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FINAL REPORT

A ZOOLOGICAL SURVEY OF MOLE NATIONAL PARK

NORTH-WESTERN GHANA

PART 1

LARGE MAMMALS

PREPARED BY
VIVIAN J. WILSON



FOREST RESOURCE MANAGEMENT PROGRAMME
GAME AND WILDLIFE DEPT/IUCN PROJECT 9786
ACCRA GHANA

DECEMBER 1993

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A ZOOLOGICAL SURVEY OF THE MOLE NATIONAL PARK

NORTH - WESTERN GHANA

P A R T I - L A R G E M A M M A L S

PREPARED BY

VIVIAN J. WILSON

WITH FIELD ASSISTANCE

BY

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ACCRA, GHANA

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RAPID POPULATION GROWTH IN THE AREA SURROUNDING THE MOLE NATIONAL PARK, THE DEMAND FOR "BUSH-MEAT" BY THE PEOPLE AND CONSEQUENTLY EXCESSIVE POACHING IN THE PARK IS STEADILY BRINGING THE VILLAGERS INTO COLLISION WITH THE AUTHORITIES OF THE PARK.

THEREFORE THE FUTURE OF THE MOLE NATIONAL PARK DEPENDS ENTIRELY ON A CLEAR UNDERSTANDING AND APPRECIATION OF THE LINKAGES BETWEEN THE WILDLIFE, THE VILLAGERS AND THE AUTHORITIES, IF THE DEPLETION OF THE RESOURCE IS TO BE AVOIDED.

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6.1 Wildlife Survey.

INSECTIVORA:

Family Erinaceidae: Hedgehogs

PRIMATES:

Family Lorisidae: Bushbabies
Cercopithecidae: Baboons & Monkeys

PHOLIDOTA:

Family Mandidae: Pangolins

LAGOMORPHA:

Family Leporidae: Hares

RODENTIA:

Family Hystricidae: Porcupines
Sciuridae: Squirrels
Thryonomyidae: Canerats
Muridae: Rats & Mice

CARNIVORA:

Family Hyaenidae: Hyaenas
Felidae: Cats
Canidae: Wild dogs & Jackals
Mustelidae: Honeybadger
Viverridae: Civets, Genets & Mongooses

TUBULIDENTATA:

Family Orycteropodidae: Aardvark

PROBOSCIDEA:

Family Elephantidae: Elephant

HYDRACOIDEA:

Family Procaviidae: Dassies

ARTIODACTYLA:

Family Suidae: Pigs
Hippopotamidae: Hippopotamus
Bovidae: Antelope & Buffalo

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SUMMARY

A brief survey of the large mammals of the Mole National Park was carried out between January and March 1993, during which time large areas of the Park were covered.

Every motorable road or bush track was covered by vehicle and several roads which had been closed for over twenty years were re-opened and many fallen trees removed from several other roads.

Foot transects were carried out as often as possible with the assistance of the Game Rangers stationed at the various field camps and night observations with a 500,000 C.P. spot light was also undertaken on twenty occasions. Wildlife was also counted from the vehicle as a daily routine.

The most important aspect of the survey was the aerial count of wildlife, especially elephant and buffalo, from a helicopter and this gave a more accurate picture of the distribution and status of some of the large mammals than any other survey method.

Populations of roan antelope, kob, elephant, buffalo, hartebeest and waterbuck were all found to be satisfactory while good numbers of mini-antelopes, such as crowned duiker, oribi and red-flanked duiker were found to be present.

Carnivore populations were found to be very low and there was no sign whatsoever of wild dog, caracal and several other species. However it is encouraging to note that the large carnivores such as lion, leopard and hyaena all still occur in the Mole National Park.

There is no doubt that poaching and excessive burning is causing considerable damage to the wildlife populations and unless these two factors are brought under strict control in the very near future wildlife populations will certainly decrease in the years to come.

The elephant and buffalo populations both appear to be in good shape but there is much evidence of buffalo poaching taking place throughout the Park.

Employment of a full-time resident ecologist is absolutely essential if wildlife populations are to be monitored and if accurate population estimates are to be obtained.

The Mole National Park is the premier conservation area in Ghana and effective management and research cannot be regarded as a luxury. Therefore unless poaching is brought under control and research and management projects are undertaken in the very near future there is every possibility that the wildlife populations could decrease to such a low level that they may never recover.

1. ACKNOWLEDGEMENTS

Particular thanks are due to the Senior Game Warden of Mole National Park, Mr. B.K. Volta-Tineh and his Technical Assistant, Mr. J. Braimoh. The Chief Game and Wildlife Officer, Mr. G.A. Punguse, as always, was most helpful and without his full support the project would never have been undertaken in the first place.

Mr. M.L. Kanton, Assistant Warden at Mole also helped a great deal and Mr. David Kpelle and Mr. Andrew Agyape acted as my Game and Wildlife counterparts for part of the field work.

Dr. John Grainger, the I.U.C.N. Project Leader, was always supportive of the work and he remained dedicated and calm throughout the entire project. I always admired the way in which he handled delicate issues and was completely responsible for the arranging of the helicopter for the aerial survey.

Yvonne Walker, Sybil Cole and Dee Higgs kindly typed and retyped the manuscript many times and to them I am also most grateful.

Finally thanks are due to my wife Paddy and my son Kevin who visited me at Mole during the survey and both helped in the preparation of this report.

2. INTRODUCTION

In order to fully understand the present day distribution and status of the large mammals of the Mole National Park, it is essential to look at the history of the entire area and more especially the section now protected as a National Park.

Ghana has over 75 different ethnic groups and historically the northern peoples and particularly the Gonjas were powerful militarily and controlled the trade routes to and from the coast (Leutzion, 1968). The area has been characterised by the highly centralised political state of the Gonja people (Craig, 1991).

However the founders of the state were formally from the North-West. These Mende peoples migrated to the Mole Region in the early 17th century and soon embarked on a rapid territorial expansion programme. (Mason, 1993).

Following a dispute over the succession of the Gonja Paramount Chieftaincy a war broke out between the Kong and Bole Divisions and this caused the loss of many lives.

The Kong people then sought the assistance of two infamous slave raiders led by Samori from Guinea and Babatu from Cote d'Ivoire. These two groups massacred a large number of Bole people before they themselves were defeated at the famous Battle of Jentilpe (Alchalo, 1988). While not much is known of the history of the Mole area before 1870, it seems that the area was fairly heavily populated by the Bole division of the West Gonja tribe.

However after the war between the Kong and Bole divisions the remaining people congregated in a few small villages which never grew to any great size. Most of the people at that time were hunters and farmers.

In the 1870's the Gonja people were the dominant ethnic group in the area after heavily defeating all the other tribes in inter-tribal wars. As a result the majority of villagers in the area today still live under the Gonja sovereignty.

Human impact after 1870 seems to have been fairly limited and has mainly affected the wildlife populations in the area. It was in the 1930's that the British Colonial Administration declared an area of 2 330 sq. km as a Game Clearance zone.

The idea was to clear the area of wildlife in an effort to eliminate the tsetse fly which fed on wild animals. Habitat clearing along river and stream courses was also carried out during the 1930's and 1940's (Kpelle, 1986).

During the tsetse control operations large numbers of antelope and buffalo were shot and finally in 1957 the elimination of wildlife discontinued (Genelly, 1968). By that time there was very little left in the area. It is quite ironical that after shooting vast numbers of animals it was finally decided that the

area was best suited as a Game Reserve and the Mole Game Reserve was created in 1958 under the Wildlife Management Group of the Forestry Department.

In 1958 about 2 330 square kilometres, which is now the southern part of the Mole National Park, was made a Game Reserve and in 1964 all the inhabitants of five villages were removed from the Park and resettled elsewhere.

It was in 1971 that the Game Reserve was extended to cover an area of 4 000 sq. kilometres and at the same time gazetted as a National Park.

In 1982 the Park was extended again to include the southern bank of the Grogro River near Gbantala Village which increased the Mole National Park to its present size of about 5 198 sq. km. The spectacular Konkori escarpment was also included in the new National Park.

The people of Gbantala Village were finally moved from the Park in December 1992/January 1993.

Today the Gonjas remain the dominant people of the area and traditional political authority is vested in the Gonja Paramount Chief (the Yagbum-wara) who resides in Damongo and his sub-chiefs in the villages surrounding the Park.

At present there are 27 villages surrounding the Park represented by ten ethnic groups each with their own language with a total population of 21 700 people. (Mason, 1993).

As any future research or management programmes for the Mole National Park requires detailed information on the size and structure of the wildlife populations, the study of population dynamics is therefore essential in order to properly understand the ecological status of the populations of the various species occurring in the Park, as well as being able to determine if the populations are increasing or decreasing over a period of time.

The object of this present survey was therefore to produce a working document of the large mammals occurring in the Mole National Park and to give some indication of their distribution and status within the Park.

We also attempted to obtain some information on the habitats in which the various species of mammals were found and to determine which species were breeding at the time of the survey.

While the large mammals occurring in the Mole National Park are already quite well known by the local staff working in the Park no species in particular has ever been studied in any great detail and almost nothing is known of the size of the populations of the various species. However a number of reports on both Zoological and Botanical aspects of the Park have been produced over the years. Those of importance include the following: Arlangdon (1986), Benzie (1976) and (1977), FAO

(1968), Geddes (1975), Gelman (1989), Gorman and Robertson (1977), Craig-Smith (1977), Hall (1975), Hall (1976a, 1976b, 1976c and 1976d), Hall and Houston (1974), Jamieson (1970, 1971 and 1972), Jenik and Hall (1969) Komoah (1987), Pegg (1969) etc.

The small mammals on the other hand are very poorly known and a great deal of work, and especially collecting of specimens, is essential if we are ever to have an accurate check-list of the species in the Park.

No form of wildlife management is possible without reliable information of numbers, population dynamics and movements of the animals occurring in the Park. However there are many problems that are met with when designing and carrying out a wildlife census, and in most cases very rarely are the estimates very accurate.

Fortunately during the present survey the use of a Ghanaean Airforce helicopter for a period of a week enabled us to fly over the entire Mole National Park during which time we obtained much useful data on the distribution of many species.

In addition some areas of the Park were covered more thoroughly than others by ground counting and with the aid of a vehicle the ground count was found to be very useful and gave excellent results.

Foot counts on the other hand, which did give some idea of the species to be found in the area, were generally impractical.

The information presented in this report is based almost entirely on visual observations obtained during the course of the survey; from unpublished records in the files of the Department of Game & Wildlife; or from members of the Department of Game & Wildlife stationed in the Park.

The field work continued over a three month period from January to March 1993. During this time, in addition to the daily routine, 20 nights were spent searching for nocturnal species which could not normally be seen during the daylight hours.

The Mole National Park is the premier wildlife Conservation area in Ghana. It is therefore important, in fact essential, that we have a detailed knowledge of the presence of all species other than those which the visitor may see, for it is the entire spectrum of wildlife that is being conserved not just the species that are large and conspicuous.

It is hoped that this report will draw attention to the wide range of smaller, yet nonetheless interesting, mammalian species which occur in Mole.

We therefore hope that by the presentation of this data obtained during the present survey, although incomplete in many respects, will encourage others, and especially the staff in the Park, to fill in the many gaps in our knowledge of the mammals.

The survey was undertaken by I.U.C.N. in conjunction with the Department of Game and Wildlife as part of the overall survey of the protected areas of Ghana.

3. LOCATION, SIZE, GEOLOGY, SOIL, CLIMATE AND VEGETATION.

3.1 Location

The Mole National Park is the largest protected area in Ghana and is situated near Damongo, some 160 km West of Tamale in the northern region of Ghana (Map 1). The Park lies between 09° 12' and 10° 06' North and 01° 25' and 02° 17' West and covers an area of over 5 000 sq.km.

The elevation ranges from 120 to 490 metres above sea level. The Park is bounded in the south by the Damongo to Sowla Road and on the north by the Kulpawn River.

As mentioned previously there are 27 villages surrounding the National Park with a total population of 21 700 people. (Map 2).

3.2 Size of Mole National Park

In 1958 about 2 330 sq. km was proclaimed a Game Reserve under the Wild Animals Preservation Regulation and in 1971 the Reserve was extended to cover 4 000 sq. kilometres and become a National Park.

In 1982 the Park was once again extended to the present size of 5 198 sq. kilometres with the inclusion of the Konkori escarpment.

3.3 Geology

The Park can roughly be divided into two separate formations. The eastern half is made up of a series of escarpment of the Voltaian rocks and the western half of a laterite underlying landscape.

The western half of the Park (west of the Kanato-Ducie road) consists mainly of the Lower Birimian System, and Middle Precambrian schists which are more than 2 000 million years old.

Granite rocks (Dixcove and Cape Coast granitoid complex are about 1 800 - 2 100 million years old) were intruded into the schists and form a band along the western boundary of the Park (Schmitt & Adu-Nsiah, 1993). Laterites (up to 20 metres in depth) and alluvial deposits of highly weathered granite are the most common Quarternay deposits (Benzie 1976, Kesse, 1985).

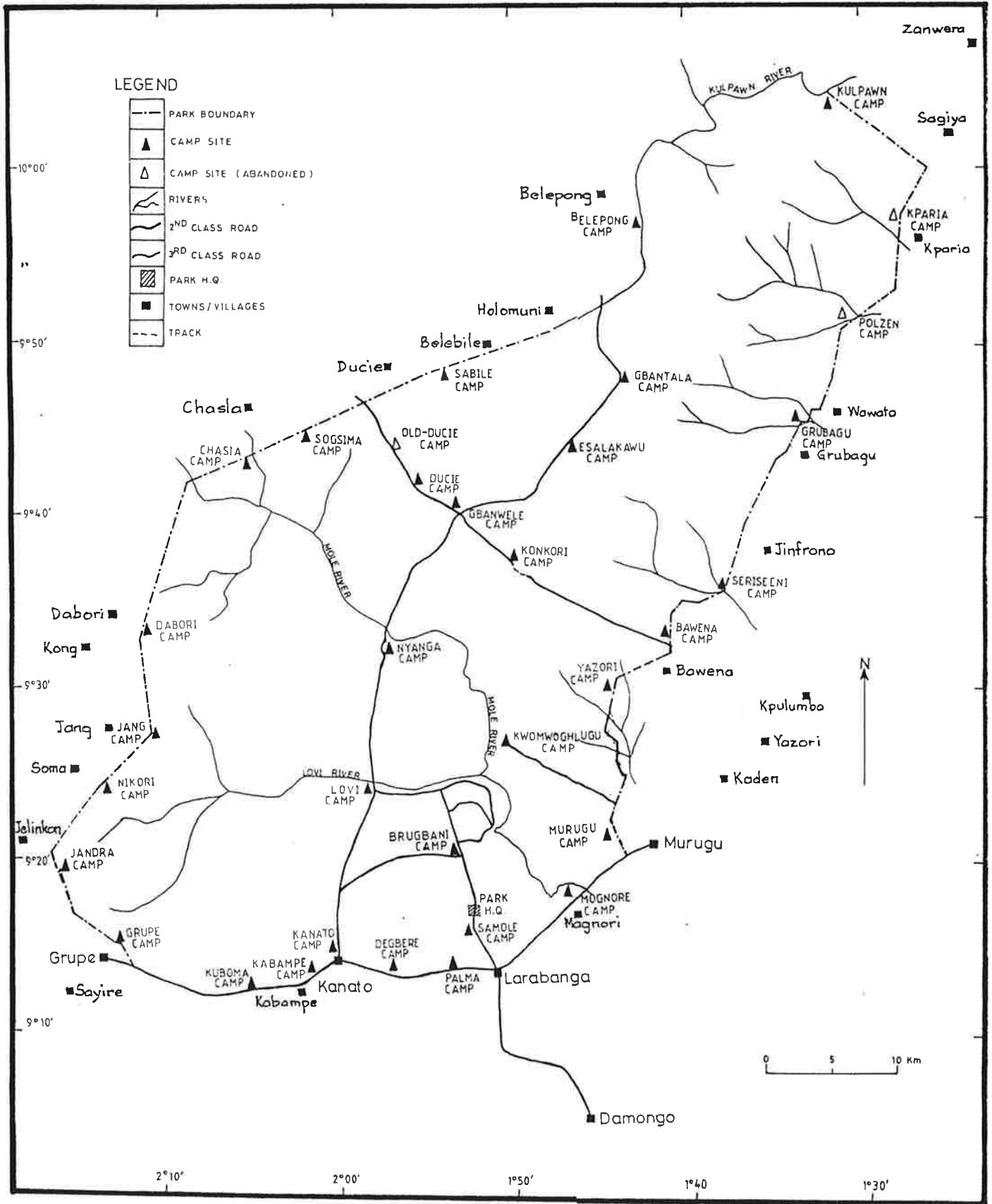
The Precambrian rocks in the eastern half of the Park are overlain by sand stones of the Voltaian System. These rocks are much younger than those in the west and while the age of the Voltaian System is controversial they are generally considered to range from 620 - 1 000 million years.

MAP 1: GHANA - Showing position of Mole National Park



National parks	
Game production reserves	
Strict nature reserves	
Wildlife sanctuaries	
Proposed	

MOLE NATIONAL PARK - GHANA



MAP 2: Showing position of 27 Villagers surrounding the Mole National Park

BY: DAVID ANNOHENE G.W.D./I.U.C.N. ACCRA JULY, 1993

The Mole River and its tributaries flow through the Park and the Konkori scarp is the highest area.

3.4 Soils

The soils of the Mole National Park are mainly rhodic Nitisols and plinthic Ferralsols. (Soil Map of Ghana, 1969). In the past these were referred to as Savanna Ochrosol and Groundwater Laterites.

The plinthic Ferralsols were in the past referred to as Groundwater Laterites and these occurred on hard pans or hardened areas and laterite outcrops which were as a result of exposure of ironrich horizons (plinthite) in the process of erosion. (Schmitt and Adu-Nsiah, 1993). These areas are common throughout the Park.

Seven soil profiles were described and analysed during the Aberdeen University Ghana Expeditions to the Mole National Park in 1974 and 1975 (Sobey 1974, Geddes 1975).

However recent work in the southern part of the Park showed four distinct soil types (Bowell and Ausah, 1993).

Table 1. Soils of Mole National Park

Soil type	Characteristics	Location	Geology
Ferralsol	ferralic B horizon, i.e. highly weathered and a high content of Kaolinite and sesquioxides	upper slopes	Volaian System. central ridge and Cape Coast Granitoids
Nitisol	argic B horizon, ie clay content higher than in overlying horizon	middle slopes and flat valley plains away from streams	
Vertisol	clay rich (> 30% in the top 18cm) dark soil	valley floor in the centre of the Park	
Solonchak	halomorphic soil high salinity	around Mole and Lovi rivers	

After Schmitt and Adu-Nsiah (1993)

3.5 Climate

The climate of the Guinea savanna zone, where the Mole National Park is situated is essentially a single season climate with 90% of the rain falling between April and October.

The average annual rainfall is 1 104 mm (over a thirty year period 1961 - 1990) with the greatest amounts falling in July and September.

The rainfall is caused by the north-south movements of the intertropical convergence (Hopkins, 1974) and there are often large year-to-year variations in the amount and timing of the rainfall which also affects the vegetation and wildlife populations (Morel & Morel, 1974).

The hot dry season lasts for five months from November to March and this type of climate has been classified a "Tropical-humid-summer Climate" (Troll & Paffen, 1964).

The mean annual temperature is 27,8°C which varies little from month to month and the average diurnal range is 13, 3°C. The coldest month of the year is December and March is the hottest. Lawson et. al. (1968) showed that cloudless weather resulted in significantly higher maximum temperatures (up to 45,9°C) near the ground.

Daytime temperatures of 40°C are common from February through April while night temperatures of only 10°C are frequently experienced in December during the harmattan. The harmattan, a hot dry wind from the Sahara, blows from the north-east between December and February, while Lawson, et. al. (1968) indicated prevailing calm air during March and April.

3.6 Vegetation

Map 3 shows vegetation types in the Mole National Park.

