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Full Length Research Paper

Aerial survey of Elephants (*Loxodonta africana africana*), other large mammals and human activities in Waza National Park, Cameroon

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Total aerial count of elephants, other large mammals and human activities in Waza National Park was conducted between 21st and 23rd February 2007. Total counts of elephants and other wildlife species were done and livestock numbers were estimated. A Cessna 206 Stationair six-seater aircraft fitted with GPS was used in navigation, recording survey paths and waypoints. A total of three different herds of 180 and 66 in the park along with a further 250 migrating elephant population towards Kalamaloue National Park were counted. The herds in the park were aggregated around central part of the park along watering point. The consideration of the number of the migrating herd then put the total Waza ecosystem elephant population at 496 individuals. The total number of carcasses recorded was 7 giving a carcass ratio of 2.85%. About 21,002 heads of livestock and over 50 farmlands and human settlement were estimated in the zone abutting the park. This signifies a high level of human pressures at the periphery and thus a high potential for loss of range for the elephants and illegal killing.

Key words: Aerial count, elephant, large mammals, human activity, Waza National Park.

INTRODUCTION

Elephants in Cameroon occur in three distinct bio-geographical regions, with the Savannah elephants occurring in the Northern Savannah ranges in the Sahelian and Sudanian regions and forest elephants in the Southern forested area (Tchamba et al., 1997). In 1936, the northern savanna population was estimated at no more than 200 individuals, while the Southern forested zone was thought to hold between 9,000 and 10, 000 elephants (Jeannin, 1936). Between the 1940s and the 1960s, populations in the Northern savanna reportedly doubled and by 1971, increasing elephant numbers were already cause of concern as elephants were destroying Acacia tree woodland in Waza National Park (Corfield and Hamilton, 1971). Most of the increase was associated to the immigration into Northern Cameroon from Chad, probably resulting from disturbances there such as the deforestation of the Mandelia Faunal Reserve (Fry, 1970). Yet, there are little accurate estimates of elephant populations in the Waza National Park. The lack of accurate information on elephant population is cause for concern for conservation and management of this species as in most cases elephants leave protected areas where they are relatively protected and roam into farmland, hunting zones or logging concessions where they become very vulnerable to poaching. Elephants could be used as a flagship species in developing management decision in and outside protected areas if numbers and distribution are well determined. This can only be done through population estimates over time as a means of detecting changes in population number (Craig, 2002). In order that this be done as effectively as possible, it is necessary to use method, which is efficient in producing accurate and precise results, which remain comparable over time.

Many attempts to estimate elephant population size in the Waza National Park had been done. Esser and Van Laveieren (1979) estimated 478 elephants; Eijs and

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Ekobo (1987); Steehouwer and Kouahoue (1989) estimated 750 elephants within the Park. An aerial sample count conducted in the Waza – Logone ecosystem in 1991 gave an estimate of 1,100 elephants (Tchamba and Elkan, 1995). No aerial total count has previously been conducted in the area and, given the disparities in counting methods and the growing length of time since the last systematic survey in 1991, it was important to get an up to date population estimate. Waza National Park is one of the Cameroon's MIKE (monitoring of illegal killing of elephant) sites and is believed to hold the largest elephant population in Northern Cameroon with high concentration of other large mammals, which makes Waza the focus of considerable conservation interest in Cameroon. Information on elephant numbers and range is important for effective conservation and management of Africa's elephants. Since the 1991 survey, information on elephant population size comes from ground counts of large mammals that, staff and students of the college of wildlife management of Garoua and the Park manager occasionally carried out. Moreover, only small areas of the park surface can be sampled from the ground, consequently, most of the population estimate of elephants has been inaccurate. We hypothesized that the elephant population in the Waza National Park may be declining as a result of poaching and illegal activities in the park. Therefore, the 2007 total aerial count of Waza National Park was undertaken with the aim to determine the current baseline status of Waza's elephant population and map out the threats to this Northern population and their distribution.

The following specific questions were addressed: (1) What is the current elephant population size and distribution? (2) What is the number and distribution of elephant carcasses? (3) What is the distribution and numbers of other species such as Giraffes, roan antelopes and livestock? And (4) what is the incidences of human activities that may be threatening elephants through protected area encroachment?

MATERIALS AND METHOD

Study area

Waza national park (Figure 1) is located near Lake Chad in the department of Logone and Chari, Northern Province of Cameroon and lies between 11º00'-11º30'N and 14º30'-14º75'E. It covers an area of approximately 170 000 ha with an average altitude of 300 – 320 m, rising to 500 m on the rocky outcrops around Waza village. The park lies in the Chad depression in an area of low relief with no permanent rivers. Soils are mainly ferruginous tropical with various catenas, hydromorphic soils and vertisols. The climate of the region is semi-arid, with a dry season extending from October to May. Rainfall is irregular, with an annual mean of 700 mm. The mean annual temperature is 28ºC. December is the coolest month, with a mean monthly minimum temperature of 16ºC and a mean monthly maximum temperature of 33ºC. April, just before the first rains, has a mean monthly minimum temperature of 21ºC and a mean monthly maximum temperature of 45ºC.

