

***Cross River State Forestry Commission  
Wildlife Conservation Society  
Pandillus  
Fauna and Flora International  
Nigerian Conservation Foundation***

Wildlife and Habitat Assessment Survey of the  
Afi River Forest Reserve, Cross River State, Nigeria  
February – April 2008



Prepared by:

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## Acronyms

AMWS	Afi Mountain Wildlife Sanctuary
AR	Afi River
ARFR	Afi River Forest Reserve
CRNP	Cross River National Park
CRSFC	Cross River State Forestry Commission
FFI	Fauna and Flora International
GIS	Geographical Information System
GPS	Global Positioning System
NCF	Nigerian Conservation Foundation
NTFP	Non-timber Forest Product
WCS	Wildlife Conservation Society

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## Summary

The Afi River Forest Reserve lies between the Afi Mountain Wildlife Sanctuary (AMWS) and the Mbe Mountains and is considered critically important as a forest corridor linking the isolated westernmost sub-population of Cross River gorillas (*Gorilla gorilla diehli*) at Afi Mountain to other gorilla groups in the Mbe Mountains and the Okwangwo Division of Cross River National Park (CRNP). The long term survival of the Afi gorillas depends to a large extent on at least occasional genetic contact with other groups. The reserve is also important as potential habitat into which other large mammals in the AMWS could expand in the future. However, the forest and wildlife within the reserve have come under serious threat from human disturbance including farming, logging and hunting and the status of the reserve as a long-term wildlife corridor is no longer assured. Although clear evidence of widespread human disturbance in the reserve exists, systematic data collection for management planning has been lacking. This survey was therefore conducted to:

- assess the level and types of threats to the Afi River Forest Reserve
- assess the viability of the reserve as a forest corridor connecting the AMWS to the Mbe Mountains;
- identify forest habitat contiguous with AMWS to help determine the size of the larger Afi River forest area available to wildlife;
- obtain baseline data for monitoring wildlife populations within the reserve;
- assess the distribution and abundance of selected non-timber forest products and economically important tree species in the reserve.

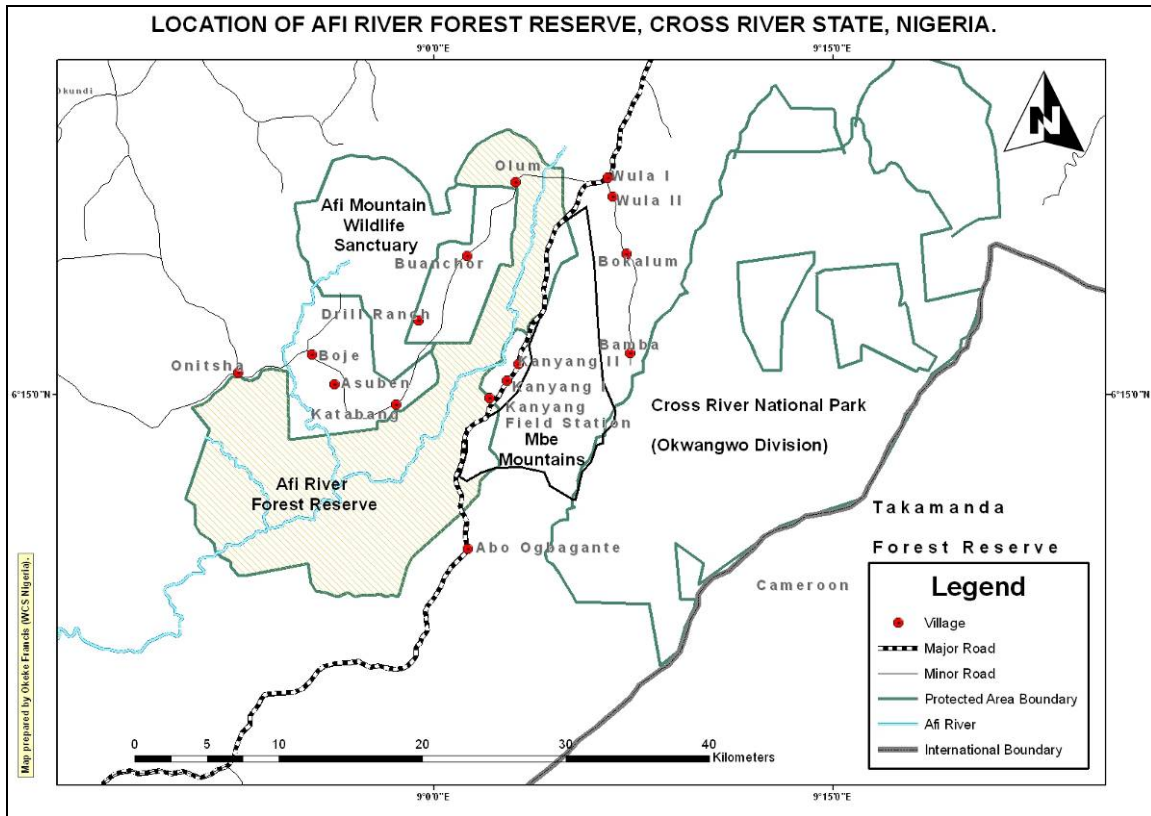
Over a period of three months from February to April 2008, a field team comprising staff of the Cross River State Forestry Commission (CRSFC), Wildlife Conservation Society (WCS), Pandrillus, Fauna and Flora International (FFI) and the Nigerian Conservation Foundation (NCF), as well as representatives of local communities, carried out guided reconnaissance walks on both sides of the Afi River and covered a total recce length of 82 km. The area surveyed represents over half of the total area of the ARFR. Results from this survey show that levels of wildlife abundance are low and that human disturbance (especially farming and logging) is high and widespread, with the northern part of the reserve being the most affected. However, substantial tracts of relatively undisturbed forest still remain in the southern part of the reserve which could serve as a wildlife corridor if adequately protected.

It is recommended that the Cross River State Forestry Commission should urgently review its reserve management policies and law enforcement strategies to stop all logging and farming activities in the reserve. It is also recommended that any efforts to create a wildlife corridor in the reserve should focus on the southern part of the reserve where most of the remaining relatively undisturbed forest occurs. A similar survey should be conducted in areas not covered in this survey – the eastern and western parts of the AMWS and the Mbe Mountains respectively to obtain a complete picture of the Afi – Mbe corridor area.

## Introduction

The Afi River Forest Reserve (8°50-9°5E and 6°7-6°10N) is one the largest remaining blocks of forest in Cross River State outside of Cross River National Park (Oates et al., 2007). Managed by the Cross River State Forestry Commission, the reserve is located at the headwaters of the Afi River in the northern part of Cross River State, west of the Okwangwo Division of CRNP. ARFR originally covered about 383 km<sup>2</sup>, in 2000 about 100 km<sup>2</sup> in the northwestern corner of the reserve was gazetted as a wildlife sanctuary – the Afi Mountain Wildlife Sanctuary (AMWS) reducing the reserve area to about 283 km<sup>2</sup>. The AMWS is home to the westernmost sub-population of Cross River gorilla and a number of other endangered mammal species. The presence of gorillas in the sanctuary has earned the AMWS greater conservation attention while the larger Afi River Forest Reserve has received relatively little conservation attention even though the reserve plays an important role as a forest corridor linking the sanctuary to the Mbe Mountains (Fig 1), a connection that is considered necessary for the long term survival of the Afi gorillas and other large mammal species in the sanctuary. The identification and protection of corridor areas has been identified as a priority conservation action throughout Cross River gorilla home range (Oates et al., 2007).

The connection between Afi and Mbe was to some extent weakened by the creation of a paved highway between the two mountains to link Ikom and Obudu (two major towns south and north of the reserve respectively), although a recent genetic study on Cross River gorillas (Bergl & Vigilant 2007) showed evidence of recent gorilla migration across this highway indicating that the highway by itself did not completely discourage gorilla migration through this corridor. Habitat destruction due to farm encroachment and logging however threatens the continued existence of this corridor. While the AMWS has received considerable attention in terms of wildlife monitoring and habitat protection, the larger Afi River Forest Reserve has remained largely neglected and as a result, little is known about the quality of the forest within the reserve and its wildlife. Although there had been no systematic assessment of the quality of forest in the reserve prior to this survey, it was evident that substantial disturbance had occurred in many areas. Effective management of the reserve requires up-to-date information on the habitat quality and wildlife abundance which before this survey, was lacking.



**Figure 1:** Location of Afi River Forest Reserve in relation to nearby protected areas

The objectives of this survey were therefore to:

- Assess the level and types of threat to the Afi River Forest Reserve.
- Assess the viability of the reserve to continue to serve as a forest corridor connecting the AMWS to the Mbe Mountains.
- Identify forest habitat contiguous with AMWS, to help determine the size of the larger “Afi forest complex” available to wildlife.
- Obtain baseline data for monitoring wildlife populations within the reserve.
- Assess the distribution and abundance of selected non-timber forest products and economically important tree species in the reserve.

## Methods

### Area surveyed

The portion of the Afi River Forest Reserve lying east and west of the Afi River between Wula and Olum in the north and Asuben and Abo Ogbagante in the south was surveyed (see location of recce paths in Fig 2). The areas north of Olum and west of Asuben and Abo Ogbagante were not covered during this survey. The topography of the survey area is undulating ranging from c.87 m above sea level (asl) to c.400 m asl. The reserve is drained mainly by the Afi River which flows from northeast to southwest and empties into the Cross River. There are many smaller rivers in the reserve which join the Afi River. The vegetation is mainly lowland forest with ridge forest on some of the steep slopes at higher elevation. The area surveyed is surrounded by twelve communities, many with populations estimated at over a thousand people.

### Survey team

The survey team comprised representatives of the AMWS partners and local communities (see below). Team size ranged between five and nine persons. As the survey progressed from one part of the forest to the other, one or two community representative(s) were selected from that community recognized to have traditional ownership of that portion of the forest. Community representatives worked with the survey team as guides and helped in cutting a recce path. A compass man directed a cutter who stayed ahead of the rest of the team and created a path for the team to follow based on a predetermined compass bearing. In addition to the data collected by the principal observer, two members of the team mapped the boundaries of some farms encountered using hand-held CI-Earth units. A member of the team who was experienced in plant identification assisted in identifying all emergent tree species within habitat assessment plots.

Permanent Team members:

1. Inaoyom Imong (WCS)
2. Kathy Wood (Pandrillus)
3. Ibiang Essien (CRSFC)
4. Martin Achu (CRSFC)
5. Martin Owan (CRSFC, retired)

Team members present for part of the survey:

6. Sam Ubi (AMWS Conservation Coordinator)
7. Pierre Ngangoumoun (FFI trainee)

Community representatives:

8. Livinus Abang (Buanchor)



9. Mathias Abang (Buanchor)
10. Peter Bisong (Olum)
11. Obi Mkpang (Olum)
12. Charles Kembre (Katche)
13. Omang Kingsley (Asuben)
14. Sunday Abang (Abo Ogbagante)
15. Obi Kache (Kanyang I)
16. Martin Abang (Wula I)

### Survey technique

The survey method used to collect data on this survey is known as a reconnaissance or “recce” walk. Based on line transect methodology, the recce survey method (White and Edwards 2000) is a linear foot survey along a predetermined compass bearing but with a relaxation of the strict requirements demanded by the line transect method. A form of recce walk referred to as a “guided recce” was used to collect data on this survey. The guided recce walk is considered more informative than the second form of recce walk – a “travel” recce, which is a random walk through the forest with deviations of any degree allowed (Kuhl *et al.*, 2008). For this survey, deviations from the line of travel were kept to a minimum. Every effort was made to walk a straight line, deviating only when the vegetation or terrain made it impossible to continue on a straight path (see Fig 2). Data collected on a guided recce does not require rigorous measurement of distances from objects to the line of travel, a good record of signs is usually sufficient. This method gives a scale of abundance rather than precise density. Nevertheless, with careful recording of observations, the method results in a reliable abundance index that is useful for comparing trends in wildlife populations within or between independent time intervals. To maximize coverage of the survey area (bearing in mind time, logistical and financial constraints) recce lines were systematically located 2 km apart and ran east to west from the Ikom - Obudu highway to the Afi River in the first phase of the survey and west to east from the Olum-Boje road to the Afi River in the second phase.

### Choice of method

The guided recce method was chosen for the present survey because this method was considered to be the most cost effective and the least time consuming, given our constraints. Also, this method would cause less damage to the vegetation when compared to a standard line transect method; and was more informative in comparison to the travel recce method.

