# STATUS OF PRIMATE POPULATIONS IN PROTECTED AREAS TARGETED BY THE COMMUNITY FOREST BIODIVERSITY PROJECT.

By

Sylvain Gatti

West African Primate Conservation Action (WAPCA) Ghana

P.O. Box GP1319 Accra, Ghana

This report is prepared for the Ministry of Lands, Forestry and Mines, Ghana, within the context of the FFEM-funded project CFBP: Community Forest Biodiversity Project, Component 1:

The report reflects the personal points of view of the author and does not necessarily represent those of the WAPCA, those of the Wildlife Division or those of their employing organizations.

This internal report of the CFBP was written to support project objectives. It is provided as a reference on components of the approach taken by the project. As a result of project progress, some of the issues and activities within the report may have been superseded at the time of its publication.

# Contents

## Executive summary

Surveys were conducted in four Protected Areas in the Western Region of Ghana in order to asses the status of primate populations. Over a period of two years, 831 surveys were conducted, totaling 5,613km walked in 3,978hrs.

At all sites the encounter rate was low and direct encounters with diurnal primates, very rare. Most were with common, non-specialist, small-bodied species such as Lowe's guenon (*Cercopithecus campbelli lowei*) and Lesser Spot-nosed guenon (*Cercopithecus petaurista petaurista*)

The status of the most endangered species remains worrying. Few encounters were recorded with White-naped mangabeys (*Cercocebus atys lunulatus*) and only in Ankasa and Cape Three Points. Signs of Chimpanzees were only recorded in Bia and Krokosua Hills; their status is unconfirmed in Ankasa. Black and white colobus (*Colobus vellerosus*) were rarely reported. The fate of the Roloway guenon (*Cercopithecus diana roloway*) is of particular concern as only unconfirmed sightings/calls are reported for Ankasa. This species may therefore be on the brink of extinction in Ghana.

Hunting pressure is alarmingly high in Forest Reserves, and does not yet seem to be under sufficient control in the two Conservation Areas to prevent the steady decline of mammal populations. It is urgent that Wildlife Division increases its effectiveness and improves conditions for its field staff in order to provide better protection in its Conservation Areas.

Areas of potential animal diversity and richness with intact or only slightly degraded habitat, such as some parts of the GSBAs of Cape Three Points and Krokosua, should be given better protection status. It is considered that their protected area status could be changed and brought under the management of Wildlife Division, if provision of the necessary resources (e.g. manpower) for effective protection can be ensured. It is thought that such an action should be implemented quickly due to the high human population pressure and levels of degradation already observed.

Ecotourism based on wildlife sightings with the current number of visitors and the low likelihood of viewing wildlife, is not currently feasible and therefore cannot provide significant income to either WD or local communities.

It is considered that there needs to be a change in political will so that the environment is seen as natural heritage to preserve rather than a resource to exploit. It is hoped that this change in priority may in turn provide WD with the necessary financial and human resources to save Ghana's wildlife and more particularly its endemic primate fauna.

# 1.  Introduction

The consultant was engaged by West African Primate Conservation Action (WAPCA) in the context of the Community Forest Biodiversity Project (CFBP) to implement the following tasks:

- To conduct field censuses to evaluate the status of primate populations according to international standards. Carry out interviews with WD staff, hunters and other local people in the target areas to identify priority sites for surveys. Conduct surveys carried out in all four areas in rotation, to account for data independence and seasonal variations.

- Training of field staff. A permanent team of WD staff and community members to be introduced to research methods, trained in data collection and monitoring. This team to ensure that work continues in the absence of the researcher. Once the data collected achieves a certain level of reliability it is used to discuss new, adjusted patrol schemes with WD, with the aim of more efficient protection of the monkeys observed.

- Support and assistance for awareness creation activities.
- Support and assistance for ecotourism activities.

**The Community Forest Biodiversity Project**

The forest of Ghana is part of the Eastern Guinean Lowland Forest eco-region, which has some of the highest biological diversity in Africa, both in terms of species richness and endemism. However, due to a combination of high human population density, agricultural practices and logging activities, it is also one of the most threatened forest ecosystems. The forests of Ghana are now reduced to less than 20% of their original size and although most are incorporated in a Protected Area system (Forest Reserves, which can be logged and National Parks or Conservation Areas which are strictly protected), they remain under considerable pressure from adjacent communities and logging activities. Recent data shows that timber extraction is still two to three times above sustainable yield and a large unaccounted portion of it is illegally extracted (World Bank 2007; Hansen & Treue, 2008).

Natural resources, particularly non-timber forest products (NTFP) have become increasingly scarce outside Protected Areas because most land is devoted to cash crops, commonly cocoa. Several animal species, including some primates, are now on the brink of extinction and are categorized globally as "critically endangered".

The overall aim of the project is to conserve a significant portion of the forest ecosystem in the Western region of Ghana by maintaining its ecological functionalities within an interconnected ecological network and as an integral part of the local socio economic landscape.

The Community Forest Biodiversity Project (CFBP) is funded by the Fond Francais pour l'Environnement Mondial, French Fund for Global Environment (FFEM, 1.2M €), the French sister organization of the Global Environmental Facility (GEF). The financial agreement for the FFEM grant was signed between the Ministry of Finance and the French Development Agency (AFD), in charge of managing FFEM funds. Therefore, the Ministry of Lands, Forestry and Mines (MLFM) is in charge of project management, supervision and monitoring. The project owner is the MLFM with Wildlife Division (WD) of the Forestry Commission (FC) as the lead implementing agency. CFBP focuses on community areas surrounding protected areas and on wildlife conservation within the National Parks and Forest Reserves. There are three main objectives carried out in three components:

*Component 1: Conservation of globally endangered species*
*Component 2: Natural resources management and restoration*
*Component 3: Capacity building*

All activities under component 1 are carried out by West African Primate Conservation Action (WAPCA), with focus on the conservation of four of the most endangered primates species (the Miss Waldron's Red Colobus: *Procolobus badius waldroni*, the White-naped Mangabey: *Cercocebus atys lunulatus*, the Roloway Monkey: *Cercopithecus diana roloway*, and the Western Chimpanzee: *Pan troglodytes verus).* Ground surveys to determine the status of these species shall be conducted in close collaboration with the local communities. They will also participate in conservation activities and, if feasible, small scale ecotourism will be developed.

The aim of component 1 of the project will be attained through the achievement of the following specific objective and related results:

*Objective 1: Conserve the most endangered species of primates of the high forest zone by involving local communities*

Result 1.1:  The conservation status of the endangered species is better known

Result 1.2:  The protection of endangered species' population is effective

Result 1.3:  The occurrence of endangered species is valorised through small-scale ecotourism

Result 1.4:  Level of education and awareness of local population on the fate of endangered species increases

**Context**

The forests of the Western Region of Ghana are known to harbor ten primate species (Table 1). Among these species, five are considered as threatened by the International Union for Conservation of Nature (IUCN, 2008). The local subspecies of red colobus (Miss Waldron's Red Colobus [*Procolobus badius waldroni*]) is believed to be extinct by experts (Oates, see McGraw)

A review of previous primate surveys conducted in Ghana was recently compiled by J. Oates along with his own surveys (Oates, 2006). In his review, he reported studies dating back to 1956 (Booth, 1956; Booth, 1958; Martin, 1976; Martin & Asibey, 1979; Asibey, 1978; Asibey, 1971) and mostly short term surveys, led by Oates *et al. (Oates et al., 1996-97; Oates et al., 2000)*, Abedi-Lartey (Abedi-Lartey, 1998; Abedi-Lartey & Amponsah, 1999; Abedi-Lartey, 1999), Magnuson (Magnuson, 2002; Magnuson & Curtin, 2003), Struhsaker *et al.* (Struhsaker & Oates, 1995; Struhsaker, 1993), Deschner & Kpelle (2004), and Deschner *et al.* (2004). His review highlights the steady decline of primate populations over recent decades despite early warning signs (Jeffrey, 1970).

**Table 1.** IUCN status of primate species found in the Western Region

| Species, subspecies | | IUCN status |
|---|---|---|
| | | |
| Bosman's Potto | *Perodicticus potto* | LR/lc |
| Demidoff's Dwarf Galago | *Galagoides demidovii* | LR/lc |
| Olive Colobus | *Procolobus verus* | LR/nt |
| Miss Waldron's Red Colobus | *Procolobus badius waldroni* | CR |
| Western Black-and-White Colobus | *Colobus vellerosus* | VU |
| Lowe's Monkey | *Cercopithecus campbelli lowei* | LR/lc |
| Spot-nosed Monkey | *Cercopithecus petaurista petaurista* | LR/lc |
| Roloway Monkey | *Cercopithecus diana roloway* | CR |
| White-naped Mangabey | *Cercocebus atys lunulatus* | CR |
| Western Chimpanzee | *Pan troglodytes verus* | EN |
| CR: critically endangered, EN: endangered, VU: vulnerable, LR: low risk, lc: lesser concern, nt: not threatened. | | |

During his own, most recent surveys, Oates confirmed his fear that this trend is ongoing and that some of the smaller Protected Areas may have already been emptied of their primates (Oates, 2006). His conclusions recommended an upgrade of the status of reserves that still contain endangered species, expansion and coordination of long term studies on Ghana's primates, increase of staff motivation through new incentives, a review of how Globally Significant Biodiversity Areas (GSBA, see below) function and financing secured for conservation, to prevent WD from facing a scarcity of funds.

The institutional context is favorable for wildlife protection in Ghana. Laws dating back to 1961, and their revision, protect most of the primate species, forbid the detention of wild animals as pets, determine a closed hunting season, forbid the use of snare traps, etc…(Wildlife Division, 2002). A recent bill of 2006 has gone a step further and updated the taxonomy of animals concerned by the laws, putting all primate species and subspecies under Schedule 1 of the law (i.e. fully protected). In reality, the enforcement of these laws is weak due to insufficient man power and a lack of knowledge/understanding of the wildlife laws amongst the police, judiciary and

customs officials, which consequently provides little support for actions by WD. Within WD there is also some inconsistency of law enforcement with examples of a lack of action against, for example, the illegal pet and bushmeat trades.

The protection of wildlife in Ghana falls under the responsibility of the Wildlife Division of the Forestry Commission. WD is also in charge of National Parks, Wildlife Sanctuaries, Nature Reserves and Ramsar sites. The remaining Protected Areas, the Forest Reserves, fall under Forest Services Division (FSD). In several Forest Reserves, surveys of the flora has lead to the establishment of GSBAs, which in addition to highlighting exceptional habitat, aims at protecting the wildlife within these areas. The protection is meant to be implemented and managed by the surrounding communities through a system of Community Biodiversity Advisory Groups (CBAGs). Unfortunately, in the field, the incentives to do this are low or non-existent and in absence of such reward, few protection activities seem to be implemented. The outcomes of this project and the efficacy of GSBA status are doubtful.