The vegetation comprises open combretaceous shrub savanna with ***Sclerocarya birrea*** tree savanna, ***Combretum*** and ***Terminalia*** shrubs and stands of ***Hyphaena thebaica***; ***Anogeissus leiocarpus*** woodland on sandy soil. ***Lannea humilis*** open grass savanna with short annual grasses, sparse trees and stands of ***Mitragymna innermis*** forming small islands around temporary waterholes. The ***Acacia seyal*** tree savanna on black clay soils which are saturated with water in the rainy season. The latter vegetation type is slowly spreading as the area gradually dries out. The Yaéré floodplains is populated with perennial grasses such as ***Vetiveria nigitana, Oriza longistaminata, Echinocloa pyramidalis***, ***E. stagnina*** and some herbaceous legumes including ***Sesbania pachycarpa***. Water continues to be one of the most serious problems for Waza. Recently, important dry season waterholes have been created and managed in the floodplain zone.

METHODS

Choice of the study design

Several survey methods are used to census animals in Africa. Foot count for small and accessible area, which shows little bias when carefully designed and carried out (Burnham et al., 1980). Vehicle counts are practicable and give excellent and consistent results in small to medium sized areas. Its use is only limited with the available road system and may be of poor accuracy for species with a clumped distribution (Jachmann, 1991). The dropping count method is widely used to estimate elephant densities (Barnes and Jensen, 1987; Fay, 1991). It provides relatively good results for its cost (Jachmann, 1991), but there are several potential sources of error related to deriving the index of abundance and turning this index into an estimate of elephant numbers (Barnes, 1993; Tchamba, 1992).

In the savannah ecosystem, direct aerial count is the recommended method, which has proven its effectiveness for quite longtime ago. It is widely used in South, East and West Africa (Bouché et al. 2003; Douglas-Hamilton, 1996). Reliable and consistent results can be obtained so long as some straightforward precautions are taken. It covers large area quickly and economically and is the only method for censuring in areas where access on the ground is difficult or impossible. Its use becomes limited when the vegetation is so thick that the animals cannot be seen from the air, or the animals concerned are too small (Craig, 1993).

There are several aerial survey methods, each appropriate to a different situation. The methods are described well elsewhere (Norton-Griffiths, 1978; Gasaway et al. 1986; Craig, 1993; Mbungwa, 1996; Douglas-Hamilton, 1996; Jachmann, 2001). According to Craig (2002) the choice of methods affect accuracy, precision and efficiency, although differing circumstances may demand different choices and one survey may even be made up of areas surveyed by different methods. There are four different approaches: (1) Aerial distance counts require more equipment, preparation and analysis than, (2) transect sample count, but may add both precision and accuracy. However, the degree of improvement is not known and may be slight for elephants, which does not justify the investment of using it (Craig, 2002). (3) Total counts are the most precise and accurate, as long as search-rate standard are adhered to. However, there are seldom the resources to carry them out and they should only be considered when the survey area is less than 100 km². Transect sample counts are recommended when there are fewer resources available and/or when the precision requirement demand a lower sampling intensity than 100%. Transect should be flown at a constant height, which is only possible over ground which is mainly flat. (4) Block sample counts are necessary in mountainous areas. Block counts can also be done anywhere transect counts can in the event that the additional equipment necessary to fly transects, particularly radar altimeter/ barometer-altimeter, is not available. However they are much less