### Field data collection

The survey team was based at the Drill Ranch near Buanchor village throughout the survey period. A vehicle dropped off the team at the start point of a recce line each morning between 07h30 and 08h00. At the start of each recce line and at every 200 m thereafter a waypoint was recorded using a Garmin GPS Map 60CSx. GPS coordinates were also recorded for every major change in habitat

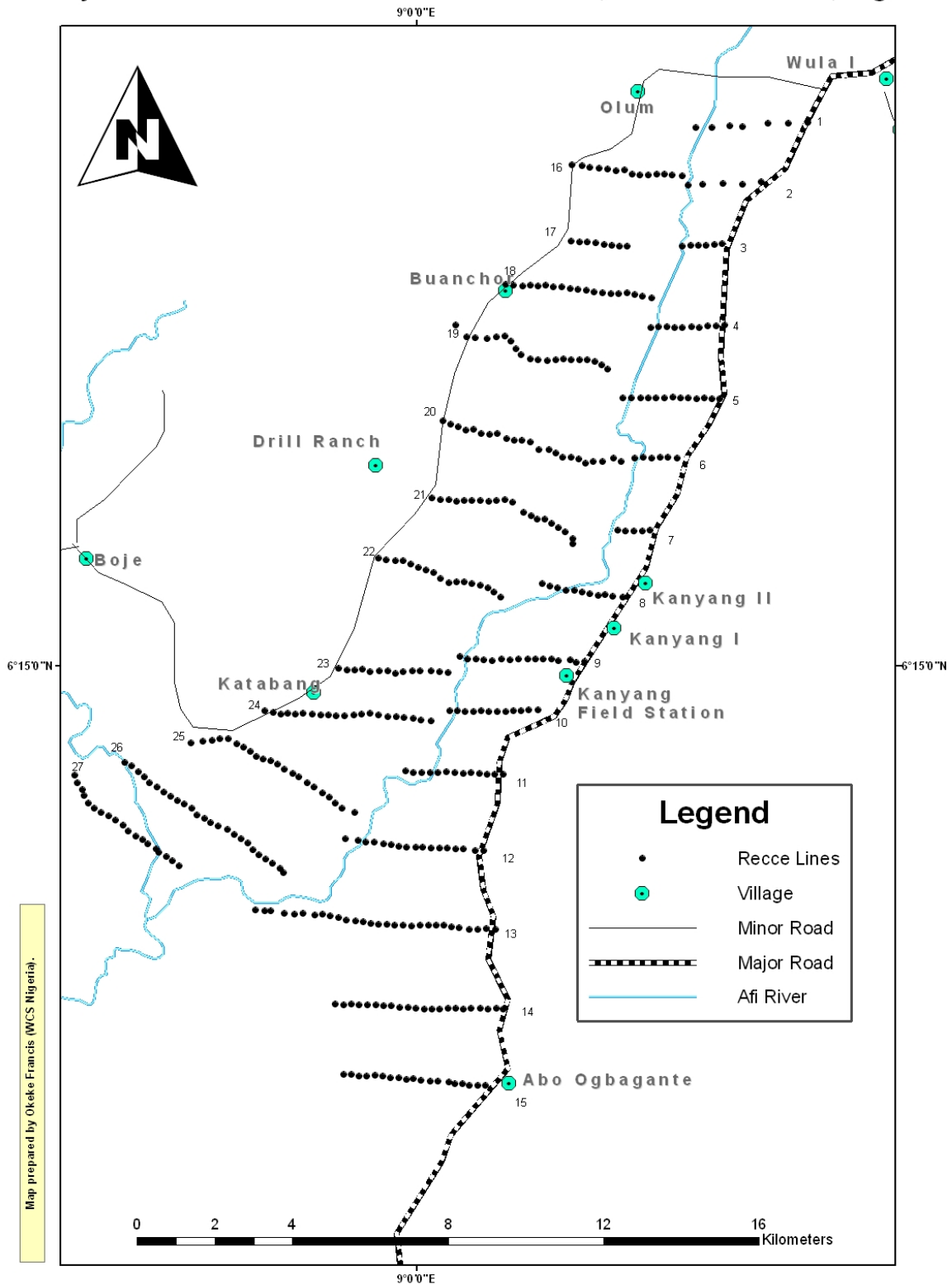
and for every human disturbance or wildlife sign encountered. The Garmin GPS Map 60CSx is capable of capturing satellite signals and recorded a waypoint even under forest closed canopy, allowing a tracklog of points along recce paths which showed entire recce lines walked during the survey.

The survey was divided into two phases with a break in-between for logistical planning. The first phase lasted 19 days (1st to 19th of February 2008) and focused on the area east of the Afi River and west of the Ikom-Obudu highway, between Abo Ogbagante and Wula (approximately 30 km long).

The second phase lasted 16 days (19th March to April 3rd 2008) and started c. 1 km south of Olum in the north to Asuben in the south (approximately 25 km long). Recce lines during the second phase started from the Olum-Boje road, moving due east to the Afi River.

A total of 27 guided recce paths were walked: 15 in the first phase and 12 in the second phase (Figure 2). All evidence of wildlife, farming, logging and hunting was recorded.

Survey area within the Afi River Forest Reserve, Cross River State, Nigeria.



**Figure 2:** Location of recce lines in the survey area.

### *Evaluation of forest quality*

In addition to data on logging, farming and hunting collected along the recce paths, a more detailed assessment of forest quality was made by establishing vegetation assessment plots every 200 meters. Measuring approximately 20 meters in radius these plots were established to make an assessment of the forest according to an agreed survey protocol. The quality of the habitat in each plot was categorized as either: primary forest, secondary forest or highly disturbed forest. The category of highly disturbed was either forest that had been substantially degraded or was characterized by farms or other cleared areas; secondary forest was defined by the presence of isolated stands of crops and other signs of disturbance, and primary forest was intact forest with no signs of disturbance. Within each plot, all emergent trees were identified and counted and their heights estimated by trained forestry personnel. An estimate of canopy cover was made by eye. The presence or absence of six selected economically important tree species and six non-timber forest product (NTFP) species (Appendix 3) was also recorded. Although the protocol for this survey specified plots located every 200 m, the first two transects had plots located at 500 m intervals because these transects were predominantly farms. All other transects had plots located 200 m apart.

### *Evidence of farming*

For the purpose of this survey a farm was defined as an area of forest that has been cleared and planted with several stands of a crop(s) including cash and/or food crops. This definition of farm does not include a single or few isolated stands of a crop in a forest that has never been cleared. The methodology used to estimate farm size was chosen depending on the size of farm encountered. It was originally planned that all farms encountered would be mapped by walking their boundaries with a hand-held computer-based data capture system based on the Cybertracker software (CI-Earth). However, this method was found to be cumbersome and time-consuming in cases where several abutting farms (some too large and/or overgrown and therefore difficult to map) were encountered along recce paths. For large farms an estimate of size was made by marking the start and end of individual farms along the survey path with a GPS and estimating the perpendicular distance from the recce line to the limit of each farm either side of the line. Complete mapping of farm boundaries with CI-Earth was therefore limited to small discrete farms. GPS coordinates for the start and end of all farms observed were recorded.

Farms were aged as “new” or “old”. A farm was aged as “new” if it was less than one year old, cleared and planted in the current farming season. Old farms were those over one year old, cleared and planted in a previous season. Newly cleared areas not yet planted were recorded as “highly disturbed forest”. However, where there was clear indication that such an area would be planted with crops soon (such as the presence of seedlings in a nearby nursery), it was recorded as farm. When it was clear that a farm had been totally abandoned then such an area was recorded as “highly disturbed forest”. In addition,

information on crop types present on farms was recorded, together with any other information obtained about the farms (e.g. farm owner, farming method, presence of trees, etc.). Farm size varied widely ranging from as small as 15m<sup>2</sup> to as large as ten hectares.

#### *Logging evidence*

Evidence of logging was collected along each transect as a GPS waypoint. This evidence included the following: presence of tree stumps, logs, sawn timber, logging camps, extraction paths/roads, audible chain-sawing, and any other evidence of logging activity. In addition to presence/absence data on logging evidence, information was collected on the species of trees logged, the number of logs/stumps/sawn timber at a site, and any additional information available for a given data point, such as identification marks put on timber, or more general information such as logging practices in an area etc. In one case, a large logging road into the forest that crossed the last three southern recce paths east of the Afi River was mapped. Although data collection focused along recce paths, all signs of logging encountered were recorded and mapped.

#### *Wildlife Evidence*

A GPS waypoint was recorded for all evidence of wildlife encountered including: sightings, dung, vocalization, track, etc. Data collection focused on large mammals. For this study, a large mammal was defined as any mammal species weighing 1 kg and above. An attempt was made identify signs to species and to age all signs, although this was not always possible.

#### *Hunting evidence*

A GPS waypoint was recorded for all hunting evidence encountered. Hunting evidence recorded included: spent cartridges, audible gunshots, hunting camps, hunters encountered, snares, poison, and animal carcasses. As described for logging data points above, any additional data was collected for a given sign of hunting, such as number of cartridges, snares, age of evidence, etc.

#### *Other signs of human pressure*

GPS waypoints were recorded for various other signs of human disturbance including non-timber forest product gathering, quarries, human settlements, and roads.

#### Data analysis

All GPS coordinates were downloaded to a PC using Garmin Mapsource software. Downloaded GPS coordinates and data from field notebooks were entered into an Excel spreadsheet. Data analysis was done in Excel and ArcView (9.0). The length of each recce line was obtained from GPS. The total length of recce path walked was obtained by adding up individual recce lengths. This was used to calculate encounter rate (per km walked) for all signs of human disturbance (such as farms, hunting and logging), and for all signs of wildlife. The data for each large mammal species was examined for relative abundance

and distribution. Habitat quality was analyzed as proportions of plots that were allotted to different forest categories – “primary forest”, “secondary forest”, and “highly disturbed forest”. The category of ‘highly disturbed forest’ included plots that were degraded forest and those that were farm. Interpolation maps were produced as a representation of estimated distribution of each habitat type and as a ranking of disturbance indicators between plots. The distribution of signs of human disturbance and mammal species was mapped.

The forest quality map (Fig 4) was based only on forest type data collected within vegetation plots. The disturbance map (Fig 6) was based on signs of logging, farming and hunting collected along recce paths. Disturbance data was analyzed in the form of presence or absence and was not weighted. For example, a pile of planks seen at a site was recorded as one observation irrespective of the number of pieces. The sum of all observations of disturbance from one plot to the next was therefore the disturbance value for that section of the recce line.

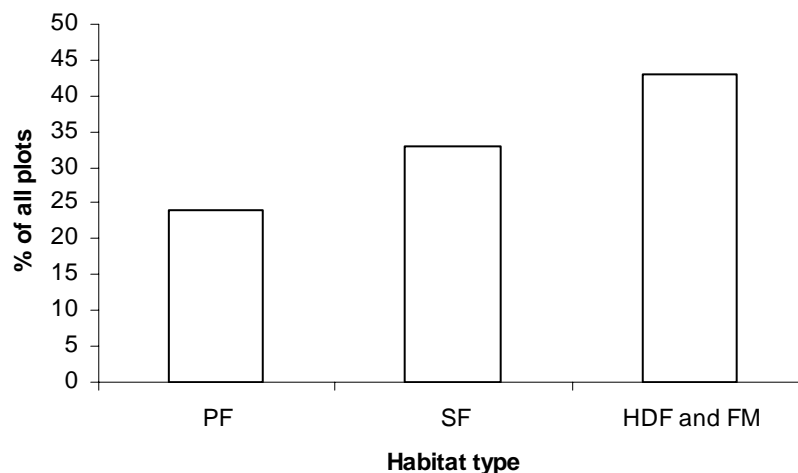
Using the spatial extraction feature in the ArcGIS 9.1 software, interpolation analysis which estimates the value of a mathematical function that lies between known values was used to produce forest quality and disturbance level maps of the survey area based on geo-referenced data collected during the survey.

## Results

Over a period of 35 days a total recce path length of 82 kilometers was covered – 39 km east of the Afi River (Phase I) and 43 km west of the Afi River (Phase II). The location of recce paths and their lengths can be viewed in Fig 2 and Appendix 1 respectively.