**Study Areas**

The four protected areas chosen for this project are located within Ghana's High Forest Zone (Fig. 1). These forests lie within the Upper Guinean Forest Zone of West Africa which has exceptional biodiversity both in terms of species richness and endemism (Conservation International, 2003).
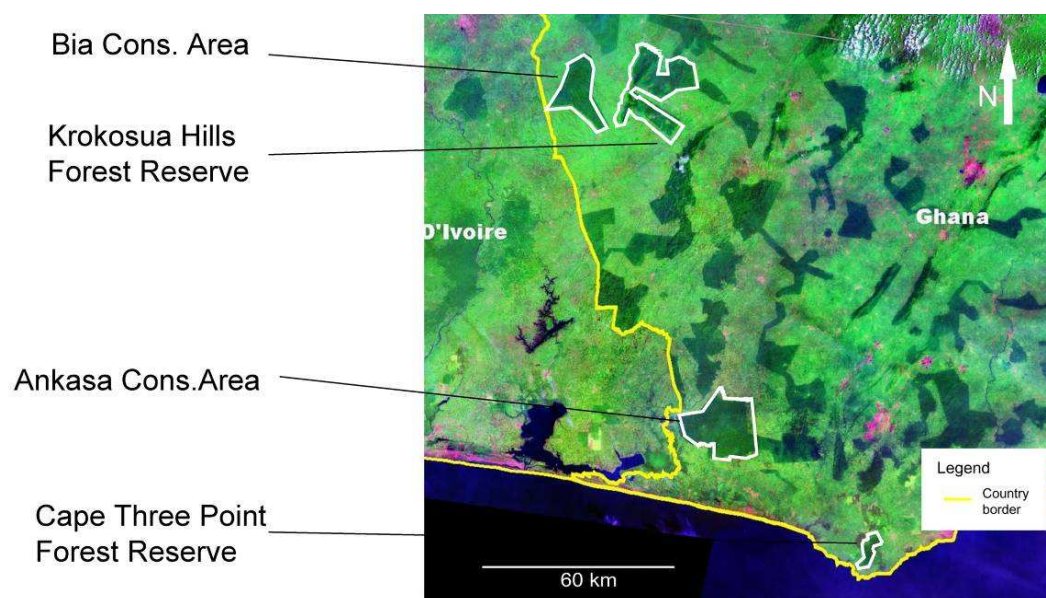


**Figure 1.** Location of the four Protected Areas targeted by CFBP.

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*Ankasa Conservation Area*

The Ankasa Conservation Area lies in Southwest Ghana on the border with Côte d'Ivoire. The Protected Area covers 509 km$^2$, combining the Nini-Suhien National Park and the adjoining Ankasa Resource Reserve. It is situated south of the Nini and Tano Rivers and north of the Axim-Elubo Road.

The total area of the two reserves was gazetted in 1934 as the Ankasa River Forest Reserve. The initial reason behind the conservation of this site was to secure water supplies and climatic conditions for the benefit of agriculture.

Until 1976, selective logging occurred south of the Suhien River. With few valuable commercial species and difficult terrain, logging activities were never intense.

At the same time, access was still granted with permits for hunting, harvesting plants and other non-timber forest products (NTFP). Some farms were admitted within the boundaries, with the village of Nkwanta as the centre of agricultural activities in the reserve.

In 1976, Ankasa was designated a Wildlife Reserve and transferred to the Wildlife Department. This was at the same time that Bia National Park was reduced in size to allow logging. After the admitted farms had been abandoned and returned to forest, Nkwanta was the only village remaining inside the reserve. Whereas most of the farmers relocated themselves along the new Axim-Elubo road in 1989, it was only in 1999 under the Protected Area Development Programme (PADP) that the issue of Nkwanta was resolved. It is probable that intensive hunting occurred in the heart of the reserve until this time.

Before the first phase of PADP, Ankasa was lacking a consistent management plan. The reserve was managed on an *ad hoc* basis and suffered chronic shortages of staff, logistics and finances. Such a situation was fertile ground for intense poaching of the area.

The climate of the Conservation Area is characterized by a distinctive bi-modal rainfall pattern occurring from April to July and September to November. The average annual rainfall is higher than in the other areas studied (1700 to 2000mm). It is classified as lying within the wet evergreen zone. The most recent detailed studies have shown exceptionally high plant

richness, and great diversity of fauna. It is believed to be the only forest under the protection of Wildlife Division to be able to support a large and diverse population of primates.

*Bia Conservation Area*

Bia National Park was the first forest park to be established in Ghana in 1974 (Asibey & Owusu, 1982). In 1976 however, pressure from logging companies drove the government to change the status of a large portion of the park, reducing the National Park to 78 km². A southern section of the former protected area became the Bia Resource Reserve (175 km²). Logging still occurred here until 1995 (Oates, 2006) and only stopped after the intervention of the PADP in 1998. The southern section of the Conservation Area (former Resource Reserve) is thus highly degraded with a broken canopy and dense secondary vegetation limiting access in many places, with some areas largely covered by the invasive plant *Chromoleana odorata* (locally known as "Achempong's Curse"). Bia lies in the transition zone between moist evergreen and moist semi-deciduous forest zones (Hall & Swaine, 1981).

Bia has been classified as an UNESCO Biosphere Reserve and despite a glorious past in primate research (most of it unfortunately unpublished work, Oates, 1999; Curtin, 2002), the change of management in the 1980s led to high levels of hunting and dramatic reductions in primate populations, most notably roloway guenons, black and white colobus and red colobus. Besides a small population of forest elephants, it has become difficult to see medium or large mammals in the Conservation Area.

*Krokosua Hills Forest Reserve*

The Krokosua Hills Forest Reserve (KHFR) was gazetted in 1935. As a Forest Reserve, its main purpose is to secure resources for timber exploitation. The whole protected area covers 482 km² and is situated east of Bia Conservation Area. Krokosua lies in the moist semi-deciduous forest zone (Hall & Swaine, 1981). Most of Krokosua has been heavily logged and is still under exploitation, but the steep hilly terrain in the north east has been designated as a GSBA (142 km²). As the lowlands of Krokosua have been

heavily logged and seemed to offer few chances for primates, activities were focused within the GSBA. In the middle of the GSBA, the village of Mem is situated several kilometres inside the forest.

Farming can be found to extend far within the GSBA, around the Mem settlement, Sanyerano, Adjumandiem and Eteso. Bushfires have also destroyed large areas that are now colonised by invasive species and farmers. Some large scale illegal mining occurs around Adjumandiem.

Previous reports highlighted the great potential of Krokosua because of the mostly untouched hills that could act as a refuge for wildlife. However in the absence of adequate protection, despite its GSBA status, it is a large open opportunity for hunters operating in the area.

*Cape Three Points Forest Reserve*

The Cape Three Points Forest Reserve (CTP) is the smallest of the four working areas, covering an area of 51km². The forest lies in the moist evergreen zone and is one of the few patches of Atlantic forest remaining along the coast of Ghana. CTP is located less than 5km from the coast and has some hilly features. The reserve is surrounded by rural settlements and extensive rubber plantations of the company, GREL (Ghana Rubber Estates Limited). There are also seven admitted farms within the reserve boundaries. In the absence of clear demarcation, as in Krokosua, these farms have slowly extended their area to the detriment of the forest. Though the vegetation remains largely intact, it is under significant pressure from the surrounding populations; illegal felling of trees for canoe carving (high demand from local fishing villages) and construction is common. Despite its small size, the reserve harbours a rich diversity of plant which has led to its designation as a GSBA. Its bird population has also been noted of significant importance during recent surveys.

## 2.    Methodology

**Survey sites**

During the Primatologist's presence, most surveys were conducted from wildlife guards' camps in the National Parks, and from adjacent villages or temporary tented camps in the Forest Reserves. The surveys teams were fully trained in animal identification, particularly of primates (call recognition, identification of species using pictures and drawings), use of GPS. compasses, maps, how to complete the observation forms and to keep personal written records of their observations. Once the teams were trained, surveys where conducted according to the patrol schemes decided by WD management. In Ankasa, most surveys started from the camps of Nkwanta, Ankasa Gate and Tweakor. In Bia, surveys started mainly from the Research Camp (camp 15), Camp 12 (Kunkumso), Chimps Camp (camp 11) and Camp 5. In KHFR, surveys started from Eteso, the enclave of Mem and Adjumandiem. For CTP, surveys started from the internal road to the admitted farm north of Aketekye, and the village of Djedukrom.

**Interviews**

In absence of an assistant for the primatologist, most of the interviews were conducted with park staff for Bia and Ankasa Conservation Areas. For Krokosua and Cape Three Points some villagers, farmers and hunters were interviewed but communication difficulties limited this exercise. Interviewees were asked to freely name all the primates they knew, then all the primates they knew to occur in the area. They were then presented with photographs and pictures of primates and asked to name those they recognized, if they had seen them directly and when was the last time. Some pictures of species not occurring in Ghana were also included as control. Finally, calls of the Ghana primates were played with the interviewees asked to identify them where possible.

**Line transects**

The line transect method has been widely used and is considered the most accurate method of conducting wildlife surveys to study animal populations and calculate species density (Plumptre, 2000; Whitesides *et al.*, 1988; Buckland *et al.*, 1993). The software package DISTANCE (Thomas *et al.*, 2005) is commonly used to analyze data from line transects. However, the use of this method requires certain criteria in order for the mathematical model to be applicable to the data (Buckland *et al.*, 2001):

- objects directly on the transect line are never missed;
- objects do not move before being detected;
- objects are not counted twice in a single transect walk;
- distances and angles are measured accurately;
- sightings are independent events;
- sufficient sightings are made for an accurate estimate of the detection function (usually > 40 sightings).

This method was advised in the implementation document for CFBP. Unfortunately, several constraints prevented use of this method. Firstly WD park management was reluctant for the project to open new transects. Besides the potential disturbance of the habitat, cutting permanent straight line transects is believed to provide additional access for hunters and NFTP gatherers to the forest. This may counteract a better understanding of local animal populations and the improved access gained also by law enforcement teams. Thus only a few new straight line transects were cut in Ankasa and Bia and the project relied mainly on existing trails to conduct surveys. Secondly, during initial surveys it was clear that the rate of encounter with primates, or with any medium or large mammals, would not be sufficient to generate the data required for the mathematical model. Therefore, all surveys conducted utilised the few cut transects, existing tourist and poacher trails, or followed the path of least resistance (scouting or "recce" surveys).

**Recce surveys**

Censuses were conducted on foot by a team of up to three people, usually early in the morning (around 6:00) or late afternoon (15:00-16:00). The team walked slowly (1-2 km/h) while detecting and noting any signs of animal

presence and human activities. The data recorded included all primates and medium-large mammals (equal or larger to a mongoose). Some anecdotal records have included some reptiles (tortoise, monitor lizard, large snakes) or rare, large birds.

Every observation was noted on a data sheet (see Appendix 1) and a GPS waypoint was recorded. Start, stop and back times were also noted to calculate time spent surveying an area and tracks were logged in the GPS to calculate the distance walked/surveyed.

**Signs recorded**

Observations were recorded for any signs of animal or human presence (see table 2).

