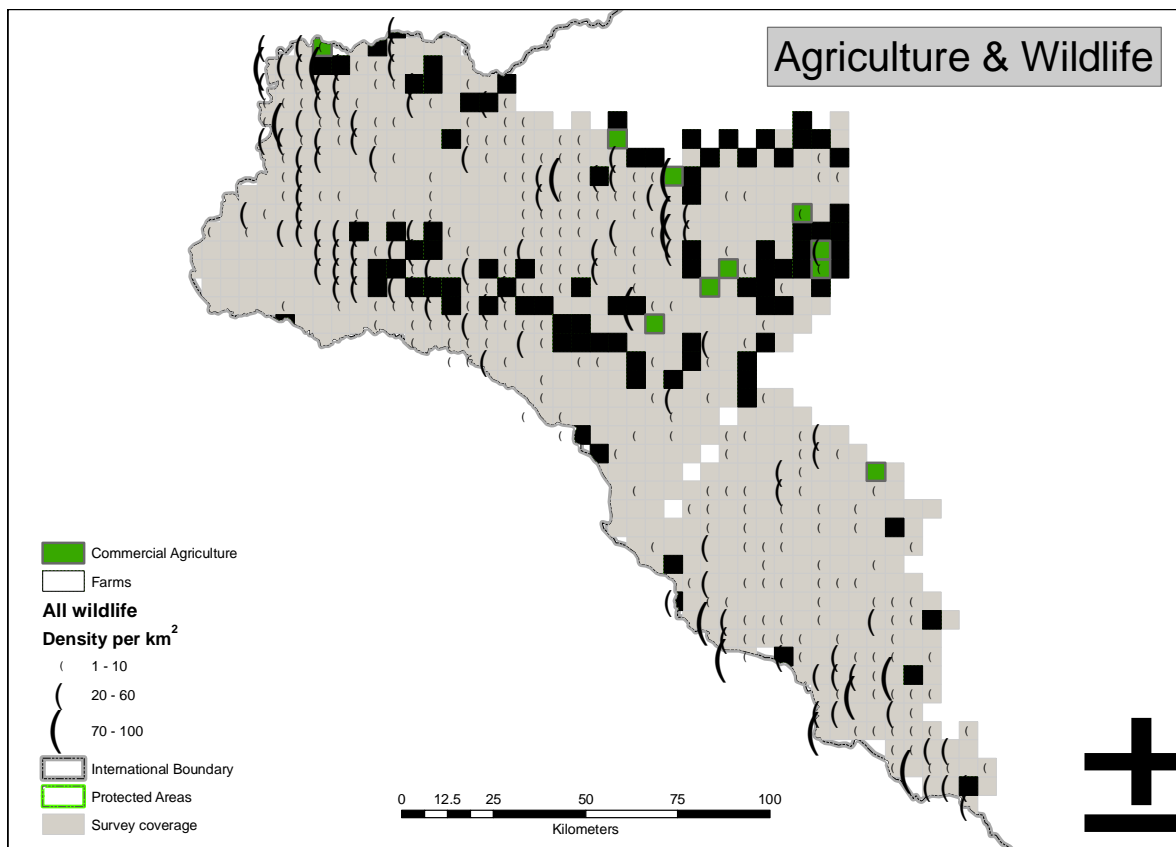
Figure 37: Overall wildlife distribution & agriculture, 2010.

4. The concentration of smallholder agriculture along the southern boundaries of the old National Park is problematic for conservation efforts, as it fragments the region; however, the low density of human settlements meant that wildlife was found within this area, completely overlapping with the local community areas.

5. Large areas are being demarcated and completely bulldozed for agricultural systems. The land and water requirements of commercial agriculture are completely incompatible with wildlife conservation, and represent extreme threats to the wildlife of the region:

    a. Large clearings upriver from and adjacent to the wetland area indicate that water may become limiting and the wetland area may no longer act as a dry-season refuge or permanent habitat for lechwe or shoebill.