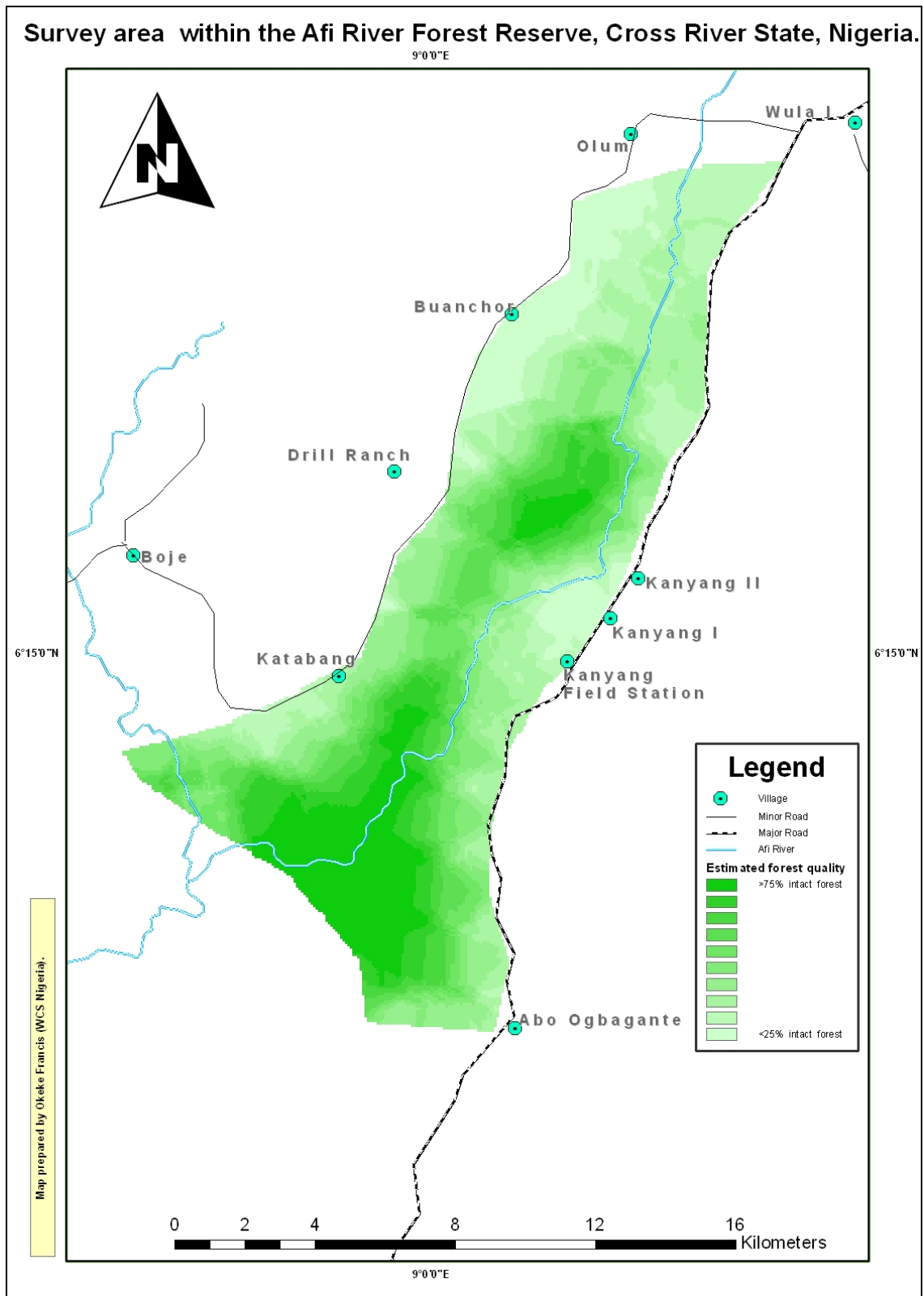
### Forest quality

Approximately 43% of all vegetation plots were classified as highly disturbed and farm. Thirty three percent of plots were classified as secondary forest. Only 24% of plots were classified as primary forest (see Fig 3 and Appendix 2). If these results are extrapolated to the whole survey area it would mean that about 75% of the forest (in the portion of the reserve surveyed) has been converted into secondary forest, highly disturbed forest or farm. It must be emphasized that this is only a rough estimate based on plot data and does not account for changes in habitat types between plots. Due to difficulty with mapping farms resulting in only small farms being mapped during this survey, estimation of farm area was based on interpolation of data collected in plots located 200 m apart using ArcGIS software (Figure 4). Proportions of habitat types (based on data collected within vegetation plots) for the whole survey area and for individual recce lines are presented in Fig 3 below and in more detail in Appendix 2 respectively.



**Figure 3:** The proportion of plots allotted to primary forest (PF), secondary forest (SF) and highly disturbed forest (HDF) and farm (FM) on all recce lines in the survey area. PF = 133 plots, SF = 123 plots, HDF = 39 plots, FM = 118 plots (HDF and FM = 157 plots).

The forest quality map in Figure 4 shows a high incidence of poor quality forest on the edges with higher quality forest limited to the middle of the survey area. This pattern may be attributed to the access provided by the Ikom-Obudu highway and the Olum-Boje road which formed the start point of most recces.



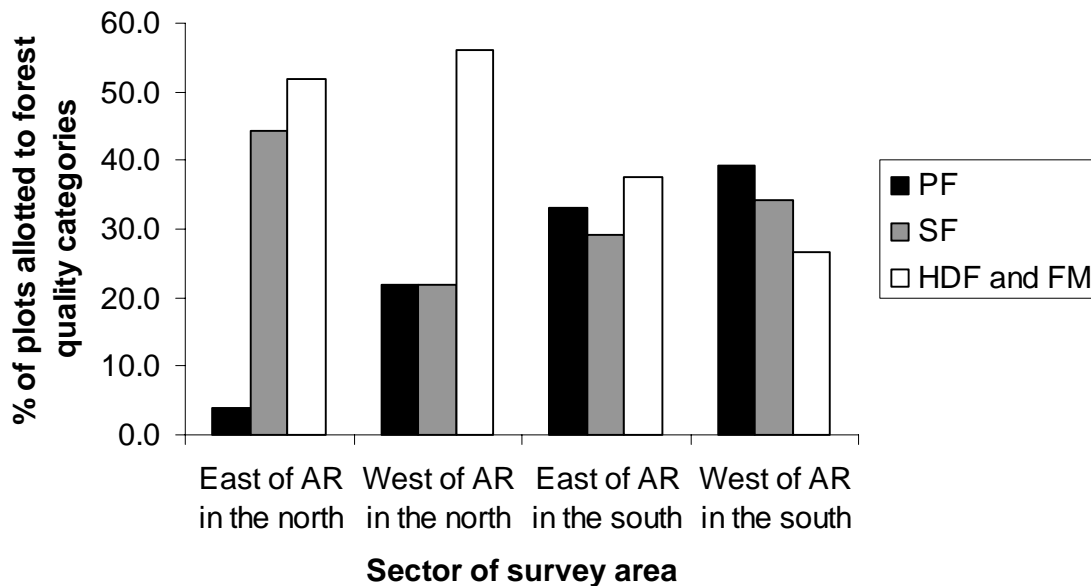
**Figure 4:** Estimated forest quality determined by interpolation from reconnaissance data.



The proportion of forest in different sectors of the survey area remaining as “primary forest”, “secondary forest” and “highly disturbed forest” or farm during this survey is presented in Table 1 and Fig 5.

**Table 1:** Proportions (%) of forest types recorded in plots along recce paths located east and west of the Afi River in the northern and southern parts of the survey area. Recce paths 1-7 located east of AR in the north, 8-15 located east of AR in the south, 16-21 located west of AR in the north, 22-27 located west of AR in the south.

Sector	PF	SF	HDF and FM
East of AR in the north	3.9	44.2	51.9
West of AR in the north	21.9	21.9	56.1
East of AR in the south	33.1	29.3	37.6
West of AR in the south	39.3	34.2	26.5

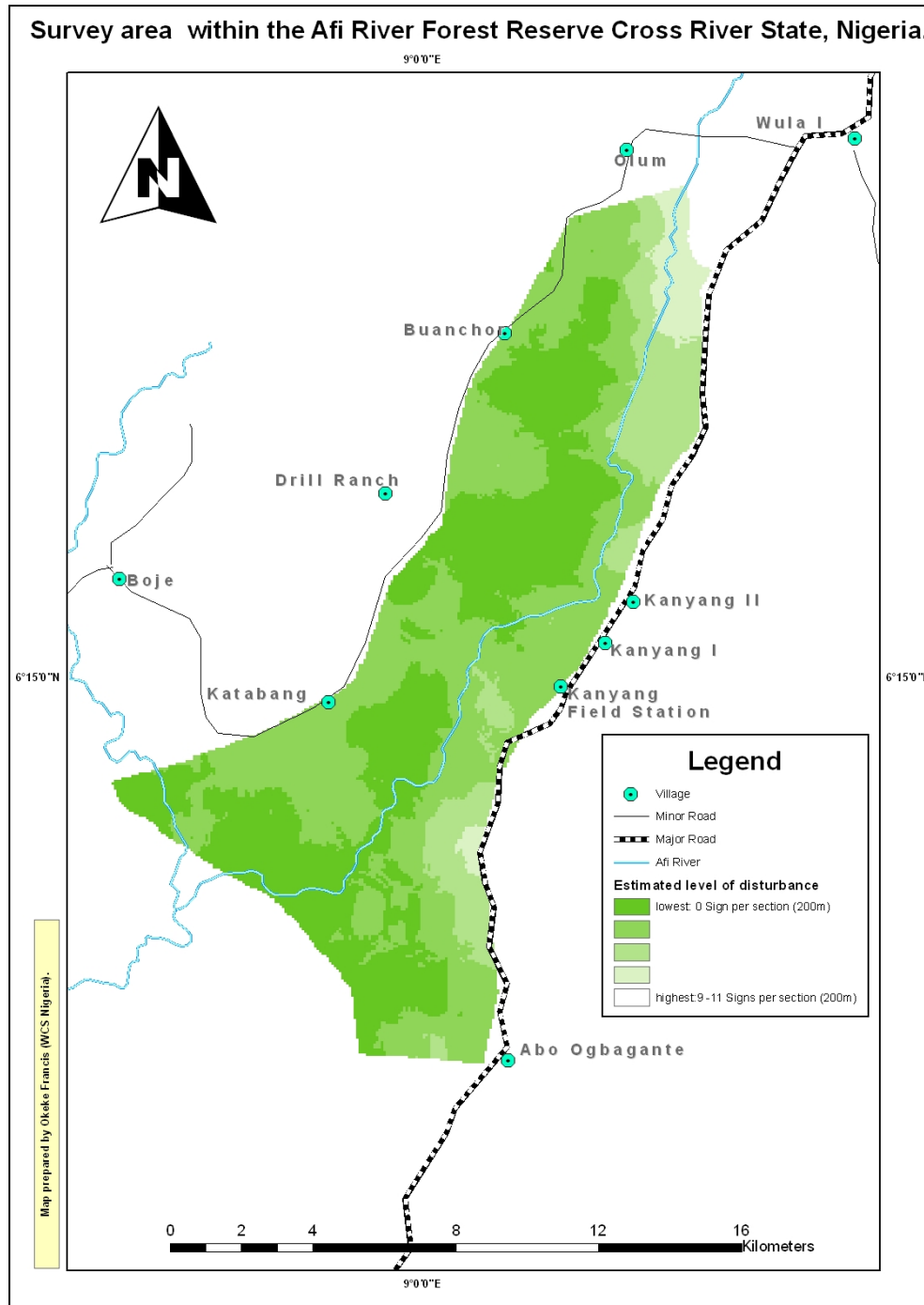


**Figure 5:** Proportions of forest types recorded in plots along recce paths located east and west of the Afi River in the northern and southern parts of the survey area.

#### Human activities resulting in forest disturbance

Overall distribution of human disturbance (including farming, logging, and hunting) in the reserve is presented in Fig 6 below. Generally, areas near the two main roads and human settlements around the reserve have received the heaviest human disturbance. Only areas 2-3 km away from the two roads and settlements are relatively less disturbed (deep green). Although the maps of the distribution of forest quality (Fig 4) and distribution of evidence of human disturbance (Fig 6) have a similar pattern (less disturbance or higher forest quality in the more remote areas of the survey area and higher disturbance or

lower forest quality around the edges) they differ slightly. The disturbance map is based on the occurrence of signs of disturbance – logging, farming and hunting data – collected along the entire length of recce paths. In contrast, the categorical forest type data (i.e. primary, secondary, highly disturbed, or farm) collected within vegetation plots was used to create the forest quality map.



