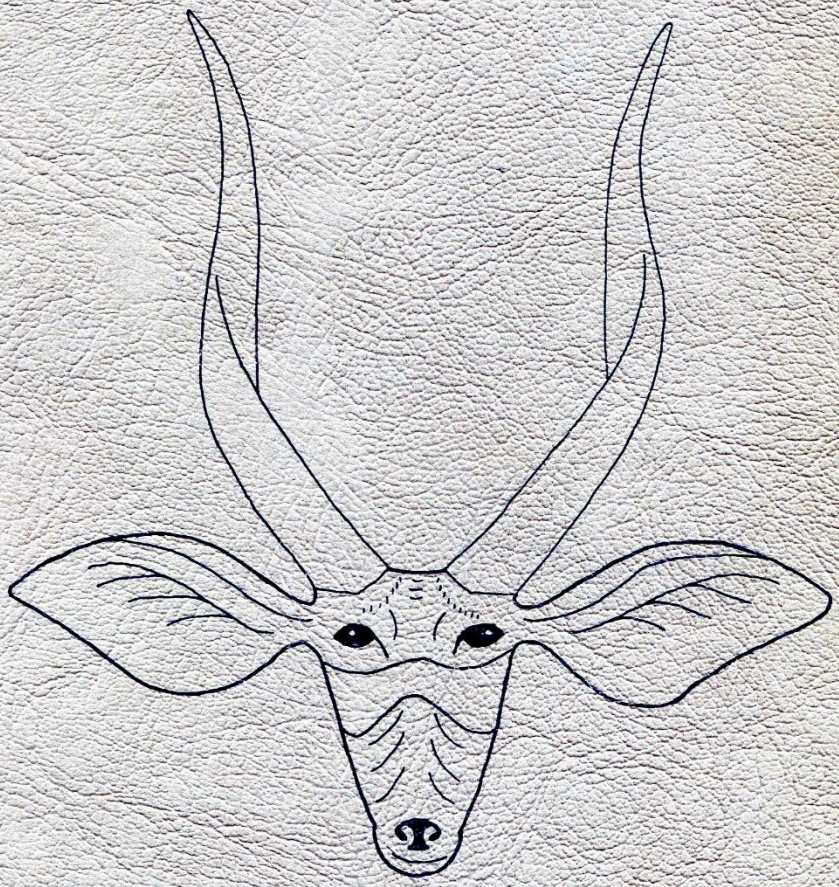
An Ecological Survey and Management Recommendations for Bangangai Game Reserve, south west Sudan, with special reference to the Bongo antelope



New York Zoological Society

An ecological survey and management recommendations for Bangangai Game Reserve, south west Sudan, with special reference to the bongo antelope

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Funded by:-

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Contents

An ecological survey of Bangangai Game Reserve, Western Equatoria Province, Southern Sudan - final report and management recommendations

1. Introduction

1.1 Project aims

This report and the management recommendations are the result of over two years field work in the Reserve, financed by the Animal Research and Conservation Center of the New York Zoological Society. The main aims of the study were to provide information to the Regional Ministry of Wildlife Conservation and Tourism on the fauna and flora of the Reserve to aid in its future management and possible utilisation for tourism, and to learn as much as possible about the bongo antelope (*Tragelaphus eurycerus* Ogilby) for which the Reserve is an important refuge.

The report is intended to bring together as much information about the Reserve as possible, for the use of the Ministry in managing the area, and for the use of any other research workers in the future. Few technical details have been presented here for the sake of simplicity and clarity. These results will be written up as scientific papers in the near future, covering the topics of - the Bangangai area and its conservation; the biology, feeding and conservation of the bongo in the Sudan; and the birds and butterflies of the Reserve. Copies of these papers will be sent to the Ministry as they are produced in the future.

The report is divided into two main parts. The first part consists of sections one to five, and considers the Reserve and its immediate surroundings in the past, and over the period of the project from July 1980 to January I983. The second part, consisting of section six, gives the management recommendations for the conservation and utilisation of the Reserve in the immediate future.

1.2 Project timing and methodology

A preliminary survey was carried out in Bangangai Game Reserve over the months of July and August 1980. This was based in a camp situated 1 km west of Bangangai village. Findings of this preliminary survey were produced as a report to the Ministry of Wildlife Conservation and Tourism and the New York Zoological Society (Hillman 1980).

Work in the Reserve was continued from April 1981 to June I982, with a further period from December 1982 to January I983. This was based at Nambia Camp, a site 11 km east of Bangangai village, near the site of the old Bangangai Game Post.

The great majority of the work was carried out on foot, and concentrated in the eastern half of the Reserve. Most of the observations are the results of extensive walking, mainly carried out early morning to early afternoon, walking between the major saltlicks and water sources, both in forest and grassland areas. On most months, 3 nights were spent up a tree platform built above Nagbagi saltlick, near Nambia camp. These nights were the night of full moon and the 2 preceding nights. Further observations were made from a hide on the ground at Napara saltlick, also near Nambia Camp, on early mornings after full moon, when the light of the moon could be used to walk to the saltlick before dawn. Information was collected on all animals seen, as well as on other evidence of their presence, including tracks, droppings and calls. On the majority of these walks and observations, I was accompanied by a Game Scout, Sgt. Atanazio Awas who has grown

up in the Bangangai area, and a local Zande tracker, Bavo Baramu, who has lived and hunted in the Bangangai and Nambia areas most of his life.

Detailed information on plants in different vegetation types was collected from point-centred quarter analysis (PCQ) along transect lines, from measures of obscurity at different heights above the ground, and from measuring grass height, weight and numbers of plants within quadrats in open grassland. Plant identification was carried out via Zande names and the lists of Zande with scientific names collected by Wyld (undated) and Andrews (1948, 1953, 1957) and confirmed from Andrews (1950, 1952, 1956).

The rumen contents of animals shot by trophy hunters in the general area were collected from Mura, Djiabio, Yubu and James Diko hunters' camps. In addition measurements were made of skulls and lower jaws collected from these camps.

Zande names forplants and animals were used during the work, and are used here to make the information more useful to people in Bangangai area.

1.3 Legal gazetting, maps and literature review

Bangangai Game Reserve was declared a Game Reserve between the years 1939 and 1942, under section 14(1) of the "Preservation of Wild Animals Ordinance (1935) and the Game Regulations (1935), as amended up to 31 December 1953." Details of the Reserve boundaries are set out in Schedule III (1953 L.R.O. 15) of the "National Parks, Sanctuaries and Reserves Regulations 1939 (1939 L.R.O. 23)" as follows:

> *"No. 12 Bangangai Game Reserve. The area enclosed within the following boundaries:*
>
> *North - the Southern Loop Road between the River Hogo and River Biki*
>
> *East - River Hogo*
>
> *West - River Biki*
>
> *South - Belgian Congo border between the River Biki and Hogo.*
>
> *The cultivation lands of the following registered Gbaria lines are excluded: Nambori -Nambasa - Putaka - Zangainme - Mataka - Kibiri."*

This last point is very significant and is dealt with in more detail below (3.7 and 5-1).

The Reserve is also a Forest Reserve, under the Forestry Department of the Regional Ministry of Agriculture. It was legislated as a Forest Reserve at about the time it was gazetted as a Game Reserve, certainly by 1948. It has not been possible to obtain the detailed legislation.

The Game and Forest Reserves share almost the same boundaries as shown on Fig. 1, the exceptions being the area (36.3 km^2) in the north west that includes the Gbaria lines mentioned above, which is excluded from the Forest Reserve, and the area (26.6 km^2) to the north east, that is excluded from the Game Reserve, but included in the Forest Reserve.

The Game Reserve is shown on map sheet NB-35-0 (old-no. 77-0), 1:250,000 series of the Sudan Survey Department, Khartoum, dated July 1954, revised 1976. There may be "further details on the Zande series of maps, scale 1:100,000, sheets 77-0-2 and 3 (October 1951), and 6 (October 1952)", but copies were not seen during the study.

No trace of any aerial photography of the area could be found in the British archives at Tolworth, Surrey, UK. There may be some in Belgian Congo or Zaire coverage.

ERTS Landsat imagery covers the area in the corners of frames 187/56 and 57 and 188/56 and 57. The clearest conditions were found in November and December 1972.

There is little literature dealing specifically with the Bangangai area. Dr. Hugh Woodman was stationed at a sleeping sickness check 'hospital' at the location of the old Bangangai Game Post (Fig. l) and published observation on the birds (Woodman 1936, 1952a and b) and animals (Woodman 1952c) of the area. Further bird collecting was carried out in about 1952 by an unknown European for three months in the present location of Bangangai village, but records of this have not yet been found. Details of birds specifically from Bangangai are mentioned by Cave and Macdonald (1955). The Game Reserve receives mention by Molloy (1957) who describes the animal species found there and the conservation situation between the years 1948 and 1954. Nikolaus (1979), and Traylor and Archer (1982) describe new bird observations in Bangangai Game Reserve.

2. Reasons for establishment of the Game Reserve

2.1 Primary interest

The main reason for establishing Bangangai Game Reserve was the presence there of the bongo and of its dense forest habitat. The story is still told locally how an early District Commissioner, Major "Tiger" Wyld encouraged the locals to net a specimen of this reported very large forest antelope. The nets always broke so permission was given to spear one. This was examined and measured, and resulted in the declaration of the area as a Game Reserve, specifically to conserve the bongo, then and now a little-known antelope that occurs in the Sudan only in the forest areas of the extreme south west, where the country borders on the Zaire republic.

2.2 Secondary interest

The Reserve area preserves part of the forest/savannah mosaic vegetation that is barely represented in the Sudan except in this south west corner. As a result it contains animal and plant species not found elsewhere in the Sudan, all of which contribute to the diversity of the nation's fauna and flora. These plants and animals are mentioned in detail below (3-8 and 4).

The area is of value as a part of the enormously diverse natural heritage of the Sudan. It is the wettest extreme of the nation and contrasts strongly with the desert of the northwest with almost no rainfall.

It is an important part of the Nile/ Congo rivers watershed; many small tributaries of the Sue river, and therefore of the Nile, rise within the Reserve. These must be conserved in the face of increasing dryness of this part of Africa generally.

The Reserve represents an important gene pool of plant and animal types not found elsewhere in the Sudan. Loss of these would be to the further impoverishment of the nation, and of the whole of Africa.

The Reserve has some potential as a resource - as a tourist attraction, for forestry, and as a reserve of animal species to replace those hunted by trophy and subsistence meat hunters in the surrounding areas. The potential as a tourist attraction can only be realized however, when the general development of the Southern Region, and of the country as a whole in terms of communication, supply and services occurs in the future.

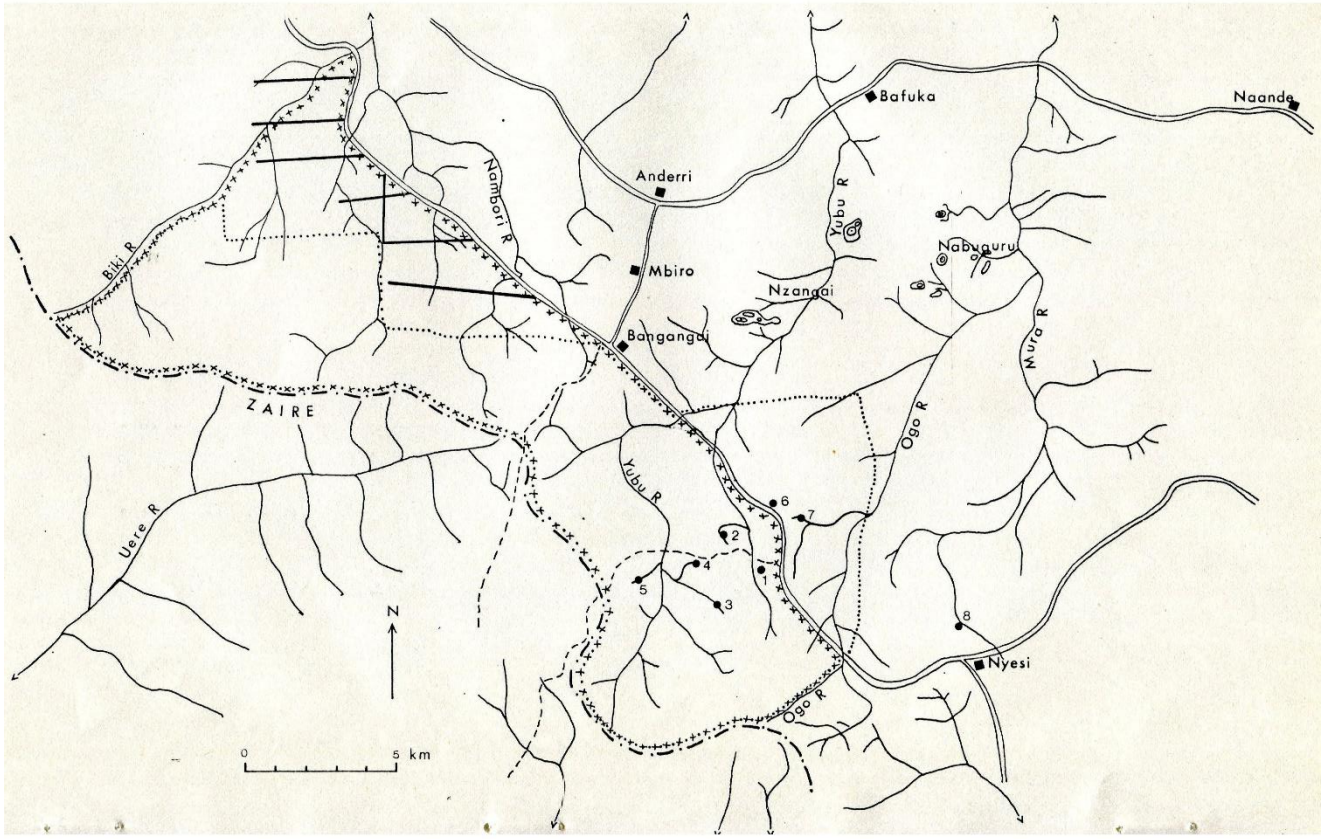


Fig. 1 Bangangai Game Reserve

- ××××× Game Reserve boundary
- ..... Forest ReServe boundary
- —·—·— International boundary
- rivers
- hills
- roads
- ■ villages
- ——— cultivation lines - 'gbaria'

1 - Nambia Camp
2 - Nagbagi saltlick
3 - Napara saltlick
4 - Nangbutoko spring
5 - Bangangai pool
6 - Old Bangangai Game Post
7 - Nanduro swamp and spring
8 - Mura hunting camps

3. Description of the area

3.1 Geographical location

Bangangai Game Reserve is located in the extreme south west corner of the Sudan, along the border with Zaire, and only 17 km from the point at which Sudan, Zaire and the Central African Republic all meet (see Fig. 2). The latitude and longitude of the four corners of the Reserve are as follows:

northwest	N 4°59.5'	E 27°38.7'
southwest	N 4°54.7'	E 27°32.4'
southeast	N 4°47.6'	E 27°45.3'
northeast	N 4°48.8'	E 27°46.5'

The Reserve Is 85km in a straight line west northwest of Yambio town, the capital of Western Equatoria Province, or 120km along the main Yambio-Nzara-Ringasi-Li Yubu road. It is 580km west of Juba and the main Nile River by road, or 430km in a straight line.

The Reserve is a long narrow rectangle, lying with its long axis (25 km) along the Sudan/Zaire border, and varying in width between 4 and 12km. Its total area, as gazetted, is 170km^2. The international boundary is here formed by the watershed of the Nile and Congo rivers.

3.2 Climate

The Reserve is located almost midway between the Atlantic and Indian Ocean coasts of Africa and could be expected to be affected by the currents and winds of both oceans. There are two seasons - a long wet season of approximately eight months from March to October, and a short dry season lasting approximately four months from November to February. The area is one of the wettest parts of the Sudan, usually receiving about 1,400mm annually. Rain ceases falling abruptly in late October, early November, after which the vegetation, especially the grass, dries out rapidly. Very little rain then falls until March. Rain in the wet season falls at a rate of 170mm a month on average. It usually occurs in heavy storms of relatively brief duration. These are preceded by very high winds which frequently knock down large forest trees. Monthly rainfall for Nambia Camp during the study is given in Appendix 1, together with mean monthly rainfall for nearby locations in the Sudan. Heaviest rainfall is experienced in the months of April to October, with a slight drop in June, suggesting some relationship with the Indian Ocean monsoon system.

Relative humidity is considerably higher in the wet season, averaging 77.6% (at 0800 hrs), compared with 62.1% over the dry months. Maximum daily temperatures are highest over the dry season at 34.3°C. Average maximum wet season temperature is 31.2°C. Minimum daily temperatures are lowest in the dry season at 16.5°C, and highest in the wet at 18.7°C

The highest recorded temperatures were 41.0°C in November and 40.5°C in March. The lowest temperature recorded was 6.0°C in December. Mean monthly maximum and minimum temperatures recorded at Nambia Camp in 1982 are also given in Appendix 1.

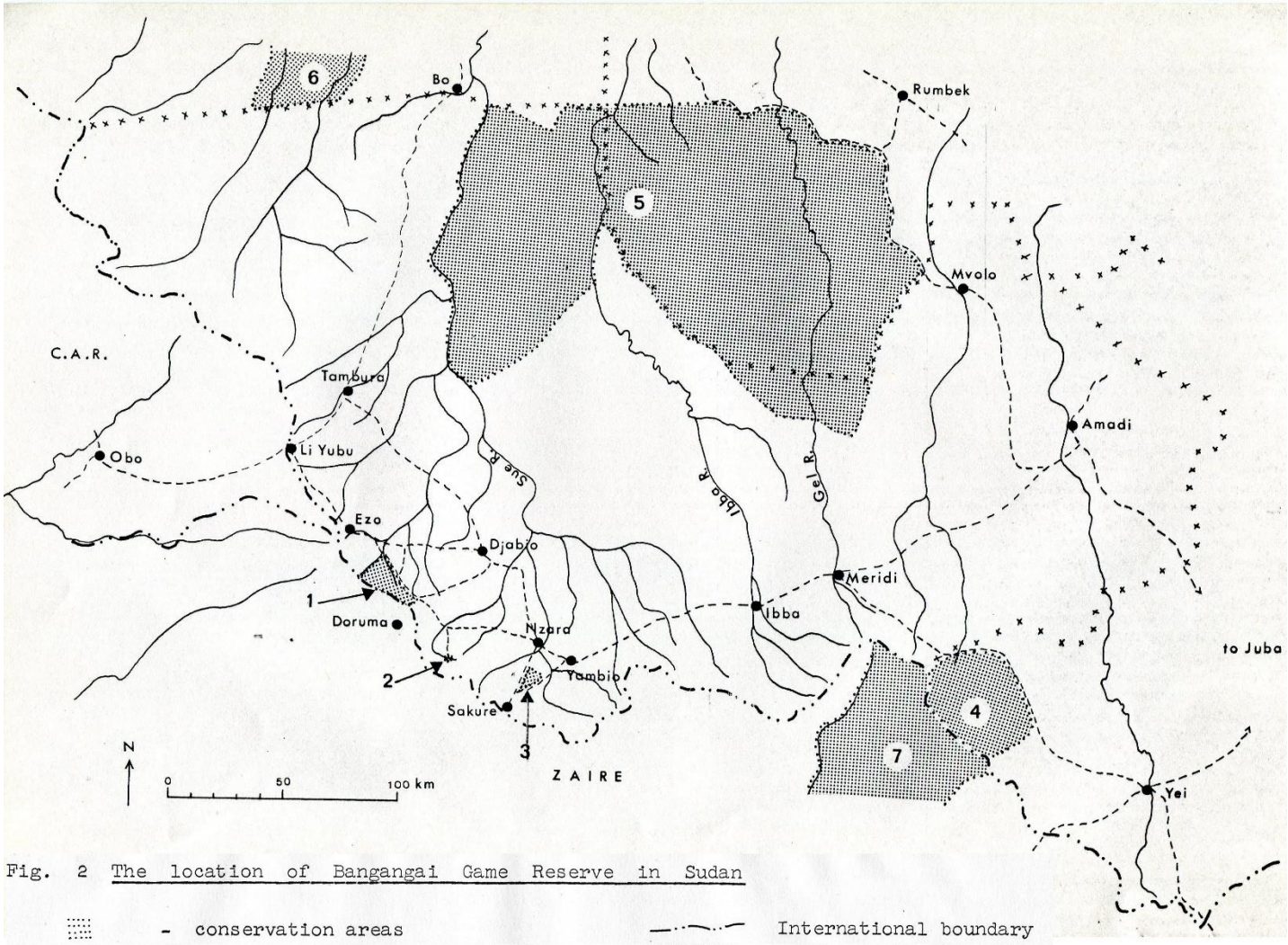


Fig. 2 The location of Bangangai Game Reserve in Sudan

⁙	- conservation areas	—·—·—	International boundary
1	- Bangangai Game Reserve	×××××××	Provincial boundary
2	- Bire Kpatuos Game Reserve	·····	conservation area bounda
3	- Mbarizunga Game Reserve	– – – –	roads
4	- proposed Lantoto National Park	⟩	rivers
5	- Southern National Park	●	town or village
6	- Numatina Game Reserve		
7	- Garamba National Park (Zaire)		

3.3 Geology and geomorphology

The area of Bangangai Game Reserve is remarkably flat and is underlain by the ironstone plateau. These red laterites are probably mid Tertiary in age, and overlay Cambrian or pre-Cambrian Basement Complex (Whiteman 1971). The Basement Complex outcrops elsewhere in the area as spectacular rounded gneiss domes, sometimes 100m above the surrounding ground, but in the Reserve there are very few outcrops, and then only low flat slabs of rock. One small area occurs at Nambia (see 3-6 below), another in the Nambori area. These rocks are gneisses, containing a lot of hornblende, biotite and quartz (Dr. David Billings, pers. com.).

The ironstone is not uniform in texture. While the Reserve is flat, drainage lines have eroded into the Ironstone. The ironstone is exposed at the edges of these lines and is there formed of pea-iron gravels. Elsewhere In the majority of areas it is vesicular ironstone, containing quartz crystals and is less nodular than the pea-iron gravels. In a few places the ironstone outcrops in flat exposed sheets with no overlying soil or vegetation, e.g. at the source of the Ogo river. In the few places where the drainage lines have eroded deeply into the ironstone, e.g. the Yubu river source and Nangbutoko spring, very large blocks have broken off the exposed ironstone face and lie in the small valley below. A few drainage lines have eroded down to a micaceous and kaolinitic layer, up to 15 m below the usual ground level.

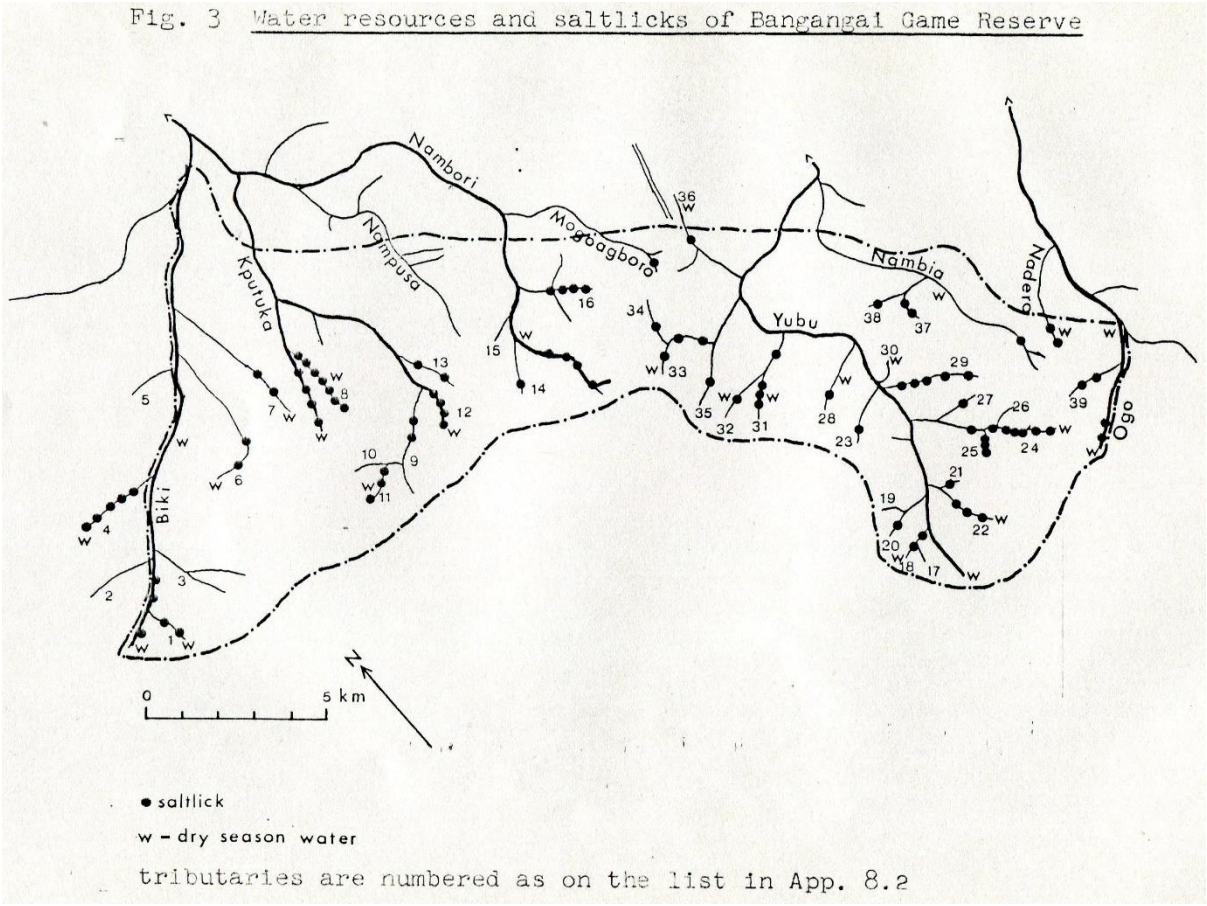
Soils in the Reserve are derived from the laterite. Those under forest cover are rich in humus and a grey to black colour. Those under grass cover appear to have a greater sand content, but this may only be the result of direct rainfall on the exposed soil surface in the early wet season when vegetation cover is minimal. Soils of the broad and low-lying drainage lines have quite a high clay content. This can be seen as a very fine white suspension in water leaving the Reserve. Some of these clays are micaceous and are in demand for pottery making, e.g. near Bangangai Pool. Over much of the Reserve soils are shallow, ironstone and pea-iron gravel being found usually-less than 30cm from the soil surface.

