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SURVEY OF THE WILDLIFE RESOURCE IN THE
BIA RIVER AREA
SEWU DISTRICT, GHANA.

by:-

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ABSTRACT

To initiate management of the wildlife resource in the Western Region, a preliminary survey was carried out in the Bia River area in early 1971. The major concerns of the study were the status of rare species, principally the Pygmy Hippopotamus (Chloropsis liberiensis), the status of the important bushmeat species, the importance of bushmeat as a source of protein in the area, and the problem of farm raiding by elephants. The study area covered 1,120 square miles of semi-deciduous Rain Forest, with a rich fauna of 35 species of larger mammals. Five separate studies were carried out, using walking transects to collect information on wildlife and land use. Interviewing the local people also provided some valuable information, as did discussions with other Government Departments.

No evidence was found of the Pygmy Hippo, but other rare species, i.e. Red Colobus, Olive Colobus, Diana Monkey and Chimpanzee were found. These species occur in low numbers and give some cause for concern. The species important in the bushmeat trade were found in the greatest numbers in the Bia-Tawya area. The two other major study areas supported wildlife numbers which were only 5% and 13% of those in Bia-Tawya. Ungulates, the most important bushmeat species, were only 4% and 7% respectively; indicating that over-hunting is seriously reducing wildlife populations in most areas. Other factors, especially other land uses, also affect wildlife and are discussed.

Elephants occur in the southern portion of the area and are a major problem due to their habit of raiding farms. A high concentration was found in Bia Trib. South F.R. near Adjuafua. Elephants also occur in the Sukusuku and Bia-Tawya areas, though in lower numbers.

Those in Sukusuku reportedly raid farms in the Niablé area in Ivory Coast and extensive raiding occurs in the eastern portion of the Bia-Tawya. The cost of elephant damage was estimated at 15,000.00 to 20,000.00 N ₣ per annum.

Land use in the area, as it relates to wildlife problems, is also discussed. Bushmeat production is discussed at a form of land use. Alternatives for dealing with the elephant problem are suggested. Opportunities for blending compatible land uses and means of dealing with incompatible land uses are discussed, as they relate to wildlife problems.

It is recommended that the Krokosua Hills should be given strict protection in the form of status as a National Park, in order to protect the rare species and develop the tourist potential of the area. It is further suggested that the presently undeveloped south portion of the study area be given status as a Game Production Area in order to control bushmeat production and put it on a sustained yield basis. Such an area would also provide long term habitat protection and control hunting so that the survival of rare species would be assured. Since the forest in the Krokosua Hills is non-economic, and since forestry and bushmeat production are compatible in the southern area, these suggestions are generally compatible with established land uses in the area and therefore provide an exceptional opportunity for establishing intelligent management of the wildlife resource.

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Distribution

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INTRODUCTION

Wildlife in Ghana is a resource of major importance. Since ancient times it has been an important source of protein. However, with the development of the country, problems concerning wildlife have intensified to a point where management to conserve the resource is necessary.

This study is the beginning of an inventory of the wildlife resource and the major wildlife problems of the country. It is the first assignment of a young unit of the Department of Game and Wildlife: called The Wildlife Resources Survey Unit. Having developed and agreed on the basic technique for the general faunal survey for Ghana, based on work in Mole National Park (then a Game Reserve), this work was begun in the Western Region of Ghana with special emphasis on the basin of the Bia river. This area was chosen as being of primary importance for the following reasons:-

(i) Interest in endangered species of the high forest area, especially in the Pygmy Hippopotamus, (Choeropsis liberiensis) shown by the Fauna Preservation Society of Britain since 1960.

In 1967, the society, besides supporting the training of Rangers in Tanzania, provided tents and camp beds which I considered to be the basic requirements for a survey to find out whether any Pygmy Hippopotamus still exists in the Bia basin. With the return of the trained rangers and the equipment still kept for the operation, it was essential to carry out the exercise.

(ii) Since 1963, it had been found that a high forest Game Reserve to be developed into a National Park, was necessary for Ghana, to contain Chimpanzees (Pan troglodytes) which are getting rare, as well as monkeys like Green Colobus (endangered) Black Colobus, Red Colobus and Diana Monkey. An area in which a population of elephants could be preserved was also of importance.

To the north of the Bia basin farming activities, coupled with timber operations, had created serious elephant control problems. Hunters camped in the Forest Reserves poached the elephants and drove them out into the surrounding farmland. There they soon acquired a taste for farm produce. In 1963, the chief of Goaso District refused to believe that elephants would turn also to feeding on cocoa. They assured me that they have lived with the elephants so far without trouble and could not believe that this would change.

Agricultural produce is now being damaged and of late the elephants have taken to eating cocoa pods in the Coaso area. Farming is being done right up to the boundary lines of the forest reserves, the remaining pockets of forest now seem too small to contain the elephants.

It is considered necessary to set aside a large tract of the forest as reserve to protect the elephants while the Department does heavy control shooting elsewhere in the area. Besides preserving a tropical rain forest which will be of ecological importance for present and future generations, the area to be reserved could also contain a viable elephant population. This is necessary to avoid the possibility that as more and more land is brought under cultivation, and with intensified lumbering in the small remaining forest reserves, the Department will be compelled to eradicate the animals; or their habitat will be so reduced that they will die out or leave the area for lack of suitable habitat.

(iii) The economic importance of the rain forest has so far been measured in terms of timber production and agricultural produce. There is however, local knowledge of the economic importance of fauna as a source of food and income though this is not acknowledged at the national level. Since fauna is not viewed as property of individuals to be managed carefully in its exploitation, but as communal or collective property, to be exploited while the going is good, it is necessary for government to ensure that this resource is properly managed. Given such a collective property vested in the Central Government, it is the responsibility of the Department of Game and Wildlife to set cash value on the wildlife of the area and thereby establish wildlife utilization as another form of land use in the rain forest; "cash value" since the present pattern of land use in the area is based on cash economy.

Consequently it was considered necessary to ensure that the faunal survey necessitated by problems (i), (ii) and (iii) above be expanded to cover land use and economic factors upon which a realistic decision can be made by the Government. Experience had shown that the fauna of the area were heavily used as a protein source and until just about a decade ago the area between River Bia and the Ivory Coast was largely a hunting ground with tapping of rubber, but little agricultural activity. The sale of bushmeat and monkey skins was a major source of income in the area at that time. I still have a black colobus monkey skin given to me by my father who once traded in the skins from that area.

In view of all these the survey team under the leadership of Mr. Bob Jamieson was assigned the duty of:-

- (i) establishing whether or not the Pygmy Hippopotamus still occurred in the Bia basin;
- (ii) investigating the present status of all major fauna of the basin;
- (iii) investigating the major factors affecting wildlife (wild animals and their habitat);
- (iv) assessing the economic importance of bushmeat in the area;
- (v) investigating the land use in the area in relation to its effects on wildlife;
- (vi) making proposals concerning wildlife management in the area.

E.O.A. Asibey
Chief Game & Wildlife Officer.

Samole
13/3/72

METHODS

Throughout the study area, farmers and hunters were questioned concerning the wildlife of the area. Though information collected in this manner has obvious limitations, this method was extremely useful in selecting areas in which to concentrate our work, and in establishing the economic importance of wildlife in the area.

In areas of special importance, A Technical Officer, a Game Scout and a local guide walked line transects through the area. The officer recorded information on topography, vegetation, evidence and sightings of wildlife, and any other relevant information. Separate studies were carried out in each of the following areas:

Bia Trib. North F.R.

Bia Trib. South F.R.

Sukusuku Proposed F.R.


Krokosua Hills F.R.

Bia-Tawya Proposed F.R.

Each of these areas are indicated in Figure 1.

In the study of land use, the facilities of the various Government Departments concerned with the resources of the area were used, primarily those of the Departments of Forestry and Agriculture.

One Ass't Game Warden, 5 Technical Officers, and eight lower grade staff were involved in the project. A total of three months was spent in the area, from December, 1970, to March, 1971.



Scale : 1:250,000

PROPOSED KATWAN F.R.

Adowlkrom o

Yanotwa

BIA TRIB. NORTH F. R.

Esam o Dekiso

Bia River

PROPOSED SUKUSUKU F. R.

Ajuafua

KROKOSUA HILLS F.R.

BIA TRIB. SOUTH F.R.

Mu Tia

Nainsim

Ivory Coast

Tawya River

Krokosua

Jebeso

FOREST RESERVE (French)

PROPOSED BIA-TAWYA F. R.

A. noya

Sud River

HONI F. R.

BASE DATA

STUDY AREA:

The area studied covers 1120 square miles of Tropical Rain Forest, (Semi-deciduous Type, Celtis-Triplochiton Association), located in the extreme north-west corner of the Western Region in the Sefwi District. The area is bounded on the west by the Ivory Coast border, on the north by the Western Region - Brong-Ahafo Region boundary and on the east by the Bia River and the Krokosua Hills Forest Reserve.

TOPOGRAPHY:

The area is gently rolling and rising from 400 feet in the south to 800 feet in the north. A range of hills rise to 1,000 feet in the south-west corner in the Tawya area, and the Krokosua Hills along the eastern edge rise to 1,800 feet. These hills are deeply incised and are therefore very steep-sided. The Bia River drains the area to the south and the Sunkan, Sukusuku and Manzan Rivers drain it to the west into Ivory Coast.

CLIMATE:

Temperature varies from a maximum of 84 - 92° during July and August to a minimum of 69 - 72° during February and March. Average monthly rainfall recorded at Sefwi Wiawso indicate rainfall peaks in June and October with an annual total of 58.062 inches. The Harmattan is noticeable but not strong.

(1. from Wiawso Group Working Plan, 1968, Forestry Department, Sefwi-Wiawso).

VEGETATION:

The area is classified by Tylor, 1952 as belonging to the Celtis Triplochiton Association of the Semi-deciduous Rain Forest. Monney, 1958, classified the Bia River area as a separate type within this Association based on an analysis of data from Forestry Department surveys.

FAUNA:

The wildlife of the area is typical of the High Forest Fauna of West Africa. A list of the species occurring in the area is presented in Table 1.

KEY:

- Obs. - Observed during the study
 - Doc. - Definitive evidence such as a skull or skin collected.
 - Ev. - Tracks or droppings observed.
 - Rep. - Reputed to occur, according to local hunters.
 - Pos. - Possible. (Within expected range of species.)
-
- 1. - Skulls or skins collected for Departmental collection.
 - * - skins or skulls collected by Sonia Jeffreys in 1968 - 70, a biologist resident in the area, for Royal Museum of Natural History, U.K.

Table 2. Species List for the High Forest in Ghana.

Species	Ob.	Doc.	Ev.	Rep.	Pos
Forest Elephant <u>Loxodonta africana cyclotis</u>	✓	x	x		
Giant Forest Hog <u>Hylochoerus m¹-nertzhageni</u>	✓	S.J.2	x		
Red River Hog <u>Potamochoerus porcus</u>	✓	x	x	x	
Pygmy Hippo <u>Choeropsis liberiensis</u>					
Bush Cow <u>Syncerus caffer nanus</u>		S.J.	x		
Bongo <u>Bococeros euryceros</u>		S.J.	x		
Bushbuck <u>Tragelaphus scriptus</u>		x	x	x	
Yellow-backed Duiker <u>Cephalophus silvicultor</u>		x			
Black Duiker <u>C. niger</u>		S.J.	x		
Bay Duiker <u>C. dorsalis</u>		x	S.J.	x	
Maxwell's Duiker <u>C. monticola maxwelli</u> (♀)		x	x	x	
Dabchame <u>C. ogilbyi brookei</u> (?)					x
Royal Antelope <u>Neotragus pygmaeus</u>	✓	x	x	x	
Water Chevrotain <u>Hymosochus aquaticus</u>	✓			x	
Bosmen's Potto <u>Pardicticus potto</u>		S.J.			
Demidoff's Galago <u>Galagoides demidovi</u>	✓	x			
Black Colobus <u>Colobus polykomos</u>	✓	x	x		
Red Colobus <u>C. badius</u>	✓	?	S.J.		
Olive Colobus <u>C. verus</u>	✓	x	S.J.		
Diana monkey <u>Cercopithecus diana</u>	✓	x	x		
Mona Monkey <u>C. mona</u>	✓	x	S.J.		
Spot-nosed monkey <u>C. retsurista</u>	✓	x	x		
White-collared Mangabey <u>Cercocebus torquatus</u>	✓	x	S.J.		
Chimpanzee <u>Pan troglodytes</u>	✓	x			
Leopard <u>Panthera pardus</u>	✓	x		x	
Golden Cat <u>Felis aurata</u>	✓	S.J.	?		
Civet <u>Viverra civetta</u>	✓	x		?	
Ratel <u>Mellivora capensis</u>	✓	?			
Palm Civet <u>Nandinia binetata</u>	✓	S.J.			
Genet <u>Genetta genettoides</u> (?)	✓	x	x	x	
Clawless Otter <u>Lutra maculicollis</u>	✓				x
Spot-necked Otter <u>Aonyx canescens</u>	✓				x
Fusimane Mongoose <u>Mungos obscurus</u>	✓	x	S.J.		
Pygmy Mongoose <u>Herpestes sanguineus</u>	✓	S.J.			
Giant Pangolin <u>Manis gigantea</u>	✓				x
Tree Pangolin <u>Manis tricuspis</u>	✓	x	S.J.		
Long-tailed Pangolin <u>Manis tetradactyla</u>	✓	x	S.J.		
Grasscutter <u>Thryonomys swinderianus</u>	✓	x	x	x	
Brush-tailed Porcupine <u>Atherurus africanus</u>	✓	x	x	x	

R E S U L T S
PART I - WILDLIFE RESOURCE

DISCUSSION OF EACH SPECIES

Below, the status of each species found in the Bia River area is discussed.