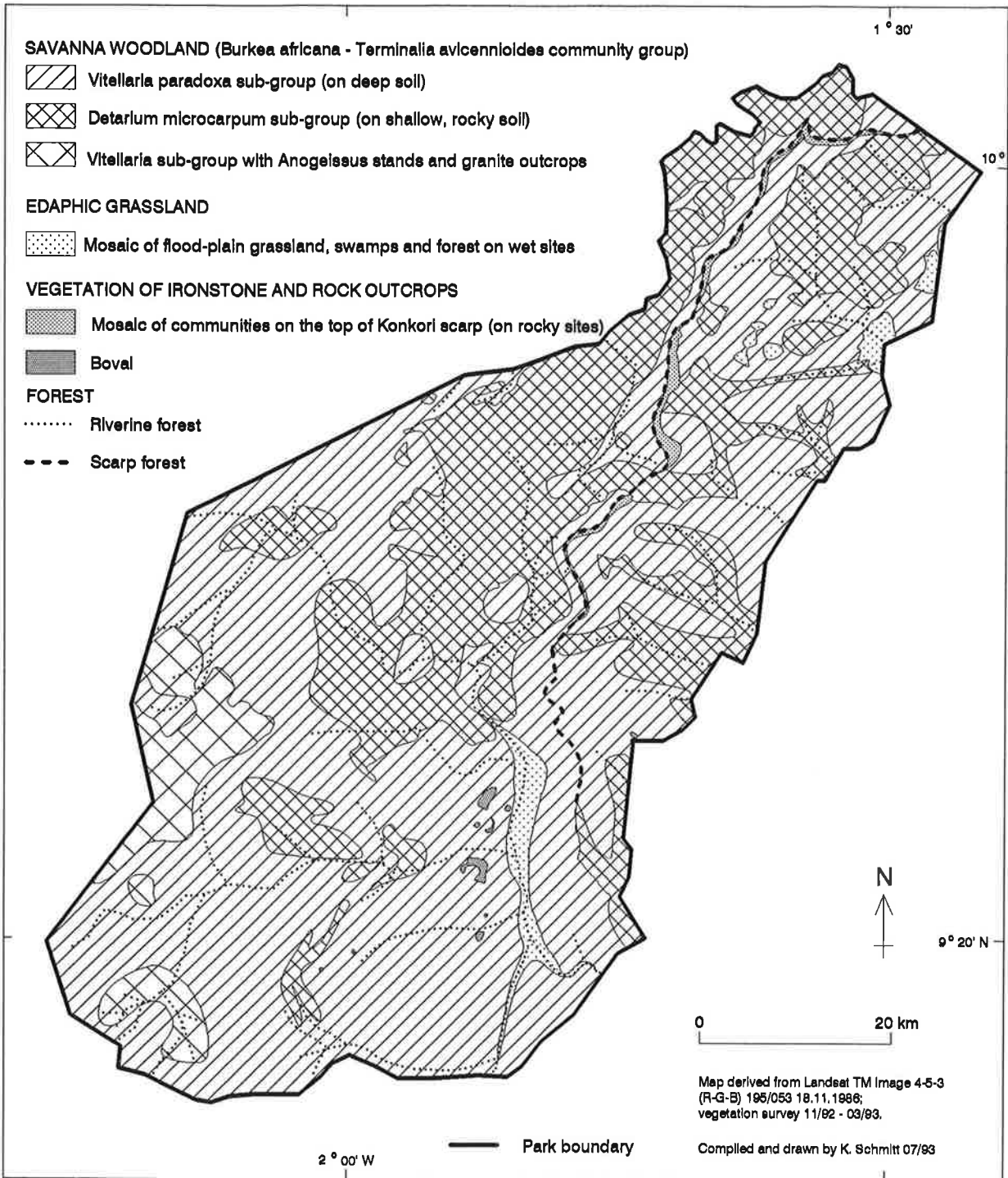
Soil depth, drainage and obviously climate are the main determinants for the distribution and composition of the vegetation of the Mole National Park.

A zonation of the West African savanna into three main zones are as follows: Guinea savanna, Sudan savanna and Sahel. These classifications have been widely accepted (Chevalier, 1900, Keay, 1959).

The Mole National Park falls within the Guinea Savanna zone and lies directly north of the rainforest belt in West Africa.

Here as discussed under Climate is a single-peak rainfall which ranges from 900 - 1 250 mm per year.

Innis (1967) classified the vegetation of the Mole National



Map 3: Vegetation Map of Mole National Park

Park as "Fire-proclimax tree savanna with perennial grasses".

However Schmitt and Adu-Nsiah (1993) have grouped the vegetation of the Mole National Park into five vegetation types comprising sixteen plant communities. These are summarised as follows:

Savanna Woodland
Boval
Riverine Forest
Flood-plains Grassland and swamps
Communities covering small areas

3.6.1 Savanna Woodland

The open Savanna Woodland is the dominant vegetation type in the Mole National Park. Tree cover varies from 5 - 65% with an average of 30%. The average tree height is 11 metres with some trees reaching a height of up to 22 metres.

The Savanna Woodland can be divided into two main communities and many sub-groups as follows:

3.6.1.1 Burkea africana - Terminalia avicennioides
Frequent occurrence of Burkea africana and Terminalia avicennioides and scattered presence of trees and shrubs of Annona senegalensis, Gardenia aqualla, G. ternifolia and Lanea acida. Several different species of Combretum can also be found.

3.6.1.2 Vitellaria paradoxa sub-group
The shea-nut tree, Vitellaria paradoxa, is a common tree on well-drained soils in the Savanna woodland. Other species which occur frequently in this sub-group are Pterocarpus erinaceus, Piliostigma thonningii and Grewia ventusa.

3.6.1.3 Isoberlinia doka - Londetiopsis scaettae
communities (Hall & Jenik, 1968).
Isoberlinia doka is a tree frequently found on deep well-drained soil throughout the Guinea savanna (Keay, 1960, White, 1983) and dominates the often dense and around 15m high tree cover areas.

3.6.1.4 Daniellia oliveri - Vitellaria paradoxa community
Here the large Daniellia oliveri tree dominates and often occurs on well-drained plains.

In this community it is possible to provisionally distinguish several sub-communities as follows:

- 4.1 The Pericopsis laxiflora sub-community
- 4.2 The Lophira lanceolata sub-community
- 4.3 The Dichrostachys cinerea sub-community.
- 4.4 The Afzelia africana sub-community

3.6.1.5 Afzelia africana - Vitellaria paradoxa community
 In this community the tree Afzelia africana is most frequently seen especially on rocky and well-drained sites, on steep slopes and broken country.

3.6.1.6 Terminalia macroptera - Loudetiopsis thoroldii community
 The species Terminalia macroptera is commonly found in low-lying and badly drained areas. The species Pseudocedra kotschyi is another tree also associated with seasonally flooded plains.

3.6.1.7 Detarium microcarpum community
 A tree often found on shallow and rocky soils.

3.6.1.8 Detarium microcarpum
 Often occurs in pure stands in small areas with only very few other trees growing between them. A dominant grass in this community is Loudetiopsis kerstingii. Other grasses include Oropetium aristatum and Loudetiopsis scaetlae.

Other communities found in the Savanna woodland in the Mole National Park include Erythrophleum africanum - Detarium microcarpum and Acacia gourmaensi - Acacia dudgeoni.

The latter community can be classified as a shrub savanna and is found on flat seasonally water-logged sites at the bottom of scarps or on low-lying ground near rivers where Acacia dudgeoni predominates.

3.6.2 Boval Vegetation

Boval vegetation consists of plant communities on flat iron pan areas of shallow soil.

Only annual species can compete on these sites which are often flooded during the rainy season and then subject to extreme water-stress in the dry season when most vegetation is burnt.

The Boval vegetation was classified by Hall & Jenik, 1968, as Loudetiopsis kerstingii - Polycarpaea tenuifolia community. Here lichens occur on bare iron pan rocks and also thick stands of annual grasses in places where soil has accumulated.

3.6.3 Riverine Vegetation

This is an extremely important vegetation type in the Mole National Park and provides food and shelter for several rare species of mammals, in particular the Colobus monkey and Yellow-backed duiker.

Bands of generally dense and species rich forests of up to 38m in height are found along many of the rivers and streams in the Park.

The width of these bands of riverine vegetation varies from a few metres to more than 100 metres on either side of the river. The width of the bands of forest are determined by topography and geology of the area.

Wide bands of riverine forest are found on the Upper Voltaian sandstone where the rivers have not cut a deep bed and where the terrain is generally flat with outcrops of sandstone in the river.

Fire may also be a factor reducing the width of the riverine forest.

Common tall trees include Khaya senegalensis, Danillia oliveri, Diospyros mespiliformis, Berlinia grandiflora, Vitex doniana, Manilkara multinervis and Anogeissus leiocarpus.

The tall Borassus palm Borassus aethiopum and Raphia sudanica are common and the stilt-rooted trees Pandanus candelbrum and Uapaca heudelotii are also common.

Other species of trees found in the riverine forest include Kigelia africana, Lonchocarpus asericeus, Cassia sieberiana, Dacryodes klaineana, Terminolia avicennioides, Vitex chrysocarpa, Garcinia afzelli, Cola laurifolia, Cebia pentandra and Pterocarpus santalinoides.

The Orchid Calypstrochilum christyanum was recorded in a Berlinia grandiflora by Hall & Houston (1974) while common shrubs in dense shrub-layers include Allophylus cobbe, Pterocarpus erinaceus, Psychotria vogeliana, Vocanga africana and Uvaria ovata.

Lianas such as Agelaea spp and climbers such as Paullinia pinnata form dense tangles at the edges of the forests and in the gaps where sunlight can reach them.

3.6.4 Flood Plain Grassland and Swamps

Here the vegetation is associated with badly-drained depressions and areas around water-holes and seasonally water-logged valleys.

The vegetation is generally dominated by grasses and sedges.

The grass Andropogon gayanus was found to dominate the ground-layer on grasslands on slightly sloping ground. Mitrogyna inermis is also common in depressions. Isolated trees of Terminalia laxiflora sometimes up to twelve metres in height are common in many areas.

Paspalum scorbiculatum has been recorded from several areas and a sedge Kyllinga spp were also found to occur in the swampy areas.

3.6.5 Other Communities

Other plant communities also occur in small areas throughout Mole National Park, especially on termite mounds.

Termite mounds are found dotted throughout the Park and provide sites for plants such as Diospyros mespiliformes which are fire sensitive. The most common trees on termite mounds are Khaya senegalensis and Azelia africana.

Small trees included Grewia vilosa and G.ventusa.

The climbing shrubs Uvarian chamae and Paullinia pinnata were often found together on termite mounds.

The most common shrubs, Securinega virosa was found on most termite mounds and Lansea acida, Mitragyna inermis and Balanites aegyptiaca were also recorded from time to time.

The wet gully vegetation can be found in many isolated places in the Park and in particular below the Konkori scarp near the Game Scouts camp.

The sides of the gullies were covered with ferns including Lycopodium cernuum, Pityrogramma calomelanos and Thelypteris microbasis.

Ficus congensis and Alchornea cordifolia were also recorded in this vegetation type with Khaya senegalensis common in many of the gorges. (Hall & Houston, 1974).

4. DURATION OF SURVEY

The survey of the Mole National Park commenced during the first week of January 1993 and continued until the end of March 1993.

While short trips were made to Accra during the survey most of the time was actually spent in the field carrying out survey work. Two previous trips of shorter duration was also made to Mole during 1992 and before the survey commenced.

In addition to the work done during the hours of daylight additional twenty nights was also spent surveying. In this case it was from the back of an open vehicle with a spotlight.

5. SURVEY METHODS:

In order to obtain as accurate a picture as possible the distribution and status of the large mammals of the Mole National Park was ascertained by using the following survey methods:

- 5.1 Foot transects.
- 5.2 Marked (Fixed) transect.
- 5.3 Road strip counts from a vehicle.
- 5.4 Night observations from an open vehicle with the aid of a spot light.
- 5.5 Aerial survey.
- 5.6 Discussions with Wardens and Game Rangers.
- 5.7 Discussions with local villagers.

Each of these methods are discussed separately:

5.1 Foot Transects:

Foot transects were usually carried out by two Game Rangers at a time. The area or direction to be covered on foot was explained to them and all transects took place in the vicinity of the Camps where the Rangers lived. In this way the Rangers were already thoroughly familiar with the surrounding country which obviously avoided them getting lost.

Whenever possible the foot transects would follow a geographical feature such as along the ridge of an escarpment, a river or stream, etc., and always commenced early in the morning.

Transects were usually between ten and fifteen km in length.

The Rangers were instructed to keep a detailed record of all wildlife seen on the transect and also to note the presence of fresh foot prints and animal droppings. They were also required to collect any

piles of droppings (Scats) of lions, leopards or hyaena encountered.

While this method of survey did not give a detailed and accurate picture of the status of the animals in the areas covered, it did however at least indicate if a species was present in the area at that particular time.

5.2 Marked (Fixed Transect): (See Map 4).

Soon after our arrival at the Mole National Park Headquarters it became obvious that a Marked transect along a fixed route would give a good indication of the population of mammals in the area around Park Headquarters and on the main road along which tourists travelled.

The transect was marked along a road starting from the Headquarters and followed a circular route and ended at the Headquarters again.

This transect was 9 km in length and was covered at different times of the day as well as at night from an open vehicle. At night a bright spot light was used which clearly showed what species were present.

Several interesting species not seen elsewhere in the Park were seen on this transect at night and the results proved to be of great value to the survey.

5.3 Road Strip Counts: (See Map 4).

The standard method of road strip counting was undertaken from a vehicle along a given road as often as possible. Two different transects were covered and used to assess wildlife populations in the centre of the Park. One transect was covered on 6 occasions and the other on 10 occasions. (See Appendix 2 for calculations.)

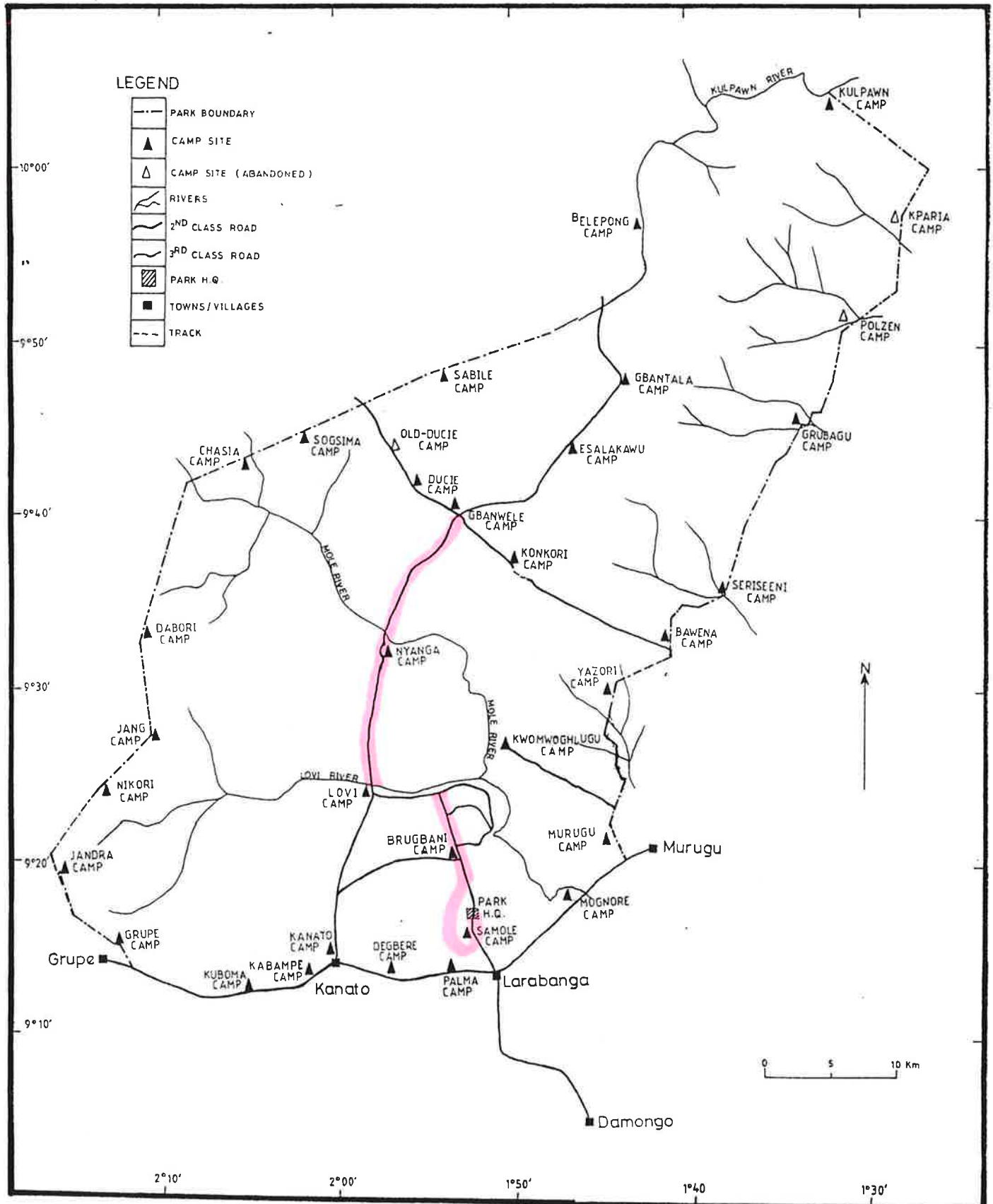
This method proved to be the most useful one for observing and counting Western Hartebeest, Oribi, Red-flanked duiker, Roan Antelope, Kob and Waterbuck.

5.4 Night Observations With a Spot Light From a Vehicle:

There was no doubt that working with a spot light from an open vehicle at night proved invaluable.

Nocturnal species such as night-apes, mongooses, genets, aardvark, porcupine, hedgehogs and hares could only be seen at night and the results clearly gave a very good indication of the status and distribution of these species in the Mole National Park.

MOLE NATIONAL PARK - GHANA



BY: DAVID ANNOHENE G.W.D./ I.U.C.N. ACCRA JULY, 1993

MAP 4: Showing position of road strip counts and fixed marked transect

In all, twenty nights were spent working with a spot light totalling approximately sixty hours of night observations. If night work had not been carried out, none of the nocturnal species would have been seen and recorded during the present survey.

5.5 Aerial Survey: (Map 5).

An entire week was spent flying over the Mole National Park in a helicopter. The whole Park was divided into transects and all game seen within a certain marked area was recorded by two observers sitting at the back of the pilot. In addition a navigator also worked from the front seat of the helicopter in order to direct the pilots to the beginning of each transect and to record other data such as amount of country burnt etc.

An attempt was made to fly the helicopter at a consistent height of 130 metres above the ground but this was not always possible especially in the northern parts of the park and over the Konkori escarpment.

The helicopter would fly in a straight line between two points from one side of the census zone to the other. Markers were attached to the side of the helicopter so that the observers could define a strip demarcated on the ground. The width of the strip of ground to be covered and therefore the area sampled was calculated for each observer as follows:

$$w = W H / h$$

w = Width of strip censured as viewed from flying helicopter.

W = Width of strip on ground as seen by observer from standing helicopter.