3.4 Hydrology

Bangangai Game Reserve is on the watershed of the Nile and Congo River systems. The watershed forms the long southern boundary of the Reserve. Many small streams rise along the watershed within the Reserve, ultimately draining into the Sue, Bahr el Ghazal and finally the Nile, via the Biki, Yubu and Mura rivers. These "streams" all have names in the local Zande language and have been approximately located on the sketch map in Fig. 3 and listed in Appendix 2. The terrain of the Reserve is mainly flat and the streams are, as a result, all very small and sluggish, except in the few places where they have eroded a channel of any depth.

Most of the sources are either broad swampy areas, or depressions into which the water seeps from small springs around the edge. The water, clear at first at the source, very quickly becomes cloudy with very fine white suspended particles. These do not settle even if left to stand for several days, and quickly clog filters with a fine clay coating. It is however drinkable for humans.

Local knowledge tells that all the main drainage lines were perennial streams until the 1960s decade. During this period many of them became seasonal, not flowing in the dry season. At the present time (1983), none of them are perennial and in the I98I/2 dry season the Reserve was almost totally without surface water by February. Surface water available in January 1982 at small seepages is shown on Fig. 3. Nambia River, beside the main camp, did not flow again until 23 July 1982, and then subsequently only for- 2 - 3 days after heavy rain. No climatic reason has as yet been discovered with the available records (since 1922 at Yambio) of either reduced rainfall, or different timing of the total amount. The years I98I and 1982 were undoubtedly dryer in the Reserve, with up to 20% less than the expected amount, but the changes in the water table began long before this. The 19601s decade was a period of fluctuating rainfall elsewhere in Eastern Africa, associated with changing lake levels (Lamb 1966).



In 1982 a well was dug on a self-help basis, with technical advice and help from Swiss Inter-Church Aid, at Nambia, just outside the Reserve. The water table in July was reached at 16m below ground level and was good and clear. A good supply of water was still in the well at this depth in January 1983, when surface water in the Reserve had largely dried up. Water was reached at a similar depth in other wells at Nyesi, Bangangai, Mbiro and Anderri (Fig. 1).

3.5 Saltlicks

There are many saltlicks (*'ndo'* in Zande) in Bangangai Game Reserve. Over 90 of these are of notable size and their locations well known to local people. There are many others of a smaller size. All are associated with drainage lines, and the majority are associated with ancient termite mounds, often with large trees growing on them. These mounds are almost the only raised features of the landscape and are especially visible after the grass fires in the dry season. They occur in both forest and grassland and can be up to 4m high and 10m in diameter. Only those in or near drainage lines are usually developed as saltlicks. This is probably because they remain wetter being nearer the water table, thus being easy to dig. Some species drink the muddy water that collects there, rather than eat the soil. The saltlicks are known by the name of the river tributary on which they occur. A list of these is given in Appendix 2, and their approximate locations are shown on Fig. 3. It has not been possible to locate these on an accurate map in the absence of aerial photography. Accurate locations of the ones mainly used in this study are shown on Fig. 1 (Nagbagi and Napara).

Soil is dug out of the saltlicks by animals using their teeth, horns, feet and tusks, and then eaten. This activity opens pits in the ground, and hollows out the termite mound into a small cave. These can become very large over the years. Large caves exist at Kpangubo and Nambori in the west, and Tiazuro and the lower Napara lick in the east. This last is now a tube running along a bank, about 10m long and 2m in diameter.

Various minerals are scarce in forest areas, since they become 'locked up' in long-lived trees. Termite mounds are 'nutrient dumps' - places where vegetation material is brought in, but never leaves again since the termites eat the material, defaecate and die in the mound. Minerals are brought to the surface through evaporation in the mound and in this way the mound becomes enriched in various substances, including the scarce salts (Hesse 1955, Watson 1962, Weir 1973). Animals then seek out this earth to obtain the 'salts'. The caves mentioned above, contained various coloured layers of soil, presumably from different periods of termite activity. Samples of soil were collected from within different licks, and for comparison from the surface soil nearby. These were analysed at the National Agricultural Laboratories in Nairobi, Kenya, for the content of the following elements:- sodium, potassium, calcium, magnesium, manganese and phosphorous. The results are summarised in Table 1. The most striking difference between the soils from saltlicks, and those from nearby topsoils, was in the content of sodium, which was on average ten times greater in the saltlicks. Similar findings were made in termitaria in the Serengeti by Weir (1973). This difference was consistent at all saltlicks. All other elements were present in greater quantities on average in lick soils than in top soils, except for potassium, but the difference was not consistent. At a few licks, the concentration was higher in the surrounding topsoil than in the lick. Potassium was on average present in greater amounts in the topsoil than in licks. Since all the licks sampled were large and much in use by animals, it would seem that it was the greatly increased presence of sodium salts at the licks that was attracting them. General comments on the soils for agricultural purposes from the laboratory report were that the contents of potassium, calcium, manganese and phosphorous were generally deficient in all samples, magnesium generally sufficient and sodium quite high, in several cases toxic (more than 2.00 m.e.%).

Most animals use the licks when they are wet or at least moist and muddy. Bushbuck, elephant and warthog were almost the only species seen to use the licks when they were completely dry. Observations at the licks by day and by night showed that buffalo and bongo generally drank the muddy water while other species eat the soil. Smaller duiker species, other than the yellow-backed, were not seen to use the licks, neither were their tracks found there.

Table 1. Comparison of the mineral content of soils from saltlicks & nearby topsoil

element	units	saltlick		topsoil		Saltlick content/ topsoil content
		mean	range	mean	range	
sodium	m.e.%	2.17	0.89 - 3.70	0.21	0.08 - 0.45	10.3
potassium	m.e.%	0.25	0.08 - 1.38	0.42	0.26 - 0.55	0.6
calcium	m.e.%	9.79	tr - 29.00	2.62	0.90 - 6.60	3.7
magnesium	m.e.%	4.68	0.80 - 9.20	2.40	1.10 - 4.00	2.0
manganese	m.e.%	0.27	tr - 0.60	0.22	0.06 - 0.43	1.2
phosphorous	p.p.m.	19.23	4 - 40	12.00	8 - 22	1.6
		n = 13		n = 5		

'tr' - trace only
m.e. % - milli equivalents %
p.p.m - parts per million

Warthog and giant forest hog were seen to ingest soil at saltlicks on the few occasions they were seen there. Bushpig were never seen to eat soil, although they were seen in the vicinity of Nagbagi saltlick for long periods at night. On these occasions they were seen to be feeding on the short grasses around the lick. Bushpig tracks were found in saltlicks on a few occasions. It is likely that this species obtains its salt requirements from the carcasses of dead animals from which they certainly scavenge.

Watches were kept at saltlicks on or near full moon nights from a tree platform at Nagbagi, in the early morning from a hide at Napara, and at other times of day at many other licks. The results of these observations are given in Table 2. Most use of saltlicks was made by animals at night and in the first hour and a half after dawn. Use in other daylight hours was minimal, though bushbuck were seen at Nagbagi at almost all hours of the day. This is of importance if use is to be made of saltlicks as a means by which visitors to the Reserve can see animals. At the right time of year (the early wet season), the saltlicks are places where animals will certainly be seen at night and in the early morning, and are easily visible in the open from hides or tree platforms.

3.6 Prehistory and ecological history

Little is known of the prehistory of the area. Two types of pre-historic site that are of relevance have been found. Undoubtedly the earlier of these are the grooves worn in the Nambia gneiss outcrop and boulders, called '*sabe mbori*' by the local Zande people. These are the result of grinding of some sort, possibly for the manufacture of stone axe heads (Larken 1926, Phillipson 1981). Larken (1926) gives the name *'fuo mbali*'; both this and the name given earlier mean the handiwork of God, or the marks of God, due to their resemblance to the impressions of a giant set of fingers in the rock. The grooves are 30 - 50cm long, and 5 - 8cm wide and deep, of semi-circular cross section, and several usually radiate out from a single point on a sloping rock surface, near water. The Zande have no other-explanation for their origin, suggesting they were made by a people prior to Zande occupation of the area, at least five generations earlier than the turn of the present century (Larken 1926). These grooves occur elsewhere - near Bangangai village outside the Reserve; where the Biki River crosses the Tembura-Djabio road and further north.

The second type of pre-historic sites are the Zande iron-smelting furnaces, about which local people know a lot more. Known as '*bigiwe*', the furnaces were a common method of extraction of iron from the pea-iron gravels of the drainage line edges. Some reasonably intact furnaces still exist, but the majority are small slag heaps which are easily found in the dry season when the grass has burnt. These contain small pieces of discarded slag and the remains of the simple clay *tuyéres* that allowed air access at the base of the furnace. The pottery furnaces were ca. 3m tall and 1.5m in diameter, like a large thick-walled earthenware pot. Local people say that their use ceased about 70 years ago because of British colonial legislation. Many of the sites are said to be "very old". Older people still know the methods that were used. Charcoal was the fuel used to fire the furnaces, and it is likely that iron-smelting would have modified the vegetation if carried out over a long period of time in a wide area. The trees used for charcoal making were exclusively 'gero' (*Erythrophloem guineense*), 'nge' (*Prosopis africana*) and '*marungu*' (*Cussonia arborea*), all large forest trees (Mr. Paulo Zaki, pers. com.). It is evident that iron-smelting was not exclusive to the Zande, other furnaces having been found at Meridi, near Wau and Nzara (Phillipson 198l).

3.7 Land use history

The Reserve area was originally under scattered Zande settlement with shifting slash and burn cultivation. The effects this may have had on the vegetation are discussed below (3.8). People were moved out of the Reserve soon after it was gazetted, about 1945. Human activities In the Reserve after this date were controlled to some extent, including hunting and gathering, especially of termites and honey. During the civil disturbances in the southern Sudan, from mid-1964 to January 1972, some four to five hundred people settled in the Reserve area, together with another ca. 150 people in an *Anya'nya* camp at Napoture. After the Addis Ababa Agreement all the people left the Reserve area again. Hut and cultivation sites can still easily be seen in the dry season after the grass has burnt off, resulting from this most recent occupation.

Table 2. The relative occurrence of animal numbers per hour at all salt licks at different times of day

animal species	time of day																									total	mean/hr
	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	01	02	03	04	05	06		
Bongo	1.5		0.04			0.2							1.6	1.4	0.5	0.9	2.1		0.2	0.1	0.6		0.03	0.5		327	0.56
Bushbuck	1.1	1.3	1.1	0.6	0.2	0.1						2.0	0.1				0.04	0.07		0.1	0.2	0.4	0.1	0.2		247	0.42
Buffalo	0.9																	0.4	0.1				0.07	0.02		76	0.13
Waterbuck					0.1																					2	<0.01
Yellow-backed duiker	0.02																0.04	0.04				0.04		0.02		5	<0.01
Elephant													0.3	0.3	0.1											20	0.03
Giant forest hog		0.03													0.04											2	<0.01
Bushpig *													0.1	0.7		0.3		0.3	1.3	1.0	0.9	1.1	0.9	0.7		213	0.36
Warthog							0.4						0.04													4	<0.01
Colobus					0.3																					5	<0.01
hours watched	66	29	24	22	19	10	7	4	2	3	29	29	28	28	28	28	28	28	28	28	28	28	28	36		588	-

* bushpig were only seen to eat short grass around saltlicks, not the soil

The northwest corner of the Reserve is legally settled by the ''Preservation of Wild Animals Ordinance (1935)" (see 1.2 above), along the '*gbaria*' lines of the now defunct Zande Scheme. People still live in this area, and the vegetation is considerably changed as a result of the prolonged occupation and introduction of exotic plant species.

A motor road to Doruma in what is now Zaire, used to run through the Reserve from what is now called Nambia village, and was formerly the Bangangai 'hospital' and later Game Post (see Pig. 1). The line of this road can easily be seen still, from the mango trees growing along it, the space in the forested parts it ran through, the remains of old bridges over the Nambia and Yubu rivers, and the places where the edges were marked with ironstone blocks (e.g. at Bangangai pool). In addition the remains of the border guards' camp can be seen at the border with Zaire, together with many names carved on trees. The route is still occasionally used by walking travellers, between Sudan and Zaire. The main walking and bicycle route now lies further west, between the present Bangangai village and Doruma (see Fig. l). It is used by Zande going to see relatives in Zaire, and to smuggle beer, soap, salt, cloth, palm oil, rice, petrol, ivory, smoked meat and stolen goods between the two countries. Its existence is acknowledged by the authorities, but largely ignored for lack of manpower and facilities to control it. Its continued existence in the Reserve is an obstruction to any realistic development (see 5.4 below).

3.8 Vegetation

This part of Africa has been included in various vegetation surveys and maps. Harrison and Jackson (1955) call it "high rainfall savannah, recently derived from rainforest (division III.B.b)". Devred (1960) places the area in his zone 11- "dense, humid, semi-deciduous sub-equatorial and near-Guinean forest, with elements of Sudano-Zambezian forest (zone 11')". Smith (1949) places the area in the "closed lowland forest" and "mixed deciduous fire-swept forest". Broader classifications of the whole of the continent place it in the forest-savannah mosaic, along the northern border of the Zaire rain forest block.

It is evident at first sight that the Reserve area includes both elements of grassland and of forest. More detailed observation shows that there are further subdivisions of these two elements as follows:-

1. Grassland

- 1.1 Open small-tree wooded grassland
- 1.2 Open large-tree wooded grassland
- 1.3 Open low-lying grassland

2. Forest

- 2.1 Primary gallery forest
- 2.2 Primary lowland forest
- 2.3 Secondary thicket forest
- 2.4 Teak plantations

As a very broad generalisation, grassland occurs in the flatter areas - either low-lying depressions such as broad drainage lines ('river valleys'), or on the flat wide 'ridge' tops between drainage lines. Forest occurs either in the bottom of the narrow drainage lines, especially near river sources, as gallery forest, or along the edges of drainage lines as fringing lowland forest. Lowland forest will cover the 'ridge' between two drainage lines where the distance between them is reduced, such as near a confluence. Further south in the Reserve, nearer the Nile/Congo divide, some very wide 'ridges' are forest covered.

It has not been possible in the present study to accurately assess the extent of each of the vegetation types given above. The extent of closed vegetation ('forest') as opposed to open-canopy vegetation ('grassland') was assessed as accurately as possible using the ERTS satellite imagery (see 1.2 above) together with the 1:250,000 series map of the area. Most grassland areas had been burnt at the time so showed as black areas, while forest was still a red colour on the false colour imagery. Accuracy of correlation, however, of the physical features and drainage lines between the satellite imagery and map was not good. The maps

were made from early foot surveys in the 1920s and 1930s and have not been updated with aerial photography. It was calculated, using this method, that 87.4km^2, or 51.4% of the Reserve is 'forest'-covered, the remainder (82.3km^2, 48.6%) being open areas of 'grassland'.

Descriptions of each vegetation type follow. Plant species typical of each, but not necessarily dominant, are listed in Appendix 3. These are not complete lists of all plant species found in each type. Such listing would be a project in its own right. Type 2.2.3, secondary thicket forest, is the most varied and dynamic of the vegetation types, and includes elements of many of the others depending on its derivation, surroundings and age.

3.8.1 Grassland

3.8.1.1 Open small-tree wooded grassland

The dominant grass and plant species in this type is '*bagau*' (*Hyparrhenia edulis*), while dominant tree species are various, including the first five species listed in Appendix 3. Trees are generally no more than 6m tall, apart from isolated forest outliers. Grass grows to over 4m tall.at the time of flowering in late August, but in the dry season is burnt away completely, changing the physical appearance of the area (3.9).

'*Bagau*' perennates through seeds. The other important grass of the area '*bingba*' (*Imperata cylindrica*), flowers In the late dry season at only 1m tall, before it is engulfed by the much taller '*bagau*'. Most of the herbs in this grassland area, mature, flower and set seed in the short period from the burning of the grass until '*bagau*' growth overtakes them. One herb species '*piridibaso*' (*Clerodendrum cordifolium*) extends its growing period after flowering, by adopting a climbing mode to climb up '*bagau*' stems. All the tree species in this grassland type flower soon after the fires. A few such as '*bagbodi*' (*Hymenocardia acida*), '*bagara*' (*Anona senegalensis*) and '*kpoyo*' (*Grewia mollis*) also fruit at this time, while the others produce fruit over the whole year, which ripen and fall just after the next season's fires ten months later.

This grassland type merges into the other two wherever they border on each other. However, it shows a more discrete separation from any of the forest types. Few of its species elements are found in any of the forest types. Open small-tree wooded grassland comprises the greatest area of grassland in the Reserve, and may well be a climax vegetation type under the present regime of climate and human activity in the area.

3.8.1.2 Open large-tree wooded grassland

The dominant grasses are '*kpokpoki*' (*Urellytrum giganteum*) and '*mbepee*' (*Beckeropsis uniseta*), and the dominant tree species is '*bakaikpo*' (*Terminalia avicennoides*). These grasses also grow to about 4m in height at the flowering stage in late August, and burn away in the dry season fires. Both species perennate through root-stocks. '*Bakaikpo*' is a relatively large tree here, growing to 10 - 15m in height with a wide spreading canopy.

This vegetation type is not discretely separate from others, least of all lowland forest, and it is likely that it is a successional stage returning to climax lowland forest. In many places young forest trees grow in their shade (e.g. '*bagu*' *Khaya grandifolia*), so that '*bakaikpo*' is overshadowed by them and incorporated into the forest. The grasses in this grassland type do not burn as well as '*bagau*' since they are much more succulent with a higher moisture content. '*Bakaikpo*' loses its leaves very late in the dry season and they are held too high to be affected by the cool fires usually experienced there. It is also one of the last species to flush in the early wet season. It has thick fire-resistant bark, and is valued as a building timber by the Zande for its fire and termite-resistant properties.

3.8.1.3 Open low-lying grassland

This vegetation type is dominated by '*gbaka*' or elephant grass (*Pennisetum purpureum*) where the water table falls very low in the dry season. In wetter marshy areas, various species of *Cyperus* are found. In the dryer drainage lines the straggly shrub 'nganza' (*Mimosa pigrans*) flourishes, making walking very difficult.

Other tree species mentioned for this type in Appendix 3, usually grow on 'islands' of slightly higher ground or at the edge of broad drainage lines. They are especially prevalent where saltlicks are associated with grassy drainage lines, '*nguruguza*' (*Acacia campylacantha*) in particular. This vegetation type can burn late in the dry season, but does not invariably do so. It usually forms a ribbon of grassland along broad drainage lines even where these pass through forest.

Narrower and wetter drainage lines are occupied by swamps and swamp forest. In a few places extensive swamps occur, such as at the junction of the Ogo and Tiazuro rivers, and along the Naturubu river. Papyrus (*Cyperus papyrus*) is found nearby, but not in the Reserve itself.

3.8.2 Forest

3.8.2.1 Primary gallery forest

This forest type is found in small isolated patches, especially near the sources of streams. The water table is high and usually the ground is swampy. Many tree species have 'knee' breather roots. Large lianes are common. The undergrowth Is relatively thick, but quite easy to walk through. It is usually formed of dense 'batingborama' (*Marantochloa flexuosa*) where there is standing water or mud. Patches of this forest are narrow and usually in relatively deep gullies up to 10m deep. Good examples occur in the Yubu, Ogo and Nangbutoko sources. There is a broad system of tree and shrub species and many trees grow to over 30m in height.

3.8.2.2 Primary lowland forest

The dominant grass species is '*bamangendo*' (*Streptogyna gerontogaea*) in dark areas with a complete canopy, many lianes and little undergrowth. '*Bamangendo*' grows to only 30 - 50cm tall and is perennial. It rarely dries sufficiently to burn in the dry season. Its long chains of pointed seeds are armed with barbed, notched awns that catch on hair, feathers and clothing in huge tangled masses and are thus transported by animals to other places. The much broader-leaved and larger grass '*rangee*' (*Setarla barbata*) grows where the canopy is broken and is about 1m tall. This grass will dry sufficiently to burn but only rarely. '*Rangee*' also grows beneath '*bakaikpo*' trees as the canopy in large-tree wooded grassland becomes more closed, showing a further stage in succession from grassland to forest. In wetter areas, and where even less light gets through the canopy, the monocotyledenous herbs '*gai*' (*Costos afer*) and '*bisimo*' (*Marantochloa leucantha*) occur as dense stands up to a meter tall.

No one tree species can be singled out as dominant and the number of tree and shrub species is very high in this forest type. Smith (1949) states of these forests "*an essential feature of the forest of the laterite is that dominance is localised. When this has been realised the fatuity becomes apparent of attempts ecologically to divide the mass……*". Trees of the upper canopy reach 30m or more in height but do not form a closed canopy of themselves usually. There is a lower secondary canopy and a shrub understorey. Lianes are common but not so dominant at lower levels as in secondary thicket forest (see below). This forest type, together with the next, form the major part of the Reserve that is 'forested'. More detailed analysis is required to determine exact coverages.

3.8.2.3 Secondary thicket forest

A derived forest type, this results entirely from the activities of man, mainly through slash and burn cultivation and possibly from extensive iron-smelting in the past (see 5.1 below). This is the least definable of the vegetation types since its composition depends partly on location and partly on time since last cultivated. The area has been inhabited by the Zande using this form of cultivation for the past five generations at least, at the turn of the century (Larken 1926), and settlement prior to the 1920s was scattered throughout what is now the Reserve area (Anania Nzeringa, pers. com.).

Generally secondary thicket forest is dense, with a high occurrence of even-aged tree and shrub saplings, and a tangled mass of lianes at a low level. The canopy is low, usually between 10 - 15m, apart from emergent trees, or relicts of the original forest. Certain introduced species give their own characteristics to this forest. In many areas along the northern boundary road, and along the original Nambia-Doruma road and the present Bangangai-Doruma bicycle track, mangoes ('*manga*' *Mangifera indica*) have spread through the agency of human and animal transport, especially elephant and baboon. These form dense stands of mature trees with a dark and crowded understorey of mango saplings. Little else seems to be able to grow in the soil beneath them. People collect fallen mango fruit off their gardens as they say they prevent other plants from growing in the soil they rot into. In the north west of the Reserve, in the area of the Zande Scheme cultivation lines, mango groves are also found, together with the oil palm ('*mbiro*' *Elaeis guinneensis*) and various *Citrus* species" while *Lantana camara* forms dense impenetrable thickets at low levels.

The species composition of secondary thicket forest depends on colonising species available in the vicinity once cultivation is abandoned. Wind borne seeds are also important in colonising these areas. Recently abandoned areas often show a near-monospecific regeneration of shrub species, often Composites such as '*bavurubate*' (*Microglossa pyrifolia*).

3.8.2.4 Teak plantation

The Reserve is also a Forest Reserve. The present aspiration of the Forest Department is to plant as much of the Reserve as possible to teak ('*tiki*' *Tectona grandis*). This activity began in 1974, apart from single trees planted as boundary markers subsequent to 1948. All plantation areas are at present in the vicinity of Bangangai village, at the centre of the northern boundary (Fig. 1). They are all within 500m of the boundary, mainly along it on the Reserve side (see Fig. 6). Since 1974, fifty four fedans (0.23km^2, or less than 0.13% of the Reserve area) have been planted. The aim is to plant at a rate of 70 fedans (30ha) annually, but this rate has never been achieved yet (see 5.7). Teak trees are largely self-weeding after four years of age, i.e. indigenous plant species will not grow beneath their canopy. These areas are largely sterile of animal life as a result, and nothing eats the teak and its fruit is hard and inedible.

3.9 Fire

The three grassland vegetation types mentioned above (3.8.1) are subject to annual burning. Fires can start as early as late October, while low-lying grassland in swampy areas may not burn until February, if at all. Fires are started by human agency either inside the Reserve, or outside that then enters the boundaries. The northern boundary road is insufficiently maintained to act as a firebreak. The reasons given for starting these fires are various - to clear land for cultivation, to open areas so that new grass growth will attract animals for hunting, to improve visibility for hunting, as a result of honey gathering, or - the commonest reason given - to open areas for accessibility and ease of walking. '*Bagau*' at the end of the flowering period collapses in heaped tangled masses through which walking is almost impossible. In theory, regulations prevent the starting of fires within the Reserves for any of these reasons; in practice all the reasons are pertinent.

Both small and large -tree grassland are occupied by fire-resistant tree species and fire-adapted grasses. '*Bagau*' seeds are adapted to burrowing deep into the soil. This is accomplished by means of the awn which is very sensitive to moisture in the atmosphere and turns in a circular motion as it alternatively dries out by day and is rehydrated at night. Once the awn touches an obstacle such as a leaf, grass stalk or stone, the turning motion is transferred to the seed in the ground. The seeds in this way are protected from most seed eaters and fire, once they have got up to 5cm underground. The seeds germinate within 36 hours of fire, and/or when the old grass cover is removed by other means such as elephant trampling. Rain is not required for this germination.

All the small tree species exhibit thick, corky fire-resistant bark. Between 20 and 35% of the radius of the tree is formed by the bark, compared with less than 10% for large forest trees. Leaves are scorched off by the annual fires, but woody growth is protected by the bark. Most of the tree species produce a new flush of leaves within a month of fire. These vegetation types have evolved with fire as one of the environmental factors.

It was evident during the course of the project that the exclusion of fire leads to immediate change. Two areas of open small-tree grassland that were not burnt, were within the next year colonised by creepers and herbs from the surrounding lowland forest. As a result they were much greener by the time the next burning took place and as a result burnt poorly or not at all. The scrambling herb '*ngiriyo*' (*Dyschoriste perottetii*) was extremely active in this invasion of unburnt grassland. Two to three years without fire would probably result in the exclusion of most fires thereafter.

The directions in which vegetation succession is likely to go in the presence and absence of annual burning is shown on Fig. 4.1. Dryer conditions and later, hot fires, would be likely to increase the grassland content of the Reserve. Early cool fires and wetter conditions would push the succession in the opposite direction towards more forested conditions.

The advantages of burning are that the area is kept heterogeneous and open areas exist. This means that a greater variety of habitat is preserved, maintaining both forest and grassland fauna and flora. Accessibility in the dry season and early wet is good, and the visibility is good for observing animal species in the grassland areas. Additionally the animals are also given the protection of a long sighting distance against poachers. The disadvantages of unmanaged fire are that changes are probably occurring in the vegetation to the detriment of the forest areas. This was especially evident in January 1983, when fires were passing right into lowland forest patches since the previous twelve months had experienced a much lower rainfall, and the grass and herb in the forest was very dry. Tree seedlings and smaller bushes were killed with the likely result that grassland species could invade. Much hotter fires also resulted in the grassland areas, killing one year old wood on the small trees, and setting fire to dead parts of the trunk of larger trees.