ELEPHANT (*Loxodonta africana cyclotis*)

This species occurs only in the southern portion of the study area, though apparently it did occur at one time in the north-east corner of the study area, just north of the Krokosua Hills Forest Reserve. A major concentration occurs in the Bia Trib. South F.R. in the Ajuafua area, lower numbers occur in the Bia-Tawya area and in the Sukusuku area. The elephant is a major problem in the area, and is discussed in detail later.

PYGMY HIPPOPOTAMUS: (*Choeropsis liberiensis*)

Establishing whether or not this species occurred in the area was a major objective of the study. It is now possible to say that it is extremely unlikely that the Pygmy Hippo does, or ever has occurred in the Bia River area. A detailed report on this aspect of our study is included as an Appendix to this report.

UNGULATES:

GIANT FOREST HOG: (Hylochoerus meinertzhageni)

During the study a specimen of this species was killed in Bia Trib. North Forest Reserve. Parts of the skull were collected by S. Jeffrey. Evidence of its presence was also found in the Bia Tawya area. Discussions with hunters would indicate that it is rare, but occurs in all the area studied.

RED RIVER HOG: (Potamochoerus porcus)

S. Jeffrey has a skull of this species from Bia Trib. North Forest Reserve and a definite observation was made in that reserve by the author. Two were also observed by the author in a hunting camp in the Bia - Tawya where they appear to be relatively common. The Officer working in that area saw evidence several times while on transect and saw 8 others in hunting camps. Evidence was also found in Sukusuku and Bia Trib. South Forest Reserve. It is expected to occur in the Krokosua Hills, based on reports by hunters.

FOREST BUFFALO: (BUSH COW) (Syncecerus caffer nanus)

This species appears to be very rare in the area. A horn tentatively identified as that of Buffalo, was seen by S. Jeffrey in the Krokosua Hills area. Tracks were found in the centre of Bia Trib. North Forest Reserve, and dung was found in Sukusuku. It is likely that it also occurs in the Bia - Tawya area and in the northern portion of the Krokosua Hills near the Bia River. This species is restricted in its range since it inhabits only swampy areas near permanent water.

BONGO: (Bococeros suryceros)

Though considered a rare and elusive animal, we were able to collect a great deal of information on this species. It was observed in Bia-Tawya and a horn was seen in the Ajuafua area. S. Jeffrey found a horn which apparently came from Bia Trib. North Forest Reserve. It is also thought to occur in the south-east portion of the Krokosua Hills Forest Reserve. A herd living near our camp in Bia Trib. North Forest Reserve was studied with some detail and is reported in Jamieson et al., (1971). The Bongo were found to be feeding intensively on regrowth vegetation along abandoned logging roads in the reserve,

primarily Musanga cecropoides and Trema guineensis. This would indicate that regrowth areas may be the natural feeding areas of the Bongo and that in virgin forest areas they feed in the regrowth areas surrounding fallen trees, rather on the scanty ground flora of the forest floor as has been usually thought. Logging and the subsequent increase in regrowth vegetation may increase the carrying capacity of an area for Bongo.

BUSH BUCK: (Tragelphus scriptus)

A young male of this species was collected in farmland in the Asupri area. It appears to be relatively common in farmland and secondary growth forest. Evidence was found in Bia Trib. North and South Forest Reserves and in Sukusuku, but always within one mile of farmland. However, it was seen in a hunter's camp in the centre of the Tawya area, which would indicate that this species can occur in virgin forest,

YELLOW-BACKED DUIKER (Cephalophus silvicultor)

The skull and skin of a young male killed by a hunter in the Sukusuku area were collected. This species is thought by the hunters to be relatively common in that area, though it is considered rare in most other area. Evidence was found in Bia Trib, South Forest Reserve and in Bia-Tawya. It is expected in Bia Trib. North Forest Reserve and lower areas in the Krokosua Hills Forest Reserve.

BLACK DUIKER: (Cephalophus niger)

This species is considered relatively rare in the Bia Trib. North Forest Reserve and the Krokosua Hills Forest Reserve, but is more common in Bia Trib. South and Sukusuku, and is fairly abundant in Bia-Tawya. One was observed in Sukusuku, and two in Bia Trib. South. Twelve were observed in the Bia-Tawya.

BAY DUIKER (Cephalophus dorsalis)

Though observed seven times in the Bia Tawya, the only evidence found in other areas was a set of tracks found in Sukusuku. According to local hunters, it does not occur in Bia Trib. North Forest Reserve, though there is no discernible difference in habitat between that area and the Bia-Tawya. It is said to occur in the Krokosua Hills Forest Reserve.

MAXWELLS DUIKER: (Cephalophus monticola maxwelli)

This is the most common ungulate and occurs in all areas. It is especially abundant in the Bia-Tawya.

DABOHENE or OGLIBYI'S DUIKER (Cephalophus ogilbyi brockei)

Though expected in the area, no evidence was found. Hunters described a "red" duiker which might have referred to this species.

ROYAL ANTELOPE (Nesotragus pygmaeus)

This is also an abundant species in all areas and in farmland. It is an important bushmeat species.

WATER OKERVOTAIN (Hyemoschus aquaticus)

Hunters in the area described a water-dwelling antelope, indicating the presence of this species.

PRIMATES:

BOSMANN'S POTTO: (Perodicticus potto)

Not observed during the study but S. Jeffrey has a skull collected in the area.

DEMIDOFF'S GALAGO or BUSHBABY: (Galagoides demidovi)

One was observed at night at close quarters in Bia Trib. North Forest Reserve, probably relatively common.

BLACK COLOBUS: (Colobus polykomos)

This species was observed a few times in each area. It's skin is much sought after and hunting has reduced it's numbers greatly. It was observed by members of the team in logged forest and has been seen by S. Jeffrey in farmland close to high forest.

OLIVE COLOBUS: (Colobus varus)

Also rather uncommon, this species was observed in Bia-Tawya and Bia Trib. South Forest Reserve. On all four occasions it was in multi-species troops with other monkeys. It has been seen in farmland by S. Jeffrey.

RED COLOBUS: (*Colobus badius*)

No definite observation of this species was made. However, it probably occurs in all areas, though in small numbers. A skin was seen for sale in Ajuafua and S. Jeffrey has collected skins and skulls in the area. Though it cannot live in farmland, it does appear to be able to exist in logged forest. They were heard, and one tentative sighting was made in a logged area in Bia Trib. North Forest Reserve. This is probably the rarest primate in the area and the one in the greatest danger of extinction, due to habitat destruction by farming and intense hunting.

DIANA MONKEY (*Ceropithecus diana*)

Also a relatively uncommon species, it was observed 5 times in Bia-Tawya, once in Bia Trib. South Forest Reserve, twice in Bia Trib. North Forest Reserve and once in the Krokosua Hills. Like the Red Colobus, it cannot live in farmland but was observed in logged forest.

MONA MONKEY: (*Cercopithecus mona*)

Relatively common, it was observed in all areas and in farmland. It was often seen in multi-species troops.

SPOT-NOSED MONKEY: (*Ceropithecus petaurista*)

Also common, two skins were collected from Sucusuku and farmland in the Ajuafua area and sightings were made in all areas. They were abundant in the Bia-Tawya, 10 sightings were made and 16 were seen in hunter's camps.

WHITE-COLLARED MANGABEY (*Cercocebus torquatus atys*)

Though observed only in the Bia-Tawya, it undoubtedly occurs in all forested areas. It is difficult to observe due to its preference for thick vegetation in swampy areas.

CHIMPANZEE: (*Pan troglodytes*)

Chimpanzee was found to be more abundant than expected. It was observed in Sucusuku and Bia-Tawya and was heard in Bia Trib. North Forest Reserve. It is also reported from the north end of the Krokosua Hills.

CARNIVORES

FOREST LEOPARD: (Panthera pardus)

One was observed in Bia-Tawya and evidence was found in all other areas. One was killed a few years ago in the Krokosua Hills near the Gliksten bungalow, and one was reported seen in the same area during the study.

GOLDEN CAT: (Felis aurata)

A skin and skull of this species has been collected by S. Jeffrey in the Sucusuku area.

CIVET: (Viverra civetta)

A young male was collected. It had been snared in farmland near Ajuafua. Evidence was found in Sucusuku and Bia Trib. North Forest Reserve.

PALM CIVET: (Nandinia binotata)

S. Jeffrey kept one as a pet two years ago. No evidence was found during the study.

GENET: (Genetta genettoides or poensis)

The genet appears to be relatively common. Due to its nocturnal habits it is often found in hunters bags. Four skins were collected from various areas.

OTHER LARGE MAMMALS

GIANT PANGOLIN (Manis gigantea)

This rare species was seen in a hunting camp last year by S. Jeffrey. A burrow was found in Bia - Tawya.

COMMON PANGOLIN: (Manis tricuspis)

Several were observed during the study.

LONG-TAILED PANGOLIN: (Manis tetradactyla or longicaudata)

Three were observed in the Tawya area.

RATEL: (Mellivora capensis)

A skull found in a hunting camp and described as a "bear" might have been of this species. Unfortunately, the skull was not collected.

CLAWLESS OTTER: (Lutra maculicollis)

SPOT-NECKED OTTER (Aonyx capensis)

Hunters described an animal that may have been one of the above.

KUSIMANSE MONGOOSE (Crossarchus obscurus)

Observed on four occasions in Bia Trib. South and North Forest Reserves.

PYGMY MONGOOSE: (Herpestes sanguineus)

S. Jeffrey has collected one from farmland in the area.

GRASSCUTTER (Thryonomys swinderianus)

Common in farmland and bordering forest, the following observations were made of this species in areas of high forest:- Part of a skull was found along a logging road in Bia Trib. North Forest Reserve, five miles from the nearest farmland. It appeared to have been killed by a predator. One grasscutter was observed on a farmland in the Bia-Tawya 5 - 10 miles from any other farms.

BRUSH-TAILED PORCUPINE: (Atherurus africanus)

Relatively common in all areas, it is an important bushmeat species. Farmers indicated that this species does some damage to corn crops.

STATUS OF RARE SPECIES IN THE AREA

Establishing the status of rare species in this area was one of the major concerns of the study. Most effort was directed toward locating any Pygmy Hippopotamus (Choeropsis liberiensis) that might occur in the area. No evidence whatever was found of this species and it is unlikely that this species ever did occur. This problem is discussed in full in Appendix A.

Though this species was not found, another species also listed in the I.U.C.N. Red Data Book on Rare Species, Olive Colobus (Colobus verus), was found in fair numbers. It was observed in two of the five study areas and is expected to occur in all the areas.

Two other species of Colobus occur in the area, the Western Red Colobus (C. badius), and the Western Black Colobus (C. polykomos). The Black Colobus is found in good numbers despite the illegal trade in the skins of this species. However, the Red Colobus was observed only once, and there is some uncertainty in the validity of the observation. Its calls were identified on three occasions and two skins were seen. This species appears to be the rarest primate in the area, and the species in the greatest danger of extinction. It is restricted in habitat to the upper canopy of mature high forest and cannot survive in farmland as some of the other species can. Booth (1960) notes that Red Colobus is the most easily hunted of the Colobus species. Work in other parts of the High Forest zone in Ghana indicate that this is not an isolated situation. The Red Colobus is probably the most endangered species of primate in Ghana. It is suggested that further work be done here and in other West African countries, (the species range extends from Ghana to Senegal), to determine if this species rates inclusion in the I.U.C.N. Red Data Book.

Several other primates were observed in the area, including Diana Monkey (Cercoptes diana), Mona Monkey (C. Mona), Spot-necked monkey (C. petraurista), White-collared Mangabey (Cercocebus torquatus) and Chimpanzee (Pan troglodytes). All of those species occur in fair numbers and in all of the areas studied, though the Diana monkey and the Chimpanzee give some cause for concern.

Several large mammals that are considered relatively rare, or certainly are rarely seen in the wild, were found to occur in this area.

They include:

Giant Forest Hog	<u>Hylochoerus meinertzhageni</u>
Bushoow	<u>Synerous caffer nanus</u>
Yellow-backed duiker	<u>Cephalophus silvicultor</u>
Bongo	<u>Boocercus euryceros</u>
Water Chervotain	<u>Hyemoschus acutitous</u>
Ratel (Dark Forest form)	<u>Mellivora capensis</u> **
Clayless Otter	<u>Lutra maculicollis</u> *
Spot-necked Otter	<u>Aonyx capensis</u> *
Giant Pangolin	<u>Manis gigantea</u>
Leopard (Forest form)	<u>Panthera pardus</u>
Golden Cat	<u>Felis aurata</u>
Palm Civet	<u>Nandinia binotata</u>

* Based on hunter's description only.

** A skull of this species was seen by one of the workers, but unfortunately it was not collected.

All the species above, except those indicated by an asterisk, were documented for the area by collection of skulls, horns or other definitive evidence. The material was collected by either the Faunal Survey Team or S. Jeffrey.

At the present time only one species is in immediate danger of extermination, but with increasing hunting pressure and poaching, and as more and more of the area is logged, it is likely that several species will become endangered. It is important to note the rapidity with which "development" has occurred in this area. As recently as 1965 there was little or no access to the area.

Though the Forest Reserves in the area provide a measure of habitat protection, it is impossible to provide the necessary protection from hunting. Though all the species discussed above are protected under the Ghana Wildlife Preservation Act, 1971, at present we do not have the manpower or facilities to enforce these regulations outside the existing Game Reserves.

