

## BEHAVIOUR OF MAMMALS AROUND ARTIFICIAL WATERHOLES in THE WAZA NATIONAL PARK (CAMEROON)

Honore Bride TEFEMPA<sup>1a</sup> Pierre NGASSAM<sup>1</sup> Pierre Marie MAPONGMETSEM<sup>3</sup>  
Bernard Aloys NKONGMENECK<sup>2</sup> Hamide GUBBUK<sup>4</sup>

<sup>1</sup> Department of Biology and Animal Physiology, Faculty of Sciences, University of Yaoundé I, P.O. Box 812, Cameroon

<sup>2</sup> Department of Plant Biology, Faculty of Sciences, University of Yaoundé I, P.O. Box 812, Cameroon

<sup>3</sup> Department of Biological Sciences, Faculty of Sciences, University of Ngaoundere, P.O. Box 454, Cameroon

<sup>4</sup> Department of Horticulture, Faculty of Agriculture, 07059, Antalya - Turkey.

Accepted 31 January 2008

### Abstract

A study was undertaken in the Waza National Park (WNP) from March to June, to monitor the behaviour of 9 mammals around the artificial waterholes named Anane and Louloubaya. Observations were made all through the day. The frequency of observation visits to the waterholes was one per day and four times a month. The results showed three categories of animals in terms of food regime. The first group is represented by herbivorous, frugivorous such as *Loxodonta africana africana*, *Phacocheorus aethiopicus* and *Erythrocebus patas*, the second group by represented by herbivorous like *Giraffa camelopardalis*, *Hippotragus equines*, *Damaliscus korrigum* and *Gazella rufifrons* and the third by group representing carnivorous like, *Canis aureus* and *Herpestes hichneumon*. Among these species, *Loxodonta africana africana* is the main consumer whereas *Giraffa camelopardalis* is the second in the Park. High temperatures reduce the activities of the animals during the dry season as well as the number of waterholes run off. Lack of water forces some animals to migrate to other localities and those which do not die in the course of time. February is the hottest month in the WNP where temperatures reach up to 48.8 °C. The mean number of the animal visits varies with the species and from one waterhole to another. *Loxodonta africana africana* was the most frequently seen species around the waterholes (47.72%) followed by *Hippotragus equinus* (16.57%) and *Damaliscus korrigum* (14.77%). *Balanites aegyptiaca* *Ziziphus* spp and *Tamarindus indica* are the main species eaten by the animals. However, these plant species are equally consumed by the local population as fruits. Therefore, it is necessary to domesticate them with a view to maintain the biodiversity of the area.