3.10 Vegetation succession

An attempt has been made in Fig.4 to describe simply the probable directions of vegetation succession between the types mentioned earlier (3.8). The main reasons for the dynamic state which the vegetation of the area is in, have been the past shifting slash and burn cultivation, a decreasing rainfall and falling water table, exacerbated by hotter and earlier fires, and with the possible influence of tree-felling for charcoal production for iron-smelting.

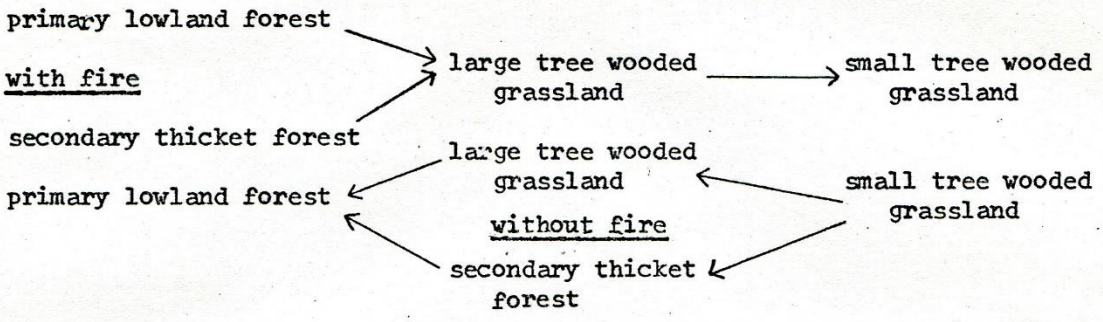
In a study as brief as this it is not possible to fully understand the dynamics of such a vegetation system. The succession from primary lowland forest cut down for cultivation and reverting to lowland forest via secondary thicket forest may well require 50 - 100 years. The absence of good long-term climatic data also makes it difficult to understand the prime causes of some of the changes which are obviously taking place.

Since it is likely that the heterogeneous nature of the Reserve has been brought about by man's activities in the past (Devred 1960), the removal of man's major influence from the Reserve thirty years ago may be resulting in the development of a more homogenous - probably forest - ecosystem. However it is likely that the annual fires maintain the heterogeneity, and may even push the succession towards grassland. This is particularly likely in the event of a failing water table and diminished rainfall that seem to have been the case since the early 1960's.

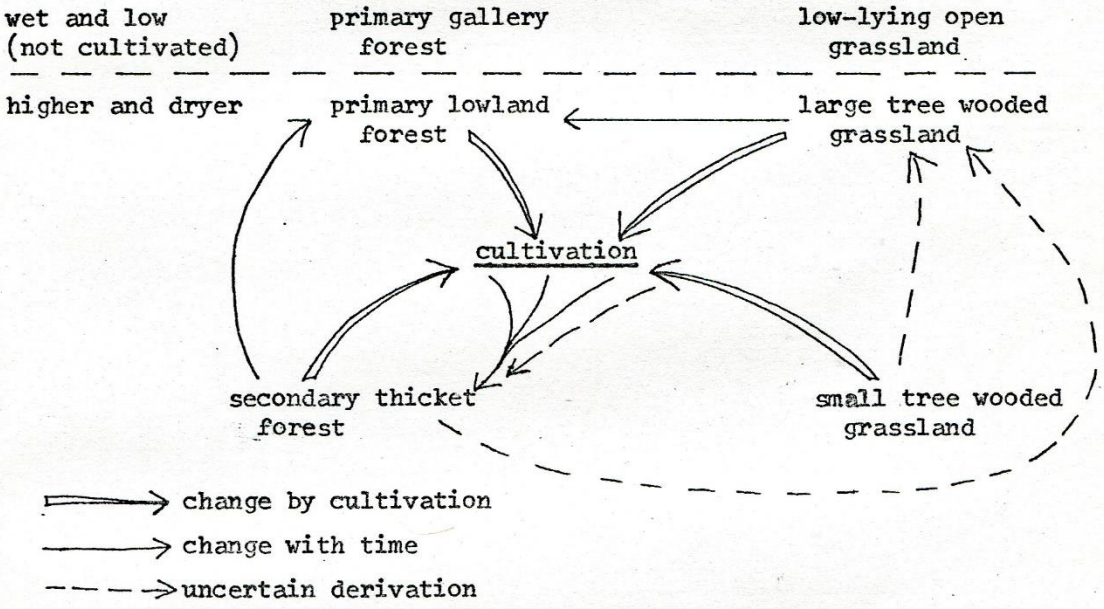
The authorities of both the Wildlife and Forest Departments have to state what their aims are in the management of this Reserve. The one factor which can be controlled to some degree is fire - if only its timing. The earlier a fire, the more moist the vegetation still is, and the cooler the resulting fire, which is then easier to control if necessary. It is also then less damaging to woody vegetation, especially seedlings.

Fig. 4. Possible routes of vegetation succession

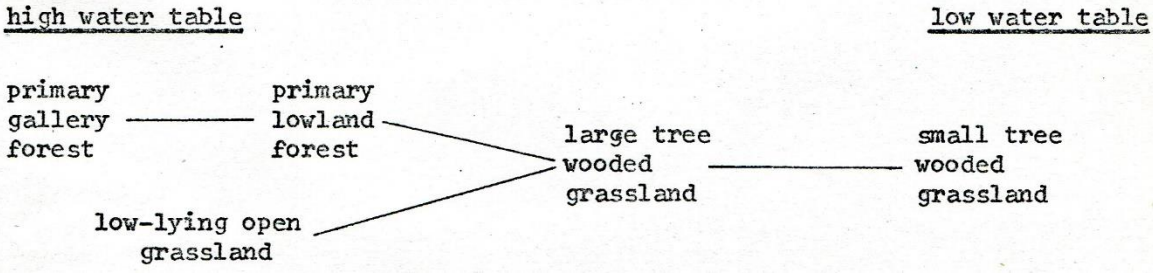
i) the effect of fire



ii) the effect of cultivation



iii) the effect of a changing water table



Nothing will be conserved unless the vegetation and water supply are conserved. The uniqueness of this area in the Sudan lies-in the presence of primary forest - both lowland and gallery, and their special fauna.

4. Wildlife

Bangangai is a Game Reserve - that is, one of its main functions is to act as a reservoir, a store, of wildlife species in a place where they are not threatened by poaching, subsistence meat hunting or trophy hunting. Further, their habitat is also protected from damage by cultivation, settlement, major agricultural projects or road-making. Bangangai is a store for various wildlife species, especially for forest species. There are only three Game Reserves in the small forest area of Sudan, and no National Parks, and of these Bangangai is by far the most important and the biggest (Mbarizunga G.R. is only 13.1km^2, Bire Kpatuos only 5.4km^2).

Bangangai is in a very interesting geographical location. It is a mixture of forest and savannah grassland areas. North of the Reserve one soon passes into the huge areas of wooded savannah grasslands, while to the south is the Zaire rainforest block. The Reserve is the meeting place of these two very different vegetation types. It is in addition the meeting place of West and East African faunas, especially in the birds. As a result there is a very great variety, and it can be seen how the faunas of these areas merge into each other.

The term wildlife includes all animal species, but tends to be accepted as those larger and more noticeable mammals and birds. Bangangai is rich in both of these groups, though they are not easily seen in the thick forest and tall grass habitat. The much smaller animals - insects, spiders, fish and frogs, should not be forgotten as these are as important as the larger animals in the overall functioning of the ecosystem. However, they are less likely to be directly exploited by man as they are so small. Provided the habitat is conserved, they also will be conserved.

Lists of the larger and more obvious animal species found in the Reserve are given in the appendices at the end of this report (App. 8.4 - 8.10). More details regarding the significant species are given in the following sections.

4.1 Large mammals

Those large mammals that have been seen in the Reserve, or whose presence has been inferred by other evidence such as calls or droppings, have been listed in Appendix 8.4 with their English, Zande and scientific names.

The Reserve is relatively rich in large mammal species, but numbers are usually low. Many species have very restricted habitats and they are very difficult to see. Most are nocturnal, or at least active only in the cooler hours of the day in the early morning or evening, as well as night.

The forest and savannah elements of the large mammal fauna can be seen easily looking through the list. Forest mammals include the bongo, the yellow-backed and blue duikers, giant forest hog, chimpanzee, black and white and red colobus, and the redtail and Brazza monkeys. Grassland mammals include the waterbuck, grey duiker, warthog, tantalus and Patas monkeys, and the lion. Another grassland species, a single lone female roan antelope ('*mbiso*' *Hippotragus equinus*) was seen in the Reserve in 1971 (Atanazio Awas, pers. com.). Other mammals are typical of both forest and grassland, or at least the edge of the forest where the two habitats meet. These are the bushbuck, buffalo, red-flanked duiker, elephant, bushpig, baboon and leopard.

If the Reserve was pure forest, many of the last two groups of animals mentioned above would not be found. If it became all wooded savannah grassland, none of the first group would be present. It is important for this reason to make sure that the vegetation of the Reserve remains as varied as it is, and that most importantly, the forest element does not become further reduced.

Most sightings of animals were made at saltlicks in 600 hours of observation. Others were seen while walking through the Reserve in over 300 hours of observation. The number of observations per hour for each species are given in Table 3. It can be seen that by day, the commonest animals sighted are bushbuck. Next in frequency are bongo, black and white colobus and redtail monkeys. However, the frequency of bongo sightings is less than half of bushbuck, and refers to numbers of animals seen, while that for the two monkey species refers to numbers of groups seen. Since bongo groups were often quite large (see 4.1.1. below), whereas bush buck are normally alone or in pairs, the relative frequency of seeing bushbuck is much higher than that for bongo. Similarly, both frequently seen monkey species occur in troops of 10 - 20 animals, so are relatively frequently seen compared with bongo. Only 7 groups of bongo were seen while actually walking through the Reserve and not at saltlicks.

4.1.1. The bongo antelope

Bangangai was made into a Game Reserve primarily because of this animal. The bongo occurs naturally in a restricted belt of forested habitat from Sierra Leone through to this south western corner of the Sudan. This is the eastern limit of the western subspecies (*Tragelaphus eurycerus eurycerus*). There is then a gap of over 1,000km before the only other bongo populations, the eastern subspecies (*Tragelaphus eurycerus isaaci*), which is now only left in small pockets of high mountain forest in Kenya - the Aberdares, Mt. Kenya and the Mau escarpment.

A total of 380 bongo were seen on 42 occasions over a two year period in Bangangai. Only 32 of this total (9%) were seen while we were actually walking through the Reserve. All the others were seen on saltlicks. Ninety five bongo (27%) were seen between the hours of five and seven in the morning while watching from a hide at Napara saltlick. Two hundred and forty seven bongo (70%) were seen while watching during the night from a tree platform over Nagbagi saltlicks. On most occasions the sightings were brief, and while walking usually for only a few seconds, as the bongo soon sensed us and moved into forest. At Nagbagi at night, bongo were seen at a rate of 7.2 animals per night, or 0.5 per hr, watched on 28 nights. They were seen on nine nights, or 32% of all nights watched. This is very similar to the sighting rate at the Ark Lodge in the Aberdares National Park in Kenya.

Evidence of bongo was seen more often. Fresh tracks and droppings were found on most days spent walking, especially in the early and later wet season period. During the dry season very few tracks were seen, and these were usually of large, single animals, in all probability lone adult males. Most of those bongo seen during the day while we were walking were seen in the early morning in open grassland areas in the late dry and early wet season (March-June).

The conclusions to be drawn from these observations are that bongo are mainly nocturnal, that they spend the day in thick forest patches, inactive, that many of them leave the Reserve area in the dry season, and that they use the grassland clearings only in the late dry and early wet season. It is at this time that the small trees in the grassland areas, and the grasses themselves, have a fresh new flush of leaves before the rains, while many of the lower forest trees and shrubs have lost their leaves and have not yet produced new ones. It is evident from the results, that while there is still a good population of bongo in the Reserve, it is difficult to see them, except at saltlicks, and then only at night, or in the very early morning during the late dry season and early wet (see Table 2). Even then, they were seen most predictably after heavy rain, when the saltlicks became flooded and bongo could easily obtain the liquid mud and water, temperatures in the early morning were cooler, and vegetation was wet.

The size of the bongo groups seen varied considerably. It was also often difficult to tell how many animals there were in a group in thick forest or at night. Lone animals were often seen, while the largest group numbered forty four animals. The mean group size of all groups seen was 8.3 bongo together. However it was obvious that all groups larger than 5 animals almost always contained adult females and young animals, while all groups of five or smaller were of adults only. The mean group size of these all-adult

groups was only 1.4 animals. The mean group size of groups that contained juveniles was 16.2 bongo. Because of these large groups 96% of all the bongo seen were in only 46% of the groups.

Table 3. Relative rates of animal observations while walking

Ungulates	number of animals	
	total seen	per hour
Bongo	58	0.18
Bushbuck	149	0.47
Buffalo	16	0.05
Waterbuck	3	0.01
Yellow-backed duiker	7	0.02
Red-flanked duiker	32	0.10
Blue duiker	14	0.04
Giant forest hog	36	0.11
Bushpig	10	0.03
Warthog	12	0.04
Primates	**number of groups**	
	total seen	per hour
Chimpanzee	7	0.02
Baboon	6	0.02
Black & white colobus	52	0.17
Redtail	56	0.18
Brazza's	1	< 0.01
Red colobus	1	< 0.01

During the dry season when very few tracks were seen in the Reserve, large groups of bongo and their tracks were seen to the north east of the Reserve in the Mura hunting block (R. Hurt, pers. com.). Other

large groups were reported to be south of the Reserve in Zaire. It is likely that the reason bongo leave the Reserve at this time, is the need for surface water for drinking. At this time, surface water in the Reserve is extremely limited, if not totally absent (see 3.4 above), but still exists lower down the streams outside the Reserve, such as the Yubu, Mura and Ogo rivers. Nanduro swamp (Fig. 1) is also an extremely important water source in the dry season, and does not dry up at the moment.

It is very difficult to make an estimate of the numbers of bongo in Bangangai Game Reserve. They are mainly nocturnal and spend a lot of time in very thick habitat. They also move out of the Reserve and it is evident from the successes of the hunters in neighbouring areas that there are numbers of bongo outside the Reserve also. A few animals were recognised by distinctive features. Three adult females were resighted on 3 occasions, always together, but the groups they were with were of a different size and composition each time. My observations suggested that there was only one such fragmented 'group' of about 30 - 40 animals in the eastern third of the Reserve, where most walking was done. This 'group' was probably rarely present as a cohesive unit, but consisted of a core group and various satellite groups that periodically joined and broke up again. If there were 3-4 such 'groups' in the whole Reserve, this would make a total estimate of between 90 and 160 females and juveniles. Male tracks were encountered more often, and one all-male group was encountered for each female and juvenile group seen, both while walking and at saltlicks. Since the average size of these small all-male groups was 1.4 animals, and there were usually 1-2 males with each of the larger female-juvenile groups a rough estimate would suggest 2 - 3 adult males In the area covered by each of the female - juvenile groups. An overall total estimate would then be between 100 and 170 bongo in the Reserve and its surroundings. This gives a density of between 0.6 and 1.0 bongo per square kilometre if all these bongo were In the Reserve at the same time. However the Reserve is very narrow (4 - 6km in most places) and these bongo are representative of a bigger area than just the Reserve. It was very evident that bongo move a great deal, so do not remain in one place for long. Further, since there is no settlement or cultivation in the Reserve area, it is likely that density of bongo in the Reserve is far higher than anywhere outside it. In the dry season the number of bongo in the Reserve is probably very low - less than fifty animals.

Sudan Zande fear they will catch leprosy from eating or touching bongo and therefore do not hunt them. All bongo that leave the Reserve are however susceptible to snares and pitfalls, regardless of the animal's sex and age. In many parts of the Reserve, they are also susceptible to these. Males have the added pressure of trophy hunting on all three Sudan boundaries of the Reserve, and all sexes and ages are apparently hunted in Zaire. There is no 'buffer' zone of a non-hunting area on any boundary of the Reserve. The difficulty of maintaining contact with individual bongo in the Reserve, strongly suggests that they move a great deal, and would therefore often wander outside the 'protected area' of the Reserve. Hunters also said that bongo will stay in or near a forest patch for only a few days at most before moving on. The Reserve is far too small to be an effective conservation area for bongo in the face of increasing human population and increased cultivation around the Reserve edges.

A distribution map of bongo sightings in Sudan is shown on Fig. 5. This has been compiled from information kindly supplied by professional trophy hunters. Also shown on the map are the remaining forest patches in the south west corner of Sudan, taken from ERTS satellite imagery. It can be seen that the species is relatively widespread but always in or near forest. All three forested Game Reserves contain bongo and are within this distribution area. It must be remembered that the information from the hunters comes from the hunting season (January to May) and is the time bongo move in search of water, and leave forest patches in search of fresh food. Total distribution may be different and is probably more restricted to the forest patches in the non-hunting season. The forest patches shown on Fig. 5 are only those most conspicuous on the ERTS satellite imagery. The two largest blocks - north of Djabio on the Iya River, and the Sakure - Simbi - Mbarizunga area, are extremely dispersed in nature, consisting of very many small patches. Much of the intervening area consists of open wooded grassland, cultivation and open secondary forest, seemingly quite dense on the ground, but of a relatively open canopy when seen from above. It is

still obviously suitable to bongo, at least in the hunting season, as can be seen from the locations of bongo sighted and/or shot on Fig. 5.

The outer limits of the bongo locations on Fig. 5 encompass approximately 10,000km^2 in Sudan. Of this, only about 10% (1,000 km^2), is covered by primary forest. This should not be allowed to diminish further, particularly in the three Game Reserves. The bongo density in areas outside the Reserves must be much lower than in Bangangai because there is no protection, and large areas are cultivated and inhabited. Bongo are very sensitive to disturbance by humans. Towards the north and east of the area on Fig. 5, the habitat becomes much more open and dryer, and far less suitable for bongo. In these peripheral areas the bongo population is likely to be very low and seasonal.

The only other estimate for bongo is that of Watson (1977) who estimated there were 825 bongo in this area of Sudan as a result of aerial surveys. This gives a density of 0.08/km^2 in the distribution area shown on Fig. 5. It is difficult to see bongo from the air, since they are mainly nocturnal, and spend the day in thick vegetation. Watson's figure is likely to be an underestimate. The true figure is probably in the region of two thousand animals, with an overall population density of 0.2/km^2. This density would of course be highest in the south, especially in Bangangai, and lowest in the cultivated areas, and to the northern and eastern edges of the forested area. Bongo occur in both Central African Republic and Zaire bordering Sudan where there is suitable forest (Bavo Baramu, Atanazio Awas, pers. com.), and can move freely between all three countries.

Observations were made during the study of the feeding habits of bongo. This was done through three methods - direct observations of bongo as they fed, following their tracks and seeing what they had eaten, and analysing the rumen contents of dead bongo shot by trophy hunters. The Zande names of over 100 plants were collected in this way. It is a very varied list that includes herbs, creepers, shrubs, trees, fruit and grasses. Grass was only eaten for a brief period in the late and early wet season when the new shoots flushed.

Analysis of the rumen contents by Dr. M.D. Gwynne of UNEP, Nairobi, showed that grass formed only 8% on average of all fourteen rumens examined, varying between one and 22%. The rest of the rumen contents were mainly composed of green dicotyledonous leaves, leaf petioles and stems. Trees and shrubs were eaten when they could be reached at low levels by the bongo. However, they exhibit an interesting method of obtaining leaves from higher up, which is to break young branches and trees by twisting them between their horns.- In this way leaves from as high as 6m were brought down to ground level. Young mahogony trees ('*bagu*' *Khaya grandifolla*) were favoured for this type of feeding.

The majority of the bongo food plants were the leaves of shrubs and trees, and the new, freshly growing shoots of small trees in the grassland areas. The bongo make use of both major vegetation types - forest and grassland - and certainly make use of secondary thicket forest, where so many food plants are found at their low feeding level. The same is apparently true further south in Zaire, near Epullu, where bongo are scarce in primary evergreen forest, and are only rarely found in secondary forest, developing where cultivation has been abandoned (John and Terry Hart, pers. com.). It would seem therefore that bongo can only occupy forest where there is low foliage, such as in secondary thicket forest, or very patchy lowland forest such as is found in Bangangai. Lower shrubs and young trees are found at the edge of forest patches where it merges into grassland. Almost all the bongo feeding seen or tracked in Bangangai was in grassland areas, or at the edge of forest areas. Although some signs of feeding were found in the forest proper, the few times bongo were watched in thick forest, they were standing resting during the day. The heterogeneous nature of Bangangai's vegetation is a very important feature for bongo.


Fig. 5
The distribution of bongo and major forest patches in south west Sudan
forest
bongo location
river
Game Reserve
International boundary
road
town, village
0 5 10 km
N
Li Yubu
Mbungu R
Biki R
Ivo R
Sue R
Mao R
C.A.R.
Eza
Yubu R
Mara R
Djabio
Anderri
Negesi
Ringesi
Sue R
Hu R
Yeke R
Banganga G.R.
Nyesi
Ringesi R
Yubu R
Range R
Li Rangu
Uere R
Doruma
Ndoruma
ZAIRE
Nzara
Guba R
Bire Kpatuas G.R.
Yambio
Mbarizunga G.R.
Gangura
Sakure

4.1.2 Bushbuck

It is difficult to assess the numbers of any species of animal in such thick vegetation. It was very evident however, that the bushbuck was the animal most commonly seen in all places, at all times of the day and year. They were usually seen alone, or as a pair - usually a female with her young. Occasionally larger groups were seen and once nine were seen together on a saltlick.

Bushhuck were seen everywhere in the Reserve, except in the larger forest patches, and at all times of day. They spend time out in the grassland areas in the late dry and early wet season, but not in the late wet season when the grass is very long and thick. At this time they are in the smaller patches of forest and at their edges. They are found on saltlicks in the Reserve at all hours of the day and night. They chew the soil out of the banks with their teeth all through the dry season.

The presence of bushbuck did not seem to be affected by the absence of surface water in the dry season. They occur throughout the areas surrounding the Reserve in addition. Despite their being a favoured quarry of Zande net-hunting and snaring, they still occur in most places in good numbers.

4.1.3 Duikers

The Reserve is situated in the best habitat in the Sudan for duikers as shown by the presence in it of four species. Three of these - the very large yellow-backed, the small red-flanked and the tiny blue duiker are 'true' duikers and inhabitants of forested areas for the most part. The fourth species, the common, grey or bush duiker (Grimm's), is usually an inhabitant of much dryer bush areas and is found in most other parts of the southern Sudan. This last duiker was only seen briefly, but its presence was confirmed from droppings and local Zande knowledge.

The other three species were commonly seen, both on the edge of forest and in the forest patches. The red-flanked duiker was also seen out in the grassland areas and does occur elsewhere in Africa in such open places (Dorst and Dandelot 1970, Kingdon 1982). The yellow-backed duiker was usually seen very close to forest patches as well as in the forest proper. The blue duiker was always seen in forest, or very thick woodland with dense shrubs and creepers at ground level.

The yellow-backed duiker was always seen alone. The blue duikers were always seen in pairs and the red-flanked duiker was usually seen alone, but in the dry season pairs were seen more often and we presume they were then mating. Very young blue and red-flanked duiker were both seen in late December and early February.

Only the yellow-backed duiker was seen to come to the saltlicks. None of the duikers were seen after June and until December. This is because they are small, and in this period the grass and vegetation are so thick it is impossible to see them. Usually all we knew of them in this period was the sound of their alarm whistles, and feet thumping their chests as they ran away In the case of the blue and red-flanked duikers, or the particular heavy crashing noise made by the yellow-backed as it fled through the undergrowth.

Rumen contents of all three 'true' duiker species were collected by the professional hunters. All three species were found to eat a lot of fruit and fallen leaves, as well as fresh leaves. Many insect parts, especially of termites and millipedes, were found in the blue duiker rumen contents.

4.1.4 Elephant

It is unlikely that elephant are permanently resident in the Reserve, mainly because it is so small. Although evidence of them was commonly seen, elephant themselves were only seen 3 times in the two years. Each occasion was at night at Nagbagi saltlick. Elephant pass through the Reserve frequently in their seasonal migrations through this part of Africa. Local knowledge is that they move between Zaire and Sudan, spending the wet season in Zaire and the dry in Sudan. They are said to enter the Sudan after the grass is burnt. Elephant were seen at Nagbagi lick in September, December and March. They were heard and fresh

evidence was found in the Reserve in all months of the year however. An elephant was poached by Zairois in the Reserve in November 1982.

It is likely that elephant play an important role in the ecology of the area.- Many grassland clearings show trampling from the passage of elephant through them, while tree species such as '*bagbodi*', '*nguruza*' (*Acacia campylacantha*) and '*bambiri*' (*Albizzia zygia*) are heavily browsed by elephant, usually to the point of destruction, such that the next fire completely burns them. Trampling of grass and exposure of soil at the end of the wet season was seen to stimulate the germination of '*bagau*' grass seeds before fire burnt off the old growth. Elephant trails through both grassland and forest become routes for other animal species and man. Elephant periodically make major modifications to the saltlicks, gouging out large new areas of soil and destroying the old banks. It is likely that these effects will become more noticeable with time, as the areas available to elephant are reduced through human settlement and poaching pressure. The Reserve will become more of a refuge for them, where they are technically safe from poaching. In practice they are not safe at the moment, with the result they are very frightened of humans and are reportedly very angry when encountered. The Reserve is obviously ridiculously inadequate as far as this species is concerned.

4.1.5 Buffalo

Buffalo were encountered on several occasions when walking and often seen at saltlicks at night and in the early morning. Groups were relatively small, varying from lone animals to the biggest group seen of 17 animals. They were seen in all habitats, but mainly wooded grassland and low-lying grassland. Evidence of buffalo presence was seen in most parts of the Reserve, indicating numbers are reasonably high. They were less evident in the dry season and probably then moved to the vicinity of permanent water.