THE STATUS OF BUSHMEAT SPECIES

Several species found in this area are important in providing bushmeat, a major source of protein in Ghana. The most important species are the more common ungulates and primates, though all species are utilized when available.

An analysis of the transects run in each of the study areas can give us some information on the status of these species. Table 2 presents an analysis of the species of animals observed in each area, Table 3 make a comparison of total numbers observed in each area. Though conditions under which the transects were run varied between areas, it is believed that the results are comparable enough to be useful in indicating the abundance of wildlife in each of the areas studied.

The number of animals observed is lowest in the Krokosua Hills area, as one would expect. This is the most heavily settled area, the smallest reserve, (containing the smallest area of unbroken forest within its boundaries), and intense hunting has been going on for an extended period. Bia Trib. North Forest Reserve supports higher numbers despite heavy hunting. The Reserve apparently is large enough that the animal population can survive, though at comparatively low numbers. Data was collected on the Sukusuku area. However, it was found to be unreliable, since most of the transects done in that area were carried out along established trails. Hunting success, as evidenced by the number of animals observed in hunting camps, and discussions with people in the area indicate that wildlife numbers are at least as high as in Bia Trib. North Forest Reserve and perhaps somewhat higher.

TABLE 2. SPECIES COMPOSITION OF ANIMALS OBSERVED IN THREE STUDY AREAS

SPECIES	STUDY AREAS					
	Bia-Tawya		Bia Trib. North		Bia Trib. South	
	ob.*	An.**	ob.	An.	Ob.	An.
Bongo	1	3	-	-	-	-
Black Duiker	8	9	-	-	2	2
Bay Duiker	7	7	-	-	-	-
Maxwell's Duiker	12	19	1	1	1	1
Royal Antelope	1	1***	3	3	3	3
Sub-Total-Ungulates	29	39	4	4	6	6
Spot-nosed Monkey	10	56	4	37	2	9
Mona Monkey	9	37	6	22	6	21
Mona Monkey	5	20	2	5	-	-
Olive Colobus	3	10	-	-	1	5
Black Colobus	2	29	1	8	-	-
Mangabey	9	49	-	-	-	-
Chimpanzee	2	9	-	-	-	-
Sub-Total-Primates	40	210	13	72	9	35
Grasscutter	-	-	-	-	1	1
Brush-tailed Porcupine	-	-	4	4	3	3
Tree Hyrax	1	1	-	-	-	-
Pangolin (2 sp.)	3	3	-	-	-	-
Revest Leonard	1	1	-	-	-	-
TOTAL	74	254	21	80	19	45

* - Observations, i.e. the number of occasions on which the animal was observed.

** - Total animals seen.

*** - Not recorded.

0000/1-

TABLE 3. OCCASIONS ON WHICH ANIMALS WERE OBSERVED AND TOTAL NUMBER OF ANIMALS OBSERVED PER 100 MILES OF TRANSECT.

Study area	Miles of Transect	No. of Observ.	Observ. /100 MI.	No. of Animals	Animals /100 MI
Krokosua	50	3	60/	6	12/
Bia Trib. North	101	22	20.8/	80	80/
Bia Trib. South	104	19	18.7/	45	43/
Bia-Tawya	168	74	44.0/	254	151/

TABLE 4. AN ANALYSIS OF THE NUMBER OF OBSERVATIONS AND THE NUMBER OF ANIMALS OBSERVED PER 100 MILES OF TRANSECTS BY SUB-GROUPINGS OF PRIMATES, UNGULATES AND "OTHER" SPECIES

	Observation/100 miles				Animals/100 Miles			
	Primates	Ungulates	Other	Total	Primates	Ungulates	Other	Total
Bia Trib. North	13/	4/	4/	21/	72/	4/	4/	80/
Bia Trib. South	9/	6/	4/	19/	35/	6/	4/	45/
Bia-Tawya	24/	17/	3/	44/	125/	23/	31/	151/

In Bia Trib. South Forest Reserve much lower numbers of animals were observed than in Bia Trib. North Forest Reserve, though the number of observations made was almost the same. From Table 4 it can be seen that ungulate numbers in Bia Trib. South Forest Reserve were actually higher, while primate numbers were less than half of those observed in Bia Trib. North Forest Reserve. Obviously, primates are being heavily hunted in this area. This effect is reflected in average group size, which is 5.54 and 5.20 in Bia Trib. North Forest Reserve and Bia-Tawya, but is 3.89 in Bia Trib. South Forest Reserve. Apparently the intense hunting is resulting in a break-down in the social groupings of the primates.

As noted, the number of ungulates observed was actually higher in Bia Trib. South, than in Bia Trib. North. This is exactly opposite to what we would expect. With the intense hunting that occurs in the area, we should expect the greatest reduction in numbers to occur in the ungulates since they are preferred by the hunters. This phenomena is probably explainable in the following terms:-

Several stories were related to us about people who had been killed or badly mauled by elephants while hunting in the reserve at night. One man was killed during our stay in the area. A lantern or hunting lamp appears to induce an attack reaction in the elephants. It would seem that the likelihood of a hunter running into the 30 to 50 elephants thought to occur in the area would be very small. However, the hunters use the elephant trails while hunting and the prime hunting period (early evening), is also the time in which the elephants move out of the reserve to feed in the surrounding farms. Further, the highest numbers of ungulates occur in the swampy areas; this is also the habitat preferred by the elephants. The end result of this has been a marked reduction in the intensity of night hunting, since hunters are afraid to go into the reserve at night. Thus the ungulates, which are hunted at night, have suffered loss from hunting than the primates, which are hunted during the day.

The Bia-Tawya area supports both the greatest diversity and the highest numbers of wildlife. These higher numbers may indicate that the wildlife habitat in the Bia-Tawya is superior to that of the other areas. This is unlikely since the high Forest is an extremely uniform habitat. The high numbers seen might be attributable to the dry season concentrations of wildlife that occur. Though the area is in the High Forest, much of the area is without surface water in the height of the dry season. Thus a substantial concentration of wildlife occurs around the available water along the Tawya and Sunkan Rivers. This might explain the high numbers seen, but this is unlikely since only a representative proportion of the transects were run through these areas. It is felt that the high numbers observed represent animal populations near carrying capacity and showing relatively little effect from hunting. By contrast all other areas show very serious effects from hunting.

From Table 4 it would appear that populations in Bia-Tawya are 25 to 50% of those in Bia Trib. North F.R. However, this does not reflect the true situation. While this study was being carried out, it was still legal to hunt at night using carbide lamps. As a result hunting had its greatest effect on the animals active at night.

Data from transects run at night, (Table 5), indicate that animal populations in Bia Trib. North F.R. were only 15% of those in Bia-Tawya, and that population in Krokosua Hills F.R. were only 7% of those in Bia-Tawya. This effect is even more serious in the ungulates. Their numbers were reduced to 7% and 4% respectively, of the Bia-Tawya populations. Obviously, these animal populations and especially the ungulates populations are being affected seriously by over-hunting.

TABLE 5
ANIMALS OBSERVED PER HOUR OF NIGHT TRANSECT AND NUMBER
OF ANIMALS OBSERVED PER VISIT TO HUNTING CAMPS

Study Area	No. of Hours	No. of Animals	Animals per Hr.	No. observed per camp visit.
Bia Trib. North F.R.	20	12	.60	.83
Krokosua Hills	12	3	.25	-
Bia-Tawya	11	43	3.91	8.93

TABLE 6
SPECIES COMPOSITION OF ANIMALS OBSERVED ON NIGHT TRANSECTS

SPECIES	<u>Bia-Trib. North</u>		<u>Bia - Tawya</u>	
	No. observed	Freq.	No. observed	Freq.
Royal Antelope	3	24.99%	1	2.33%
Maxwell's Duiker	2	16.66	18	41.84
Bay Duiker	0	0	5	11.65
Black Duiker	0	0	4	9.30
Sub-Total	5	41.65	28	65.12
Red River Hog	0	0	9	20.94
Pangolin	1	8.33	3	6.99
Tree Hyrax			1	2.33
Giant Rat	0	-	2	4.65
Brush-tailed				
Porcupine	1	8.33	0	
Bushbaby	1	8.33	0	
Genet Cat	4	33.33	0	
TOTAL	12	99.87%	43	100.02%

THE EFFECT OF LOGGING

The effect of logging on the wildlife habitat in the high forest, as practised in the established Forest Reserves, is less drastic than one would expect. The most important factor operating here is the low stocking rates of exploitable trees. This, combined with the Forestry Department's Policy of allowing cutting of over-mature trees only, makes the effect of logging minimal. The area studied in Bia Trib, North Forest Reserve included an area of recently logged forest. Though the upper canopy was obviously thinned out, the logging seemed to have had relatively little damaging effect on the area as a wildlife habitat. All or most of the high forest species were observed in the logged area. Diana Monkey was seen and Red Colobus was heard and tentatively observed in the area. These two species are restricted in habitat to the high canopy and are the species which one would expect to be most affected by logging. Some species seem to react favourably to the opening of the canopy due to logging. Evidence of Bongo was found concentrated along the old logging yards and roads where they were feeding on regrowth vegetation, primarily Musaena carcopoides and Trema guineensis (Jamieson et al. 1971). The increase in regrowth vegetation probably increased the carrying capacity of the area for Bongo and perhaps some of the other smaller ungulates. This may be of special importance if this same effect could be shown for the small ungulates which are important bushmeat species.

The general effect on the landscape is minimal since all roads are built along the height of land to minimize the need for bridge building. Thus watersheds are little affected. The flat character of most of the area is such that very little erosion occurs. Road building is carefully planned to minimize the mileage of roads that has to be built, thus a relatively small proportion of the area is altered by roads or tractor trails.

It is important however, to note that these points are relevant only in discussing logging carried out by the large logging companies who plan their logging operations carefully. One small portion of Bia Trib, North Forest Reserve had been logged illegally by a small contractor and habitat destruction was much more extensive. The hauling track was built along a water-course. In the area logged, they took all age classes of the economic trees and a large number of other species were knocked down.

Outside the ~~Forest Reserves~~ in "Protected Timberland", all age classes of economic trees are taken during the logging operation. The area is then converted to farmland as farmers move in along the roads built during the logging operation.

THE EFFECT OF FARMING

The destruction of the forest environment and the simplification of the environment remaining in the farming areas has a much more serious and permanent effect on wildlife than does hunting.

Based on our work in the Bia area I would suggest that the diversity of species in the area will be affected as shown in Table 9.

Conversion to farmland has the immediate effect of exterminating over half the species and over 80% of all species are seriously affected by the change. A community of 35 species in the forest, of which 14 are important bushmeat species is reduced in farmland to a community of 15 species of which 9 are important bushmeat species. More important though, than this reduction in the diversity of species, is the overall decrease in productivity of the land and the subsequent reduction in the number of animals that the area can support.

The effect of farming on basic productivity in the high forest is an extremely complex subject, and relatively little work has been done. Nye (1959) indicated that with "normal" methods of shifting cultivation, (2 or 3 years of crop and 10 years of fallow), the level of human ^{land} drops to about three quarters of the "virgin" level. Areas of secondary forest, (old farmland, allowed to go into fallow), provide good habitat for some of the smaller ungulates, but the comparative quality of this habitat is not known.

It is expected that overall-productivity in terms of the numbers and biomass of ungulates and primates will be significantly below that of the natural high forest.

TABLE 7. THE EFFECT OF HABITAT DESTRUCTION ON SPECIES DIVERSITY

SPECIES WHICH CANNOT LIVE IN FARMLAND	SPECIES SERIOUSLY REDUCED IN FARMLAND	SPECIES WHOSE NUMBERS REMAIN THE SAME OR INCREASE
Elephant		
Giant Forest Hog		
Red River Hog*		
Bush-Cow		
Bongo		Bushbuck*
Yellow-backed Duiker*		
Black Duiker*	Maxwell's Duiker*	
Bay Duiker*	Royal Antelope*	
Dabohene(Oglibyi's Duiker)		
Water Chervotain		
Black Colobus	Bosman's Potto	Spot-nosed Monkey*
Red Colobus	Dermidoff's Galago	
Diana Monkey	Mona Monkey*	
Managabey	Olive Colobus	
Chimpanzee		
Forest Leopard		
Golden Cat		Gafof Civet
Palm Civet		Kusimanse Mongoose
Giant Pangolin	Pangolin(2 sp.)*	Pygmy Mongoose
	Brush-tailed Porcupine*	Grasscutter*

* Important bushmeat species.

THE ELEPHANT PROBLEM

Up until 7 years ago, only a few elephants occurred in the Bia area and rarely raided the few farms then found in the area. About 7 years ago, a major movement of elephants into the area occurred, probably coming from other areas where the forest had been destroyed by farming or logging. It is also possible that the increase in the number of farms in the area over the last 5 to 7 years has resulted in the increase in farm raiding, but it is felt that the advent of intensive raiding occurred too suddenly to be explained by this fact alone. The raiding problem has increased each year and the area affected has expanded. This however, is thought to be due to the abandonment of some farms along the Reserve boundary which has forced the elephants to go further afield for food, rather than any large increase in elephant numbers. The number of elephants in the area is estimated at 30 - 50 animals. The density of elephant in the Ajuafua area; .5 to 1.0 animals per square mile, is thought to be well in excess of the natural carrying capacity of the area, indicating that the elephant herd in that area is dependent upon the farms as a source of food, at least in the wet season.