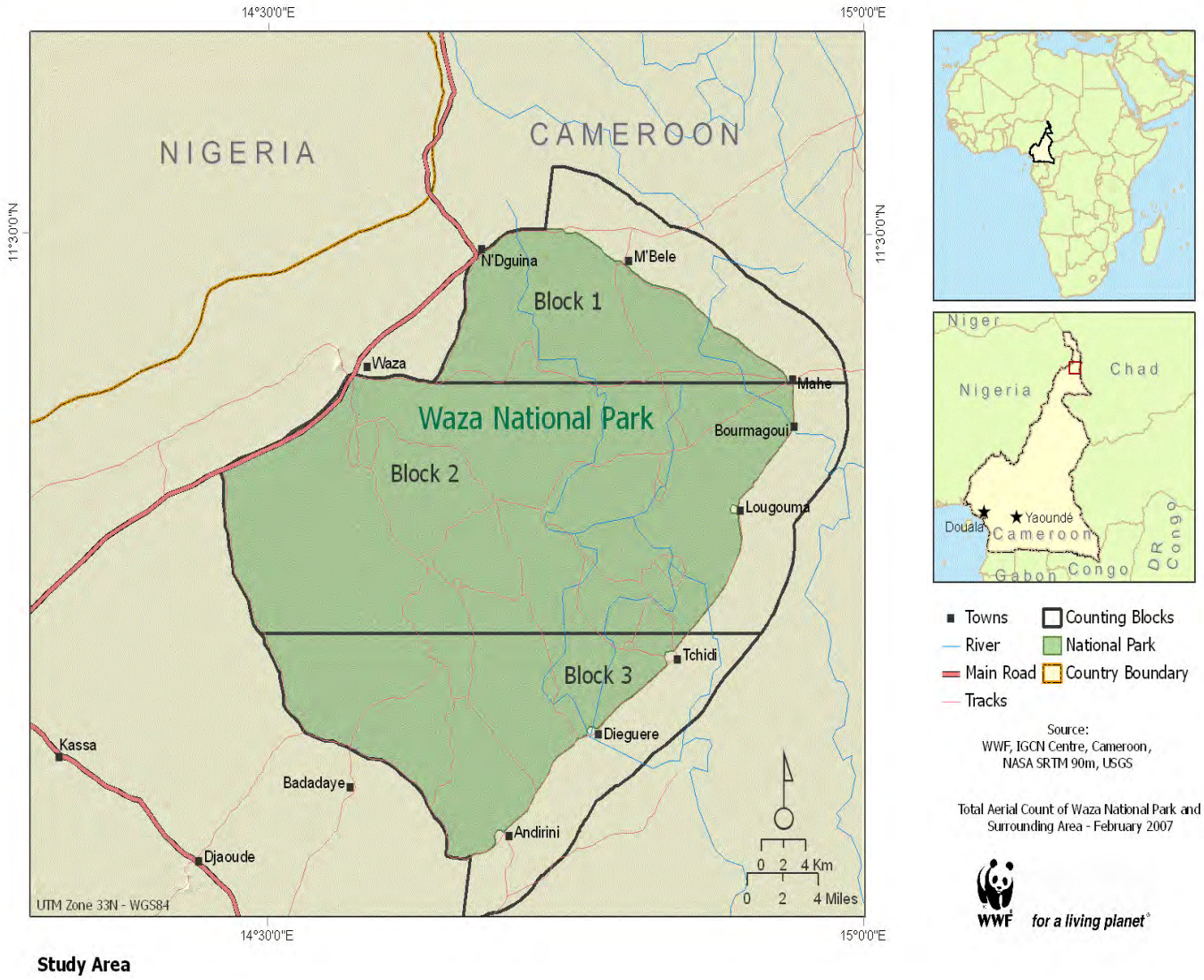

Figure 1. Study Area, Waza National Park and the buffers.

precise at the same level of effort than transect counts. We have chosen to implement total counts because of its precision and accuracy as well as the availability of the resources to carry them out.

Aerial total count: Design and data collection

Because up to date information on wildlife population in the Waza National Park was scanty, the entire area was flown to determine large mammal species occurrence and distribution. The count was carried out in February 2007. The total aerial survey technique standards for the MIKE (monitoring of illegal killing of elephant) programme as detailed in Craig (2004) and as described in Omondi et al. (2002) and Douglas-Hamilton (1996) was adopted. This technique aimed to systematically cover the entire surface of the defined census zone and to record every species of animal being counted and its geographical location (Litoroh, 2002). Total aerial count relies heavily on the experience of both the pilot and the flight crews (Douglas-Hamilton et al., 1994; Litoroh, 1995). The survey crew consisted of a pilot and his co-pilot; 01 Front Seat Observer (FSO) and 02 Rear Seat Observers (RSO). Flight crews were instructed in their roles following the protocol of Norton-Griffiths (1978) and improved upon by Douglas-Hamilton et al. (1994) and Douglas-Hamilton (1996) by incorporating the use of GPS technology.

The census area included the entire National Park and a 5 km buffer and covered an area of 1,970 sq km. The area was divided into 3 discrete counting blocks, bordered by well-defined features such as roads, rivers, and the Park boundary (Figure 1). Each crew was provided with flight maps of the block for the pilot and Front Seat Observer (FSO). Flight paths to cover each block were then selected by Pilot, FSO and GIS expert. Transects ran East-West, and were paced at 1km. The area of each block was 401 Km² for Block 1, 1,031 km² for Block 2 and 538 km² for Block 3. The count employed the Global Positioning System (GPS) technique with ArcView software used for plotting species distribution maps. A light aircraft Cessna 206 Stationair six-seater was used in the count. The aircraft had a GPS for use in navigation and recording survey paths. The animals recorded were elephants (EL) both live and

Table 1. Flight summary details of the flight logs.

Date	Take off time	Block	Start Count	End Count	Landing time	Distance (km)
21-Feb	6:32	1	6:37	9:23	9:33	326
22-Feb	6:26	2	6:30	10:47	10:55	536
22-Feb	16:21	2	16:28	17:56	17:58	177
23-Feb	6:38	3	6:47	9:31	9:58	358

(NB: Distance does not include ferrying distance to and from the blocks).

Table 2. Number and density of some large herbivores mammals' population observed in the Waza National Park in February 2007.