Both black and 'red' colour forms of buffalo were seen and always in the same groups. The red individuals were both adult and juvenile. All the adults of both colours had relatively small, curved and upright horns, and no large horn bosses were seen as are typical in the 'plains' form. These facts show that the Bangangai buffalo are an intermediate between the all-black 'plains' sub-species (*Syncerus caffer caffer*) and the all-red forest subspecies (*S. c. nanus*) of West Africa.

Although buffalo have a reputation for ill-temper and unpredictability, in all instances where they saw us walking or got our scent, they made every effort to leave the vicinity as fast as possible. They are no threat to anyone walking through the Reserve, provided they are not cornered, surprised at close quarters or purposefully frightened.

4.1.6 Pigs

All the three wild pig species that occur in the southern Sudan are to be found in Bangangai. The warthog is usually a grassland species, while the bushpig and giant forest hog are usually inhabitants of bushed and forested areas. This emphasises once again the heterogeneous nature of the Reserve vegetation, and the wide variety of wildlife species found there as a result.

Warthog were seen most commonly in the dry season and early wet, when visibility was good in the grassland areas. Large young were seen at all times. Twice they were seen at saltlicks, once at night. This is surprising considering the warthog is normally diurnal. They were not seen as often as the other pig species.

Bushpig and giant forest hog were seen to be active both by day and night. Bushpig tracks were very rarely seen at saltlicks but giant forest hog were seen to actively use licks at night and in the early morning. Evidence was seen several times that bushpig eat animal carcases and this may explain the source of their salt. Both species were encountered in forest and forest patches, as well as in grassland. Bushpig were seen in cultivation, and are the worst problem people experience in their gardens.

The largest pig groups seen were of bushpig, eleven being seen together on one occasion. The other two species were only seen in groups of one to three adults together with their young.

4.1.7 Chimpanzee

Chimpanzees are one of the more obvious occupants of the Reserve. The noises they make carry a long way, and their sleeping nests are easily seen. They were relatively easy to track and see, even in forest areas, once their calls could be followed. Calling was heard at night as well as by day, but night calling was usually stimulated by lion or leopard calling in the same vicinity.

Chimpanzee were always seen in forest, except for one occasion when a small group was seen crossing grassland to join another group in forest. This was in the dry season when the grass flush was still very short.

Several older animals were seen with white-coloured backs. Troops were generally small, of less than ten animals. They were seen feeding on the fruit of '*mbirikombiri*' (*Santaloides gudjuanum*) - a large forest creeper.

Calling was least frequent in the Nambia area in the dry season. It is presumed that a.t this time they moved to permanent surface water. Nests were most frequently seen high in tall trees of the primary gallery forest, but occasionally in lower trees of the lowland forest.

4.1.8 Monkeys

Bangangai is especially rich in primates, there being nine species including the chimpanzee and a bushbaby. Many of the monkey species are easy to see, partly because they are noisy, also because they are more visible being arboreal and diurnal. The most commonly seen species were baboon, black and white colobus and redtail monkeys. The tantalus monkey was common in more open areas, especially near human settlement, and along drainage lines. Patas monkey - a grassland species, was not actually seen In the Reserve, but within 5km of it, near Nyesi in the east. Brazza's monkey was heard often in the early morning, but was seen only twice. This monkey occurs singularly or in very small groups, and has the habit of remaining motionless and silent for long periods in the upper canopy when disturbed. The red colobus was seen only once In the Ogo gallery forest, but is said to be present in other suitable forest in the Reserve. Very large troops were seen in Bire Kpatuos Game Reserve, only 35km to the south east, also in gallery forest (see 8.13).

Baboon were seen in troops of 20 -40 animals. They were mostly seen in grassland in the short grass period when ground visibility was good, in the mango groves when these were fruiting (March - May), and in or near cultivated areas. They are a great nuisance in cultivation, but being diurnal are more easily counteracted than bushpig.

Black and white colobus were seen in groups of 10 - 20 animals. They were often seen in the company of redtails. The synchronised early dawn calls of the males were a feature of most days beginning at about 0430 hrs. Odd calls were heard at other times during the day and night Black and white colobus were seen in both primary and secondary forest, including quite small patches provided there were tall trees present. They were once seen on the ground at a saltlick, but it was not seen if they were ingesting earth. They were also occasionally seen on the ground on the boundary road.

Redtails were seen in groups of 10 - 40 animals, usually high in the canopy of primary forest. They were also once seen lower, at ground level in very dense secondary thicket forest at the western end of the Reserve.

4.1.9 Carnivores

None of the carnivores listed in Appendix 8.4 and 8.5, were seen in the Reserve with the exception of the civet and all three mongoose species. Evidence for the presence of the others was however definite.

Leopard were heard often at night at Nambia, particularly in the dry season, and tracks often seen in many parts of the Reserve. Droppings were commonly found, containing mainly bushbuck bones and fur.

Lion were heard on many but irregular occasions at night. Droppings and tracks were found a few times. A young female buffalo was killed by two lion in December 1982 at Nauwoo. Bushpig were killed twice near Nambia near the boundary track.

Hyaena droppings and tracks were found on a few occasions. They were not seen, nor heard.

Evidence of civet was found often. Tracks were seen most days and various dung piles were monitored periodically to see what they had been eating. This included a variety of fruits and insects, also colobus and baboon fur, snake scales and pangolin scales. Civet were seen mainly in the very early morning before 0600 hrs, at night and in the late afternoon.

The marsh mongoose was seen once in the Ogo/Tiazuro confluence swamp and at Nambia swamp in the dry season. Droppings were found near several swampy areas, mainly containing exoskeletons of freshwater crabs ('*ngare*' *Potamonitas* sp.)

Packs of banded mongoose were seen several times in the short grass periods. A pack was found with young in an anthill near Nagbagi in April.

The white tailed mongoose was seen once at night at Nagbagi saltlick.

4.1.10 Other mammals

A variety of other mammals occur in the Reserve, mostly small. Many of them are known to occur from local Zande knowledge, and identification of them is not certain (App. 8.5).

Scales of the tri-cusped pangolin were found on a civet dung pile. Porcupine quills were often found and two major burrow areas known. Aardvark burrows and evidence of their diggings in termite mounds were frequently seen.

Mole hills of the pale grey mole rat (*Cryptomys ochraceocinereus*) were often seen in grassland, and some live captive examples were seen. Various squirrels were seen but not finally identified. These included a ground squirrel, and at least two arboreal squirrel species.

The sitatunga possibly occurs in swamps in the Reserve, reputedly along the Nambori River in the west. Two were shot in the 1982 hunting season and others seen on the Mura and Ogo rivers, north east of and close to the Reserve.

The large fruit bat '*ndema*' was heard at night, particularly in the wet season, and when mango and '*dama*' (*Nauclea latifolia*) were fruiting. They were also often disturbed from trees during the day while driving along the boundary road. One was found dead in Napara saltlick.

A nocturnal primate, identified as the dwarf galago or bushbaby, was heard many nights, but never seen. It is known locally as '*noyngbi*'. Other mammals said to occur include the brush-tailed porcupine and giant pangolin. Various rodents were trapped and names have been given In Appendix 8.5. The probable diversity of rodents can be judged from the fact that Gore and Gore (1925) give over twenty names for rodents in their Zande dictionary.

4.2 Birds

Over 270 species of birds have been recorded for Bangangai Game Reserve. These are listed in Appendix 8.6. They have been recorded on the present project, as well as by previous visitors to the area (Woodman 1936, 1952a and b, Cave and Macdonald 1955, Nikolaus 1979, and Traylor and Archer 1982). This number of species is probably still well below the total, since many of the forest birds are difficult to see and identify, being dark-coloured, similar to each other and retiring in their habitats. Mist-netting was carried out in March, November and December 1982, and January 1983 in a small grassland clearing between two forest patches at Nambia. This enabled better identification of some forest birds in the hand, and the ringing of migrant species that were passing through.

The number and variety of bird species in the Reserve is impressive. It is not possible in a report of this nature to discuss all the species individually. The variety does serve to illustrate the varied habitat of the Reserve, its location between West and East Africa, and on the boundary of the wooded savannah grasslands to the north and the Zaire forest block to the south.

Bangangai provides suitable habitat for both forest and grassland birds. Amongst the forest species can be listed the various greenbuls, pied hornbill, crested guinea fowl, Afep pigeon, malimbes, yellow-mantled weaver and green-backed woodpecker. In contrast, grassland species include the secretary bird, the tufted guinea fowl and the various species of vulture.

Representatives of East African bird faunas that are not found much further to the west include the tufted guinea fowl, the bronze-naped pigeon, the white-browed coucal, the eastern grey plantain eater and the cinnamon-chested bee-eater. West African bird species that are not found much further east include the long-tailed hawk, the black-headed bee-eater, the West African goshawk, the white-spotted crake, the white-crested turaco, the great blue turaco, the shining blue kingfisher, and the white-tailed and black-wattled hornbills.

Various inter-continental migrant bird species spend time in Bangangai during their time in Africa in the European winter. Such birds include the European swallow, red-throated and tree pipits, white wagtail, nightingale, cuckoo, honey buzzard and black stork. Intra-African migrants are also seen periodically, such as the pennant and standard-winged nightjars, the Madagascar and white-throated bee-eaters, the Abyssinian roller and grasshopper buzzard.

Finally there are various bird species endemic to this part of Africa - the haut-Uelle region - that are found nowhere else. These very interesting birds include the Zande parrot, red-faced lovebird, forest and Heuglin's francolin, white-naped pigeon, black-billed turaco, blue-breasted and chocolate-breasted kingfishers, the black dwarf hornbill, the hairy-breasted barbet and the brown-eared woodpecker.

One great advantage of the birds is that they present such variety, that with sufficient interest and enough patience they provide an attraction for visitors at any time of year, regardless of the grass height or water supply. There is probably a greater variety of birdlife in Bangangai than in most other places in the Sudan.

4.3 Other animals

A list of those butterfly species collected and/or seen in the Reserve is given In Appendix 8.7. Butterflies were also collected by Michael Rae and Paul Waring of the Jonglei Research Project. Identification was kindly carried out by Mr. Michael Clifton of the National Museums of Kenya. Butterflies are evident at all times of the year, but particularly in the rains. They are colourful and easily seen for the most part and provide another facet of interest for a visitor. They further illustrate the savannah and forest elements of the Reserve. About 90% of the species identified are found In Western Africa, and about 45% in eastern Africa. This shows the extent of overlap of the fauna of these two areas in Bangangai. One species – *Abisara neavi neavi* - has not been recorded from Sudan before, and several others are probably also new records for the country.

Reptiles seen and/or collected in the Reserve area are listed in Appendix 8.8. Many snakes were seen, but usually for only brief instances. Those collected were killed by local people who are very scared of all snakes regardless of size. Most were seen in the dry season when vegetation cover was sparse and they were more evident.

Amphibia collected in the Reserve are listed in Appendix 8.9 and fish in Appendix 8.10.

Little collecting has been done in the Reserve. Future intensive collecting would certainly produce a lot of interesting information. Body lice (*Anoplura*) collected off a red-flanked duiker that was reared in camp, have proved to be a new species of *Linognathus* (Dr. K.C. Emerson, Smithsonian Institution, pers. com.)

5. Human needs in the area

Bangangai Game Reserve is surrounded on all sides by areas in which now live the Zande people (in Sudan and on one side in Zaire). It would be entirely selfish to presume that the Reserve is apart from their lives and needs, especially in a developing country such as Sudan. Older Zande people recognise the need for a Reserve, a ‘store' as they call it, to maintain stocks of water, vegetation and wildlife, and to replenish those that are used up in the surrounding areas. It would be Impractical to assume that the Reserve is sacrosanct and is not used by these people. They are hunters and gatherers in this environment, as well as practising slash-and-burn agriculture. Pressures on the Reserve area and its contents will increase with development of the country and as a result of an increasing population. Consequently the function of the Reserve as a 'store' will become more and more important in the future in preserving the sources of the Nile contained in it, and the fauna and flora.

The needs of people in the Reserve vicinity will be discussed in this section. The management compromises that need to be made as a result will be discussed in the following section (6. Management recommendations).

5.1 Agriculture

The northern boundary of the Reserve is formed by the 'Southern Loop Road' between Nyesi in the east and Ezo in the west. People are settled along this between the river Biki and Bangangai village almost continuously, then again at the river Nangondi, and at Nambia (Fig. 6). In addition the northwest corner of the Reserve where the '*gbaria*' lines of the Zande Scheme were located, is all settled. Settlement at Nambia is currently increasing, since the area was recently annexed from the Forest Reserve by Chief Gbatanyaki of Naande. Areas that are settled, and changes that have occurred between 1980 and 1983 on the Ogo to Bangangai stretch of the boundary, are shown on Fig. 6.

Zande agriculture is traditionally based on a five to seven year occupation of an area, which is systematically cleared over that period of all natural vegetation. The trees, bushes and creepers that can be easily cut are first cleared and then burnt. Larger trees are felled more slowly using fire and ring-barking. On average a man will clear 1-2 hectares in this period of time. Favoured areas are maturing secondary forest, primary lowland forest and some grassland areas.

Crops grown include cassava, peanuts, forest rice, eleusine, dura, maize, sweet potatoes, sesame, bananas, pineapple, and pawpaw. People of more standing In the local community and near to villages with facilities such as Bangangai, take over larger areas of several hectares and plant longer-lived cash crops such as coffee, citrus and oil-palm. Cotton has to be grown by everyone by government order, after the second year of dwelling in one location.

The significance of settlement along the edge of the Reserve, is that it brings people into close contact with the boundary, and their agricultural activities then radically alter the natural vegetation in the area. Their other needs in hunting and gathering have more significance to the survival of the Reserve. The Zande population shows signs of increasing, and traditionally international aid to a developing country has the primary effect of increasing the birth rate and decreasing the death rate. Areas along roads are where people mainly settle, and are encouraged to, so as to enable government to reach and service them more easily. These road fringes are showing signs of being 'worked over’ and land-hungry people will begin to look to seemingly 'unused' areas for further settlement and fresh unused soil. One first sign of this is the

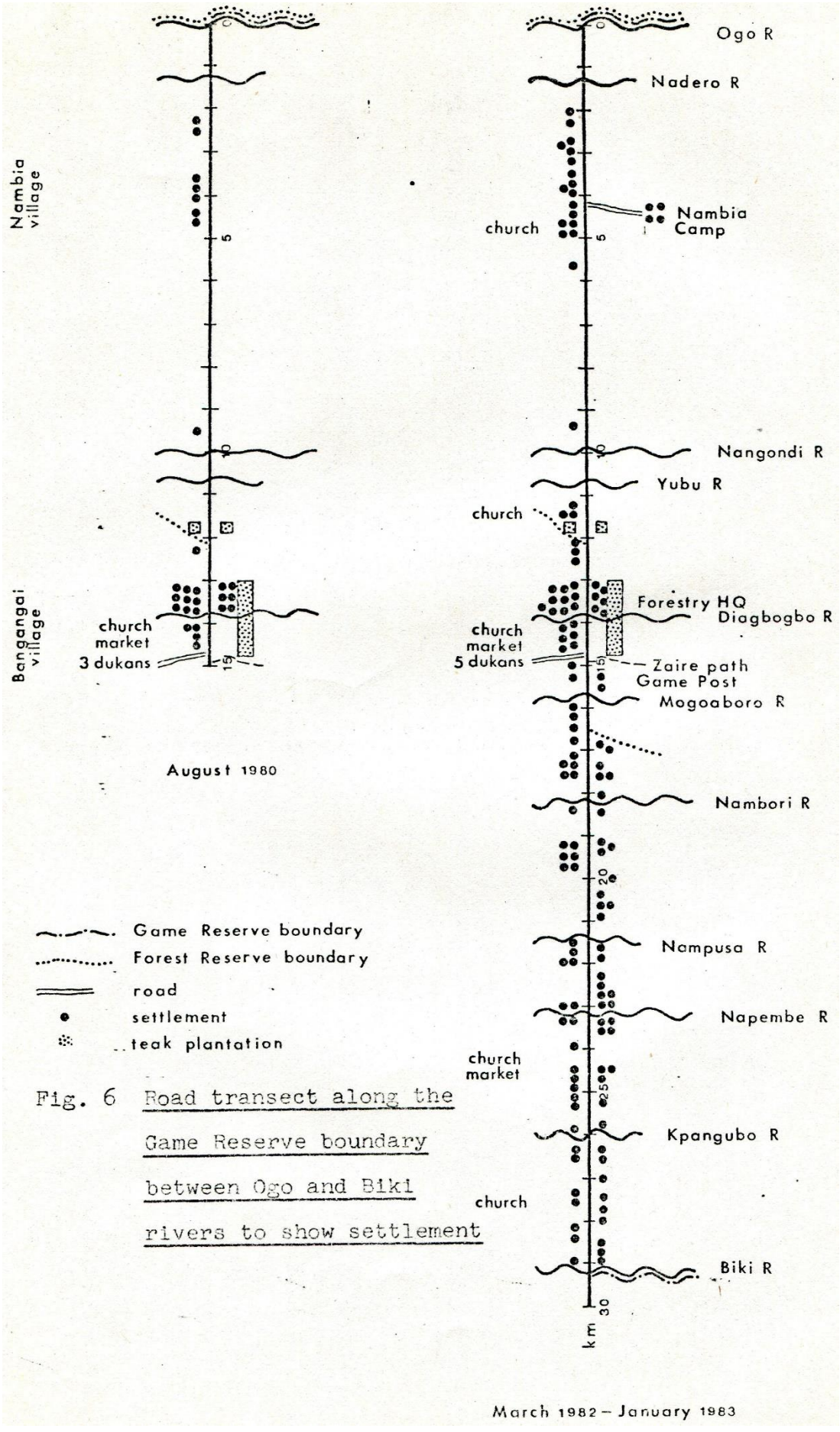


Fig. 6 Road transect along the Game Reserve boundary between Ogo and Biki rivers to show settlement

illegal annexation of the eastern portion of the Forest Reserve by the chief. The reason given was that the people settling there would maintain the road. In practice they do not do this and more and more families are settling there (Fig. 6).

Various wildlife species are only too happy to take advantage of areas planted with one or two species of food plants growing close together. The worst offenders are baboon by day and bushpig by night. Other larger wildlife species that occasionally raid the gardens are elephant, tantalus monkey, porcupines and squirrels. People also keep chickens and these can be preyed upon by civet, mongooses and serval. Crop protection is minimal. People mainly rely on their hearing to know when animals are in their gardens, and then chase them away. Various forms of traps are placed on paths used by animals into the gardens, sections of bamboo are exploded on fires at night and drums are beaten to frighten bushpig away. A few people drape their hunting nets around their gardens to prevent animals entering. A practice that was more common in the past but is rarely seen now, was to use the cut trees from clearing the area to make a heavy log fence about 1m high to keep bushpigs out.

The damage that can be done by a few animals in a short space of time is considerable, and causes much hardship since these people subsist on their crops. Technically people are required to go and see the nearest Game Post, in the past at Bangangai, currently at Nambia, and ask the scouts to deal with the crop raiders. In practice the Game Post may be up to 20km away, the animals have usually gone when the scout arrives, and he often has very little or no ammunition. Shooting animals such as baboon is a very short term solution, they are usually prepared to return in a few days. Labour-intensive watching of crops, the use of felled trees to construct pig-barriers and the use of hunting nets around the garden at susceptible periods of crop-ripening would seem to be the most practical solutions under present conditions of development. People will use crop-raiding by wild animals as an excuse to 'get their own back' and go hunting in the Reserve. However, bush and forest patches occur both in and out of the. Reserve, and species such as bushpig and baboon are found in both areas.

5.2 Meat

People need protein in their diet, and this is most easily obtained as meat. The Zande cannot keep cattle, sheep or goats because of trypanosomiasis carried by tsetse fly, and because the vegetation is unsuitable. Chickens do not thrive and are preyed upon by various small carnivores. Consequently the traditional source of meat for the Zande is bush-meat from wildlife species. The main effect of the settlement along the Reserve boundaries, especially the Zaire boundary, is that it brings people, who are hunters by tradition, into close contact with an unhunted area. As areas or species outside the Reserve are over-hunted so people turn to those in the Reserve. The traditional reply to this problem of over-hunting is that "there will always be enough animals, they were not finished in my grandfather's time".

Zande are ardent hunters and have evolved numerous ingenious methods and traps with which to capture animals. The main method is communal netting of small and medium-sized antelope. Nets made of natural fibres are strung around an area of grassland or forest, and animals driven into them by men and dogs and then speared. Animals killed in this way include all the duiker species and bushbuck. Pigs and larger animals are trapped in deep pitfalls dug along major paths. Animals of all sizes are caught in snares made of natural fibres, either at head height, or powerful spring snares set in small holes along paths. Smaller animals such as guinea fowl, cane rats, squirrels etc. are caught in small snares, deadfalls and the like.

There are very few animals that Zande will not eat. Various species are not eaten by all the people, or by some clans. The bongo is in theory, an anathema to all Zande, who fear they will catch leprosy from eating its meat, or even touching it. However, Zande from Zaire do not have this taboo, and influence the Sudan Zande when they settle there. Expatriate staff at tourist hunting camps will eat bongo meat, another influence on the Zande when they see no harm resulting. Unscrupulous people have found that the dried meat can easily be sold elsewhere under the guise of another species. Pitfalls and snares are unselective

and bongo when captured by these are still dead, whether eaten or not. Three complete bongo skeletons were found in the course of the project in pitfalls.

Bushpig, colobus, chimpanzee and sitatunga are also generally not eaten, or by very few clans. Each clan has one or more taboo species of animal. Most mammals will be eaten, but various species are now being ignored through the influence of Western 'civilisation'. These include rats and smaller mammals. Equally, snakes and birds are receiving less attention than formerly. The duikers and bushbuck would seem to be the most commonly hunted species in my experience. Despite this, populations of all these species are remarkably high in the Reserve. Smaller species such as these, tend to be more resilient to hunting pressure, and to thrive in a patchy environment of cultivation, old cultivation, forest and grassland.

Populations of these species are seemingly also high outside the Reserve. Neither subsistence nor trophy hunters complain of difficulties in obtaining them. However, conditions in Zaire in the Doruma area south of the Reserve are reportedly different. Apparently the lack of control of hunting and the methods employed, as well as the large areas affected by agriculture have reduced populations considerably. The result is that the main poaching pressure is from the Zaire border.

The methods employed in hunting give great cause for concern. Traditional methods were outlined earlier. Sophisticated weapons and materials are now becoming more common. These include modern firearms, including those stolen every year from hunting camps in Sudan, homemade guns (locally called '*fabrication*'), nylon and steel cable snares, and the use of poison (mainly intended as cotton insecticides). The advantages of traditional weapons and traps to wildlife conservation, are that killing rates are low because of the efforts needed to construct the nets, pitfalls etc., and the materials, being natural, have a time limit of usefulness before they are decomposed by rain, termites etc.. Hence even if a larger animal is snared and breaks away, the snare will rot and fall off. A nylon or steel cable snare however, will continue to become entangled and cut deep into the animal. Modern and homemade weapons, have far greater certainty of killing their quarry, but the danger is then overkill. This is not only to the long-term disadvantage of the environment, it is also to the disadvantage of the hunter himself, who is killing off his meat source.

The greatest danger is the trade in smoked meat, smuggled across the border on bicycles to Zaire, where most wildlife has already been overhunted. This trade is only likely to increase as human populations expand and living expectations rise. The final result of overhuntlng through the high killing rate and resulting commercial sale of bush-meat, is best illustrated by the situation in various West African countries, where guns became more generally available earlier than in eastern Africa. There, the commonest source of meat is species such as cane rats and squirrels, larger species having been hunted out long ago, to the detriment of the local population's meat supply, and the impoverishment of their environment.

The local demand for bush-meat must be respected as a legitimate need, but it must be controlled, so that the wildlife is used rationally for the benefit of the Sudanese people, and with regard to the future meat supply in particular. Firearms also allow local people to pander to the Western demand for ivory. Poaching for high-value ivory is as attractive to people in this area as elsewhere In Sudan and Africa. In the Bangangai area it is mostly carried out by people from Zaire, taking, advantage of the remoteness of the area and lack of Game Scouts, and by Sudanese armed forces, In particular the Police (although Prisons, Army and Wildlife Department personnel are also guilty). The situation cannot improve until greater control of the area and education of forces by the government is achieved, and until the demand for ivory in the West is considerably reduced, thus decreasing its present Inflated value. Trophy hunters feel that the elephant is the species most threatened, and that it has been most reduced in numbers over recent years.

5.3 Gathering

Various activities have been included in this category, such as collecting termites, honey, fish, wild yams, firewood, wood and thatch for building, mud for pottery, and water. All these activities are carried, out within the Reserve area by people living along the boundaries. They are carried out in areas outside the Reserve as well, but laziness, the proximity of the Reserve, and population pressure, cause people to harvest the Reserve area which to them seems 'unused'.

Termites are gathered when the winged allytes swarm and fly at the beginning of the rains, between February and June. Several species are collected, usually by attracting them with the light of a fire, into a small steep-sided pit at the edge of the termitarium. Most mounds have known 'owners', including those up to 2km into the Reserve near the settled areas. The ants are fried in their own oil and stored for later use, or are ground down to a paste. They are a very important source of protein for the Zande. The period over which they are harvested is brief - a few days spread over several months, and the disturbance to the environment is minimal, apart from the disturbance caused by frequent passage of people through the area at these times.

Honey-gathering is carried out between April and September mainly. Hives are natural in hollow trees. A certain amount of management is practiced in that hives found to be poor in honey are blocked up again for a later visit. The honey is largely used in beer making ('*duma*'), or sold to buy products from shops. Damage to the environment can be considerable. Fires used to smoke bees out are neglected once the honey is collected, and left to burn. This can cause damage to forest where the hive was in a dead tree or log which burns for a long time, first killing then burning other vegetation around it. Entire, large forest trees will be felled to bring a hive down to ground level, or to construct ladders for easier access, even when this requires several days' work, sleeping out in the forest.

Fishing is a dry season activity, carried out as water levels in rivers and pools drop. Streams are dammed and divided into lagoons with earth and vegetation. These are then drained and all larger fish collected, smaller ones being left to die. This is done regularly to Bangangai pool by people from Zaire, Naturubu pool and the Ogo River by people from Sudan. This has caused a drop in both the size of fish caught and total numbers of fish according to local people. Dried fish is now imported from larger rivers such as the Sue and Ibba further north and east. The water table is falling anyway (see 3-4 above) with the result that the fish fauna is probably now considerably depleted. The cash or food returns from fish today are more important to people, than the less tangible future with few or no fish. The use of cotton insecticide as fish poison is also on the increase, dangerous both to humans who consume these fish, as well as the non-selective nature of the poison, affecting fish and other water fauna not collected, and animals or humans drinking the water.