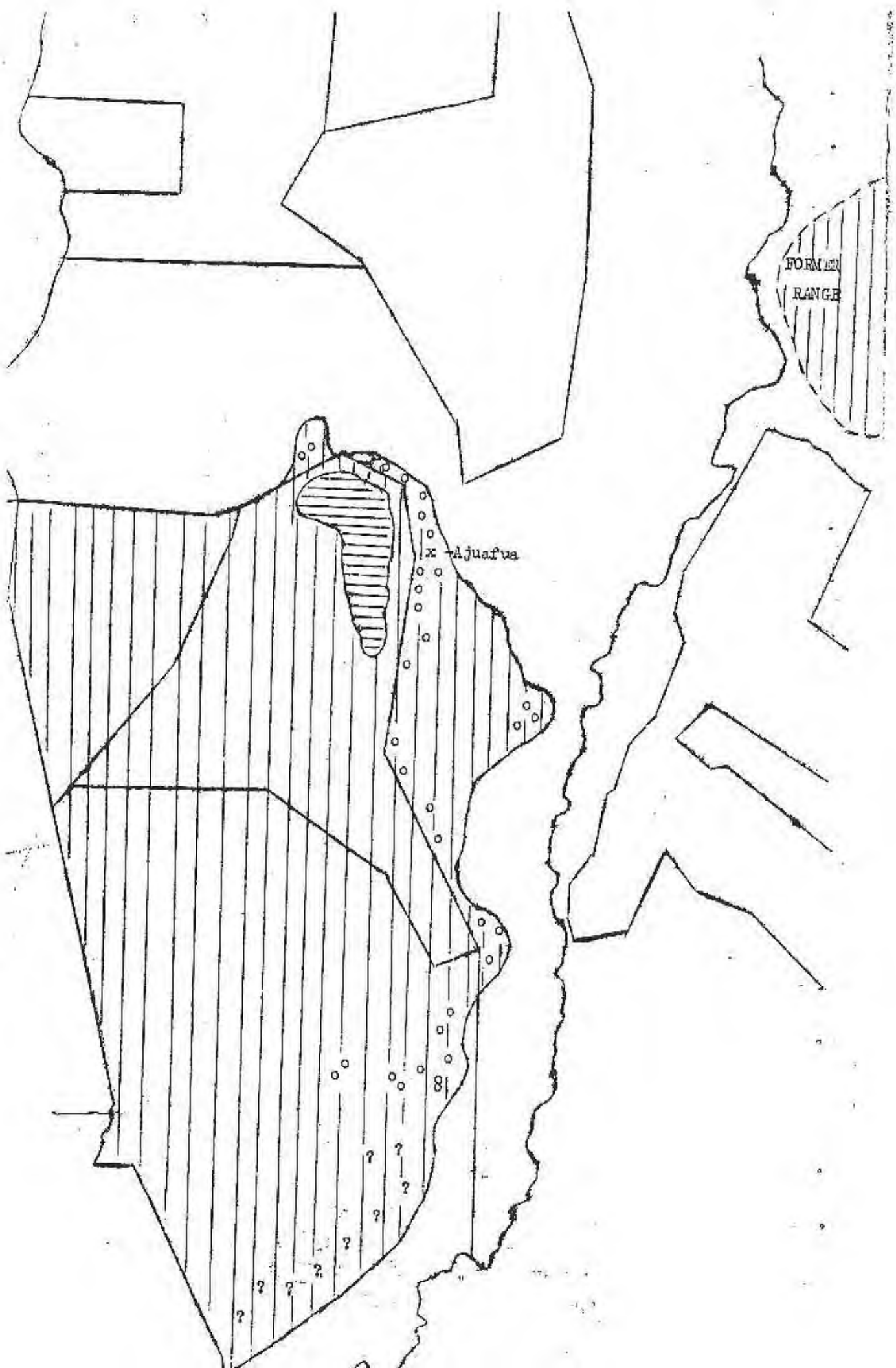
The dry season feeding habits of the elephants were studied by analysis of faeces and by visiting feeding areas. The study of faeces, though not quantitative, indicates that the dry season diet of elephants in the Ajuafua area is split roughly 50 - 50 between fruits, bark and vegetation from the forest, and plantain, cocoyam and water-yam from neighbouring farms. During the study 58 seeds of Barlomite species were identified in faeces as well as 36 other seeds of several types, as yet to be identified. Fibres from plantain were very evident in the faeces and one cola-nut was identified. Evidence was found of feeding on leaves and shoots of Musanga oerocarpoides, the fruits of Tieghemella hackelii, the bark of Antandrophragma angolense, fruits of Barlomite sp., the trunks of wild Palm (Raphia sp.), leaves of Strombosia glaucocense and some unidentified climbers.

S. Jeffrey(1970) describes the crops destroyed by the elephants during the 1969 wet season. Our work in the area, based on discussions with farmers and examination of areas raided during the study period (in the height of the dry season), agree with her findings. The elephants eat much plantain, and cocoyam, but show a special preference for water-yam.

All food crops in the area were taken to some degree, and they destroy many plants by stepping on them or up-rooting the plants without feeding on them. However, damage of this kind was not found to be the major form of damage, as indicated by Curry-Lindahl(1969). Cocoa was damaged in some areas where elephants brushed against the cocoa trees and dislodged the delicate flowers and young pods while on their way to food farms. Cocoa seedlings inter-planted with food crops were often trampled while the elephants fed. However, no direct damage to cocoa due to feeding was found, though rumours were heard of elephants eating the mature cocoa while it was being fermented.

Raiding took place entirely at night, though some herds remained in the farms up to two hours after sunrise. They generally enter the farms just after sunset and remain in the farming areas until the next morning. They then retreat into the Forest Reserve and spend the day around the numerous wallows they have created in swampy areas in the reserve. The trails leading from the farms to these wallows are well-used and numerous. Over 50 such trails were counted crossing the Forest Reserve boundary between pillars one and eleven (6 miles), in the Ajuafua Area.

Several farms totalling 97.2 acres were visited in the Ajuafua area. Damage approached 100% of the year's crop on most of this acreage. It is estimated that over 250 acres of food farms were extensively damaged in the Ajuafua area. The cost of the damage inflicted by the elephants was estimated using the farmers estimates as a maximum and comparing it to a figure worked out for the value of farmland in the area based on the rate of compensation paid by the logging companies, for crops destroyed by their road building operations. The cost of the damage was thus estimated as lying between N\$10,000.00 and N\$5,000.00 per annum. Elephants also occur in the Sucusuku and Bia-Tawya Proposed Forest Reserve. Elephant numbers in both these areas are much lower than those found in the Ajuafua area. Elephants from the Sucusuku area are reportedly raiding farms in the Niiblé area in Ivory Coast. No raiding occurs on the Ghanaian side of the border; the Gliksten logging road running along the north boundary of the area appears to act as a barrier to the elephants(S. Jeffrey, pers. comm.).



FORMER
RANGE

X Ajuafua

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However, it remains to be seen if this barrier will continue to be effective, now that the logging trucks are no longer using the road. Human disturbance may have been the factor restricting the movement of the elephants.

In the Bia-Tawya area there is also a major problem with elephants. Damage was found to be extensive during the dry season, apparently as a result of the elephant's use of plantain leaves and stocks as a source of water. Damage was examined on a total of 1900 acres in this area, this constitutes 80 - 90% of the farm acreage in the area. Some damage was found in all farms visited, however damage was not as complete as in the Ajuafua area. The cost of the elephant damage in this area was estimated at over N\$10,000 per annum.

Obviously this presents a very serious problem. Alternatives for dealing with this problem are presented later in this paper.

RESULTS PART II - LAND USE

RESOURCES OF THE AREA

MINERAL RESOURCES

Relatively, little information was collected. It appears to be of little importance in the area. Some pits were seen which we were told were dug by gold miners in the last century. One area of diamond diggings were indicated on a map of the Mafia area, and the Wiswso Group Working Plan (Forestry Department, 1968), describes the Krokosum Hills as having "a bauxitized mantle" which may indicate that bauxite occurs in that area.

SOIL RESOURCE

Soils in the upland areas are latosols, i.e. soils in which weathering is so far advanced that little or no unweatherable material remains. They are based on phylites tuffs, schists and grey rocks of the Birrimian series. The soils are often gravelly and in the dry season water shortage may be well marked. Soils in the lower areas are a variety of sedimentary types.

The south half of the area is in the oxsol zone, the north half is in the ochrosol zone. (Forestry Department, 1968). Soils are rather infertile in Bia Trib. South Forest Reserve and on the Krokosua Hills. On the top of the hills, the soils is rarely more than 12 inches deep, and the underlying "bauxitized mantle" is often exposed. On the high slopes in the Bia Trib. South Forest Reserve, the soil is also very thin, the underlying gravels are exposed in some areas.

FOREST RESOURCE:

The forest in the area is classified as belonging to the Celtis-Triplochiton Association of the semi-deciduous forest, by Taylor (1952), Monney (1958) however, based on an analysis of the Forests of the area carried out by the Forestry Department, identified the Bia area as a separate sub-type within the Celtis-Triplochiton Association. This is based on differences in over-all productivity and in age-class structure as indicated below in Table 8. Also included in the table are the results of a small survey done during this study of the forest on the highest portion of the Krokosua Hills, an area of special interest in this report. It is important to note that the forest in this area is the poorest in the forest region of Ghana, and the forest on the Krokosua Hills is impoverished further still by its severe site and poor soil.

TABLE 8. STOCKING OF ALL SPECIES PER ACRE. (FROM MOONEY (1958))

FOREST TYPE	Sample (in acres)	Girth Class (In feet)						15+ 13-15	Total Trees Expt. All**
		1 - 3	3 - 5	5 - 7	7 - 9	9 - 11	11 - 13		
Rain Forest	3104	117.00	33.13	5.54	2.32	1.00	.28	.08	.04 3.72 159.41
Celtis-Tripolichiton Association									
Wet Facies	6320	133.40	29.56	5.99	2.66	1.24	.56	.25	.20 4.91 173.86
Dry Facies	4832	110.50	25.34	6.24	3.15	1.62	.80	.38	.35 6.30 148.38
Bia	1792	60.30	25.06	5.76	2.32	.76	.25	.07	.06 3.46 94.58
Krokosua Hills	15	1.73	1.93	1.33	.73	.13	.00	.06	.00 .93 5.53

* Exploitable trees, taken as all trees over seven feet in girth.

** Assumed to mean all economic trees.

LAND USES

FARMING

All areas outside the proposed and established Forest Reserves, with the exception of a small area of inaccessible Protected Timber Land in the north-east corner of the study area, have been farmed. A minor land rush has occurred in the last several years as land has been made accessible by roads built by the logging companies. Most of the farmers are the local Sefwi people, with small food farms; but many farmers from other parts of Ghana have come into the area. Some of them have large farms, up to four square miles in size. Cocoa and Coffee are the major cash crops, Plantain and Cocoyam are the major food crops.

In the proposed Forest Reserves there is some contention as to whether the area should remain as forest land or be converted to farmland. Several farms have been established in the last few years in the Sukusuku area, primarily along the north and eastern boundaries. The Forestry Department has on two occasions attempted unsuccessfully to remove these farmers. In the Bia-Tawya area, there is a major settlement some 20 years old on the Debe River, within the proposed Reserve. Other newer farms have been cleared along the boundary of Bia Trib. South F.R. and along the Tawya River. The location of these farms is indicated in Figure 3.

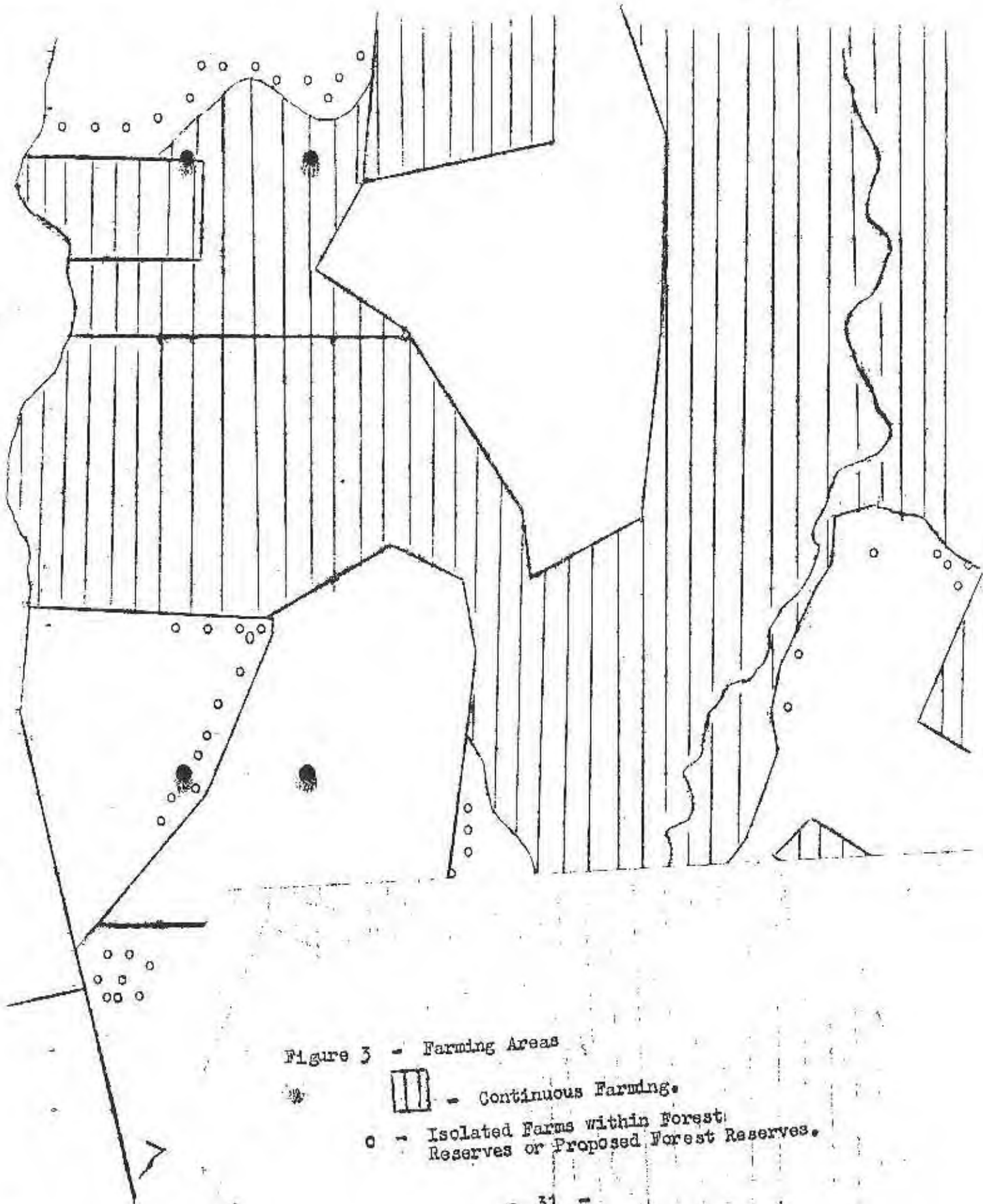




Figure 3 - Farming Areas

-  - Continuous Farming.
-  - Isolated Farms within Forest Reserves or Proposed Forest Reserves.