**Figure 6:** Estimated level of disturbance determined by interpolation from reconnaissance data.

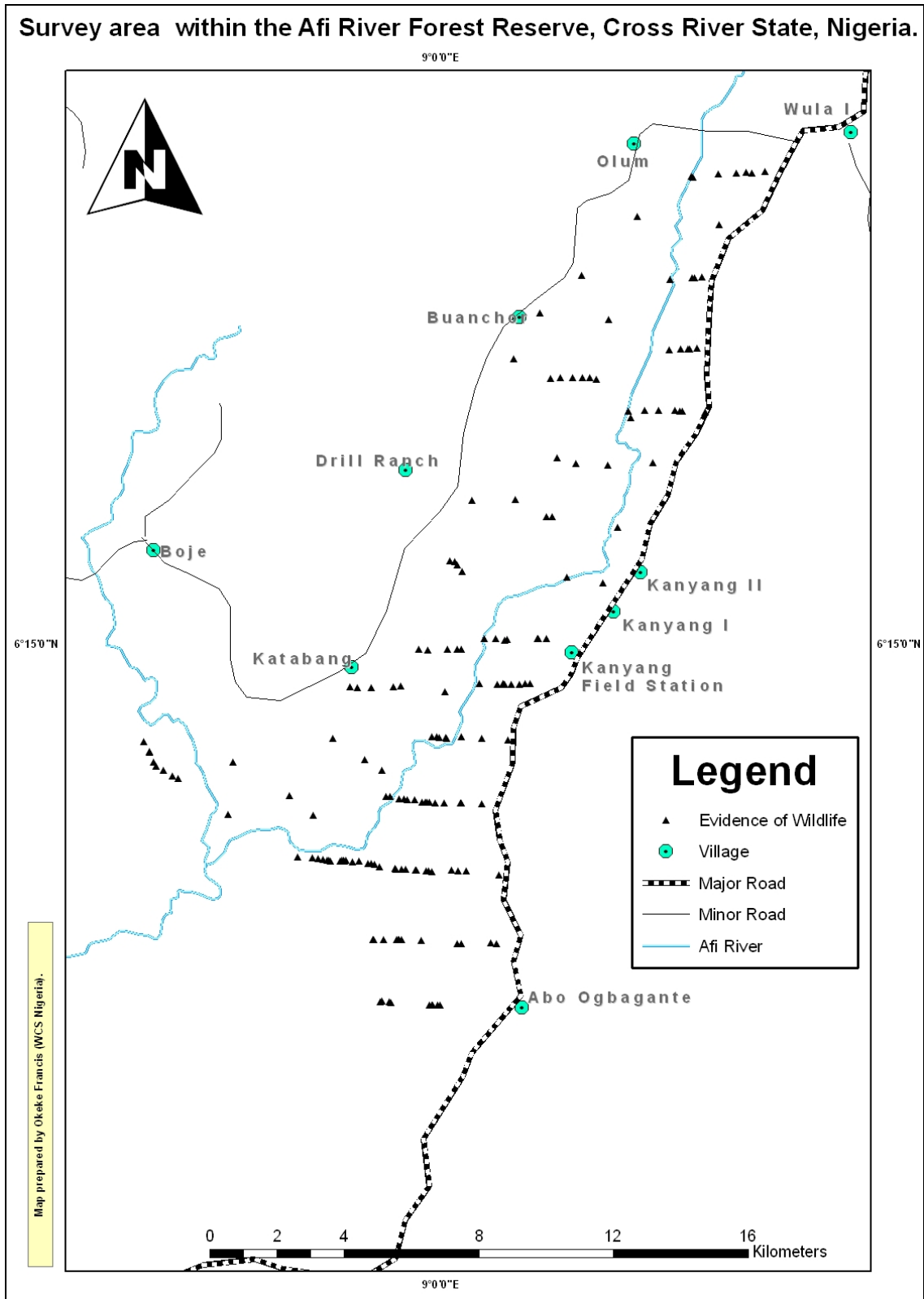
## Wildlife

Signs of wildlife were generally scarce throughout the reserve (Appendix 1). As expected, wildlife signs were relatively more common in areas where the forest was less disturbed such as in the southern area east of the Afi River (Fig 7). Most of the evidence recorded was in the form of indirect observations (tracks, dung and vocalizations). The only direct sighting of a large mammal during the entire survey was one blue duiker and one 'red' duiker (bay or Ogilby's). The only evidence of primates recorded during the entire survey was a single call from a mona monkey *Cercopithecus mona* (see Table 2). Species of birds, reptiles, amphibians and fish were observed and noted but were not included in the data for analysis.

The most common evidence of wildlife encountered during the survey was piles of duiker dung. Blue duiker was the species for which sign was most frequently observed during the survey (Table 2) and the category of 'red duiker' (comprised of two medium-sized duikers: the bay and Ogilby's duikers which are difficult to distinguish in the field) was the second most frequently observed sign. Together, these three duiker species accounted for 63% of all the animal sign observed. The Red river hog and the African brush-tailed porcupine occurred at a moderate rate of encounter relative to other species. And finally, sign of African civet, bushbuck, water chevrotain, mongoose, rock hyrax, Emin's rat and mona monkey were among the least frequently recorded during the survey (Table 2).

**Table 2:** Encounter rates (per km) of large mammals recorded during the survey. Mammal signs recorded included tracks (50%), dung (47%), sightings (2%), and calls (<1%). See also Appendix 1.

<b>Species</b>	<b>Number of encounters</b>	<b>Proportion of encounters</b>	<b>Encounter rate</b>
Blue duiker ( <i>Cephalophus monticola</i> )	64	0.32	0.78
"Red duikers" (includes Bay duiker; <i>C. dorsalis</i> and Ogilby's duiker, <i>C. ogilbyi</i> )	62	0.31	0.75
Red river hog ( <i>Potamochoerus porcus</i> )	26	0.13	0.32
African brush-tailed porcupine ( <i>Atherurus africanus</i> )	19	0.10	0.23
Emin's rat ( <i>Cricetomys emini</i> )	7	0.04	0.09
African civet ( <i>Civettictis civetta</i> )	5	0.03	0.06
Common kusimanse ( <i>Crossarchus obscurus</i> )	5	0.03	0.06
Yellow-backed duiker ( <i>C. silvicultor</i> )	5	0.03	0.06
Bushbuck ( <i>Tragelaphus scriptus</i> )	2	0.01	0.02
Water chevrotain ( <i>Hyemoschus aquaticus</i> )	2	0.01	0.02
Mona monkey ( <i>Cercopithecus mona</i> )	1	<1%	0.01
Rock hyrax ( <i>Procavia ruficeps</i> )	1	<1%	0.01
<b>Total</b>	<b>199</b>		<b>2.43</b>



**Figure 7:** Distribution of wildlife evidence recorded along recce paths in relation to forest quality.

An interesting result from this survey (in terms of wildlife) was the observation of dung and footprints identified as belonging to the yellow-backed duiker<sup>1</sup>. Although it is difficult to identify duiker dung and tracks to species, it is possible to distinguish between sign left by different groups of duiker (small, medium or large). The size of dung and footprints observed was considered by all team members to be too large to have been left by any duiker smaller than the yellow-backed duiker. Given the high level of hunting in the reserve it is an encouraging surprise that a few large bodied mammals such as yellow-backed duiker, red river hog and bushbuck have managed to survive at all. Although not recorded during this survey, elephants were sighted in the southern part of the reserve in 2006 having crossed the Ikom-Obudu highway from the Okwangwo Division of Cross River National Park south of the Mbe Mountains. Forest buffalos are also believed to occur in parts of the reserve though no sign of their presence was recorded during this survey.

### Farming

GPS waypoints were recorded for the start of 244 farms; this gives an encounter rate of 2.98 farms per kilometer. Farm sizes were highly varied ranging from as small as 15 m<sup>2</sup> to as large as ten hectares. Due to the difficulty encountered in mapping the boundaries of all farms we are unable to provide estimates of average farm size or the total area that has been converted to farms. An estimate of the proportion of the survey area converted to farms was obtained from interpolation of forest quality data obtained within vegetation plots. We recommend therefore that the estimate of the proportion of forest in the survey area converted to secondary forest and highly degraded forest or farm presented in this report (i.e. 75%; Fig 3) should be taken with caution.

Farms were frequently encountered east of the Afi River especially in the northern area between Kanyang and Wula. Farms were observed from the highway up to the Afi River on most recce paths in this northern area (Fig 8), with only small patches of “secondary forest” still present. In the southern area between Kanyang and Abo Ogbagante farms were less frequently encountered. In fact, 33% of the forest in this southern area was found to be “primary forest” (Table 1 and Fig 5). Farms were observed only up to 1 km from the highway on recce paths 12-15 in this southern area. Beyond this point, “primary forest” was the main forest type observed. Although the two southernmost recce paths east of the Afi River (recce paths 14 and 15) did not reach to the Afi River, there was no indication of the existence of farms from the end of these recce paths westward to the Afi River.

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<sup>1</sup> This species is sometimes called “black duiker” or “bush cow” by local people. However, Black duiker (*Cephalophus niger*) is not known to occur in this area. Locals in the area are familiar with a large species of duiker with a yellow patch on the back and rump, but claim that there is also a large species of duiker occurring here that lacks the characteristic yellow dorsal patch of the yellow-backed duiker which they call black duiker. However, the entire team agreed that the size of the dung and footprint observed was too large to belong to any duiker smaller than Yellow-backed. These signs are therefore likely to belong to yellow-backed duiker (*Cephalophus sylvicultor*) which historically occurs here and is also known from the Mbe Mountains. The animal without the yellow patch which locals refer to as “black duiker” could be juvenile yellow-backed duiker which usually lacks the patch.

For recce lines west of the Afi River, on recce paths located between Baunchor and Katabang, farms were observed up to 1.5 km from the Olum-Boje road. Isolated farms were also observed close to or by the Afi River on these recce paths. Between Katabang and Asuben, farms were encountered up to 1 km from the Olum-Boje road.

Most of the farms observed during this survey were “old” (i.e. cleared and planted earlier than the current farming season (81%), with a smaller percentage of farms recorded as “new” (i.e. cleared and planted in the current planting season). Slash and burn was the main farming method observed to be in use by farmers during the survey. The degree of slash differed between farms planted with banana and plantain and farms planted with other crops such as cocoa, oil palm and cassava. Banana and plantain farms typically had many trees left standing to provide shade. Local farmers believe that these crops require much shade from tree canopy to survive well. Crops such as cocoa, oil palm and cassava on the other hand, are believed to be less shade tolerant. Therefore, farms grown with these crops were observed to have only few trees left standing providing less shade. Crops commonly observed in the survey area include banana, cocoa, plantain, cassava, and oil palm. The most common crop grown was banana (48%), followed by cocoa (33%), cassava (9%), oil palm (8%) and plantain (2%). Mixed cropping was observed to be a common practice in the area.

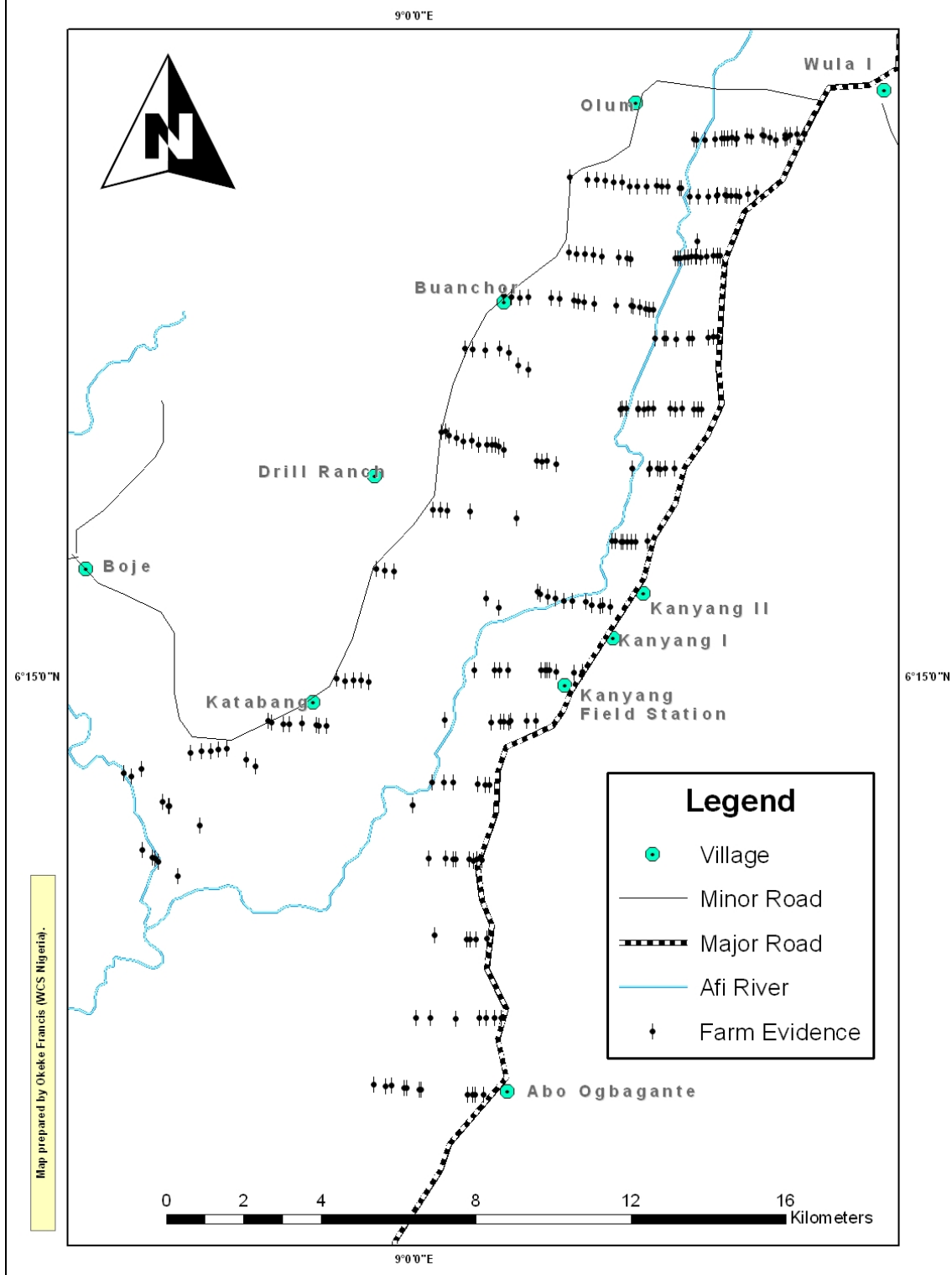
### Hunting

Hunting sign was recorded at 0.66 per km. Wire snare was the most frequently recorded hunting evidence during the survey. Surprisingly few hunting trails and hunters were encountered during the survey (Table 3) and no gunshots were heard during survey hours (daylight hours only). The reason for the very low rate of encounters with hunters and hunting camps as well as the absence of gunshots is not clear. One possible reason could be that levels of wildlife abundance are so low that hunting in the reserve is no longer profitable. Another possible explanation is that hunting was done mostly at night when the survey team did not collect data (data collection was carried out only during the day). Only 1 hunter was encountered during the survey period. Fig 9 shows the distribution of hunting evidence in the reserve.