**Key words:** WNP, Mammals, Waterholes, Meteorology, Behaviour, Biodiversity

### Waza (Camerun) Ulusal Parkında Yapay Su Göletleri Çevresinde Memelilerin Davranışları

#### Özet

Bu çalışmada, mart ayından haziran ayına kadar geçen surede Wasa Ulusal Parkın'da (WNP) Anane ve Louloubaya olarak adlandırılan yapay göletlerin çerçevesinde 9 memelinin davranışları incelenmiştir. Gözlemler gün boyunca yapılmıştır. Yapay göletlerde gözlem sıklığı günde bir ve ayda 4 defa yapılmıştır. Araştırma sonuçları, yiyecek rejimleri bakımından hayvanların 3 kategoriye sahip olduğunu göstermiştir. Birinci grup, *Loxodonta africana africana*, *Phacocheorus aethiopicus* ve *Erythrocebus pata* olmak üzere ot obur ve meyve ile beslenenler olarak gruplandırılmış, ikinci grup *Giraffa camelopardalis*, *Hippotragus equines*, *Damaliscus korrigum* ve *Gazella rufifrons* gibi ot obur ve üçüncü grup ise *Canis aureus* ve *Herpestes hichneumon* gibi et obur olarak adlandırılmıştır. Parkta bu türler arasında, *Loxodonta africana africana* ana ve *Giraffa camelopardalis* ise ikinci tüketici olarak saptanmıştır. Yüksek sıcaklık, kurak sezonda hayvanların aktivitesini azaltmış ve ayrıca yapay göletlerin kurummasına neden olmuştur. Suyun azlığı bazı hayvanların göç etmesine neden olmuş ve bu sure zarfında hayvanlar ölmemiştir, Şubat ayı WNP'de en sıcak ay olarak saptanmış ve bu ayda sıcaklık 48,8 °C'nin üzerinde saptanmıştır. Hayvanların ortalama olarak bir yapay göletten diğerine seyahatleri türlerine göre değişiklik göstermiştir. *Loxodonta africana africana* yapay göletler etrafında en yüksek oranda (%47.72) görülen tür olarak saptanmış ve bunu *Hippotragus equinus* (%16.57) ve *Damaliscus korrigum* (%14.77) izlemiştir. *Balanites aegyptiaca* *Ziziphus* spp ve *Tamarindus indica* hayvanlar tarafından yenen başlıca türler olarak saptanmıştır. Fakat bu bitki türleri, orada yaşayan yerli halk tarafından da esit şekilde tüketilen meyve türleri olarak saptanmıştır. Bu nedenle, bu alanlarda genetik çeşitliliği artırmak açısından, bu türlerin kültüre alınmasına ihtiyaç duyulmaktadır.

**Anahtar Kelimeler:** WNP, Memeliler, Yapay Gölet, Meteoroloji, Davranış ve Genetik Çeşitlilik

<sup>a</sup> Corresponding author: H. B. Tefempa, e-mail: [tefempa@yahoo.fr](mailto:tefempa@yahoo.fr)

## **1. Introduction**

Nowadays, mammal populations in Cameroon are observed to be decreasing. Numerous species which were abundant before have either disappeared today or are under severe threat (Banque Mondiale, 1990). According to the World Bank it is partly due to the destruction of their habitat usually by grassing (65 %) and / or due to agriculture. Various other constraints continue to fragilise their remaining habitat (the increasing pressures of human population, the critical national economic situation of the developing countries and so on). In addition, 75 % of the developing countries population mainly in the sub-Saharan Africa depend on wild fauna as the source of food (Asibey, 1974; Ngandji, 1997). Hunting is at the origin of the extinction or of the scarcity of the wild fauna (UICN, 1990). The Waza National Park (WNP) hosts a highly diversified mammalian fauna among which exist an extremely abundant population of ungulates, artiodactyls, carnivorous and primates (Tefempa *et al.*, 2006a). During the dry season when the temperature is very high between 13 and 16 hours, they remain under *Acacia* spp., *Balanites aegyptiaca* and *Tamarindus indica* trees for shade (Tefempa *et al.*, 2006b). Water is a determinant in these animal species for their biological needs. In the Central African forests, the availability of fruits has an influence on the mobility and distribution of elephants during the dry season (Blacke, 2000). Mostly where food and water become scarce, they could be concentrated in great number around the same source of water (Tsague, 2004). Seasonal migrations and habitat selection by the elephant populations are done with respect to the availability of the aforementioned factors (Tchamba, 1993). Spatio - temporal distribution of the waterholes is fundamental for their daily and seasonal migration (Fryxell and Sinclair, 1988; Senzota and Mtaliko, 1990). The quantity of water available in the medium varies according to the time and the meteorological conditions, the pedagogical factors as well as the intensity of their utilization by the animals (Lemoine and Katrin, 2003). The use of the artificial water

sources becomes very important during the driest periods in the year when natural water sources by rain dry up. The water supply from the artificial waterhole has become very important for the management of the wildlife in most of the African National Parks. The WNP is one of the most important parks in Africa in general and in Central Africa in particular. From year to year the dryness in the region is becoming preoccupied problem.

The present study has been undertaken in view to understand the daily behaviour of the mammals in the WNP under climate constraints. The specific objectives are to identify the frequent mammals remaining in the area; to determine the daily period during which their activity is intensive; to evaluate the evolution of environmental factors such as hygrometry, wind, light, intensity and temperature.