LOGGING

Most of the logging concessions in the area belong to Gliksten West Africa Limited., including all three proposed Forest Reserves. They have not begun exploitation in any of these. They are presently working in the Debiso area in the north-west and in the north-east along the Bia River. They are planning to move from these areas into the Manzan Proposed Forest Reserve and possibly into the Sukusuku Proposed Forest Reserve. In the Protected Timber Land in which they are presently working, they cut all sizes of trees from pole size up, since they do not expect to log the area again. In the Forest Reserves however, they are required to cut only mature and over-mature timber in order to produce timber on a sustained yield basis. There has been a problem in some areas with small contractors using the roads constructed by Gliksten to go into their concessions after they are finished and illegally removing the under-mature trees.

Mim Timber Ltd., has a large concession in the north two-thirds of Bia Trib. North Forest Reserve and they have the concession for all of Bia Trib. South Forest Reserve. They are presently working in Bia Trib. North F.R. and will complete that area by early 1972.

The only other logging company working in the area is Kaffour Logging Ltd. which has a small concession in Bia Trib. North Forest Reserve, which has already been worked, and the concession in the Krokosua Hills Forest Reserve.

The location of all these concessions is indicated in Figure 4.

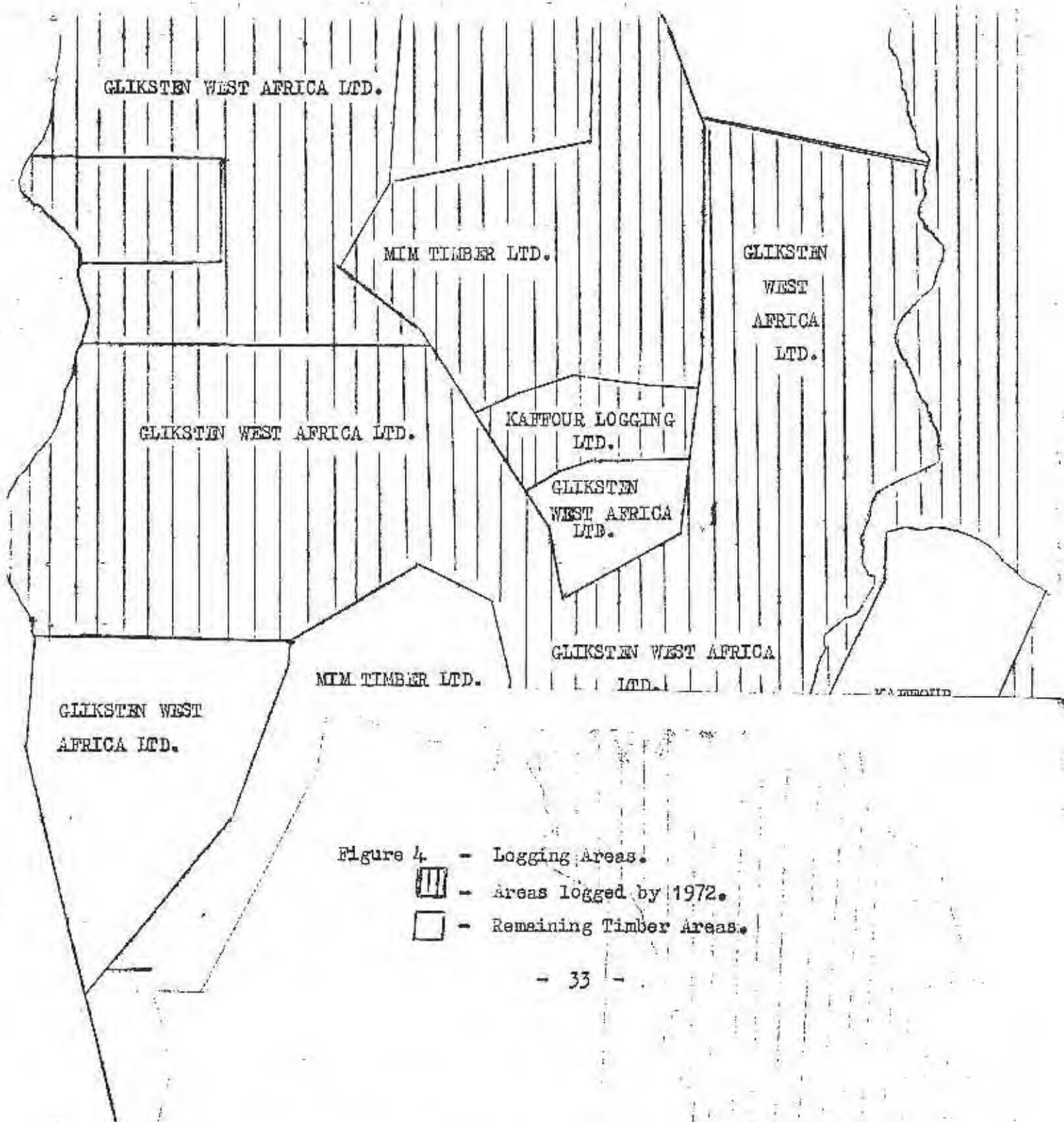


Figure 4. - Logging Areas.
 [Hatched Box] - Areas logged by 1972.
 [Empty Box] - Remaining Timber Areas.

BUSHMEAT PRODUCTION

Though perhaps not generally considered as a form of land use, the collection, preparation, transport and selling of meat from wild animals is an industry of major importance in this area. 1

Within the Bia River area itself, bushmeat is the major source of fresh protein. During the study we lived for a six week period in the town of Adjuafua, we were thus able to make an informal study of the protein available to people in the village. The major source of animal protein (in any form), available was dried fish, either brought in from other parts of Ghana, or from local rivers. Imported canned sardines are also important. No cattle occur in the area, and goats and sheep, though abundant, are rarely eaten due to local traditions. Chickens and ducks are raised, but do not contribute significantly to the food supply. The only commercially available fresh protein is fish brought in by freezer trucks. However, this occurs very rarely, only once during our stay in the area.

The most important source of fresh protein is bushmeat. The major component of this is the Giant Forest Snail (Achaetina sp.) which is very abundant during the wet season. It probably constitutes the single most important form of protein, of any kind, in the diet of the local people. This is a result of the fact that the snails cannot be marketed as easily as the other forms of meat, and is therefore usually eaten, rather than sold and the money collected used to buy the much cheaper starch foods. Throughout the year, the Royal Antelope, Maxwell's Duiker, Giant Rat, Grass-cutter, Brush-tailed Porcupine and Common Pangolin provide an important component of the available protein. Though there is a preference for ungulates and the larger rodents, all species which occur are eaten when available. The Potto is the only species which is not generally considered eatable (Jeffery, 1970), though the monkeys are considered to have inferior meat and sell for about half the price of ungulates and rodents.

The system that produces, transports and sells this bushmeat is well established and has a relatively rigid structure. The major source areas are the larger and more inaccessible forest Reserves, though all areas contribute significantly. As Jeffrey (1970) notes, much bushmeat is brought out of the forest and sold to passing timber lorry drivers who resell the meat at higher prices in the larger towns. This appears to be the major means by which bushmeat is transported out of the forest areas in the north half of the study area. Most of this meat finds its way to Sefwi Wiawso and is consumed there.

The single most important source area is the Bia-Tawya area. The production from this area may well exceed that of the remainder of the area. Because of the inaccessibility of the hunting areas, the bushmeat must be head-loaded from the hunting camps some 25 miles to the nearest road at Krokosua or Amoya. From these access points the meat is then transported to the Asanyuniso market; from there much of it is transported to Kumasi. The prices of various species at these three points are indicated in Table 9. The prices, volumes, markets and consumption of bushmeat in the major centres has been discussed by Asibey (1970).

Hunting Methods

Hunting and snaring is intensive in all farming areas and easily accessible portions of the Forest Reserves. In the more inaccessible areas hunting camps have been set up by professional, full-time hunters. Fifteen such hunting camps were located in the Sukusuku area, ten in the Bia-Tawya and three in the Bia Trib. North F.R. The distribution of these camps is quite uniform as each camp has an informal "hunting territory" surrounding it. The "density" of hunting camps, expressed as the number per 100 square miles, is:

Bia Trib. North F.R.	11.6/100 sq. miles
Sukusuku	18.7/ " "
Bia-Tawya	5.9/ " "

As we would expect the density of hunting camps is much lower in

Table 9. Prices of Bushmeat.

SPECIES	Price of Animal of average size, smoked.		
	Bia-Tawya	Asanyuniso	Kumasi
Giant Forest Hog	18.00 ₵	22.50 N₵	31.50 N₵
Yellow-backed Duiker	14.00	17.00	23.50
Bushbuck	14.00	17.00	23.50
Red River Hog	10.00	12.50	17.50
Bay Duiker	8.00	10.00	14.00
Royal Antelope	.60	.80	1.50
Chimpanzee	12.00	15.00	21.00
Mangabey	6.00	7.50	10.50
Black Colobus	4.00	5.00	7.00
Spot-nosed Monkey	2.00	2.50	3.50
Mona Monkey	"	"	"
Diana Monkey	"	"	"
Olive Colobus	"	"	"
Brush-tailed Porcupine	1.00	1.20	2.00
Pangolin	.60	-	-
Genet Cat	1.00	-	-
Civet Cat	1.00	-	-

the Bia-Tawya than in other areas. The figure for Bia Trib. North F.R. is lower than actual, since several villages around the perimeter of the Reserve also hunt the area. No camps were found in Bia Trib. South F.R., but camps in the Sukusuku area hunt the western part of that reserve. Two abandoned camps were found in the Krokosua Hills. They apparently were abandoned due to pressure from the local Forest Guards, though the low success of hunting in that area probably contributed to their abandonment.

The hunting camps consisted of one or two small huts, a cooking fire, a smoking fire and a meat rack. They were located in small clearings in the forest, usually surrounded by a small garden of plantain and cocoyam. The camps were occupied by from two to five men, though larger, semi-villages occur in the Sukusuku area. Some of the hunters in the Bia-Tawya and Sukusuku areas were from Ivory Coast and there was a steady movement of people back and forth across the border in these areas. Much of the bushmeat killed in these areas is taken across the border and sold in the Ivory Coast.

Hunting was carried out using old 12 gauge shot-guns, mostly of Spanish make. Shells were purchased in the towns for 50-60np each. Hunting was done primarily at night, travelling in pairs and using a carbide lamp attached to a head-band to catch the eye-shine of the animals. The peak hunting periods were 6-8 p.m. and 3-6 a.m., though this varied considerably. The presence of moonlight appeared to be a major factor affecting movement of animals, and thus the peak hunting periods. The hunters often continued through the night, despite the lower success found during certain periods. The number of hours hunted was probably defined by the time it took to acquire what the hunters considered an acceptable bag for the night.