Various wild vegetable foods are collected in the Reserve area, mostly '*gbara*' (*Dioscorea dumetorum*) - the 'wild yam', the tubers of which are dug from the ground. Other vegetables gathered are mainly fruits, eaten in season as people pass through the area. These include '*ndavu*' (*Landolphia comorensis*), '*warawara*' (*Landolphia owariensis*), '*nongaa*' (*Amomum korarima*) and '*bema*' (*Chlorophora excelsa*). Their availability is for only a brief period, and collecting them does not involve significant damage to the vegetation.

Firewood, poles and thatching grass for building are collected from the Reserve only in the close proximity of settlements on the boundary. These materials are not carried for great distances and their collection, though technically illegal in the Reserve, is of minimal importance at present levels. The same is true of other materials used to make nets, ropes, baskets and mats.

Clay, for making pots, is collected by people from Zaire from beneath the swamp south of Bangangai pool. Large pits have been dug, from the lower levels of which the clay is extracted and carried away. Actual collecting of the clay causes little damage to the environment, but people have been accosted at Bangangai pool in groups of up to ten and fifteen people, armed with spears. These are in theory for 'self-defence';

however, the Zande being opportunistic hunters, they will readily use them should an animal be seen on the way. The same people are responsible for damming and draining the pool to collect fish.

Water is collected in the Reserve near the boundary at Nambia and from the Nadero River. This has been discouraged through the encouragement of the self-help well dug outside the Reserve, from which much cleaner water is available year round. However, people not living close enough to the well, still persist in collecting in the Reserve.

5.4 Contact with Zaire

The Zande tribe is split between three countries - Sudan, Zaire and Central African Republic. The division is artificial, having been made by colonial rulers over 70 years ago, using the convenience of the watershed between the Nile and Congo rivers as an international boundary. Family, clan and tribal ties are still very strong across the borders with constant movement of people. The result is people cross the border wherever it is most convenient to do so, and family ties are much stronger than any feelings of national identity. Systems of identity papers have not yet been enforced.

Contact with Zaire by people living along the boundary is by four main routes. These are from Ezo, Bangangai village, Nambia and Nyesi. The Bangangai and Nambia routes cross the Reserve (Fig. 1). The Bangangai route is the most used, especially for smuggling, since the village has no administrative presence, beyond a Forester and sub-chief. It is suitable for bicycles. As a result of this 'trade', Sudanese currency is said to be more in use in the Doruma area than Zairean. These people may be travelling to see relatives, but are mainly smuggling goods to centres as far away as Ezo, Nzara and Yambio. Once they have crossed the border they are as unidentifiable as to country of origin as any Zande. The Nambia track (the old motor road to Doruma) is not used so much as yet, it is unsuitable for bicycles since the vegetation is thick, the old bridges have collapsed and there are many fallen trees. As the settlement at Nambia increases however, it is being used more.

The effects on the Reserve of these paths are to make it easy for anyone to enter the Reserve with a 'legitimate' (though illegal) reason, create disturbance along the route, make it easy for poachers from either country to pass quickly into the heart of the Reserve, and enable criminal elements of the community to move easily undetected between the two countries. Twice our camp was raided at night and no trace of stolen items found. Once the thief was tracked all the way to the Zaire border on the Bangangai track. The same things have happened when local people have had their houses broken into. This has obvious implications if tourists do begin to visit the Reserve. It is already a problem for trophy hunters' camps anywhere in this border region with Zaire, guns and ammunition being the main target.

5.5 Trophy hunting

Trophy hunting of wildlife is legally carried out on the boundary of the Reserve. Two hunting blocks adjoin the Reserve boundary, these being Mura to the east, and Ezo to the west. Two hunting camps are at Mura, one of Nile Safaris and one of Nimmerico/Sudan safaris, within 8 km of the Reserve boundary. The main objectives in this area are bongo, yellow-backed duiker and elephant.

Expatriate hunters are prepared to pay up to US $850 - 1,000 per day for hunting in Southern Sudan. This is before paying for licences for each species to be shot, and a head fee after each animal is shot. This industry brings in much-needed foreign exchange, and is almost the only foreign exchange earned by the Southern Region on its own merits, not received from international aid or from central government.

In theory the effects should be beneficial to the Reserve, if the money earned from the hunting industry were ploughed back, to some extent, into the Wildlife Department for maintenance and development of its operations in and near conservation areas. The annual budget for Bangangai Game Reserve at present, consists of only the salary of one sergeant and one game scout, a total of Sudanese pounds 804 per annum

(US$ 625). A more tangible return of some of the wildlife earnings to the areas where they were generated, would also gain respect locally for wildlife and some of its values to the country.

The Reserve is also meant to function as a reserve, or 'store' of breeding animals to replenish those that have died naturally or been hunted, whether for meat or trophies, in the surrounding areas. Professional hunters come under the pressure of their paying tourist clients, and when a trophy animal is difficult to find, and time becomes short, the temptations to look to the Reserves for trophies are very great. The temptations are also great for the Game Scouts accompanying those hunters to take them into the Reserve to hunt there, especially when they are offered rewards. Two tourist hunting parties entered Bangangai Game Reserve In May 1981, accompanied by Game Scouts of the Wildlife Department, and hunted there hoping to obtain bongo. The excuses offered were that the professional hunter did not know there was a Reserve, while the Game Scout knew, but claimed they were following a wounded animal. Ignorance is the 'professional' hunters fault - he is meant to be a professional. The Sudanese hunting laws forbid the following of wounded animals into conservation areas, and no animal had in any case been wounded.

These same 'professional' hunters have told me they will do the same again, as soon as they know there is no European research worker in the Reserve. They have also admitted it is easy to bribe Game Scouts in Reserves with ammunition, and so be allowed to hunt in these Reserves. The fact that the philosophy of Game Reserves is ignored by professional hunters on occasion, can only mean they are unable to find sufficient numbers of animals, in this case bongo, in the hunting blocks to fill the quotas allowed by the Wildlife Department. If this is the reason, it would naturally be best to reduce the annual quota of 65 bongo, in order to safeguard the bongo population from over-exploitation. Both the professional hunters and the Sudan Wildlife Department should be looking to the future of their livelihood.

5.6 Tourism

The Southern Region of the Sudan receives very few tourists at present, and Bangangai is a long way off the beaten track for any that do come. It is a long way from Juba and there is little else to see or do in the same area. Bangangai cannot stand alone as a tourist attraction, except for the very keen naturalist or specialist. The best period for visiting the Reserve is limited to the early wet season. There is little of the infrastructure in the south that is a primary requirement for tourism - roads, hotels, regular, reliable air transport, vehicles for hire, fuel, maintenance and other safari necessities. A tourism industry of any economic importance is unlikely to develop until these services can be provided and relied upon.

A few tourists came to the Reserve during the course of this project. Eight visitors came in 1981 and a total of 12 in 1982. All of these people were expatriates working on international aid projects in the south, mainly in Yambio. The others were from Juba and Bor, and were in addition keen naturalists. People are only prepared to come at the moment either because the Reserve is near to Yambio, or because they have a special interest in the place.

Facilities at the Reserve are minimal. As a result of this project there is now a small resthouse at Nambia Camp. Water and firewood are available, and there is the security of two Game Scouts living in the camp; an officer may be posted there soon for whom housing has already been constructed. Visitors can be taken by Game Scout into the Reserve to look for animals and visit some of the saltlicks, and a local tracker and guide can be hired.

Many of the visitors who have been recently, have been lucky enough to see bongo and chimpanzee, in addition to bushbuck, buffalo, red-flanked duiker, redtail and colobus monkey. Most were appreciative of the many other aspects of the Reserve, in particular the rich bird life, the butterflies and the stands of unspoilt primary forest that are so rare in Sudan.

There are no roads through the Reserve so all wildlife viewing is on foot. The best time to visit is at full moon to use the platform at night over Nagbagi saltlick, or soon after full moon to take advantage of its light to reach saltlicks at dawn after a pre-dawn walk. The best time of year is early in the rains, between

March and June. Prior to this the Reserve is very dry and burnt, water is in short supply and animals are not seen in good numbers. After June the grass is over shoulder height and again observations are difficult. At the time of the first rains, the chances of seeing bongo are high in the very early morning in the grassland areas and at saltlicks, especially on the morning after heavy rainfall.

5.7 Forestry

Most of Bangangai Game Reserve is also included in Bangangai Forest Reserve. The focus of the Forest Department activity is at Bangangai village. This consists of clearing natural forest, burning all the trees so cut down, and planting teak trees (*Tectona grandis*) in some of this cleared area. Since 1974 when planting began, 54 fedans (0.23 km^2) or 0.13% of the Reserve area have been planted to teak trees. The aim of the Forestry Department (stated by the Deputy Forest Conservator, Yambio) is to plant the whole Forest Reserve area to teak at a rate of 70 fedans (0.3km^2) per year.

This planting rate is not alarming as it would take over 500 years for the Reserve to be totally planted to teak, and in any case the planting rate has not yet been achieved for various reasons. The main reason given is that seed has not been supplied by the Forestry Department. Attempts have not been made to collect seed from the trees already planted, although these set viable seed every year which are made use of by local people. The permanent Forestry staff is 12 people. Teak should be thinned at 3 - 4 years after planting; the poles so produced are suitable for building, and would be in demand where there is no natural forest, but there is no transport. Those poles that have been cut have rotted and been eaten by termites' since there was no demand. Thinning has not been repeated. Further thinning should be undertaken at 7-10 years old; small logs are then produced suitable for milling. This has not been done with the oldest trees, now nine years old, again because of lack of transport and lack of Instructions from higher authority. The result is that the oldest plantation is rapidly becoming over-crowded. Local demand is minimal - for furniture and door making, which most people can produce more cheaply from indigenous trees they fell themselves.

Greater concern is caused by the area actually cleared of indigenous primary forest by the Forest Department, ostensibly for plantation of teak. This now amounts to over 1.5 km^2, which is mainly used for cultivation by the Assistant Forester, his staff and their associated families. The result is that anyone arriving at the Reserve by way of Anderri and Bangangai village, can see nothing but teak plantation, dead and cleared forest, cultivation and housing. This is along 2.6km of the boundary track in the Forest and Game Reserve. While it is current forestry practice In many parts of the world to interplant young trees with crops for a few years, until the trees are large enough to shelter the exposed soil beneath for themselves, the temptation to clear more indigenous forest than can be planted up, and use it for cultivation, is an abuse of the concepts of a Forest Reserve.

5.8 Communication and access

The northern boundary of Bangangai Game Reserve is the 'Southern Loop Road'. This is linked to the main Yambio-Nzara-Ezo-Tembura road at Negesi and near Ezo. There is a track also linking Bangangai village to Anderri on the main road. The Reserve can also be approached from Nzara through Ndorumo (in Sudan). This road is shorter than the main road through Ringasi, but is currently in poor condition. Ndorumo is the junction for the road south to Bire Kpatuos Game Reserve (Appendix 8.13, see Fig. 1). The 'Southern Loop Road' between Bangangai village and Ezo is passable only to the Biki river, but there the bridges are down and have not been repaired for some years.

During the course of this project, we repaired and maintained the bridges over rivers Ogo, Nadero, Nangondi and Yubu (two). If we had not, it would not have been possible to use the Nyesi to Bangangai section of the road. This is no longer an important access road, vehicles rarely having recourse to using it. It was probably used by five vehicles other than the project vehicle and visitors, in the period June 1980 to January 1983. The route of the road is an important communication line for people living along the Reserve

boundary, either walking or on bicycles. The track would have disappeared long ago but for their movement.

In theory, the people living at Nambia, in the Forest Reserve, were allowed to live there by the Chief so that they would keep the road open and the bridges repaired. They do not do this, except under specific orders to repair a bridge. At the present time (January 1983) the track between Bangangai and Nyesi is being cleared apparently by workers of the roads department. The intention is said to be to clear and repair the Bangangai-Ezo section also.

Improvement of the road, and the introduction of facilities, such as the dispensaries at Nyesi and Bangangai, and wells at both places and Nambia, will attract more settlers to the area in the future. This has to be taken into consideration when planning for the future of the Game Reserve, and the needs and effects of the human population along its boundaries.

6. Management recommendations

It is necessary here to define the aims of having a Game Reserve at Bangangai, before recommending how it be managed to achieve those aims. In this report it has to be noted that it is a joint Game and Forest Reserve, and therefore comes under the jurisdiction of two different departments - Wildlife in the Ministry of Wildlife Conservation and Tourism, and Forestry in the Ministry of Agriculture. It is of paramount importance that these two departments co-operate with each other in conserving the Reserve.

The recommendations below are made In the light of the present development conditions of the south west corner of the Southern Region, and of the Ministry of Wildlife Conservation and Tourism. Development is progressing, albeit slowly, and an attempt is made to predict the requirements of the different parties involved in the Reserve, including those people that live close to it, in the near future. Appropriate management policies are recommended wherever possible, that is, methods which the Wildlife Department has the means and ability to carry out now. They do not call for the use of sophisticated equipment or transport, which the Department does not have the means to purchase, run or maintain at the present time. If the Departmental budget increases with time, so equipment such as motorized transport and radios can be brought into use.

6.1 The alms of Bangangai Game Reserve

The Reserve was originally gazetted about 40 years ago to preserve the bongo antelope, and other 'rare' or unusual wildlife species including the yellow-backed duiker, giant forest hog and black and white colobus monkey. It was additionally gazetted as a Forest Reserve to preserve the fine indigenous forests in the area.

The aims of the Reserve have not changed, but an attempt is made here to state the various aims succinctly and to suggest ways in which the area can best be managed to achieve these aims.

i) To conserve an area of natural primary lowland forest and primary gallery forest, a vegetation type which is poorly represented In the Sudan.

ii) To conserve the vegetation and the animals that live in it, in particular those species that are rare in the Sudan, or in other parts of Africa, or whose habitats are threatened by the activities of man, such as the bongo antelope and yellow-backed duiker.

iii) To conserve those water sources that arise in the Reserve, namely tributaries of the Biki, Yubu and Ogo rivers, themselves tributaries of the Sue and ultimately Nile rivers.

iv) To benefit the economy of the Sudan as far as is possible through the well-managed non-consumptive utilisation of the area and its fauna and flora through tourism.

v) To benefit the education of the Sudanese people in being an example of how environmental conservation can benefit the nation, its water and food supply, its economy and its heritage of habitat variety and the variety of plant and animal species occurring there.

vi) To conserve reasonable, self-sufficient populations of wildlife species, that are consumed in the surrounding areas, either for meat, or as hunting trophies.

vii) To conserve reasonable, self-sufficient areas and populations of plant species that are consumed in the surrounding areas for timber or destroyed in the process of shifting cultivation.

The responsibility of the Wildlife Department in the Reserve is to manage it for the optimum benefit of the wildlife. The main requirements of the wildlife are to be able to lead an existence that is as natural as possible, undisturbed by man or his activities. This means different things for different species. A blue duiker for example, probably only requires a few hectares of undisturbed forest, not a difficult situation to achieve. Elephant on the other hand, require many hundreds if not thousands of square kilometres of habitat in which to lead a natural existence. In this day and age and in a poor and developing country, it is impossible to achieve this ideal, least of all within a tiny Reserve such as Bangangai. It is possible however to make It into an undisturbed 'way-station' for elephant, where they can exist for a while during their movements through this part of Africa.

A compromise has to be aimed at between the requirements of each wildlife species and the overall situation in which the Reserve is situated, so as to benefit as many species, as much as possible. And it must not be forgotten that man is one of those species and his needs must be taken into account. Each of the following sections deals with different aspects of the environment of the Reserve, and suggests how it should be best managed to achieve the aims of the Reserve.

6.3 Administration of the Reserve

The Reserve is administered by two Departments. In the past they shared a common camp and both Forest Guards and Game Scouts patrolled the area and demarcated boundaries each year. Now there is no co-operation between the Departments, nor is there any patrolling. The Forestry Department directs its energies into teak planting. The Wildlife Department puts its energy into anti-poaching in the area that the two Game Scouts can cover on foot from their camp on the northern boundary. The greater part of the Reserve exists through a system of benign neglect. That it has survived as it has points to the resilience of the environment and the species in it, and the principles of the local people. That is not to say that neglect is the best form of administration however, especially in the face of rising human populations along both the Sudan and Zaire borders, and falling rainfall and water tables.

The Wildlife Department must maintain a greater presence in the Reserve. More Game Scouts should be posted there, and they should be distributed along the Nyesi-Biki boundary road, at least in pairs. One man alone can achieve very little in the face of armed poachers. Communication should be maintained between them, preferably by two-way radio. The resources of the Department do not stretch to radios at the present time. An appropriate solution is the use of bicycles, preferably by an officer or sergeant moving between the camps at frequent intervals. There are sufficient Game Scouts already at Province Headquarters in Yambio who are used very little, except as messengers, or on the infrequent major anti-poaching exercise in the Southern National Park area. Fifteen Game Scouts would be sufficient for the moment, stationed in threes in the following places:-

- Ogo bridge
- Nambia Camp
- Bangangai village
- Nambori bridge
- Biki bridge

Camps should be built outside, as salaries and food supplies are insufficient that Game Scouts can live without cultivating. Cultivation should be kept strictly outside the Reserve. There is sufficient land for this purpose outside the Reserve. The Scouts would also then be nearer the local population, and be better informed of what is going on, as well as being in contact with dukans and markets for supplies, dispensaries and schools for their families. The mistake has been made too often elsewhere in eastern Africa, of camps developing into large villages of extended families. The result is they are a drain on the Reserve facilities, the area loses its natural undisturbed qualities and looks unsightly for visitors. This has already happened at the Forestry camp in the Reserve at Bangangai village.

Camps should be constructed of local materials to reduce costs, and to keep the Game Scouts as 'close' to the local people as possible. The Swiss Interchurch Aid team has admirably demonstrated that hand dug wells about 15m deep can be dug in this area for good clean water. No sophisticated equipment is required. Costs are labour which is cheap, and cement for the concrete support rings. Latrines and rubbish pits can easily be dug in the same way to improve health standards and the general quality of life. Wells, latrines and rubbish pits should be constructed at each camp. It should be made part of the Game Scouts' duties to both construct and maintain their own houses and camp facilities.

Game Scouts duties must be clearly defined; in the past the position has been seen as merely a convenient Government salary coupled with minimal duty to counteract poaching. Game Scouts and officers posted to the Reserve should be well trained in the positive aspects of wildlife conservation. Training is currently in the negative aspects - the use of guns in anti-poaching, crop protection and helping trophy hunters. Guns are often misused in obtaining meat, more than the needs of the Scouts. This meat is sold to the local populace whom they are preventing from hunting, and the temptation to also take ivory is very great.

Simple monitoring of the environment and wildlife can easily be achieved. A simple daily 'record sheet' for use on patrols, records the sightings of wildlife or their recent tracks, calls or droppings, and gives information on location, time of year, time of day and habitat. A good officer can collate such records, either in the Reserve, or stationed in Yambio or Juba to collate records from several conservation areas. The Wildlife Department can then get a good idea of wildlife in the different areas. Such a sheet was used in this project with good results. Ah example is given in Appendix 8.11. A simple rain gauge was also operated and recorded by the Game Scouts for a year.

Patrolling should not be limited to the boundaries of the Reserve. Objectives and areas of responsibility should be set for each camp and team of three scouts, and these should be visited periodically. The officer should accompany different teams periodically on their patrols, which should include all major saltlicks, pools such as Bangangai and Naturubu, and main rivers and their springs. The Zaire border should not be neglected, nor the main routes crossing the Reserve at Bangangai and Nambia. It would not be possible at the moment to station Game Scouts on the Zaire border since this would lead to international difficulties, and to problems of food supply and living far from other Sudanese communities. The destination of patrols should obviously not be revealed to the local population beforehand.

The habitat is a difficult one to negotiate. Local guides should be used until Game Scouts know the area well enough for themselves. Remuneration to employ these guides would have to be supplied. Alternatively, local people should be selected for training as scouts or Game Guards, to work in the Reserve. The present Department policy is to move Game Scouts frequently between stations, mainly to prevent them from exploiting a local situation and population to their own advantage. This means they do not get to know their own areas at all. The problem of fraternization with the local population can be eliminated by making sure officers are motivated and can be trusted to keep an eye on the relation between Game Scouts and the local population, and on their activities. The local population should not be abused as free labour, nor as suppliers of free food, liquor and women. Such exploitations do not lead to any feeling of respect by the local population for 'their' Game Reserve and its aims. The employment of local people as trackers and/or Game Scouts will also foster respect for the Reserve and its benefits to the local population.

One or more Game Scouts should be fluent in English and capable of guiding tourists into the Reserve, to prevent them from getting lost, and to help them see and learn as much about all aspects of the Reserve as possible.

6.4 Boundaries

The boundaries of the Game Reserve are clearly demarcated on the 1:250,000 map of the area (Yambio sheet NB-35-0) and in the Sudan Government Wildlife Acts and Orders (1953, 1976 a and b). These are shown on Fig. 7. However, there is confusion locally as to where the boundaries now are. Some people think the Game and Forest Reserves coincide exactly. Others that the area north of Nambia (part 'C' Fig. 7) was recently annexed from both Reserves by the Chief for settlement.

The Nambori area (part 'B' Fig. 7) was effectively annexed a long time ago by the settlement of the old Nzara Scheme, and this is legal (Sudan Government 1935). It is not considered Game Reserve by anyone living there and consists now of active cultivation and settlement, or very dense secondary thicket forest containing a lot of exotic plants.

It has not been possible to obtain any ruling from the Ministry of Wildlife Conservation and Tourism on this question of the legal boundaries, either in response to letters to the Director or in conversations with him or the Deputy Directors. The result is that the size of the effective Game Reserve (area 'A' Fig.7) is only 134km^2.

Two previous reports on wildlife in the Southern Region (Hofmann 1975, Blower 1977) have pointed out the anomalies in the boundaries of both this and other conservation areas stating that the Ministry must sort it out to make conservation more effective, and to ensure the security of conservation areas. This has not been done.

A reasonable solution would be to voluntarily excise the Nambori area (area 'B' Fig. 7) and to include the area north of Nambia (area 'C' Fig. 7). This would involve the least problem to the smallest number of people. There are about eleven families at Nambia, all of whom have only been there since 1980 or more recently. The Game and Forest Reserve boundaries would then coincide, making joint administration much more effective. This must be done immediately, and legally, before more people move illegally into what is now Forest Reserve area.

The size and shape of the Reserve is unsuitable for effective practical conservation. The two long boundaries are heavily settled, and the Reserve is very narrow (only 4 - 6 km in most places) making access for poaching very easy. The long southern boundary is also the international boundary with Zaire, bordering an area in Zaire with no complementary Reserve, nor staff of the Zaire Wildlife Department. This means that it is difficult to patrol, easy for non-Sudanese nationals to enter and hunt, and impossible for Sudanese Wildlife Department staff to follow and apprehend poachers.

The water resources of the Reserve at the moment, are insufficient in the dry season (see 3.4 above). The Inclusion of the area north of Nambia as suggested above would enclose the important Nanduro swamp and spring in the Reserve. The water resources northeast of the Reserve along the Yubu and Mura rivers are apparently of a more permanent nature even now. It is likely that both bongo and elephant leave the Reserve for this area, and other areas, in the dry season. This area also contains several large gneiss rocky hills in the Nzangai and Nabuguru areas. These would be a scenic addition to the Reserve, providing both vantage points for staff for management, and tourists for viewing, and add a habitat type not included at present.

Careful surveys and planning would have to be carried out before making any such additions to the Reserve. It was not possible during this study to carry out any more than cursory examination of the area but it is evident that there is already some settlement there. The Mura area is already a well-used and lucrative

hunting block. It is desirable to increase the Reserve area, if only to ensure that there can be a relatively undisturbed core that is too far for people to reach easily and poach from the boundaries.

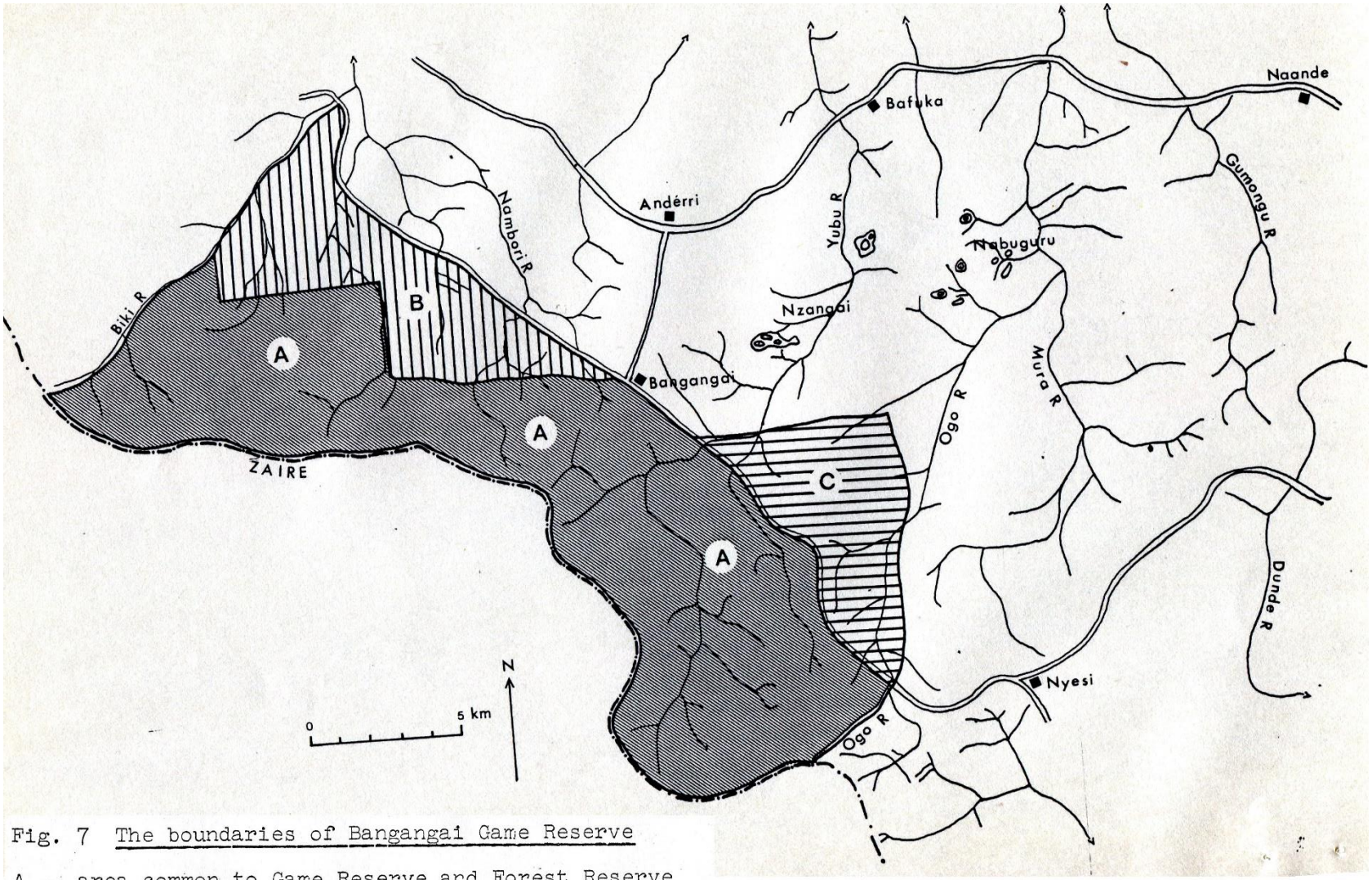


Fig. 7 The boundaries of Bangangai Game Reserve

A - area common to Game Reserve and Forest Reserve
B - Game Reserve only (Nambori cultivation line area)
C - Forest Reserve only (Nambia area)

International boundary

Rivers

Roads

Hills

Villages

6.5 Management for forests

The current activities of the Forestry Department in the Reserve are limited to the planting of exotic trees (see 5.7 above). The stated aims of the Forestry Department, to conserve indigenous forest, are not pursued at all. There is no demand locally for the teak produced and there is no transport to carry it to where there is demand. Teak can be grown in a broad variety of habitat and rainfall regimes, including Juba itself, where there is a desperate need for fuel wood, building and furniture timber. It is pointless to destroy some of Sudan's only remaining indigenous forest, simply to plant exotic trees for which there is no local demand. The energies of the Forest Department would be better employed in planting teaks in more marginal areas, where vegetation cover has already been destroyed, and to attempt to reduce soil erosion and increase productivity in those areas. These are areas where timber is at a premium, not least as fuel.