We aim that this information will serve as a baseline to develop appropriate management strategies in order to keep animal diversity in the WNP and also to identify mammals which can be domesticated and used in existing farming systems of the area to alleviate some of the constraints of farmers.

## **2. Materials and methods**

### *2.1. Study site*

The National Park of Waza is located in the far northern province of Cameroon. The climate is soudano-sahelian type. It is characterized by a much extended dry season and a short rainy season. The mean annual pluviosity is 800 mm with great interannual variation. The mean annual temperature is 27.7°C (Letouzey, 1968). The rain is randomly distributed along the year. Nevertheless 50 to 60% of the precipitation is recorded during August and September (Beauvillain, 1968). The vegetation of the WNP is made up of savannah and steppe. These plant formations are characterized by large area of herbs mainly, Gramineae protected by wooding layer showing variable density. Wooding layer is

composed by various *Acacia* spp., *Balanites aegyptiaca*, *Ziziphus* spp.; among which species like *Anogeissus leocarpus*, *Bauhinia reticulata* and various *Ficus* sp. are also equally present. The altitude of the landscape varies from 300 to 310 m of altitude from the east to the west with little denivellation in flooding area locally known as ‘yaeres’ in fufulde (UICN, 1997).

## 2.2. Methodology

Investigations were carried out from March to June around two artificial waterholes of Anane (324 m of altitude, 11.3297N latitude and 14.61869E longitude) and Louloubaya (329m of altitude, 11,3290N latitude and 14,5616E longitude). These two waterholes have been targeted on the basis of frequency of the animals passing through. They were sampled and geo referenced. Parallel to the above-mentioned location characteristics of the waterholes, daily physical parameters (temperature, relative humidity, light and wind) were registered respectively by thermohygrometer, luxmeter and anemometer.

Animals were observed daily for 5 days, twice per month from 6 to 18.30 hours. During the day, the arrival and departure hours of the animals were noted with respect to one waterhole per day. The structure of the animal troop was evaluated as well as the sex distinction (males and females). The number of individuals per flock was counted and the herd profile determined. Data was analysed using Statgraphic Plus package.

## 3. Results and discussion

### 3.1. Biodiversity and distribution around artificial waterholes

#### 3.1.1. Major animals

A total of 1448 animals distributed into nine species, were monitored in the WNP from March to June 2004. A total of 1448 visits of 9 animals species has been registered around the artificial waterholes in respect to 952 at Anane (65.71%) and 496 at Louloubaya (34.29%). The nine species are regrouped into three orders (Ongules, Artiodactyles, Carnivores and Primates). The frequency of visit varies from 0.27% to 47.72% (Table 1).

The most frequent species found around the mare were mostly *Loxodonta africana africana* (47.72%), *Hippotragus equinus* (16.57%) and *Damaliscus korrigum* (14.77%). This result suggests that water is a determinant factor for the aforementioned species. They frequent these waterholes several times during the day. The main periods of visits are as follows: 8-9h, 12-13h and 16-18hours. After drinking water, animals rest under trees. The drinking duration of these animals is affected by the noises of vehicles of tourists.

#### 3.1.2. Plants and animal interactions

In general, the animals forage the vegetation around the waterholes, and the foraging behaviour varies among the species found. The *Giraffa* are extremely selective

Table 1 Distribution of Animals Around Two Waterholes

Species	Number of Individuals		
	Anane	Louloubaya	Total Number
<i>Loxodonta africana Africana</i>	437 (30.17)	254 (17.54)	691(47.72)
<i>Giraffa camelopardalis</i>	30 (2.07)	57 (3.93)	87 (6.00 )
<i>Hippotragus equines</i>	180 (12.43)	60 (4.14)	240 (16.57)
<i>Damaliscus korrigum</i>	136 (9.39)	78 (5.38)	214 (14.77)
<i>Gazella rufifrons</i>	20 (1.38)	0	20 (1.38)
<i>Phacocheorus aethiopicus</i>	15 (1.03)	24 (1.65)	39 (2.68)
<i>Canis aureus</i>	31 (2.14)	0	31(2.14)
<i>Herpestes hichneumon</i>	4 (0.27)	0	4 (0.27)
<i>Erythrocebus patas</i>	99 (6.83)	23 (1.58)	122 (8.47)
Total	952 (65.71)	496 (34.29)	1448 (100)

regarding their food pattern. They eat selectively *Balanites aegyptiaca* and *Acacias* (*Acacia seyal* and *A. ataxacantha*). The following examples illustrate strategies and choices of each animal.