**Table 2:** Examples of animal and human signs

| Animal signs | Human signs |
|---|---|
| sighting<br>call<br>footprints<br>droppings (fresh/old)<br>feeding signs<br>carcasses<br>nests (recent / old). | sighting (hunter / harvester / trapper)<br>gunshot<br>spent cartridge (recent / old)<br>snare trap (active / inactive)<br>NTFP harvesting<br>carbide pile (byproduct of lanterns used for hunting at night)<br>digging for rats<br>farming<br>mining<br>logging |

For acoustic cues (monkey calls, gunshots…), the compass bearing to the observation was taken. For direct sightings, in addition to compass bearing, the distance was evaluated with a metered rope or tape. Some additional notes were also taken, such as age of the sign (fresh / old, active / inactive trap) and for direct sightings, the number of individuals seen.

In the absence of habituated groups, it is very difficult to describe any group structure for the primates encountered. Following the methods use by Oates (2006) during his last surveys, the data is presented in terms of encounters with one species when one or more individual of one species was detected within less 100m from one or more individual of the same species.

An encounter with a poly-specific association was noted if one or more species were detected at the same point.

No formal night surveys were conducted so the data contains no estimates for the abundance of nocturnal prosimians. However, during night walks or night patrols, the surrounding habitat was search with torchlight to try and confirm the presence of galagos or pottos.

**Data analysis**

As the mathematical models associated with line transects could not be applied to calculate densities, the results take the form of Kilometric Indices of Abundance (KIA), where recorded signs are presented according to the distance walked during the surveys.

**GIS methods**

All data was processed with the Geographical Information System (GIS) software ArcGis 9 (ESRI).

The primatologist gathered maps of the protected areas from PADP I archives as well as from the Resources Management Support Centre *(*RMSC*)*, in Kumasi. In many cases, the maps were not directly exploitable and much time was dedicated to producing electronic maps for the four target areas.

The database of all records and survey tracks were entered on computer and compiled to form a geodatabase. Within this there is a corresponding track for each survey and a series of observations, allowing calculation of the details of a survey (length, time) and the rate of encounter of signs during the survey.

In order to add a spatial dimension to the surveys, a method was developed to calculate the distribution of signs in the targeted areas. KIA is calculated for an entire area, which is not useful for examining the distribution of the abundance of signs within an area. The area was thus divided into a grid of 500x500m cells. For each cell, the sum of the distance walked during all surveys within the cell was calculated, and the numbers of each type of sign was summed. For each cell a KIA was obtained, thus enabling mapping of the distribution of KIA (per 500mx500m cell) on the map of the area. These

calculations were made possible using the Hawth Tools add-on to ArcGis (Beyer, 2004).

**Summary of survey activities**

Several field staff were contracted on a short term basis to assist the primatologist to conduct the research surveys. See Appendix 2 for details of which staff participated in each Protected Area.

The Table 2 shows a summary of the survey activities conducted in the four protected areas. Figures 2a-d show maps of the trails and signs of primates and human activities encountered.

**Table 2.** Summary of survey activities, December 2006 to October 2008.

| Protected Areas | No. of surveys conducted | Total distance surveyed (km) | Total survey time (hr:min) | Total observation time (hr:min) |
|---|---|---|---|---|
| Ankasa Conservation Area | 529 | 3704.17 | 1943:17 | 2468:13 |
| Bia Conservation Area | 204 | 1411.26 | 879:32 | 1085:44 |
| Cape Three Points Forest Reserve | 8 | 50.21 | 36:33 | 36:33 |
| Krokosua Hills Forest Reserve | 90 | 448.24 | 324:15 | 387:57 |
| **Total** | 831 | 5613.88 | 3183:38 | 3978:29 |
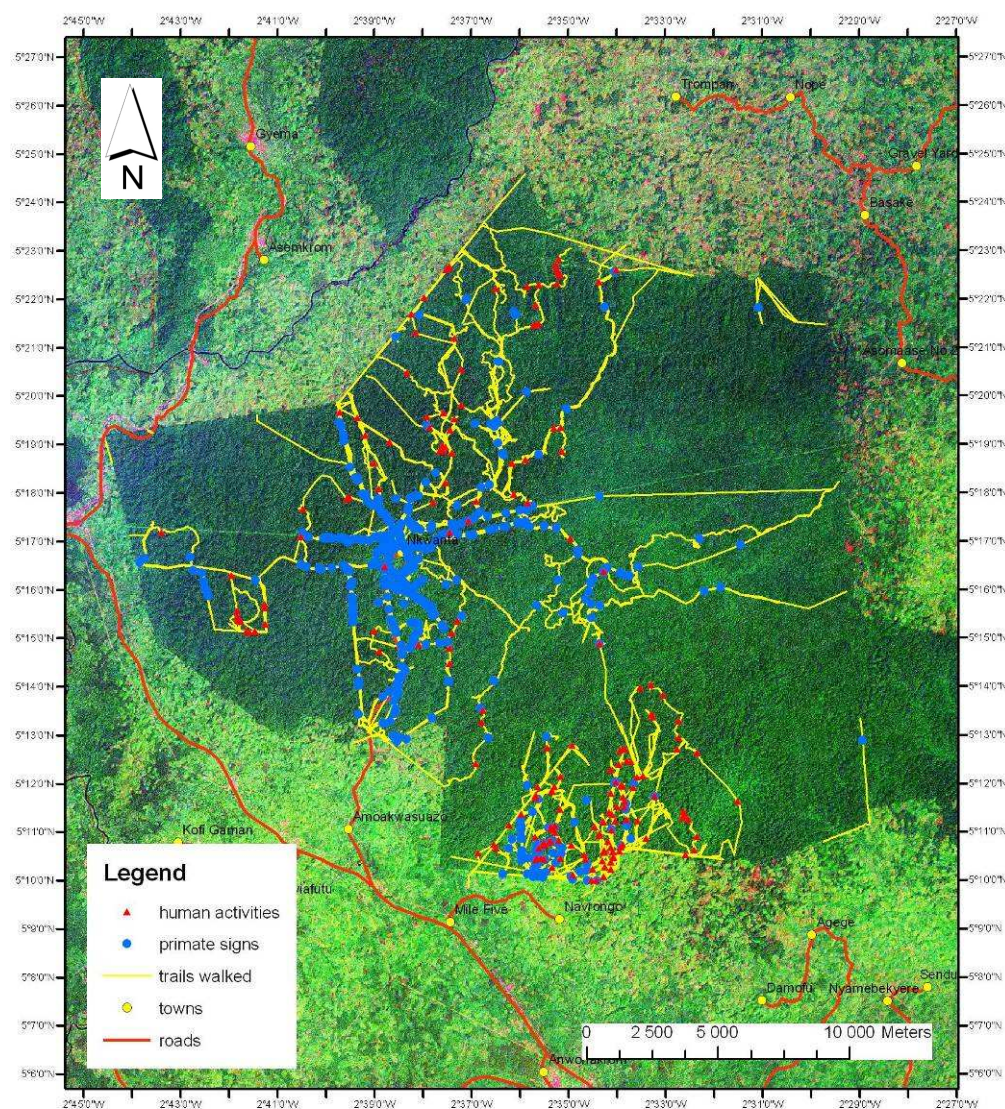
**Fig 2a:** Map of trails, primate and human activity signs in Ankasa Conservation Area.