Species	Number (Census blocks)				Density (k (Census blocks)			Density (km²) (census zone)
	Blocks				Blocks			
	1	2	3	Totals	1	2	3	Mean (95% CL)
Elephant (EL)	180	66	0	246	0.45	0.05	0.00	0.17
Giraffe (GF)	99	458	47	604	0.25	0.44	0.09	0.26
Gazelle (GZ)	8	20	0	28	0.02	0.02	0.00	0.01
Kob (KB)	100	1462	0	1562	0.25	1.42	0.00	0.56
Lion (LN)	2	3	0	5	0.01	0.00	0.00	0.00
Ostrich (OS)	0	6	3	9	0.00	0.01	0.01	0.00
Roan antelope (RA)	2	142	4	148	0.01	0.14	0.01	0.05
Topi (TP)	61	785	2	848	0.15	0.76	0.00	0.30
Warthog (WH)	13	7	1	21	0.03	0.01	0.002	0.01

dead. Giraffes (GI), (HI) Hippotrague; (DA) Damalisque; (AU) Autruche; (Ph) Phacochere; (CB) Cobe de Buffon; (GZ) Gazelle seen were also recorded. The aim was to fly parallel lines across each block, to scan the entire surface and to record the accurate position and number of each group of animals. Dead elephants were recorded in the categories defined by Craig (2004). All observations made were saved in the GPS (Garmin X12) by the Front Seat Observer (FSO) as waypoints with the geographical location referenced and were used in producing species distribution maps. The GPS was downloaded onto a computer at the end of each day's operation and the Front Seat Observer (FSO) and the crew did a summary table of each block. Any double counts were also worked out and eliminated during these sessions. The exercise started every morning at 7.30am and ended late in the evening. Breaks were taken during refuelling of the aircraft.

Data analysis

The densities known as numbers of direct sightings or signs per unit area (km²) were calculated per block for each animal. Densities were also used for human activities. The regression analysis was carried out to test relationship between animal densities and the level of human activities. Regression analyses depend upon the assumptions of normality and homoscedasticity, with regard to the values of Y, the dependent variable. To evaluate the relative habitat preference for the survey period, the relative frequency of the species occurring in each vegetation type were calculated as the density of the species in the type compared to total density of the species in the park.

RESULTS

Survey efforts

A total of 12:27 h was flown during the survey, with a total count time of 11: 15 h giving a search rate of 175 km per hour. Table 1 provides the flight summary details of the flight logs. All species were counted in order to ascertain species diversity, distribution and status. Dead elephants were also counted and their distribution mapped.

Population number and density

09 wildlife species were counted, 85% of which was found in the central part (Block 2) of the Park. A total of 246 elephants were counted in the park and were aggregated into two large mixed groups of 180 and 66. This herd was migrating towards Kalamaloue National Park to the North.

Table 2 provides the number and the density of each species counted across census blocks. Elephants were clumped and they were counted (246 animals) along with 604 Giraffes. 75.8% of these records were in the central part of the park (Block 2). It is worthy to mention that, with known elephant migration northward in the region during

Photo 1. A herd of 66 elephants photographed during the count.

the dry season, a further recce survey conducted counted 250 elephants migrating in Kalamaloue National Park in one big aggregation. This sub-population together with the population counted in the park give a picture of 496 elephants that reside or migrate throughout Waza National Park. Seven (07) elephant carcasses spread into different categories (Recent/Old/Very old) were found. 02 carcasses were in the category recent, 04 were old and 01 was very old.

This has direct implication of poaching, which might explain the absence of most species from along the boundaries to the interior. Illegal hunting of elephant is certainly most important along the park border towards the interior. Other species counted included Roan antelope (***Hippotragus equines***), 148; Topi (***Damaliscus korrigum***), 848; Kob (***Kobus kob***), 1562; Lions (***Panthera leo***), 5; Red-fronted gazelle (***Gazella rufifrons***), 28; Ostrich (***Struthio camelus***), 9; and Warthogs (***Phacochoerus africanus***), 21 (Table 2). The animals' densities were calculated per unit area in each block surveyed and averaged across blocks. Observations show that the highest animals densities were found primarily in the kob population (0,56 animal/km²), secondarily in the topi population (0,3 animal/km²) and thirdly in the giraffe population (0,26 animal/km²). Elephant was the fourth abundant species with a mean density of 0, 17 animal/km². There were generally very low species densities of less than 0, 1 animal/km² in the remaining animals species' population per surveyed blocks (Table 2). These were Gazelle, Lion, Ostrich, Roan antelope and Warthog.

Distribution

Elephants and other large mammal distributions

There was a notable scarcity of elephants in most part of the park particularly in block 3. The total number of elephant found would be the minimum estimate given the migratory behaviour of the animal at the beginning of the dry season. Therefore, it is probable that the true figure for the park is slightly more. Figure 3 below represents elephant and carcass distribution within the study area. The elephants spotted from the air (photo 1) were ranging within the confines of watering points within the central part of the park. Most of the carcasses were sighted in areas where there were presence of livestock, farmland and human settlement (Figure 2).

The animal distributions plotted on a 1:100 000 map of the park, are shown in Figure 2. All the species were not distributed evenly. Giraffes tend to occur in high number in the central portion of the park though they can be seen widespread in low number except in the eastern section. The Kobs are concentrated in high number in the central to the eastern part of the park. They tend to congregate in the grassland around settlement. The red-fronted gazelle was recorded exclusively in the central portion of the study area particularly in the woodland zone to the west and the north and the grassland zone around settlement to the east. Topi and Roan antelope were restricted to central portion of the park. Lion and ostrich were very scarce as did warthog. Animals were in general very scanty in the southern portion of the census area. The highest densities of most species were found in the central towards the north-eastern part of the park, animals becoming scanty in the south, southeast and western portion towards the periphery. This might be explained by the presence just across the boundary, of a number of villages.