*Loxodonta africana africana* prefers *Acacia* spp., *Balanites aegyptiaca*, *Tamarindus indica*, *Ziziphus mauritiana*, *Terminalia macroptera*, *Piliostigma reticulatum*, and *gramineae*s (Tefempa *et al.*, 2007). However, *Erythrocebus patas* survives on various fruits whereas; *Phacocheorus aethiopicus* eats tree roots, bulbs, rhizomes and *Poaceae*s. *Hippotragus equinus*, *Damaliscus korrigum* and *Gazella rufifrons* forage on young buds of shrubs and *gramineae*s. *Herpestes hichneumon* eats small reptiles and insects whereas *Canis aureus* birds, small rodents and rest of meats left by *Panthera leo* (lions) and *Hyena* spp. (hyenas).

### 3.2. Visits scheduling during the day around the waterholes

Waterholes are visited by various animals usually from 0600hrs a.m to 1800h pm while the *Giraffa camelopardalis*, visit the waterholes between 8-12h am and 14-18h pm. These animals are able to spend more than 3 to 4 days without drinking. A *Giraffa* can consume in average 90 to 100 litres per up take. Similar results are reported in the Benue National Park (BNP) (Asibey, 1974; Tsagué, 2004). In case of insecurity, it may spend a month without drinking (Tsagué, 2004; Kingdon, 1997). *Hippotragus equinus* visits the waterholes from 7 to 12hours and 14 to 18hours. In the BNP of Cameroon, Tsagué (2004) reported that *Hippotragus* visits waterholes in the morning and in the evening. Our findings in the WNP concerning the abovementioned animals (*Giraffa camelopardalis*, *Hippotragus equinus*) in terms of daily visits are in agreement with those registered in BNP (Tsague, 2004). The author registered 50 and 250 visits for *Giraffa camelopardalis* and *Hippotragus equinus* respectively. These figures can increase as soon as food resources (food and water) became scares. If these conditions prevail, animals regroup themselves in search of new

water points and grazing area (Tsagué, 2004; Tefempa *et al.*, 2006a; Ngandjui, 1997). For *Damaliscus korrigum*, the drinking time is between 7-9hours and 15 - 18hours, whereas, in *Gazella rufifrons*, it is between 6 and 13hours. The *Phacocheorus aethiopicus* drinks between 6-11 hours in the morning and 14-18hours in the evening. *Canis aureus* drinks later in the morning around 9-11 hours and from 14 to 17 hours. As far as *Herpestes hichneumon* is concerned, the drinking time is scheduled only in the morning and very early between 6 and 8 hours. *Erythrocebus patas* like the other animals drink two times during the day: 9-13 hours and 16-18 hours.

Generally, animals do not visit the waterholes between 12 and 13 hours. During this period, temperatures are very high and animals are seen to rest under shades of *Acacia* spp., *Balanites aegyptiaca* and *Tamarindus indica* trees (Tefempa *et al.*, 2006b; Tefempa *et al.*, 2007). The great number of animals registered in WNP suggests that the mammalian fauna is very diversified and rich.

### 3.3. Daily variation of environmental parameters around the artificial waterholes

The behaviour of the animals around the waterholes is significantly influenced by meteorological conditions of the site.