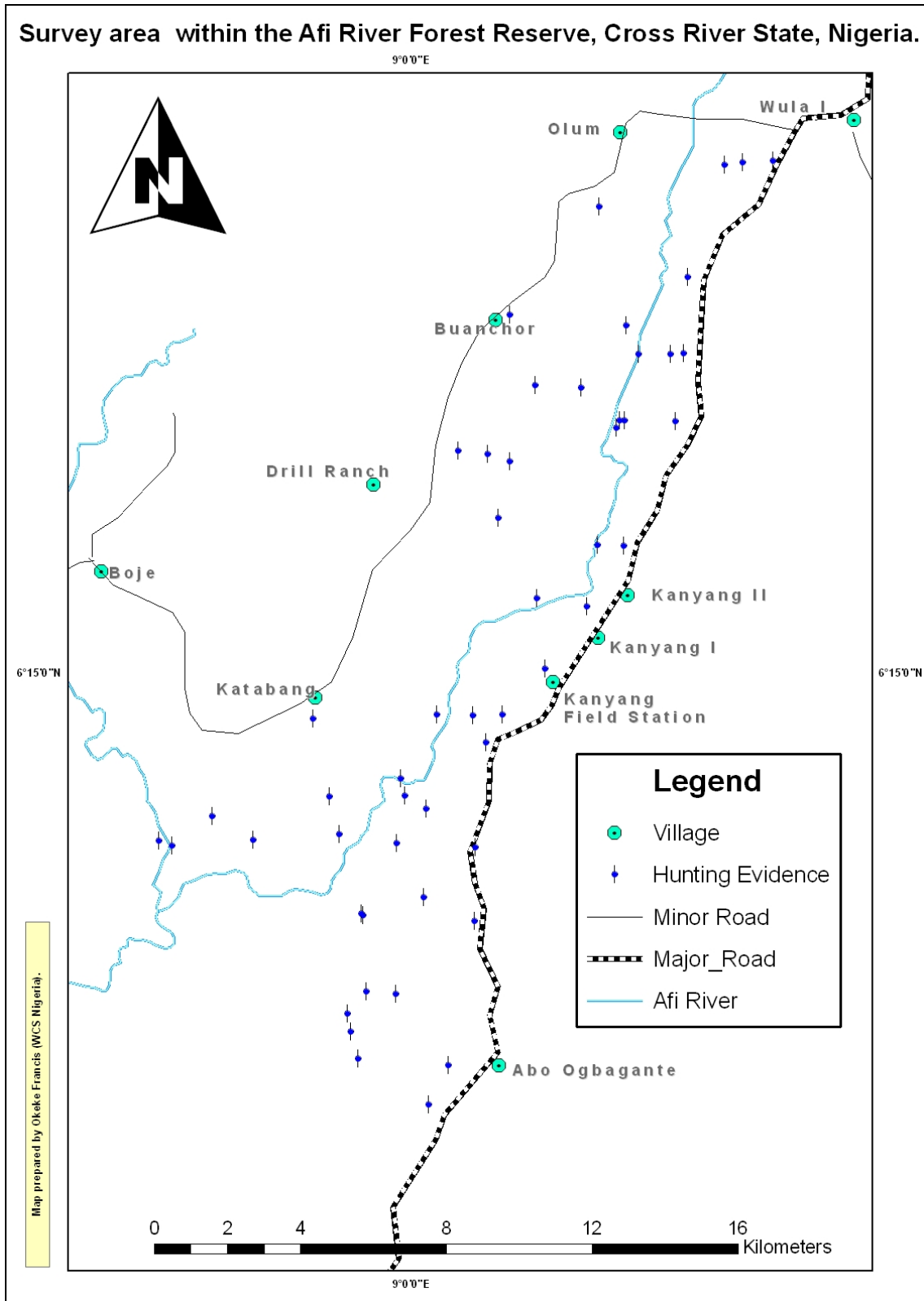
**Table 3:** Encounter rates of hunting evidence recorded, ARFR, February – April, 2008.

Hunting evidence	Number	Encounter rate
Wire snare	31	0.38
Cartridge casings	12	0.15
Poison	3	0.04
Hunting trail	1	0.01
Hunter encounter	1	0.01
Hunting camps	0	0
Gunshots heard	0	0
<b>All evidence</b>	<b>48</b>	<b>0.59</b>

Survey area within the Afi River Forest Reserve, Cross River State, Nigeria.



**Figure 8:** Distribution of farms recorded along recce paths.



**Figure 9:** Distribution of hunting evidence recorded along recce paths.



### Logging

Evidence of past and ongoing logging was encountered throughout the area surveyed, with a concentration in the south (Figure 11). Most of the logging evidence recorded involved tree stumps (Table 4). The second most frequently observed evidence of logging was timber; several large piles of planks and other types of timber (e.g. 4" x 6" x 12ft and 2" x 4" x 12ft) were seen at different locations across the survey area. A pile of 2" x 12" x 12ft planks numbering as many as 800 pieces was recorded on one occasion. A total of 3,671 pieces of timber were counted during the survey. Other signs of logging recorded included logging roads, logging camps and sound of chain-sawing. Two chainsaw operators and men evacuating timber from the forest were encountered.

Several active logging roads with fresh tire marks were observed during this survey. A broken down tractor was seen once being repaired on one of the logging roads close to a stack of timber in the southern part of the survey area, west of the Afi River. Several abandoned logging roads were also observed. Logging roads were observed to start from the Ikom-Obudu highway or the Olum-Boje and Katabang-Kanyang dirt roads and run through the forest towards the Afi River. These logging roads have facilitated access into the remote parts of the reserve. Many farmers who owned farms in these remote parts of the survey area were observed to frequently use logging roads to access their farms. The number of observations of logging roads (Table 4) recorded during this survey may not accurately represent the actual number of logging roads in the survey area since it is very likely that some of these logging roads were crossed more than once.

**Table 4:** Encounter rates of logging signs recorded within the ARFR from February – April, 2008.

<b>Logging evidence</b>	<b>Number</b>	<b>Encounter rate</b>
Tree stump	170	2.07
Logging road	50	0.61
Sawn timber/planks	40	0.49
Log	15	0.18
Chainsaw heard	13	0.16
Loggers seen	4	0.05
Logging camp	3	0.04
<b>All sign</b>	<b>295</b>	<b>2.93</b>

Most of the logging activity observed in the reserve was judged to have occurred within the past year (38%) and over half (58%) of all the logging activity recorded during this survey was judged to have occurred within the last 3 years (Fig 10). The most recent logging activities were concentrated in the southern part of the reserve where most of the remaining relatively good forest occurs.

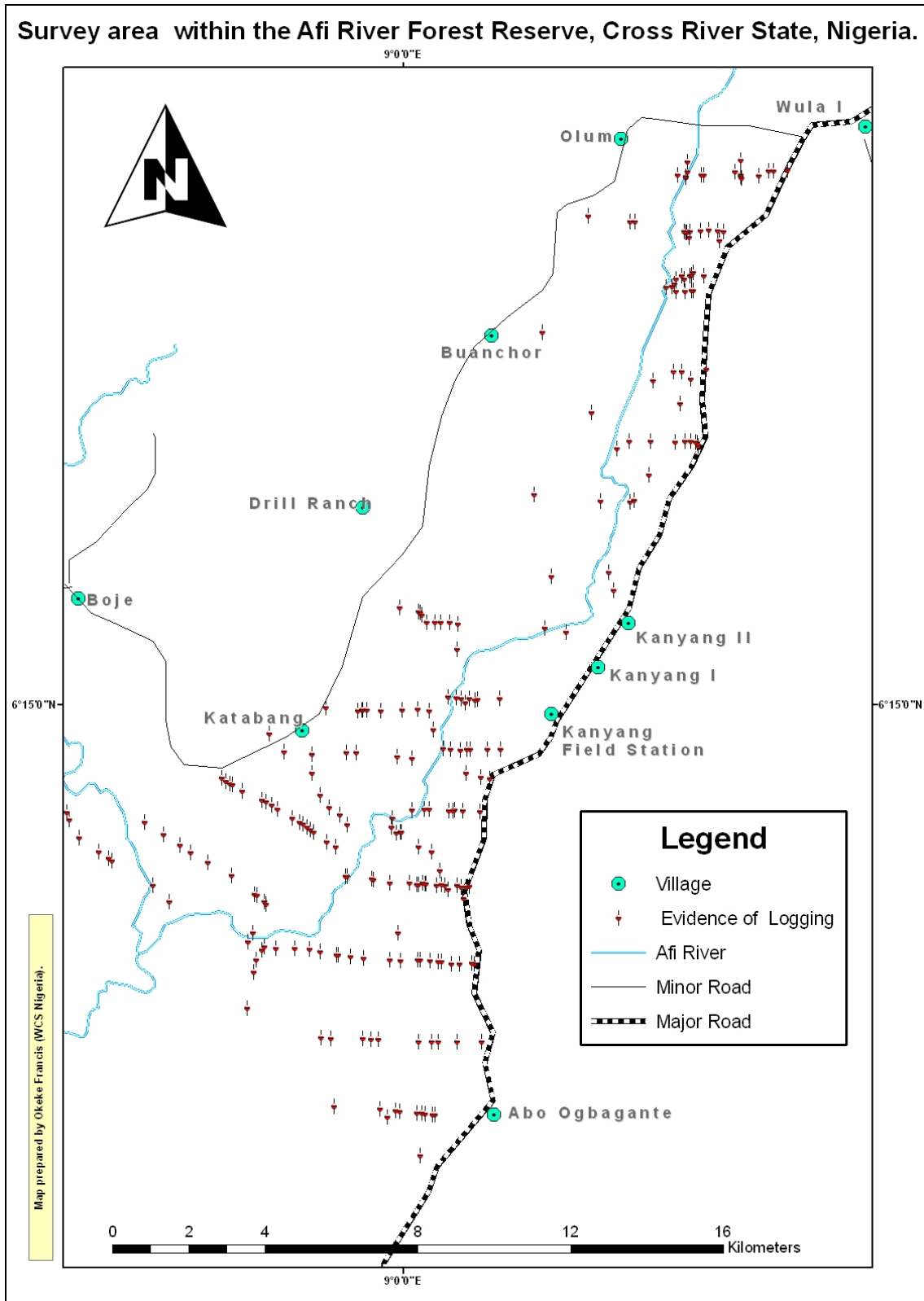


**Figure 10:** Proportions of age classes recorded for logging activities

A total of 22 different tree species were found to be logged in the reserve during this survey. The four most frequently encountered species logged were *Diospyros* spp., *Khaya senegalensis*, *Baillonella toxisperma* and *Pycnanthus angolensis* (Table 5).

**Table 5:** Proportions of logged tree species recorded during the survey

<b>Species</b>	<b>Proportion</b>
<i>Diospyros</i> spp.	0.19
<i>Khaya senegalensis</i>	0.17
<i>Baillonella toxisperma</i>	0.13
<i>Pycnanthus angolensis</i>	0.09
<i>Khaya</i> spp.	0.07
<i>Piptadeniastrum africanum</i>	0.07
<i>Staudtia stipitata</i>	0.06
<i>Terminalia ivorensis</i>	0.05
<i>Nauclea diderrichii</i>	0.02
<i>Lophira alata</i>	0.02
<i>Milicia excelsa</i>	0.02
<i>Terminalia superba</i>	0.02
<i>Alstonia congensis</i>	0.01
<i>Brachystegia eurycoma</i>	0.01
<i>Brachystegia</i> spp.	0.01
<i>Canarium</i> spp.	0.01
<i>Baphia nitida</i>	0.01
<i>Combretodendron africanum</i>	0.01
<i>Funtumia elastica</i>	0.01
<i>Distemonanthus benthamianus</i>	0.01
<i>Mitragyna ciliate</i>	0.01
<i>Pterocarpus osun</i>	0.01
unidentified species	0.01



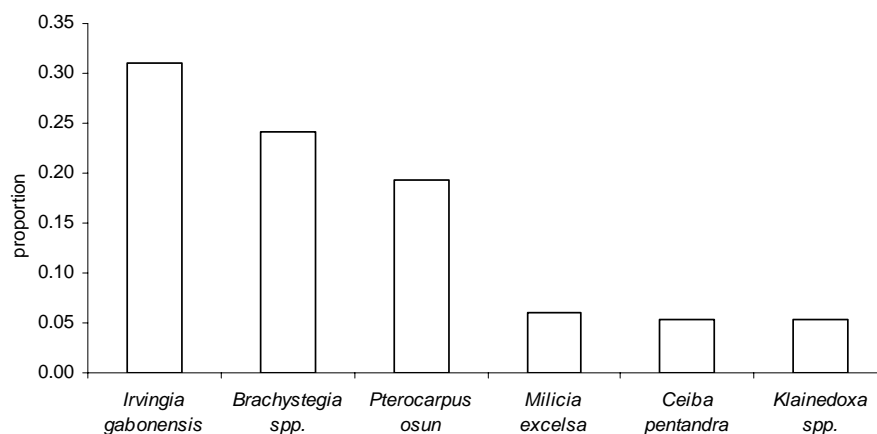
**Figure 11:** Distribution of logging evidence recorded during the survey.