**Fig 2b:** Map of trails, primate and human activity signs in Bia Conservation Area.

**Fig 2c:** Map of trails, primate and human activity signs in Cape Three Points FR.



**Fig 2d:** Map of trails, primate and human activity signs in Krokosua Hills FR.

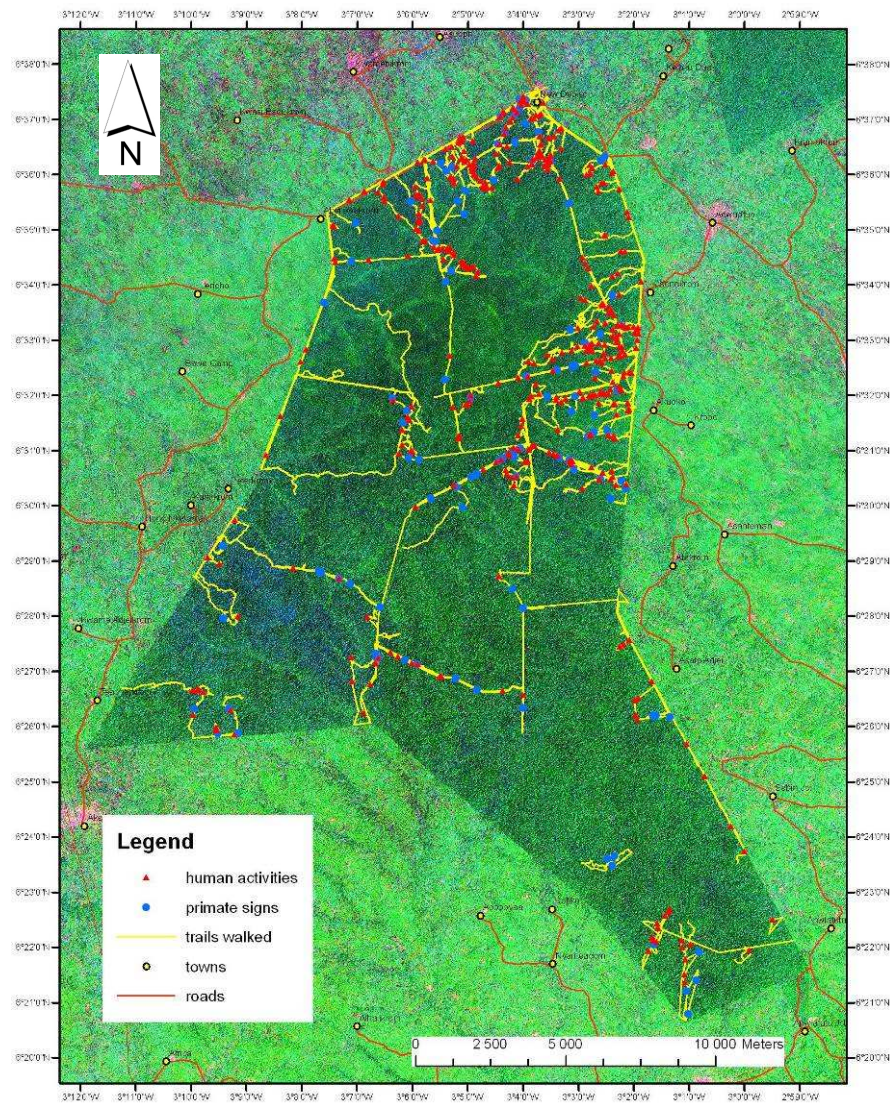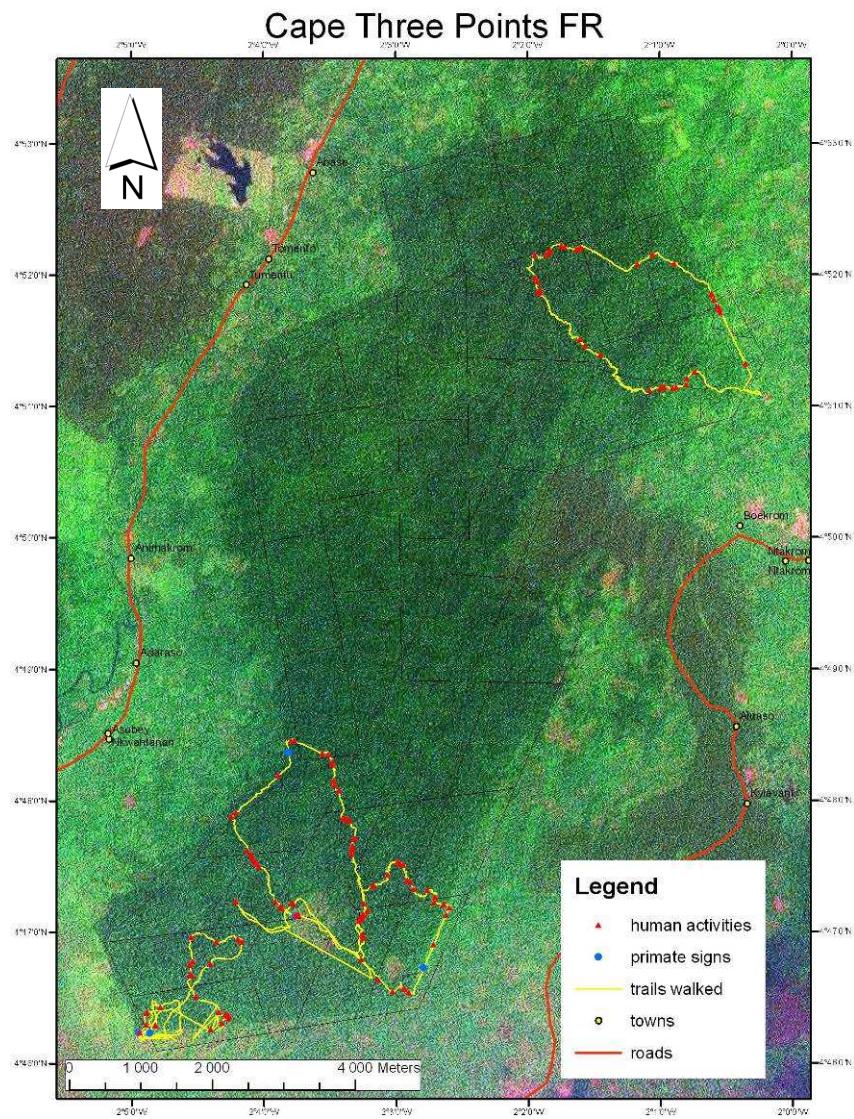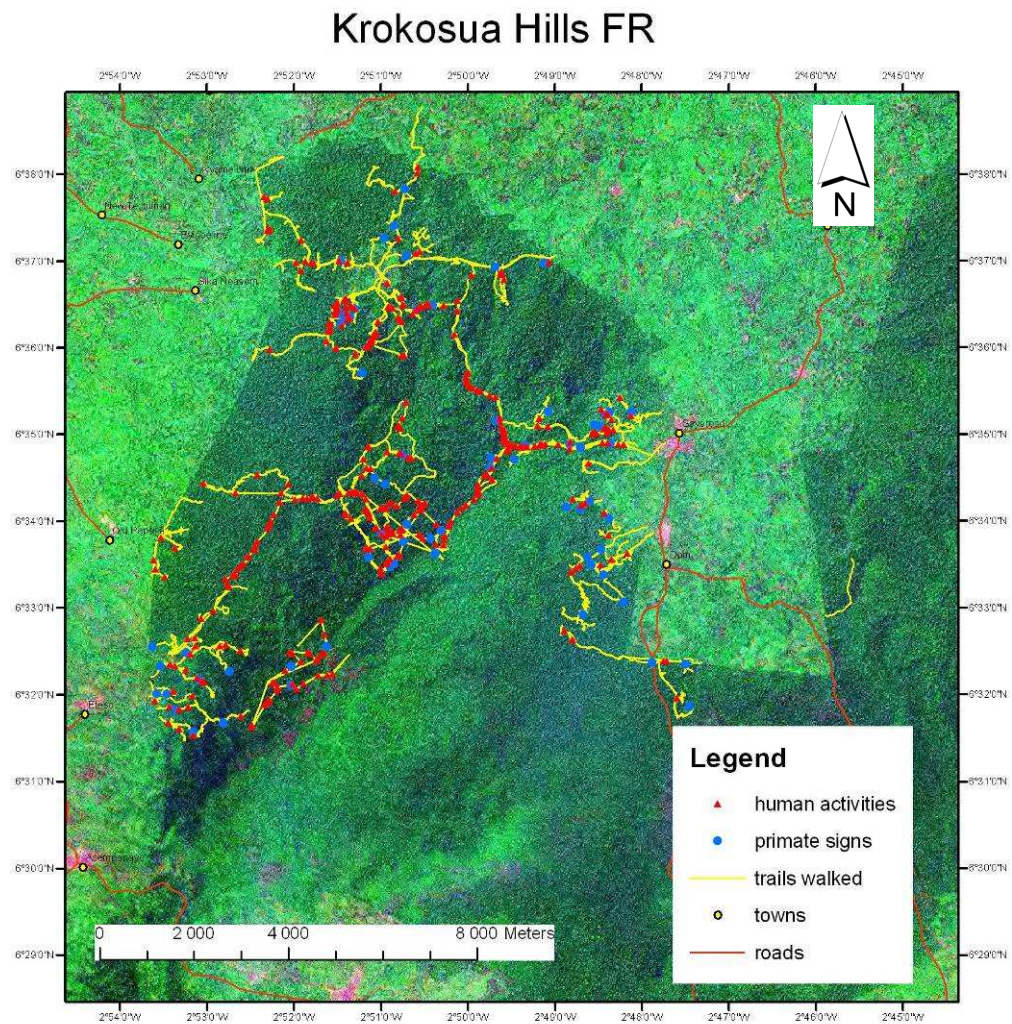## 3.    Study Results

**Interviews**

Results of the interviews showed surprising variability in the accuracy of knowledge on primates. One common feature though, especially among WD staff, was the better knowledge of older interviewees as compared to younger ones. This is not surprising as the dramatic decrease in wildlife has left only the elder with knowledge of the species formerly occurring in the area. Most of the younger recruits from WD have never had the opportunity to encounter most of these animals. This was obvious particularly in Bia where the most accurate answers were given by staff that had experienced the "golden days" of the park during the 70s where they were following habituated troops. The turnover of staff, or recent migration in the case of community members, also accounts for the relative unreliability of local knowledge. In many cases, only Mona monkeys and Spot-nosed were correctly identified. This is not surprising as these are the most common species encountered. Chimpanzees were also mentioned very often but mostly because of their emblematic status; people knew them from sources other than personal experience. Patas and Red Colobus were commonly confused and many were surprised that the whistling of the Olive Colobus was not a bird call. The accuracy on date of the last observation was also variable. From local knowledge, old stories and past status of wildlife lingers. Observations often date from "last year" even when the interview was repeated several times during the last three years. Some people with accurate knowledge on primates were genuinely surprised when informed of their current threatened status in the nearby forest. It is likely the local knowledge has not been able to keep up to date with the pace of change and degradation.

Interviews have to be considered with great care and always paired with observations on site. Except with skilled, experienced and active staff or hunters, the discrepancy between the interview and reality is a challenge since there is no method to ascertain the reliability of the information given.

On this basis, it seemed urgent that the WD staff receive training on primate identification. This was done both for the staff forming the research teams and also on a larger scale during workshops for all WD staff organized in Bia and Ankasa. Furthermore, any story should be confirmed by direct observation, and future studies should be encouraged to verify any report of species occurrence by conducting fieldwork to confirm.

**Primates**

Table 3 summarizes findings on the distribution of primate species within the four targeted Protected Areas.

**Table 3.** Overview of primate sightings in the four Protected Areas.

| Species, subspecies | | Ankasa | Bia | Cape Three Points | Krokosua Hills |
|---|---|---|---|---|---|
| Bosman's Potto | *Perodicticus potto* | C | C | C | C |
| Demidoff's Dwarf Galago | *Galagoides demidovii* | C | C | C | C |
| Olive Colobus | *Procolobus verus* | C | C | | C |
| Miss Waldron's Red Colobus | *Procolobus badius waldroni* | | | | |
| Western Black-and-White Colobus | *Colobus vellerosus* | P | P | C[1] | C |
| Lowe's Monkey | *Cercopithecus campbelli lowei* | C | C | C | C |
| Spot-nosed Monkey | *Cercopithecus petaurista petaurista* | C | C | C | C |
| Roloway Monkey | *Cercopithecus diana roloway* | P[2] | | | |
| White-naped Mangabey | *Cercocebus atys lunulatus* | C | | C[1] | |
| Western Chimpanzee | *Pan troglodytes verus* | C[2] | C | | C |

C: confirmed by direct sightings or acoustical clues; P: presence possible according to indirect evidence or unconfirmed sightings
[1] confirmed by loud calls recorded the ornithologist Ben Phalan, by the confiscation of a young captive animal in an adjacent village and during recent surveys by the WAPCA-trained team outside the report period.
[2] based on calls heard (and unsure sightings for roloways) by WD/WAPCA-trained staff but more evidences are needed for definitive confirmation.

Nocturnal prosimians were present and relatively abundant in all sites. The crescendo calls of the galagos were heard regularly at night in all locations.

Olive Colobus were very discreet and met only on few occasions. They seemed to be absent from Cape Three Points. Black and White Colobus are only possibly present in the two Conservation Areas, but were confirmed in the two Forest Reserves. Sadly, but not surprisingly, there was no sign of red colobus in any area. It should be noted that even during the interviews, with people who genuinely recognized the species, no one claimed presence of this species more recently than a decade.

Mona and Spot-nosed monkeys were found at all sites, often together in poly-specific associations.

The rare White-naped Mangabey was only detected in Ankasa and in Cape Three Points. More disturbing is the lack of detection of the Roloway Guenon. Only in Ankasa, it was claimed to have been observed and heard. Unfortunately, the primatologist could not confirm these observations and staff are still debating the reliability of this report.

Finally, chimpanzees were only confirmed in Bia, where knuckle prints and old nests were found and calls heard at night from Bongo camp; and in Krokosua where a hunter lead us to an old nest group. They were reported repeatedly in Ankasa, based on calls heard at night and some reports from patrols, but definitive evidence is still needed. Considering the low number of signs or encounters, it is likely that there are only small groups or scattered individuals. It is a question whether these small populations are viable in the long term.

Table 4 shows the rates of encounter with primate associations and species according to distance (Kilometric Index of Abundance) or time spent walking during surveys. Most of the encounters were made with Mona and Spot-nosed monkeys. These species are relatively small and more importantly they have a broad diet and relatively unrestricted habitat preference. On the contrary, larger, more specialized species were uncommon or absent.