    b. The clearing and construction along the eastern border of the old Park have the potential to completely fragment the wildlife populations in the region, and such developments (increased human populations and roads) generally lead to a reduction in surrounding wildlife numbers.
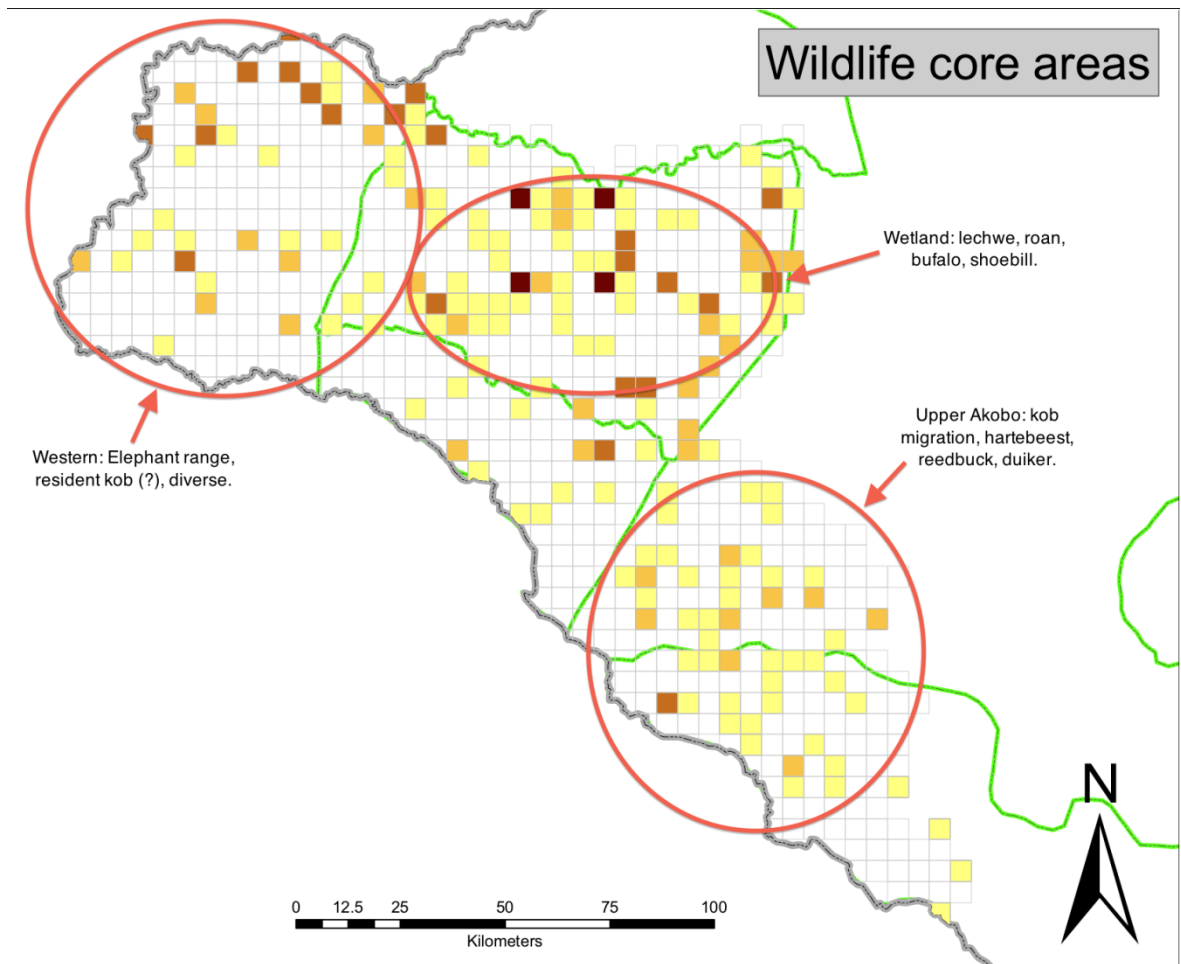
Figure 38: Possible core wildlife area.

Recommendations

In addition to the immediate conservation value of these surveys, they also act as a baseline for monitoring, comparison with later surveys, and to better design future survey work. Suggested future activities:

1. **Stratified aerial counts or total counts**: the core wetland area should be assessed at a higher intensity, at least at 2.5 km spacing, or ideally total-counted for target species including buffalo, lechwe, shoebill and roan. A total count of this small area is entirely feasible and can be added to a normal transect sample count.

2. **Yearly aerial surveys:** to better establish the patterns suggested in this report, and as an aid to ongoing conservation planning and monitoring, yearly aerial surveys should be carried out.

3. **Cross-border cooperation:** the Gambella region is part of a larger ecosystem, which is best shown by the regular (and probably continuous) movements of kob and elephant across the border. Survey efforts in the future should be coordinated with the Sudanese wildlife authorities, ideally with survey aircraft allowed to cross the border and survey entire ecological blocks.

4. **Ground surveys:** systematic transects on foot and from vehicle can give far better information about biodiversity of vertebrates and invertebrates, as well as act as patrols for protection of wildlife and protected area boundaries. Much of the east of the region is forested an impossible to survey from the air, and ground transects the only practical way to determine the presence and abundance of other species.