Species habitat association

Relative habitat preferences of the nine species, as derived from animal distributions plotted on a 1:100 000 vegetation map of the survey area, were established. Nearly all species exhibited habitat preference. Elephants were only found in the floodplain zone. Giraffe seems to be restricted primarily to zone, which is probably

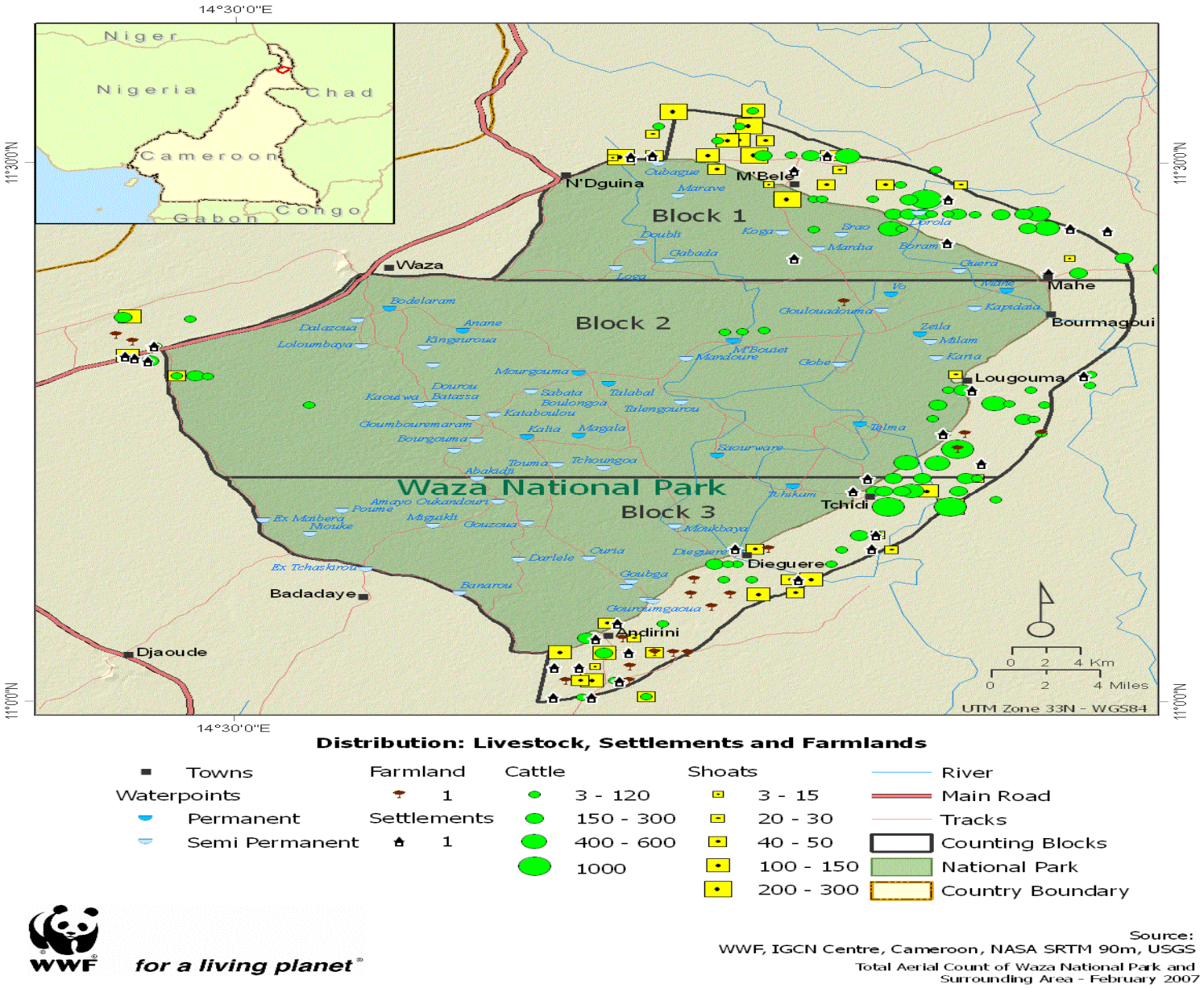

Figure 3. Distribution of livestock, settlements, farmland and other human activities in zone abutting Waza National Park in February 2007.