Ankasa has overall higher encounter rates followed by KHFR, CTP and Bia. Most of the signs were indirect evidence (mainly calls heard). KIA using direct sightings were generally four times lower than indirect encounters. On several occasions, primates were detected by their movement in the foliage but no vocalizations were emitted preventing any identification. This relative silence may result from long term hunting pressure, and as such the primates in Ghana forests may have adapted their behavior to escape detection by hunters.

Overall, the rates of encounter are low (0.09 enc./km for Bia - 0.25 enc./km for Ankasa), lower than reported previously for Ghana (0.26 - 1.26 enc./km, Oates *et al.*, 2000; , 0.38 - 3.5 enc./km, Magnuson, 2002). Considering the distance walked and the time spent, these values can be considered robust. Such low encounter rates can be compared to the those found in similar forests in Cote d'Ivoire where Herbinger (2007) reports rates between 0.39 – 4.21 enc./km in Tai National Park.

**Table 4.** Encounter rates with diurnal primate species during surveys in the four targeted areas. Encounter rates are presented according to signs (direct or indirect) and in the form of Kilometric Index of Abundance (KIA) and number of encounters per search hours.

| Protected area | Total distance surveyed (km) | Total observation time (hr:min) | Species | Species encounters (in assoc.) | Species direct sightings | Species indirect evidences | KIA all signs (enc. / km) | KIA direct enc. (enc. / km) | Total enc. rate (enc. / hr) | Direct enc. rate (enc. / hr) |
|---|---|---|---|---|---|---|---|---|---|---|
| Ankasa | 3704.17 | 2468:13 | *Cerco. cam. lowei* | 587 (238) | 158 | 429 | 0.1585 | 0.0427 | 5.7077 | 1.5363 |
| | | | *Cerco. p. petaurista* | 292 (229) | 129 | 163 | 0.0788 | 0.0348 | 2.8393 | 1.2543 |
| | | | *Cercoc. atys lunulatus* | 18 (11) | 7 | 11 | 0.0049 | 0.0019 | 0.1750 | 0.0681 |
| | | | *Cerco. diana roloway** | 6 (4) | 3 | 3 | 0.0016 | 0.0008 | 0.0583 | 0.0292 |
| | | | *Procol. verus* | 11 (7) | 7 | 4 | 0.0030 | 0.0019 | 0.1070 | 0.0681 |
| | | | *Col. vellerosus** | 6 (6) | 2 | 4 | 0.0016 | 0.0005 | 0.0583 | 0.0194 |
| | | | *Pan t. verus** | 1 (0) | 0 | 1 | 0.0003 | 0 | 0.0097 | 0 |
| | | | Total | | | | 0.2486 | 0.0826 | 8.9554 | 2.9754 |
| Bia | 1411.26 | 1085:44 | *Cerco. cam. lowei* | 75 (34) | 13 | 62 | 0.0531 | 0.0092 | 1.6578 | 0.2874 |
| | | | *Cerco. p. petaurista* | 45 (35) | 12 | 33 | 0.0319 | 0.0085 | 0.9947 | 0.2653 |
| | | | *Procol. verus* | 2 (1) | 1 | 1 | 0.0014 | 0.0007 | 0.0442 | 0.0221 |
| | | | *Pan t. verus* | 4 (0) | 0 | 4 | 0.0028 | 0 | 0.0884 | 0 |
| | | | Total | | | | 0.0893 | 0.0184 | 2.7852 | 0.5747 |
| CTP | 50.21 | 36:33 | *Cerco. cam. lowei* | 4 (1) | 3 | 1 | 0.0797 | 0.0598 | 2.6257 | 1.9693 |
| | | | *Cerco. p. petaurista* | 1 (1) | 1 | 0 | 0.0199 | 0.0199 | 0.6564 | 0.6564 |
| | | | Total | | | | 0.0996 | 0.0797 | 3.2822 | 2.6257 |
| KHFR | 448.24 | 387:57 | *Cerco. cam. lowei* | 55 (49) | 13 | 42 | 0.1227 | 0.0290 | 3.4025 | 0.8042 |
| | | | *Cerco. p. petaurista* | 53 (49) | 13 | 40 | 0.1182 | 0.0290 | 3.2788 | 0.8042 |
| | | | *Procol. verus* | 1 (1) | 1 | 0 | 0.0022 | 0.0022 | 0.0619 | 0.0619 |
| | | | *Col. vellerosus* | 2 (0) | 2 | 0 | 0.0045 | 0.0045 | 0.1237 | 0.1237 |
| | | | *Pan t. verus* | 2 (0) | 0 | 2 | 0.0045 | 0 | 0.1237 | 0 |
| | | | Total | | | | 0.2521 | 0.0647 | 6.9906 | 1.7940 |

*N.B. Aforementioned cautions regarding these observations in the paragraph above.

The maps presented in the Figures 3a – d show the distribution of KIA for primate signs in the four protected areas. For comparison, they are presented side by side with maps of the distribution of KIA for hunting evidence.

In Ankasa, primate signs are concentrated around the core of the Conservation Area, where Nkwanta Camp is situated. The KIA is the highest in a band going from this camp to the Ankasa Gate Camp. This is likely due to the intense activity of WD staff and visitors in that area. Unfortunately, our surveys present gaps in the Breproh area (east-northeast) and other remote, difficult to access areas. In Bia, at lower rates, primate signs are found scattered over the whole Conservation Area. Again, due to staff limitations, the whole surface has not been covered, but compared to Ankasa, it can be remarked that in Bia, there does not appear to be an area where primates occurred preferentially. The Forest Reserves do not show a marked pattern either, though KHFR seems to present a higher abundance of primates in the center of the GSBA along the hill ridge.

No clear areas of special priority arise from these maps. The overall abundance is so low that a dramatic increase in protection effort is the first priority before any more targeted approach.