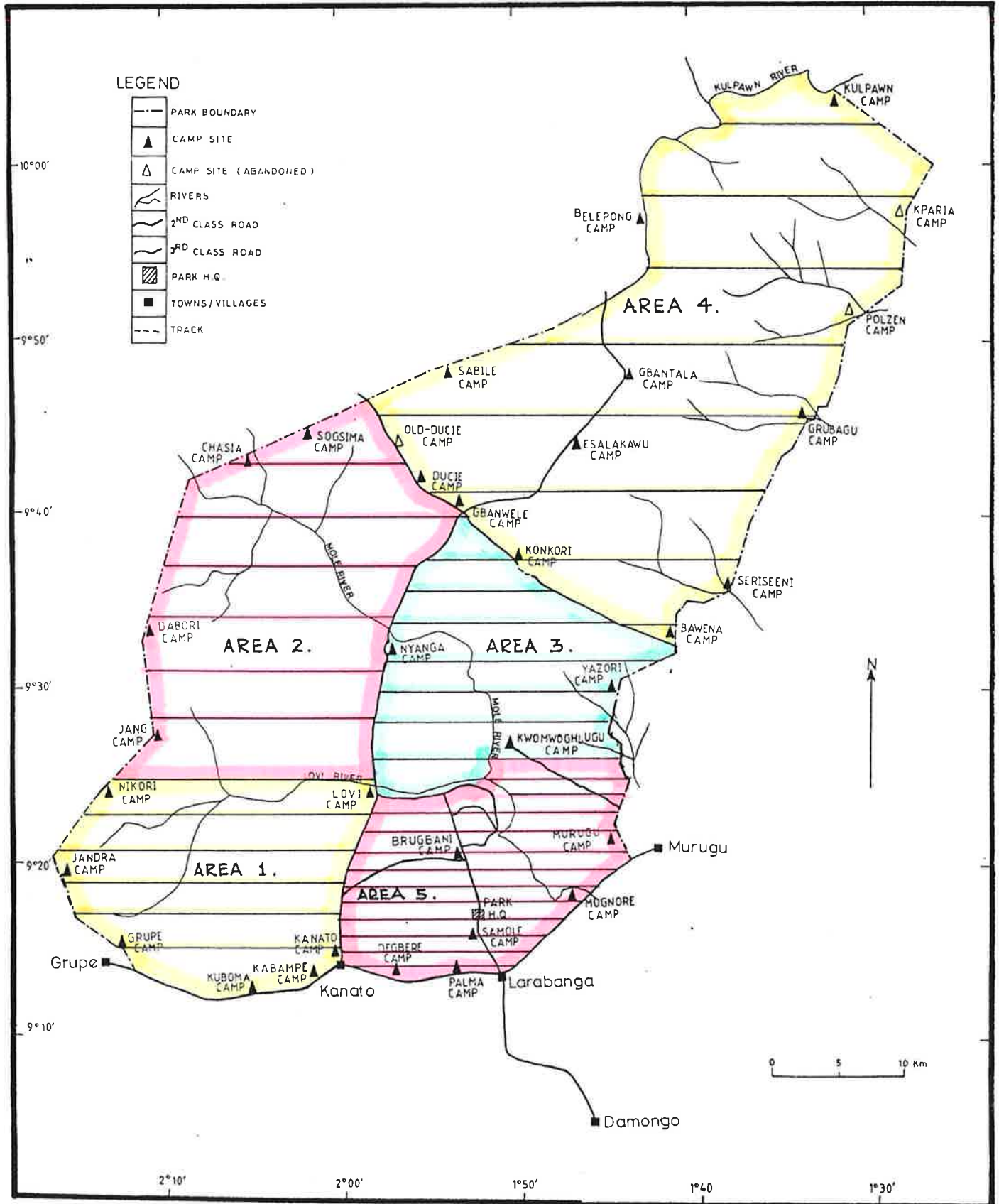
H = Height of flying helicopter.

h = Observers height at eye level above ground of standing helicopter.

The two heights, h and H, are expressed in the same unit.

(See Figure 1 below).

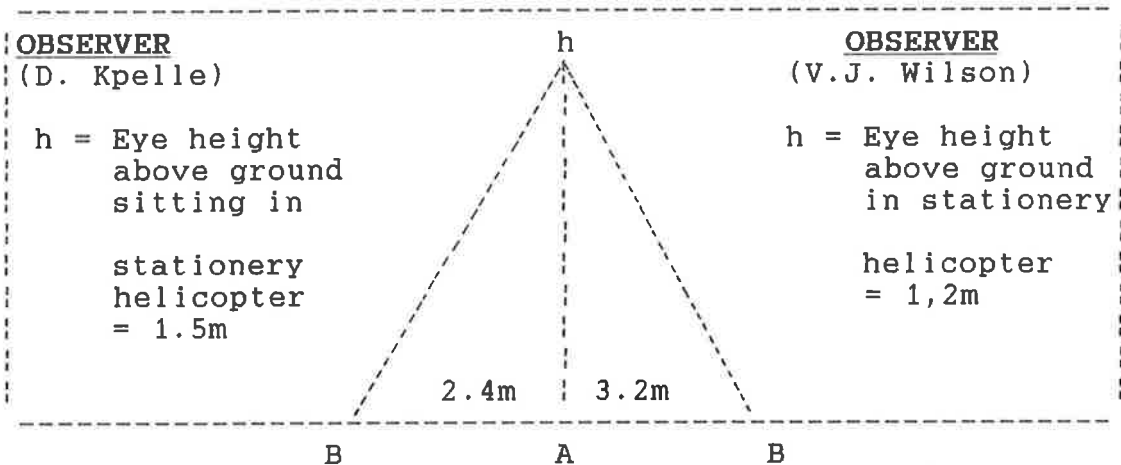
MOLE NATIONAL PARK - GHANA



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**MAP 5: Position of Aerial Survey Transects
(Aerial survey)**

Figure 1: Eye level height of observers above ground of standing helicopter.



The calculations for one observer was as follows:

$$w = W \frac{H}{h}$$

$$= 2.4 \times \frac{130}{1.5} = 208 \text{ metres.}$$

Therefore the second observer was calculated to cover a distance of 346 metres giving a total distance of 554 metres to be covered on the ground at a height of 130 metres.

The entire National Park was then divided into five distinct areas and the amount or percentage of the area to be sampled was decided from ground observations of animal population and distribution before the survey commenced.

In other words some areas, e.g. No. 1 and 4 supported very little wildlife whereas areas 3 and 4 held the heaviest concentration of game. Therefore areas 3 and 4 were covered more thoroughly than 1 and 4, while area 2 fell in between.

Details of each area is as follows: (Map 5).

Area 1: Covered an area of 949 km²
Six transects gave a total distance of 168.8 km covered.
Therefore 10.9% of the area was sampled.

Area 2: Covered an area of 1 058 km²
Six transects gave a total distance of 164 km covered.
Therefore 8.5% of the area was sampled.

Area 3: Covered an area of 722 km²
Seven transects gave a total distance of 173 km covered
Therefore 13.17% of the area was sampled.

Area 4: Covered an area of 1 608 km²
Eight transects gave a total distance of 203.4
km covered
Therefore 6.9% of the area was sampled.

Area 5: Covered an area of 676 km²
Twelve transects gave a total distance of
271.3 sampled
Therefore 22.1% of the area was sampled.

Visibility during the survey was exceptionally good as a great deal of the Park had been burnt and most species could be seen from the air including mini-antelopes such as duiker and oribi.

The counting of animals depended on whether an animal was inside or outside the demarcated area. If inside, it was counted. If a group extended beyond the width of the transect the number of the whole group was noted as well as the number within the transect.

The aerial survey proved to be exceptionally valuable for counting elephant and buffalo, but less reliable when it came to the antelopes and other species.

The general rule the observers followed was that if an animal was seen within the sample area (i.e. the streamers) then it must be counted. Any animals seen outside the sample areas were ignored.

The counting of buffalo and elephant proved to be very easy and accurate while kob, waterbuck, roan and hartebeest were definitely under-counted. Warthog, mini-antelopes and baboons could often be seen but once again the figures of animals counted would represent an under-count.

5.6 Discussions with Wardens and Game Rangers:

Every Game and Wildlife Department camp in the Mole National Park was visited and detailed discussions were held with the staff at each of these camps. Most of the staff had a very detailed knowledge of the wildlife in their areas under their control and their remarks were always useful and constantly checked with our own survey results in the area. The activities of poachers operating in each area was also discussed with the staff.

5.7 Discussions with Local Villagers:

Many of the villagers surrounding the Mole National Park were visited and detailed discussions held with a number of people. It was only as a result of talking

to the people in the villages that we were able to find out to what extent poaching was taking place in the Reserve.

Skulls of animals found in the villages and at the Game Rangers camps were also recorded.

6. RESULTS

6.1 WILDLIFE SURVEY:

INSECTIVORA

Family Erinaceidae (Hedgehogs) West African Hedgehog (Atelerix albiventris)

A live specimen was seen on one occasion at the junction of the Lovi and Mole Rivers and the skin of a dead animal was found in the same general area a few days later.

It had also been recorded at the Park Headquarters by Robertson (1977).

PRIMATES

Family Cercopithecidae (Baboons and Monkeys) Anubis Baboon (Papio anubis)

After the Night-ape, the Anubis baboon was the next most common primate in Mole. Troops of baboons were seen throughout the Park and one troop spent a great deal of its time foraging amongst the building at the Park Headquarters. In fact they drank water daily from an open tank within a few metres of where people worked and lived.

They were in fact becoming a nuisance around the camp and in a very short time numbers of them will have to be shot in order to control their activities or they may have to be captured and translocated elsewhere.

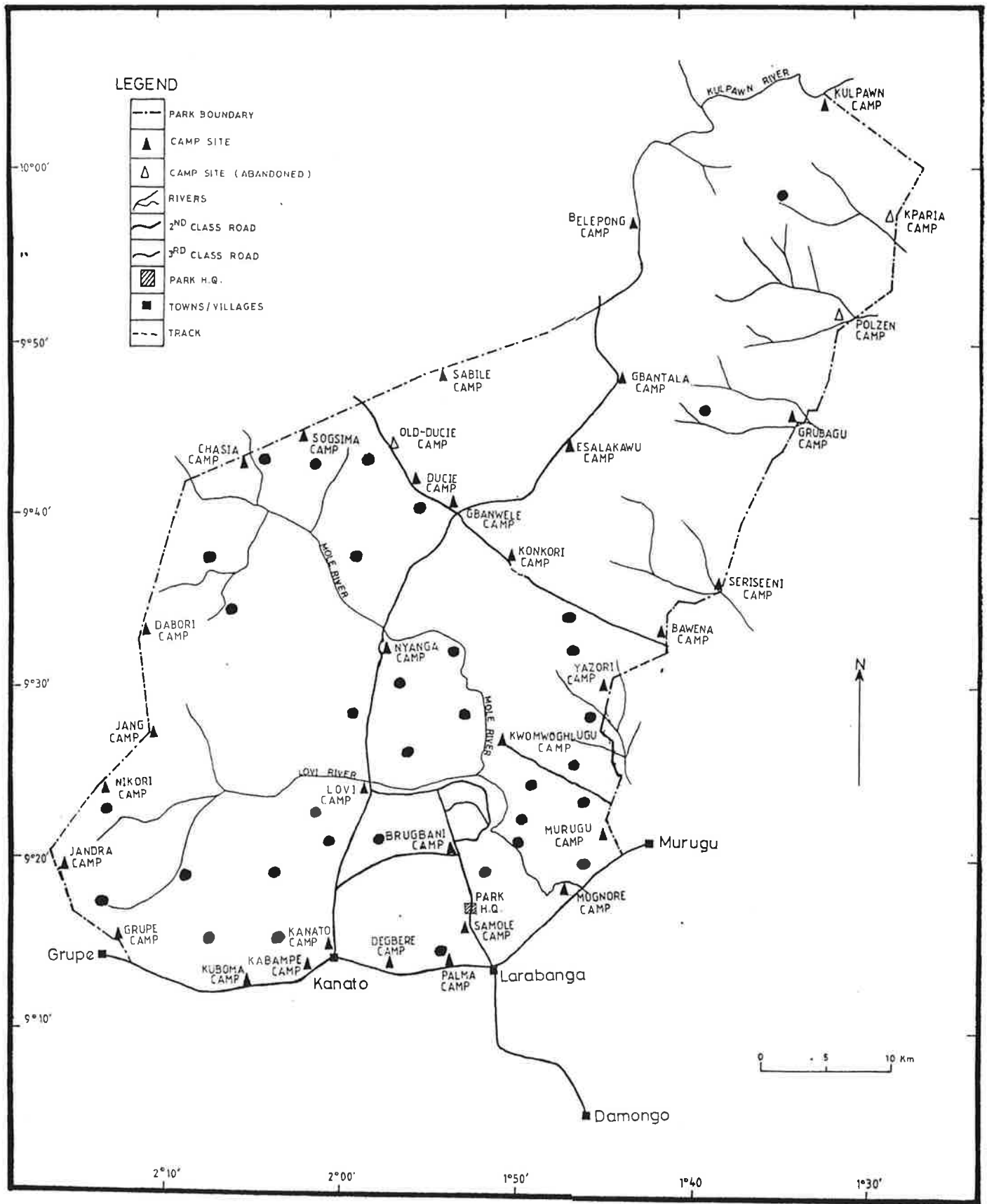
They also regularly entered through a hole in the roof of the V.I.P. lodge near the Main Visitors Camp and they were also reported catching and killing poultry belonging to the staff at the camp.

Troops of baboons were very easily seen from the helicopter during the aerial count and while it was not possible to count the number of animals in each troop spotted as they scattered when the helicopter was heard the behaviour of the animals made their presence quickly known.

Map 6 shows the distribution of the 34 troops of baboons spotted from the helicopter. (See Appendix 1). During normal ground operations the numbers of baboons in seven troops were counted accurately and these observations gave a range of from 12 - 32 animals with an average of 21.

Calculations taking into account the percentage of area covered by the transects in relation to the

MOLE NATIONAL PARK - GHANA



**MAP 6: Distribution of 34 Troops of Baboons
(Aerial survey)**

BY: DAVID ANNOHENE G.W.D./ I.U.C.N. ACCRA JULY, 1993

entire area of the Park gave a population of 290 troops of baboons.

Therefore if the average size of the 290 troops seen from the helicopter was 21 animals it would give a rough population estimate of 6 090 baboons in the Park.

Red Patas Monkey (Erythrocebus patas)

This species was seen on numerous occasions in several different areas of the Park. The number of animals in each troop was almost impossible to count and consequently no accurate figures are available of the size of the troops encountered.

One group was regularly seen at the Park Headquarters of the Park and they even ventured very close to the buildings, while another troop was seen on several occasions on the Samole River below the Headquarters. Two different troops therefore occurred in the area close to the Park Headquarters.

Only one group was seen from the air but obviously the animals in other troops were not seen as the species would "freeze" as soon as the helicopter was heard and they were therefore missed.

Calculations taking into account the percentage of area covered by the transects in relation to the entire area of the Park gave a population of 15 troops of Patas monkeys. However because of their behaviour this figure is certainly an underestimate.

Green Monkey (Cercopithecus aethiops)

A common primate in the Mole National Park. Troops of Green monkeys were seen in many areas and they certainly occurred throughout the National Park. On one occasion a vervet monkey was observed grooming a Red-flanked duiker close to the tourist road below the Park Headquarters. This type of grooming behaviour of duikers by monkeys has previously been recorded in Natal, South Africa, where Vervet monkeys (= Green monkeys) were seen grooming a Natal Red duiker (Cephalophus natalensis). Borland (1979).

In addition to the record mentioned above, Green monkeys were again seen associating with Red-flanked duikers on another two occasions in different parts of the Park. On each occasion it was the monkeys which sounded the alarm call which immediately sent the Red-flanked duikers diving into the thickets for cover. (See also remarks concerning baboons and Red-flanked duiker).

It was never easy to obtain accurate counts of the number of monkeys in a troop but of 18 troops observed for a short time, the average number of animals was found to be 17 with a range of 11 - 28 animals.

Newly born young, still very blue in colour, were seen on no less than eight occasions which indicates that at least some young are born during January to March.

Black & White Colobus Monkey (Colobus polykomos)

This species was only recorded on four occasions during the survey. On two occasions troops were seen in the riverine vegetation on the Lovi River and the species was also recorded on the Mole River on another two occasions.

Apart from the riverine vegetation most areas in the surrounding Guinea savannah woodland were unsuitable as a habitat for this species so it is obvious that the Black and White Colobus is confined to the dense riverine vegetation in the Mole National Park.

One group encountered late one afternoon about 1 km from Lovi camp on the Lovi River, was of 18 animals. The troop was in the process of settling down for the night and many were already cuddling up together to sleep. The troop was distributed between two large trees. One was a Khaya senegalensis and the other a Ceiba pentandra.

It is quite possible that the troop mentioned above were roosting in the same group of trees as those mentioned by Fleming (1976) when he studied the Colobus monkeys in the Lovi area in 1976.

It is worth mentioning that Fleming (1976) recorded a group of fifteen Black and White Colobus in the same area.

It is therefore possible that the group now observed by the writers during the present survey was the same group studied by Fleming seventeen years earlier.

Senegal Galago or Night-ape (Galago senegalensis)

Robertson (1977) says - "This species was searched for at night but we failed to see any or hear the distinctive call. This species does occur, however, as the Game Department staff know it and there is a skin in the Mole Skin room which was from a dead specimen found at the Headquarters. Not common near the Headquarters but would be worth looking for at Lovi camp."

It is of interest to note how different survey methods

can give different results. It is also of value to record that during the present survey the writers found the Night-ape to be the commonest mammal species in the Mole National Park and it was not in any way rare. Table 1 gives the numbers of Night-apes seen at night and the areas in which they were recorded. In fact Night-apes were seen on every occasion that we went out at night and sometimes at a density of 1,5 to 2,5 animals per kilometre travelled.

Robertson (1977) possibly did not see any nightapes because they did not go out at night with a bright spot light in a vehicle. One should bear in mind that during the present survey a 500,000 C.P. spot light was used with which night-apes and other nocturnal species were very clearly seen and as a result of the reflection of their eyes they could be accurately counted.

TABLE 1 - NUMBER OF NIGHTAPES SEEN AT NIGHT IN VARIOUS PARTS OF MOLE NATIONAL PARK

Ref. No.	Nightapes seen	Locality
	7	H/Q - 9km Drive-Brugbani-Lovi River Transect
2	11	-do-
3	29	-do-
4	18	-do-
5	17	-do-
6	22	-do-
7	19	-do-
8	31	-do-
9	11	-do-
10	7	Lovi Camp - Nyanga Camp
11	12	-do-
12	36	Lovi Camp - Asibey Pools
13	29	-do-
14	8	9km Drive
15	17	-do-
16	15	-do-
17	6	-do-
18	108	H/Q - Larabanga - Grupe Village
19	132	Grupe Village - Larabanga (50 km)
20	31	H/Q - Lovi River - Asibey Pools

PHOLIDOTA

Family Mandidae (Pangolin) Giant Pangolin (Phataginus giganteus)

The presence of four pangolin scales in the scats of a lion certainly confirms the presence of pangolins in the Mole National Park. While it is not possible to say which species is involved it is possible that they are from a Giant Pangolin as all four scales were exceptionally large.

This species was also mentioned by Robertson (1977) as occurring in the Park.

No actual live specimens were recorded during the survey.

LAGOMORPHA

Family Leporidae (Hares) Togo Hare (Lepus victoriae)

This species is certainly not as common as one would expect and not many were seen at night when we operated with a bright spot light.

However they were widespread enough to say that they certainly occurred throughout the National Park.

RODENTIA

Family Hystricidae (Porcupines) Crested Porcupine (Hystrix cristata)

Only a single animal was actually seen during the survey and that was in the Samole River area where the Brugbani road crosses it.

However shed porcupine quills were found on numerous occasions not only by the writer of this report, but also by the Game Rangers while on patrol.

Appears to have a wide distribution and possibly occurs throughout the Park.

Family Sciuridae Gambian Sun Squirrel (Heliosciurus gambianus)

Seen on several occasions in widely separated areas of the Park. A small population which was once recorded in the Anogeissus woods near the Park Headquarters (Robertson, 1977) still occurs there although they now appear to be rare compared to Robertsons remarks that they were particularly common. It is also worth

recording that many of the trees in the Anogeissus wooded area are now dead and fallen and this could have caused the reduction in the squirrel population.

The species was also recorded at Nyanga camp near the Mole River and in the Samole River area near the Park Headquarters.

Striped Rope Squirrel (Funiscuirus pyrropus)

A Tree Squirrel which appeared to be F. pyrropus was recorded in riverine vegetation along the Mole river but it could not be positively identified.

Specimens are essential if an accurate determination is to be obtained.

Western Ground Squirrel (Euxerus erythropus)

Common throughout the Park and often seen in a wide variety of habitats. All specimens seen were solitary.

Family Thryonomyidae (Canerats)

Canerat (or Cutting Grass)) (Thryonomys swinderianus)

There was evidence of the species in the reedbeds in the Mole River near Nyanga Camp, at the place where the Brugbani camp road crosses the Samole River and in the Lovi camp area. They no doubt occur in many other areas but they were seldom seen, even at night with a spot light. They are no doubt a lot more common than the few records show. (see also leopard section).

Family Muridae (Rats & Mice)

Giant Rat (Cricetomys gambianus)

Not as common as one would expect, but several live animals seen at night on the roads with the aid of the spot light which confirms their presence in several places. On one occasion two animals were seen high up in the branches of a tree.

CARNIVORA

Family Hyaenidae (Hyaenas)

Spotted Hyaena (Crocuta crocuta)

While no hyaena were actually seen by any of the survey team during the survey, fresh tracks and droppings were found from time to time.

According to the Game Rangers at Nyanga and Lovi camps, hyaena were heard calling at night on several occasions in January 1993.

While the species may indeed be rare in the Park, it nevertheless still occurs in several areas.

Family Felidae (Cats)
Lion (Panthera leo)

During the survey and over a period of one week in January 1993, there was evidence of the presence of lions in three widely separated areas in the Mole National Park.

A single lion was heard roaring in the valley below the Game & Wildlife Department's Headquarters on several consecutive nights and at the same time lions were heard calling on the Lovi River near Lovi camp.

A day later, Dr. John Grainger saw and photographed a single lioness early in the morning near Gbanwele camp.

