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Fire and grazers in the West African savanna

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Chapter 2

Study area

2.1 LOCATION

This study was carried out in Bénoué National Park (1800 km^2), located in the northern Guinea savanna belt in north Cameroon (Fig. 1). Annual rainfall ranges from 1200 to 1500 mm and is strongly unimodal with a wet season from April to October. Soils are ferruginous tropical (Brabant & Humbell 1974). Although the highest point reaches up to over 1000 m, most of the terrain is characterised by low hills with two-thirds of the area between 300 and 450 m altitude. The main watercourse in the park is the Bénoué River, which originates south of the park and is one of the main tributaries of the Niger River. Bénoué N.P. is connected to two other national parks in Cameroon North Province, Bouba Ndjida N.P. and Faro N.P., by 26 hunting zones that are exploited for commercial hunting (Fig. 2). Together these areas constitute a protected areas network of over 23,500 km^2, which equals 44% of the North Province land area (Mayaka 2002).

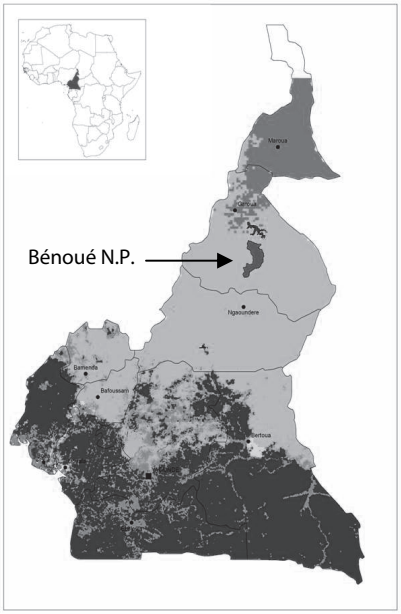

Fig. 1. Location of Bénoué National Park, Cameroon.

2.2 VEGETATION

The dominant vegetation type in Bénoué N.P. is woodland savanna dominated by the tree *Isoberlinia doka* (Leguminosae–Caesalpinoideae). Along watercourses riparian forest dominated by *Anogeissus leiocarpus* (Combretaceae) is found. Other vegetation types are open savannas dominated by the tree genera *Terminalia* (Combretaceae), *Burkea* and *Detarium* (Leguminosae–Caes.) (Stark & Hudson 1985). The main grass species in the park belong to the genera *Andropogon*, *Hyparrhenia*, *Loudetia* and *Schizachyrium* (Verweij *et al*. 2006). Dominant grass species that were recorded in an experimental plot in the south-eastern part of the park include *Loudetia flavida* and *Schizachyrium*

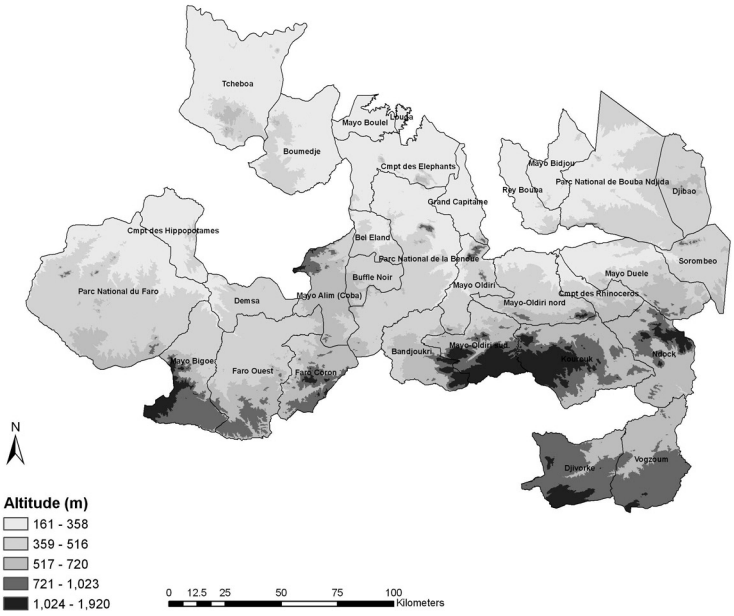

Fig. 2. National parks and hunting zones of Cameroon North Province. Elevational data based on USGS/NASA SRTM data (Jarvis *et al*. 2006).

schweinfurthii (Table 1). The species and cover percentages in other parts of the park may be different, however. Other grass species recorded in the park include *Andropogon canaliculatus* Schumach., *Beckeropsis unisetum* (Nees) Benth., *Diheteropogon amplectens* (Nees) Clayton, *Panicum pansum* Rendle and *Sporobolus festivus* A. Rich.