It is noteworthy that no pattern emerged where a higher abundance of primates is seen deeper within the protected areas. This means that primates are not pushed more inside by surrounding human activities. As the maps of hunting signs indicate, human activity goes as deep within the protected areas and as such, distance to the surrounding community does not appear to be a deterrent.
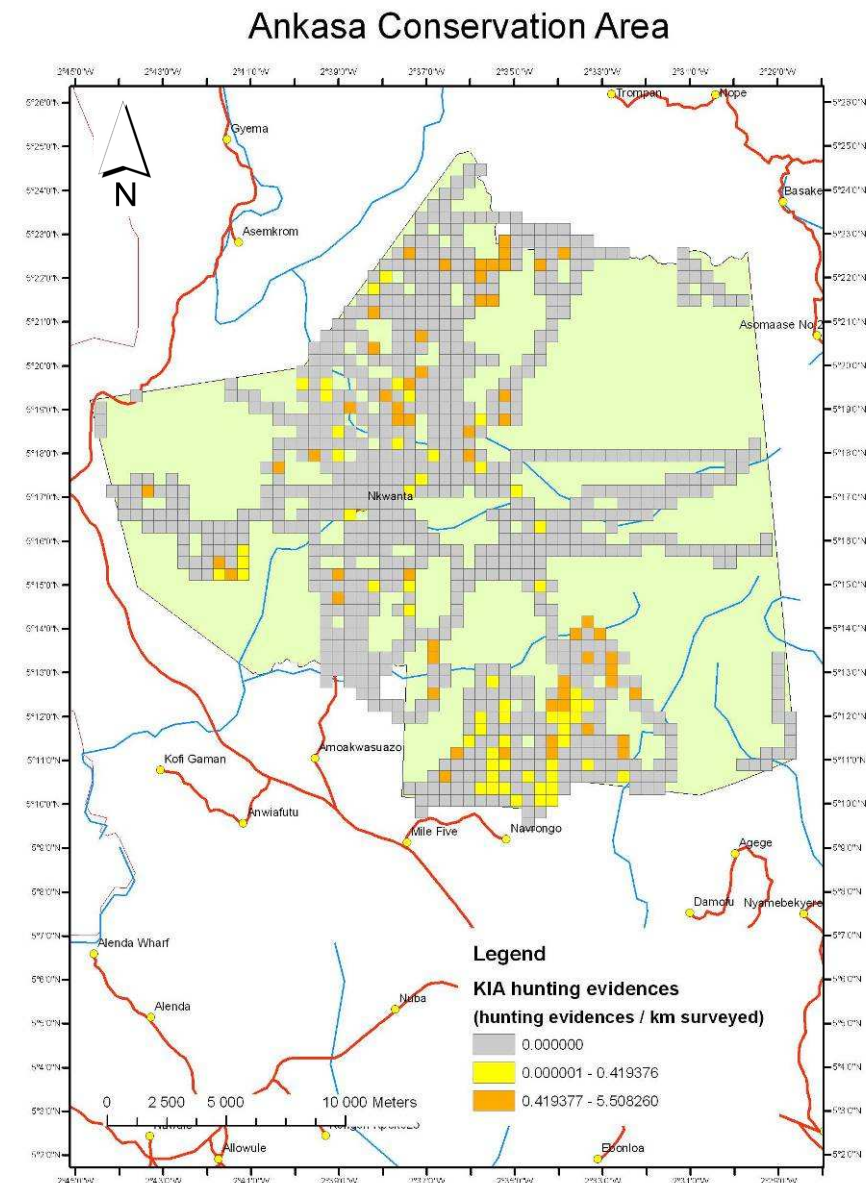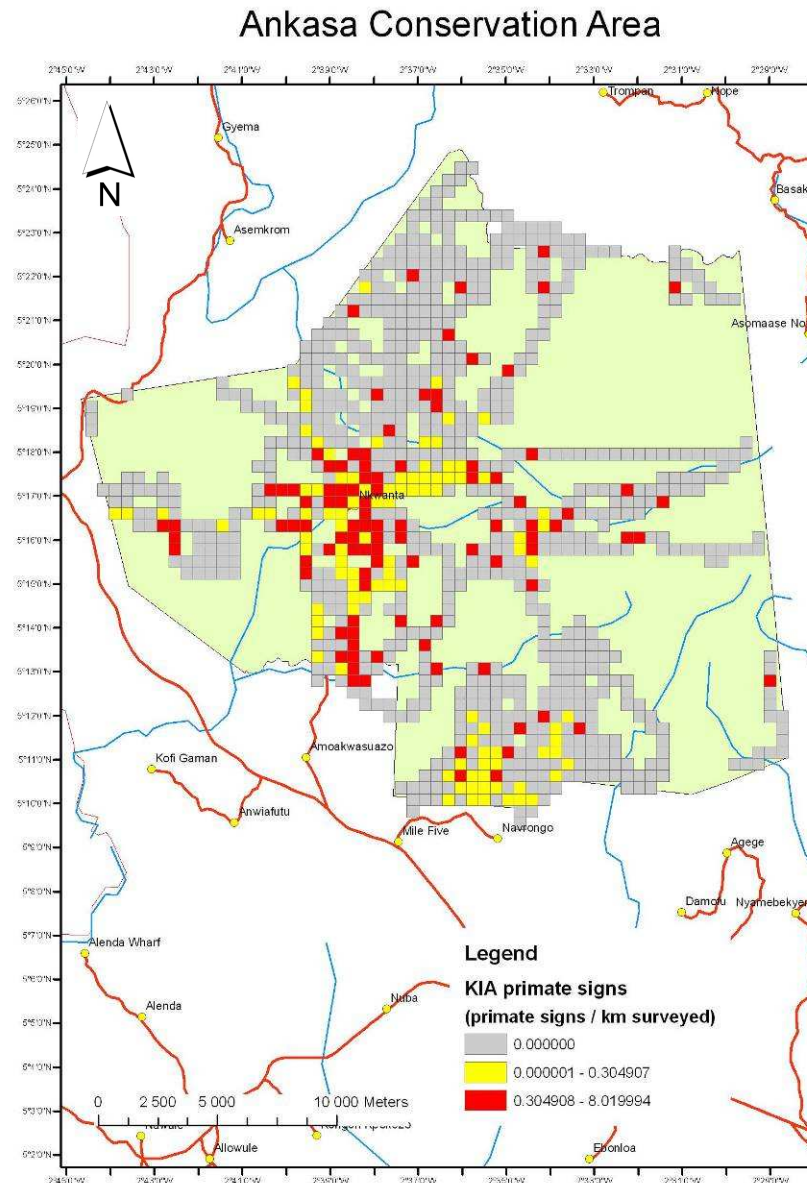
**Figure 3a:** Ankasa – Distribution of Kilometric Index of Abundance for primate signs (**L**) and hunting evidence (**R**).
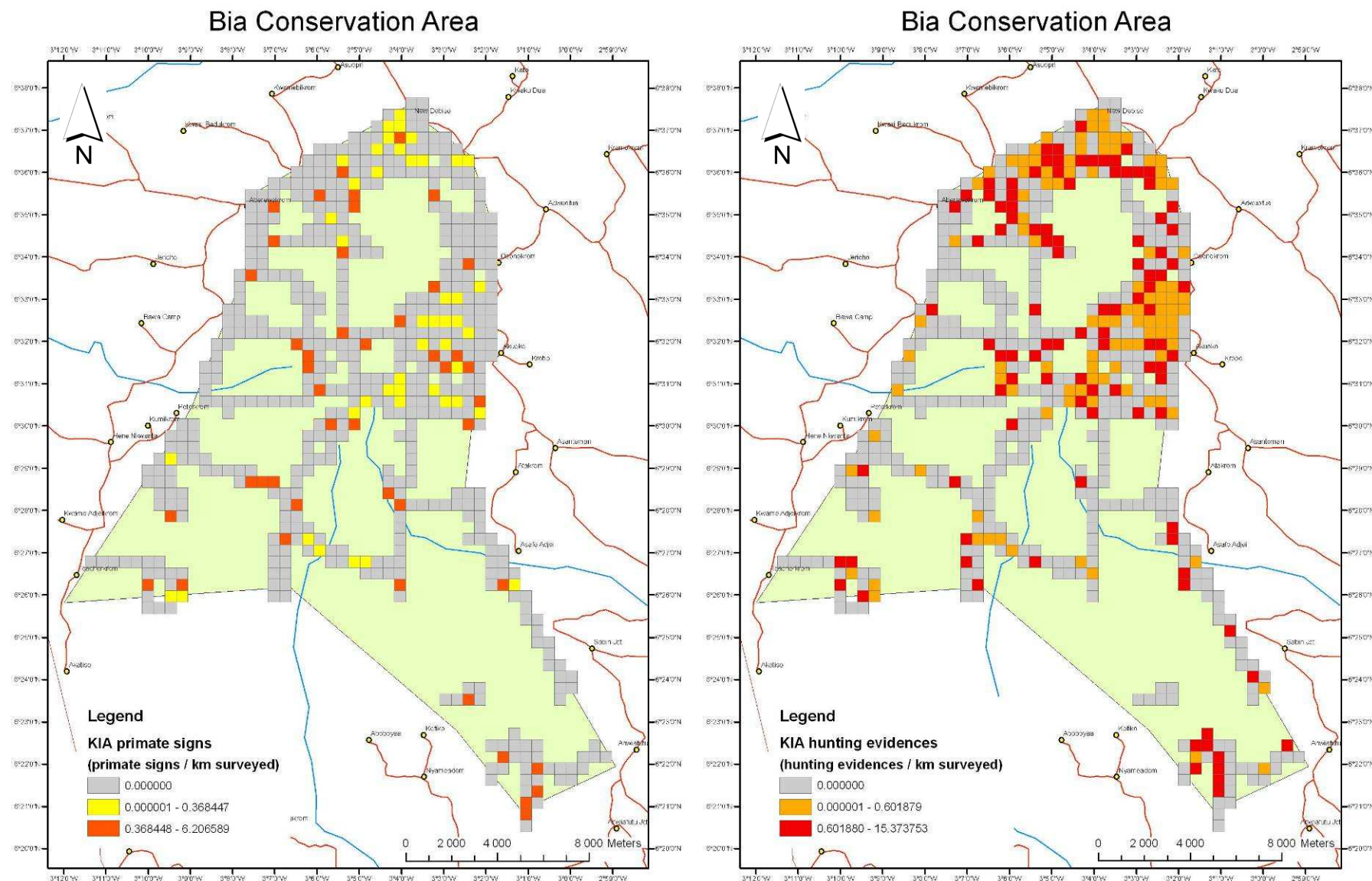
**Figure 3b:** Bia – Distribution of Kilometric Index of Abundance for primate signs (**L**) and hunting evidence (**R**).

**Figure 3c:** Cape Three Points – Distribution of Kilometric Index of Abundance for primate signs (**L**) and hunting evidence (**R**).

**Figure 3d:** Krokosua Hills – Distribution of Kilometric Index of Abundance for primate signs (**L**) and hunting evidence (**R**).

**Other mammals**

Table 5 presents the non-primate mammal species detected in the four Protected Areas.
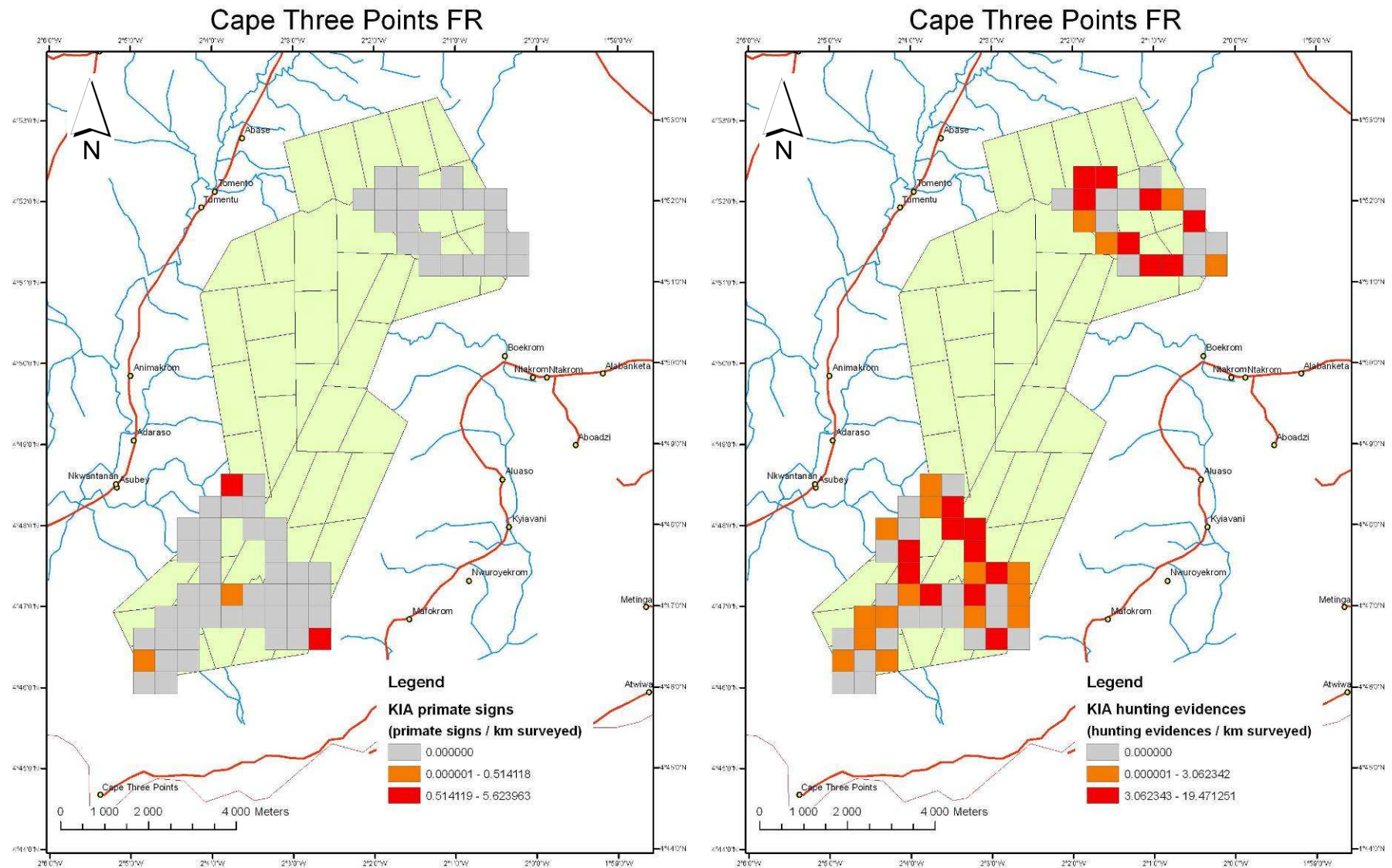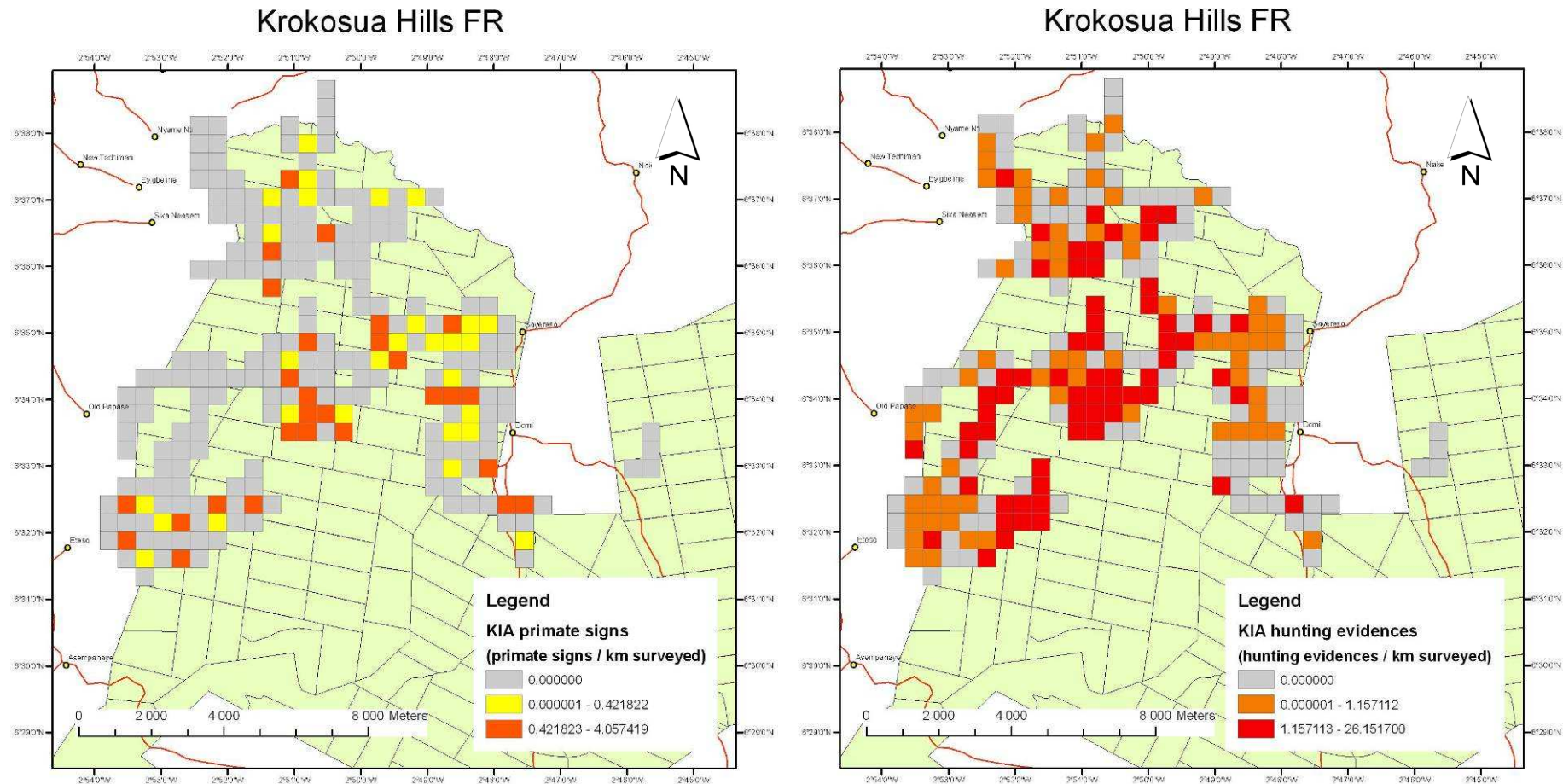
A lower diversity of mammals was recorded in the Forest Reserves. It can not be determined whether this is a genuine difference as compared to the Conservation Areas or an indication of the varying competence between the staff operating in the different areas (WD/WAPCA staff vs. community members/WAPCA staff).