### Threats to the Afi River

Evidence of the use of poison for fishing in the Afi River was recorded during this survey. Six dead fishes were seen floating in the river by recce line 8 (photo in Appendix 5). Community representatives on the survey team confirmed that poisoning of the Afi River for fishing was presently a common practice. Local efforts to stop the use of poison for fishing in the river through a traditional ban have not been successful. The Afi River is threatened not only by harmful fishing methods but also by destruction of forest along its banks due to farming (Fig 8). Farms were observed by the river on recce lines 1-11 (east of the river) and on recce lines 22 and 23 (west of the river). The Afi River plays an important role in drainage of the Afi forest area and is also very important for supporting diverse aquatic life. The destruction and loss of this important river would result in the loss of many ecosystem services that it provides and would also have a direct negative impact on the livelihoods of the many people who depend on it.

### Economically important tree species

Out of a sample of six tree species selected on the basis of their economic value to both the local and outside (urban) population (see list in Appendix 3), *Irvingia* spp., *Brachystegia* spp. and *Pterocarpus osun* were the most frequently encountered (Fig 12). It is not surprising that *Irvingia* spp. was the most frequently encountered of all six species since only its fruits are harvested and it is not a preferred timber species. Three of the selected economically important tree species – *Pterocarpus osun*, *Milicia excelsa* and *Brachystegia* spp. were also among the most logged species in the reserve (see Table 5). Only presence or absence data was collected on these species. Therefore, the data provides information on their distribution and not abundance. Estimating species abundance from this data is difficult because many factors (such as the dispersion pattern of individual species and the number of trees of each species recorded within the plots) would have to be taken into consideration. The results are however useful for monitoring changes in their distribution due to human exploitation.



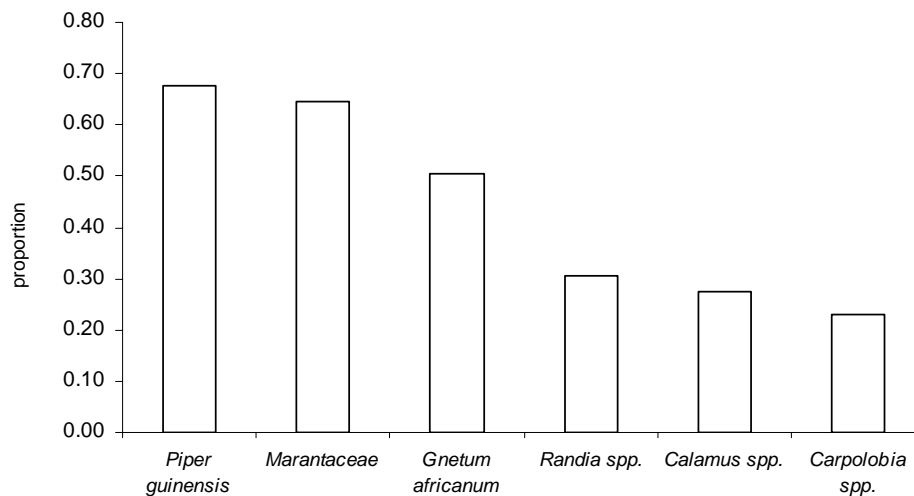
**Figure 12:** Proportion of plots in which each species of economically important tree occurred

### Non-timber forest products

Data was collected on six selected non-timber forest products that are gathered from the forest (Table 6 and Appendix 3) The frequency of occurrence of the six selected NTFPs in plots varied (Fig 13). All species were found in the reserve although some (*Calamus* spp., *Randia* spp. and *Carpolobia* spp.) were recorded in only in a small number of plots. Only presence/absence data was collected on NTFPs and therefore an estimate of abundance can not be made based on data from this survey.

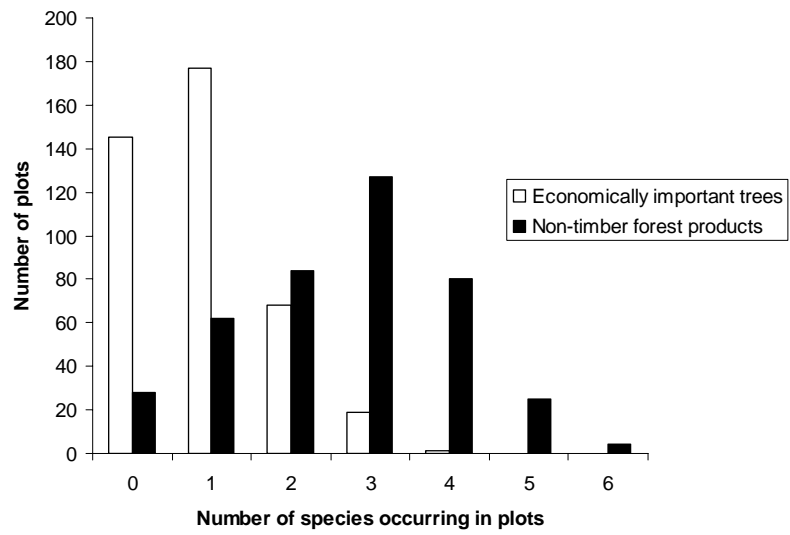
**Table 6:** The six important non-timber forest products and their uses.

Species	Common Name/Use
<i>Calamus</i> spp.	cane rope
<i>Carpolobia</i> spp.	cattle stick
<i>Gnetum africanum</i>	'afang', salad
<i>Marantaceae</i>	wrapping leaves
<i>Piper guinensis</i>	bush pepper
<i>Randia</i> spp.	chewing stick



**Figure 13:** Proportion of plots in which each species of non-timber forest product occurred.

There were few occurrences of more than three of the six selected economically important tree species in any one plot. At least three of the six selected NTFPs, occurred in about half the number of plots, although in some plots none occurred (Fig 14). The pattern of occurrence of the economically important trees and non-timber forest products is interesting. More non-timber forest products were recorded where few of the selected economically important tree species occur. It is known that some of the selected non-timber forest products (such as *Marantaceae*, *Piper guinensis*, *Gnetum africanum*, and *Calamus* spp.) are species which often prefer light gaps.



**Figure 14:** Occurrence of selected economically important tree and NTFP species in plots.

## Discussion

### Comparison of encounter rates to other sites

In order to ascertain how the Afi River Forest Reserve compares to other forests within this region, we compared encounter rates of wildlife and disturbance signs from this survey to encounter rate data from nearby sites. Encounter rates using comparable methodology were obtained from a transboundary survey of the Nigeria-Cameroon border at Okwa-Obonyi (Imong and Warren 2008) and from surveys in Cameroon for the proposed Takamanda National Park (Mboh and Warren 2007), the Banyang Mbo Wildlife Sanctuary (Greengrass and Maisels 2007), the Mone Forest Reserve (Warren and Ekinde 2007), the Mbulu Hills Community Forest (Warren and Bila 2008), the Ejagham Forest Reserve (Eno-Nku 2003a), and the Nkwende Hills and Upper Banyang Forest Concessions (Eno-Nku 2003b).

Encounter rates for wildlife sign from the Afi River Forest Reserve and the above listed other sites are based on dung, tracks, vocalizations, and direct sightings of a species and can be examined in Appendices 5 and 6. Direct comparison of the results of these studies is problematic due to possible differences in methodologies. For example, the size of the survey team can obviously bias the results because larger teams will be less likely to see more elusive species. Likewise, differences in substrate, vegetation and/or season can influence whether signs of a particular species' passage are detected. However, results from these studies use similar methodologies and give an estimate of abundance for a given length of recce path.

Results from this study show low encounter rates for signs of many species of wildlife in the ARFR. In the case of dung encounter rates for large mammals (Appendices 5 and 6), the ARFR has a higher overall encounter rate than the other sites, but this is mainly due to duiker species. All other signs occurred at encounter rates that were less than 0.1 encounters per km excepting tracks of red river hog and brush-tailed porcupine. Overall, encounter rates for the ARFR were lower than most other sites and were most comparable to the transboundary region between Cross River National Park and to the proposed Takamanda National Park. Our results showed no evidence at all of the presence of the following species in the ARFR; Elephants, Forest Buffalo, Cross River Gorilla, Chimpanzee, Drill, Putty-nosed monkeys, Preuss' monkey, Red-eared monkeys, Pangolins, and Cane rats. These species were present in several of the other studies, but notably absent in the reserve. Although encounter rates of signs of wildlife in the ARFR were lower than in other sites, levels of hunting were found to be comparable to these other sites (Appendix 5).

The absence of any evidence of the presence of ape and monkey species (except for a single distant Mona monkey vocalization) in the reserve during this survey is a cause for major concern. Primate vocalizations can be a useful indicator of primate abundance in an area (Mboh and Warren 2007) and the

ARFR is markedly low in primate vocalizations compared to most other sites (Appendices 5 and 6). This absence of primate vocalizations in the ARFR demonstrates the high level of human disturbance in the reserve. The complete absence of any evidence of larger primates such as drills, chimpanzee and gorilla is especially disturbing if this area is thought to be used by wildlife for passage between the Afi and Mbe mountains. Drill monkey signs and ape nests could not have been missed by the survey team made up of people with considerable field experience. Results from this survey indicate that current human pressure might be too high for larger primates to survive in the reserve and that remaining suitable habitat is being rapidly lost. These results have implications for the long term survival of the drill and ape populations within the AMWS should the area not be more rigorously protected. In particular, it has negative implications for a planned future release program for drills from the Drill Rehabilitation and Breeding Centre of Pandrillus, and for the long term survival of the remaining small population of Cross River Gorilla in the AMWS.

#### Evaluation of human disturbance in the Afi River Forest Reserve

Based on encounter rates of approximately 3 farms and 3 logging signs per km, results from this survey demonstrate very high levels of farming and logging in the Afi River Forest Reserve. Such high encounter rates are a clear indication that unless concerted conservation action is taken to reverse the current trend the entire reserve could become converted to farm in the foreseeable future. Already, over one third of the reserve area, mostly in the northern part of the area surveyed has been converted to farm and more forest area is being opened for farms in relatively less disturbed areas. Although many communities surround the reserve and demand for agricultural land and forest products is high, it appears that other factors may also play a role. Factors such as the traditional land tenure system (which ascribes ownership of an area of forest to the first community member to clear it), and very weak, almost non-existent enforcement of forestry and wildlife laws in the reserve have contributed significantly to the extensive encroachment on the reserve for farming and logging. Many farms located deep inside the reserve, (far from human settlements) were reported to have been cleared to lay claim of ownership on the land, even though the land was not actually needed in the short term. In many cases such farms receive hardly any attention from their owners except a few occasional inspection visits to prevent counter claim from other community members.

The prevalence of logging activity, as demonstrated by an encounter rate of almost 3 signs per km, and coinciding hunting evidence, both concentrated in the less disturbed southern part of the reserve (Fig 11) demonstrates that these human activities are now focused where forest resources are relatively abundant. This concentration of logging and hunting activities in the remaining areas of primary forest in the south is especially alarming. The presence of high levels of human activities within areas of the best forest highlights the fact that the remaining good forest in the reserve is under threat of destruction if urgent steps are not taken to discourage further exploitation. An analysis of the ages of logging evidence recorded during the survey shows that there has been a



massive increase in logging activities in the reserve in the last five years. The CRSFC anti-logging gate on the Katabang road designed to reduce illegal logging in the reserve appears to have had little effect in discouraging logging. The anti-logging gate was put up in 2006 as a joint initiative of CRSFC and the local communities. The gate was planned to be manned constantly by staff of CRSFC and representatives of Katabang, Kanyang and Buanchor communities and to stop all illegal transport of wood on the Katabang-Kanyang road through the gate. This however appears not to be the case as the gate is often left unmanned and timber is let through. During the survey a large truck full of timber was observed passing through the gate.

Results from this survey suggest that the southern part of the reserve offers the best option for a possible wildlife corridor linking the AMWS and the Mbe Mountains. Compared to the northern part the southern part of the reserve still contains a considerably large tract of less disturbed forest, although continued survival of this forest is not yet assured.

## **Conclusion**

Twenty-four percent of forest in the area surveyed was classified as primary forest. Thirty-three percent was classified as secondary forest. Together, fifty-seven percent of the area surveyed remains as forest (secondary and primary) located predominantly in the southern part of the survey area. If habitat destruction (through logging and farm encroachment) and hunting pressure are reduced to a level which does not discourage animals from using the area this southern area could serve as a wildlife corridor between the AMWS and the Mbe Mountains. Unless the current rate of habitat destruction is reduced, the critical link between the AMWS and the Mbe Mountains that this reserve provides will be lost, with the obvious consequence being further isolation of the Afi gorillas and other wildlife. Other consequences of losing the forest in the reserve include the loss of an important watershed. Results of this survey show that farming, uncontrolled logging, and hunting are currently the most important threats to the Afi River Forest Reserve. These threats need to be urgently addressed in order to protect this very important corridor area.