Soon after our arrival in the Mole National Park we instructed all Game Rangers and other staff to collect all piles of lion droppings found while patrolling or travelling in the Park and to keep them at their camps until collected by us.

Over the period of three months we were given twelve separate piles of lion droppings which were then taken back to Bulawayo in Zimbabwe where they were sieved in order to determine what prey remains had passed through the gut undigested. The droppings were collected from the Lovi, Brugbani, Gbanwele, Samole and Nyanga areas.

Table 2 shows what prey remains were recovered from these droppings.

In addition the skulls of all large mammals found in the bush by the Game Ranger's at each camp, were collected and examined.

Warthog, roan antelope, hartebeest, waterbuck, kob, buffalo and bushbuck were the only mammal skulls found in the Park by the Rangers and they attributed all the skulls to lion and leopard kills.

While the population of lions in the Mole National Park is certainly not high there must be at least sufficient to maintain a breeding population.

The Rangers at Lovi reported seeing a pride of seven lions in December 1992 which included two cubs and there is also a report of a group of five adults and three cubs seen in the Nyanga area.

TABLE 2 - PREY REMAINS IDENTIFIED IN LION DROPPINGS

NO.	AREA:	PREY REMAINS IDENTIFIED:
1.	Lovi Camp	Roan Antelope and hartebeest hair, small bones from the hooves of an antelope.
2.	Lovi Camp	Large quantities of waterbuck hair.
3.	Lovi Camp	Small pieces of bone - unidentified.
4.	Lovi Camp	Hartebeest hair and four pangolin scales.
5.	Nyanga Camp	Scales, pieces of skin and claw of a tortoise (Kinixys sp.).
6.	Nyanga Camp	Large quantities of roan antelope hair.
7.	Nyanga Camp	Bushbuck hooves, feet bones and quantity of bushbuck hair.
8.	Nyanga Camp	Waterbuck hair (small amount).
9.	Brugbani Camp	Nil.
10.	Brugbani Camp	Small quantity of kob hair.
11.	Gbanwele Camp	The entire droppings consisted of compacted hair of a hartebeest.
12.	Samole Camp	Nil.

It is suggested that the main lion population in the Mole National Park is centred around Lovi and Nyanga camps extending towards the Mole River in the east and south to Brugbani camp and Samole River. There is no doubt that lions, perhaps in smaller numbers also occur around Gbanwele and Konkori and in the vicinity of Kwomwohlogu. As lions are known to be great wanderers they will often travel great distances and no doubt some individuals also leave the Park from time to time.

This movement of lions out of the Park has already been reported by the staff in the Kanato, Jang, Gbanwele and Gbantala camps.

Leopard (*Panthera pardus*)

Throughout their range in Africa, leopards are extremely difficult to count and the Mole National Park proved to be no exception.

No leopards were actually seen during the survey but there were ample signs of their presence in many areas. Fresh leopard tracks were seen in the following areas: Samole River below Park Headquarters, in a dry river bed near Brugbani, several times at the river crossing at Nyanga Camp, along the Lovi River, at a spring near Kwomwohlogu Camp and near Konkori Camp.

A leopard was also heard calling at night while we were camping at Lovi Camp and the remains of a canerat killed and eaten by a leopard were found near Nyanga camp.

Game Rangers reported the permanent presence of leopards near Mognori, Yazori, Kwomwohlogu, Gbanwele, Nyanga, Lovi, Kanato, Jang and Gbantala.

The species obviously has a wide distribution in the Park and while the population is possibly not high, the species nevertheless still continues to survive.

In addition to the lion droppings collected by the Game Rangers, leopard scats were also collected and prey remains identified.

Table 3 gives results of fifteen piles of leopard droppings collected.

The examination of prey remains passed out undigested in the droppings of leopards proved to be a most useful way of determining what leopards feed on in any particular area. Grobler & Wilson (1972) used this technique in Zimbabwe and Hoppe-Dominik (1984) did the same thing in the Tai Forest in Cote d'Ivoire, while Norton, Lawson, Henley & Avery (1986) studied the feeding habits of leopards in the Cape Province of South Africa, also by identifying prey remains in leopard droppings.

While the sample from the present study was too small to form any definite conclusions as to food preferences of leopard in the Mole National Park, the results clearly show that the small

duikers and Canerats are well represented. Reptile remains and birds feathers were also found in several leopard scats.

In the other studies mentioned above small mammal species such as Dassies (Hyrax), rodents, hares and mini-antelopes all featured high in the list of species eaten by leopards.

As with many other areas where leopard occur they are certainly opportunists and will take virtually any consumable animal encountered. However in order to obtain sufficient food for their daily requirements they show a definite preference for medium sized mammals such as mini-antelopes, Canerats etc.

TABLE 3 - PREY REMAINS IDENTIFIED IN LEOPARD DROPPINGS

NO.	AREA:	PREY REMAINS IDENTIFICATION:
1.	Lovi Camp	Hooves and hair of red-flanked duiker and rodent remains.
2.	Lovi Camp	Canerat hair and claws.
3.	Nyanga Camp	Canerat hair and small bones, Francolin feathers.
4.	Nyanga Camp	Reptile remains - skin and scales of large unidentified lizard.
5.	Brugbani Camp	Crowned duiker hair and a few bird feathers.
6.	Brugbani Camp	Mongoose (unidentified) hair and small pieces of warthog skin and hair.
7.	Brugbani Camp	Bushbuck hair and rodent remains.
8.	Mole River	Small pieces of crocodile skin.
9.	Mole River	Feathers and rodent remains.
10.	Mole River	Canerat hair and claws. Exo skeleton from insects.
11.	Mole River	Canerat hair and pieces of reptile skin.
12.	Samole River	Large quantity of kob hair.
13.	Samole River	Red-flanked duiker hair and two molar teeth of some species.
14.	Kanato Camp	Red-flanked duiker hair.
15.	Kanato Camp	Waterbuck hair.

Serval (Felis serval)

In spite of over twenty hours of night work with the aid of a very powerful spotlight in many parts of Mole National Park, no servals were seen. None of the Game Rangers whom we spoke to had ever seen a serval during their work in the Park and most staff felt the species did not occur in the Park.

However the species was mentioned as occurring in the Park by the Aberdeen University Ghana Expedition Marshall (1974), but there is no indication if they actually saw a living animal or not.

In the 1977 report by the same university (Robertson, 1977), mentions a serval seen near the Park Headquarters during the 1976 expedition. Therefore it appears as if the species does occur in Mole but it is certainly not a common species.

Caracal (Felis caracal)

If this species does occur in the Mole National Park it should be regarded as extremely rare. There were no signs of it whatsoever during the present three month survey and none of the Game Rangers questioned had ever seen or heard of one.

Robertson (1977) says, and I quote - "There is some doubt whether this species occurs, though some Park personnel think they have seen it".

Family Canidae (Wild dogs and Jackals) Wild dog (Lycaon pictus)

In areas where wild dogs are hunted or disturbed in any way the species becomes very secretive and are therefore extremely difficult to see. They tend to hide and are seldom seen. The Game rangers whom we questioned mentioned that they had never seen Wild dogs or even heard them calling in recent years although several people did mention that 3 - 4 years ago they did come across this species from time to time.

It is well known that Wild dogs move considerable distances and no doubt they have moved out of the Park in the past. It is perhaps on these occasions that they have been hunted and killed outside the Park.

However the fact that none have been seen or even recorded in the Park or surrounding country for several years suggests that they may in fact now be extinct in the Mole area.

Side-striped Jackal (Canis adustus)

Several Game Rangers indicated that this species occurs in the Mole National Park especially in the area around Konkori and Gbanwele camps.

One Game Scout from Gbanwele reported seeing a jackal on the

road between Gbanwele and Ducie Camps in December 1992.

The species, while rare, nevertheless still occurs in the Mole National Park.

Family Mustelidae (Honeybadgers, otters)

Ratel, Honeybadger (Mellivora capensis)

In spite of a considerable amount of night work being carried out and after questioning dozens of Game Rangers and local villagers, nobody reported seeing this species in the Park or even the surrounding country.

Robertson (1977) found a skin of a Honeybadger in the Skin Room (Museum) at the Wildlife Department Headquarters at Mole but that does not necessarily mean it came from the Mole area. If it does occur in Mole it must be very rare indeed.

Family Viverridae (Civets, Genets & Mongooses)

Civet (Civettictis civetta)

The African Civet is a predominantly nocturnal animal and is usually seen in well-watered areas and rarely occurs where the vegetation is very dry. Well-watered areas provide good cover for them in the form of under-bush and shrubs and in many places where civets are known to be plentiful there is a large variety of fruit and high populations of insects, rodents and reptiles. These are essential habitat requirements for the species.

In the Mole National Park only one civet was seen and this was at night on the 9 km Marked Transect near the Headquarters. In fact the Marked Transect was the only place in the Park that was covered at night where a well-watered habitat existed and where visibility was good.

It is therefore suggested that as there are several other places in Mole where the habitat is suitable for civets it was only on the 9 km Marked Transect that we could combine nocturnal work with a suitable civet habitat.

A skin of a civet was found at Damongo Village near the Park and a hunter was found selling a dead animal near Tamale.

The species may well be more common in the Mole National Park than the single record shows especially along the Mole River.

Genet (Genetta sp.)

There are possibly two species of genets in the Mole National Park represented by the small spotted Genet (Genetta genetta) and the Pardine Genet (Genetta pardina) Robertson (1977).

As no specimens were collected during the present survey and as no proper zoological collection exists of the small mammals of the Mole National Park it is not possible at this stage to give an accurate determination of the genets of the Park.

However it was very evident, as seen from the night work carried out, that genets are very common in the Park and several animals were seen every night while we were out with a spot light.

During January 1993, on no less than ten occasions, two kittens were seen together so it is obvious that December/January must be the period when young are born and by that time the babies have also left the mothers but have remained together for a short time. By the end of March 1993, no pairs of young genets were seen together so it appeared as if by that time the young had already separated from each other and dispersed.

Gambian Mongoose (Mungos gambianus)

The Gambian Mongoose is by far the commonest mongoose in the Mole National Park and is more likely to be seen than any other species.

This mongoose is diurnal in habits and moves about in quite large groups sometimes up to 28 animals together.

In fact the largest group seen was of 28 while an additional seven other groups ranged from 4 to 22 animals. The average of the eight groups was sixteen animals (range 4 - 28). However on three occasions it was not possible to count all the animals seen as they moved through the woodland savannah.

The Gambian Mongoose has a uniform colour with a distinct yellowish-grey throat and the head is rather small with a short muzzle while the ears are rounded and often hidden by the long hair on the sides of the head.

The tail is fairly long and coarse and very similar to the general body colour. The colour of the tail becomes darker towards the tip which is usually black.

Five of the groups seen were on open dry laterite pans with very short grass where they were easily observed and counted. The other three groups, as mentioned above, were in woodland savannah where Isobertinia doka predominated.

In addition to the eight groups seen in the Mole National Park an additional five groups were recorded outside the Park. However it is of interest to note that the average size of the groups seen outside the Park was only six animals (Range 3 - 11 animals). Hunting by the local people may well have contributed to the smaller size of the groups outside the Park.

Three dried, but nevertheless identifiable Gambian Mongoose specimens were also recorded at the Techniman "Bush-meat" Market in January 1993, but it was not possible to find out where the specimens came from.

Four young animals were recorded in the group of 21 seen on the Gbinine Flats on 12th January 1993. While they were still very small they could still run very fast and were perhaps about two

months old. On another occasion six young were recorded in a group of fifteen in Isoberlinia woodland.

A Martial eagle (Polemactus bellucarus) was witnessed swooping down on a group of Gambian Mongooses on 15th January 1993. While the attack was unsuccessful the mongoose nevertheless immediately scattered into the long grass close to riverine forest and their chattering could be heard for sometime after the eagle had left the area.

While no food items were actually seen being caught and eaten by the mongooses at any time, they did spend a lot of time digging open small holes in the ground and tearing open rotten logs. They were also observed turning over small stones and digging furiously in dry litter.

Marsh (Water) Mongoose (Atilax paludinosus)

This species was seen on numerous occasions at night near the Samole River area on the Marked Transect below the Park Headquarters. After several nights one animal became so accustomed to the bright spot light being shone on it, it continued it's feeding forages in the mud and water, very often close to the vehicle.

Several different animals were located in the Park Headquarters area but all very close to water. They were not seen anywhere else in the Park, but they no doubt have a very wide distribution as suitable habitat for the species is to be found in many areas and especially along the Mole and Lovi Rivers.

Unidentified Mongoose

On six occasions an unidentified mongoose was seen in the Mole National Park.

The animal was always solitary and only seen at night and on each occasion it was seen in a very dry area. In fact three of the animals were seen on dry laterite pans and very far from water. The other three observations were also in areas where no streams or any surface water was nearby.

When first seen the species appeared to be a Marsh mongoose but it was much smaller than the Marsh mongoose and had small round ears and the tail was not fluffy or long haired but rather pointed with no tuft of hair.

In colour it resembled the Marsh mongoose but was much lighter coloured.

It was definitely not the Marsh mongoose (Atilax paludinosus) the Egyptian mongoose (Herpestes ichneuman) or Kusimause (Crossarchus obscurus).

Therefore it is essential that a couple of specimens are collected as soon as possible so that it can be positively

identified.

White-tailed Mongoose (Ichneumia ablicauda)

Robertson (1977) mentions a skull of a white-tailed mongoose in the skin room at the Headquarters of the Mole National Park. While the presence of the skull does not mean that the specimen actually came from Mole, a single sight observation of the species on the Marked Transect near the Samole River does show that the White-tailed mongoose occurs in the Park. This visual record was at night but the animal was close enough for positive identification. The species no doubt also occurs in other areas of Mole, but as it is predominantly a nocturnal species, it is hardly ever seen during the day.

Slender Mongoose (Galerella sanguinea)

Unlike the previous species the Slender mongoose is strictly diurnal and is very rarely seen about until the sun is already high in the sky. It is also territorial and generally solitary. However a single animal was on one occasion found in the low branches of a tree feeding on a freshly caught lizard, so it is obvious that they do climb trees from time to time.

On only two occasions were two animals seen together in the Mole National Park with an additional eleven observations of single animals.

They were recorded from all areas of Mole so obviously they have a wide distribution in the Guinea Savannah woodland and are by no means a rare species.

TUBULIDENTATA

Family Orycteropodidae (AARDVARK)

Aardvark (Orycteropus afer)

This species is perhaps a lot more common in the Mole National Park than the single record shows.

A very large specimen was recorded on the night of 13th January 1993, on the main Marked Transect just below the Game & Wildlife Headquarters. It ran in front of the vehicle on the road for over 100 metres before swerving off to the left and disappearing into the thickets.

It is of interest to note that it emitted a very strong smell as it ran along which could be smelt from a distance of over 25 metres.

Fresh Aardvark droppings and tracks were recorded from several other places in the Park so it is obvious that the species is widespread.

PROBISCIDEA

Family Elephantidae (Elephants) Elephants (Loxodonta africana)

Apart from Roth and Douglas-Hamilton (1991) who estimated the elephant population in the Mole National Park to be about 500 elephants, there are no other records which can be found indicating the number of elephants in the Northern part of Ghana.

While Roth and Douglas-Hamilton (1991) gave the figure of 500, this information was obtained from Dr. Asibey in 1981, who was at that time Chief Game & Wildlife Officer in Ghana.

During the present survey, elephant numbers in the Park were estimated in three ways, as follows:

- (a) By counting the elephants which visited the waterhole at the foot of the scarp in front of the Park Headquarters at Samole.
- (b) By road-strip counts along certain roads in the Park, and,
- (c) By the aerial survey of the entire Mole National Park.

Each of these three methods will now be discussed:

(a) Elephants at waterhole in Samole River Area (Park Headquarters)

A twelve hour game count (06:00a.m. - 06:00 p.m.) of all mammal species including elephants visiting the waterhole on 1st February 1993, gave a total of 34 elephants as follows:

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:10:15 a.m. - 11 adults (2 adult males with broken tusks) :  
:10:25 a.m. - 8 adults (3 were definitely males)           :  
:11:25 a.m. - 14 adults                                     :  
:11:28 a.m. - 1 adult (Large bull with single tusk)        :  
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Notes were made of the description of every elephant so there was no doubt that none of the animals were counted twice.

Another twelve hour game count on 20th February 1993, gave a figure of 38 elephants as follows: 8, 4, 3 and 23.

The group of eight were definitely the same elephants that visited the waterhole on 1st February 1993, while those of 4, 3 and 23 were different herds.

The herd of 23 consisted of eleven adult females and 4 very small and possibly newly born young. Two large adult males were also part of the group.

However, the 1st March 1993 gave a completely different picture when over 100 elephants visited the waterhole

between 06:00 a.m. and 06:00 p.m.

Details were as follows:

08:20 a.m.	-	4 adult males	(One with very large tusks each in excess of 30 kilograms)
09:15 a.m.	-	22 elephants	(14 adults, 7 sub-adults and 1 calf)
11:30 a.m.	-	8 adults	
12:10 p.m.	-	11 adults	(2 with very short broken tusks)
1:40 p.m.	-	2 large bulls	
1:50 p.m.	-	17 adults	
2:30 p.m.	-	4 adults	
2:35 p.m.	-	14 elephants	(11 adults and 3 young)
2:45 p.m.	-	6 adults	
3:15 p.m.	-	15 elephants	(9 adults, 3 sub-adults and 3 calves)
TOTAL		103 Elephants	

This was the largest number of elephants seen at any time during a single day in the Mole National Park but the largest herd of elephants known to occur in the Park was not included in this figure, as they were seen north of the Lovi River.

None of the 103 elephants seen at the pan had come to drink twice on that day and they definitely all represented different animals.

However several of the animals had been seen previously on 1st February and 20th February 1993 during the first two counts.

In other words the herd of eight seen on 1st March 1993 was the same group seen on 20th February 1993 and before that on 1st February 1993.

Also the group of 11 seen on 1st March were previously recorded on 1st February 1993.

It is therefore possible to say that on 1st March 1993 there were at least 103 different elephants in the Samole River area near the Park Headquarters. As water could still be found in pools in many places along the course of the Mole River it is highly probable that other elephants used the Mole River for drinking and did not move as far south as the Samole River near the Park Headquarters.

(b) **Road-Strip Count:**

A 40.0 km transect along the road from Lovi Camp to Nyanga and on to Gbanwele Camp was covered on six occasions and elephants were recorded on four of the six occasions as follows: 2, 0, 0, 3, 1 and 4, giving an average of 1.7

elephants. (See Table 4 and Appendix 2).

Using the standard formula for assessing wildlife populations as shown in Appendix 2, a population of 151 elephants was obtained for this particular area.

Another road-strip count this time between the Park Headquarters, around the 9 km drive to Brugbani and Lovi River was covered on ten occasions and elephants were seen on seven occasions. (See Table 5 and Appendix 3). This road-strip count gave a population of 176 elephants.

(c) Aerial Survey:

A full week was spent flying over the Mole National Park during which time 980.5 km of transects was flown covering 39 transects.

Elephant herds were seen on nine occasions (See Map 7) which amounted to seventy elephants, as follows: 32, 2, 1, 6, 2, 3, 1, 6, and 17. (See Appendix 1).