**Table 5.** Non-primate mammal species encountered in the four project areas.

|  | Species |  | Area Ankasa | Bia | C3P | KHFR |
|---|---|---|---|---|---|---|
| Rodents | Flying squirrel | *Anomalurus sp.* | X | X |  | X |
|  | Crested porcupine | *Hysterix cristata* | X |  |  |  |
|  | Brush-tailed porcupine | *Atherurus africanus* | X | X | X | X |
| Carnivores | African Civet | *Civettictis civetta* | X | X |  | X |
|  | Mongoose | *prob. Crossarcus obscurus* | X | X | X |  |
|  | Marsh mongoose | *Atilax paludinosus* |  | X |  |  |
|  | Leopard | *Panthera pardus* | X |  |  |  |
|  | Palm civet | *Nandinia binotata* | X | X |  |  |
| Pholidotes | Long tailed pangolin | *Uromanis tetradactyla* | X | X |  |  |
|  | Tree pangolin | *Phataginus tricuspis* | X | X |  | X |
| Afrotheria | Tree hyrax | *Dendrohyrax dorsalis* | X | X | X | X |
|  | Elephant | *Loxodonta africana* | X | X |  |  |
| Ungulates | Bongo | *Tragelaphus euryceros* | X | X |  |  |
|  | Bushbuck | *Tragelaphus sriptus* | X | X | X | X |
|  | Maxwell's duiker | *Cephalophus maxwelli* | X | X | X | X |
|  | Black duiker | *Cephalophus niger* | X | X |  |  |
|  | Bay duiker | *Cephalohus dorsalis* | X | X | X | X |
|  | Red River hog | *Potamocherus porcus* | X | X |  |  |
|  | Yellow-backed duiker | *Cephalohus sylvicultor* | X | X |  |  |
|  | Royal antelope | *Neotragus pygmaeus* | X | X |  | X |

**Illegal activities**

During the surveys, records were made of any signs of human activity that could be considered as disturbance for wildlife (Table 6), either directly (e.g., hunting) indirectly, by affecting the habitat (e.g., farming, logging) or constituting the first step before a more destructive activity (e.g., NTFP harvester could be evaluating a potential hunting site).

Signs of trapping (snare traps, wires to make snares) and shotgun hunting were found most often. In the Forest Reserves, the trap lines found, contained several dozens of snares. In Bia, poacher camps were discovered with more than fifty wire snares waiting to be set. Later the same day the research team came across a dead pregnant female bay duiker. On several occasions, decaying carcasses of rats, pangolins or duikers were found in the snares. Hunters lay such a large number of traps that it seems they have no means to check them all regularly. Such methods lead to additional unnecessary killings and render this type of hunting even more destructive and inefficient.

**Table 6.** Encounter rates with human activities during surveys in the four project areas. Encounter rates are presented according to type of sign (hunting or other activities) and in the form of Kilometric Index of Abundance (KIA).

| Protected area | Total distance surveyed (km) | Shotgun hunting signs | Trapping signs | Other hunting signs[1] | Other activities[2] | Total hunting evidence (signs/km) | Shotgun hunting evidence (signs/km) | Total illegal activities evidence (signs/km) |
|---|---|---|---|---|---|---|---|---|
| Ankasa | 3704.17 | 91 | 43 | 25 | 40 | 0.043 | 0.025 | 0.054 |
| Bia | 1411.26 | 202 | 248 | 19 | 15 | 0.332 | 0.143 | 0.343 |
| C3P | 50.21 | 23 | 100 | 5 | 11 | 2.550 | 0.458 | 2.769 |
| KHFR | 448.24 | 192 | 183 | 9 | 10 | 0.857 | 0.428 | 0.879 |

[1]: other hunting signs include poacher encountered, camps, etc.
[2]: other activities include mining, logging, farming, NTFP harvest, etc.

Shotgun hunting poses the most threat to primates, although snares have also been proven to catch primates. This is especially true for species that can spend time on the ground such as mangabeys. In Cape Three Points, the primatologist confiscated a young female White-naped Mangabey whose mother was killed in such a snare. The farmer had set traps in his maize crop and caught a nursing female. The female was killed whilst the infant was kept in the hope of selling it as pet.

Notably the abundance of hunting and illegal activities signs was dramatically higher in Forest Reserves. In Cape Three Points mostly snares were found whereas in KHFR, shotgun hunting and trapping were found at the similar levels. This difference may be attributed to the variance in the abundance of large mammals between the two reserves as larger game species may have already been depleted in Cape Three Points. There also may be a difference in location where CTP, situated close to the coast, is surrounded by villages with a fishing tradition, whereas with the inland KHFR, hunting may be the preferred option for provision of animal protein.

In the Conservation Areas, where WD is operating, hunting is found to a lesser extent, although Bia still shows levels of hunting seven to eight times higher than Ankasa, from both shotgun hunting and trapping. During his time in Bia, the primatologist encountered several poachers, and gunshots were commonly heard close to the research camp. Footprints of hunters with their dogs were also evident next to this camp on the internal Bia road. On one occasion, a fresh spent cartridge, shot overnight was found a few hundred meters from the primatologist's tent. It is notable that shotgun hunting is not limited to large game. Hunters reported that they would use a cartridge to kill animals as small as a giant pouched rat (*Cricetomys sp.*).

With the exception of direct encounters with poachers in Bia where they ran away, hunters were generally not afraid by presence of the survey team. Several discussions revealed that in Forest Reserves, there is virtually no deterrent to hunting. FSD is apparently struggling to deal with illegal logging let alone any other forms of offences. For the CBAGs, their activities consist almost exclusively of clearing forest boundaries; any form of law enforcement seems non-existent.

## 4.    Conclusion

Similar to the findings of Oates (2006) and other previous surveys (Oates *et al.*, 1996-97; Oates *et al.*, 2000; Struhsaker & Oates, 1995; Struhsaker, 1993; Whitesides & Oates, 1995; Magnuson, 2002; Abedi-Lartey, 1999, 1998), the primate populations in the four targeted areas are very low. Primates were mostly detected from their calls and very few direct encounters occurred. It is a fear that the steady decline of primate populations in Ghana is still ongoing, despite the actions of WD.

The major concerns come from the status of critically endangered species. If it is almost certain now that Miss Waldron's Red Colobus is extinct in Ghana (or reduced to such small number that it is undetectable and thus unlikely to constitute a viable population), the Roloway monkey and White-naped Mangabey seem to be following the same path. Even though there was some evidence of mangabeys in small numbers in a forest as small as CTP, or even off reserve, the fate of this species is still very precarious. The fate of the Roloway monkey is more concerning. Only in Ankasa there were some unconfirmed sightings for this species; seemingly, it is nowhere else to be found.

If strict, efficient and broad protection is not enforced immediately, no raising of awareness, community involvement or other mitigating measures are likely to be effective enough and in sufficient time to prevent the Roloway monkey, and the White-naped Mangabey after it, following the same fate as the red colobus in Ghana.

Hunting is still the major threat, and protection is still no match to the rate of destruction of wildlife. With the state of the primate population, where a small number of individuals are thriving in patches of forest, even just a few hunters could entirely wipe out a species.

With the combination of habitat destruction and hunting, Ghana is also the second last country before Senegal in West Africa in terms of chimpanzee population (Magnuson *et al.*, 2003). The only available estimate for the country, reports a population of 300-500 individuals (Teleki, 1989). With few records during recent surveys (Magnuson, 2002; Oates, 2006) and observations from these surveys, it is likely that chimpanzees are also nearing extinction in Ghana. Even if Bia, Ankasa and KHFR still harbor one or two communities (which seems a maximum according to

these results), the potential total number of individuals and the absence of connectivity between these population do not leave much hope for the species.

In the light of this data, there is no targeted, specific measure or priority zone that should be focused on in order to improve the protection of primates. The only solution is a dramatic increase in the conservation effort, with strict, total protection of the Protected Areas by WD staff and uncompromising law enforcement that will deal with offenders in a deterrent way.

**Project outcomes**

It is believed that the data gathered over two years and the training given over three years has improved the knowledge and capacity of WD regarding primate populations in the Western Region. This data will serve as a baseline for future analyses on population trends for these endangered species.

During the course of this project, several WD staff were trained more specifically on techniques of wildlife monitoring, primate identification and research methods. They have shown great interest in the learning process and in the implementation of new methods. Most of them were motivated to improve their work practices, showed great learning skills and quick understanding of how to use these new tools. A simple measure, such as providing staff with the user manual for their equipment, was met with great appreciation.