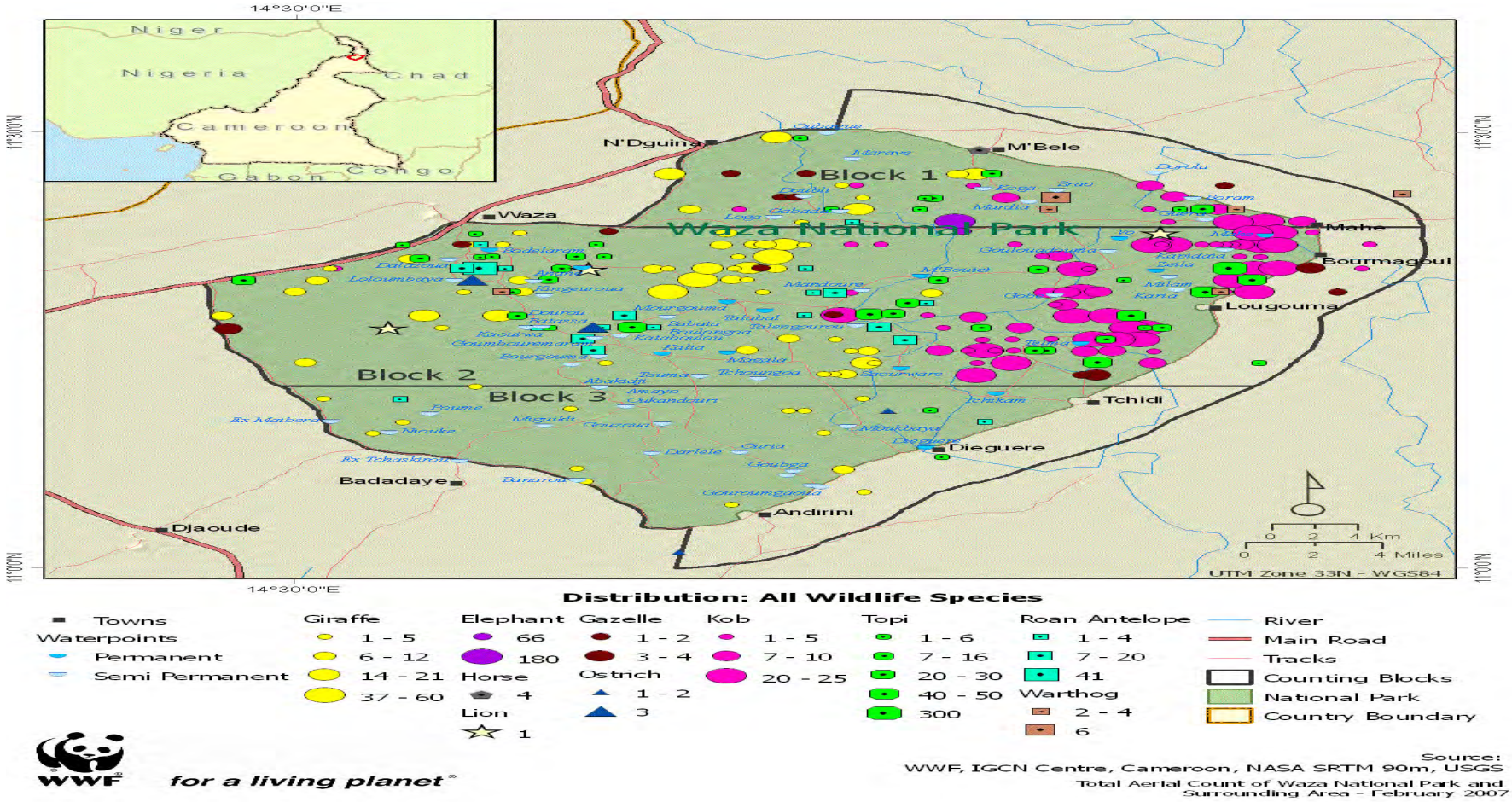

Figure 2. Wildlife species distribution in the Waza National Park in February 2007

explained by the fact that ***Acacia seyal*** is it's primarily food item. Red-fronted gazelle preferred the Floodplain zone and ***Acacia seyal*** zone and avoid the Woodland zone. Topi was mainly found in the floodplain zone and secondarily in the ***Acacia seyal*** zone. Woodland zone was the less preferred habitat for this species. Roan antelope was restricted in the ***Acacia seyal*** zone and the edge between this habitat type and the woodland zone while kob avoid the Woodland and showed a preference for the Floodplain zone probably because of the dry season growth of perennial grass such as ***Vetiveria nigritana,*** which might be excellent grazing for this species. Warthog was concentrated in the Floodplain zone and occurs in isolated individual at the edge between woodland and ***Acacia seyal*** zone. Lion occurs indiscriminately between the Floodplain zone and the woodland zone while Ostrich was restricted in the ***Acacia seyal*** zone. It appears clearly that wildlife in the Waza ecosystem avoids the

Table 3. Livestock and human settlements densities.

	Livestock and other human activities (5 Km buffers zone)				Densities (km²) (5 km buffers zone)		
	Block 1	**Block 2**	**Block 3**	**Totals**	**Block 1**	**Block 2**	**Block 3**
Illegal activity (IL)	0	0	5	5	0.00	0.00	0.01
Horse (HS)	4	0	0	4	0.01	0.00	0.00
Shoats (SH)	1.95	270	1.323	3.543	4.86	0.26	2.46
Settlement (ST)	10	8	14	32	0.03	0.01	0.03
Cattle (CT)	7.37	4.656	5.433	17.46	18.38	4.52	10.10
Fire (FI)	4	2	5	11	0.01	0.00	0.01
Farmland (FL)	0	6	13	19	0.00	0.01	0.02

Woodland zone and exhibited preferences to the ***Acacia seyal*** and the Floodplain zone. The Woodland zone might be the less suitable habitat for most species. In summary, the results showed that in general, the animal species do not use the different habitat type randomly but are to some extend selective in their choice. There is a certain preference for some habitat. We next analyzed to what extend the various ungulates are spatially associated. Observations indicate that, with the exception of elephants and to a lesser extend Lions and Giraffes nearly all other species show an increase in the number of species with which they are spatially associated, probably pointing to the limited resources availability. Multi-species groups were not observed which excludes the possibility of active aggregation behaviour among species.