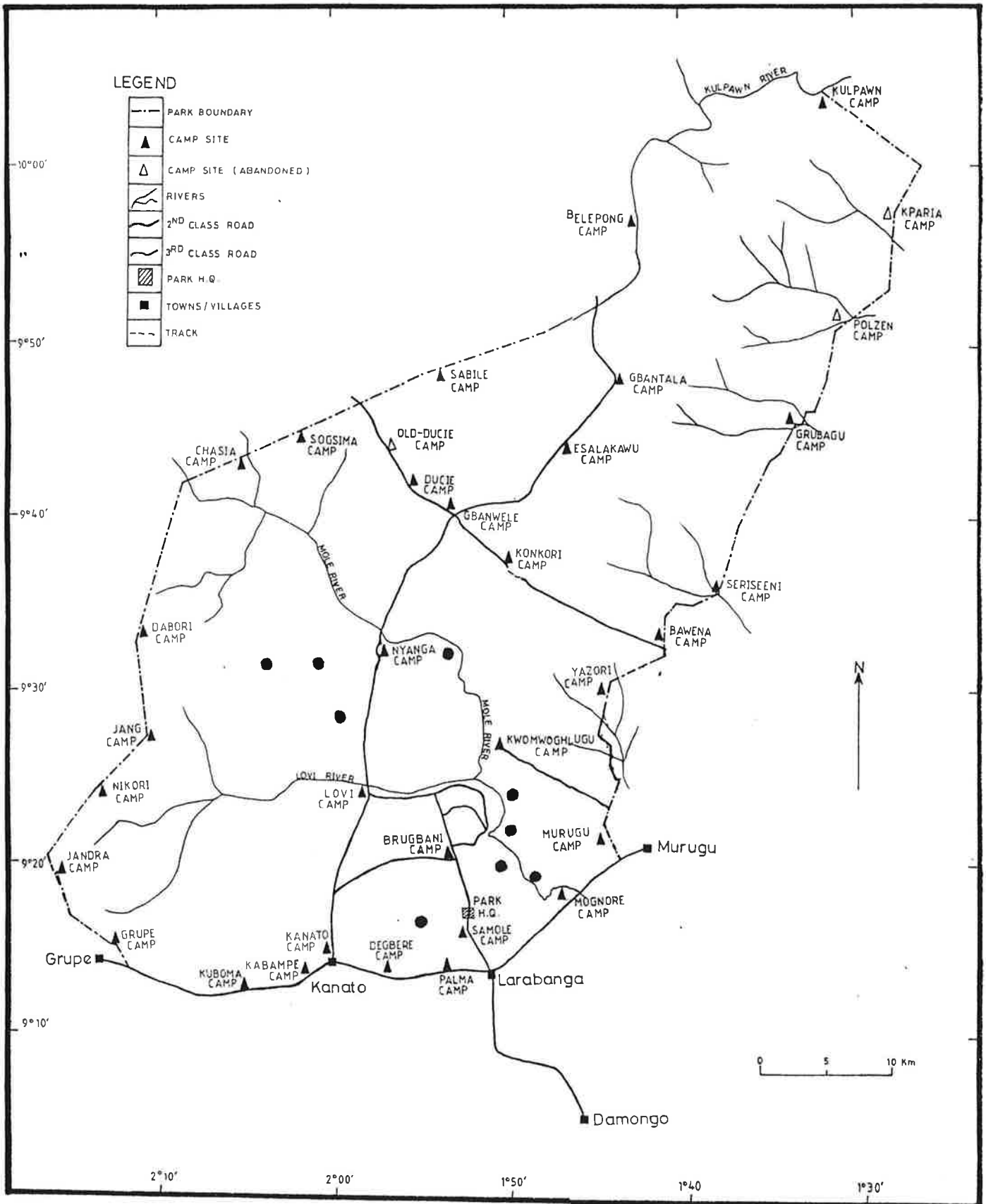
After detailed calculations using the percentage of area covered (See 5.5 above) in relation to numbers of elephants seen, a population of 589 elephants for the Park was obtained. Using the formula based on the 95% confidence limits (Norton-Griffiths, 1975) a result of 37% was obtained for the sample estimate for the Mole National Park. This resulted in having a S.D. of 4.9 for the elephant population. This figure of 589 is close to the estimate given by Roth and Douglas-Hamilton (1991).

The aerial survey gave a figure of 131 elephants for area 5, the road-strip count gave a figure of 176 elephants for the same area and 107 were counted at the waterhole below the Park Headquarters at Samole on 1st March 1993. In areas 2 and 3 the aerial survey showed a population of 458 elephants, and the road-strip count 151 elephants.

It has been shown in many areas in Africa that Aerial surveys of elephant and buffalo are far more reliable and accurate than ground counts. Therefore the figures presented above support these statements where more than double the number of elephants were seen from the air, compared to road-strip counts and other observations, other than in area five.

As pointed out by Norton-Griffiths (1975) sample error is caused by animals clumping together instead of spreading out uniformly. Transects tend to reduce the effect of this clumping while other methods tend to accentuate it. Therefore in practical terms transects will give a more precise estimate of populations than either blocks or quadrants and will have a lower variance than a population of blocks or quadrants and consequently a lower sampling error.

MOLE NATIONAL PARK - GHANA



BY: DAVID ANNOHENE G.W.D./I.U.C.N. ACCRA JULY, 1993

MAP 7: Distribution of 9 Herds of Elephant (Aerial survey)

A study on the feeding habits of elephants during both wet and dry seasons in the Mole National Park gave a total of 94 plant species eaten. (Komoah, 1987). He established that during the rainy season 61.7% of the diet was grass and only 38.3% browse plants. However this changed during the dry season when the browse increased to 80.1% and grass dropped to 19.9% (Komoah, 1987).

It is well known that the elephant changes its feeding habits and diet according to the seasons of the year. It is therefore not surprising that during the dry season the rate of browsing in the Mole National Park increases as the grass is burnt and is no longer readily available. While much work on the food and feeding habits of elephants has been carried out in East and southern Africa, Wing & Buss (1970), Field & Ross (1976), Guy (1976), Bere (1966), etc., very little has ever been undertaken in West Africa.

Apart from Komoah (1987) some observations on elephant feeding habits were also done during the present survey and many plants eaten by elephants were recorded. It was found that trees broken and leaves eaten by elephants were very noticeable and additional details of actual feeding of elephants was also recorded during the present study.

All plants not identified on the spot were collected and later identified.

It was found that Combretum collinum, Pterocarpus santalinoides and Mitragyna inermis were all very important trees fed on during the period of the present survey and in many cases even large trees were pushed over and the fresh leaves eaten.

Other trees eaten included Ximenia americana, Parinari curatellifolia and Diospyros mespiliformis.

On two occasions entire Piliostigma thonningii trees were completely destroyed by browsing elephants and many Daniellia oliveri trees showed signs of severe damage from browsing elephants.

In one area near the Samole River five large Isoberlinia doka trees were pushed over by a group of elephants which were observed for over an hour feeding on the fallen trees and surrounding vegetation including Grewia lasidioscus and the sedge Cyperus distans.

In the Mole National Park it was found that elephant live almost entirely on browse during the dry season and they also require water at least once every day. This therefore explains the presence of elephants along the Mole River and its tributaries and near other pans of water where there is also a good supply of browse on which they can feed.

Judging by the dry tracks of elephants found in many areas of the Park it is very obvious that during the wet season elephants are found in all types of habitats, and often well away from any permanent rivers.

In a survey of the Samole-Lovi Area carried out during April/May (dry season) of 1971 Jamieson (1972) obtained some basic data on wildlife populations upon which game viewing roads could be planned.

He mentioned that only a few small groups of elephants occurred in the area at that time and those that were present tended to remain in the riverine areas along the Mole River (Jamieson, 1972).

He goes on to say that he thought the major concentrations of elephant in the reserve occurred just north of the Lovi River.

During Jamieson's wet season survey in Mole National Park (September and November, 1970) he indicated that only two solitary bull elephants were recorded in the Samole Area. One was near Palma and another near Brugbani (Jamieson, 1972).

It is of interest to note that during the dry season of 1971 Jamieson recorded very few elephants in the Samole Valley area whereas during the present survey elephants were seen very often and at least 100 different animals occurred in the area south of the Lovi River. This could possibly be explained by the fact that the elephant population has increased considerably over the past twenty years, which one assumes is the case, and secondly the elephants are now more accustomed to the presence of humans and therefore do not hide away in the riverine vegetation as much as they did twenty years ago.

In addition, during the present survey, it was very noticeable that most elephant activity and all elephant sighting, were recorded in the valleys, low-lying areas and riverine vegetation and no elephant observations were recorded on the plateau or upland areas.

TABLE 4 - LOVI CAMP - NYANGA - GBANWELE TRANSECT
(ROAD STRIP COUNT - 40.0KM)

Number of times transect covered

Species	12/1/93	16/1/93	1/2/93	3/2/93	7/2/93	22/2/93	(Average)
Buffalo	3	2	5	0	0	6	(2.7)
Elephant	2	0	0	3	1	4	(1.7)
Oribi	6	6	7	5	4	3	(5.2)
Red- flanked Duiker	4	3	2	3	3	4	(3.2)
Crowned Duiker	6	7	5	3	4	4	(4.8)
Hartebeest	41	30	28	52	17	29	(32.8)
Roan	27	17	31	17	22	18	(22.0)
Waterbuck	6	3	7	8	2	4	(5.0)
Warthog	8	4	4	7	9	7	(6.5)
Bushbuck	2	1	0	2	3	1	(1.5)

Actual number of large mammals seen each time the transect was covered.

(See also Appendix 2).

TABLE 5 - PARK H/Q - 9km DRIVE-BRUGBANI-LOVI TRANSECT
(ROAD STRIP COUNT - 23.4KM)

Species:	Number of times transect covered										
	1	2	3	4	5	6	7	8	9	10 (Average)	
Elephant	1	0	7	3	5	5	2	1	0	0	(2.4)
Buffalo	0	0	0	2	0	0	0	2	0	0	(0.4)
Hartebeest	0	0	0	0	4	0	7	0	8	0	(1.9)
Roan	3	0	0	0	7	0	0	0	0	2	(1.2)
Oribi	2	0	2	0	4	3	2	1	0	0	(1.4)
Red-Flanked Duiker	1	2	0	2	1	1	3	0	1	1	(1.2)
Crowned Duiker	0	0	0	0	2	0	1	1	0	1	(0.5)
Waterbuck	14	11	12	6	18	11	7	9	16	12	(11.6)
Bushbuck	1	0	2	0	0	1	0	0	1	0	(0.5)
Warthog	2	11	7	3	5	7	2	14	12	6	(6.9)
Kob	37	30	18	11	62	11	19	31	22	32	(27.3)

Actual number of large mammals seen each time the transect was covered.

See Also Appendix 3.

TABLE 6 - PARK H/Q - 9 KM DRIVE-BRUGBANI-LOVI RIVER TRANSECT
(NIGHT OBSERVATIONS) - 23.4 KM

Species:	Number of times transect covered										
	1	2	3	4	5	6	7	8	9	10 (Average)	
Elephant	0	0	1	0	0	4	0	0	0	0	(0.5)
Roan	0	8	0	0	0	0	0	0	0	0	(0.8)
Oribi	4	3	5	6	4	2	2	1	4	3	(3.4)
Red-flanked	0	0	1	1	1	1	0	1	0	2	(0.7)
Grey Duiker	4	4	6	3	5	5	4	3	4	3	(4.1)
Waterbuck	10	16	11	12	18	7	2	11	19	20	(12.6)
Bushbuck	9	3	2	5	4	3	7	2	8	2	(4.5)
Kob	66	35	41	82	17	39	42	51	118	39	(52.9)
Nightapes	7	4	11	29	18	17	22	19	31	11	(16.9)
Hare	3	2	4	6	2	4	3	7	11	2	(4.4)

Actual number of animals seen each time the transect was covered. It was not possible to estimate visibility distances at which animals were seen at night. Therefore population densities were not calculated for night observations.

However these figures should be compared with those in Table 5 which gives some indication of the number of animals seen at night compared with day observations.

TABLE 7 - PARK H/Q-9KM DRIVE - BRUGBANI-LOVI RIVER TRANSECT
(ROAD STRIP COUNT - 23.4KM)

Total Populations			
Species	Range	Average	Population
Elephant	0 - 7	2.4	176
Buffalo	0 - 2	0.4	27
Hartebeest	0 - 8	1.9	135
Roan	0 - 7	1.2	88
Oribi	0 - 4	1.4	101
Red-flanked Duiker	0 - 3	1.2	88
Crowned Duiker	0 - 2	0.5	34
Waterbuck	6 - 18	11.6	832
Bushbuck	0 - 2	0.5	34
Warthog	2 - 14	6.9	500
Kob	11 - 62	27.3	1 974

Populations of various species as calculated from
covering transect ten times
(See also Table 5 and Appendix 3)

HYDRACOIDEA

Family Procaviidae (Dassies - Hyraxes) Tree Hyrax (Dendrohyrax dorsalis)

Robertson (1977) mentions the Tree Hyrax as a new species for the Mole National Park on the basis of a skull collected at Mole by Dr. Ian Taylor of the University of Legon, Ghana, and the fact that a Game Guard based at Lovi Camp remembers hearing the calls of this species, though only occasionally.

There was no evidence of its presence at Lovi or anywhere else in the Park during the present survey so if it does still occur in Mole it must be very rare.

ARTIODACTYLA

Family Suidae (Warthogs & Bushpigs) Bushpig - Red River Hog (Potamochoerus porcus)

A few Game Rangers in the Mole National Park say that the Red River Hog is present in the Mole National Park and the writers have come across a document in the files of the Department of Game & Wildlife which includes the Red River hog as a species occurring in the Park. However other wardens doubt the presence of the Red River Hog.

Robertson (1977) says "The occurrence of this species is in some doubt; some of the Game Guards think they have seen it but there is no tangible evidence of its presence. The species would best be considered a possible resident until its presence is verified".

One of the Senior Game Guards of Mole who accompanied the present survey team during the survey of the Park on two occasions pointed out Warthogs which he referred to as Red River Hogs. He believed that there were two species of "hogs" as he called them. One he said was a Warthog and the other a Red River Hog. While this man had been in the Mole National Park for over ten years he certainly did not know the difference between a Warthog and a Red River Hog. On some occasions he would call the animal a Warthog and on other occasions a Red River Hog.

There was also no evidence of skulls of Red River Hogs at any of the Game Scout camps visited during the survey and none were seen at night when we were out with a spot light. On the other hand Warthog skulls were located at every Game scout camp visited.

If the Red-River Hog does occur in the Mole National Park it must be very rare indeed.

WARTHOG (Phacochoerus aethiopicus)

A very common species and seen frequently in all areas of the

Mole National Park. Even in very dry areas where there appeared to be no surface water whatsoever warthogs were seen. On three occasions Warthogs were seen digging in dry river beds for water.

Very few warthogs were seen from the helicopter during the aerial survey but on the road-strip counts they were often encountered.

The transect (Road strip-count) from the Park Headquarters to the Lovi River via the 9 km drive and Brugbani camp which was covered on ten occasions gave a population of 500 warthogs for that area. The average number of animals seen each time the transect was covered was 6.9 animals with a range of 2-14 animals. (See Table 5).

The transect (Road-Strip count) from Lovi camp via Nyanga to Gbanwele was covered on six occasions during which time 39 warthogs were seen with a range of 4-9 animals (Average 6.5).

The population of this particular area was therefore calculated at 587 animals. (Appendix 2).

Taking into account the two transects (Road strip-counts) mentioned above, a population of 1 087 warthogs was calculated. Considering that vast areas of the Park remained unsurveyed it is postulated that the warthog population in the Mole National Park would be in the region of at least 2 000 animals.

Calculations taking into account the percentage of area covered by the aerial transects in relation to the entire area of the Park gave a population of only 105 warthogs. This is certainly a gross underestimate of the population.

HIPPOPOTAMUS (Hippopotamus amphibius)

The Kulpawn River in the extreme north of the Mole National Park is the only area in the Park where large pools of permanent water existed and where hippo could survive.

It is not known exactly how many hippo there are in the area but it is generally believed that the single group consisted of about 6-8 animals.

Family Bovidae (Antelope & Buffalo) Crowned or Grey Duiker (Sylvicapra grimmia)

The Crowned duiker is a common species in the Mole National Park and was often seen on the sides of the road between Lovi and Nyanga camps.

On numerous occasions singles and pairs of duikers were seen very early in the morning or again late in the afternoon just as the sun was setting. However this species was more common in the drier areas between Lovi and Gbanwele (See Table 4) than the

Red-flanked duiker.

On one occasion a vulture was seen feeding on the ground and on investigation it was found to be the leg bones of a young crowned duiker that was being eaten. In fact as the vehicle stopped close to where the vulture was feeding, so an adult female crowned duiker was seen running away into the bush.

It appeared as if the calf belonged to the adult female, but were unable to determine how it had died.

The hair of a Crowned duiker was also found in leopard droppings collected in the Brugbani camp area and on another occasion, a Bataleur eagle was seen feeding on the remains of a half-grown Crowned duiker.

As Oribi were also comparatively common in the Lovi-Nyanga area, this species and the Crowned duiker were often confused at night and on many occasions it was difficult to determine accurately what species we were looking at, especially if they were running away.

Red-flanked Duiker (Cephalophus rufilatus)

This species was more common in the more well watered areas of the Mole National Park than the Crowned duiker but the Red-flanked duiker was nearly always more difficult to see.

The Red-flanked duiker often "froze" when a vehicle was seen approaching or even if we were walking they were very difficult to see especially in areas where small red termite mounds were present. It is of interest to note how similar a brightly coloured Red-flanked duiker and a red termite mounds are. Red-flanked duiker were also more active very early in the morning and late in the afternoon and none were seen during the heat of the day or at night with a spot light.

After three months work in the Mole National Park we soon got to know exactly where and when to find certain Red-flanked duikers and if we passed the area where they were known to occur, we would look out for them and very often see the very duiker we were looking for.

The species is very territorial and covers a small home range and as a result of these fixed habits, they are easy to hunt especially by hunters knowing their habits.

They also move a lot slower than the Crowned duiker and seldom rush off at a great speed as so often happens with the Crowned duiker.

On four different occasions the association of Red-flanked duikers with primates was observed.

Details are as follows:

1. On one occasion a Green monkey was seen grooming a Red-flanked duiker near the Park Headquarters close to the Samole River (See section under Green monkey).
2. About 200 metres from Lovi camp early one morning, baboons were found feeding in a small Daniellia oliveri tree very close to the road. On approaching the tree we suddenly saw a Red-flanked duiker run off and the baboons descended from the tree and ran off in the opposite direction. On closer examination of the spot where the duiker was seen, we found a large number of white flowers and newly flushed leaves lying on the ground. It was therefore assumed that the Red-flanked duiker was feeding on the fallen flowers and leaves which the baboons had dislodged from the tree.
3. A few days later and again in the Lovi camp area, but some 100 metres from the road we stopped to watch some baboons feeding in a very large D. oliveri tree. We had been watching the baboons for several minutes eating small bunches of flowers when quite suddenly we noticed a Red-flanked duiker standing below the tree, picking up the fallen flowers and eating them.

After a few more minutes the duiker slowly ran off towards some riverine vegetation that was close by and as it passed a clump of Piliostigma thonningii trees, so it disturbed an adult Yellow-backed duiker, which also ran off into the riverine vegetation.

4. The fourth record of a Red-flanked duiker with Primates was once again with Green monkeys, and on this occasion, a single duiker was seen feeding amongst a group of Green monkeys, which were all on the ground. This occurred near the Park Headquarters camp, a little south of the Samole School late in the afternoon and just at sunset.

The only breeding record of Red-flanked duiker during the present survey was of a dead newly born duiker found by school children near Samole school. The dead specimen was brought to us and examined. The cause of death of the calf could not be determined.

It was definitely newly born and very fresh as the umbilical cord was still very soft and red.

Oribi (Ourebia ourebi)

The Oribi is another common Mini-antelope in the Mole National Park. In fact of all the places that I have visited in Africa, the Oribi was found to be more common in the Mole National Park than anywhere else. Oribi were seen every day we were out in the field and a very tame pair (male and female) occurred close to the Mole Park Headquarters and at night they often wandered between the buildings.

Pairs were seen more often than any other grouping and single animals were also observed from time to time. Groups of three were also seen occasionally and groups of 4 were seen on only four occasions.

Table 8 gives a breakdown of the 86 groups of Oribi seen during the survey.

Oribi were more common in the Lovi/Nyanga area and also along the road between Lovi camp to Kanato than anywhere else. In fact apart from Baboons, Oribi were the only species of large mammal recorded along the road between Lovi camp and Kanato, although the aerial survey showed the presence of several other species in the area. The entire area on either side of the road was very dry and there was no evidence of surface water anywhere and yet Oribi were seen on several occasions.

During the aerial survey by helicopter, pairs of mini-antelope were recorded on many occasions (See Appendix 1), and while it was not possible to say for certain that they were Oribi, many of the mini-antelope seen were obviously that species. These aerial observations have not been included in the 86 groups mentioned above.

Oribi were found in all types of woodland including the very dry area along the road between Kanato and Lovi camps. They are obviously independent of surface water (de Bie, 1991).

On eleven occasions during the present survey Oribi were seen feeding on woody vegetation such as Gardenia sp. etc. As they are generally grazers during the wet season there is certainly a shift towards browsing during the height of the dry season. Oribi in the Lake Kainji National Park seem to prefer browse as a source of food (Child, 1974) while de Bie (1991) also found the Oribi switch to browse during the dry season in the Baoule Park in Mali.

As a result of these findings it is suggested that Oribi are not typically grazers as one would imagine but could more correctly be classified as mixed feeders.