2.3 FAUNA

The large herbivore fauna in the park is represented by a total of 17 species of ungulates (Table 2), ignoring the western subspecies of black rhinoceros (*Diceros bicornis longipes*) which is likely to be extinct (www.iucn.org/en/news/archive/2006/07/7_pr_rhino.htm). The ungulate species list contains 12 species of antelopes and buffalo (family Bovidae), including the world's largest antelope species, i.e., Derby's eland. By far the most common antelope species in Bénoué N.P. is kob, a strongly water-dependent species which is always found within 3 km of water (Stark 1986). Curiously, kob is very rare in the nearby Bouba Ndjida N.P. where bohor reedbuck is the dominant species. Korrigum was

Table 1. Grass species composition recorded in a fire experiment in the study area. Species names follow Van der Zon (1992).

Species	Percentage
Andropogon gayanus Kunth	2.1
Andropogon pinguipes Stapf	0.8
Andropogon tectorum Schumach. & Thonn.	0.8
Ctenium newtonii Hack.	3.8
Cymbopogon giganteus Chiov.	4.0
Elymandra androphila (Stapf) Stapf	16.7
Hyparrhenia rufa (Nees) Stapf	0.8
Loudetia flavida Stapf	20.7
Loudetia simplex (Nees) C.E. Hubbard	1.3
Pennisetum unisetum (Nees) Benth.	0.6
Schizachyrium brevifolium (Sw.) Büse	2.5
Schizachyrium schweinfurthii (Hack.) Stapf	35.2
Schizachyrium platyphyllum (Franch.) Stapf	6.1
Schizachyrium sanguineum (Retz.) Alston	4.4
Total	100.0

never recorded in three years of field work and is certainly very rare or possibly locally extinct. However, it does still occur in the region (e.g., Bouba Ndjida N.P.) and a small population may be present in the more arid northern parts of Bénoué N.P. In addition to the antelopes, Bénoué harbours two species of pigs, the western subspecies of giraffe (*G. c. peralta*), common hippopotamus and savanna elephant (Table 2). Warthog is an obligate grazer whereas red river hog is omnivorous. The latter species is more common in the forest zone of West Africa (Kingdon 1997, Grubb *et al*. 1998) and within savanna areas such as Bénoué N.P. it is only found in gallery forest. Hippopotamus are found in the Bénoué River where groups of tens of individuals reside in the deeper pools ('mares des hippopotames') (Ngog Nje 1986). Mountain reedbuck (*Redunca fulvorufola*) and sitatunga (*Tragelaphus spekii*) have been recorded in the region but are not known to

Table 2. The seventeen species of ungulates recorded in Bénoué N. P., exluding the possibly extinct subspecies of black rhinoceros (*Diceros bicornis longipes*). Body mass data are taken from Kingdon (1997) and refer to the average weight of male and female. The status in the park is based on field observations during transect counts.

Common name	Species	Body mass (kg)	Guild	Status
Red-flanked duiker	*Cephalophus rufilatus* Gray	10.0	Browser	Common
Oribi	*Ourebia ourebi* Laurillard	17.0	Grazer	Common
Common duiker	*Sylvicapra grimmia* Linnaeus	17.5	Browser	Fairly common
Bohor reedbuck	*Redunca redunca* Pallas	47.0	Grazer	Rare
Bushbuck	*Tragelaphus scriptus* Pallas	48.5	Browser	Fairly common
Red river hog	*Potamochoerus porcus* Linnaeus	80.0	Omnivorous	Rare
Warthog	*Phacochoerus africanus* Gmelin	82.5	Grazer	Uncommon
Kob	*Kobus kob* Erxleben	85.8	Grazer	Very common
Korrigum	*Damaliscus lunatus* Burchell	126.5	Grazer	Rare / extinct?
Hartebeest	*Alcelaphus bucelaphus* major Pallas	161	Grazer	Fairly common
Waterbuck	*Kobus ellipsiprymnus* Ogilby	215	Grazer	Uncommon
Roan	*Hippotragus equinus* Desmarest	261.3	Grazer	Uncommon
Derby's eland	*Taurotragus derbianus* Gray	539.3	Browser	Rare
Buffalo	*Syncerus caffer* Sparrman	550	Grazer	Rare
Giraffe	*Giraffa camelopardalis* Linnaeus	1340	Browser	Uncommon
Hippopotamus	*Hippopotamus amphibius* Linnaeus	1715	Grazer	Locally common
African savanna elephant	*Loxodonta africana* Blumenbach	4000	Mixed Feeder	Rare

occur in the park. Large predators in the park are lion (*Panthera leo*), leopard (*Panthera pardus*) and spotted hyeana (*Crocuta crocuta*), whereas smaller carnivores include serval (*Felis serval*) and various species of mongooses (Herpestidae) and genets (Viverridae).