Livestock and other human activities

Quantitative observations on human activity noted a heavy concentration of livestock particularly cattle and shoats. Table 3 gives livestock and human settlements spotted during the count. Figure 3 shows locations of human incidences in the park and buffers. Most of the east, southeast and northeast of the park is under heavy human pressure. Nomadic pastoralists and their herds were seen mostly at the edge of the park. Locally there was destruction of grass cover as a result of frequent and accidental burning to improve dry season growth of forage for cattle.

A total of 21,002 livestock was estimated within the buffer zone abutting the conservation area easterly. The buffer zone abutting Block 1 had the highest number of livestock 44.38% of the total with a density of 18,10/km2 and 4,86/km2 for cattle and shoats (goats and sheep) respectively, followed by the buffer zone abutting Block 3; 32,17% with densities of 10,10/km2 and 2,46/km2 for cattle and shoats respectively (Table 3 and Figure 3). The entire Park was surrounded by heavy human settlement with densities calculated at 0,03/km², 0,01/km² and 0,03/km² respectively in the zone abutting block 1, block 2 and block 3 easterly. Some isolated farmland on the park as well as bush fire was also observed. When counts recorded on all large mammal species were pooled and averaged across surveyed blocks, the results indicated a weak relationship between the animals densities and human activities densities in the three blocks (r^2 = 0.29, F = 0.692929, P > 0.05,). The Durbin-Watson statistic test of the residuals confirms a lack of significant correlation between the two variables (P > 0.05). The fitted regression line is shown in Figure 4. Therefore, animals' densities distributions in the park were not influenced by human activities. However, pressures at the periphery of the park are high.

DISCUSSION

Aerial total count was used in this study versus systematic aerial transect sampling conducted in 1991 (Tchamba and Elkan, 1995). In the dry season, aggregation of elephants is likely in some patches where they have access to water (Eltringham, 1977). Sample counting in such condition can resulted in either population underestimates or may give overestimates with high standard errors especially when large aggregations are included in a sample count (Ottichilo, 1999). Aerial total count in such condition is the most appropriate method for wildlife survey in open habitat and was therefore implemented in this study. As a result, this count puts Waza elephant population at 246 elephants sighted inside the park giving a density of 0, 17 elephant/km². Although the count was done just at the end of wet season, the visibility was good enough, and the crew could spot even a red-fronted gazelle from the air. This figure therefore represents the currently found in the park during the surveyed period. Using Tchamba and Elkan (1995) estimate of 1100 this represents a decline of 77, 5%; which is quite high and suggests this population is declining at an alarming rate. It should be noted however that the two counts used different census methods, aerial sample for the 1991 count (Tchamba and Elkan, 1995) and aerial total count during this survey. It is

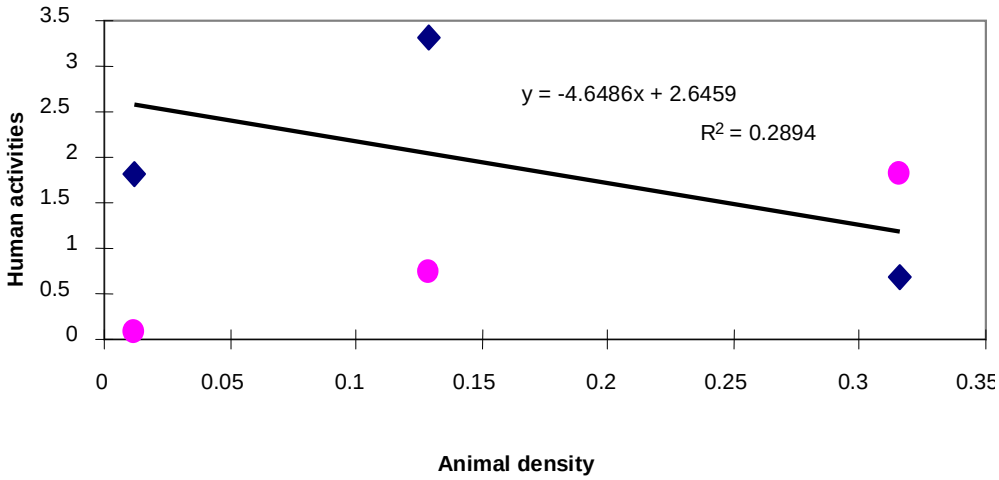

Figure 4. Fitted regression line of pooled animal and human activities' densities.

very probable that the 1991 sample count was an over estimate given the aggregation groupings of the West African elephant population. Although the population comprises of mixed group of young, sub-adults and adults a detailed study should be initiated to establish the sex, age, and social structure of this population.