Also as the Oribi has a very narrow muzzle it is able to select its grasses more carefully during the dry season and together with the fact that woody vegetation is also eaten during the dry season the animal is more likely to remain in good condition when much of the savanna vegetation and especially the grasses are burnt. The woody vegetation is also of a higher nutritional value at a time when the quality and quantity of grasses is at its lowest.

Oribi do not appear to be seasonal breeding in the Mole National Park as young of different sizes were recorded during the survey, during the months of January to March.

TABLE 8 - COMPOSITION OF 86 GROUPS OF ORIBI SEEN DURING SURVEY

Group Size		No. of Records
Single Animals	-	12
Two Together	-	63
Three Together	-	7
Four Together	-	4 occasions
TOTAL:		<u>86</u> Groups

TABLE 9 - DRIED CARCASSES OF ANIMALS RECORDED AT TECHNIMAN
"BUSH-MEAT" MARKET ON 21ST FEBRUARY 1992

Species		No. of Animals
Patas Monkeys	-	10
Warthogs	-	39
Oribi	-	131
Green Monkeys	-	75
Roan Antelope	-	4
Grasscutters	-	720 +
Togo Hares	-	16
Hartebeest	-	6
Buffalo	-	2

It is of interest to note that on 21st February 1992 and not during the present survey, I visited Techniman "Bush-meat" market and in addition to hundreds of other carcasses which were for sale (See Table 9), a total of 131 dried Oribi carcasses were counted. It can be seen from Table 9 that all of the species recorded at the market on that particular day were of species occurring in the northern parts of Ghana and according to the women at the market, all carcasses that arrived at Techniman were already smoke-dried.

While it is not possible to accurately estimate what the population of Oribi is in the Mole National Park, I am of the opinion that it must be at least 5 000 animals.

Yellow-backed Duiker (Cephalophus silvicultor)

Only one animal was seen during the survey and that was in the Lovi River area on 29th January 1993, when it was clearly seen close to a single Red-flanked duiker and the Baboons.

While the Yellow-backed duiker is reported to occur in the Konkori river area, it was not actually recorded there during the survey. However, there is no reason to doubt it's occurrence, as the habitat is very suitable for it, especially close to the escarpment where there is an abundance of riverine vegetation and patches of evergreen forest in the valleys close to the hills.

According to the Game Rangers, and also the villagers along the eastern boundary of the Mole National Park, the Yellow-backed duiker still occurs in the riverine vegetation along many of the streams in the Bawena, Seriseeni and Grubagu camp areas.

In these areas wide bands of forest fringing the streams, forming a closed canopy over much of the flowing water, trees of up to 30 m high occur. Some of the prominent trees are Diospyros mespiliformis, Elaeis guinensis, Daniellia oliveri and Afraegle paniculata. Isolated pockets of uniform stands of Borassus aethiopum, Elaeis guinaensis and Pandanus candelbrum also occur along the river. In many places this fringing forest is impenetrable especially where the canopy is open and there are also numerous lianas where the canopy is closed. This type of riverine vegetation also extends outside the Mole National Park eastwards and it is in these places where there is ample evidence of the presence of Yellow-backed duiker as shown by the high frequency of footprints and fresh droppings.

The protection of the riverine forest is therefore of utmost importance as its destruction could mean the loss of the Yellow-duiker in the area.

Bohor Reedbuck (Redunca redunca)

While Robertson (1977) mentions the presence of Reedbuck around the dams in the dry season, there was no evidence of the species anywhere in the Park during the present survey.

On two occasions medium sized Antelope were seen in the Park Headquarters area which appeared to be Reedbuck, but on closer observation they proved to be sub-adult male Kob, which have very similar horns to Reedbuck. Young male kobs can easily be confused with reedbuck.

However if the Reedbuck still occurs in the Mole National Park, it must be very rare indeed.

West African Bushbuck (Tragelaphus scriptus)

A common species in the Mole National Park and recorded in many areas where sufficient cover in the way of thickets and riverine vegetation occurred. They were also seen from time to time in more open country and will often move away from thickets or riverine vegetation.

The species was common and often seen around the dams and Samole River area at the Park Headquarters and along the Lovi and Mole Rivers.

No doubt very good populations occurred throughout the National Park where suitable habitat exists.

Calculations taking into account the percentage of area covered by the aerial transects in relation to the entire area of the Park gave a population of only 55 Bushbuck. Road strip counts gave a ground population of 34 bushbuck in one area (see Table 7) and 142 Bushbuck for another area. It is obvious that none of these figures are correct as there are many more Bushbuck in the Park than the figures show.

On 31st January 1993, an adult male Bushbuck which was wounded by poachers had to be destroyed by the Game & Wildlife Department staff at the Park Headquarters.

It was measured and weighed. Details are as follows:

Total Length:	-	155	cm	(Tip of nose to tip of tail)
Tail Length:	-	27	cm	
Hindfoot & Hoof:	-	38	cm	
Hoof:	-	5	cm	
Shoulder Height:	-	75	cm	(Standing height)
Ear:	-	13.5	cm	(From notch to fleshy tip)
Mass:	-	50	kg	

No pedal glands were present but Inguinal glands were present and 6 cm deep with a very strong smelling substance in them.

It was in good condition with a large quantity of kidney fat and very waxy bone marrow. A large quantity of Parkia biglobosa flowers were found in the stomach contents.

BUFFON'S KOB (Kobus kob)

Results obtained from the aerial survey clearly showed that kob were not evenly distributed throughout the Mole National Park and this was confirmed from ground-work.

Concentrations of kob were found in three distinct populations which included the Samole River area near the Park Headquarters, around Asibey Pools and Kwomwoglulu Camp and in the area of the upper Mole River (See Map 8). However odd kob were recorded in several other places but not in large numbers.

Aerial survey results gave a kob population of 200 in Area 2, 205 in Area 3 and 367 in Area 5 giving a total of 781 animals with only 9 in Area 1.

As the kob is a comparatively small antelope they were not easily seen from the air and therefore many hundreds were no doubt missed during the aerial survey.

The Park Headquarters to Lovi River transect which was covered ten times (See Tale 5) during the day gave a population of 1 974 kob. As the kob was certainly more active at night in the Mole National Park than during the day several large herds of kob were missed during the day. (See Tables 4 & 5).

However, the transect from Lovi Camp to Gbanwele which was covered on six occasions did not record any kob at all.

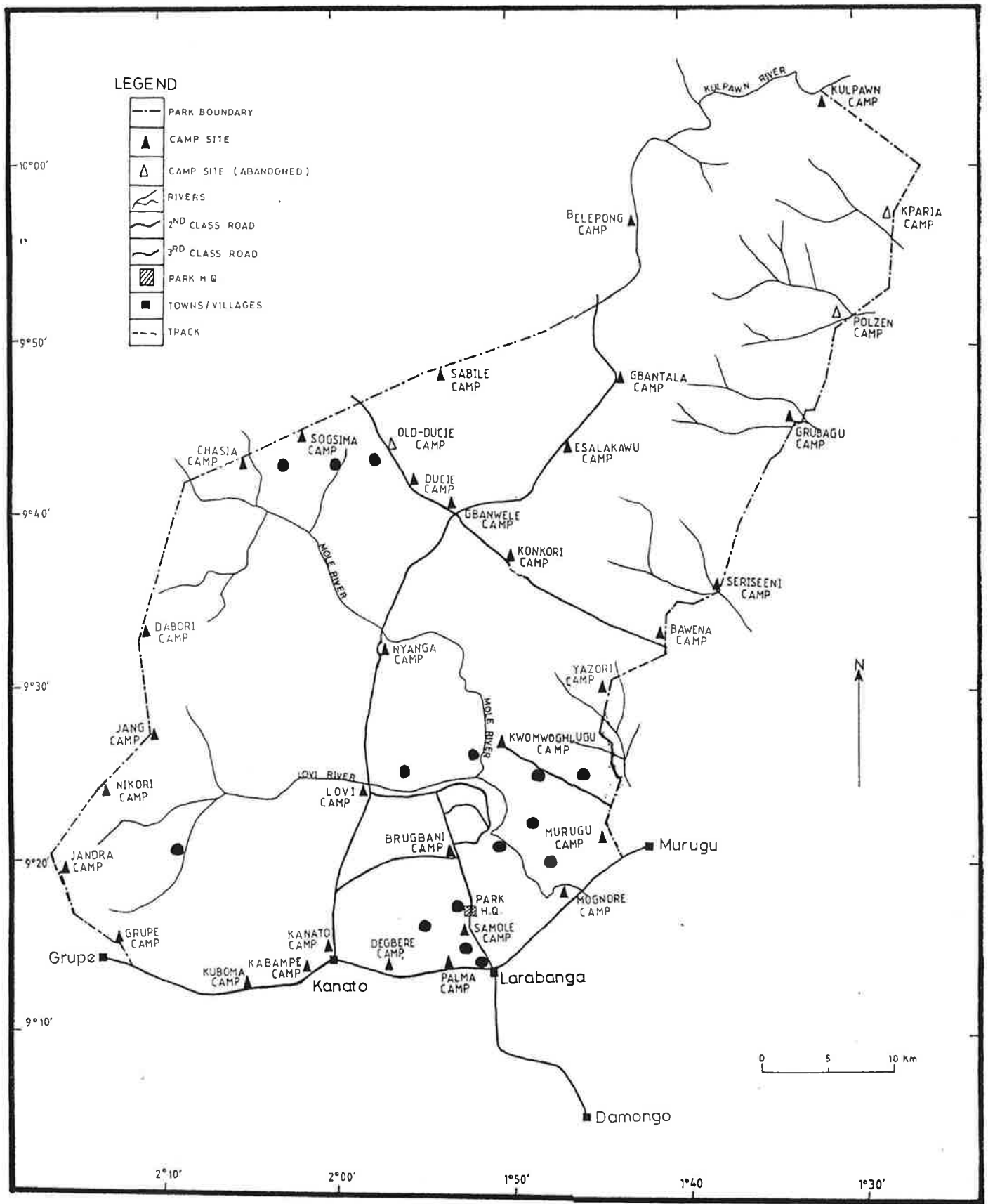
Considering that the transect from Headquarters to the Lovi River (Table 7) gave a population of 1 974 kob and that this figure excludes the animals around Asibey Pools and Kwomwgburgu and the Upper Mole River where at least another 200 (Area 2) plus 176 (Area 3) occur the population of the Mole National Park must be several thousand animals. As mentioned above the counts from the helicopter in Areas 2 and 3 must have missed many animals so therefore the kob population in the Mole National Park would be in the region of about 4 000 animals.

WESTERN HARTEBEEEST (Alcephalus buselaphus)

Hartebeest were very easy to see from the air and they nearly always ran as the noisy helicopter approached and flew overhead making counting comparatively easy. With the exception of Area 4 (Northern area), See Map 9, good populations of hartebeest were recorded from each of the other four areas covered and after calculations a figure of 1 631 animals was determined. (Table 10).

However, the largest population of hartebeest in the Park occurred in the area between Lovi Camp and Gbanwele where hartebeest were seen every time we travelled along the road and each time the actual transect was covered large numbers of hartebeest were seen. An average of 32 hartebeest was seen on each of the six times the transect was covered with a range of 17-52 animals. Calculations suggested a population of 2 919

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**MAP 8: Distribution of 15 Groups of Kob
(Aerial survey)**

hartebeest in this area alone.

Considering the fact that fair numbers of hartebeest also occurred in Area 1, and 5 where at least another 300 hartebeest were recorded, it is postulated that the hartebeest population in the Park must be between 4 000 and 5 000 animals and perhaps even more.

Hartebeest were definitely the commonest of the large mammals occurring in the Mole National Park and they also had the widest distribution. (See Map 9).

Hartebeest were found scattered throughout the Park and even in some of the very dry areas where no water whatsoever existed. Hartebeest is a species potentially independent of surface water. They were recorded in most habitat types with the exception of riverine vegetation, but preferred the dry savanna woodland. They were also found on dry laterite pans and flood plains, but only when the ground was dry and during the late dry season.

The Hartebeest is strictly a grazer and as a result it is one of the species that would be subject to protein deficiency and would suffer during the reduction in the availability of suitable grasses during the dry season. As a result the distribution of hartebeest is strictly limited by the availability of dry season growth of perennial grasses (de Bie, 1991). Bush fires are another important feature that helps determine the distribution of hartebeest in the Mole National Park. Early fires would therefore preserve the grass component and thus stimulate dry season growth of perennial grasses. Without fires the Guinea savanna would gradually change into a dry forest and the effect on hartebeest would be considerable. In fact the timing and intensity of bush fires are crucial for the preservation of the ungulate community and the presence and therefore abundance of hartebeest largely depends on the regular occurrence of fires.

de Bie (1991) has indicated that the savanna woodland and also the ungulate community should be regarded as a "fire-climax".

Therefore the long term absence of fires will certainly have a considerable effect on the populations of certain species: grazers would gradually disappear from the area while browsers would remain (de Bie, 1991).

The hartebeest in the Mole National Park has a strict calving season with a peak at the end of February when every herd located had one or more calves with them.

ROAN ANTELOPE (Hippotragus equinus)

Fifteen groups of Roan Antelope were recorded during the aerial survey with the greatest concentrate occurring along the Mole River. (See Map 10). Table 10 shows that a total population of 1 012 was calculated for the aerial survey with the largest

number being in Area 2 and Area 4. This was confirmed from results of the transect from Lovi Camp to Gbanwele which was covered on six occasions where a population of 1 958 roan was calculated. In fact roan was seen each time the transect was covered (six times) with an average of 22 animals and a range of 17 to 31 animals.

At least another 88 animals occurred in the Park Headquarters Brugbani-Lovi River area (see Table 7) and a good population existed around Asibey Pools.

TABLE 10 - WILDLIFE POPULATIONS CALCULATED
AS A RESULT OF AERIAL SURVEY

THE MOLE NATIONAL PARK

Species	Area 1	Area 2	Area 3	Area 4	Area 5	Total
Kob	9	200	205	0	367	781
Waterbuck	28	83	8	116	63	298
Baboons	73	94	53	29	41	241
Mini- Antelope	92	24	38	73	14	241
Warthogs	18	24	0	0	63	105
Buffalo	18	114	251	15	1 240	1 665
Hartebeest	147	741	554	44	145	1 632
Roan	120	306	152	203	131	1 012
Elephant	0	412	46	0	131	589
Bushbuck	18	0	87	29	0	55
Patas Monkeys	0	0	0	15	0	15

Taking all ground and aerial survey work into account, we believe that the roan population in the Mole National Park could possibly be in the region of about 3 000 animals.

The relative abundance of roan antelope in certain parts of the Mole National Park gave us the opportunity to collect additional data on feeding and breeding habits.

During the wet season the roan antelope, as with other grazing species, has several times more grass available to feed on than during the dry season especially after the bush fires have burnt off all the dry grass and much of the woody vegetation.

Woody plants, regardless of the phenological group, have higher crude protein levels through the year (de Bie, 1991) but the highest levels of crude protein are found when plants are sprouting (de Bie, 1991).

During the dry season roan antelope also move from the more hilly and plateau areas to the low-lying country where water is more readily available as they need to drink daily. This movement provides them with their daily requirements of water and at the same time they change their diet to become mixed feeders and thus consume large quantities of browse. Most of the year roan antelope are found in all types of woodland and scrub savanna but by the end of the dry season (February and March) they restrict their activities to the flood plains and areas where water is plentiful. However they are very adaptive and can certainly be classed as mixed feeders and can survive on both grasses and browse.

WATERBUCK (*Kobus ellipsiprymnus defassa*)

Only ten groups of waterbuck were seen from the air (Map 11) and they were definitely not as easy to spot as roan antelope and hartebeest. They also tended to stick closer to riverine vegetation and as a result were not that easy to see.

The aerial survey results gave a population of only 298 animals which is very much on the low side.

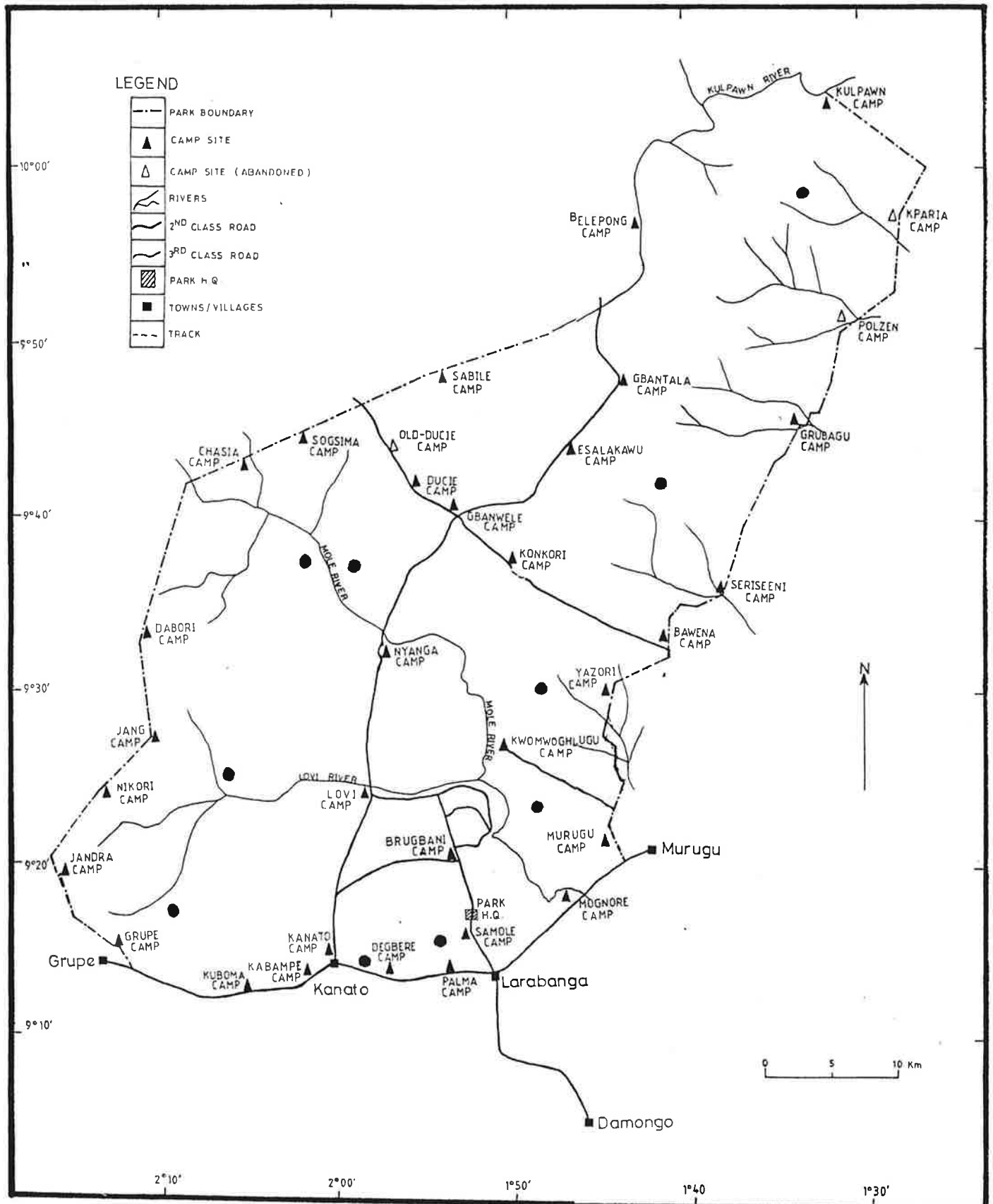
Then on the other hand the Park Headquarters to Lovi transect (Table 7) gave a population figure of 832 animals.

A very good population of waterbuck, perhaps the best concentration in the Mole National Park occurred in the Samole River area near the Park Headquarters where it is estimated that at least 1 500 animals were present.

The Lovi-Gbanwele Camp area supported another 445 animals (Appendix 2) and many groups also occurred in the Asibey/Kwomwolulu area - perhaps another 300-500 animals.

The total population of waterbuck in the Mole National Park would most probably be between 2 500-3 000 animals.

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MAP II: Distribution of 10 Groups of Waterbuck (Aerial survey)

BUFFALO (Syncerus caffer)

At a flying height of 130 metres and a strip width of 560 metres on the ground, it was possible to count almost every buffalo encountered as long as they were in small herds as they were very conspicuous and could very easily be counted. However it was much more difficult when very large groups of twenty or more were seen.