Co-operation between Forestry and Wildlife Departments would reduce the expenses for both in managing the Reserve, and make a more efficient united front in conserving the area. This requires co-operation at the highest level to begin with, between the two Ministries in Juba. Decisions made for the joint management of the Game/Forest Reserve should then be followed by lower ranking officers in the field,

Positive management seems to be lacking - that is the conservation and wise utilisation of those resources that the Sudan already has. Rather, the attitude is that the indigenous forest has no use, and should therefore be replaced with exotics. The indigenous forests are a tourist attraction, as is the bongo, and without the forest there will be no bongo. The natural forests are as much a part of the national heritage of this country as any number of wildlife species, and are a part of the natural ecosystem on which man depends. While it is not possible to determine why the rainfall is being reduced and the water table is dropping in the area, it is very likely that the wholesale destruction of natural vegetation cover in Sudan and neighbouring Zaire for the purposes of shifting agriculture has some relation to it. Cutting down the indigenous forests for the purposes of planting teak trees is part of that destruction. Teak planting should be concentrated where it is needed - where wood and soil conservation are needed.

6.6 Conservation of water resources

A lot of water used to rise in the Reserve all year, but now it does so only at the height of the wet season. The amount of water leaving the Reserve in the Biki, Yubu and Ogo rivers has decreased in the last twenty years and no change in the, management of the Reserve has occurred in that time. The period of occupation and cultivation of parts of the Reserve in the late sixties was brief, being only seven years. It is known that forest areas act as water reservoirs. Large and long-lived trees trap water from rainfall and the water table, and release it slowly into the atmosphere where it forms the basis of rain. This is not of direct benefit to the forest area, but to areas downwind of that forest. It is likely therefore that destructive land use practices in areas away from the Reserve have helped bring about this change in rainfall. Certainly human populations have increased, and greater areas of land have been cleared of natural vegetation cover over much of eastern and central Africa. The rainfall has also fluctuated over the same area in the last two decades (Lamb 1966).

It is of the greatest importance therefore, that as much indigenous forest as possible is preserved to conserve these sources of water. International wrangling at the turn of the last century deprived the Sudan of all but this small portion of high rainfall forest. The water flowing from it is but a tiny portion of the flow of the Nile River, on which so many people depend for their livelihood in both Sudan and Egypt. Every effort should be made to conserve and use wisely as many of the sources of this water as possible.

6.7 Fire management

The grassland areas of the Reserve have evolved with fire, and are populated with fire resistant plants. This is a feature of the wooded savannah grasslands further north and there are many plant species in common

in the two areas. Fire maintains grassland. The question to be answered is therefore - is grassland wanted? The advantages of grassland, in a forested area, are:-

i) It provides a broader variety of species, both plant and animal, from both grassland and forest.
ii) The animals can be more easily seen in the open areas.
iii) It is easier to walk through grassland, when the grass is short, than it is through forest.

The disadvantages of grassland mixed with forest are:-

i) Mismanagement of fires is slowly reducing the area of forest every year.
ii) It reduces the area available for true forest animal species, of which Sudan has very few, while there are enormous areas of wooded grassland.
iii) The animals being more easily seen are more easily poached, especially with modern firearms that work best at long range in open areas.
iv) Grassland areas allow people greater access to the Reserve area and the forest patches to poach or otherwise exploit the forest.
v) Grassland probably reduces the water-holding capacity of the Reserve area.

Since the main aims of Bangangai Game Reserve are the conservation of the forest, the forest animals and water resources, anything that reduces these conservation aims is to the detriment of the Reserve. Various practical considerations have to be made however, before any attempt is made to stop all fires:-

i) It will be difficult to prevent fire entering the Reserve. Clearing of the entire Reserve boundary (74km) for the purposes of demarcation and access would make a very good firebreak. This however would be very expensive in time and labour every year. The surrounding areas are consistently burnt every year for the reasons given earlier (see 3.9 above), and these fires sweep into the Reserve unhindered. Illegal collection of honey causes many fires In the Reserve, but is very difficult to prevent or track down the culprits after the event.
ii) The result of stopping all fire would be the succession of dense secondary thicket forest over very large areas of the Reserve within three to five years. This would make access extremely difficult for both management and visitors. Succession of primary lowland forest would take far longer, a slow gradual process of probably 50 - 100 years.
iii) It seems likely from the present project, that bongo - one of the principal aims of conserving the area, feed much of the time at the forest edge and in secondary forest where the vegetation is nearer the ground. While bongo would benefit very greatly at first from the cessation of fire, eventually the Reserve might be less suitable for them in primary forest. Much depends on what the climax vegetation for the area would be, and on the changes the climate is undergoing at present.

The answer concerning fire must lie in compromise between too much and too little control. The Reserve should not be allowed to progress further towards grassland, and would benefit from an increase in forest cover. The compromise would be to start all fires in the Reserve on purpose, and as early as possible in the dry season (October or November). This gives cool slow-burning fires and allows more tree saplings to survive. A programme of not burning small grass clearings, would allow larger forest patches to develop,- thus increasing overall forest cover, but not greatly diminishing the heterogeneity of the vegetation. There should strictly be no fires in forest proper, especially at the height of the dry season. A few large experimental areas of grassland should be left unburnt for several years, and monitored to see what succession does occur - whether forest species take over, or other grasses first.

At the current time (January 1983) fires in grassland are sweeping uncontrolled through the very dry undergrowth in primary lowland forest, killing off shrubs and tree saplings, and damaging large trees as

well. This is as a result of late fires and the very dry climatic conditions pertaining, together with unusually strong dry season winds.

6.8 Tourism

The potential for developing Bangangai for tourism in the immediate future is not great. The main limitations are the poor development context of the Southern Region at the moment, and the extremely short season during which the Reserve is suitable for viewing wildlife (March - June).

Improvements in the general development of the Southern Region have occurred in the recent past. A new airport is being built in Juba which may help to provide more regular transport services. The Juba-Yambio-Wau road is being resurfaced, and has already passed Negesi near the Reserve. A hotel is being built In Yambio and petrol stations have been built in various places between Juba and Yambio. A management survey of the nearby Southern National Park area has been completed by the Italian Government (Boltanl 1981). All of these developments could help encourage a tourist trade if they are completed and, more importantly, maintained at a reasonable standard.

The government is keen to encourage tourism to earn foreign exchange, and to show some tangible returns for maintaining conservation areas. However, more will need to be done before organised international tourism will be prepared to come to the country. The attitude in Sudanese embassies abroad is discouraging. The Southern Region is a difficult and expensive place to reach. Various permits and formalities have to be obtained which is time-consuming as officials are often not present. There are few vehicles to be hired in Juba, suitable for travel to the conservation area, and these are very expensive. Fuel is still not available on the open market. There are frequent police stations at which vehicles have to be registered. Photographic permits have to be obtained and these are often not understood by local officials. None of these things is very encouraging and these matters require attention.

There are many expatriates working in the Sudan on international aid projects from several nations. Many of these people want to learn more about the country they are working in and see as much of it as they can and this is where tourism should start. The necessary formalities and fees to be charged should be worked out by the Ministry, so that the present confusion when someone applies to visit a conservation area need not arise. Most ex-patriates, by virtue of their jobs In Sudan, have reasonable vehicles and camping equipment, and are therefore able to go and visit undeveloped conservation areas. All that need be provided by the Ministry is information, and the services of Game Scouts as guides and for security. This, is the way the tourism started in East African countries, with do-it-yourself camps. These evolved into Simple cottage ('tukl') type accommodation with the provision of firewood and water and later into proper 'full-board' lodges as can be seen today.

Bangangai already has a 'do-it-yourself camp set up as a result of this project. An information sheet has been written that tells prospective visitors how to get there, what they need, what facilities exist there, and what they can hope to see and do. A copy is included here as Appendix 8.12, and copies have been left at the Wildlife Department in Yambio and the Ministry in Juba. The house that was built at Nambia is suitable as a small and secure resthouse, provided it is maintained. There are in addition a kitchen shelter, chairs and a pit latrine. Firewood is readily available and local people can be employed to collect this, and water from a well 800m away. The same people can be employed as guides to the Reserve. There are two Game Scouts at Nambia Camp at present, one of whom has excellent English, and both have acted as guides and guards for visitors. Checklists of animals and birds to be found in the Reserve, and of their Zande names, have also been left at the camp. Nagbagi and Napara saltlicks, Nangbutoko spring, the Ogo source, Ogo/Tiazuro swamp and Bangangai pool all make good walks and are within easy reach of the camp.

It is very important to keep these facilities in good condition. The Resthouse and kitchen shelter will need re-thatching at the end of 1983. Shelter screens for the latrine and washing place should be re-made from grass each year. The example of using an elephant lower jaw for a latrine seat is one that could be used in

most National Parks and Game Reserves in the Southern Region. A well should be dug in the camp now. Local expatriate visitors do not need sophisticated and expensive provisions to be made. These can come later. All that is needed is shelter, security, a good water supply and information so that they know what to expect. This information should be made available by the Ministry and Department offices to all potential visitors already working in the Southern Region.

6.9 Human Settlement

Two areas of settlement give cause for concern, Nambori and Nambia. Nambori area is legally settled by the Gazette notice of 1953 (see 1.2). The vegetation of the area has been considerably altered and exotics introduced, in particular *Lantana camara*. It would be best if this area was legally excised from the Reserve, as it now is to all intents and purposes,

Instead the Game Reserve and Forest Reserve boundaries should be made to coincide completely by including the area north of Nambia (area 'C' Fig. 7) in the Game Reserve. The few families that illegally settled in the Forest Reserve in the last two years should be told to move out again. The Chief should be informed that his rights of government do not include the annexation of land from gazetted reserves.

Settlement with cultivation in the Reserve by families of the Forest Guards or Game Scouts should not be allowed. Forest and Game Posts should be placed just outside the Reserve boundary, such that any necessary clearing of land and cultivating can be done on land outside the Reserve.

6.10 Meat hunting

The greatest cause of aggravation between local people, the police, the Chief and the Game Scouts in the Reserve, is to do with the acquisition of meat. The Game Scouts' sole function is seen as preventing people from obtaining bush meat from wildlife and in many cases this is a legitimate complaint. Local Zande traditionally eat bush meat, and the laws laid down by the colonial administration demanded that only certain methods be used, and that licences or permission had to be obtained for any form of meat hunting. Those methods that use traditional weapons and natural materials are largely now ignored by the Wildlife Department. The use of modern and home-made firearms, and of steel snares, cause greater concern however, and unlicensed firearms are regularly apprehended and confiscated. All too often the local police do not back up these actions; owners of unlicensed guns are released and the guns are not destroyed but re-enter circulation again.

The greater problem is the illegal use of government firearms and ammunition by the Police in particular, and Game Scouts, Prison's staff and the Army. The Police are spread throughout this area in most small towns and consider it a right to take any bush meat they can shoot. The armed forces, of all the people in Sudan, should be the least in need of poaching since they have such high salaries. Attempts by Game Scouts to apprehend poachers of any sort should be supported by all the armed forces. It should be made clear to Chiefs and officers just what the penalties are for poaching and the misuse of firearms, and what the benefits of wildlife and environmental conservation are to the country. The armed forces should be working together for the overall development of the Sudan, not for the personal gain of the individuals within those forces.

Meat hunting with firearms should be licensed and controlled, whether with private or government guns. Meat hunting using other methods, in this part of Sudan, should be allowed unlicensed, provided traditional methods and materials only are used, and that the meat is not to be sold commercially, least of all to be exported to Zaire. Only plentiful species should be allowed to be hunted in this fashion - those on Schedule III and unprotected species in the 1975 Act. It is possible to be selective as to which species are killed when using hunting nets.

Alternative meat supplies do exist to the area. Cattle are walked into the smaller towns by Dinka herdsmen and slaughtered every few days, or once a week. Dried fish is brought in from the Sue and Nile Rivers. In the past, Dinka were encouraged to dry beef in their areas and trade it with the Zande (Crowther 1948). This practice has however ceased. Education as to the benefits of controlled hunting, and of wildlife conservation in general, should be carried out amongst ordinary citizens and the armed forces (see 6.14 below).

6.11 Trophy hunting

The Reserve cannot fulfil its aims of conserving wildlife while trophy hunters, their professional hunters and accompanying Game Scouts are prepared to poach in the Reserves. Trophy hunters in their literature and their magazines claim that it is the hunt that matters, not the final trophy. In that case, it should not matter how difficult the hunt is in the hunting block, nor how long it takes to obtain a trophy, or even whether a trophy is obtained at all. These people all come from countries where conservation areas are recognized and respected as part of the management necessary for wildlife conservation, together with trophy hunting. They should not therefore take advantage of the underdeveloped situation in the Sudan, and the poor level of staffing and lack of transport in the Wildlife Department.

Elsewhere in the world, such blatant poaching in a Game Reserve would result in the cancellation of all licences held by client and professional hunter, and the dismissal of the Game Scout. There is no reason why Sudan should not treat such offenders any differently. The only arguments they have in their favour, is that Reserves are poorly demarcated, and information regarding their location is not available. Every attempt should be made to demarcate all Reserves and National Parks as clearly as possible. There is however a limit as to what the Wildlife Department is capable of at present, and signposts are usually stolen for the wood or metal of which they are made, and are quickly obscured by vegetation in forest areas. Many conservation areas are well demarcated on the 1:250,000 maps of Sudan, particularly Bangangai and Bire Kpatuos in this area. These maps are cheap and readily available In Khartoum. Boundaries of all other conservation areas have also been described in the "*Sudan Wildlife Information Booklet*" produced by this project (see 6.14 below, Hillman 1982), and available from the Wildlife Conservation Education Unit of the Ministry of Juba. It should be the duty of all hunting companies in Juba to see that their professional hunters are sufficiently educated in these matters.

6.12 Communication and access

Improvement of the Nyesi-Bangangai village-Biki-Ezo road will lead to increased use of the road, better facilities and increased settlement along the Reserve boundary. The Wildlife and Forestry Departments must be prepared for increased pressures being brought to bear on the resources of the Reserve, and for the results of improved access to more sophisticated poachers or meat hunters with transport. The improved road will obviously have the advantage of increasing accessibility to Wildlife Department staff and visitors to the Reserve.

No roads should be made into the Reserve. The Reserve is small enough that it can easily be covered on foot by staff and visitors alike. The animals can be seen by walkers but would be frightened by the noise of a vehicle. The Wildlife Department currently does not have sufficient vehicles for one to be used in a Reserve of this size. Roads into the Reserve would also increase accessibility to the heart of the area by poachers, either on foot or in vehicles.

The paths to Zaire should he closed. There are alternative routes at Biki and near Nyesi that can he used both on foot and by bicycle. The Bangangai path has been a cause of trouble for a long time and both local people and those in Zaire say it is mainly used by smugglers or criminal elements who steal in one country and find refuge in the other. It has been closed at the Zaire end on occasion by the Army in Doruma. Co-operation in this matter should be sought with the Zairean authorities (see 6.13 below).

6.13 Liaison with Zaire

Contact with Belgian colonial authorities was made when Bangangai was first gazetted a Game Reserve, with the intention of creating a complementary Game Reserve on the (then) Congo side of the boundary. These contacts were not fruitful. Contact should be made again with the Zaire wildlife, authority with the same intention, should this suit their aims in wildlife conservation. If the area is no longer suitable as a Reserve, their co-operation should at least be sought in making sure that Zairois do not illegally cross into Sudan, particularly with the intention of poaching in the Reserve. There are no Game Scouts or officers stationed in Doruma, and hunting is said to be free and uncontrolled of the little wildlife remaining. Game Scouts are stationed to the west in a small Reserve near the meeting of all three countries near Ezo in Sudan.

Co-operation should also be sought in closing the path between Doruma and Bangangai village to reduce disturbance to that area of the Reserve and poaching within it.

There is currently a major wildlife conservation project being undertaken in the north east of Zaire by the Food and Agriculture Organisation of the United Nations. It would be useful to make contact with that project now and see in what ways the two countries can assist each other in wildlife conservation.

6.14 Education

There is little appreciation in the Bangangai area of wildlife and the environment, of the purposes of wildlife conservation and of the Wildlife Department and the role of the Game Scouts This is true of the populace at large, the Chief and sub-chiefs, the Police and Forestry officials, and of some members of the Wildlife Department itself. Wildlife is generally seen as a limitless and free source of meat; the Wildlife Department as a nuisance that prevents people from enjoying this free meat.

Trophy hunting at the moment provides considerable revenue to the Southern Region and employment to local people. It is hoped that in time further revenues will also be forthcoming from tourists visiting Reserves and National Parks. These revenues, mainly in the form of valuable foreign exchange, go into the Ministry of Finance where they contribute to government expenditure in providing facilities for the people of Sudan. It is not easy for local people, or even government employees to see the route by which wildlife is contributing towards their welfare and salaries. They need to be informed of this, so that they can respect the natural resources of their country.

The commonly held misconception that "*Wildlife can never be finished*" should be dispelled by education programmes in the area. It is only necessary to ask the older people in the community, to learn that numbers of animals have decreased, drastically in the case of elephant. People must learn that the situation will only get worse if poaching and the unwise use of natural resources continues. There are good reasons behind the controls on hunting. The government cannot provide a replacement for bush meat, trees, soil and rainfall when these are greatly reduced or finished. Man depends on his environment, and one man's greed in respect to its use is to the detriment of everybody.

The "*Wildlife Information Booklet*" was written and produced during the course of this project with this educational need in mind. It, and material from it, can be used to educate Wildlife Department personnel, as well as those of other departments, school children and ordinary citizens. Materials will also be produced in the future by the Wildlife Education Unit of the Ministry of Wildlife Conservation and Tourism. People must learn to respect their environment, and realize their dependence upon it.

7. Conclusions

Bangangai Game Reserve is an extremely Interesting and valuable area of natural primary lowland forest. It is the last sizeable area, of such vegetation in south west Sudan, and one of the few remaining areas of natural forest in the whole of Sudan. (Others are the Aloma plateau near Yei, and the Imatong mountains). It is an important conservation area for the bongo antelope, as well as several other little-known, relatively

rare and hard-to-see larger mammal species, that do not occur anywhere else in Sudan. These include the yellow-backed, red-flanked and blue duikers, giant forest hog, chimpanzee, Brazza's monkey, red-tail monkey and red colobus monkey. The area is also important in conserving sources of the Nile River. The area is an important part of Sudan's natural heritage.

Bangangai has potential as a tourist attraction and as such could earn valuable foreign exchange for the nation. However it is not possible for this potential to be realised at present. The Reserve cannot stand alone as an attraction as it is too small and isolated from Juba and other centres. Also, developments in the Southern Region, of the most basic infrastructure for a tourist trade, are still in their infancy. These include reliable air service, hotels and transport in particular. Until these are developed, and other attractions in the Bangangai area, such as Southern National Park, are made accessible, Bangangai will remain a point of interest to only the most determined and well-financed naturalist, or to the more interested people already in this part of Sudan for other reasons.

It is an important educational asset, particularly for the University, of a demonstration of one extreme of the enormously varied and interesting range of environments present in the Sudan. As such it could be investigated and monitored by university students on field trips or vacation projects, as well as interested Wildlife Clubs as these develop.

That Bangangai Game Reserve has survived as well as it has since its inception over 40 years ago, and through the civil strife in the area, is mainly due to the resilience of the habitat, a low human population density, and respect by these people for the Reserve, their 'store' for the future. Population pressure is already apparent (see Fig. 6) and the state of neglect currently existing will not be sufficient to ensure the survival of this area.

The following recommendations have been made in this report, resulting from findings during the course of this project. Action must be taken now if the Reserve area is not to be engulfed by the needs of the increasing human population around it, and the effects of a lowered rainfall and water table over the past decade which are likely to continue in the future. They are all courses of action which the Ministry of Wildlife Conservation and Tourism can undertake now with the resources currently available to it.

1. **Increase the Reserve size.** The Reserve area is far too small and of an impractical shape. It is so narrow that no core area can exist that is preserved from the effects of man and his activities around the edges, and moving into and through the Reserve. Neither is it wide enough to provide a sufficient core area for the conservation of the species the Reserve was created to conserve - the bongo. These animals need an undisturbed area of at least 20km in diameter in which to survive. This will be less available as human settlement Increases in the surrounding areas. The best solution is to increase the Reserve by adding to it the area of the Mura hunting block to the north east, to include the areas drained by the Yubu, Mura, Ogo and Gumangu (Diebigo) rivers, bounded by the roads between Nyesi and Negesi, Negesi and Anderri, and Anderri and Bangangai village (Fig. 1 and 7). It-can be seen from Fig. 5 that this is an area of major forest and as such is Ideal for bongo. This is evident from its success as a bongo hunting block, and from the arguments that occur over its allocation to hunting companies every year. Addition of this area to Bangangai Game Reserve would make it into a practical conservation area, for bongo in particular, and make Bangangai Game Reserve worthy of National Park status for international development and funding. It would also add new habitats, scenery and the scenic vantage points of the Nzangai and Nabuguru hills. A buffer zone should be left between the new Reserve area and the roads.

The same limitations of size are obviously even more critical for the tiny Bire Kpatuos and Mbarizunga Game Reserves (App. 8.13).

2. Maintain an effective Wildlife Department presence in the Reserve. The number of Game Scouts and officers in the Wildlife Department is being increased all the time through recruitment and training. These staff are not however being effectively used in the field, particularly in the conservation areas. There must

be at least 6-15 Game Scouts and an officer in Bangangai Game Reserve permanently. They should be effectively stationed around its borders, and must patrol, monitor and know the Reserve area on the ground. They must guard against poaching and human incursion and co-operate with the other authority in the Reserve, the Forestry Department staff. Further, they should respect the needs of the people around the Reserve with reference to crop protection and subsistence meat hunting, and thereby gain the respect of the local people for their duties and the aims of the Wildlife Department. They must maintain visitor facilities at Nambia Camp and be ready and able to guide and guard any visitors who come to see the Reserve.

3. Co-operation with the Forestry Department. The Reserve is a Game and Forest Reserve and must be respected as such. Neither Department is superior to the other, and the aims of both are to conserve a unique part of the natural environment of the Reserve. As far as is possible, the aims of both Departments must emphasize conservation, and the destruction of natural primary lowland forest for the purpose of planting teak should cease. It is contrary to the aims of conservation, there is no local demand for teak, there is no transport to carry teak to where there is demand, and there are many other areas nearer to demand centres where teak is already being planted in secondary forest and wooded grassland areas e.g. Marengu, Mangondi, Yabongo and Yatta Forest Reserves in the Yambio and Nzara areas. Co-operative management of the Reserve will reduce the capital and staff outlays necessary for each Department for the purposes of patrolling the area and maintaining boundary cuts, roads and bridges for transport, access and as fire breaks. It will also increase the efficiency with which the Reserve is conserved. Discussions on joint aims and management of the Reserve should be held now between the two Ministries concerned, and at Provincial headquarters in Yambio. Areas of conflict should be recognised and compromises investigated. Areas of responsibility of each Department for different aspects of Reserve management must be outlined and recognised by senior staff and communicated to junior field staff for action.

4. Fire Management. Fire is a natural part of the environment as already described (see 3.9). It can however be managed by means of fires set on purpose early In the dry season to ensure cool, slow-burning fires to ensure the survival of the forest patches and outlying forest tree saplings. Encouragement of the spread of existing forest patches through non-burning of intervening grassland areas should also be carried out in some areas. Local people should be prevented from setting fires within the Reserve. Roads and boundary cut-lines must be kept clear at the right time of year (late wet season, September - October), to prevent fires set outside the Reserve from spreading into the Reserve. More details are given in this report (see 6.7).

5. Adequate control of hunting. Hunting by 'professional' hunters and their clients must not be allowed in the Reserve. Incidents of this nature are described earlier in this report (see 5.5). Such occurrences must not be tolerated and should be severely punished. The hunter in question was back in the area the next season, though reportedly only as a 'helper', though he had been banned from hunting in Sudan. The consequences of incidents of this nature should be made clear to all hunters in writing, and they should be provided with details of conservation area boundaries near their allocated hunting blocks. Detailed maps of hunting blocks should be prepared on existing 1:250,000 maps of relevant parts of Sudan, for obligatory purchase by hunting companies. As far as is possible, conservation areas should be demarcated with permanent boundary markers, that are not of value to the local population as firewood or roofing material (e.g. pierced metal sheet from old fuel drums, as were used in Bangangai). Details covering bongo hunting in Sudan are discussed in Appendix 8.14.