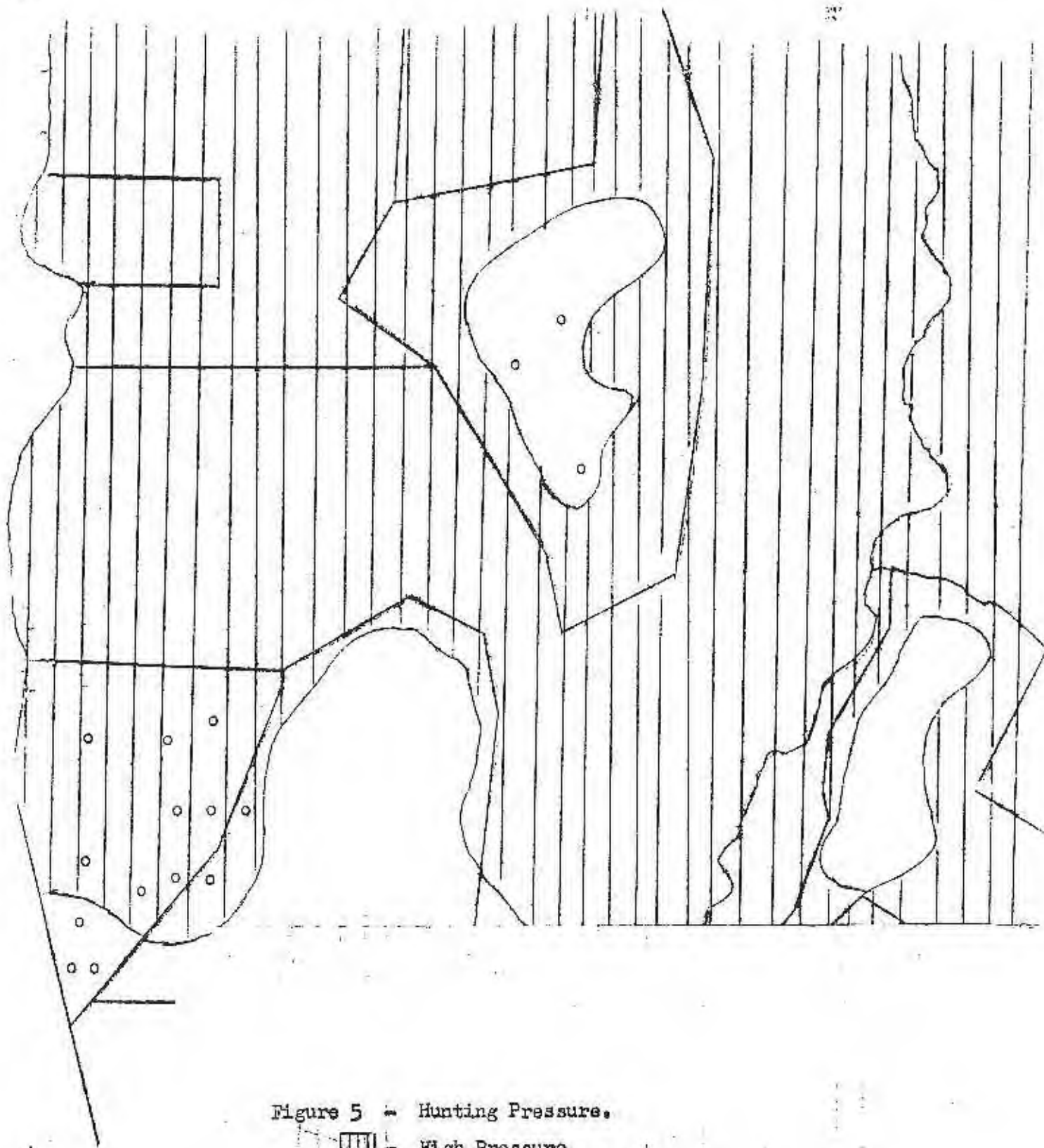





Figure 5 - Hunting Pressure.

 - High Pressure

 - Low Pressure

 - Hunting Camps.

Hunting Success

Hunting success varied greatly between areas. Highest success was found where animals populations were highest, though the species composition of the hunted population was also important. Both of these differences are reflected in the hunter's kill. As a measure of hunting success we recorded the number of animals observed each time we visited a hunting camp. A major difference was found between the average number of animals observed per visit, 8.93 animals per visit in the Bia-Tawya and .83 animals per visit in Bia Trib. North F.R. This would indicate that hunting success in Bia Trib. North F.R. is less than 10 % of that in Bia-Tawya. A further difference is found in the species composition of the kill. The three most valuable ungulates, Red River Hog, Black Duiker and Bay Duiker were not observed in the camps in Bia Trib. North F.R. at all. The Royal Antelope which was the most important ungulate in the kill in Bia Trib. North F.R., was rarely shot in Bia-Tawya. The Royal Antelope occurs in good numbers in the Bia-Tawya, but hunters there do not feel that this tiny antelope is worth enough, i.e. 60 np, to warrant the expenditure of a cartridge. On the other hand, in Bia-Tawya they shot a greater proportion of primates. This could be due to a greater abundance of primates, a difference in hunting methods or a difference in attitude towards the meat of primates.

The value of bushmeat observed in the hunting camps is given in Table 10. The total value of the meat observed divided by the number of visits made gives:

Bia Trib. North F.R.	$\frac{20.90 \text{ N}\text{\textcircled{C}}}{12 \text{ visits}}$	= 1.74 N\text{\textcircled{C}} per visit
Bia-Tawya	$\frac{607.20 \text{ N}\text{\textcircled{C}}}{15 \text{ visits}}$	= 40.95 N\text{\textcircled{C}} per visit

Difference in hunting methods are such that these figures cannot be extrapolated to give the economic return per hunter, but they are useful in comparing the economic return from hunting in different areas. It can be seen that hunting in the Bia Trib. North F.R., where over-hunting has reduced animal populations to very low levels, provides an economic return that is less than 5% of that from the Bia-Tawya area, where animal populations are still high.

Table 10. The value of bushmeat observed in hunting camps.

SPECIES	UNIT VALUE	BIA TRIB, NORTH F.R.		BIA-TAWYA AREA	
		No.	Value	No.	Value
Royal Antelope	.60 Nø	4		2	1.20 Nø
	1.20	4	4.80 Nø		
Maxwell's Duiker	4.00	3	12.00	50	200.00
Bay Duiker	18.00	-	-	13	104.00
Black Duiker	10.00	-	-	11	110.00
Red River Hog	10.00	-	-	10	100.00
Sub-total -ungulates		7	16.50	86	515.00
Spot-nosed Monkey	1.20	1	1.20		
	2.00			17	34.00
Mona Monkey	2.00	-	-	11	22.00
Olive Colobus	2.00	-	-	1	2.00
Black Colobus	4.00	-	-	1	4.00
Mangabey	6.00	-	-	4	24.00
Green Monkey (?)	2.00	-	-	1	2.00
Sub-total -primates		1	1.20	45	188.00
Pangolin (2 species)	.60	-	-	5	3.00
Genet Cat	1.40	1	1.40	-	-
Civet Cat	1.00	-	-	1	1.00
Brush-tailed Porcupine	1.00			7	7.00
	1.50	1	1.50		
TOTAL		10	20.90 Nø	134	614.20 Nø

NATIONAL PARKS AND TOURISM

Another form of land use related to the wildlife resource is the development of areas as National Parks. Such areas can contribute substantially to the economy of an area, if a strong tourist trade is developed. It should be noted that the road running through the Bia River area is an important potential route for a road connecting Kuvasi to Abidjan via Sefwi Wiawso and Abengourou. In the future the road will probably become a major route. A visitor facility developed in the Bia River area could provide an excellent stop-over point for people travelling between these two points. A National Park would add to the attraction of this route and undoubtedly would be included in the plans of any tourists travelling through West Africa.

The wildlife of the high forest could become a very important tourist attraction. All primates, especially chimpanzees, hold a special fascination for visitors. The ungulates, from the spectacular Bongo with its multiple stripes, to the diminutive Royal Antelope provide no less fascination. Many of the other species present, many of which are unique to West Africa, would also be very interesting to visitors to West Africa. Development of a National Park in which the high forest species could be observed relatively easily would require very careful planning and management. However, once developed such an area would be unique. Numerous National Parks in Africa provide visitors with an opportunity to see the wildlife typical of the savanna zone, but at present none provides an opportunity to see the wildlife of the high forest. Development of a National Park in this area therefore provides Ghana with a special opportunity for development of their tourist industry.

However, development of this kind must be considered carefully. Development of this kind requires a substantial outlay of resources, since no other forms of land use can be allowed within a National Park.

RESOLUTIONS OF CONFLICTS BETWEEN LAND USES

To properly plan development of resources in the area it is necessary to look at conflicts between different land uses and attempt to find means of dealing with such conflicts. Each of the potential problems of this kind are listed below and discussed.

FARMING AND LOGGING

These two land uses are primarily incompatible where farming takes place before the area has been logged. The incompatibility lies in the fact that farmers destroy many trees of economic value when they clear land for their farms. On the other hand, the road building necessary in logging operations often results in damage to farmland, though in this case, the farmers are paid compensation by the logging companies.

The obvious solution to this problem has been implemented in this area; forest lands are protected as Forest Reserves, other areas are logged and then converted to farmland. This however, leaves the problem of the Proposed Forest Reserves in which it is yet to be decided which form of land use will dominate.

FARMING AND WILDLIFE

HABITAT DESTRUCTION: As discussed, farming severely damages wildlife's habitat. It is therefore necessary to separate these two forms of land use.

ELEPHANT DAMAGE - This problem is widespread in Africa and has been studied in several areas. The following alternatives are generally thought to be available for dealing with this problem.

(a) Extirpation

This is an obvious solution to the problem. However, it is untenable in this area and in Ghana due to the scarcity of this species. Extirpation is not an alternative until the elephant is protected in at least one area in the High Forest. However, one possibility does present itself. Elephants in the Bia area are noticeably restricted to areas in which water is readily available, at least in the dry season. The elephants in the area can be divided into three distinct herd units, one each in the drainages of the Adjuafoa, Tawya and Sukusuku Rivers. It may be possible to destroy the herd in the Adjuafoa River drainage without expecting an immediate movement into the area from the other areas. The height of land might act as a barrier. Though the chances of success are very slim, this alternative should be tested.

since it might provide a easy and inexpensive solution to the problem.

b. Buffer Zones

The use of buffer zones of Forest Reserve around a Reserve for elephants has been suggested by Gennely (1962) and Curry-Lindal (1968) as a solution to the problems in the Goas area. A variation on this concept may provide a viable solution to the elephant problem in some parts of the Bia area. In the Sukusuku and Bia-Tawya areas, numerous farms are established and probably will be allowed to remain. They will provide a major problem in the future as elephant raiding will no doubt continue, but the density of farms in these areas is not sufficient to warrant the expenditure of elephant-proof ditches. However, if farming in these areas could be restricted to the growing of cocoa and coffee only, then an effective buffer zone could be set up. The elephants would have to travel approximately 5 miles in order to reach food farms outside the Forest Reserve boundary, and would have to leave one watershed and move into another.

c. Elephant-proof Barriers

Barriers consisting of a ditch and fence have been found to be the only 100 % effective and permanent method of controlling elephants. Extensive work has been done on this subject by Woodley (1965) in Kenya. He has developed a combination ditch and fence described in Figure 6. This barrier has been used in Abedares National Park in Kenya and has been completely effective. The dimensions of the ditch appear at first to be too small to effectively stop an elephant, but the design of the ditch utilizes:

- i. the elephant's fear of falling.
- ii. the elephant's inability to jump.

Thus the relatively narrow ditch can act as a barrier. Woodley found that such a ditch cost approximately N/ 2,000.00 per mile in

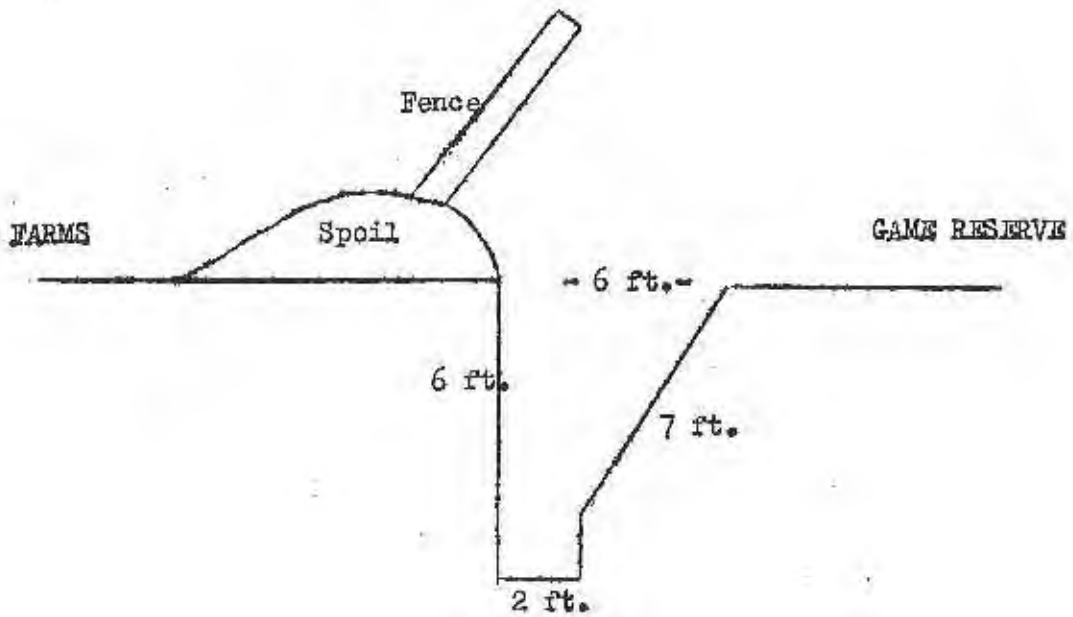
mountains terrain in Kenya. During our work in the area two short ditches were dug to get an estimate of the cost of building such a ditch in that area. It is estimated that an effective ditch could be built for approximately N/1,000.00 per mile. The lower cost is primarily due to:

- i. The low cost of labour.
- ii. All the potential routes for ditches are in areas which have already been cleared, i.e. forest reserve boundaries.

A second alternative has been tested by Vesey-Fitzgerald (1968) in Arusha National Park in Tanzania. This method utilizes an electric fence which gives the elephant a shock when he touches it. Though problems were found in the early stages, the fence was found to be effective once the elephants became used to the presence of the fence. This type of barrier could be used very cheaply in our situation, since no fence posts would be necessary and an electric generator is already located within 300 yards of where the barrier is needed. However, the success of this barrier hinges on it's observability, and this may provide a problem.

An elephant barrier, either a ditch or an electric fence, running from the Gliksten Bungalow south to Pillar 13 of Bia Trib. South F.R., and covering a distance of 7 miles, should provide effective control of the elephants in that area. Implimentation of course, will involve much more study of the problem.

Figure 6. Elephant-proof Barrier. (From Woodley, 1965.)