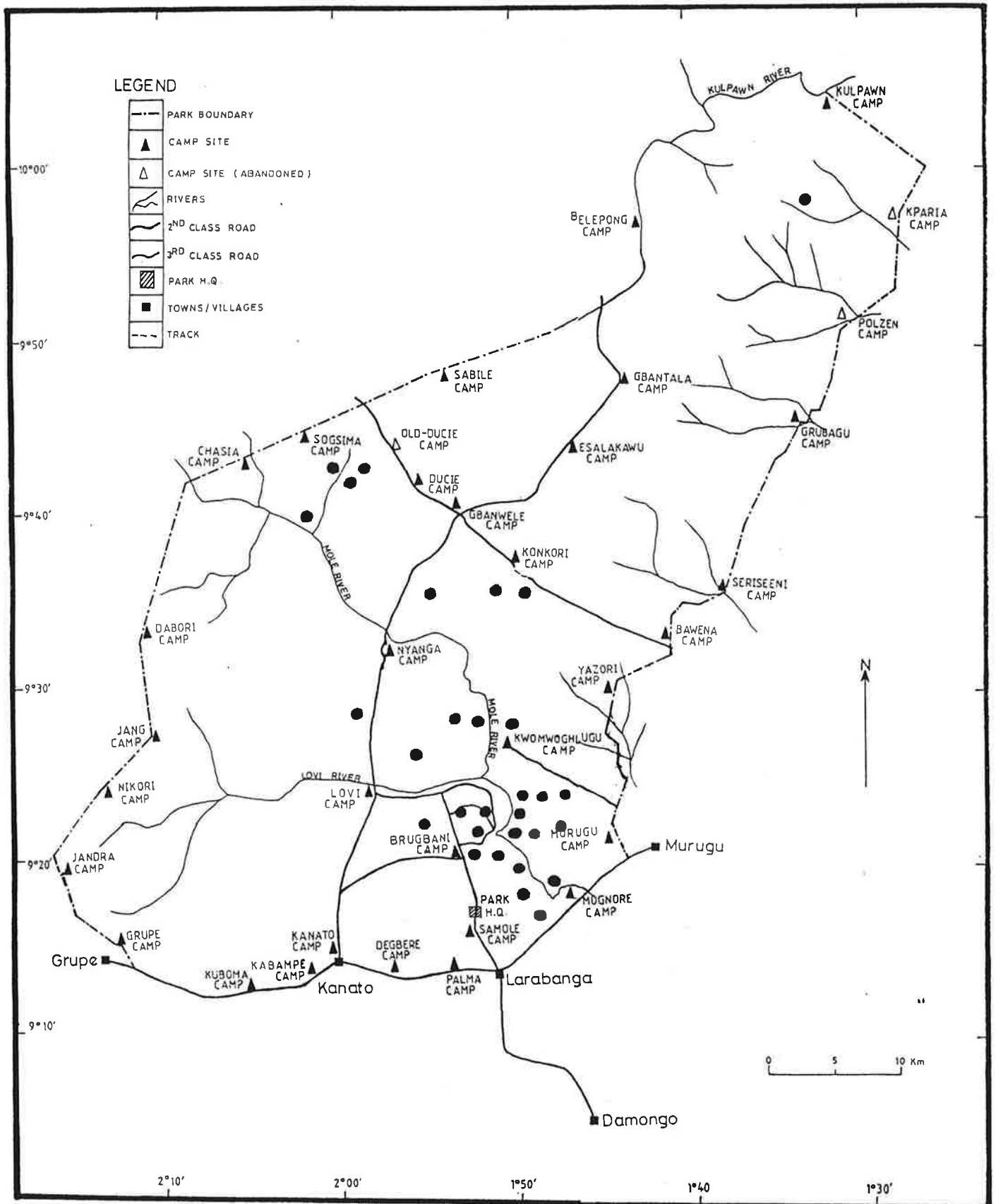
The aerial survey gave a total of 1 665 buffalo seen with all the large herds being recorded in Area Five and where there was an abundance of water. Herds of 22, 46, 38, 26 and 42 were recorded and on nine occasions single animals were encountered. (See Map 12).

In the large herd of 46 animals there were several buffalo which were distinctly brick-red in colour which is typical of the forest buffalo, while the majority were black. A single albino buffalo was also recorded in the same group.

As mentioned above it was difficult to count every buffalo in each large group especially when flying at a height of 130 and therefore the large herds mentioned above may have had more animals in them.

This would have affected the calculations and it is therefore assumed that the figure of 1 665 buffalo as given in Table 10 is certainly an under-estimate of the buffalo population in the Park. It is therefore postulated that the buffalo population in the Mole National Park would be in the region of about 3 000.

MOLE NATIONAL PARK - GHANA



MAP 12: Distribution of 30 Groups of Buffalo (Aerial survey)

6.2 POACHING AND "BUSH-MEAT"

In most places in West Africa, and Ghana in particular, wildlife is now hunted for economic reasons.

Originally hunting was for subsistence purposes but today this has developed into a very intensive and very often uncontrolled occupation. This no doubt has been brought about by the very high demand for "bush-meat" together with the growing human population. A decline in the traditional social structure and the lack of control by Chiefs has also helped this over-exploitation of the wildlife resources in Ghana. Wildlife regulations are now completely disregarded in view of the commercial value of "bush-meat".

However in the area surrounding the Mole National Park many of the animals killed are still used for subsistence purposes and the meat is used to feed the hunters family and other people in the villages. On the other hand commercial hunters still supply the various "bush-meat" markets to the south of Mole and especially those at Techniman and Kumasi.

The fragmentation of animal populations is often brought about by massive cultivation and use of the woodlands by cattle and by greater hunting pressure, and as a result contributes to the low animal numbers.

Traditional hunting still continues throughout Ghana and this subsistence hunting is one of the main pillars of the rural economy with at least 50% of animal protein coming from wildlife in rural areas.

The increased demand for land for cattle and arable agriculture coincides with the higher hunting pressure not only from the rural people, but also from commercial hunters coming from the urban areas. These latter people are often armed with modern equipment.

In much of northern Ghana and especially around the Mole National Park most of the larger mammals such as Roan, Waterbuck, Hartebeest and Buffalo have been exterminated and the only populations now left are in the protected areas.

As far as the Mole National Park is concerned it was in 1943 that the Paramount Chief moved to Damongo and naturally with him a large number of other people moved as well. As a result the village increased considerably and the local people hunted mainly to satisfy their own basic requirements.

Over the years, the hunting intensity increased and this came about as a result of the increase of modern weapons and to satisfy the great demand for "bush-meat".

Since the inception of the Mole National Park in 1958, poaching has always been a major problem and over the years vast numbers of animals have been removed from the area.

This has come about as the people living around the Park have traditionally depended on the area for their source of meat and also no doubt as a result of the Chief's control over tribal hunting ground having broken down. As a result, hunting in the surrounding country and poaching in the Park has continued unabated for decades.

The conservation efforts of the Department of Game & Wildlife have not been accepted by the local communities and when poachers are caught and taken to court, the fines have been so low that it has not acted as a deterrent at all.

During the period of our survey in the Mole National Park (January-March 1993), Mr. John Mason, a foreign Masters student working with the Social Economist team in the same area, produced a detailed list of animals which were poached in the Mole National Park. The figures which follow were given to him by the local hunters during interviews with him:

1. Elephant	-	1	7. Bushbuck	-	176
2. Roan Antelope	-	133	8. Duikers	-	237
3. Hartebeest	-	260	9. Buffalo	-	231
4. Waterbuck	-	235	10. Warthog	-	121
5. Kob	-	156	11. Monkeys	-	264
6. Oribi	-	127	12. Baboons	-	178

Some people with whom the matter was discussed believe that the figures quoted above are an under-estimate of the real situation that prevails in the Park because the figures were only given by those willing to contribute and Mason (1993) believes the poaching activities are far greater than the figures show.

On the other hand there are several Game & Wildlife Department staff who believe the situation is not as bad as the figures indicate because hunters all over the world boast how efficient they are and often exaggerate how many animals they have killed merely to try and impress others of how good they are. Also as hunters do not keep detailed records of their kills all figures given are purely guesses and not accurate in any way. In addition many of the animals may well have been shot outside the Park.

The figures given above apparently represent the number of animals killed in one year and I personally believe that if 260 hartebeest, 235 Waterbuck, 231 buffalo and 133 roan were removed by poaching in only one year, there would be very little, if nothing left at the present time, which is

clearly not the case.

The populations of large mammals in the Park could not possibly withstand that amount of take-off. Therefore, I certainly agree that poaching is indeed a very serious problem in the Mole National Park, but I also believe that far fewer animals are taken off each year than the above figures indicate. Hunting is not in any way a full-time occupation of any of the people in the area and there are far fewer good hunters than we expect.

However, the situation should be very carefully watched as poaching could have a disastrous effect on wildlife population and in no time the overall population could drop considerably and to a very low level. On the other hand, if the figures of poached animals are correct, then the population could not stand this high level of take off and in only a few years there will be very little left in the Mole National Park.

6.3 BURNING

There has been no burning policy in the Mole National Park for many years and the game rangers and other staff have automatically set fire to every patch of grass as soon as it was dry enough to burn. This also takes place in the surrounding country outside the Park and as a result "wild fires" soon spread into the Park. This type of random and complete burning has been going on for many years.

The Guinea savanna is a "fire sub-climax" vegetation and the entire ecosystem has developed over a long period of time by regular burning. Many of the trees have developed as a result of burning and have dense/heavy bark and are resistant to fires.

However it is also obvious that almost the entire Park is completely burnt out every year and during the present survey very few areas were found where the grass was not burnt.

During the aerial survey every minute of flying time Dr. J. Grainger recorded the amount of vegetation that was burnt and as a result of the survey it was found that approximately 74% of the Park was burnt and in some areas 100% of the area was burnt. This contributed to the good visibility during the survey but did not in any way help the wildlife populations.

On numerous occasions buffalo were seen from the air which appeared to be in very poor condition and it is obvious that this was due to starvation. In fact it is surprising how well the large antelope of the Park, e.g. Roan, Hartebeest, Oribi, Waterbuck have managed to survive during the dry season with so little grass about. (See Oribi, Roan Antelope and Hartebeest for details of feeding

behaviour).

However the early burning that takes place every year in the Mole National Park at the beginning of the dry season is at a relatively low temperature and as a result the woody plant species are able to hold their own and both fire sensitive and fire-climax grass species of the genus Hyperrhenia and Audropogan flourish.

On the other hand late fires which take place at the end of the dry season are often of very high temperature and these fires drastically affect the woody species and the fire-sensitive grasses. However the fire-climax grasses benefit from the late burns and as a result open savanna grasslands develop with dense stands of coarse grasses.

Fires have adverse effects on the wildlife populations which destroy their habitats and make them more vulnerable to predation. On the other hand it benefits several species by stimulating the growth of nutritious dry-season perennial grasses and the development of new leaves on woody species.

However heavy uncontrolled burning is very harmful not only to the wildlife species in the Park but to the soils and vegetation as well.

During the wet and early dry season grass-eating herbivore have three or four times more grasses to feed on, but as a result of bush-fires in the dry season the picture changes completely and as a result soon after the fires have swept through an area there is a lot more woody browse available than grass.

Therefore the change in the quality and species of plants available from season to season in the environment is most important from a nutritional point of view; and this in turn determines the long-term suitability of certain areas for sustaining permanent viable populations of grazing animals.

It is also important to note that during the dry season when much of the area is burnt semi-evergreen and evergreen woody plants and perennial grass along river beds and low lying areas keep their leaves or produce new growth, thus providing some food for the ungulates during a period of the year which is generally unfavourable for many species. Roan antelope is one good example.

In the dry season and after fires have burnt a great deal of vegetation grass-eating ungulates face a severe shortage of food, which has been reduced not only quantitatively, but qualitatively.

7. MAMMAL SPECIES OF SPECIAL INTEREST:

Mole National Park has good populations of many mammal species of special interest. For example good numbers of elephant, buffalo, Buffon's kob, Western hartebeest, Roan, Oribi and Red-flanked duikers occur. The existence of rare species of mammals in the Guinea savannah such as Yellow-backed duiker and Black and White Colobus monkeys is very important and every effort should be made to protect the riverine habitats in which these two species are found. The destruction of the riverine forest would obviously cause the extinction of these forest species in Mole National Park. Leopards, lions and hyaena are important large carnivores and as such constitute a major tourist attraction.

The buffalo population is also of great scientific interest since both black and red colour varieties of buffalo were seen from the air and also an Albino buffalo. Unfortunately a detailed small mammal survey was not carried out but the writer is of the opinion that several interesting species of bats and rodents are still to be found in the area. Detailed work on these groups is essential and the small carnivores also require additional attention.

8. DISCUSSION AND RECOMMENDATIONS:

The Mole National Park has a tourist potential of unbelievable importance.

The fact that the camp was nearly always full of visitors while we were in the area is an indication that people are willing to travel hundreds of kilometres to get to Mole, and in spite of the poor conditions at the Rest Camp and the very bad roads over which the visitors have to travel most people interviewed thoroughly enjoyed the experience.

The Government of Ghana will have to decide very quickly if it wishes to attract visitors to Ghana or not. People with foreign currency, especially those from the Western World, would willingly part with their money for the experience that can be obtained in the Mole National Park.

The Park is "wild" and not over-exploited but poaching is a major problem. It has good populations of elephants, buffalo, kob, waterbuck, hartebeest and roan and most species are easily seen from a vehicle. Bird life is also very good and a large variety of species can be seen.

The view from the main camp overlooking the waterhole is beautiful and the staff friendly and courteous. But facilities will have to be improved considerably and especially the swimming pool and the provision of an adequate supply of cold soft drinks, during the heat of the day. It really is not good enough to expect visitors to drink beer all the time which is always available at the bar, while cold soft drinks are hardly ever obtainable.

Funding will therefore have to be made available either by the Government or by donor agencies if Mole National Park is to attract visitors. A Curio shop is essential and so is a well designed Museum and Interpretive Centre. During the heat of the day visitors would spend a lot of time at the swimming pool and drinking cold drinks, looking at displays in an Interpretive Centre and Museum or purchasing items from a Curio shop. Others would merely look at wildlife as it comes down to the waterhole to drink.

However while all the above is very important the employment of a full-time ecologist and several assistants is a high priority. A proper fully equipped Research branch is essential.

Our brief survey of only three months has only scratched the surface and it is essential that wildlife populations are monitored and research projects and programmes implemented as soon as possible.

The Mole National Park is without doubt the premier National Park in Ghana and the only place in Ghana where large mammals can be seen in good numbers and certainly one

of the few places in West Africa where elephant can be seen at a waterhole. An ecologist with supporting staff, vehicles and equipment is therefore important and every effort should be made to employ someone without delay. The longer the Park is left without a full time ecologist the worse the situation will become and the more wildlife will be poached.

A good net-work of roads is also essential as this will enable the ecologist and management staff to move about more easily in the Park and will also help patrolling by vehicles and as a result curtail a lot of poaching.

As we showed during our brief survey old roads can very easily be re-opened and maintained at very little effort.

It is also suggested that another visitor's camp with a good infrastructure and additional staff be constructed in the very near future.

The present state of Government funding in the Mole National Park, the almost lack of infrastructure in the Park (other than at the Park Headquarters), the lack of confidence of the local rural population in the staff of the Game & Wildlife Department, the lack of vehicles and equipment, the very poor roads and finally the total lack of supervision of junior staff by the senior wardens of the Mole National Park indicates that something is drastically wrong with the system which therefore requires urgent re-organisation.

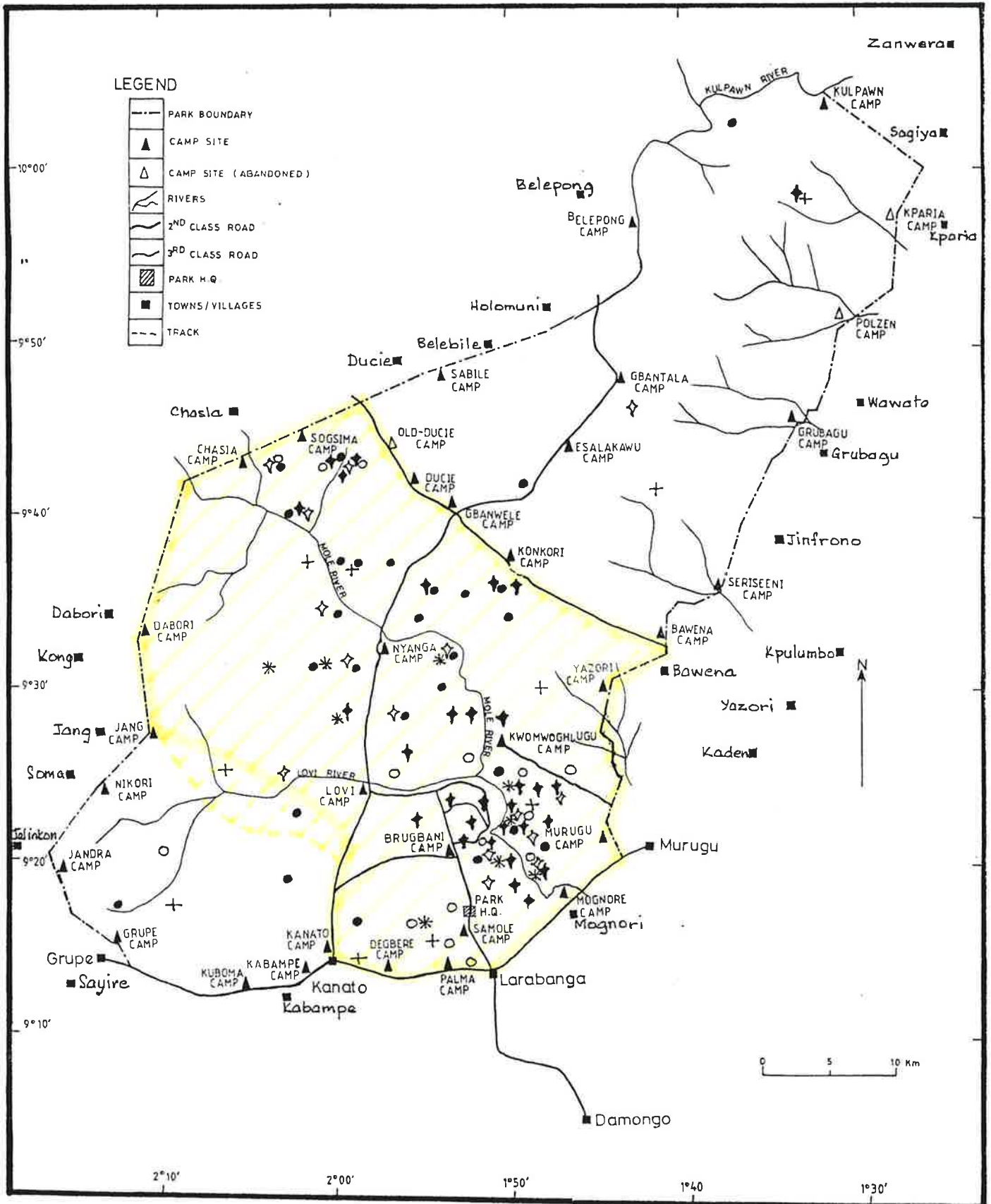
The aerial survey of the Mole National Park together with ground work has very clearly and definitely located the areas of major populations of the large ungulates in the Mole National Park and this can be seen from Map 13, which shows the areas where all aerial sightings of kob, hartebeest, elephant, roan, buffalo and waterbuck were located.

This data cannot be ignored and no matter how much more detailed work is required in the future, Map 13 clearly shows the position as it is today.

With the exception of a few small hartebeest herds, the odd waterbuck, small numbers of kob and a few other animals all the large species and more than 95% of the total wildlife population is distributed within the central section of the Park. (See Map 13). No elephant were seen outside this central area and 99% of the buffalo were also found along or near the Mole River, with its permanent pools of water and riverine vegetation which is essential for the survival of most species.

Looking at the distribution of the Game Rangers camps (Map 13) and the areas where wildlife is concentrated it is obvious that more than 50% of the Game and Wildlife staff

MOLE NATIONAL PARK - GHANA



- | | | | |
|------------|---------------|------------|-----------|
| ◇ 15 HERDS | ROAN ANTELOPE | + 10 HERDS | WATERBUCK |
| ● 27 HERDS | HARTEBEEST | * 9 HERDS | ELEPHANT |
| ▲ 30 HERDS | BUFFALO | ○ 15 HERDS | KOB |

BY: DAVID ANNOHENE G.W.D./I.U.C.N. ACCRA JULY, 1993

MAP 13 : PROPOSED CORE AREA AND DISTRIBUTION OF LARGE MAMMALS.

are patrolling in areas where there is little or no wildlife left.