6. Determination of boundaries. The conception of where the boundaries of Bangangai Game Reserve lie must be recognised by the Ministry and Department of Wildlife, and communicated to its staff in Yambio and in the Reserve area, and to local authorities and the Forestry Department In the Reserve area (to the Chief, sub-chiefs and headmen). One of the values of Bangangai is that it is already clearly gazetted and exists in law (Sudan Government 1935 and 1976). Should the decision be made to excise the- settled

cultivation area of the '*gbaria*' lines in the Nambori area and/or increase the size of the Reserve in the Nambia and Mura hunting block areas (see 1 above, this section), this should be legislated as soon as possible, and the results and consequences of the action made known to Departmental staff and local government authorities in the area.

7. Contact with Zaire. Contact should be made with the relevant Zairean wildlife authority now, concerning the Zaire border of the Reserve. This should investigate the possibilities of either i) the declaration of complementary Reserve area on the Zaire side of the border if that area is suitable, or ii) a request that the Zaire Wildlife authority patrol the Zaire border of the Reserve to prevent poaching in the Reserve from Zaire, and co-operate with Reserve staff when Zairois poachers are apprehended in the Reserve, or chased from it to Zaire. This is especially important where poaching for ivory is concerned.

Contact should be made also with the same authority, or with the Zaire civil government authorities to close the paths across the Reserve immediately.

The best approach for both problems may be through the United Nations Project at the following address

Wildlife Project Director PNUD/FAO
Box Postale 72448
Kinshasa
Zaire

Finally, it can only be reiterated that Bangangai Game Reserve is an important part of Sudan's natural environment, worthy of the greatest conservation effort. There is much that can be done towards this end by the Ministry now to ensure its survival, for the future of the nation's environment, and to contribute to a tourist programme in the future when local economic conditions permit.

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Finally thanks for the great debt I owe Sheila Campbell - for typing the draft, for her constant encouragement and support and much much more.

8. Appendices

Appendix 8.1 Climatic data for the Bangangai area

	Nambia Camp - 1982			long-term mean monthly rainfall - mm.					
	mean temp. °C		rainfall	Naande	Ezo	Li Yubu	Tembura	Nzara	Yambio
	max.	min.	mm.						
Jan	34.3	15.8	45	9.6	4.1	11.6	5.1	11.3	8.2
Feb	34.6	13.6	6	11.1	23.8	20.7	20.3	27.9	14.6
Mar	34.6	17.6	29	119.7	113.1	89.4	65.2	102.8	95.9
Apr	32.4	17.6	115	176.4	183.7	157.0	130.9	171.2	155.5
May	28.1	16.5	177	180.6	173.6	176.2	175.5	172.7	179.2
Jun	28.7	18.0	141	157.7	199.4	182.9	160.6	199.1	213.8
Jul	30.6	19.6	219	160.2	166.4	202.5	195.3	172.9	191.4
Aug	30.9	20.4	167	217.2	230.3	224.8	220.7	218.6	247.6
Sep	32.4	20.6	143	169.5	217.8	219.2	219.8	184.8	178.1
Oct	31.5	19.2	157	178.7	208.6	204.9	224.1	174.9	168.1
Nov	33.9	20.1	29	70.0	76.0	56.5	49.9	6o.4	46.6
Dec	29.9	10.7	0	20.8	25.0	18.2	20.0	14.2	6.7
	31.8	17.5	1,228	1,471.1	1,614.0	1,563.6	1,416.9	1,514.1	1,487.8
	mean	mean	total	long-term average annual rainfall total					

Appendix 8.2 List of Zande names for River tributaries in Bangangai Game Reserve and the number of associated major saltlicks (‘*ndo*’)

(from the north-west to south-east corners of the Reserve)

Main river	Tributary	Number of major licks
Biki	-	3
	1. Yabuwa	2
	2. Angobando	-
	3. Nakofo	-
	4. Mangurume	5
	5. Nagbaka	-
	6. Napere	2
	7. Nanguru	2
Kputuka	-	4
	8. Nagbukuru	7
	9. Namama	2
	10. Nabagu	-
	11. Nafopia	3
	12. Kpangubo	4
	13. Naserekate	2
Nampusa	-	-
Nambori	-	5
	14. Mangbangau	1
	15. Nawaku	-
	16. Nagori	4
Mogoagboro	-	-

Yubu	-	-
	17. Nambaga	-
	18. Diabiso	2
	19. Mawiako	-
	20. Dukungu	1
	21. Diragbua	1
	22. Gariagba	3
	23. Bangangai	1
	24. Nawo	7
	25. Rimesende	3
	26. Dibagbiagine	-
	27. Namvura	1
	28. Ziangada	1
	29. Napara	5
	30. Nangbutoko	-
	31. Naturubu	4
	32. Napioture	1
	33. Bamangana	3
	34. Namawa	1
	35. Nakofo	1
	36. Diagbogbo	2
Nambia/Nangondi	-	1
	37. Nagbagi	2
	38. Nakingoro	1
Nadero	-	2
Ogo	-	2
	39. Tiazuro	2

Numbers refer to the location of tributaries on Fig. 3.

Appendix 8.3 Plant species and Vegetation Types

1. Grassland

1.1 Open small-tree wooded grassland

	Zande name	Scientific name
grasses -	Bagau	Hyparrhenia edulis
	Kpitikpi	Hyparrhenia rufa
	Bingba	Imperata cylindrica
trees -	Bagbodi	Hymenocardia acida
	Bagara	Anona senegalensis
	Kau	Piliostigma reticulata
	Kpoyo	Grewia mollis
	Dama	Nauclea latifolia
	Gasiangbara	Stereospermum kunthianum
	Imewireanya	Strychnos inermis
	Banga	Anogeissus leiocarpus
	Dakadia	Combretum ghasalense

1.2 Open large tree wooded grassland

grasses -	Kpokpoki	Urellytrum giganteum
	Mbepee	Beckeropsis uniseta
	Bangenze	Panicum maximum
trees -	Bakaikpo	Terminalia avicenoides

1.3 Open low-lying grassland

grasses -	Gbaka	Pennisetum purpureum
trees -	Nganza	Mimosa pigra
	Nguruzuga	Acacia campylacantha
	Rangbu rangbu	Kigelia aethiopica
	Pusikiwe	Acacia hockii

2. Forest

2.1 Primary gallery forest

"grasses"	-	Batingborama	Marantachloa flexuosa
trees	-	Gero	Erythrophloeum guineense
		Kofo	Mitragyna stipulosa
		Gbanga	Cannarium schweinfurthii
		Nzeri	Phyllanthus discoideus
		Nzungba	Fagara macrophylla

2.2 Primary lowland forest

"grasses"	-	Bamangendo	Streptogyna gerontogaea
		Rangee	Setaria barbata
		Gai	Costus afer
		Bisimo	Marantachloa leucantha
trees	-	Kukuruku	Cola cordifolia
		Fundurokuri	Antidesma venosum
		Banga	Anogeissus schweinfurthii
		Nguru	Albizzia coriaria
		Kuma	Caloncoba schweinfurthii
		Gitikiri	Phialodiscus unijugatus
		Bagu	Khaya grandifolia
		Bema	Chlorophora excelsa
		Irya	Croton macrostachyus
		Giwi	Paradaniella olivierii
		Kpawe	Afzelia africana
		Bambiri	Albizzia zygia
creepers	-	Mbirikombiri	Santaloides gudjuanum
		Ndavu	Landolphia comorensis
		Warawara	Landolphia senegalensis
		Ngbanduge	Dioscorea schimperiana

		Mereanya	Dioscorea bulbifera
		Bayungumba	Dioscorea dumetorum
		Diki	Dioscorea sansibarensis
2.3	Secondary thicket forest		
grasses	-	Bangenze	Panicum maximum
trees	-	Bambiri	Albizza zygia
creepers	-	Duwambu Abakpa	Mucuna pruriens
exotics	-	-	Lantana camera
		Manga	Mangifera indica

Appendix 8.4 Large Mammals in Bangangai Game Reserve

Common English name	Zande name	Scientific name
Elephant	Mbara	Loxodonta africana
Buffalo	Gbee	Syncerus caffer
Antelopes		
Bongo	Mbangana	Tragelaphus euryceros
Bushbuck	Gbodi	Tragelaphus scriptus
Sitatunga *	Doroga	Tragelaphus spekei
Waterbuck	Mbaga	Kobus defassa
Yellow-backed duiker	Mbiyo	Cephalophus sylvicultor
Red-flanked duiker	Kpangban-ingbo	Cephalophus rufilatus
Blue duiker	Mvuru	Cephalophus monticola
Bush or grey duiker*	Gbafu	Sylvicapra grimmia
Pigs		
Giant forest hog	Mukuru	Hylochoerus meinert-zhagenii
Bushpig	Zikubire	Potamochoerus porcus
Warthog	Zigba	Phacochoerus aethiopicus
Primates		
Chimpanzee	Tangua	Pan troglodytes
Baboon	Waku	Papio anubis
Black and white colobus	Nvugo	Colobus abyssinicus
Red colobus	Ndakpa	Colobus pennanti
Redtail	Mbiru	Cercopithecus ascanius
Tantalus	Ngarangara	Cercopithecus aethiops
Brazza's	Rimo	Cercopithecus neglectus
Patas *	Bagianya	Erythrocebus patas
Carnivores		
Lion	Bahu	Panthera leo

Leopard	Moma	Panthera pardus
Spotted hyaena *	Zege	Hyaena hyaena
Civet	Tia	Viverra civetta
Two-spotted palm civet	Mbatu	Nandinia binotata
Serval	Paka	Felis serval

* - presence inferred from droppings, tracks, and/or local Zande knowledge.

Appendix 8.5 Small Mammals recorded from Bangangai Game Reserve

Common name	Zande name	Scientific name
Carnivores		
Marsh mongoose	Gbaga	Atilax paludinosus
White-tailed mongoose	Derenvugo	Ichneumia albicauda
Banded mongoose	Ndotua	Mungos mungo
Rodents		
Porcupine	Nzingini	Hystrix cristata
Cane rat	Revo	Thryonomys sp.
Giant rat	Sumba	Cricetomys sp.
-	-	Otomys sp.
Mole rat	Tundua	Cryptomys ochracinereus
-	-	Mastomys natalensis
-	-	Gramomys surdasted
Ground squirrel	Badari	-
Tree squirrel	Ngberengenze, Gambe	-
Pangolins		
Giant pangolin*	Koka	Manis gigantea
3 cusped pangolin*	Kero	Manis tricuspia
Bats		
Hammer-headed bat	Ndema	Hypsignathus monstrosus
Yellow-winged bat	Fura	Lavia frons
-	-	Epomophorus sp.
Other groups		
Aardvark	Garawa	Orycteropus afer
Bushbaby *	Noyngbi	Galago demidovii
Shrew	Nderi	Crocidura sp.

* Presence inferred from droppings, tracks, and/or local Zande knowledge.

Appendix 8.6 Birds recorded from Bangangai Game Reserve

Common name	Scientific name
Herons, egret, bitterns	
Grey heron	Ardea cinerea
Black-headed heron	Ardea melanocephala
Purple heron	Pyrrherodia purpurea
Great white egret	Casmerodius albus
Yellow-billed egret	Mesophoyx intermedius
Little bittern	Ixobrychus minutus
Storks	
Hammerkop	Scopus umbretta
Black stork	Ciconia nigra
Woolly-necked stork	Dissoura episcopus
Ibises	
Sacred Ibis	Threskiornis aethiopicus
Hadada ibis	Hagedashia hagedash
Duck	
Hartlaub's duck	Pteronetta hartlaubii
Birds of prey	
Secretary bird	Sagittarius serpentarius
White-backed vulture	Pseudogyps africanus
White-headed vulture	Trigonoceps occipitalis
Hooded vulture	Necrosyrtes monachus
African hobby hawk	Falco cuvieri
Kestrel	Falco tinnunculus
Black kite	Milvus migrans
Honey-buzzard	Pernis apivorus
Tawny eagle	Aquila rapax
Ayre's hawk-eagle	Hierraaetus dubius
Long-crested hawk-eagle	Lophoaetus occipitalis

Lizard buzzard	Kaupifalco monogrammicus
Brown harrier-eagle	Circaetus cinereus
Grasshopper buzzard	Butastur rufipennis
Bateleur	Terathopius ecaudatus
Palm-nut vulture	Gypohierax angolensis
Red-necked buzzard	Buteo auguralis
African goshawk	Accipter tachiro
West African goshawk	Accipiter tousenelii
Long-tailed hawk	Urotriorchis macrourus
Harrier-hawk	Polyboroides typus
Francolins	
Forest francolin	Francolinus lathami
Heuglin's francolin	Francolinus icterorhynchus
Scaly francolin	Francolinus squamatus
Guinea-fowl	
Tufted guinea-fowl	Numida meleagris
Crested guinea-fowl	Guttera edouardi
Crake	
White-spotted crake	Sarothrura pulchra
Wader	
Green sandpiper	Trianga ocrophus
Pigeons and doves	
Olive pigeon	Columba arquatrix
White-naped pigeon	Columba albinucha
Afep pigeon	Columba unicincta
Bronze-naped pigeon	Turturoena delegorguei
Red-eyed dove	Streptopelia semitorquata
Mourning dove	Streptopelia decipiens
Ring-necked dove	Streptopelia capicola
Laughing dove	Stigmatopelia senegalensis
Tambourine dove	Tympanistria tympanistria

Blue-spotted wood-dove	Turtur afer
Green pigeon	Treron australis
Cuckoos	
European cuckoo	Cuculus canorus
Red-chested cuckoo	Cuculus solitarius
Black cuckoo	Cuculus cafer
Thick-billed cuckoo	Pachycoccyx audeberti
Great spotted cuckoo	Clamator glandarius
Levaillant's cuckoo	Clamator levaillantii
Emerald cuckoo	Chrysococcyx cupreus
Didric cuckoo	Chrysococcyx caprius
Klaas cuckoo	Chrysococcyx klaas
Coucals	
Blue-headed coucal	Centropus monachus
Senegal coucal	Centropus senegalensis
White-browed coucal	Centropus superciliosus
Yellowbill	Ceuthmochares aereus
Turacos	
Black-billed turaco	Tauraco schuttii
White-crested turaco	Tauraco leucolophus
Ross's turaco	Musophaga rossae
Great blue turaco	Corythaecola cristata
Eastern grey plantain-eater	Crinifer zonurus
Parrots	
Niam-niam parrot	Poicephalus crassus
Red-headed lovebird	Agapornis pullaria
Rollers	
Abyssinian roller	Coracias abyssicica
Broad-billed roller	Eurystomus glaucurus

Kingfishers	
Shining-blue kingfisher	*Alcedo quadribrachys*
Pigmy kingfisher	*Ispidina picta*
Dwarf kingfisher	*Myioceyx lecontei*
Woodland kingfisher	*Halycon senegalensis*
Blue-breasted kingfisher	*Halycon malimbicus*
Grey-headed kingfisher	*Halycon leucocephala*
Chocolate-backed kingfisher	*Halycon badius*
Striped kingfisher	*Halycon chelicuti*
Bee-eaters	
Black-headed bee-eater	*Merops breweri*
Carmine bee-eater	*Merops nubicus*
White-throated bee-eater	*Aerops albicollis*
Cinnamon-chested bee-eater	*Melittophagus oreobates*
Madagascar bee-eater	*Merops superciliosus*
Swallow-tailed bee-eater	*Dicrocercus hirundineus*
Hornbills	
White-tailed hornbill	*Bycanistes sharpii*
Black and white casqued hornbill	*Bycanistes subcylindricus*
Black-wattled hornbill	*Ceratogymna atrata*
Pied hornbill	*Tockus fasciatus*
Black dwarf hornbill	*Tockus hartlaubi*
Red-billed dwarf hornbill	*Tockus camurus*
Hoopoes	
Hoopoe	*Upupa epops*
Black wood-hoopoe	*Scoptelus aterrimus*
Owls	
African wood-owl	*Ciccaba woodfordii*

African scops owl	Otus scops
Nightjars	
Dusky nightjars	Caprimulugus pectoralis
Fiery-necked nightjar	Caprimulugus fervidus
Plain nightjar	Caprimulugus inornatus
Standard-wing nightjar	Macrodipteryx longipennis
Pennant-wing nightjar	Semeiophorus vexillarius
Mousebird	
Speckled mousebird	Colius striatus
Barbets	
Double-toothed barbet	Lybius bidentatus
Hairy-breasted barbet	Tricholaema flavipunctatum
Spotted-flanked barbet	Tricholaema lacrymosum
Grey-throated barbet	Gymnobucco bonapartei
Lemon-rumped tinkerbird	Pogoniulus leucolaima
Yellow-throated tinkerbird	Pogoniulus Subsulphureus
Yellow-billed barbet	Trachylaemus purpuratus
Honey-guides	
Black-throated honey-guide	Indicator indicator
Spotted honey-guide	Indicator maculatus
Lesser honey-guide	Indicator minor
Least honey-guide	Indicator exilis
Woodpeckers	
Green-backed woodpecker	Campethera permista
Brown-eared woodpecker	Campethera caroli
Buff-spotted woodpecker	Campethera nivosa
Fine-banded woodpecker	Campethera taeniolaema
Little spotted woodpecker	Campethera cailliautii
Golden-tailed woodpecker	Campethera abingoni
Brown-backed woodpecker	Ipophilus obsoletus

Yellow-crested woodpecker	Mesopicos xantholophus
Elliot's woodpecker	Mesopicos elliotii
Wryneck	
Red-breasted wryneck	Jynx ruficollis
Swifts	
Common swift	Apus apus
Palm swift	Cypsiurus parvus
Lark	
Red-tailed bush-lark	Pinarocorys erythropygia
Wagtails	
White wagtail	Motacilla alba
Pied wagtail	Motacilla aguimp
Pipits	
Tree pipit	Anthus trivialis
Red-throated pipit	Anthus cervinus
Babblers	
Dusky babbler	Turdoides tenebrosa
Thrush-babblers and illadopses	
Thrush-babbler	Ptyrticus turdinus
Brown illadopsis	Malacocincla fulvescens
Scaly-breasted illadopsis	Malacocincla albipectus
Puvel's illadopsis	Malacocincla puveli
Bulbuls	
Yellow-vented bulbul	Pycnonotus tricolor
White-vented bulbul	Pycnonotus barbatus
Red-tailed greenbul	Tricophorus calurus
Bristle-bill	Bleda syndactyla
Green-tailed bristle-bill	Bleda eximia
Yellow-throated leaf-love	Pyrrhurus flavicollis
Leaf-love	Pyrrhurus scandens

Simple leaf-love	Chlorocichla simplex
Honey-guide greenbul	Baeopogon indicator
White-throated greenbul	Phyllastrephus albigularis
Baumann's greenbul	Phyllastrephus baumanni
Slender-billed greenbul	Stelgidillas gracilirostris
Cameroon sombre greenbul	Andropadus curvirostris
Little greenbul	Eurillas virens
Yellow-whiskered greenbul	Stelgidocichla latirostris
Flycatchers	
Pied flycatcher	Muscicapa hypoleuca
Ashy flycatcher	Alseonax cinereus
Grey tit-flycatcher	Parisoma plumbeum
Pale flycatcher	Bradornis pallidus
Rufous flycatcher	Stizorhina fraseri
Shrike-flycatcher	Megabyas flammulatus
Black and white flycatcher	Bias musicus
Yellow-bellied flycatcher	Hyliota flavigaster
Chin-spot puff-back flycatcher	Batis molitor
Black-headed puff-back flycatcher	Batis minor
Wattle-eye	Platysteira cyanea
Chestnut wattle-eye	Dyaphorophyia castanea
Blue flycatcher	Erannornis longicauda
Blue-headed crested flycatcher	Trochocercus nitens
Dusky crested flycatcher	Trochocercus nigromitratus
Paradise flycatcher	Tchitrea viridis
Thrushes, chats etc.	
African thrush	Turdus pelios
Abyssinian ground-thrush	Geokichla piaggiae
Red-capped robin-chat	Cossypha natalensus

Snowy-headed robin-chat	Cossypha niveicapilla
Forest-Robin	Stiphrornis erythrothorax
Fire-crest alethe	Alethe castanea
Redstart	Phoenicurus phoenicurus
Nightingale	Luscinia megarhynchos
Warblers	
Garden warbler	Sylvia borin
Willow warbler	Phylloscopus trochilus
Buff-throated apalis	Apalis rufogularis
Green-tailed apalis	Apalis caniceps
Green crombec	Sylvietta virens
Green-backed eremomela	Eremomela canescens
Olive-green camaroptera	Camaroptera chloronata
Grey-backed camaroptera	Camaroptera brevicaudata
Yellow longbill	Macrosphenus flavicans
Trilling cistocola	Cisticola woosnami
Red-faced cisticola	Cisticola erythrops
Siffling cisticola	Cisticola brachyptera
Tawny-flanked prinia	Prinia subflava
White-chinned prinia	Prinia leucopogon
Moustache-warbler	Melocichla mentalis
Swallows	
European swallow	Hirundo rustica
Striped swallow	Hirundo abyssinica
Eastern rough-wing swallow	Psalidoprocne orientalis
Cuckoo-shrikes	
Black cuckoo-shrike	Campephaga sulphurata
Red-shouldered cuckoo-shrike	Campephaga phoenicia

Drongos	
Velvet-mantled drongo	*Dicrurus modestus*
Drongo	*Dicrurus adsimilis*
Helmet-shrikes	
Straight-crested helmet-shrike	*Prionops plumata*
Curly-crested helmet-shrike	*Prionops cristata*
Shrikes	
Northern brubru	*Nilaus afer*
Woodchat shrike	*Lanius senator*
Yellow-billed shrike	*Corvinella corvina*
Sooty boubou	*Laniarius leucorhynchus*
Puff-back	*Dryoscopus gambensis*
Black-headed tchagra	*Tchagra senegala*
Brown-headed tchagra	*Tchagra australis*
Blackcap bush-shrike	*Bocagia minuta*
Grey-headed bush-shrike	*Malaconotus blanchoti*
Nicator	*Nicator chloris*
Tits	
Black tit	*Parus leucomelas*
Orioles	
African golden oriole	*Oriolus auratus*
Western black-head oriole	*Oriolus brachyrhynchus*
Black-winged oriole	*Oriolus nigripennis*
Starlings and ox-peckers	
Violet-backed starling	*Cinnyricinclus leucogaster*
Splendid glossy starling	*Lamprocolius splendidus*
Yellow-billed oxpecker	*Buphagus africanus*
White-eyes	
Yellow white-eye	*Zosterops senegalensis*

Sunbirds	
Splendid sunbird	Cinnyris coccinigaster
Northern orange-tufted sunbird	Cinnyris oseus
Northern double-collared sunbird	Cinnyris reichenowi
Olive-bellied sunbird	Cinnyris chloropygius
Green-throated sunbird	Chalcomitra rubescens
Scarlet-chested sunbird	Chalcomitra senegalensis
Olive sunbird	Cyanomitra olivacea
Collared sunbird	Anthreptes collaris
Green sunbird	Anthreptes rectirostris
Violet-backed sunbird	Anthreptes longuemarei
Little green sunbird	Anthreptes seimundi
Green hylia	Hylia prasina
Creepers	
Spotted creeper	Salpornis spilonota
Weavers, waxbills etc.	
Chestnut-crowned sparrow-weaver	Plocepasser superciliosus
Grey-headed sparrow	Passer griseus
Black-headed weaver	Ploceus cucullatus
Northern masked weaver	Ploceus taeniopterus
Baglafecht weaver	Ploceus baglafecht
Yellow-backed weaver	Ploceus capitalis
Black-necked weaver	Hyphanturgus nigricollis
Spectacled weaver	Hyphanturgus ocularis
Viellot's black weaver	Melanopteryx nigerrimus
Emin's weaver	Othyphantes emini
Compact weaver	Pachyphantes pachyrhynchus
Yellow-mantled weaver	Melanoploceus tricolor
Blue-billed malimbe	Malimbus nitens
Red-headed malimbe	Malimbus rubricollis

Buntings

Cabani's bunting	*Emberiza cabanisi*
Golden-breasted bunting	*Emberiza flaviventris*
Cinnamon-breasted rock-bunting	*Fringillaria tahapisi*

All the names given are those used in Mackworth-Praed and Grant (1952, 1955, 1970). Birds listed here were recorded during the present project and by Woodman (1936, 1952 a and b), Nkiolaus (1979, 1982 and pers. com.), and Traylor and Archer (1982 and pers. com.)

Appendix 8.7 Butterflies recorded from Bangangai Game Reserve

Papilionidae

Papilio dardanus dardanus Brown
Papilio phorcas sudanicola Storace
Papilio bromius chrapowskii Suffert
Papilio sosia pulchra Berger ?
Papilio demodocus demodocus Esper
Graphium angolanus pylades Fabricius
Graphium leonidas leonidas Fabricius
Graphium policenes Cramer

Pieridae

Catopsilia florella Fabricius
Eurema hecabe solifera Butler
Nepheronia thalassina simulata Suffert
Belenois calypso sudanensis Talbot
Belenois solilucis loveni Aurivillius
Appias sabina phoebe Butler ?
Mylothris chloris chloris Fabricius
Mylothris poppea continua Aurivillius

Acraeidae

Acraea rogersi lankasteri Carpenter
Acraea viviana Staudinger
Acraea acerata Hewitson
Acraea natalica abdima Ribbe
Acraea cepheus cepheus Linnaeus

Danaidae

Danaus chrysippus aegyptiacus Schreber
Danaus petiverena Doubleday
Amauris niavius aethiops Rothschild & Jordan

Satyridae

Bicyclus sebetus Hewitson
Bicyclus mandanes Hewitson
Bicyclus funebris Guerin

Nymphalidae

Phalanta eurytus microps Rothschild & Jordan
Salamis parhassus Drury
Junonia westermanni westermanni Westwood
Junonia terea fumata Rothschild & Jordan

Ariadne albofasciata Joicey & Talbot

Neptidopsis ophione velleda Mabille

Eurytela dryope angulata Aurivillius

Eurytela hiarbas hiarbas Drury

Sallyia occidentalium occidentalium Mabille

Sallyia boisduvali omissa Rothschild

Neptis metanira Holland

Neptis strigata Aurilillius

Cymothoe caenis Drury

Cymothoe jodutta ssp. ?