## **Recommendations**

- The Cross River State Forestry Commission should urgently review its law enforcement strategies to stop all logging and farming activities in the reserve.
- Focus law enforcement activities in ARFR on the southern part of the reserve, where most of the remaining relatively undisturbed forest occurs, and that currently connects AMWS and the Mbe Mountains.

- The anti-logging gate on the Katabang-Kanyang road was well intentioned but its management has been poor. It is recommended that those persons charged with manning the gate should be more closely supervised by CRSFC to ensure that it is more effective. Completely closing the gate (so there is no need for any lock and key) should be considered to discourage abuse. Other major outlets in the reserve should also have such gates since it is difficult to effectively control logging in an area with multiple access routes with a single anti-logging gate.
- Carbon-credit schemes that could potentially protect the habitat corridor should be explored. These could relieve pressure to log the reserve for monetary gain and preserve this habitat on a long-term basis.
- A similar survey should be conducted to assess the quality of the forest in the eastern parts of the AMWS and corresponding areas in the Mbe Mountains to obtain a more complete picture of a possible wildlife corridor between AMWS and the Mbe Mountains.
- A separate survey dedicated to mapping farms in the reserve may be necessary to obtain more detailed information on the nature and extent of farms in the reserve. This information could then be used to monitor any changes that may occur in the future.

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**Appendix 1:** Number of observations and encounter rates of individual wildlife species recorded during the survey.

TRAN-SECT	transect length (km)	Blue duiker	Red duiker	Red river hog	Porcupine	Emin's Rat	African Civet	Mongoose sp.	Yellow-backed duiker	Bushbuck	Water chevrotain	Mona monkey
1	3.00	3	2	1	0	0	0	0	0	0	0	0
2	2.00	0	0	0	0	0	0	0	0	0	0	0
3	1.00	0	2	0	1	0	0	0	0	0	0	0
4	1.84	4	1	0	0	0	0	0	0	0	0	0
5	2.45	3	4	0	5	0	1	0	0	0	0	0
6	1.00	1	0	0	0	0	0	0	0	0	0	0
7	0.88	1	1	0	0	0	0	0	0	0	0	0
8	2.08	0	0	0	2	0	0	0	0	0	0	0
9	3.00	4	4	0	0	1	0	0	0	0	0	0
10	2.36	2	3	0	1	0	0	0	3	0	0	1
11	2.40	2	6	0	0	0	0	1	0	0	0	0
12	3.35	8	6	2	3	2	0	1	0	1	0	0
13	5.60	12	16	6	0	2	1	0	1	1	0	0
14	4.25	1	9	2	0	0	0	0	0	0	0	0
15	3.60	7	2	0	1	0	1	0	0	0	0	0
16	2.65	1	0	0	0	0	0	0	0	0	0	0
17	1.56	1	0	0	0	0	0	0	0	0	0	0
18	3.73	0	1	0	1	1	0	0	0	0	0	0
19	3.80	3	0	2	1	0	0	0	0	0	0	0
20	4.90	1	1	0	1	0	0	1	0	0	0	0
21	4.00	2	0	0	0	0	0	0	1	0	1	0
22	3.27	3	0	0	1	0	0	0	0	0	0	0
23	2.75	1	0	3	0	0	1	0	0	0	0	0
24	4.13	1	1	2	1	1	0	0	0	0	0	0
25	4.20	1	0	2	1	0	0	0	0	0	0	0
26	4.80	2	0	0	0	0	0	0	0	0	1	0
27	3.60	0	1	6	0	0	1	2	0	0	0	0
<b>totals</b>	<b>82.19</b>	<b>64</b>	<b>60</b>	<b>26</b>	<b>19</b>	<b>7</b>	<b>5</b>	<b>5</b>	<b>5</b>	<b>2</b>	<b>2</b>	<b>1</b>
<b>Num enc./transect</b>		<b>2.37</b>	<b>2.22</b>	<b>0.96</b>	<b>0.70</b>	<b>0.26</b>	<b>0.19</b>	<b>0.19</b>	<b>0.19</b>	<b>0.07</b>	<b>0.07</b>	<b>0.04</b>
<b>encounter rate/km</b>		<b>0.78</b>	<b>0.73</b>	<b>0.32</b>	<b>0.23</b>	<b>0.09</b>	<b>0.06</b>	<b>0.06</b>	<b>0.06</b>	<b>0.02</b>	<b>0.02</b>	<b>0.01</b>

**Appendix 2:** The proportion of the plots along each recce line that were allotted to highly-disturbed forest or farm (HDF or FM), secondary forest (SF) and primary forest (PF). The predominant forest quality type is in bold for each recce line and ties are underlined. Recce paths 1-15 were located east of the Afi River, and lines 16-27 were located west of the Afi River.

<i>Recce path number</i>	<b>PF</b>	<b>SF</b>	<b>HDF and FM</b>
1	0.00	0.29	<b>0.71</b>
2	0.00	<b>0.60</b>	0.40
3	0.17	0.17	<b>0.67</b>
4	0.10	<b>0.60</b>	0.30
5	0.00	<b>0.54</b>	0.46
6	0.00	<u>0.50</u>	<u>0.50</u>
7	0.00	0.40	<b>0.60</b>
8	0.00	0.09	<b>0.91</b>
9	0.06	0.38	<b>0.56</b>
10	0.17	<b>0.50</b>	0.33
11	0.31	<b>0.38</b>	0.31
12	<b>0.59</b>	0.24	0.18
13	<b>0.72</b>	0.10	0.17
14	<b>0.59</b>	0.23	0.18
15	0.21	<b>0.42</b>	0.37
16	0.00	0.14	<b>0.86</b>
17	0.00	0.38	<b>0.63</b>
18	0.05	0.21	<b>0.74</b>
19	0.16	0.26	<b>0.58</b>
20	<b>0.46</b>	0.13	0.42
21	<b>0.65</b>	0.20	0.15
22	<u>0.35</u>	0.29	<u>0.35</u>
23	0.29	<u>0.36</u>	<u>0.36</u>
24	<b>0.48</b>	0.24	0.29
25	0.27	<b>0.45</b>	0.27
26	<b>0.60</b>	0.24	0.16
27	0.37	<b>0.47</b>	0.16
<b>Average</b>	0.24	0.33	<b>0.43</b>

**Appendix 3:** Selected economically important tree species and shrub/herb (NTFP) species for which data was collected

Selected economically important tree species

1. *Pterocarpus osun*
2. *Milicia excelsa*
3. *Ceiba pentandra*
4. *Brachystegia* spp.
5. *Irvingia* spp.
6. *Klainedoxa* spp.

Selected NTFP species

1. *Calamus* spp. (cane rope)
2. *Piper guinensis* (bush pepper)
3. *Randia* spp. (chewing stick)
4. *Carpolobia* spp. (cattle stick)
5. *Marantaceae* (wrapping leaves)
6. *Gnetum africanum* (salad)

**Appendix 4:** List of emergent tree species identified in plots

1. *Albizia ferruginea*
2. *Albizia lebeck*
3. *Albizia zygia*
4. *Allanblackia floribunda*
5. *Amphimas pterocarpoides*
6. *Antiaris africana*
7. *Anthocleista vogelii*
8. *Baillonella toxisperma*
9. *Blighia sapida*
10. *Bosqueia angolensis*
11. *Brachystegia eurycoma*
12. *Brachystegia nigerica*
13. *Canarium schweinfurthii*
14. *Ceiba pentandra*
15. *Ceiba* spp.
16. *Celtis brownii*
17. *Celtis zenkeri*
18. *Chrysophyllum* spp.
19. *Combretodendron africanum*
20. *Cylicodiscus gabonensis*
21. *Daniellia oliveri*
22. *Diospyros* spp.
23. *Distemonanthus benthamianus*
24. *Enantia cholarantha*
25. *Fagara* spp.
26. *Ficus* spp.
27. *Funtumia* spp.
28. *Gossweilerodendron balsamiferum*
29. *Irvingia gabonensis*

30. *Khaya* spp.
31. *Khaya senegalensis*
32. *Klainedoxa* spp.
33. *Lophira alata*
34. *Lovoa trichilioides*
35. *Macaranga* spp.
36. *Mitragyna ciliata*
37. *Musanga cecropioides*
38. *Nauclea diderrichii*
39. *Panda oleosa*
40. *Parkia bicolor*
41. *Pentaclethra macrophylla*
42. *Piptadeniastrum africanum*
43. *Pterocarpus erinaceus*
44. *Pterocarpus mildbraedii*
45. *Pterocarpus osun*
46. *Pycnanthus angolensis*
47. *Ricinodendron heudelotii*
48. *Staudtia stipitata*
49. *Sterculia oblonga*
50. *Sterculia rhinopetala*
51. *Sterculia tragacantha*
52. *Terminalia ivorensis*
53. *Terminalia superba*
54. *Tetrorchidium didymostemon*
55. *Treculia obovoidea*
56. *Uapaca togoensis*
57. *Vitex doniana*

## Appendix 5:

Comparison of dung encounter rates between the Afi River Forest Reserve (ARFR) and eight other sites; one on the Nigeria-Cameroon border (Okwa-Obonyi<sup>2</sup>), and seven in Cameroon.

<i>Species</i>	<i>ARFR</i> <sup>1</sup>	<i>Okwa-Obonyi</i> <sup>2</sup>	<i>TNP</i> <sup>3</sup>	<i>BMWS</i> <sup>4</sup>	<i>MFR</i> <sup>5</sup>	<i>Mbulu</i> <sup>6</sup>	<i>Ejagham FR</i> <sup>7</sup>	<i>Nkwende Hills</i> <sup>8</sup>	<i>Upper Banyang</i> <sup>8</sup>
Elephant	0	0.12	0.07	2.03	0.02	0	0.36	0.14	0
Yellow-backed duiker	0.01	0.06	0.02	0	0	0.01	0	0.03	0
Red duiker	0.41	0	0.19	4.35	0.06	0.03	1.31	0.91	0.81
Blue duiker	0.46	0.06	0.16	2.55	0.07	0.01	1.4	0.22	0.47
Red river hog	0.02	0	0.06	0.16	0	0.01	0.45	0.47	0.68
Water chevrotain	0	0.12	0	0	0	0	0.05	0.03	0
<b>TOTALS</b>	<b>0.90</b>	<b>0.36</b>	<b>0.50</b>	<b>9.09</b>	<b>0.15</b>	<b>0.06</b>	<b>3.57</b>	<b>1.80</b>	<b>1.96</b>

ARFR = Afi River Forest Reserve; Okwa-Obonyi = Nigeria-Cameroon border; TNP = proposed Takamanda National Park; BMWS = Banyang Mbo Wildlife Sanctuary; MFR = Mone Forest Reserve; <sup>1</sup> This study ; <sup>2</sup> Imong and Warren 2008; <sup>3</sup> Mboh and Warren 2007; <sup>4</sup> Greengrass and Maisels 2007; <sup>5</sup> Warren and Ekinde 2007; <sup>6</sup> Warren and Bila 2008; <sup>7</sup> Eno-Nku 2003a; <sup>8</sup> Eno-Nku 2003b.

Comparison of primate vocalization encounter rates between the Afi River Forest Reserve (ARFR) and seven other sites; one on the Nigeria-Cameroon border (Okwa-Obonyi<sup>2</sup>) and six in Cameroon.

<i>Species</i>	<i>ARFR</i> <sup>1</sup>	<i>Okwa-Obonyi</i> <sup>2</sup>	<i>TNP</i> <sup>3</sup>	<i>BMWS</i> <sup>4</sup>	<i>MFR</i> <sup>5</sup>	<i>Ejagham FR</i> <sup>6</sup>	<i>Nkwende Hills</i> <sup>7</sup>	<i>Upper Banyang</i> <sup>7</sup>
Gorilla	0	0	0.004	0	0.03	0	0	0
Chimpanzee	0	0	0.017	0	0	0	0	0
Drill	0	0	0	0	0	0	0	0
Putty-nosed monkey	0	0.19	0.056	0.72	0.17	0.23	0.17	0.13
Red-capped mangabey	0	0	0	0.033	0	0	0.06	0
Preuss' monkey	0	0	0.013	0	0	0	0	0
Mona monkey	0.01	0	0	0.33	0.06	0	0.03	0.09
Red-eared monkey	0	0	0.009	0	0.06	0	0	0
<b>TOTALS</b>	<b>0.01</b>	<b>0.19</b>	<b>0.10</b>	<b>1.08</b>	<b>0.32</b>	<b>0.23</b>	<b>0.26</b>	<b>0.22</b>

ARFR = Afi River Forest Reserve; Okwa-Obonyi = Nigeria-Cameroon border; TNP = proposed Takamanda National Park; BMWS = Banyang Mbo Wildlife Sanctuary; MFR = Mone Forest Reserve; <sup>1</sup> This study ; <sup>2</sup> Imong and Warren 2008; <sup>3</sup> Mboh and Warren 2007; <sup>4</sup> Greengrass and Maisels 2007; <sup>5</sup> Warren and Ekinde 2007; <sup>6</sup> Eno-Nku 2003a; <sup>7</sup> Eno-Nku 2003b.

Comparison of some human sign encounter rates between the Afi River Forest Reserve (ARFR) and seven other sites; one on the Nigeria-Cameroon border (Okwa-Obonyi<sup>2</sup>) and six in Cameroon.