During the dry season, the temperature varies from 27.17 to 47°C (Anane) and 29.5 to 48.8°C (Louloubaya). While the variation in relative humidity, raises from 0.3 to 5.4% (Anane) and 4 to 8.3% (Louloubaya). With respect to light, the quantity varies at Anane from 430 lux to 1903.6 lux whereas; it ranges from 1236 to 1995 lux in Louloubaya. The speed of the wind varies significantly ( $P < 0.05$ ) from Anane (2.7 to 7.2 m/s at Louloubaya 2.9 to 9.2 m/s).

Generally, the climatic parameters are significantly different in the sites. The high point for each parameter varies from site to site and is also different with respect to time. In Anane, the maximum temperature is at 18h30min whereas, at Louloubaya, it varies between from 12h30 and 16h30min. However, in case the

of relative humidity, the reverse is observed. In Louloubaya two maximum time period such as 6h30 and 15h30min and in Anane 14h30min are observed. The evolution of light is similar in both the sites. The highest point is located between 9h30 and 15h30min. While the high point of the velocity of the wind is 16h30min in Anane

and 17h30min Louloubaya (Figure 1). Climatic affects does has an affect on the behaviour of the animals while also the availability of the water in the mare.

Water is a determinant resource in the life of the animals during the dry season in the National Park of Waza. Waterholes are found where animals drink water in the