This is particularly the case with Game Ranger camps at Kulpawn, Belepong, Gbantala, Sabile, Kparia, Polzen, Grubagu, Seriseeni, Esalokawa, Kabampe, Kuboma, Grupe, Jandra, Nikori, Jang and Dabori. In fact some of these camps do not even have staff in them at all.

While detailed and statistical analysis of Wildlife populations is very important to scientists and people sitting well away from the area of operation basic data easily read and interpreted is essential for people on the ground and those actually working in the field. Therefore this report contains the minimum of complicated calculations and an attempt has been made to present the report in such a way that we hope all the field staff at the Mole National Park request a copy of it.

: MY RECOMMENDATIONS FOR THE MOLE NATIONAL PARK :
: ARE AS FOLLOWS :

1. CORE AREA

A well planned strategy is essential and the zoning of the Mole National Park into various management zones is very important.

The highest priority as I see it is the recognition that a "Core area" is necessary. We have already shown in Map 13 where the "Core area" should lie. The "Core area" should have the highest ecological potential in the Park and should obviously be within the boundaries of the present Park.

The "Core area" should meet the requirements of all the large mammals in the Park (as it already does at the present time) and be able to support the large numbers of animals during the dry season, which it also does at present.

The "Core area" requires very strict protection and therefore should be managed efficiently and great concentration should be placed on that area. At a later stage, and as wildlife populations increase and move out of the "Core area" into the south-west and north of the Park so new and additional programmes can be implemented.

While the concentration of management activities in the "Core area" should include anti poaching patrols, research, road and camp development etc., these activities should not reduce the value of the Park as a whole. The reason for the "Core area" is to protect

what wildlife populations there are at the present time and to develop additional facilities for visitors so they enjoy and pay for the experience of viewing West African species in a wilderness area.

The boundaries of the "Core area" need not necessarily be as I have shown them on Map 13 and these could be changed or varied according to local demand or circumstances especially in the area between Kanato - Lovi - Jang camps, however a "Core area" is essential if the wildlife is to be protected from the dangers of poachers now operating (without fear) in the Mole National Park.

It should also be remembered that while the highest priority should be the patrolling of the "Core area" the north and south-west of the Park should not be abandoned and the presence of Game Rangers patrolling in those areas is still very important.

2. DISTRIBUTION OF CAMPS AND STAFF

A very close and detailed look should be made of all the camps and staff in the Mole National Park. It will be necessary that new camps be built along the boundaries of the "Core area" and some staff moved from the south-western corner and the north of the Park to the "Core area" where the majority of the staff should be working. New camps will definitely be required along the Lovi-Jang road and also between Kanato and Lovi. Some problems will no doubt be encountered regarding sites with sufficient water for the staff but with careful planning and a good road system this could be overcome. Well constructed camps are essential if good staff are to continue to work in the Game & Wildlife Department and new ones be attracted to the service.

3. ROADS

Without a good network of roads it will not be possible to patrol the "Core area" properly and it will also not be possible for the senior staff at Samole Park Headquarters to get to the various camps. It is essential that the senior staff get out into the field as often as possible in order to visit the staff. This is not being done at all at the present time.

A considerable amount of funding is therefore required for road and causeway construction and external or donor funding is essential for this programme to be implemented. It may even be possible to get the services of the National Army to participate in a programme of this nature or perhaps even the American army.

Good roads are required throughout the "Core area" and

also a major road from Kanato to Gbanwele. This Kanato/Gbanwele road could be developed as a major feeder road.

4. MOTOR CYCLES

It would be of considerable benefit to everyone if a number of motor cycles could be made available (as has already been done recently) for the staff of the "Core area". Together with fairly good roads it will be much easier for staff to get from one camp to another and as a result of the increased activity along the roads in the "Core area" poaching will obviously be a lot less than it is at present.

Again this is an area where funding agencies can be asked for help.

5. NEW VISITORS CAMP

An additional Visitors camp for the Mole National Park is required. This camp needs to be of a more "rustic" nature and should not have major developments such as a large restaurant, swimming pool and expensive accommodation. It need not even have electricity.

The "bush-camp" as it can be referred to can consist of a series of stone buildings in which visitors can sleep and cook their own food. Each "hut" could be fully equipped with the necessary furniture and cooking/eating utensils and a small shower. Not much more is necessary.

One of the best sites for such a camp could be at Gbanwele on the top of the high ridge overlooking the plain below. The main access route could be through Wa and Ducie. During the dry season, and at a time when the area is dry and when many people visit the Mole National Park the main route could be direct from Kanato via Lovi and Nyanga to Gbanwele.

Not only would this "bush-camp" provide additional accommodation for visitors it would also help by the presence of people to reduce the possibility of poaching. It would open up the Park a lot more and at the same time develop the north end of the "Core area" into a larger settlement. In other words the northern headquarters of the Park could be developed with the presence of a Senior Warden and the necessary vehicles etc.

6. RESEARCH UNIT

It is quite unbelievable that the premier National Park in Ghana and the area of the greatest wildlife concentration and potential in the country does not have

an active and resident wildlife ecologist.

Here we are 36 years after independence sitting with a fantastic natural resource in the form of large wildlife populations completely neglected due to lack of funding. The potential of the Mole National Park with its spectacular elephant population is unlimited and could earn the country millions of U.S. dollars per year. However a re-look at the priorities of the Department of Game & Wildlife is necessary.

A Research Biologist/Ecologist and a small team of assistants is essential. The Department of Game & Wildlife already has many well qualified and dedicated Biologists on its staff who spend all their time undertaking administrative duties and as a result no field research whatsoever is carried out.

Projects which could be undertaken by one of the existing staff is unlimited and there is absolutely no point now in producing a list of projects to be done, when this can be decided and discussed once a person is employed.

Ghana has well qualified people. There is no necessity whatsoever of employing expatriate biologists when the job can quite easily be done by locals. Initiative and enthusiasm are the only ingredients for a successful operation.

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APPENDIX 1 - MAMMALS SEEN ON AERIAL COUNT

AREA ONE: (SEE MAP 5)

3rd March 1993 (Afternoon) - Area 949 km² (6 Transects,
Total 168.8km)

Observers

Transect	Time	Species	Wilson	Kpelle
No. 1 (25.8 km)		Baboons	Troop	-
		Mini-Antelope	1	-
		Baboons	Troop	-
		Mini-Antelope	-	1
		Mini-Antelope	1	-
		Mini-Antelope	2	-
No. 2 (29.2 km)		Baboons	Troop	-
		Waterbuck	-	1
		Mini-Antelope	1	-
		Hartebeest	11	-
No. 3 (30.2 km)	3:46pm	Hartebeest	3	-
		Mini-Antelope	-	1
		Baboons	Troop	-
		Warthog	-	2
		Baboons	Troop	-
No. 4 (30.2 km)		Mini-Antelope	-	1
		Kob	-	1
		Baboons	-	Troop
No. 5 (27.3 km)		Mini-Antelope	2	-
		Baboons	Troop	-
		Hartebeest	2	-
		Baboons	-	Troop
No. 6 (26.1 km)	4:20pm	Roan	12	-
		Waterbuck	-	2
		Bushbuck	1	-
		Buffalo	2	-
		Bushbuck	-	1

SUMMARY OF ANIMALS SEEN:

Baboons	8 Troops	Buffalo	2
Mini-Antelopes	10	Roan	12
Bushbuck	2	Kob	1
Hartebeest	16	Warthog	2
Waterbuck	3		

APPENDIX ONE (CONTINUED)

AREA TWO (SEE MAP 5)

4th March 1993 (Morning) - Area 1 058 km² (6 Transects,
Total 164 km)

Transect	Time	Species	Observers	
			Wilson	Kpelle
No. 1 (22.9 km)	8.21am	Buffalo	-	1
	8.25	Buffalo	-	1
	8.26	Buffalo	-	1
	8.27	Baboons	Troop	-
	8.27	Roan	-	10
	8.28	Kob	-	3
	8.29	Hartebeest	-	1
		Baboons	-	Troop
		Hartebeest	9	-
		Roan	-	1
		Baboons	Troop	-
	8.31	Mini-Antelope	-	1
	8.32	Kob	-	12
		Warthog	-	2
8.33	Kob	-	2	
No. 2 (28.0 km)	8.38	Mini-Antelope	-	1
	8.41	Buffalo	-	1
	8.46	Roan	-	6
		Hartebeest	2	-
		Baboons	Troop	-
No. 3 (29.0 km)	8.54	Hartebeest	2	-
		Baboons	Troop	-
	9.01	Waterbuck	-	6
		Hartebeest	-	18
		Waterbuck	1	-
		Hartebeest	3	-
	Baboons	-	Troop	
No. 4 (28.6 km)	9.08	Hartebeest	-	16
	9.21	Roan	8	-
	9.26	Baboons	Troop	-
No. 5 (25.7 km)	9.35	Hartebeest	-	1
	9.37	Elephant	-	2
	9.38	Hartebeest	11	-
	9.39	Roan	-	1
	9.40	Elephant	1	-

AREA TWO (Continued)

Transect	Time	Species	Observers	
			Wilson	Kpelle
No. 6	9.53	Elephant	-	32
(23.3 km)	10.02	Buffalo	-	8
	10.11	Baboons	-	Troop

SUMMARY OF ANIMALS SEEN

Buffalo	12	Baboons	8 Troops
Roan	26	Kob	17
Hartebeest	63	Mini-Antelopes	2
Elephant	35	Warthog	2
Baboons	8 Troops	Waterbuck	7
Kob	17		

APPENDIX ONE (CONTINUED)

AREA THREE: (SEE MAP 5)

4th March 1993 (Afternoon) - Area 722 km² (7 Transects,
Total 173 km)

Transect	Time	Species	Observers	
			Wilson	Kpelle
No. 1 (17.0 km)	3.55pm	Buffalo	-	1
	3.57	Buffalo	-	1
	4.01	Hartebeest	-	5
	4.02	Buffalo	-	2
		Hartebeest	11	-
		Mini-Antelope	3	-
		Hartebeest	5	-
No. 2 (23.6 km)	4.06	Baboon	Troop	-
		Mini-Antelope	1	-
		Elephant	6	-
		Hartebeest	-	8
		Mini-Antelope	-	1
		Hartebeest	16	-
No. 3 (29.4 km)	4.13	Roan	-	11
		Hartebeest	5	-
		Baboons	Troop	-
	4.18	Mole River	-	-
		Baboons	Troop	-
No. 4 (25.3 km)	4.26	Hartebeest	7	-
	4.31	Waterbuck	-	1
		Baboons	-	Troop
No. 5 (25.3 km)	4.42	Roan	9	-
		Baboons	-	Troop
		Buffalo	-	18
		Buffalo	-	4
		Hartebeest	-	16
		Buffalo	-	2
		4.45	Baboons	Troop
	No. 6 (25.4 km)	4.49	Kob	-
4.53		Kob	-	15
		Buffalo	5	-
		Baboons	Troop	-

AREA THREE (Continued)

Transect	Time	Species	Observers	
			Wilson	Kpelle
No. 7		Bushbuck	-	1
(15.8 km)		Kob	-	6

SUMMARY OF ANIMALS SEEN:

Buffalo	33	Roan	20
Hartebeest	73	Kob	27
Mini-Antelopes	5	Bushbuck	1
Baboons	7 Troops	Waterbuck	1
Elephant	6		

APPENDIX ONE (CONTINUED)

AREA FOUR: (SEE MAP 5)

5th March 1993 (Morning) - Area 1 608 Km² (7 Transects,
Total 203.4 km)

Transect	Time	Species	Observers	
			Wilson	Kpelle
No. 1 (21.7)	8.39	Hartebeest	Troop	1
No. 2 (28.9 km)	8.46	Baboons	Troop	-
	8.47	Buffalo	-	1
	8.56	Waterbuck	-	2
No. 3 (27.2 km)	9.12	Mini-Antelope	-	1
No. 4 (29.3 km)		Nil		
No. 5 (45.2 km)	10.28	Baboons	Troop	-
		Roan	-	14
No. 6 (31.0 km)	10.49	Mini-Antelope	-	1
	10.58	Mini-Antelope	-	1
		Hartebeest	-	2
		Waterbuck	-	6
No. 7 (20.1 km)	11.04	Mini-Antelope	2	-
		Patas Monkeys	Troop	-
		Bushbuck	-	2

SUMMARY OF ANIMALS SEEN:

Bushbuck	2	Waterbuck	8
Hartebeest	3	Mini-Antelopes	5
Baboons	2 Troops	Roan	14
Buffalo	1	Patas Monkeys	1 Troop

APPENDIX ONE (CONTINUED)

AREA FIVE: (SEE MAP 5)

6th March 1993 (Morning) - Area 676 km² (12 Transects,
Total 271,3 km)

Transect	Time	Species	Observers	
			Wilson	Kpelle
No. 1 (10.8 km)	9.45	Mini-Antelopes	-	1
No. 2 (10.9 km)	9.52	Buffalo	-	22
	9.54	Hartebeest	-	18
	9.54	Elephant	17	-
		Buffalo	3	-
	9.55	Baboons	-	Troop
	9.58	Buffalo	-	1
	10.00	Mini-Antelope	-	1
	10.00	Kob	-	3
	10.02	Kob	17	-
No. 3 (27.7 km)	10.06	Buffalo	-	1
		Waterbuck	-	2
		Buffalo	5	-
		Roan	7	-
		Buffalo	3	-
		Baboons	Troop	-
No. 4 (27.7 km)	10.19	Buffalo	-	46
	10.21	Buffalo	-	38
		Kob	-	6
		Buffalo	12	-
		Elephant	6	-
	10.23	Hartebeest	-	8
		Buffalo	-	5
		Roan	4	-
		Baboons	-	Troop
		Buffalo	11	-
No. 5 (28.9 km)	10.31	Hartebeest	-	1
		Baboons	-	Troop
	10.32	Buffalo	-	26
		Roan	7	-
		Kob	17	-
		Warthog	4	-
		Baboons	-	Troop
		Warthog	-	4
		Warthog	-	2
	10.38	Buffalo	-	42

AREA FIVE: (Contd).

Transect	Time	Species	Observers	
			Wilson	Kpelle
No. 6 (28.1 km)	10.41	Kob	-	7
		Roan	-	14
		Buffalo	7	-
		Elephant	2	-
		Baboons	Troop	-
		Hartebeest	2	-
No. 7 (27.2 km)	10.54	Roan	-	8
		Mini-Antelope	-	1
		Baboons	-	Troop
		Elephant	3	-
		Buffalo	12	-
No. 8 (25.4 km)	11.07	Buffalo	-	36
		Roan	11	-
		Baboons	Troop	-
No. 9 (24.2 km)	11.18	Kob	-	2
		Buffalo	4	-
No. 10 (22.0 km)	11.27	Kob	14	-
		Hartebeest	3	-
		Elephant	1	-
No. 11 (20.0 km)	11.32	Waterbuck	7	-
		Warthog	4	-
		Kob	11	-
No. 12 (18.4 km)		Kob	4	-
		Baboons	Troop	-
		Waterbuck	5	-

SUMMARY OF ANIMALS SEEN:

Kob	81	Warthogs	14
Waterbuck	14	Buffalo	274
Baboon	9 Troops	Hartebeest	32
Mini-Antelopes	3	Roan	51
		Elephant	29

APPENDIX 2 - POPULATION OF LARGE MAMMALS
RECORDED ON LOVI-NYANGA-GBANWELE TRANSECT
(ROAD STRIP COUNT) SEE TABLE 4

SIZE OF TOTAL AREA = 1 058 KM² AREA 2
+ $\frac{722 \text{ KM}^2}{1\ 780 \text{ KM}^2}$ AREA 3

LENGTH OF TRANSECT = 40.0 KM

WIDTH OF STRIP CENSUSED = 0.5 KM

FORMULA = $D = \frac{N}{L \ W}$

D = Density, animals per sq. kilometre.

N = Number of animals observed per transect.

L = Length of transect (kilometres).

W = Estimated width of strip censused (250 metres on either side of road)

Buffalo $D = \frac{N}{L \ W} = \frac{2.7}{40.0 \times 0.5} = 0.135 \times 1\ 780 = 240.3$
Buffalo population = 240 animals.

Elephant $D = \frac{N}{L \ W} = \frac{1.7}{40.0 \times 0.5} = 0.085 \times 1\ 780 = 151.3$
Elephant population = 151 animals.

Oribi $D = \frac{N}{L \ W} = \frac{5.2}{40.0 \times 0.5} = 0.26 \times 1\ 780 = 462.8$
Oribi population = 463 animals.

Red-Flanked Duiker $D = \frac{N}{L \ W} = \frac{3.2}{40.0 \times 0.5} = 0.16 \times 1\ 780 = 284.8$
Red-Flanked Duiker population = 285 animals.

Crowned Duiker $D = \frac{N}{L \ W} = \frac{4.8}{40.0 \times 0.5} = 0.24 \times 1\ 780 = 427.2$
Crowned Duiker population = 427 animals.

Hartebeest $D = \frac{N}{L \ W} = \frac{32.8}{40.0 \times 0.5} = 1.64 \times 1\ 780 = 2\ 919.2$
Hartebeest population = 2 919 animals.

Roan $D = \frac{N}{L \ W} = \frac{22.0}{40.0 \times 0.5} = 1.1 \times 1\ 780 = 1\ 958$
Roan population = 1 958 animals.

APPENDIX 2 (CONTINUED)

Waterbuck $D = \frac{N}{L W} = \frac{5.0}{40.0 \times 0.5} = 0.25 \times 1\ 780 = 445$
 Waterbuck population = 445 animals.

Warthog $D = \frac{N}{L W} = \frac{6.5}{40.0 \times 0.5} = 0.33 \times 1\ 780 = 587.4$
 Warthog population = 587 animals.

Bushbuck $D = \frac{N}{L W} = \frac{1.5}{40.0 \times 0.5} = 0.08 \times 1\ 780 = 142.4$
 Bushbuck population = 142 animals.

APPENDIX 3 - POPULATION OF LARGE MAMMALS
 RECORDED ON HEADQUARTERS - 9 KM DRIVE - BRUGBANI-
 LOVI RIVER TRANSECT
 (ROAD STRIP COUNT) SEE TABLE 5.

SIZE OF AREA = 676 KM²

LENGTH OF TRANSECT = 23.4 KM

WIDTH OF STRIP CENSURED = 0.4 KM

FORMULA: $D = \frac{N}{L W}$

D = Density, animals per sq. kilometre.

N = Average number of animals observed on transit.

L = Length of transect (per Kilometre).

W = Estimated width of strip censused (0.2Km on either side of the road)

Buffalo $D = \frac{N}{L W} = \frac{0.4}{23.4 \times 0.4} = 0.04 \times 676 = 27.04$
 Buffalo population = 27 animals.

Elephants $D = \frac{N}{L W} = \frac{2.4}{23.4 \times 0.4} = 0.26 \times 676 = 175.76$
 Elephant population = 176 animals.

Hartebeest $D = \frac{N}{L W} = \frac{1.9}{23.4 \times 0.4} = 0.20 \times 676 = 135.2$
 Hartebeest population = 135 animals.

Roan $D = \frac{N}{L W} = \frac{1.2}{23.4 \times 0.4} = 0.13 \times 676 = 87.88$
 Roan population = 88 animals.

Oribi $D = \frac{N}{L W} = \frac{1.4}{23.4 \times 0.4} = 0.15 \times 676 = 101.4$
 Oribi population = 101 animals

Red-Flanked Duiker $D = \frac{N}{L W} = \frac{1.2}{23.4 \times 0.4} = 0.13 \times 676 = 87.88$
 Red-Flanked Duiker population = 88 animals.

Crowned Duiker $D = \frac{N}{L W} = \frac{0.5}{23.4 \times 0.4} = 0.05 \times 676 = 33.8$
 Crowned Duiker population = 34 animals.

APPENDIX 3 (CONTINUED)

Waterbuck $D = \frac{N}{L W} = \frac{11.6}{23.4 \times 0.4} = 1.23 \times 676 = 831.48$

Waterbuck population = 832 animals.

Bushbuck $D = \frac{N}{L W} = \frac{0.5}{23.4 \times 0.4} = 0.05 \times 676 = 33.80$

Bushbuck population = 34 animals.

Warthog $D = \frac{N}{L W} = \frac{6.9}{23.4 \times 0.4} = 0.74 \times 676 = 500.24$

Warthog population = 500 animals.

Kob $D = \frac{N}{L W} = \frac{27.3}{23.4 \times 0.4} = 2.92 \times 676 = 1973.92$

Kob population = 1 974 animals.