LOGGING AND BUSHMEAT PRODUCTION

Intelligent logging, as carried out by the large contractors in the Forest Reserves, is not incompatible with utilization of the wildlife resource for bushmeat production. As discussed, the effect of logging on the wildlife habitat is less important than was expected.

This compatibility gives us a very important alternative, that of managing areas both to produce timber and to produce bushmeat.

LOGGING AND NATIONAL PARKS

One of the most important aspects of National Park management is retaining the vegetation of the Park in its unaltered, natural state. Therefore logging cannot be allowed. Therefore, in the Bia River area, establishing a National Park would come in direct conflict with plans for utilizing the timber of the area. The best way to minimize this conflict is to make a complete inventory of both forest and wildlife resources to locate the most important areas for each resource and to locate those areas in which the two forms of land use are most compatible, that is, where the values of one are maximized and those of the other are minimized. In the Bia River area viable alternatives to this problem do present themselves, as discussed below.

PART III - RECOMMENDATIONS

Based on the information provided in the previous section, it is recommended that:-

- (1) The north half of the Krokosua Hills be developed as a National Park, to:
 - (a) Act as a reservoir in which wildlife numbers can build up and then begin re-stocking the surrounding area;
 - (b) Provide protection for the several rare species which are in danger of extinction in the area;
 - (c) Protect an area which is unique ecologically;
 - (d) Protect the scenic potential of the area so that it can eventually be developed as a tourist attraction.
- (2) A Game Production Area be established to encompass the Bia Tributaries South Forest Reserves and the Proposed Sukuusuku and Bia-Tawya Forest Reserves to:
 - (a) Control the production of bushmeat in the area and eventually to develop programmes to put production on a sustained yield basis.
 - (b) Find a solution to the elephant problem in the area, utilizing one of the alternatives available, or more likely a combination of them.
 - (c) Protect the rare species in the area by:-
 - i. Providing habitat protection over a large area;
 - ii. Establishing our staff in the area, who can enforce regulations protecting rare species.
 - iii. Establishing wildlife protection over a large enough area that important larger species such as the Bongo, Elephant, and Yellow-backed Duiker will be able to survive.

The potential of these areas and the best avenues for their development are discussed below.

KROKOSUA HILLS

A variety of factors make this an excellent location for the establishment of a National Park. All the high forest species occur in the area, and all the primates and more abundant ungulates are found in the hills themselves. However, they occur in very low numbers. Many species in the area need immediate and complete protection if there are to survive.

(a) The Reserve could be very effective in it's first goal, that of re-stocking the surrounding areas, since it is connected to other areas by arms of the Krokosua Hills Forest Reserve. Thus, after the numbers of wildlife in the area have been allowed to build up, they could then disperse to re-stock other areas via these connecting arms.

(b) As discussed previously, it is also of prime importance to provide protection for the rare species found in the area, since this is a matter of international concern. A Reserve in the Krokosua Hills as discussed below would provide protection for the following species:-

Olive Colobus (Colobus verus) - listed in I.U.C.N. list of
Endangered species.

Red Colobus (Colobus badius)

Black Colobus (Colobus polykomos)

Diana Monkey (Cercopithecus diana)

Chimpanzee (Pan troglodytes)

Forest Leopard (Panthera pardus)

Several other rare or uncommon species occur in the Bia River area. Some of these species have probably survived in low numbers in the Krokosua Hills.

(c) The area contains the "Nsesreso", a series of small meadows found on the ridge-top on the highest part of the hills. They are unique to Ghana, the only other meadows of this type were on the Bibiani Hills, and have been destroyed by mining practices in that area (Hall, J. pers. comm.) They are also unique ecologically, several species of plants have been found in the meadows which are not found anywhere else in Ghana (See Appendix B).

(d) The area is also very scenic. The view from 1800 feet up on the ridge is exceptional, the forest on the ridge-top is very open and pleasant, the streams running down from the hills are crystal-clear and fast flowing.

Two water-falls, both small but very pretty, were found during the study. Both are of special significance in local traditions.

Even on the hottest days it is still quite pleasant on the ridge-top. All of these give the area excellent long-term potential as a tourist resort. A lodge could be built on the ridge-top with a view, the cool environment, trails along the ridge and streams, and perhaps the development of a semi-wild community of primates and small ungulates around the lodge. The Spanish doctors at the hospital at Asafo had developed a similar situation in their court-yard. They have raised several monkeys and quikers brought to them by local hunters, all of which run wild in their enclosure. A similar situation could be set up around a lodge on the ridge-top. The animals would probably remain in the vicinity of the lodge if water and food were provided, since the steep hill sides would act as fairly effective barriers on two sides. We could thus provide an extremely attractive situation for visitors.

A variety of other more practical factors are operating to make this an excellent choice as an area for a National Park. During the study, a short survey was done of the economic species present in the forest on the steep hilly portions of the Krokosua Hills. The results of this survey are shown in Table 8. It is obvious from these figures that, from a logging point of view, the forest on the hills is extremely poor, even when compared only to the surrounding flat-lands. (They in turn, support the poorest forest found in Ghana). The pooriness of the forest, coupled with the short bole lengths which occur and the extreme steepness of the hills (the hills are deeply incised and the many slopes are extremely steep), make it impossible to log the area economically. The Forestry Department considers the entire hill area to be unexploitable and has defined it as part of the Protection Working Circle, which is designed to provide watershed protection, not to produce timber. As a result there should be minimum of conflict with logging interests in the area.

Another related factor is the presence, within 500 yards of the Reserve boundary, and on the only access road to the Reserve, of a large 9 room, two-storey bungalow built during the Nkrumah era for the District Administrator. It has never been occupied, though it is fully furnished. If arrangements could be made, it would be a perfect location for the Headquarters of the Department in the area.

DEVELOPMENT

The initial steps in development would involve first, the demarcation of the unexploitable portion of the Reserve, roughly along the boundaries indicated for the Protection Working Circle in Figure 7, in conjunction with the Forestry Department and the Concession Holder, Kaffour Logging Limited. The area could then be gazetted as a National Park, covering approximately 30 square miles. Anti-poaching work could then be begun.

Further possibilities for expansion are:-

- (a) Addition of the southern half of the Krokosua hills. This would involve making some arrangement concerning the 15 farms which are included in the Reserve.
- (b) Establishing the remainder of parts of the Krokosua Hills Forest Reserve as Game Production Areas.
- (c) Including some of the surrounding lowland forest in the Reserve. This would provide habitat for the Bongo (Boocorucus euryceros) the Yellow-backed Duiker (Cephalophus silvicultor) and the Giant Forest Hog (Hylchoerus meinertzhageni), all of which occur in the area but are not believed to occur in the steep hilly portions of the Reserve.
- (d) Extending the boundaries in the north-west to include riverian habitat along the Bia River. Bush Cow (Synerosus caffer nanus) is thought to occur in that area.

From this discussion I think it can be seen that this area provides an excellent opportunity in which a National Park can be established with a minimum of conflict with other land uses in the area. It would also provide a base from which wildlife management in the greater area can be initiated, and help establish a tourist industry in the area.

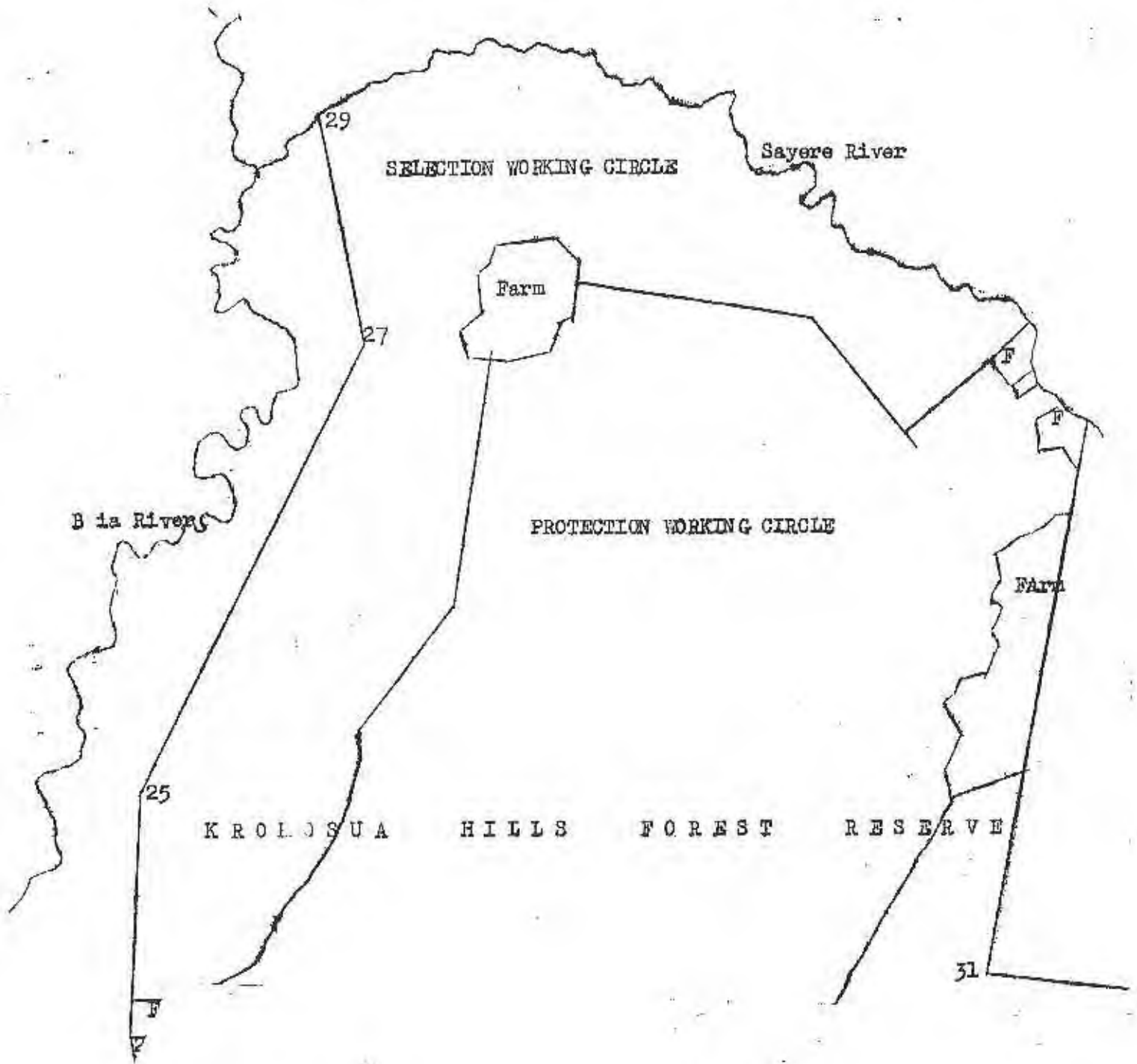


Figure 7. - Krokosua Hills Proposed National Park

GAME PRODUCTION AREA

The establishment of a large Game Production Area in the southern portion of the Bia area should probably be considered a priority.

BIA TRIBUTARY SOUTH FOREST RESERVE

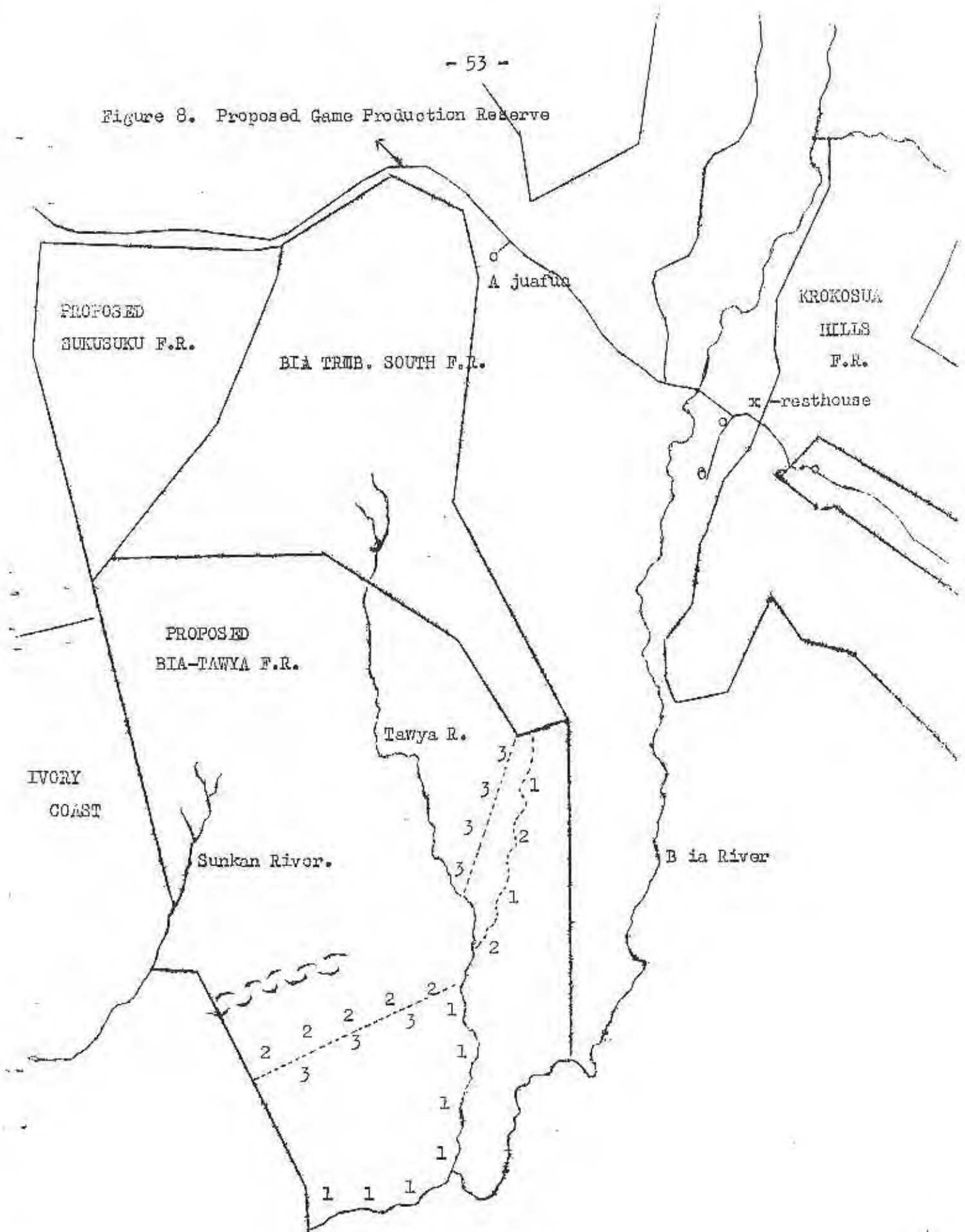
This area is of interest primarily due to the elephant problem, but its inclusion is necessary to the larger reserve. Hunting in the area is less intense than in other areas due to the hunter's fear of the elephants.