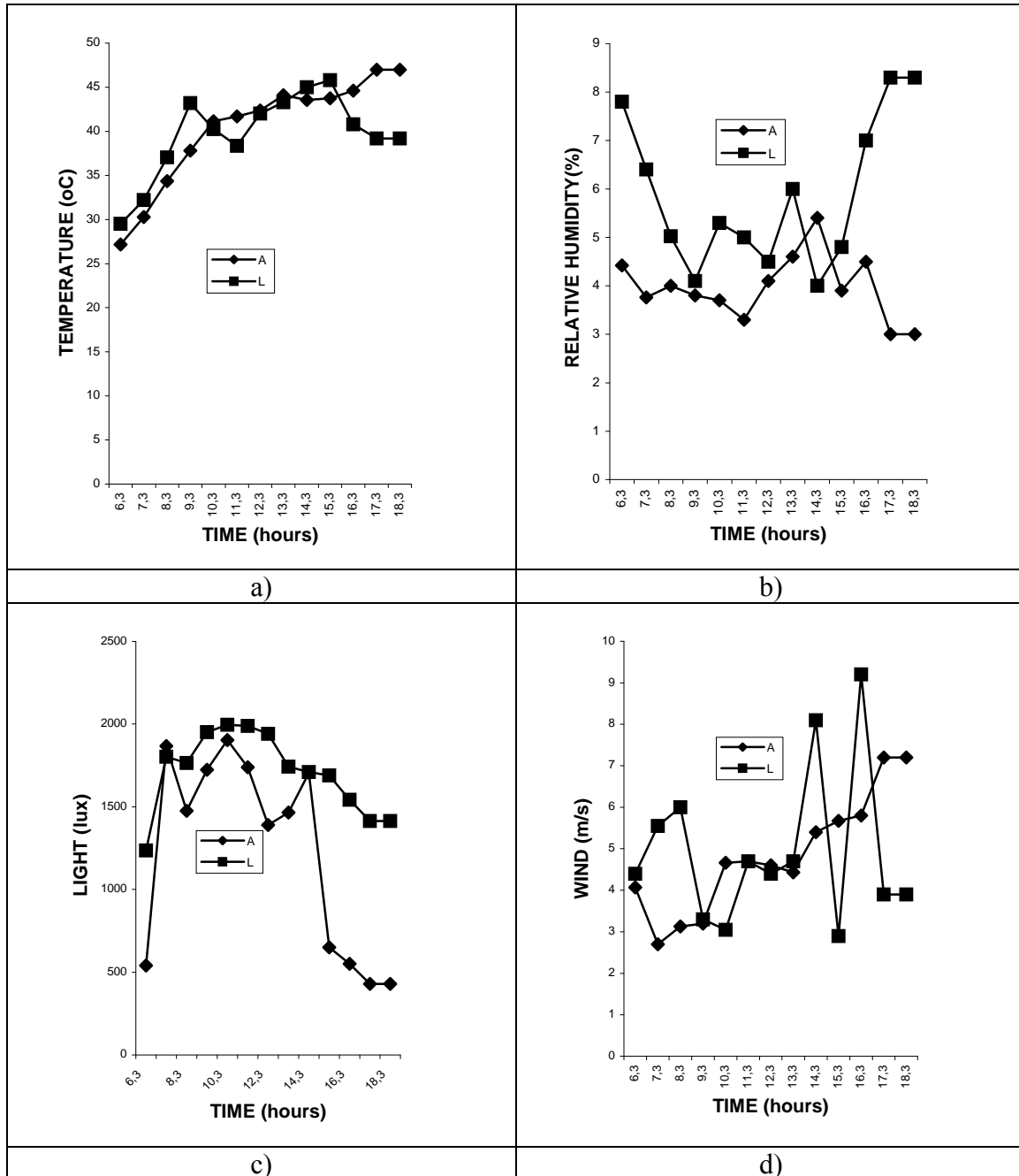


Figure 1 Daily distribution of environmental parameters around Anane (A) and Louloubaya (L) waterholes in Waza National Park during the dried season with respect to temperature (a), relative humidity (b), light intensity (c) and wind rate (d).

Park. The waterhole capacity is a function of the size of the animal troops visiting the waterholes. From March to June, the capacity of water in the Anane artificial waterhole varied significantly ( $P < 0.05$ ) from 1632.4m<sup>3</sup> to 307.69 m<sup>3</sup> whereas in Louloubaya, it decreased from 1453.45 m<sup>3</sup> to 287.48 m<sup>3</sup>. These variations can be attributed to abiotic (effect of the meteorological conditions that we described) and biotic factors (effect of the various animals visiting the area).

In the abiotic conditions, meteorological conditions play a determinant role via temperature and light. The high temperature and light leads to water evaporation and dryness. We notice that when the climatic conditions of the park become drastic, animals spend most of their time around the waterhole to drink water several times. This behaviour permits animals to replace the water transpired or passed by urine. Our investigations reveal that temperature existing around the waterholes varies from 27 to 47 °C while the total light quantity rises from 540.25 to 1995 lux. These values when compared with those registered in the Maroua airport meteorological station are very high. They suggest that a particular microclimate exists in the WNP. This harsh microclimate affects significantly the evapotranspiration of the area. In addition to climatic conditions, the physical properties can allow water infiltration. In South East parts of Australia, Trent *et al.* (2006) reported that *Helieioporus australiacus* is active from December to June. During this period, the mean temperature is 8°C whereas the relative humidity is 50 %. When the temperature increases to 16 °C and the relative humidity to 60%, the species are in a state of stress. Similar constraints prevail in the WNP from February to March 2007 where many waterholes gets dried up among Gombouemaram, Bodelaram, Mougourma and Dourou Batassa. The dryness of these waterholes forces some animals to leave the WNP to other areas in search of suitable conditions. Those which could not migrate die for lack of water which is mostly common in the case of *Canis aureus* and *Herpestes hichneumon*. Distance between the two waterholes is about 5 to 6 km. These

results suggest that high temperatures reduce animals' activities.

#### 4. Conclusion

A total of 1448 visits of 9 animal species have been recorded around Anane and Louloubaya artificial waterhole in WNP. The main groups of species are comprised of Ongules, Artiodactyles, Carnivores and Primates. The visit frequency varies from less than 0.27% to more than 47.72%. The most frequenting species are *Loxodonta africana africana* (47.72%), *Hippotragus equines* (16.57%), *Damaliscus korrigum* (14.77%) and *Erythrocebus patas* (8.47%). These animals visit the artificial waterhole all the day long from 06 hours to 18.30 hours. Meteorological conditions affect animals' activities as well as the availability of water. Water is a key resource in the life of the animals during the dry season in WNP. The quantity of water in the artificial waterhole varies according to the size of the animal troops visiting it.