In addition to the herbivore species described above, a number of non-ungulate species larger than 2 kg that include grass in their diet are found in Bénoué N.P.: Whyte's hare (*Lepus [saxatilis] victoriae*), Egyptian goose (*Alopochen aegyptiacus*),

rock hyrax (*Procavia capensis*), spur-winged goose (*Plectropterus gambensis*), greater cane rat (*Thrynonomys swinderianus*) and olive baboon (*Papio [cynocephalus] anubis*). These species were excluded from the research presented in this thesis.

2.4 FIRE

Annual fires are an important feature of the savanna in Bénoué N.P. and its surrounding hunting zones. As is shown by satellite data (Tansey *et al*. 2007), fire frequencies in West Africa are generally higher than in East or southern Africa due to higher fuel loads. These data show that fire frequencies in Cameroon North Province are highest in the parks of Bouba Ndjida and Faro and in the hunting zones Z14 (Boumedje) and Z18b (Mayo Bigoe). The mean fire return interval in the period 2002–2007 in Bénoué N.P. was 2.26 years.

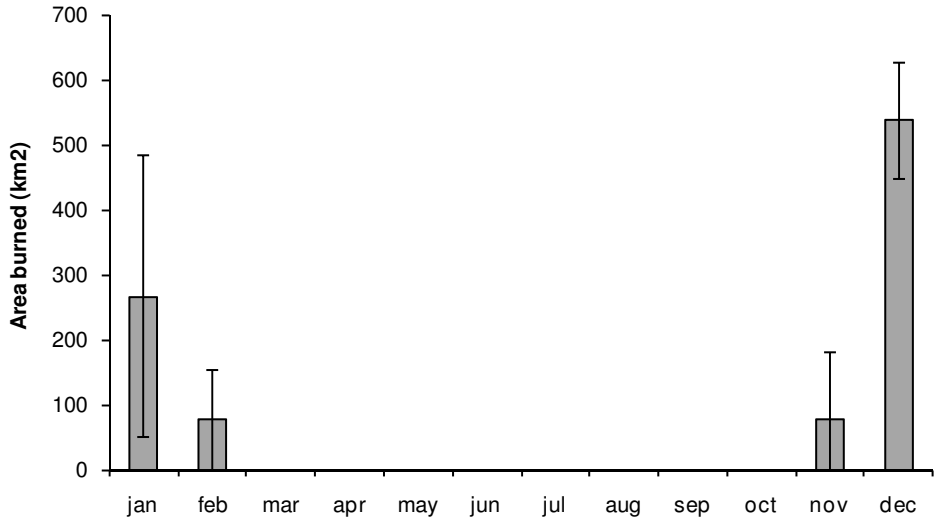

Fig. 3. Mean total burned area per calendar month in Bénoué N.P. Data based on L3JRC satellite observations (Tansey *et al*. 2007) during the period 2003 – 2006.

Based on L3JRC satellite data (Tansey *et al*. 2007), the total burned area in Bénoué N.P. in the years 2003 to 2006 varied from 765 to 1088 km^2 (mean: 962 km^2), which is equal to 42.5 to 60.4% of the park area. However, field data collected during this research indicated much higher burned percentages of up to 85%. The difference is likely to be caused by the fact that both burning activity and field data collection concentrated in accessible areas that could be reached by road, whereas burning activity was probably much lower in remote and inaccessible parts of the park. In addition, some small-scale or low-intensity fires may not have been recorded by satellites. As shown by Fig. 3, burning takes place in the early and middle dry season, with most of the area burned in December and January.

Fire intensity depends on fuel load, moisture content of the grasses, temperature and wind speed (Tainton 1999). Measured fuel loads of unburned grass swards in Bénoué varied widely, ranging from 0,35 kg m^{-2} to over 0,80 kg m^{-2} depending on time and location. Using a standard value of the heat yield of 18000 kJ kg^{-1} for savanna grasses (Tainton 1999), mean fire intensities recorded in Bénoué N.P. were 617.8 kJ s^{-1} m^{-1} (SD=516.6) during early dry season burning and 813.1 kJ s^{-1} m^{-1} (SD=1028.0) when burning in the middle of the dry season.

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