5. **Wildlife Collaring:** Collaring should be done to the key species of the area (particularly Elephant and White Earded kob) to properly understand the migration routes and patterns as well as habitat ranges of these species. Sharing the data generated by WCS Sudan will also help to complement the data collected in the Ethiopian side.

The wildlife populations in Gambella are diverse and widespread, and significant populations of many species of international and local importance are present. However, the long-term potential for conservation of wildlife and habitats in this region is threatened by habitat fragmentation and encroachment, and immediate action must be taken to demarcate and protect core areas, and work with communities to set up effective conservation and natural-resource use practices.

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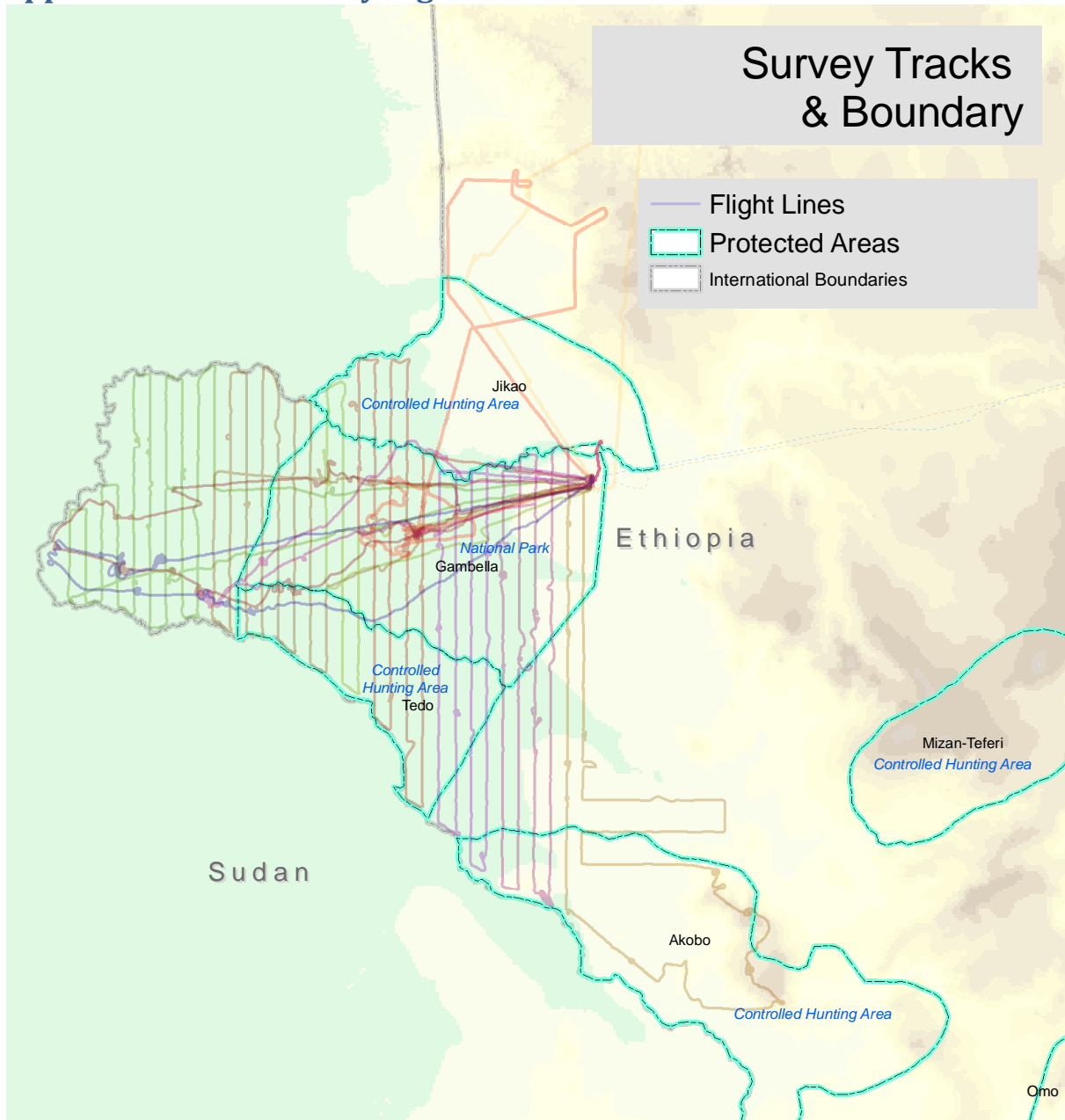
Appendix 1: 2009 survey flights

Figure 39: November 2009 reconnaissance survey flight lines.

Appendix 2: IUCN range maps

[IUCN range maps kob + lechwe)