Euryphura plautilla Hewitson

Euphaedra medon vindininotata Butler

Euphaedra eleus Drury

Euphaedra coprates Druce

Pseudacraea lucretia protracta Butler

Charaxes etesipe etesipe Godart

Charaxes castor castor Cramer

Charaxes brutus augustus Rothschild

Charaxes pollux pollux Cramer

Charaxes protoclea protonothodes van Someren

Charaxes aubyni ssp. ?

Charaxes cedreatus Hewitson ?

Charaxes catachrous van Someren & Jackson

Charaxes candiope candiope Godart

Charaxes subornatus minor Joicey & Talbot

Charaxes dilutus ngonga van Someren

Euxanthe eurinome ansellica Butler

Lycaenidae

Aphnaeus orcas Drury

Spindasis crustaria Holland

Lipaphnaeus loxura Rebel

Axiocerces harpax kaduqli Talbot

Hypolycaena hatita ugandae Sharpe

Hypolycaena antifaunus latimaculata Joicey & Talbot

Anthene larydas Cramer

Uranothauma heritisa intermedia Tite

Azanus mirza Plotz

Riodinidae

Abisara neavei neavei Riley

Hesperiidae

Abantis venosa contigua Evans

Moths

Pyralidae

Margaronia sinuata Fabricius

Geometridae

Pitthea fuliginosa Druce

Noctuidae

Episparis penetrata Walker

Appendix 8.8 Reptiles recorded from Bangangai Game Reserve

Common name	Zande name	Scientific name
Snakes		
House snake	-	Boadon fuluginosus
Night adder	-	Causus rhombeatus
Egg-eating snake	Nyoropara	Dasypeltis scabra
"Blind" worm	Magingi	Typholps sp.
-	-	Elapsoidea laticiuta
-	-	Prosymna ambigua
-	-	Hormonatus modestus
White-lipped snake	-	Crotaphopeltis hotamboeia
-	-	Meizodon sp.
Puff adder	Kpokorokusu	Bitis arietans
Python	Gbara	Python sebae
Lizards		
Blue-tailed skink	-	Mabuga quinquetaeniata
Long-tailed skink	-	Mabuga planifrons
Monitor lizard	Kare	Varanus niloticus
Agama lizard	Kokoso	Agama sp.
Tortoises		
Leopard tortoise	Dakada	Testudo pardalis
Hinged tortoise	-	Kinixys belliana
Terrapin	Zekpete	Pelusios sp.
Chameleon	Mvua	Chamaeleo gracilis

Appendix 8.9 Amphibia recorded from Bangangai Game Reserve

Hildrebrandtia ornata

Hyperolius sp.

Ptychadena hylara

Athroleptis stonodactylus

Bufo steindachneri

Bufo kisoloensis

Afrixalus sp.

Xenopus sp.

Phyrnobatrachus sp.

Appendix 8.10 Fish recorded from Bangangai Game Reserve

Clarias lazera

Bartus sp.

Ctenopoma murei

Appendix 8.11 Simple Daily Record Sheet for Game Scouts

Bangangai Game Reserve - Daily Record Sheet of animals seen

People: _____ Date: _____

animal	Time: 5 a.m.	6 a.m.	7 a.m.	8 a.m.	9 a.m.	10 a.m.	11 a.m.	12 a.m.	1 p.m.	2 p.m.	3 p.m.	4 p.m.	5 p.m.	6 p.m.	7 p.m.	total seen
Elephant - mbara																
Buffalo - gbee																
Bongo - mbangana																
Bushbuck - gbodi																
Waterbuck - mbaga																
Yellow-backed duiker -mbiyo																
Red-flanked duiker - kpangbaningbo																
Blue duiker - mvuru																
Common duiker - gbafu																
Warthog - zigba																
Bushpig - zikubire																
Giant forest hog - mukuru																
Leopard - mama																
Lion - bahu																
Hyaena - zege																
Civet - tia																
Chimpanzee - tangua																
Baboon - waku																
Colobus monkey - nvugo																
Redtail monkey - mbiru																
Vervet monkey - ngarangara																
Red colobus - ndakpa																
Brazza monkey - rimo																

Places walked and times:

number seen	3,1,2
tracks seen	T
droppings seen	D
sounds heard	S
unknown number	✓
approximate number	~20

Notes - here and on back (about other animals, weather, grass, mud, water, people, birds etc.)

Appendix 8.12 Information sheet for visitors

Bangangai Game Reserve

Bangangai is a small forest game reserve on the Sudan border with Zaire, west of Yambio. It was set up around 1948, principally for the conservation of bongo antelope. March, April and May are the best months to visit the Reserve, the 3 months previous to this being very dry and after June the grass is above head height and animals are very difficult to see. Basic living accommodation is available.

Formalities: In order to visit the Reserve, people should either contact the Wildlife Department in Juba (at the Ministry) or Yambio (opposite the police station).

Directions: (all distances are measured in kilometres from the previous point mentioned).

- Take the main Yambio - Ezo road which leaves Yambio past the market.
- Travel through Nzara (27), Ringasi (35), to Nagasi (17).
- By the well at Nagasi, take a left turn on to a small track to Nyesi (30):
- In Nyesi there is a dispensary and a well, and the track to the Reserve Is signposted on a large kapok tree.
- The Reserve boundary is 6km from Nyesi and is a bridge over the river Ogo.
- Drive 5km along the boundary road and Nambia camp is down a small track to the left.

An alternative route is to stay on the main road through Djiabio (5 from Nagasi), Naande (l4), Bufuka (26), to Anderi (8). Take a left turn here to Bangangai village (6). At the village, turn left on to the Reserve boundary road and follow it for 11.5 km„ until the track to Nambia camp on the right.

A robust 4 wheel drive vehicle is recommended. There are 6 log bridges along the Reserve boundary road which should be crossed cautiously.

Map sheet: Sudan 1:250,000 Yambio NB-35-0

Reserve facilities: The following are available - A large thatched tukl for cooking etc., a lockable store with sleeping room above, firewood and water. Keys are with the sergeant of the Reserve at Nambia, and the Senior Inspector at Yambio. There are small local markets on Sundays at Bangangai and Nyesi villages.

Points of Interest: The Reserve is approximately 150km^2 in area, but is nowhere wider than 10 km. There are no roads within the Reserve, and walking is the best way to enjoy the many plant and animal species that occur here. There are numerous saltlicks in the Reserve, and animals using these can be observed from a tree platform over Nagbagi saltlick (2.4km from camp) on nights at or near full moon, or from a hide at Napara saltlick (4km from camp) very early in the morning.

Larger mammals that may be seen in the Reserve include bongo, bushbuck, yellow-backed duiker, red-flanked duiker, blue duiker, buffalo, elephant, bushpig, giant forest hog, warthog, chimpanzee, baboon, colobus, redtail and tantalus monkeys. Over 200 bird species have been identified in the Reserve, and include the great blue and other turacos, go away bird, green and Senegal coucal, wattled and other hornbills, pennant and standard wing nightjars, Zande parrot and palm nut vulture.

The Reserve is in Zandeland and a particular point of interest is Zande music, played on '*sagiru*' (lyre), '*kondi*' (thumb piano) and '*kpaningbo*' (xylophone).

Appendix 8.13 Bire Kpatuos and Mbarizunga Game Reserves

These two Game Reserves are in the same part of Sudan as Bangangai, located further east along the Sudan/Zaire border (see Fig, 2 and 5). It was not possible to find time to study-both these Game Reserves as well as Bangangai, despite their small size and proximity. A visit was made to both areas in February 1982 and a brief report follows.

Both Reserves occur within much larger Forest Reserves that bear the same names. They are both therefore under joint management, as is Bangangai. There is also confusion in both places as to where the Reserves boundaries lie, though these are clearly Indicated on the 1:250,000 Yambio map (sheet NB-35-0) and in the 1935 and 1976 Wildlife Acts.

Bire Kpatuos however, is only vaguely referred to in the Wildlife Acts as "*that forest known as Bire Kpatuos, Chief Tali's country, Zande district*". This is obviously open to all sorts of misinterpretation, especially should the forest become any smaller through human activity, and since Chief Tali has long since died.' At Bire Kpatuos it is presumed that east of the Forestry Station is Game Reserve and west is Forest Reserve.

At Mbarizunga it is assumed that the whole Forest Reserve Is also Game Reserve, or in other people's minds, that west of Nzara - Sakure road is Game Reserve, instead of east of it.

As with Bangangai, confusion of this nature is of no help to management or co-operation.

The Reserves are small; Bire Kpatuos is only 5.4km^2 and Mbarizunga is only 13.1km^2.

i) Bire Kpatuos. It was possible for us to spend one day in Bire Kpatuos. The Game Scout Post is situated 3km from the Reserve. There is supposedly a rest house at the Post; the roof was collapsing, there was no door, the floor was filthy and there was a pair of waterbuck horns which someone had been attempting to destroy in a fire in the room. Two Game Scouts were present but showed no interest in our visit, neither did they offer any help. We continued to the Forest Station where we were made welcome. A tukl was prepared for us, chairs, firewood and water were brought to us, and a guide arranged for early the next morning to show us the Reserve. The Forest Station is on the Forest Reserve boundary.

We were able to enter the Reserve early the next morning with the Forestry guide, and the Game Scout Sgt. Andrea from the post. Neither were familiar with the area, and both were unprepared to enter the Bire Kpatuos forest block. We eventually walked in ourselves and they followed.

The Game Reserve as shown on the map and in the gazette, consists of a block of primary groundwater forest, between two to three kilometres in diameter, and in a basin eroded into the ironstone plateau by the many springs that are the headwaters of the Ringasi (Lingasi) river. It is extremely beautiful forest in good condition. There are very many tall trees, festooned with large creepers, with a secondary canopy of smaller trees and bushes. It is very similar to areas of primary groundwater forest in Bangangai, but much more extensive in area and homogenous in nature. Water at the time was plentiful, though in the dry season. Several small saltlicks were seen. The forest basin is surrounded on the north and west by open large tree wooded grassland, again more extensive than such areas in Bangangai. It is dominated here by '*bakaikpo*' trees (*Terminalia avicenoides*) and '*mbepee'* (*Beckeropsis uniseta*) and '*kpokpoki*' grasses (*Urellytrum giganteum*). To the south-west it is enclosed by primary lowland forest and small-tree wooded grassland, dominated by '*bagbodi*' trees (*Hymenocardia acida*) and '*bagau'* grass (*Hyparrhenia edulis*).

Few animals were seen in the forest basin, but there was a lot of evidence of them in the mud by the streams and saltlicks, particularly of elephant, but also of bongo, bushpig, yellow-backed duiker and bushbuck. Animals seen were giant forest hog, common duiker, waterbuck, black and white colobus, redtail and a very large troop of red colobus - over 100 animals. There are said to be many in this area, presumably as the large area of gallery/basin forest is their kind of habitat. Only one red colobus was seen in Bangangai, also in gallery forest on the Ogo River.

The Game Scouts claimed they had only been stationed in the area a few months and therefore did not know it well. This was checked on later and it was found that the sergeant had been there over 4 years. In addition he has a reputation for poaching elephant and allowing professional hunters to hunt in the area in return for 'gifts' of ammunition. It is obviously pointless having such a person in charge of a Reserve, especially when in 4 years he has been too frightened or too lazy to get to know the 5.4km^2 he is responsible for. Senior officers in Yambio must share some of the blame for allowing such a situation to develop, and apparently they have never visited the Reserve.

Hand-drawn maps of the area, which were on the walls of the Yambio office, showed the Reserve as having two paths across it, through the centre of the forest block. Several Game Posts were shown and rest houses for visitors. These seem to be the result of someone's creative imagination since no such developments were seen in the Reserve except for the Game Post and 'rest house' mentioned earlier.

ii) Mbarizunga Game Reserve. No Wildlife Department staff were at the Game Post at the time of our visit in February 1982. The Game Scout normally stationed there was located for the hunting season (5 months) with the hunting camp at Mura, near Bangangai. This apparently happens every year. In October 1982 he had been transferred to Yambio, and so the area was again without any Wildlife Department staff.

Forestry Department staff at the Reserve were insistent that the Game Reserve was west of the Nzara - Sakure road, while the Wildlife Acts both clearly state it is east of that road. There was no one present who could guide us into the Reserve. We were able to drive down the Western boundary (on the Nzara -Sakure road) and the vegetation as far as could be seen was very similar to that of Bangangai - heterogeneous, with forest patches and grassland areas, some mango groves, and relatively flat terrain.

It is obvious that both Reserves are suffering from neglect by the Wildlife Department. Both are said to contain reasonable numbers of bongo and other species. They are rapidly becoming islands in areas of cultivation and as such are important reserves of flora and fauna, despite their small sizes. Bire Kpatuos in particular, is important for its extensive gallery/basin forest area, not represented in Bangangai, or anywhere else in Sudan, and for its very large red colobus population. The potential for Mbarizunga to become important for tourism and education is great, owing to its proximity to the development centres of Nzara (15km) and Yambio (20km), and to the main Juba - Wau road. At the moment, both Reserves are totally unknown to the expatriates in the area who would otherwise visit them.

Good Game Scouts should be posted in both Reserves, and they should collect information on what animals and plants the Reserves contain. The major water sources and saltlicks should be located to which visitors could be taken to see animals. Local style rest houses and kitchen shelters should he constructed for visitors on a do-it-yourself basis. Information on each Reserve should be advertised in Yambio and Juba for potential visitors, Wildlife Clubs etc.

Appendix 8.14 Bongo hunting in the Sudan

The bongo is one of the main species to attract trophy hunters to the Sudan. These people consider it one of the most difficult species to hunt, because of its shy nature and dense forest habitat, and one of the most beautiful trophies. Other reasons hunters choose the Sudan are that it is one of the few countries left In Africa where it is still possible to hunt, and there are other species such as the giant eland (*Tragelaphus derbianus*), white-eared kob (*Kobus kob leucotis*) and Nile lechwe (*Kobus megaceros*) that occur In few other countries and are difficult to hunt there. The bongo is an important source of foreign exchange for Sudan In this way.

Currently there is a quota set by the Ministry of Wildlife Conservation and Tourism of 65 adult male bongo per annum. One of the aims of this project was to assess the bongo population and see whether this quota is a reasonable one. Information was collected on bongo distribution in the Southern Region, on the size and age of bongo being hunted and on hunting returns to the Ministry.

The distribution of bongo in the Southern Region is shown in Fig. 5. Bongo only occur in Sudan in this part of Western Equatoria Province. They also occur in other countries in Africa. The locations marked are those where bongo were seen by trophy hunters and other people in the recent past. Speculation on bongo density in this area of approximately 10,000 square kilometres suggest there is probably a population of about two thousand bongo (0.2 bongo per square kilometre, see 4.1.1). An alternative figure suggested by Watson (1977) as a result of aerial surveys, was 825 bongo (0.08 per square kilometre). It is likely that the true figure lies between the two estimates. It is difficult to count bongo, either from the air or on the ground, and estimates have to be made from those that are seen and from the evidence found such as tracks and droppings.

The aim of a trophy hunting programme is to take trophy males - those with the greatest horn development, that are usually the older males, often physiologically incapable, or less capable in breeding. Removal of these males is thought to decrease the social competition for the younger males and increase their chances of participation in mating. However, removal of both old and young males, is obviously going to place all breeding in jeopardy, with resulting damage to the survival of the species - and the hunting programme.

Using data from Western (1980) in relation to body size, longevity and other features of survival, it is possible to postulate a reasonable bongo hunting quota for southern Sudan. This is based on a longevity of 15 to 20 years in the wild, and a body weight of 250 - 300kg and a sex ratio of approximately one male to one female. If the population is of about two thousand bongo as speculated earlier (4.1.1), then the expected calving rate of 2.0% would produce 400 calves per year. Sexual maturity is between two to three years of age for both sexes from zoo records. At this age, 55%, or 220 calves are expected to have survived, roughly half of each sex, or 110 males. However, although sexually mature these males are not socially mature (able to compete with older males in mating), neither do they bear trophy-sized horns. Observations on many known-age zoo animals, have shown that trophy-sized horns (ca.70cm. 28 inches long) are not developed until between 5-10 years of age. At 8 years of age, 40% of the projected lifespan has been lived, and 33% of those surviving at sexual maturity (2.5 years, 110 males) are expected to be alive still - that is only 36 males. This is the number of trophy-sized and aged males being added to the stock of mature males each year. The hunting quota set should not exceed this number, since not only will the mature male stock be used up in hunting, but also the immature, under-sized males will be shot. This is already being done as is shown by the "trophies" of only 57cm that were shot In the 1981/82 season (see below).

Other factors also suggest that the quota is too high. Examination of skulls and lower jaws in various hunters' camps showed that several of the animals shot were young, probably only about three to four years old. This was evident from the recent eruption of the third molar cheek tooth, and the state of torsion of the horns, which had not begun a second curve. Additionally, the fact that hunters descend to the level

of attempting to hunt bongo in Bangangai and other Game Reserves (see 5.5) shows that they cannot find enough adult mature bongo in the hunting blocks to fill the quota of licenses allowed each year. Both these facts show the quota is too high to be supported by the present population, and older males have been shot out in some of the hunting blocks.

It was not possible to obtain sufficient hunting returns from the Ministry for past years, to see whether the quota of 65 a year has always been filled. Those records that could be found showed the following for bongo hunted in the past:-

	1978/79 season	1980/81 season
quota	65	90
licences issued	73	90
licences filled	41	68

Records for giant eland were equally inconsistent:-

	1978/79 season	1980/81 season
quota	25	35
licences issued	85	35
licences filled	14	15

In two cases the licences issued exceeded the quota, and the quotas were different every year. Details were made available for the 1980/81 season, and of 65 bongo for which returns were filed, 17 (26%) were shot in the one hunting block of Sakure. There is apparently no control of where the quota of 65 bongo is shot, the quota being allocated by company, and not by hunting block. While the returns from Sakure could suggest a very good population of bongo there, they could also suggest that the adult male population in the area is being decimated - if indeed they are all mature male bongo.

Clearly, closer control of the allocation of the bongo quota must be maintained by the Ministry. The quota should be allocated on a block, not company basis to ensure an even crop of males is taken from each area. Returns should be monitored closely and should be properly and fully filled in by the hunters. In the 1980/81 season, two bongo were reportedly shot at Nagero, 125 km north of the edge of the distribution area shown on Fig. 5. Nagero is a very arid, wooded grassland area.

It should be feasible to insist on the return of lower jaws of all bongo shot, so that the age can he assessed from tooth wear. A set of lower jaws was left at the University from this project, and their ages will be assessed by tooth sectioning. These can be used for comparative age determination in the future to ensure that the ages of bongo shot are not too young.

Thirty skulls from shot trophies in the 1981/82 season were measured (Rowland Ward method). The average horn length was 73.3cm (28.9 inches) with a range from 56.8cm to 83.2cm (22.4 to 32.8 inches). A minimum trophy horn length of 70cm (approx. 28 inches) should be enforced to ensure that only mature are taken. A fine should be levied for horns taken shorter than this minimum.

Game Scouts should be trained as to what the legal and accepted forms of hunting are, such that when they accompany professional hunters and their clients they can ensure that only accepted methods are used. This should ensure that a reasonable hunting standard is maintained, without the use of fire or driving, nor shooting at saltlicks and hunting at night. In this way the animals are given a chance, the client is given a 'good' hunt, with the proper element of chance, and has to exhibit some skill to obtain his trophy.

It is only of short term economic benefit to the country if too many bongo are shot, or if young ones are taken. The result will be poor returns in the future. The bongo quota and fees should be adjusted to

maintain the 'rarity' value of the trophy, not to enable every hunter who wants a bongo's head to obtain one regardless of age or the means used to obtain it.

9. Bibliography

Andrews, F.W. (1948) Vernacular names of plants as described in "Flowering plants of the Anglo Egyptian Sudan Vol. I McCorquodale and Co. (Sudan) Ltd., Khartoum. 23 pp.

Andrews, F.W. (1950) The Flowering Plants of the Anglo Egyptian Sudan. Vol. I. Sudan Government, T. Buncle and Co. Ltd., Scotland. 237 PP.

Andrews, F.W. (1952) The Flowering Plants of the Anglo Egyptian Sudan. Vol. II Sudan Government, T. Buncle and Co. Ltd., Scotland. 485 pp.

Andrews, F.W. (1953) Vernacular names of plants as described in "Flowering plants of the Anglo Egyptian Sudan Vol. II" McCorquodale and Co. (Sudan) Ltd., Khartoum. 88pp.

Andrews, F.W. (1956) The Flowering Plants of the Anglo Egyptian Sudan. Vol. III. Sudan Government, T. Buncle and Co. Ltd., Scotland. 579 pp.

Andrews, F.W. (1957) Vernacular names of plants as described in "Flowering plants of the Anglo Egyptian Sudan Vol- III" McCorquodale and Co. (Sudan) Ltd., Khartoum. 37 pp.

Behrensmeyer, A.K. and Hill, A.P. (1980) Fossils in the making: Vertebrate Taphonomy and Paleoecology. University of Chicago Press, Chicago. 338 pp.

Blower, J.H. (1977) Wildlife Conservation and Management in the Southern Sudan. FAO final report Proj: F0: DP/SUD/76/02I 103 PP.

Boitani, L. (1981) The Southern National Park - a master plan. Instituto di Zoologia, Facolta di Scienze dell Unlversita di Roma, Italy. 221 pp. 89 maps.

Cave, F.O. and Macdonald, J.D. (1955) Birds of the Sudan, their identification and distribution. Oliver and Boyd, Edinburgh and London. 444 pp.

Crowther, F. (1948) A review of experimental work. In: Tothill, J.D. (Ed.) p. 439-592

Devred, R. (I960) La cartographie de la vegetation au Congo Beige. Bull., agricole du Congo Belge et du Ruanda-Urundi LI (3): 529-542 + map.

Dorst, J. and Dandelot, P. (1970) A Field guide to the larger mammals of Africa. Collins, London. 287 pp.

Gore, H. and Gore, P. (1925) A Zande dictionary. Church Missionary Society, London.

Harrison, M.N. and Jackson, J.K. (1955) Ecological Classification of the Vegetation of the Sudan. Forests New Series 2, Forests Dept., MIn. of Agriculture. Khartoum. 45 pp. and map.

Hesse, P.R. (1955) A chemical study of the soils, of termite mounds in East Africa. J. Ecol. 43:449-61.

Hillman, J.C. (1980) Bangangai Game Reserve, Western Equatoria Province, Southern Sudan. Report to Ministry of Wildlife Conservation and Tourism of the Regional Government of the Southern Sudan, and the New York Zoological Society. Mimeo, 27 pp

Hillman, J.C. (1982) Wildlife Information Booklet. New York Zoological Society, New York. 143 pp

Hofmann, R.R. (1975) Southern Sudan, Wildlife Conservation Report. Federal German Government Project 75-2015.8 (GTZ) 83 pp.

Kingdon, J. (1982) East African Mammals: an atlas of evolution in Africa. Vol. IIIC Bovids. Academic Press, London. 393 pp.

Lamb, H.H. (1966) Climate in the 1960s: changes in the world's wind circulation reflected in prevailing temperatures, rainfall patterns and the level of the African lakes. Geog. J. 132(2):183-212.

Larken, P.M. (1926) An account of the Zande. Sudan Notes and Records 9(1):1-7

Mackworth-Praed, C.W. and Grant, C.H.B. (1952) Birds of Eastern and North Eastern Africa. Vol. I. Longmans Green and Co., London 836 pp.

Mackworth-Praed, C.W. and Grant, C.H.B. (1955) Birds of Eastern and North Eastern Africa Vol. II. Longmans Green and Co., London 1154 pp

Mackworth-Praed, C.W. and Grant, C.H.B. (1970) Birds of West Central and Western Africa. Vol. I. Longmans Green and Co., London. 671 pp.

Molloy, P. (1957) Cry of the Fish Eagle. Michael Joseph, London. 254 pp.

Nikolaus, G. (1979) Notes on some Birds new to South Sudan. Scopus 3:68-73

Phillipson, D. (1981) A preliminary archaeological reconnaissance of the Southern Sudan, 1977-8. Azania XVI: 1-6.

Smith, J. (19^9) Distribution of tree species in the Sudan in relation to rainfall and soil texture. Bull. Min. Agriculture, Rep. of Sudan 4:67 pp

Sudan Government (1935) The Preservation of Wild Animals Ordinance 1935 and the Game Regulations 1935. Amended to 31 December 1953. Issued as a Supplement to Sudan Government Gazette No, 622 dated 15th December, 1935. 29 pp.

Sudan Government (1976a) The Wildlife Conservation and National Parks Act, 1975. Sudan Government Provisional Order Nov 2. 33 pp

Sudan Government (1976 b) The Game Reserve and Controlled Areas Order, 1975. Sudan Government Legislative Rules and Orders. No. 4. 5pp.

Tothill, J.D. (1954) Agriculture in the Sudan. Oxford University Press, London. 974 pp.

Traylor, M.A. and Archer, A.L. (1982) Some results of the Field Museum 1977 expedition to South Sudan. Scopus 6(1):5-12

Watson, J.P. (1962) The soil below a termite mound. J. Soil Science 13:46-51

Watson, R.M. (1977) Sudan National Livestock and Resource Inventory Vol. 31. The results of an aerial census of resources in Sudan from August 1975 - January 1977. Sudan Veterinary Research Administration, Min. Agriculture, Food and Natural Resources, Khartoum. 34 pp.

Weir, J.S. (1973) Air flow, evaporation and mineral accumulation in mounds of *Macrotermes subhyalinus* (Rambur) J. Anim. Ecology 42:509-20.

Western, D. (1980) Linking the ecology of past and present mammal communities. In: Behrensmeyer, A.K. and Hill, A.P. Eds.) p. 41-54.

Whiteman, A.J. (1971) The Geology of the Sudan Republic. Clarendon, Oxford. 290 pp.

Woodman, H.M. (1936) Rare birds of the Zande district. Sudan notes and records XIX (1):184-188

Woodman, H.M. (1952a) Some Birds of the Zande District Border Forests. Part I. Sudan Wildlife and Sport 2(3):23-27

Woodman, H.M. (1952b) Some Birds of the Zande District Border Forests. Part II Sudan Wildlife and Sport 2(4):21-27.

Woodman, H.M. (1952c) Game Animals of Zande District. Sudan Wildlife and Sport 2(4):28-38

Wyld, J.V.G. (undated) A Flora of Zande District Mimeo 44 pp.