Tchamba (1993) hypothesized that there are three elephant sub-populations in Waza Park. The first sub-population resides in the northern part of the park and migrates to Kalamaloue National Park at the beginning of the dry season (December-January). They return at the beginning of the wet season (May-June). The second sub-population resides year-round inside Waza National Park. The third sub-population uses the central and southern part of the park and spills out to the south of the park at the onset of rains (June-July). Indeed a recent survey conducted at the end of this survey counted 250 elephants migrating towards Kalamaloue National Park in one big aggregation. The consideration of this number then put the total Waza ecosystem population at 496 individuals and this will still represent 44.2% decline compared to the 1991 survey. Future censuses should therefore include Kalamaloue and environs particularly if they are to be done during the dry season. The migratory behavior of Waza elephants is therefore a factor, which has affected the accuracy of the present census. It is alleged that elephants are subjected to severe poaching during migrations; it is therefore possible that the population that is known to undertake short-term migration towards the Nigerian territory was missed. And, if this was the case the total population estimates for Waza elephant would be lower than expected. From the survey there was evidence of rapid habitat loss from encroachment into the elephant range. The high densities of livestock/km² inside and at the periphery of the park alongside numerous human settlements, farmlands and illegal activities indicate a rapid habitat loss that need to be addressed immediately by the Government. The shrinkage of the elephant habitats must be arrested by securing the boundaries of the current known elephant range and by evicting illegal settlers from the range. Human activities such as farming, logging, and even hunting that has led to the loss of the habitat and disturbs elephants must be immediately prevented.

From the survey, it is also evident that the on-going human activities might make Waza an "ecological island" and elephants' movement may be curtailed in the future. These elephants move in large aggregation, which could be a sign of their harassment and insecurity. An immediate attempt should be made to stop all illegal activities within the park and buffers. The boundaries of the protected elephant habitats should be clearly demarcated and secured to prevent further encroachment.

Seven elephant carcasses (recent/old/very old) were recorded during the census giving a carcass ratio of 2.85%. Poaching could therefore be one of the factors that have contributed to the decline of the Waza population. A programme to estimate age structures and sex ratios should be initiated to understand this dynamics and also establish the level of illegal killing by elephants. Although MIKE has been operational in this site since 2003, no organized patrolling goes on in Waza, and very little resources have been set aside by the Government for elephant patrols and protection. There is poor record of illegal killing in the site and with the general lack of security patrols; the future of these elephants is bleak especially if encroachment and other illegal activity continues to flourish in the Park. More resources should be set aside for wildlife protection in this Park. Intensive air and ground patrols should be carried continuously to monitor the elephant status and ensure the survival of this population. Although ***Acacia seyal*** zone had high number of species counted, population sizes of giraffe (***Giraffa camelopardalis***), roan antelope (***Hippotragus equinus***), Kob (***Kobus kob***) and topi (***Damaliscus korrigu***), Red-fronted gazelle (Gazella rufifrons) and Ostrich

(***Struthio camelus***) showed a declining trends from the 1991 estimate by Tchamba and Elkan (1995). This decline could be attributed to the level of pressure (Goldspink et al., 1998) by livestock and the illegal activities witnessed during the census. Not surprising, interviews with government officials and local villagers suggests that poaching has been proceeding in the park and environs on a large scale in the last four to seven years. Currently, ineffective (even inexistent) and inadequate Park protection remains the major source of the plight of large mammals in the area. Management structures (the Park Management Committee and the Scientific Committee) set in place to ensure the protection of the park are weak and in some cases inexistent. As such, the park has become vulnerable and if the trends continues the long-term viability of many wildlife species as well as the stability of the ecological character of the park and its environs in the long-term will be seriously endangered. Of course, because small populations of wildlife are likely to be at risk of losing genetic variability which can lead to long-term problem of inbreeding in the population (Litoroh, 1997), elephants and other animals of the park require immediate protection if they are to survive. Presently, this could be achieved by making use of the existing community guards and the few (5) game guards allocated for the protection of the conservation area of about 1700 km². Unfortunately the lack of motivation and equipment prevent efficiency. The possibility to reinforce park surveillance team with army force during field patrols should be considered. Information on elephant movement is important for their conservation and management. While modern techniques for monitoring elephant movement is cost-prohibitive, conservation body such as WWF-CCPO could assist in carrying out long-term monitoring of elephant movement along Cameroon - Tchad border as well as possible movement along Cameroon-Nigeria frontier. Concerted efforts have to be made by the relevant government of these countries concerning a joint survey, as a long-term approach to managing this elephant population.

There is an urgent need to set up a special elephant conservation program for Waza Conservation Area to conform to the strategy for the conservation of West African Elephants. The conservation program should address encroachment, establishing efficient protection systems, stopping illegal killing and managing the cross-border elephant sub-population that moves between Waza, Chad and Nigeria. The strategy should also ensure:

- Adequate park protection and surveillance for the elephants.
- Securing the buffers of Waza National Park by promoting compatible land use practices within the dispersal areas. Such an action should develop strategies that would maximize benefits from elephants to the local communities through eco tourism project. A team of Park managers, community opinion leaders should for example visit Kenya where such venture has led to efficient elephant management.
- Recruit, train, equip and motivate anti-poaching and other illegal activities patrol teams to make them efficient.
- Establish village or community game guards to control poaching and other illegal activities.
- Establish intelligence networks to combat poaching and investigate the linkage between domestic ivory trade and illegal killing.
- Undertake intensive research into the bio-diversity of the park, to establish the impact of encroachment.

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