These methods and skills were also taught to some community members involved in the surveys and they were in a short time independently implementing their data collection task. Some of them were recruited by WD to reinforce their monitoring and patrolling teams. By this process the involvement of community members was rewarded and the skills gained by the individual, transferred to WD capacities.

These skills and training need to be spread throughout all monitoring staff and should be repeated regularly to maintain knowledge and a certain level of motivation. With WD, workshops were organized in early 2009 in both Bia and Ankasa, where all law enforcement staff were trained in monitoring techniques, GPS and compass use and given a detailed lecture on primates.

The modern techniques of monitoring require such training at every level of the law enforcement and monitoring chain. In the same way, GIS has become an important part of the analysis tools for management of a protected area. Establishing

use of the MIST system in Ankasa and Bia by PADP has been one of the major improvements to management. By giving field staff proper training, WD must ensure the quality of the data collected. The training received by those involved in the surveys conducted by WAPCA has greatly contributed to that. The MIST system is a powerful tool but requires a dedicated database manager who has also some competence in GIS. With an increased amount of data collected in the field comes also an increased work load. To be useful, the data must be analyzed in the proper way. To some extent, the primatologist helped with issues in the initial phase of MIST implementation. It would be advisable now, for the data to be useful, to improve the analyses. MIST is used to analyse the information from monitoring and law enforcement but also shows performance of staff. So far the data has been presented in terms of absolute numbers. In order to detect trends in any of the parameters measured (wildlife abundance, hunting pressure, etc…) these data should be weighted by the survey/patrol effort.

**Ecotourism**

In light of the findings of primate populations in the protected areas, it is not feasible to base ecotourism on wildlife viewing at any of the sites. If we consider even the best encounter rates, a tourist willing to get just a glimpse of a primate would have to walk more than 10km. In the absence of habituated troops, such a scheme is coming too early or too late for any of the Protected Areas considered here.

If ecotourism based on wildlife viewing was to be an option, the relatively low number of tourists who reach the Protected Areas (a mere thousand for Ankasa, a hundred for Bia) would not be sufficient to provide the surrounding community with resources significant enough to deter its members from hunt or encourage them to participate in the protection effort.

**Sustainability**

The only solution to improving conservation of primate populations in the areas considered is an increase of protection effort. The current situation is still impaired by insufficient staff, low motivation and the general lack of deterrent affect of law enforcement. WD must take every possible measure to increase the number of wildlife guards. An area the size of Ankasa cannot be effectively protected by 20 people. The solution can only come from the political will to improve the situation of

WD. At the park level, the staff should be given all the possible means to fulfill their mission in a secure, motivated way. The provision of better equipment, tents for patrol, rain protection, and the recognition of the danger of their mission should be a minimum. The motivation of staff will come from better consideration of their hierarchy, both in terms of salary and social reward. One cannot expect someone to perform hard work under challenging conditions, sometimes risking his life for a minimal monthly salary, lower than the market price of four duikers that a poacher would easily kill during the same time. In a similar way, the dedication of wildlife guards cannot be entire if his salary does not cover his living expenses, let alone what is required to support his family.

For sustainability of the actions begun during this project, the community members trained to the monitoring techniques and the primate surveys should find their place within WD. This has been achieved in Ankasa, but it should also happen in Bia, otherwise these capacities will be lost.

Monitoring is an essential tool in the management of a Protected Area. It measures the trends in animal population, distribution, intensity of threats and the efficiency of patrol effort. It is also a deterrent in itself as it increases the presence of staff in the Protected Area. This is why its design is important. Conducting patrols on existing trails or following a path of least resistance without cutting transect avoids opening new trails for poachers and limits the logistics involved to reach remote places. It also however, prevents the even, regular coverage of the area. It can bias the representation of results and with less precise estimates; it impairs the identification of risk / priority zones. Despite the reluctance of WD to open straight line transects, it would be advisable to design a monitoring grid similar to those employed in other Protected Areas (e.g., Tai National Park, Cote d'Ivoire, Herbinger, 2007), or the one used by Danquah (2009), and to walk this grid regularly as part or in addition to the patrol effort.

The situation in the Forest Reserves is concerning and as it is, there is not a sustainable or effective system of monitoring/protection. As such, a suggestion that could be considered is that Protected Area status of the GSBAs be changed to either a National Park or Resource Reserve and brought under the management of WD. This may then enable provision of the necessary resources and skills for effective protection of the habitat and wildlife.

Finally, even if awareness campaigns and community education must be done or continued, the emergency of the situation calls for strict law enforcement without compromise, within as well as outside the Protected Areas. It is not consistent to enforce the law inside the Park and not take sufficient action on offences witnessed in neighboring communities. The failure to do so will reinforce the feeling of powerlessness towards WD and the impunity of offenders. On three occasions, the primatologist dealt with the confiscation of highly endangered White-naped Mangabeys, with limited support. Also, in Elubo, the town neighboring WD headquarters for Ankasa, African Grey Parrots were seen on display, as well as a young spot-nosed monkey in a drinking spot, and no action was taken. If on one side the wildlife laws of Ghana are not strictly enforced, it is unlikely that awareness of the local community will come in time to have anything left to protect.

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## Appendix 1: Data sheet used to record observations

**WAPCA Data Collection Sheet**

Date:               Transect / trail:               Observer(s):

Time start :          Time stop :               Time back :

position :           position :

| Time | Species | Detection (visual, audio, other) | Code | GPS position | Sighting distance SD (meters) | Direction (degrees) | Perpendicular distance PD (meters) | Position on transect (meters) | Notes/Remarks |
|------|---------|----------------------------------|------|--------------|-------------------------------|---------------------|-----------------------------------|-------------------------------|---------------|
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## HOW TO FILL THE DATA SHEET

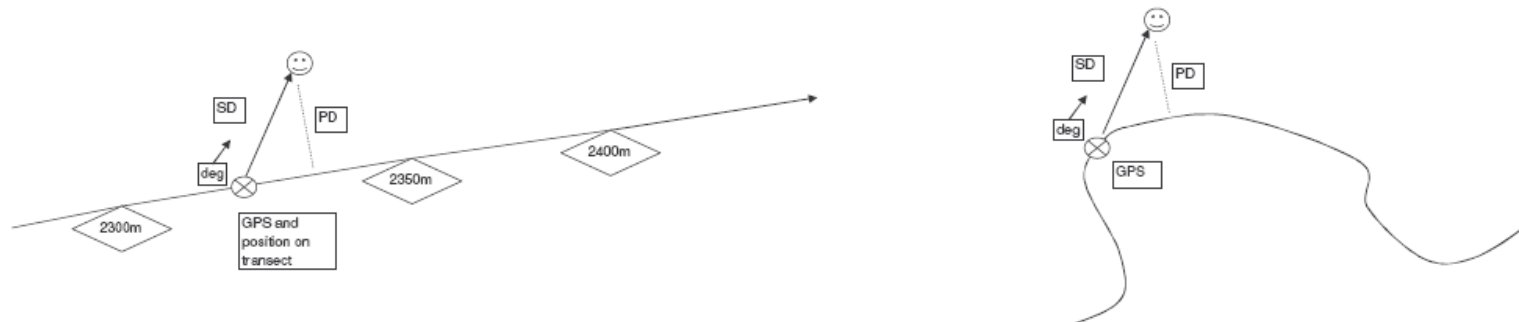| | | | |
|---|---|---|---|
| **Date :** | the date of observations | **Transect / trail:** | name or code of the transect or the trail | **Observer(s):** | name(s) of the person(s) making the observations |
| **Time start :** | time when you sart your observations | **Time stop :** | time you stop walking at the end of the trail to come back | **Time back :** | time you come back at your initial position (sart of the transect or trail) |
| **position :** | GPS position of the begining of your trail or transect | **position :** | GPS position when you stop walking at the end of the trail to come back | | |

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| Time | Species | Detection (visual, audio, other) | GPS position | Sighting distance SD (meters) | Direction (degrees) | Perpendicular distance PD (meters) | Position on transect (meters) | Observations and remarks |
|---|---|---|---|---|---|---|---|---|
| time of the observation | species of the animal detected | how was the animal detected? if you saw it = visual if you heard it = audio if you both heard it and saw it, then it is both visual and audio it can also be tracks, droppings, etc... | write the two series of numbers from your GPS latitude and longitude | measure the distance between the place where you have detected the animal(s) and the place where the animal(s) was (were) seen. the distance should be measure precisely with the measuring tape in meter, this is only for visual detection | measure the direction where the animal(s) was (were) detected with your compass. the direction should be in degree this is for both visual and audio detection | measure the distance from the place on the transect which is the closest to the place you have seen the animal(s) and the place where the animal(s) was (were) seen. the distance should be measure precisely with the measuring tape in meter, this is only for visual detection | Note the position where you have detected the animal with the help of the flag on the transect. example: you have detected the animal 23m after the flag of 2500m, then your position on the transect is 2500m + 23m = 2523m | write here all your observations about the animal or the tracks you have detected, or any remark concerning your observations |

**EXAMPLE**

| Time | Species | Detection (visual, audio, other) | GPS position | Sighting distance SD (meters) | Direction (degrees) | Perpendicular distance PD (meters) | Position on transect (meters) | Observations and remarks |
|---|---|---|---|---|---|---|---|---|
| 07:03 | mona | audio | N 05,25687 W 002,39654 | | 228 deg | | 1250 + 12 = 1262 m | call far away |
| 08:24 | spot-nosed | visual and audio | N 05,32278 W 002,39753 | 32 m | 164 deg | 25 m | 2300 + 21 = 2321 m | group of 7 at least, eat water pool, call when we arrive |
| 10:02 | | | | | | | | start raining |
| 10:25 | | | | | | | | stop raining |
| 11:37 | maxwell duiker | audio | N 05,3456 W 002,39886 | | | | | |
| 11:52 | elephant | droppings | N 05,3456 W 002,39886 | | | | | |

## Appendix 2: People involved in research surveys

| Protected Area | Staff |
| --- | --- |
| | |
| Ankasa | Moro Yakubu (WD) |
| | Victor Agyemang-Duah (WAPCA/WD) |
| | Emmanuel Kojo Kwaw (WAPCA/WD) |
| | Micheal Mensah (WD) |
| | Enoch Dowana (WD) |
| | |
| Bia and KHFR | Philip Mensah (WD) |
| | John Santah (WAPCA) |
| | Vincent Nyame (WAPCA) |
| | Kwasi Gyamfie (WAPCA) |
| | Edward Agyei |
| | |
| KHFR only | Enoch Kwabena |
| | Somalah Dappah |
| | |
| CTP | Samuel Amamu |
| | John Cudjoe (FSD) |
| | Bernard Cudjoe |
| | |
| (WD and FSD indicate WD and FSD staff respectively, WAPCA indicates WAPCA-trained and employed staff [some have since been recruited by WD]. The remaining were community members temporarily employed as guides). | |