In view to manage National Parks in a sustainable manner, it is necessary to track some animals by using Radio-VHF team collar and satellite transmitter; increase the number of waterholes and supply them with water during dry season; increase the number of invigilators; mobilise sufficient resource and equipment to invigilators to enable them to deter bandits. These precautions will maintain animals in place and limit their migration toward neighbouring parks.

#### Acknowledgments

The authors would like to thank friends and anonymous reviewers who edited the paper and make comments which help improving the quality of the manuscript.

#### References

- Asibey E.O.A., 1974. Wildlife as a source of protein in Africa south of Sahara. *Biology. Conservation*, 6(1):32-39.
- Bouvillain A., 1989. Nord-Cameroun. Crises et

- peuplements. Thèse de Doctorat. Lettre, Université, Rouen, 648p
- Banque Mondiale., 1990. Living with wildlife: wildlife resources management with local participation in Africa. Document technique. Washington 130: 530p
- Blacke S., 2000. Quand on essaie d'en savoir plus sur les éléphants de forêt. Bulletin sur l'Environnement et en Afrique Centrale. Canopée. 19: 3p
- Fryxell J.M. and Sinclair A.R.E., 1998. Seasonal migration of the white eared kob in relation to resources. *Afr. J. Ecol.* 26: 17-31.
- Kingdon J., 1997. The kingdon field guide to African Mammals. Academic Press, London 44(15): 211-218.
- Lemoine N et Katrin B.G., 2003. La migration des oiseaux affectés par le réchauffement climatique. Johannesburg Gutenberg. University (Mairiz, Allemagne), Centre International de Recherche Scientifique. <http://www.ip.org/afr>.
- Letouzey R., 1968. Phytogéographie du Cameroun. Paris, France. Lechevalier (éd.). 511p.
- Ngandjui G., 1997. Inventaire et utilisation durable de la faune mammalienne en milieu forestier équatorial. Cas du secteur ouest de la réserve de Biosphère de Dja (Sud Cameroun). Thèse de Doctorat, Université Paul Valéry, Montpellier III, 215p.
- Senzota K.B.M and Mtaliko., 1990. Effect of wildlife on a waterhole in Mekume National Park, Tanzania. *Afr. J. Ecol.* 28: 147-151.
- Tefempa H.B, Ngassam P, Mapongmetsem P.M, Mvondo A.J.P. et Dongmo F., 2006a. Démographie et stratégies alimentaires des éléphants dans le Parc National de Waza. *Procédés Biologiques et Alimentaires*, 3(1): 104-116.
- Tefempa H.B, Ngassam P, Mapongmetsem P.M, and Dongmo F., 2006b. Disponibilité de l'eau et comportement des éléphants dans les zones sèches d'Afrique. Communication orale, Biosciences, Douala, du 14 au 16 Décembre 2006, 18p.
- Tefempa H.B, Ngassam P and Mapongmetsem P.M., 2007. Utilisation de l'espace et de l'habitat par les éléphants dans les zones sèches du Cameroun. 18 ème congrès de Aetfat, Palais de congrès Yaoundé du 26 février 2006 au 3 mars 2007. 9p.
- Trent D.P, Frenk L.L and Michael J.M., 2006. Meteorological effects on the activity of the giant burrowing frag (*Heleioporus australiacus*) in South-eastern Australia. CSIRO Publishing. *Wildlife Research*. 33: 35-40.
- Tsagué L., 2004. Contribution à l'étude des ongulés Artiodactyles de la réserve de biosphère de la Bénoué (Cameroun): diversité spécifique, structure des peuplements et utilisation de l'espace. Thèse de Doctorat d'Etat. Université de Yaoundé I. Faculté des Sciences 181p.
- Tchamba N.H., 1993. Number and migration patterns of savanna elephant in northern Cameroon. *Pachyderm* 16 : 66-71.
- UICN., 1997. Plan directeur d'aménagement du Parc National de Waza. 63p.
- UICN., 1990. Ressources et espaces Naturels. *Bulletins de la délégation régionale en Afrique de l'Ouest* 5:269p.