Development of the area should begin with gazetting the area, after discussions with the Forestry Department and the Min Timber Company. No farms occur in the area, and all the boundaries are already established, out and pillarod. This would give us the kind of control over the area necessary for controlling and studying bushmeat production in the area, and testing the alternatives available for dealing with the elephant problem.

SUKUSUKU PROPOSED FOREST RESERVE

This is an area of contention between logging interest and farmers. The area has been demarcated as a proposed Forest Reserve, but at the same time numerous farms have been established. However, none of the farms are more than 3 years old. Hunting is the most important form of land use in the area. Fifteen different hunting camps were found in the area. The meat production from these camps is considerable, but it was noted that much of the meat killed in this area, especially in the southern portion, is taken into Ivory Coast and sold there. Elephants occur in fair numbers in the area, but do not cause any damage in Ghana. Though inclusion of this area is not absolutely necessary to the large Game Production Area, if farming is allowed in this area, a number of problems will result that will be difficult to solve. For example, the elephants in the area would have to be either removed entirely from Sukusuku and Bia Tributary South Forest Reserve or about 10 miles of barrier built. Also the effectiveness of the Production Reserve would be seriously reduced.

Figure 8. Proposed Game Production Reserve



BIA-TAWYA PROPOSED RESERVE

This is a large and relatively untouched area with great potential for development of the wildlife resource. Gliksten West Africa Limited does not plan to begin logging in the area for several years, and farming is restricted to the eastern portion of the area along the Debe, Bia and the Tawya Rivers (See Figure 8). It appears that a dry season concentration of wildlife occurs in the centre of the Tawya area, probably in part explaining the large number of animals observed. Much of the upper basin of the Tawya River is entirely dry at the end of the dry season when this study was carried out. The result is wildlife concentrations that rarely occur in the high forest, making this an area of special importance.

DEVELOPMENT

The Bia-Tawya Proposed Reserve, as presently demarcated, probably can not be used for establishing a Game Production Area. Some villages occur within the present boundaries and it is unlikely that they will be removed. (They have been farming in the area for 22 years). Therefore demarcation is necessary. Three alternatives are available.

1. The Debe, Tawya and Bia rivers could be used for boundaries and no line would have to be cut. (See Figure 8). This would include 15 established farms. None are over 300 acres and no large villages are included, but some of the farms have been established for some time.
2. The Debe, and Tawya Rivers could be used and eight miles of line cut from the Tawya River to the International boundary along the base of the range of hills in the area. This would be an excellent route, providing natural barriers which will probably be valuable in the future in dealing with elephant raiding problem. Only three farms would have to be removed using this route.
3. The Tawya River could be used and 13 miles of line cut, the miles described above and a further 5 miles connecting the Tawya River to the southern boundary of Bia Tributary South Forest Reserve. This would mean that only one farm, (actually just as a large hunting and fishing camp), would remain inside the borders of the Reserve.

Establishment of a Game Production Area as described above and establishing a buffer zone of Forest Reserve along the eastern border would be an excellent arrangement for dealing with the elephant problem and other wildlife problems likely to arise in the future.

It is important to note that the Bia-Tawya is the most important of the three reserves from a wildlife stand-point, due to the dry season concentrations that occur in the area. Much of the upper Tawya basin and the Bia Tributary South Forest Reserve lack water during part of the year and thus could not be expected to support viable wildlife population on their own. The areas along the Sunken and Tawya Rivers which retain water throughout the year will be the focal point of the Reserve. It will be necessary in the future to protect these areas. At the present time too little is known about the habitat requirements of High Forest wildlife, or about the Bia-Tawya area, to be able to delineate these areas. Further work is necessary, leading to the establishment of a National Park or Strict Nature Reserve in the area of greatest concentration. This would give complete protection to a sample of the low-land forest type, as opposed to the upland type found in the Krokosua Hills, and would provide an area in which research on unexploited wildlife populations could be carried out. Such research is necessary for proper management of exploited wildlife populations.

A further point that should be given consideration; Wildlife workers in Ivory Coast are apparently considering setting up a Game Production Area in one of their Forest Reserves which abuts the Bia-Tawya area. This provides an excellent opportunity for establishment of an international reserve, thus solving boundary problems on both sides.

CONCLUSIONS

The reserves suggested here provide an opportunity for developing wildlife in the Sefwi area with a minimum of conflict with other land uses. By so doing it is hoped that wildlife management can become an accepted form of land use in the area and so contribute to the development of the area.

APPENDICES

- Appendix A - The Status of the Pygmy Hippo (Choeropsis liberiensis) in the Western Region, Ghana.
- Appendix B - The botanical uniqueness of the Nsesareso meadows in the Krokosun Hill, By J.B. Hall, Botany Department; Legon.

THE STATUS OF THE PYGMY HIPPO
(*Choetopris Liberiensis*)

IN THE WESTERN REGION, GHANA.

The Faunal Survey Team of the Department of Game and Wildlife spent a total of three months between December 1st 1970 and March, 1st 1970, carrying out a faunal survey of the Bia River area in Sefwi District, Western Region. The primary purpose of the survey was to establish the status of Pygmy Hippo in the area.

The study was initiated as the result of a skull, thought to be that of a Pygmy Hippo, found for sale in the Kumasi market, in 1963. The animal was thought to have come from the Bia River area. The Pygmy Hippo is known for southern Nigeria and from Ivory Coast west of the Bandama River so the possibility existed that a small pocket of Pygmy Hippo occurred in the Bia area. *Raphia* swamps, *Raphia vinifer* and *R. gigantea*, which Dekeyser (1955), indicates as the habitat of this species, is found extensively in the Bia area.

A total of 8 personnel were involved in the project; one Asst. Game Warden, 5 Game Rangers and 2 Game Scouts. Of these, one Game Ranger and one Game Scout spent a total of one month in the Tawya River area, a very inaccessible area, and the area in which the Pygmy Hippo would most likely occur. Several trips were also made into potential areas in the Sukuakui and Bia Trib. South Forest Reserves. Staff working in relatively dry and hilly area, (Bia Trib. North and Krokosua Hills Forest Reserve), also checked on the Pygmy Hippo though there was little chance of it occurring in those areas.

The areas studied is in the extreme west of Ghana abutting the Ivory Coast border, 100 - 150 miles inland. The area is flat and slightly rolling, elevation is 600 - 700 feet rising to 1800 feet in the Krokosua Hills. The vegetation of the area is classified as the *Celtis-Triplochiton* Association of the Moist Semi-deciduous Forest Zone, by Taylor, (1952). Monney (1959), further subdivides the Bia area as a separate sub-type within this association. The area was, until recently, one of the least developed and most inaccessible areas remaining in southern Ghana. As a result wildlife is more abundant here than in other areas.

During the survey, several hundred miles were walked through the areas in which Pygmy Hippo was expected. No evidence was found. However talking to the local people produced the following:

- i. A school boy at the Secondary School at Sefwi Wiawso described seeing a large creature in the Tano River near the school. If not just imagination alone, then it could have been either African Manatee (Trichechus senegalensis) or the large Hippopotamus (Hippopotamus amphibius). Both species are reputed to occur in the lower portions of the Tano River.
- ii. A hunter from Ajuafua gave me an excellent description of the body shape and size, the track, and the habitat of the Pygmy Hippo. However, I learned that he had heard previously of our search and had discussed the Pygmy Hippo with other members of the team. Other hunters in the same area were unable to identify the animal.
- iii. A few hunters in the Tawya area were able to describe an animal that was definitely a "hippo". One claimed to have killed five in the Ivory Coast. From the description given, it is most likely that they were the large Hippo (Hippopotamus amphibius).

The most probable explanation for the supposed occurrence of Pygmy Hippo in this area is the following:-

The large Hippo (Hippopotamus amphibius) is known to occur or has occurred until recently, in the lower portions of the Tano and Bia Rivers south of the study area, and the Komoe River some 20 miles west of the study area, in the Ivory Coast. In the wet season, it is possible that young hippo could have moved into the study area via the Bia, Tawya, Sunkan, Sukusuku and Manzan Rivers. (Hippos moving up the Tano River could account for the possible sighting at Sefwi Wiawso). This provides, I feel, the best explanation for the supposed occurrence of Pygmy Hippo. It is very unlikely that Pygmy Hippo occurs or ever has occurred in the area.

However, work will be continuing in the area and the final possibilities will be checked out. A study of the Ankasa Forest Reserve near the mouth of the Tano River was carried out in March and April, but no evidence was found. (This is the one other large inaccessible area remaining in the Western Region and is the one other area in which the Pygmy Hippo might occur.) We hope to return to the Bia River area in September, to establish a permanent station for the Department of Game and Wildlife. Thus, if the Pygmy Hippo does occur in that area, it's presence will eventually come to light.

Though the Pygmy Hippo was not found, a variety of other rare or uncommon species were found in the area. They include:-

Chimpanzee <u>Pan troglodytes</u>	Observed.
Diana Monkey <u>Cercopithecus diana</u>	Obs.
Red Colobus <u>Colobus badius</u>	tantatively observed
Black Colobus <u>C. polykomos</u>	Obs.
Olive Colobus <u>C. verus</u>	Documented, (skull & skin collected), by Sonia Jeffrey, a biologist living in the area.
Bushcow <u>Syncerus caffer nanus</u>	evidence found.
Bongo <u>Boccorcus euryceros</u>	Evidence, Doc. by Sonia Jeffrey.
Yellow-backed Duiker <u>Cephalophus sylvicultor</u>	Doc. - skin & skull
Giant Pangolin <u>Manis gigantea</u>	Obs. by S. Jeffrey
Giant Forest Hog <u>Hylochoerus meinertzhageni</u>	Doc. by S. Jeffrey
Golden Cat <u>Felis aurata</u>	Doc. by S. Jeffrey

All but a few members of the High Forest faunal community have been documented and/or observed in the area by the Faunal Survey Team or Sonia Jeffrey.

KROKOSUA HILLS FOREST RESERVE - SUITABILITY AS NATURE
RESERVE

This forest is situated in the Celtis-Triplochiton Association of Taylor i.e. it is moist, semi-deciduous forest, because the hilly parts of the Reserve are difficult of access they have remained relatively undisturbed, and form an excellent sample of this type of forest which, because of its richness in timber species, is generally greatly affected by lumbering operations. It would be useful to obtain a strict Nature Reserve here as part of an overall plan to secure for posterity a sufficient area of each of the main vegetation types of Ghana.

The level summits of the hills bear a thick ironstone capping which cannot support typical high forest. Here are to be found unique natural openings (nseareso), which bear an interesting flora of forbs and grasses, including:

<i>Andropogon perligulatus</i>	<i>Aeschynomene deightonii</i>
<i>Loudetia kagerensis</i>	<i>Brillantaisia lanium</i>
<i>Panicum lindleyanum</i>	<i>Hyptis atrorubens</i>
<i>Panicum parvifolium</i>	<i>Thunbergia chrysopa</i>

Aeschynomene deightonii is especially rare, being known elsewhere in Ghana only from the Nyinahin Range.

In a waterhole at one of the nseareso, Dr. E.W. Jones of the University of Oxford recently found a Cleistocarpic moss belonging to a genus Nanomitrium which is probably new to Africa. Growing in a swamp near this opening is a forest dominated by Gilbertiodendron limba which is similar in several ways to forests occurring in the same kind of situation on the Atewa Hills; for example Preussiella kamerunensis and Begonia omini are present in both places. As it seems likely that the Atewa Range will soon be devastated by bauxite mining, reservation of Krokosua Hills would ensure that this type of forest does not disappear. These Gilbertiodendron limba swamps are the only representative in Ghana of true "mossy forest". The limbs of the trees are swathed in hanging festoons of mosses and liverworts such as Bazzania sp., Radula spp., and rare species of Plagiochila, as well as Orthostichidium, Floribundaria, and Pilotrichella.

Orchids are especially abundant in the trees surrounding the mesoso. Some, such as Angraecum birrinense and Ansellia africana have flowers of exceptional beauty, while others, such as Bulbophyllum bufo and B. nigritianum are notably rare.

Interesting ecological studies could be undertaken on this summit plateau into the dynamics of the relationship between forest and savanna. There is some low, dry forest with species such as Elaeophorbia grandifolia, Narkhania tomentosa, and Belonophora hypoglauca. This may possibly represent a stage in the colonization of grassland. Ironstone pan is present under this dry forest, but shows signs of being broken up by the development of forest.

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