<i>Human Sign</i>	<i>ARFR</i> <sup>1</sup>	<i>Okwa-Obonyi</i> <sup>2</sup>	<i>TNP</i> <sup>3</sup>	<i>MFR</i> <sup>4</sup>	<i>Mbulu</i> <sup>5</sup>	<i>Ejagham FR</i> <sup>6</sup>	<i>Nkwende Hills</i> <sup>7</sup>	<i>Upper Banyang</i> <sup>7</sup>
Gunshots	0	0	0.03	0.07	0.02	0.05	0.06	n/a
Cartridges	0.15	0.06	0.10	0.14	0.19	0.23	0.25	0.11
Snares	0.38	0.49	0.42	0.8	0.68	0.41	0.47	0.41
<b>TOTALS</b>	<b>0.53</b>	<b>0.55</b>	<b>0.55</b>	<b>1.01</b>	<b>0.89</b>	<b>0.69</b>	<b>0.78</b>	<b>0.52</b>

ARFR = Afi River Forest Reserve; Okwa-Obonyi = Nigeria-Cameroon border; TNP = proposed Takamanda National Park; MFR = Mone Forest Reserve; <sup>1</sup> Current survey; <sup>2</sup> Imong and Warren 2008; <sup>3</sup> Mboh and Warren 2007; <sup>4</sup> Warren and Ekinde 2007; <sup>5</sup> Warren and Bila 2008; <sup>6</sup> Eno-Nku 2003a; <sup>7</sup> Eno-Nku 2003b.



## APPENDIX 6:

Encounter rates for dung in ARFR in comparison to guided and travel recces in the transboundary regions in Cross River National Park, Nigeria and in the proposed Takamanda National Park in Cameroon.

Species	Common Name	ARFR <sup>1</sup>	O-O (guided) <sup>2</sup>	Obonyi (travel) <sup>2</sup>	Okwa Hills (travel) <sup>2</sup>	TNP <sup>3</sup>
<b>UNGULATES</b>						
<i>Loxodonta africana cyclotis</i>	Elephant		0.12		0.33	0.073
<i>Syncerus caffer</i>	Forest Buffalo					0.004
<i>Potamochoerus porcus</i>	Red river hog	0.024		0.03	0.02	0.056
<i>Tragelaphus scriptus</i>	Bushbuck	0.024				0.026
<i>Cephalophus sylvicultor</i>	Yellow-backed duiker	0.012	0.06		0.02	0.017
<i>Cephalophus monticola</i>	Blue duiker	0.462	0.06		0.02	0.164
<i>Cephalophus</i> spp.	Red duikers	0.414		0.03	0.07	0.19
<i>Cephalophus dorsalis</i>	Bay duiker					0.026
<i>Hyemoschus aquaticus</i>	Water chevrotain		0.12			
unidentified duiker spp.		0.012				
<b>PRIMATES</b>						
<i>Gorilla gorilla diehli</i>	Cross River gorilla		0.07	0.10		0.004
<i>Pan troglodytes vellerosus</i>	Chimpanzee					
Great ape spp.	Either gorilla or chimp					
<i>Mandrillus leucophaeus</i>	Drill					
<i>Cercopithecus mona</i>	Mona monkey					
<i>Cercopithecus nictitans</i>	Putty nosed monkey					
<i>Cercopithecus preussi</i>	Preuss' monkey					
<i>Cercopithecus erythrotis</i>	Red-eared monkey					
unidentified monkey spp.	unidentified					
<b>SMALL CARNIVORES</b>						
<i>Civettictis civetta</i>	African civet	0.012				0.004
<i>Herpestes</i> spp.	Mongoose spp.					0.017
Unidentified small cat						
<b>OTHER</b>						
<i>Atherurus africanus</i>	Brush-tailed porcupine	0.012	0.06			0.099
<i>Manis tetradactyla</i>	Long tailed pangolin					
<i>Procavia ruficeps</i>	Rock hyrax	0.012			0.02	0.047
<i>Thryonomys swinderianus</i>	Cane rat					0.022
<i>Cricetomys emini</i>	emin's rat	0.024				
<b>TOTALS</b>						
		1.01	0.49	0.16	0.48	0.749

ARFR = Afi River Forest Reserve; O-O = Okwa-Obonyi, Nigeria-Cameroon border region; TNP = proposed Takamanda National Park

<sup>1</sup>This study ; <sup>2</sup> Imong and Warren 2008; <sup>3</sup> Mboh and Warren 2007

Encounter rates for tracks in ARFR in comparison to guided and travel recces in the transboundary regions in Cross River National Park, Nigeria and in the proposed Takamanda National Park in Cameroon.

Species	Common Name	ARFR <sup>1</sup>	O-O (guided) <sup>2</sup>	Obonyi (travel) <sup>2</sup>	Okwa Hills (travel) <sup>2</sup>	TNP <sup>3</sup>
<b>UNGULATES</b>						
<i>Loxodonta africana cyclotis</i>	Elephant				0.09	0.026
<i>Syncerus caffer</i>	Forest Buffalo			0.03	0.14	0.026
<i>Potamochoerus porcus</i>	Red river hog	0.23	0.25	0.61	0.65	0.284
<i>Tragelaphus scriptus</i>	Bushbuck	0.01		0.17	0.12	0.034
<i>Cephalophus sylvicultor</i>	Yellow-backed duiker	0.04			0.14	0.004
<i>Cephalophus monticola</i>	Blue duiker	0.39	0.37	0.48	0.21	0.25
<i>Cephalophus</i> spp.	Red duikers	0.17	0.68	1.88	0.93	0.323
<i>Cephalophus dorsalis</i>	Bay duiker					0.013
<i>Hyemoschus aquaticus</i>	Water chevrotain	0.01				0.017
unidentified duiker spp.						
<b>PRIMATES</b>						
<i>Gorilla gorilla diehli</i>	Cross River gorilla			0.1	0.05	0.004
<i>Pan troglodytes vellerosus</i>	Chimpanzee					0.013
Great ape spp.	Either gorilla or chimp			0.1		
<i>Mandrillus leucophaeus</i>	Drill					
<i>Cercopithecus mona</i>	Mona monkey					
<i>Cercopithecus nictitans</i>	Putty nosed monkey					
<i>Cercopithecus preussi</i>	Preuss' monkey					
<i>Cercopithecus erythrotis</i>	Red-eared monkey					
unidentified monkey spp.	unidentified					
<b>SMALL CARNIVORES</b>						
<i>Civettictis civetta</i>	African civet	0.04	0.07			0.022
<i>Herpestes</i> spp.	Mongoose spp.	0.06				0.022
Unidentified small cat				0.38		0.013
<b>OTHER</b>						
<i>Atherurus africanus</i>	Brush-tailed porcupine	0.11	0.49	0.44	0.23	0.379
<i>Manis tetradactyla</i>	Long tailed pangolin			0.07	0.02	
<i>Procavia ruficeps</i>	Rock hyrax					
<i>Thryonomys swinderianus</i>	Cane rat					
<i>Cricetomys emini</i>	emin's rat					
<b>TOTALS</b>		1.06	1.86	4.26	2.58	1.43

ARFR = Afi River Forest Reserve; O-O = Okwa-Obonyi, Nigeria-Cameroon border region; TNP = proposed Takamanda National Park

<sup>1</sup> This study ; <sup>2</sup> Imong and Warren 2008; <sup>3</sup> Mboh and Warren 2007

Encounter rates for sightings (direct observation) in ARFR in comparison to guided and travel recces in the transboundary regions in Cross River National Park, Nigeria and in the proposed Takamanda National Park in Cameroon.

Species	Common Name	ARFR <sup>1</sup>	O-O (guided) <sup>2</sup>	Obonyi (travel) <sup>2</sup>	Okwa Hills (travel) <sup>2</sup>	TNP <sup>3</sup>
<b>UNGULATES</b>						
<i>Loxodonta africana cyclotis</i>	Elephant					
<i>Syncerus caffer</i>	Forest Buffalo					
<i>Potamochoerus porcus</i>	Red river hog					0.009
<i>Tragelaphus scriptus</i>	Bushbuck					
<i>Cephalophus sylvicultor</i>	Yellow-backed duiker					
<i>Cephalophus monticola</i>	Blue duiker	0.024				0.013
<i>Cephalophus</i> spp.	Red duikers	0.012			0.02	
<i>Cephalophus dorsalis</i>	Bay duiker					0.004
<i>Hyemoschus aquaticus</i>	Water chevrotain					
unidentified duiker spp.						
<b>PRIMATES</b>						
<i>Gorilla gorilla diehli</i>	Cross River gorilla					
<i>Pan troglodytes vellerosus</i>	Chimpanzee					
Great ape spp.	Either gorilla or chimp					
<i>Mandrillus leucophaeus</i>	Drill					
<i>Cercopithecus mona</i>	Mona monkey					0.004
<i>Cercopithecus nictitans</i>	Putty nosed monkey			0.03		0.004
<i>Cercopithecus preussi</i>	Preuss' monkey			0.1		
<i>Cercopithecus erythrotis</i>	Red-eared monkey			0.07		0.009
unidentified monkey spp.	unidentified					
<b>SMALL CARNIVORES</b>						
<i>Civettictis civetta</i>	African civet					
<i>Herpestes</i> spp.	Mongoose spp.					
Unidentified small cat				0.03	0.05	
<b>OTHER</b>						
<i>Atherurus africanus</i>	Brush-tailed porcupine			0.03	0.05	0.013
<i>Manis tetradactyla</i>	Long tailed pangolin					0.004
<i>Procavia ruficeps</i>	Rock hyrax			0.03		
<i>Thryonomys swinderianus</i>	Cane rat					
<i>Cricetomys emini</i>	emin's rat					
<b>TOTALS</b>		0.04	0.00	0.29	0.12	0.06

ARFR = Afi River Forest Reserve; O-O = Okwa-Obonyi, Nigeria-Cameroon border region; TNP = proposed Takamanda National Park

<sup>1</sup> This study ; <sup>2</sup> Imong and Warren 2008; <sup>3</sup> Mboh and Warren 2007

Encounter rates for vocalizations in ARFR in comparison to guided and travel recces in the transboundary regions in Cross River National Park, Nigeria and in the proposed Takamanda National Park in Cameroon.

Species	Common Name	ARFR <sup>1</sup>	O-O (guided) <sup>2</sup>	Obonyi (travel) <sup>2</sup>	Okwa Hills (travel) <sup>2</sup>	TNP <sup>3</sup>
<b>UNGULATES</b>						
<i>Loxodonta africana cyclotis</i>	Elephant					0.004
<i>Syncerus caffer</i>	Forest Buffalo					
<i>Potamochoerus porcus</i>	Red river hog					
<i>Tragelaphus scriptus</i>	Bushbuck					
<i>Cephalophus sylvicultor</i>	Yellow-backed duiker					
<i>Cephalophus monticola</i>	Blue duiker					
<i>Cephalophus</i> spp.	Red duikers					
<i>Cephalophus dorsalis</i>	Bay duiker					
<i>Hyemoschus aquaticus</i>	Water chevrotain					
unidentified duiker spp.						
<b>PRIMATES</b>						
<i>Gorilla gorilla diehli</i>	Cross River gorilla					0.004
<i>Pan troglodytes vellerosus</i>	Chimpanzee			0.02		0.017
Great ape spp.	Either gorilla or chimp					
<i>Mandrillus leucophaeus</i>	Drill					
<i>Cercopithecus mona</i>	Mona monkey	0.01				0.013
<i>Cercopithecus nictitans</i>	Putty nosed monkey		0.19	0.24	0.14	0.056
<i>Cercopithecus preussi</i>	Preuss' monkey			0.07		0.013
<i>Cercopithecus erythrotis</i>	Red-eared monkey			0.03	0.05	0.009
unidentified monkey spp.						
<b>SMALL CARNIVORES</b>						
<i>Civettictis civetta</i>	African civet					
<i>Herpestes</i> spp.	Mongoose spp.					
Unidentified small cat						
<b>OTHER</b>						
<i>Atherurus africanus</i>	Brush-tailed porcupine					
<i>Manis tetradactyla</i>	Long tailed pangolin					
<i>Procavia ruficeps</i>	Rock hyrax					
<i>Thryonomys swinderianus</i>	Cane rat					
<i>Cricetomys emini</i>	emin's rat					
<b>TOTALS</b>		0.01	0.19	0.36	0.19	0.12

ARFR = Afi River Forest Reserve; O-O = Okwa-Obonyi, Nigeria-Cameroon border region; TNP = proposed Takamanda National Park

<sup>1</sup> This study ; <sup>2</sup> Imong and Warren 2008; <sup>3</sup> Mboh and Warren 2007

**Appendix 7:** Some photos taken in the survey area during the survey



**Plate 1:** Empty sachets of animal poison



**Plate 2:** Dead fish from poisoning of the Afi River



**Plate 3:** A pile of sawn timber located on recce 10



**Plate 4:** A young banana farm on recce 6



**Plate 5:** A tree killed to open up the canopy on a cocoa farm



**Plate 6:** A banana and vegetable farm by the Afi River at the end of recce 17